

POLTEKITA : JURNAL ILMU KESEHATAN

ISSN

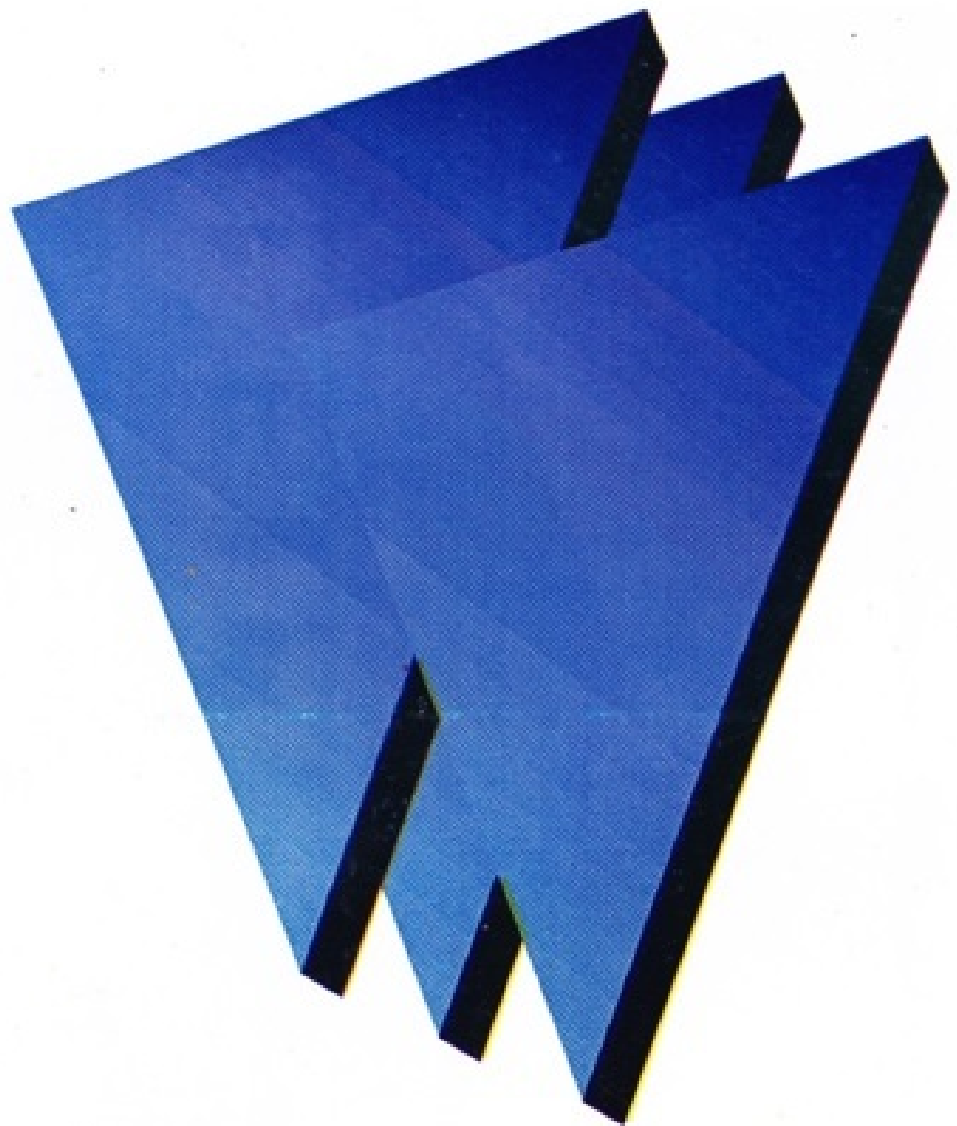
1907

459X



JURNAL ILMU KESEHATAN

POLTEKITA



Association Between Low Birth Weight and Stunting Incidence: Scoping Review

Silviatul Amalia^{1*}, Ismarwati¹

¹ Universitas 'Aisyiyah Yogyakarta, Yogyakarta, Indonesia

(Correspondence author's email: viaamalia40031@gmail.com, 085742263913)

ABSTRACT

Babies with low birth weight have slower growth and development compared to babies with normal birth weight as they experience digestive disorders resulting in poor nutritional intake. If this condition lasts longer without inadequate nutrition, children can be infected and experience stunting. This research aims to examine the association's evidentiary basis between low birth weight and stunting. Inclusion criteria: Indonesian or English articles published in the last 5 years; original articles focused on low birth weight on stunting incidence. This study used PRISMA-ScR Checklist with 5 stages referring to Arksey and O'Malley. The article search used 4 databases: PubMed, DOAJ, Wiley Online Library, and EBSCO. The result is a total of 16 out of 2704 articles obtained were relevant and met the inclusion criteria. This review generated two themes: the factors and impact of low birth weight. It can be concluded that babies with low birth weight significantly correlate with stunting incidence.

Keywords : *Low Birth Weight, Stunting, Scoping Review*

<https://doi.org/10.33860/jik.v17i2.2171>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Stunting is defined by the World Health Organization (WHO) as a developmental problem in children caused by malnutrition, repeated infections, and inadequate psychosocial stimulation¹. Meanwhile, UNICEF defines it as a developmental delay in which children are short for their age due to malnutrition or health interfering with prenatal and postnatal development. Stunting is children's height <-2 standard deviations in the growth chart².

Stunting has become a global issue and challenge. The World Health Organization (WHO) reports that the global prevalence of stunting in 2020 was 149.2 million or 22%. In 2019, the highest stunting incidence was in African countries (55%) and Asian countries

(51%)². According to the 2021 Indonesian Nutrition Status Survey (SGBI), the stunting prevalence in Indonesia was 24.4%³. This figure has not met the government's target for 2024 set out in the 2020-2024 Medium Term Development Plan and Presidential Regulation No. 72 of 2021, namely below 14%³.

Some factors affect stunting in developing countries such as low birth weight, mother's education levels, household income, and sanitation⁴. Babies with low birth weight affect 20% of the stunting incidence⁵. LBW infants have a birth weight of less than 2500 grams, regardless of the underlying cause or gestational age⁶. LBW is a serious problem, contributing to high infant morbidity and mortality. Infants born prematurely or with a low birth weight are more likely to develop stunting, which can lead to death⁷.

Babies with LBW experience slower growth and development as they have experienced intrauterine growth retardation (IUGR). Therefore, babies with LBW have slower growth and development than those with normal birth weights. Babies with LBW can experience digestive disorders because they don't function properly, resulting in malnutrition and electrolyte imbalances. The process of breastfeeding also becomes problematic as the baby is small and weak, has small digestive organs, and cannot suckle properly. Thus, if this situation last longer with inadequate or inappropriate nutrition, children are often infected and experience stunting⁸.

Stunting, directly and indirectly, affects children in the short and long term. Stunting affects low birth weight, hinders cognitive development and achievement, and limits chances of living into adulthood⁹. Short-term effects can cause problems with brain development, intelligence, physical growth, and metabolic disorders. Long-term effects can cause a decrease in cognitive skills and learning success, weakening the immune system so that children are easy to get sick, obesity and disability in old age¹⁰.

A study conducted in Seberang Ulu 1 Sub-district, Palembang in 2020 revealed that newborns with a low risk of stunting were 2.9 higher than normal newborns⁸.

The Scoping Review aims to determine the association between low birth weight and stunting incidence.

METHOD

The review used a scoping review technique as the sources used varied from some articles. Scoping reviews are used to identify information gaps, make systematic assessments, and determine the impact of decisions¹¹. The PRISMA-ScR Checklist was utilized for this scoping review¹². Arkshey and O'Malley's stages covered identifying research questions, identifying relevant articles, selecting articles, mapping data, and presenting data/results, discussion, and conclusions.

Identifying research questions

This research utilized the Population, Exposure, Outcomes, Study (PEOS) framework to locate articles, establish inclusion and exclusion criteria, and identify relevant articles.

The review asks, "What is the latest obstetric scientific evidence regarding the relationship between low birth weight and stunting".

Table 1. PEOS Framework

P(Population)	E(Exposure)	O(Outcome)	S(Study)
Stunting incidence	Low birth weight	Association	Any articles discussing low birth weight and stunting incidence

Identifying relevant studies

The search strategy according to the research questions and objectives, the researcher determined the inclusion and exclusion criteria as presented in the following table:

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion criteria
a. Articles in Indonesia or English	a. Review/Opinion Articles
b. Original research article	b. Books
c. Articles related to low birth weight and stunting incidence	c. Reports
d. Articles published in the last 5 years (2018-2022)	d. Guideline
	e. Final assignment (Thesis)

Articles search used some strategies: keywords, medical subject headings (MESH), truncation, Boolean operators (OR, AND, and NOT), and keywords in British and American English. The search involved four databases (Pubmed, DOAJ, Wiley online library, and EBSCO and supporting websites) to determine the scope of this review. Meanwhile, gray used the World Health Organization (WHO), and the United Nations International Children's Emergency Fund (UNICEF). The keywords used in the search for articles were low birth weight infant* OR low birth weight* AND stunting* OR growth disorder* OR stunted* OR malnutrition* OR undernutrition* OR nutritional deficiency*. Besides, the researcher included a five-year filter (2018-2022) as well

as the kind of original research publications. Then, the search results were downloaded and saved for future reference.

After gathering the evidence, a critical appraisal was conducted using the Joanna Briggs Institute (JBI) framework. The predetermined criteria were used to choose the data.

Selecting the Outcome of the Study

The selection of articles found 2704 articles consisting of 572 articles from PubMed, 446 articles from Wiley online library, 406 articles from DOAJ, and 1280 articles from EBSCO. The next step was inserting the articles into Mendeley software and finding 30 duplicate articles. After removing duplicate articles, the researcher filtered the titles and abstracts, doing a scoping review by reading

research publications in whole to determine the applicability of research articles. Eleven related articles were obtained. The articles search process can be seen in the following PRISMA Flowchart:

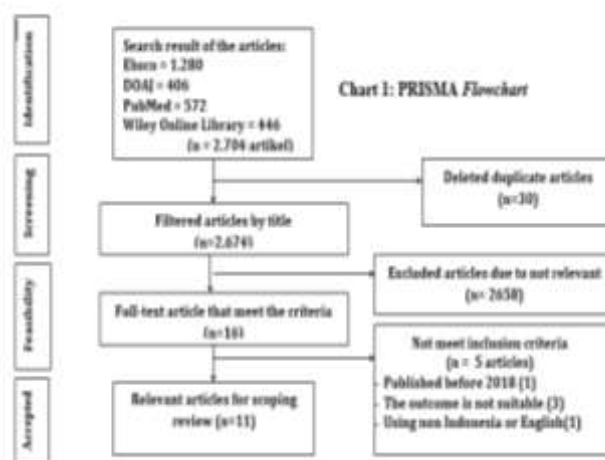


Table 3. Data Charting

No.	Author, Year	Population, Sample	Data Collection	Type of Research	Results
A1	Saimin <i>et al.</i> , 2019 ¹³	Population: 64 children aged 6-59 months. Sample: 16 cases and 48 control	Low birth weight baby data: documentation, medical record Weight: Anthropometric measurement	case control	The results of the study obtained an odds ratio (OR) value of 5.923 (> 1) indicating that a history of LBW was significantly a risk factor for malnutrition with a lower limit of 1.724 and an upper limit of 20.346
A2	Adedokun & Yaya, 2021 ¹⁴	Population: Women aged 15 to 49, and children aged 0 to 59 months. Sample: 189, 195 children aged 0-59 months	Demographic and Health Survey Questionnaire and interview	cross-sectional	The results showed that the likelihood of experiencing stunting increased by 25% and 83%, respectively for children born with average weight and children with low birth weight <0.001. While the likelihood of stunting incidence decreased by 75% for children younger than 12 months and it increased by 12% for children aged 12-23 months.
A3	Ansuya <i>et al.</i> , 2018 ¹⁵	Population: 1485 children Sample: 570 children (190 cases and 380 control)	Demographic perform Economic status measurement scale semi-structured risk factor questionnaire and anthropometric measurement	case control study	The results showed that being underweight was significantly associated with parents' socioeconomic status, birth weight <2000 p<0.002, recurrent diarrhea, recurrent colds, and coughs, worms, and pre-lacteal feeding.

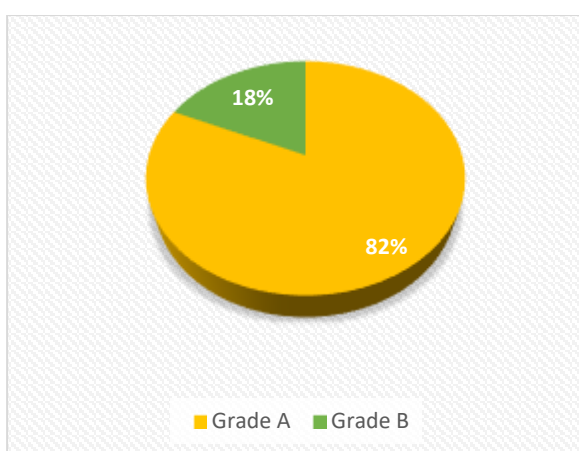
No.	Author, Year	Population, Sample	Data Collection	Type of Research	Results
A4	Ferreira <i>et al.</i> , 2020 ¹⁶	Population: 1992 (1231 children), 2005 (308000 children) and 2015 (328000 children) Sample: children aged 0-60 months 1992 (n=1231), 2005 (n=1381) and 2015 (n=988) Instrument: Survey, interviews, and anthropometric measurement		cross-sectional surveys	The results showed that in 1992, 2005 and 2015, the prevalence of stunting reached 22.6, 11.2 and 3.2% (85.8% decrease), while the prevalence of overweight reached 6.9, 7.5 and 14.9%, respectively (115.9% increase). Based on the multivariate analysis, the following positive associations with stunting were observed in 1992: age group >24 months (28.3% vs 14.5%), mothers with ≥2 children (28.8% vs 12.8%), low birth weight (28.3% vs 15.7%) p-value <0.006 and mothers with low education level (29.3% vs 7.2%).
A5	SK, B & Rana, 2021 ¹⁷	Population: 750 mothers with children aged 36-59 months Sample: 731 mothers/caregivers responded and completed the survey	Structured questionnaire and anthropometric measurement	cross sectional	The prevalence of stunting in children aged 36-59 months was 40%. The prevalence of stunting reached 40%, which is very high according to the WHO public health significance threshold (≥40%). The results of the multilevel analysis showed that low birth weight (p<0.001), birth spacing, mother's age at delivery, duration of breastfeeding, education level and mother's occupation were risk factors for stunting.
A6	Nshimiyiryo <i>et al.</i> , 2019 ⁶	Population: 12,793 Sample: 3594 children	Anthropometric measurement and growth indicator	cross sectional	A total of 3594 children under 59 months consisting of 51% boys. The prevalence of stunting in all children reached 38%. In unadjusted analysis, the following factors were significant: boys children aged 6–23 months and children aged 24–59 months compared with those aged 0–6 months with low birth weight p<0.01, short mothers, history of deworming during pregnancy, mother's education levels, illiterate mothers and poor households
A7	Sunguya, B.F <i>et al.</i> , 2019 ¹⁸	Population: 37,409 children in 1991-2016 Sample: 1991–1992 (n=6587), 1996 (n=5437), 1999 (n=2556), 2004–2005 (n=7231), 2009–2010 (n=6597), and 2015–2016 (n=9001)	Six TDHS dataset namely demographic and health survey (DHS), Aids indicator survey (AIS), Service temporary assessment (SPA), Malaria indicator survey (MIS),	cross sectional	Results of the study showed a 30% reduction in stunting over 25 years in Tanzania. Factors related to stunting were children living in households with women as head of household (OR= 1.16, P=0.014), aged 24–35 months (OR= 1.75, P=0.019), newborn babies (OR=2.14, P<0.001) and with inconsistent or no breastfeeding (OR=3.46, P<0.001 and (OR=4.29, P=0.001). Children who live in

No.	Author, Year	Population, Sample	Data Collection	Type of Research	Results
			indicator survey (KIS) and National Bureau of Statistics (NBS)		urban areas have a higher risk of stunting (OR=0.56, P<0.001) with caregiver education (OR=0.56, P=0.018), maternal obesity (OR=0.63, P<0.001), highest wealth index (OR=0.42, P<0.001), and among girls (OR=0.77, P<0.001).
A8	Khan, Z & Safdar, 2019 ¹⁹	Population: 13944 Sample: children aged 0-59 months (n=3071) Women who ever married aged 15-49 years (n = 14,569)	Secondary analysis of 2012-2013 PDHS data	cross sectional	Results showed that 44.4% of toddlers experienced stunting, 29.4% were thin, and 10.7% were thin. Children whose mothers live in rural areas (OR=0.67, 95%CI 0.48–0.92), aged <18 years when married (OR=0.76, 95%CI 0.59–0.99) and have more than 3 times ANC visits (OR = 0.61, 95% CI 0.38–0.98) were less likely to experience stunting. Low maternal education level (OR=2.55, 95%CI 1.26–5.17), short stature (OR=2.31, 95%CI 1.34–3.98), low birth weight (OR=1.67, 95% CI 1.14–2.45) and the mother's BMI were significantly related to the child's underweight status. Children whose mothers were uneducated were more likely to experience wasting (OR=3.61, 95% CI 1.33–9.82)
A9	Sartika <i>et al.</i> , 2021 ²⁰	Population: Mothers of caregivers and babies whose mothers participate in the previous study. Sample: 559 children aged 0-11 months	Anthropometric measurement and interview	Cross sectional	Results of the study showed that 20.8% of the 559 children experienced stunting. In the model using LBW as a predictor of stunting, children with a birth weight of <2,500 g significantly increased the likelihood of stunting. children with diarrhea in the last 2 weeks and infants aged 9–11 months who did not receive vaccination had imperfect immunity. In the non-LBW model, premature babies, short mothers, and babies aged 9-11 months who did not receive basic immunization were significantly more likely to experience stunting.
A10	Giao <i>et al.</i> , 2019 ²¹	Population: children aged 12-24 months receiving EPI vaccine in the community health center in Ho Chi Minh City Sample: 768 children	Questionnaire and anthropometric measurement	cross sectional	The results showed that the average age of 768 children was 16.8 ± 4.2 months, 51.7% of whom were boys. The prevalence of stunting and obesity was (8.2%) and (10.7%) respectively. Stunting was associated with older age, lower birth weight for boys and girls,

No.	Author, Year	Population, Sample	Data Collection	Type of Research	Results
					and mother's occupation (P<0.05).
A11	Binagwaho <i>et al.</i> , 2020 ²²	Population: all women aged 15-49 years and children under five years Sample: National representative 9696, 10,272, 12,540, and 12,699 households with the response rate of 99.5, 99.7, 99.8, and 99.9% respectively from 2000, 2005, 2010, and 2015	Interview and anthropometric measurement	cross sectional	The prevalence of stunting in under 5 years in Rwanda declined from 2000 (47.4%) to 2015 (38.3%), although the rate remained relatively stable between 2000 and 2010. Factors associated with higher stunting rates were low birth weight, low economic status, mother's education levels, smoking and male gender

After data charting, the quality of the journal was assessed with critical judgement by assessing the potential for methodological bias or systematic error in the studies so that the reviewer can consider findings based on bias²³. The articles were assessed using the JBI which is a critical assessment instrument freely available for investigating the methodological limitations of primary research studies²⁴. Based on the assessment using Critical Appraisal, the selected items had good quality covering 9 articles with grade A and 2 articles with grade B.

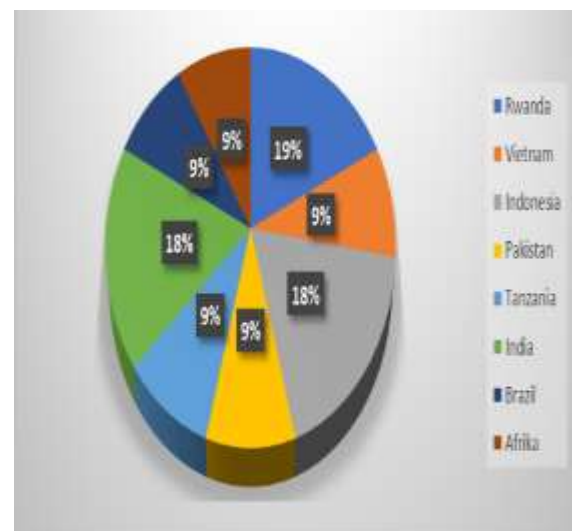
Diagram 1. Analysis by Article Grade



RESULTS

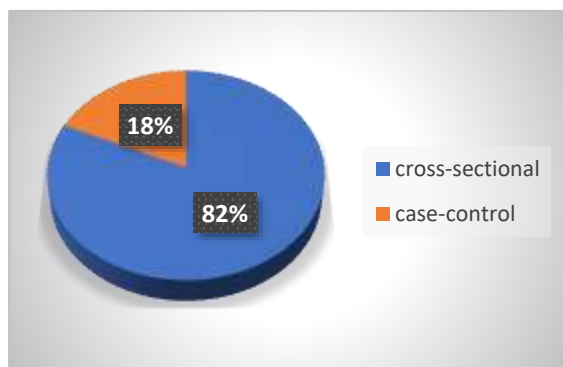
Based on the diagram above, the results of the analysis by country showed that all articles came from developing countries with 2 articles from Rwanda, 1 from Vietnam, 2 from Indonesia, 1 from Pakistan, 1 from Tanzania, 2 from India, 1 from Brazil and 1 from Africa.

Diagram 2. Analysis by types of country



Based on the diagram below, eleven articles were selected quantitatively consisting of 9 articles with the cross-sectional method and 2 articles with case-control method.

Diagram 3. Analysis by types of study



Mapping/Scoping

1. Geographical Characteristics

The systematic search results obtained 11 articles published between 2018-2022. The articles come from some developing countries, namely Rwanda, Vietnam, Indonesia, Pakistan, Tanzania, India, Brazil, and Africa.

2. Thematic

The results of the review identified some topics that are in accordance with the focus of the review, namely:

Table 4. Mapping/Theme Grouping

THEME	SUB-THEME
Factors influencing stunting	1. Age ^{1,4,6,7,8,10}
	2. Number of children ⁴
	3. Birth weight ^{3,4}
	4. Economic status ^{2,5,6}
Impacts of low birth weight	1. Infection ^{3,9}
	2. Increasing infant Mortality ⁹
	3. Stunting ^{1,2,3,5,7,8,9,10}

DISCUSSION

According to the review results involving 11 relevant articles, some articles discussed themes that could affect LBW on the stunting incidence.

Factors Affecting Stunting

Low birth weight is birth weight <2500 grams⁶. Low birth weight babies risk developing conditions that hinder their growth¹⁶. Nutrition is important at every stage of a person's life, from before birth to older

people. Infants and toddlers are vulnerable to malnutrition⁶.

Malnutrition causes disorders in children's growth and development, which can continue into adulthood if not treated soon. This study shows that most children with stunting in the coastal areas of Southeast Sulawesi are aged 25-48 months¹³. The research results are almost the same in Rwanda, Vietnam, Pakistan, Tanzania, India, Brazil, and Africa, where the prevalence of stunting in toddlers is high. When children grow, the prevalence of stunting typically rises to its peak between 24 and 35 months and then declines¹⁹.

Economic status influences stunting incidence. Children from low economic status have a higher chance of being short and thin than those from high economic status¹⁴. Child nutrition suffers due to poverty because poor households do not have the financial ability to buy and eat foods high in vitamins and minerals that can enhance children's health. However, rich households can access these foods, greatly supporting growth and development⁶. Thus, better socioeconomic conditions and promoting global access to health and education are the basic strategies for reducing stunting incidence¹⁷.

The number of children also influences stunting incidence, as "mothers with three or more children" contributed to malnutrition. Referring to the 1992 and 2015 surveys, more education expenditure is required to improve population health standards. It is predicted that moms will have less time to care for their children and have poorer per capita availability regarding the higher frequency of stunting in children whose mothers have three or more children¹⁶.

Impacts of Low Birth Weight

Low birth weight infants are more vulnerable to illness, stunting, and possibly neonatal death. Babies with low birth weight are more susceptible to infections such as diarrhea and lower respiratory tract infections and have a higher risk of complications such as sleep apnea, jaundice, anemia, chronic lung disease, fatigue, and loss of appetite than those with normal birth weight. Low birth weight can also cause infant death²¹. Besides, the infection can also cause malnutrition, which makes children more susceptible to infectious diseases and increases the risk of growth delays¹⁵.

Babies with low birth weights grow

slower than babies with normal birth weights. Babies born with LBW can experience digestive disorders as they don't function properly, resulting in poor food intake and electrolyte imbalances that hinder growth and development, resulting in stunting¹⁸. Children whose birth weight is low are 5 times more likely to be stunted than those whose birth weight is normal¹⁴. Meanwhile, a study by Binagwaho et al. (2020) reveals that the likelihood of stunting is more than double compared to children with normal weight. Another study²⁵ shows that A low birth weight increases the risk of stunting by 1.58 times compared to a normal birth weight. The study found that children with low birth weights are more likely to experience stunting¹⁵. It is supported by the article findings^{1,2,3,5,7,8,9,10} that LBW infants significantly correlate with stunting¹⁹.

The limitations in this scoping review are using articles from developing countries due to limited international scopes that discuss the relationship between LBW and stunting incidence in developed countries. In terms of the type of study, most articles used the quantitative method so the information obtained tends to be short and not in-depth.

CONCLUSION

Children with a low birth weight of <2500 and children of mothers with children ≥ 3 with a low economic status have a low health awareness and nutritional status resulting in high stunting rates. Babies with low birth weight are at risk of infection, which causes malnutrition, stunting, and even neonatal death. And most births with low birth weight occur in low- and middle-income households in developing countries. Low birth weight has a significant relationship with the prevalence of stunting.

ACKNOWLEDGEMENT

The author highly appreciates the Midwifery Masters Study Program of Aisyiyah University Yogyakarta for facilitating various online databases for article search and the Ministry of Research, Technology and Higher Education for funding research.

REFERENCE

1. WHO. Observatorium Kesehatan Global [Internet]. 2022. Available from:

- https://www.who.int/data/gho/data/themes/topics/sdg-target-2_2-malnutrition
2. UNICEF. Malnutrition prevalence remains alarming: stunting is declining too slowly while wasting still impacts the lives of far too many young children [Internet]. 2022. Available from: <https://data.unicef.org/topic/nutrition/malnutrition/>
3. Kemenkes RI. Profil Kesehatan Indonesia [Internet]. Jakarta: Kemenkes RI. Available from: <https://www.kemkes.go.id/downloads/resources/download/pusdatin/profil-kesehatan-indonesia/Profil-Kesehatan-2021.pdf>
4. Apriluana G, Fikawati S. Analisis faktor-faktor risiko terhadap kejadian stunting pada balita (0-59 bulan) di negara berkembang dan asia tenggara. *Media Penelitian dan Pengembangan Kesehatan*. 2018 Dec 31;28(4):247-56.
5. Kemenkes RI. Cegah Stunting, itu Penting. Pusat Data dan Informasi, Kementerian Kesehatan RI. 2018.
6. Nshimiyiryo A, Hedt-Gauthier B, Mutaganzwa C, Kirk CM, Beck K, Ndayisaba A, Mubiligi J, Kateera F, El-Khatib Z. Risk factors for stunting among children under five years: a cross-sectional population-based study in Rwanda using the 2015 Demographic and Health Survey. *BMC public health*. 2019 Dec;19(1):1.
7. Kristiana N, Juliansyah E. Umur, pendidikan, pekerjaan dan pengetahuan dengan kejadian berat badan lahir rendah (BBLR). *Jurnal Ilmiah Ilmu Kesehatan: Wawasan Kesehatan*. 2017;4(1):7-14.
8. Sari IP, Ardillah Y, Rahmiwati A. Berat bayi lahir dan kejadian stunting pada anak usia 6-59 bulan di Kecamatan Seberang Ulu I Palembang. *J Gizi Indones (The Indones J Nutr [Internet]*. 2020;8(2):110–8. Available from: <https://ejournal.undip.ac.id/index.php/jgi/article/view/26254>
9. Chowdhury TR, Chakrabarty S, Rakib M, Afrin S, Saltmarsh S, Winn S. Factors associated with stunting and wasting in children under 2 years in Bangladesh. *Heliyon [Internet]*. 2020;6(9):e04849. Available from: <https://doi.org/10.1016/j.heliyon.2020>

- e04849
10. Argaw D, Hussen Kabthyer R, Endale T, Wudneh A, Daniel Meshesha M, Tadesse Hirbu J, et al. Stunting and associated factors among primary school children in Ethiopia: School-based cross-sectional study. *Int J Africa Nurs Sci* [Internet]. 2022;17(November 2021):100451. Available from: <https://doi.org/10.1016/j.ijans.2022.100451>
 11. Munn Z, Peters MDJ, Stern C, Tufanaru C, Aromataris AM& E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol*. 2018;18:143.
 12. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Ann Intern Med* [Internet]. 2018;169(7):467–73. Available from: <https://www.acpjournals.org/doi/full/10.7326/M18-0850?journalCode=aim>
 13. Saimin J, Nugraha AF, Asmarani A, Ashaeryanto A. Low Birth Weight Is a Risk Factor of Malnutrition in Children Under Five Years Old in Coastal Areas. *Public Heal Indones*. 2019;5(2):25–9.
 14. Adedokun ST, Yaya S. Factors associated with adverse nutritional status of children in sub-Saharan Africa: Evidence from the Demographic and Health Surveys from 31 countries. *Matern Child Nutr* [Internet]. 2021 Jul 1;17(3):e13198. Available from: <https://doi.org/10.1111/mcn.13198>
 15. Ansuya, Nayak BS, Unnikrishnan B, George A, N SY, Mundkur SC, Guddattu V. Risk factors for malnutrition among preschool children in rural Karnataka: a case-control study. *BMC Public Health*. 2018 Dec;18:1-8. <https://doi.org/10.1186/s12889-018-5124-3>
 16. Ferreira HD, Albuquerque GT, Santos TR, Barbosa RD, Cavalcante AL, Duarte LE, Assunção ML. Stunting and overweight among children in Northeast Brazil: prevalence, trends (1992-2005-2015) and associated risk factors from repeated cross-sectional surveys. *BMC Public Health*. 2020 Dec;20(1):1-5.
 17. SK R, Banerjee A, Rana MJ. Nutritional status and concomitant factors of stunting among pre-school children in Malda, India: A micro-level study using a multilevel approach. *BMC public health*. 2021 Dec;21:1-3.
 18. Sunguya BF, Zhu S, Mpembeni R, Huang J. Trends in prevalence and determinants of stunting in Tanzania: An analysis of Tanzania demographic health surveys (1991-2016). *Nutr J*. 2019;18(1).
 19. Khan S, Zaheer S, Safdar NF. Determinants of stunting, underweight and wasting among children < 5 years of age: Evidence from 2012-2013 Pakistan demographic and health survey. *BMC Public Health*. 2019 Apr 1;19(1).
 20. Sartika AN, Khoirunnisa M, Id EM, Ermayani E. Prenatal and postnatal determinants of stunting at age 0 – 11 months: A cross-sectional study in Indonesia. 2021;1–14. Available from: <http://dx.doi.org/10.1371/journal.pone.0254662>
 21. Giao H, Le An P, Truong Vien N, Van Khanh T, Quang Vinh B. Stunting and Overweight among 12-24-Month-Old Children Receiving Vaccination in Ho Chi Minh City, Vietnam. *Biomed Res Int*. 2019;2019:1547626.
 22. Binagwaho A, Rukundo A, Powers S, Donahoe KB, Agbonyitor M, Ngabo F, et al. Trends in burden and risk factors associated with childhood stunting in Rwanda from 2000 to 2015: Policy and program implications. *BMC Public Health*. 2020 Jan 20;20(1).
 23. Stanhope J, Weinstein P. Critical appraisal in ecology: What tools are available, and what is being used in systematic reviews? *Res Synth Methods*. 2022;(October):1–15.
 24. Barker TH, Stone JC, Sears K, Klugar M, Leonardi-Bee J, Tufanaru C, Aromataris E, Munn Z. Revising the JBI quantitative critical appraisal tools to improve their applicability: an overview of methods and the development process. *JBI Evidence Synthesis*. 2023 Mar 1;21(3):478-93.
 25. Huynh G, Huynh QH, Nguyen NH, Do

QT, Van Tran K. Malnutrition among 6–59-month-old children at district 2 hospital, Ho Chi Minh City, Vietnam: prevalence and associated factors. *BioMed Research International*. 2019 Feb 5;2019.

Article Review

Potential Toxicity of The Combination of Hydroxychloroquine and Azithromycin for Covid-19 Therapy: Literature Review

M. Sabir Mangawing^{1*}, Rosa Dwi Wahyuni²

¹ Laboratory of Molecular Microbiology and Immunology of Tropical Diseases, Department of Medical Microbiology, Faculty of Medicine, Tadulako University, Palu, Central of Sulawesi, Indonesia

² Laboratory of Clinical Pathology, Immunology and Tropical Diseases, Department of Clinical Pathology, Faculty of Medicine, Tadulako University, Palu, Central of Sulawesi, Indonesia

(Correspondence author's e-mail, m.sabir@untad.ac.id)

ABSTRACT

One of the therapies often used for COVID-19 patients is a combination of Hydroxychloroquine and Azithromycin. Although only short-term treatment, Hydroxychloroquine and Azithromycin may increase the risks of QTc and TdP intervals prolongation. This literature review aims to determine the potential toxicity of the combination of Hydroxychloroquine and Azithromycin for COVID-19 therapy. This study involved the PubMed, NCBI, Science Direct, NIH MEDLINE, Google Scholar and ProQuest databases. The 24 articles collected were then selected. Finally, 15 articles were found feasible for references in a literature review. The study results showed that combined Hydroxychloroquine and Azithromycin in COVID-19 therapy could increase the risk of QTc and TdP waves prolongation. It can be concluded that the combination of Hydroxychloroquine and Azithromycin carried the risk of prolongation of QTc and TdP waves in the heart rhythm cycle. There is a need for monitoring and/or recommendation regarding instructions for the use of combination therapy of the two types of drugs among patients with COVID-19.

Keywords : Hydroxychloroquine (HCQ), Azithromycin (AZM), Therapy, COVID-19

<https://doi.org/10.33860/jik.v17i2.2890>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

In 2019, precisely in December, it was reported a kind of pneumonia in Wuhan, China. Upon identification, the pathogen became known as acute respiratory syndrome coronavirus (novel coronavirus) or COVID-19. Since then, the virus has spread internationally and infected millions of people resulting in high mortality rate¹.

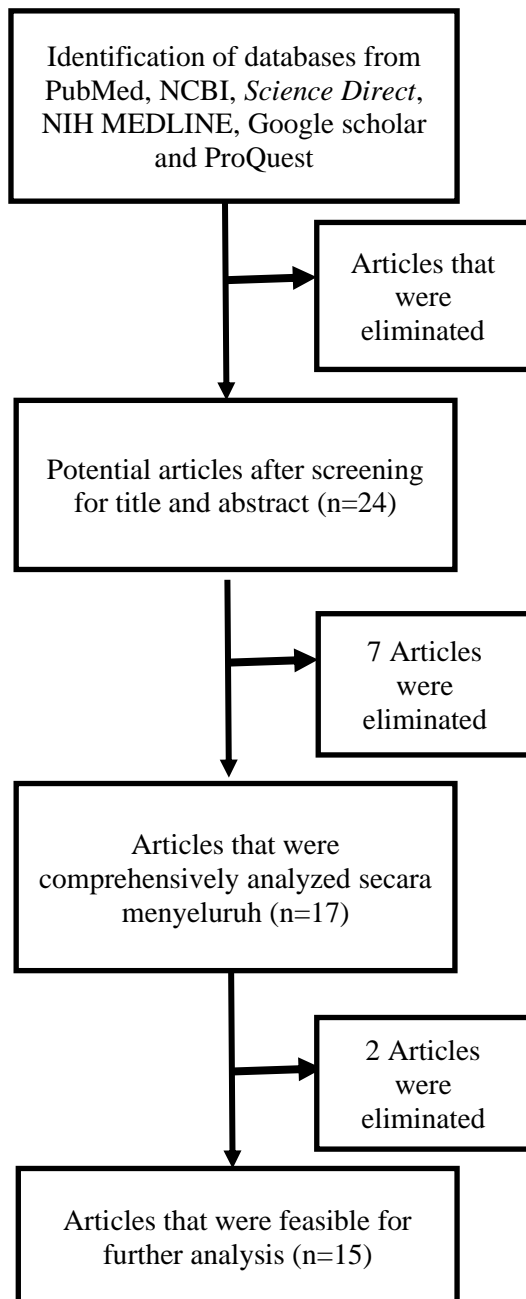
Drugs used as therapy for acute respiratory syndrome coronavirus-2 (SARS-CoV-2) are preferred due to their effectiveness against earlier strains of coronavirus (SARS-CoV and Middle East Respiratory Syndrome Coronavirus). One of the drugs often used in therapy for COVID-19 patients is a combination of Hydroxychloroquine (HCQ) and Azithromycin (AZM)².

Several studies have addressed the toxicity of HCQ and AZM combination drug administration in Covid-19 patients³. Even though HCQ is generally well tolerated, doctors and patients must remain concern about the serious side effects that may occur. Even if it is only a short-term treatment, one of the potential risks of treatment is prolongation of the QTc interval. Such potency will increase if it is used in combination with AZM. In addition, the administration of drug combination therapy can also result in drug interactions⁴.

METHOD

A systematic review was conducted using databases obtained through PubMed, NCBI, Science Direct, NIH MEDLINE, Google scholar and ProQuest by searching for

appropriate keywords such as: potential toxicity in the use of the combination of Hydroxychloroquine and Azithromycin on COVID-therapy and words related to the effects of Hydroxychloroquine and Azithromycin treatment. Literature selection was performed based on inclusion criteria, namely articles with title, abstract, accessible full text and were published in the last 5 years. The exclusion criteria were articles that only showed the abstract or journal manuscripts that could not be accessed in full text.



Graph 1. Literature Review Selection Process

RESULTS

Based on the search results using the database, 24 journals were found and selected. Based on the results of the review and selection of journals, 15 research journals were obtained with the feasible category to be involved as samples and further analyzed in this review literature.

DISCUSSION

Hydroxychloroquine (HCQ) has been used to prevent and treat malaria and chronic inflammatory diseases such as rheumatoid arthritis and systemic lupus erythematosus⁴. However, hydroxychloroquine (HCQ) in vitro had also shown its efficiency as antiviral against SARS-CoV-2^{4,5} by changing the endosomal pH required for virus-cell fusion as well as the ability to interfere with glycosylation of SARS-CoV cellular receptors^{1,4,5}. It seems that hydroxychloroquine (HCQ), combined with Azithromycin (AZM), have a certain level of effectiveness against viruses that was faster to cure compared to using HCQ as a single monotherapy. However, the use of combination therapy must be implemented with caution due to the side effects of the drugs given which can be potentially life-threatening⁶.

The antimalarial drug of HCQ and the macrolide antibiotic of AZM used in combination for COVID-19 therapy are known to increase the QT interval. COVID-19 patients who were hospitalized and treated with HCQ and AZM showed a much greater increase in the corrected QT interval when compared to monotherapy of HCQ drug^{1,3}.

Azithromycin (AZM) is a macrolide antibiotic that can broadly inhibit gram-positive and negative bacteria with a target on disrupting bacterial ribosomal protein synthesis. AZM and HCQ work simultaneously by inhibiting Sars-CoV-2 in vitro⁷.

The administration of HCQ and AZM was correlated with a three-fold higher risk of QTc interval prolongation than no treatment. In addition, the administration of HCQ was also correlated with an increased risk of QTc and TdP intervals prolongation through blockade of HERG/Kv potassium channels. The torsadogenic potential of these drugs could be mutually reinforcing if other QTc-prolonging drugs such as azithromycin were administered together⁸.

Furthermore, Hydroxychloroquine (HCQ) works by inhibiting signals mediated by Toll-Like Receptors (TLR), including TLR-7 and TLR-9, endosomal innate immune sensors capable of detecting single-stranded RNA, modulating complement-dependent antigen/antibody reactions, activating Regulatory T cells, and inhibiting the production of proinflammatory cytokines such as interleukin-6, tumor necrosis factor- α and interferon- γ . Therefore, HCQ immediately attenuates the inflammatory response directed against SARS-CoV-2 causing a cytokine storm, which is considered severe COVID-19⁶.

hydroxychloroquine can also interfere with ventricular repolarization, which leads to prolongation of the QTc interval and increased risk of torsades de pointes (TdP)⁹. At the cellular level, HCQ prolongs the duration of cardiac action potentials, increases automaticity, and reduces maximum diastolic potential. Consequently, HCQ causes prolongation of the QT and QRS intervals on the EKG view. In addition, patients receiving the combination of HCQ + AZM showed a greater change in the median QT interval compared to those receiving HCQ alone^{2,11}. Other potentially serious dangers include hypoglycemia, neuropsychiatric effects, idiosyncratic hypersensitivity reactions, and drug interactions if used simultaneously with AZM^{4,10}.

The administration of HCQ and AZM requires careful cardiac monitoring, especially in menp with a high-risk Tisdale score, and patients with an initial QTc interval score of ≥ 450 milliseconds⁵. Treatment should be discontinued if there are any danger signs: QTc of >550 ms or the appearance of VES or TdP¹⁶.

These two drugs have been widely used over the past few decades. According to the 2013 IMS Health in the United States, approximately 52.5 million prescriptions were written for Azithromycin in 2012 and approximately 4.5 million prescriptions were written for hydroxychloroquine. However, to date, there are very limited data on the safety of combined use among COVID-19 patients^{13,14,15}.

Potential antiviral activity could be achieved at usual doses of the drug Hydroxychloroquine (400-600 mg daily) which was considered clinically safe. The clinically effective dose of Hydroxychloroquine for combination therapy with Azithromycin in Covid-19 had not yet been determined^{6,14}.

Therefore, further studies regarding the appropriate dosage for Covid-19 therapy is required. Similarly, the level of safety regarding the level of QTc prolongation for HCQ+AZM therapy among patients with COVID-19 needs further studies in order to investigate the prevalence of arrhythmias and the risk of death¹².

CONCLUSION

The combination of Hydroxychloroquine and Azithromycin had a higher risk of QTc and TdP waves prolongation. So, there is a need for monitoring or recommendation regarding instructions for the use of combination therapy of the two types of drugs among patients with COVID-19.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Saleh M, Gabriels J, Chang D, Soo Kim B, Mansoor A, Mahmood E, Makker P, Ismail H, Goldner B, Willner J, Beldner S. Effect of chloroquine, hydroxychloroquine, and azithromycin on the corrected QT interval in patients with SARS-CoV-2 infection. *Circulation: Arrhythmia and Electrophysiology*. 2020 Jun;13(6):e008662.
2. Özdemir İH, Özlek B, Özen MB, Gündüz R, Çetin N, Bilge AR. Hydroxychloroquine/azithromycin treatment, QT interval and ventricular arrhythmias in hospitalised patients with COVID-19. *International journal of clinical practice*. 2021 Feb;75(2):e13896.
3. Yendrapalli U, Ali H, Green JL, Edwards J. Effects of cardiac toxicity of combination therapy with hydroxychloroquine and azithromycin in COVID-19 patients. *Journal of Infection and Public Health*. 2021 Nov 1;14(11):1668-70.
4. Juurlink DN. Safety considerations with chloroquine, hydroxychloroquine

- and azithromycin in the management of SARS-CoV-2 infection. *Cmaj*. 2020 Apr 27;192(17):E450-3.
5. Eftekhari SP, Kazemi S, Barary M, Javanian M, Ebrahimpour S, Ziaei N. Effect of hydroxychloroquine and azithromycin on QT interval prolongation and other cardiac arrhythmias in COVID-19 confirmed patients. *Cardiovascular Therapeutics*. 2021 Feb 27;2021:1-7.
 6. Mégarbane B, Scherrmann JM. Hydroxychloroquine and azithromycin to treat patients with COVID-19: both friends and foes?. *Journal of clinical pharmacology*. 2020 Jul;60(7):808.
 7. Li C, Cheng G. Will hydroxychloroquine still be a game-changer for COVID-19 by combining azithromycin?. *Frontiers in Immunology*. 2020 Aug 7;11:1969.
 8. Huang HD, Jneid H, Aziz M, Ravi V, Sharma PS, Larsen T, Chatterjee N, Saour B, Aziz Z, Nayak H, Trohman RG. Safety and effectiveness of hydroxychloroquine and azithromycin combination therapy for treatment of hospitalized patients with COVID-19: a Propensity-Matched study. *Cardiology and Therapy*. 2020 Dec;9:523-34.
 9. Voisin O, le Lorc'h E, Mahé A, Azria P, Borie MF, Hubert S, Ménage E, Guillermin JC, Mourad JJ. Acute QT interval modifications during hydroxychloroquine-azithromycin treatment in the context of COVID-19 infection. In *Mayo Clinic Proceedings* 2020 Aug 1, 95,(8), 696-1700. Elsevier.
 10. Echarte-Morales J, Minguito-Carazo C, del Castillo-García S, Borrego-Rodríguez J, Rodríguez-Santamarta M, Sánchez-Muñoz E, Bergel-García R, González-Maniega C, Prieto-González S, Menéndez-Suarez P, Tundidor-Sanz E. Effect of hydroxychloroquine, azithromycin and lopinavir/ritonavir on the QT corrected interval in patients with COVID-19. *Journal of Electrocardiology*. 2021 Jan 1;64:30-5.
 11. O'Connell TF, Bradley CJ, Abbas AE, Williamson BD, Rusia A, Tawney AM, Gaines R, Schott J, Dmitrienko A, Haines DE. Hydroxychloroquine/azithromycin therapy and QT prolongation in hospitalized patients with COVID-19. *Clinical Electrophysiology*. 2021 Jan 1;7(1):16-25.
 12. Hache G, Rolain JM, Gautret P, Deharo JC, Brouqui P, Raoult D, Honoré S. Combination of hydroxychloroquine plus azithromycin as potential treatment for COVID-19 patients: safety profile, drug interactions, and management of toxicity. *Microbial Drug Resistance*. 2021 Mar 1;27(3):281-90.
 13. Tuncer T, Karaci M, Boga A, Durmaz H, Guven S. QT interval evaluation associated with the use of hydroxychloroquine with combined use of azithromycin among hospitalised children positive for coronavirus disease 2019. *Cardiology in the Young*. 2020 Oct;30(10):1482-5.
 14. Ramireddy A, Chugh H, Reinier K, Ebinger J, Park E, Thompson M, Cingolani E, Cheng S, Marban E, Albert CM, Chugh SS. Experience with hydroxychloroquine and azithromycin in the coronavirus disease 2019 pandemic: implications for QT interval monitoring. *Journal of the American Heart Association*. 2020 Jun 16;9(12):e017144.
 15. Ouarradi AE, Abdeladim S, Oualim S, Filali RA, Bensahi I, Elharass M, Hafid S, Tazi H, Naitlhou A, Bouaiti EA, Moustaghfir A. Hydroxychloroquine and azithromycin as a treatment of Covid-19: electrocardiogram variability. *Journal of the Saudi Heart Association*. 2020;32(3):350.

16. Cavalcanti AB, Zampieri FG, Rosa RG, Azevedo LC, Veiga VC, Avezum A, Damiani LP, Marcadenti A, Kawano-Dourado L, Lisboa T, Junqueira DL. Hydroxychloroquine with or without Azithromycin in Mild-to-Moderate Covid-19. *New England Journal of Medicine*. 2020 Nov 19;383(21):2041-52.

Article Review

Interprofessional Collaboration Practices in Integrated ANC Services: Scoping Review

Yohana Samosir^{1*}, Sulistyaningsih¹

¹ University of 'Aisyiyah Yogyakarta, Yogyakarta, Indonesia

(Correspondence author's email, yohanasamosir2003@gmail.com)

ABSTRACT

Obstetric complications often occur in pregnant women because not all pregnant women regularly make integrated ANC visits, causing problems of maternal mortality that never go away. This research aims to examine interprofessional collaboration practices in integrated ANC services. The method used is Scoping Review as a research design. A scoping review is a precursor to a systematic review, aiming to identify the types of evidence available about the topic under discussion. They are using the PRISMA-ScR framework by searching for articles through relevant databases. Research results: Based on a search of 1,534 selected papers, ten essays met the inclusion criteria, and of the ten articles reviewed, it was found that the role of interprofessional collaborative practice among various health workers had not carried out their duties based on the responsibilities of each profession and the development and empowerment of human resources. Obstacles were found in supporting facilities, skills, awareness, and communication by Health workers to be overcome to obtain integrated ANC services to increase visits and obtain quality pregnancy checks, thereby reducing cases of maternal and neonatal deaths.

Keywords: *Integrated ANC, Interprofessional Collaborative Practice, Pregnant Women, Indonesia*

<https://doi.org/10.33860/jik.v17i2.2488>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Interprofessional collaboration is a collaboration between several health professionals from different educational backgrounds with patients and their families to provide the best health services. Good collaboration between professionals is necessary to provide efficient care to patients so that it will increase patient satisfaction. Interprofessional collaboration can support the quality of integrated Antenatal care services if there are good infrastructure and human resources¹.

Integrated antenatal care is a pregnancy examination carried out collaboratively by professionals such as general practitioners, midwives, nutritionists, and nurses. Antenatal care (ANC) is an evidence-based intervention of international character to improve maternal and child health².

Poor implementation of

interprofessional collaboration in integrated antenatal care will hurt teamwork and cause tension, gaps, hostility, and less effective communication between health workers and patients, resulting in a decline in the quality of service due to increasingly serious patient illnesses³.

Poor quality of service in Antenatal services (ANC) is still around 37.8%, so there is a decline. The highest frequency of visits is still less than four times a visit. The decline in visits is due to a need for more taste. Pregnant women's satisfaction with the services they receive impacts reducing the frequency of antenatal care visits. Affairs This shows that lousy collaboration practices will decrease satisfaction with accepting pregnant women's integrated antenatal care.⁴

The application of health services for mothers with two bodies can be evaluated by looking at K1, K4, and K6 coverage. The information released by the Indonesian

Ministry of Health shows the number of visits for mothers with two bodies in Indonesia in 2021 is K1, 98.0%, visits of pregnant women K4 88, 8%, and visits of K6 pregnant women 63.0%⁵.

In Indonesia, there are obstacles to implementing the integrated ANC program, namely the need for more healthy human resources and a large workload. So, implementing SOPs sometimes fails to meet standards, such as not carrying out early detection in integrated ANC services.⁶

The main problems that hinder compliance with ANC services during clinical practice are ANC guidelines (SOPs), such as the ANC sheet format, which lacks detail and is impractical, making it challenging to follow quickly, and the availability of special equipment and supplies for ANC services. Such as cutting off electricity supplies, making services difficult. Laboratories must be more functional in health facilities such as community health centres⁷.

In the Tewodros study, more than 1 in 4 women in Ethiopia did not receive quality ANC visits due to the provider's inability to adhere to focused ANC guidelines⁴. In the Nagaraj study in India, 2/3 of pregnant women in India experienced pregnancy complications, namely hypertension and diabetes, due to limited access to and quality of health care⁸.

Based on data in 2021, 4,466 (0.18%) pregnant women were reactive, and pregnant women screened for Hepatitis B 1.6% of pregnant women were positive for hepatitis B⁹. Tuberculosis (TB) in pregnant women is associated with increased spontaneous abortion and low birth weight. There are 5-10% of cases of TB in pregnant women can be at risk of transmitting to the fetus; mental health problems in pregnant women are a concern; in 2014-2016, there were 545 pregnant women who had their mental health checked, it was found that 1 out of 4 pregnant women as much as 25% experienced mental health problems during pregnancy¹⁰.

One of the promising health transformations is the implementation of interprofessional collaboration practices, namely health services provided by many health workers from different professional backgrounds providing comprehensive services in collaboration with patients, families, health workers, and the community or society to provide the best quality for the whole range.

Health¹¹. Because there are still many problems in implementing early detection in integrated ANC that can cause maternal death, one profession cannot solve these problems alone. Based on the issues above, the authors would like to review "interprofessional collaboration practices in integrated ANC services"¹⁰.

METHOD

The author intends to use the Scoping Review study as a research design. A scoping review is used as an introduction to a systematic review, which aims to identify the types of evidence available about the topics covered, provide an overview of how research is conducted on a particular subject or field, identify critical characteristics or factors associated with a concept, and describes a systematic review⁹. Two from the same educational institution, one lecturer and one student, wrote this scoping Review.

The preparation of this scoping Review uses a guide from *preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) scoping review extension checklist*¹². The adapted reviews include (1) document identification through a systematic search, (2) Screening of articles based on title and abstract, (3) Assessment of the feasibility of the article in full text, (4) Critical Appraisal, and (5) Entering relevant articles.

RESULTS

Identification of Research

Articles (Searching and Screening Process)

Researchers use the Population, Exposure, and Outcome (PEO) framework to manage and finalize the Review focus when developing study focus and search strategies¹³. PEO makes it easy to choose which key concepts to focus on in the Review, set inclusion and exclusion criteria, and generate search phrases that appropriately characterize the issue¹⁴. PEO was deemed appropriate since the research article was the focus of the search. The research framework is Population: Health professionals, exposure: Integrated ANC Interprofessional Collaborative Practice, Outcomes: In Integrated ANC, early detection. Table 1 describes medical subject titles (MeSH) and Boolean operators (OR and AND) used for keywords in this study.

Table 1. Keywords

Population	Exposure	Outcomes
Doctors OR Midwife Dentist, Nurses OR Nutritionists, Laboratory assistants OR Public Health	Relations Interprofessiona l Practice integrated ANC, OR Collaboration Interprofessiona l Practice integrated antenatal care.	Nutritional Problems OR Pregnancy Risk Factors OR Pregnancy Complications OR Mental Disorders OR Communicabl e and Non- Communicabl e Diseases

Search for articles discussing inclusion criteria. Inclusion criteria in this study are articles related to interprofessional collaboration studies in integrated ANC services that have been published for a

Article Selection

The authors went through a screening procedure and ensured that the ten articles they got were good enough for this research. Found 1534 articles from search results of three databases. Two hundred sixty-eight articles from Willey Online Library, 569 from Science Direct, and 697 from Pubmed. Including all articles in the Mendeley Reference Management Tool is the next step¹⁷. The two researchers then filtered the articles based on

maximum of the last five years using English or Indonesian as research articles or original research that is complete and accessible¹⁵. To reduce the danger of conducting unrelated research, exclusion criteria are employed for papers written in opinions and study designs utilizing systematic and scoping reviews. This study used the Pubmed, Science Direct, and Willey Online Library databases, which can be accessed through the National Library of the Republic of Indonesia¹⁶. The first step is that the researcher searches the three selected databases, namely Pubmed, Science Direct, and Willey Online Library. The PRISMA Flowchart described the article's findings. All article results are downloaded and entered into the Mendeley referencing manager tool, which then detects duplicate reports and deletes pieces seen as duplicates.

titles and abstracts related to "Interprofessional Collaborative Practice in Integrated ANC Services"; 14 duplicate reports brought the total to 1520. Fifty-six articles met the requirements after 1464 irrelevant articles were excluded. We read the entire article; out of the remaining 46, only ten were considered relevant. Ten articles found eligible for assessment were subjected to a Critical Appraisal by the Joanna Briggs Institute (JBI)¹⁸.

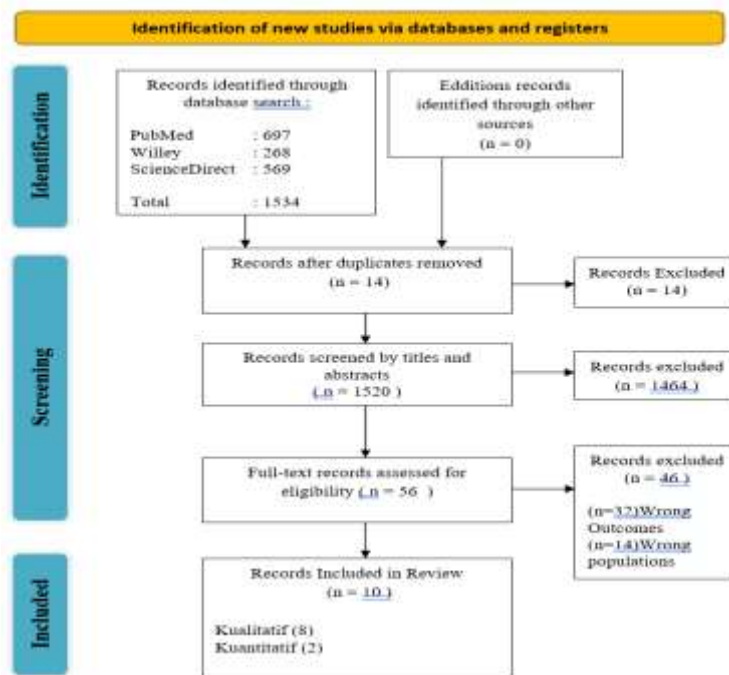


Figure 1. PRISMA Flowchart

Table 2. Data Charting

No	Title/Authors/ Year	Country	Purpose	Types of research	Data collection	Participants/ Sample Size	Results
1	A multi-method evaluation of interprofessional education for healthcare professionals caring for women during and after pregnancy/ 19	London	To assess interprofessional impact and targets for enhancing cooperation between medical staff members providing care during and after pregnancy.	Quantitative research with a cross-sectional study	Before and after questionnaires to measure attitudes and willingness to collaborate.	Thirty-eight health professionals: midwives, nurses, nutritionists, and general practitioners.	There are many barriers: staff shortages, limited time in providing services, service breakdown, and difficulty in sharing information consistently stated to be barriers to successful collaborative work. The training resulting from this research was identified as influencing participants to shift their practice toward greater collaboration.
2	Interprofessional collaboration and smartphone use as promising strategies to improve prenatal oral health care utilization among US underserved women: result from a qualitative study/	California	to comprehend prenatal oral health care strategies for underserved pregnant women	Qualitative research with a descriptive study	Semi-structured in-depth interviews and thematic analysis	Eight pregnant women and ten people with health professionals, dentists, and social workers	Barriers identified were low-income women for health care utilization to promote interprofessional collaboration, innovative education programs to prenatal oral health care guidelines, and dedicated dental facilities for low-income women.
3	Antenatal Testing For Anemia, HIV and Syphilis In Indonesia – a Health System Analysis of Low Coverage/	Indonesia	The goal is to decrease the number of unfavourable pregnancies by identifying and treating antenatal anemia, HIV, and syphilis.	Qualitative research with a descriptive study	The utilization of semi-structured interviews (SSI) at the sub-district and district levels	Community Health Officers = 16, Midwives = 9, and Laboratory and counselling 13 from 8 villages in 2 sub-districts	Not a single antenatal test result for HIV, syphilis, or anemia was recorded in the village. The more widely used haemoglobin test is acceptable and reported to be used more often. The HIV and syphilis test is less prevalent and scarcely used. However, it became apparent that leadership and

							accountability were crucial to prioritizing prenatal care and closing the testing gap.
4	Provider-perceived benefits and constraints of complete adherence to antenatal care guideline among public health facilities, Ethiopia: A qualitative study	Ethiopia	to investigate how providers view the advantages and limitations of using ANC guidelines.	General Qualitative Research	Semi-structured interview	There were 9 participants in this study, including two obstetricians and seven midwives.	Following ANC guidelines was said to help reduce provider workload and improve performance, promote safe motherhood, and improve service delivery. The three groups to focus on are organizational issues, the knowledge, attitudes, and skills of existing service providers, and the availability of training and mentoring. The main things that keep providers from following all of the ANC guidelines are: <ol style="list-style-type: none"> 1. Organizational Issues 2. It is the existing knowledge, attitudes, and skills of care providers. 3. Availability of training and mentoring.
5	Integrated Antenatal Care by Midwives in Surabaya	Indonesia	To find out the quality of Integrated ANC services at puskesmas (Midwives HR, Supporting Facilities and service infrastructure, planning, 10 T Integrated ANC services, and organization)	Qualitative research with a descriptive study	Interview	12 MCH Coordinating Midwives from 12 Public Health Centers.	To implement the integrated ANC program, human resources still need to be improved for midwives at Surabaya Public Health Center. Still, facilities and infrastructure are adequate according to Integrated ANC guidelines standards.

6	The Comparison of the Interpersonal Action Component of woman-centred Care Reported by a Healthy Pregnant Woman in Different Practices in the Netherlands: A cross-sectional study ²⁰	Netherlands	To examine the interpersonal measures of woman-centred care primary care midwives provide in practices of varying sizes.	Quantitative research with a cross-sectional study	Questionnaire 15 items self-report Client-Centred Care Questionnaire (QC)	Women who are pregnant and get their primary care from midwives in small practices (with 1-2 midwives), medium procedures (with 3-4 midwives), and large trials (with 4-5 midwives)	There is a significant difference in getting the highest score for pregnant women getting care from no more than two midwives. A small practice could elevate women-centred care from good to excellent.
7	Needs of parents and professionals to improve shared decision-making in interprofessional maternity care practice: a qualitative Study	Netherlands	Investigate the perspectives of parents and healthcare providers regarding the challenges and opportunities presented by shared decision-making in antenatal care.	General Qualitative Research	Interview	11 Groups, i.e., Parents, primary care midwives, hospital-based midwives, obstetricians, obstetric nurses, and delivery nurse assistants	Before making a final decision, parents and professionals should have discussed preferences and options with other professionals. The obstacles that were found were good communication skills between parents and professionals. Interventions obtained: raise awareness and understanding, cultivate effective communication techniques, and promote interprofessional cooperation.
8	Integrated point-of-care testing (PCOT) For HIV, Syphilis, Malaria, and anemia at antenatal facilities in western Kenya: a qualitative study exploring end-users	East Africa, Kenya	To determine whether or not integrated testing at ANC using POCT (Point-of-Care-Testing) for HIV, syphilis, malaria, and anemia is appropriate, acceptable, and possible.	General Qualitative Research	Semi-structured interviews with open-ended questions were used to investigate the intervention's applicability, acceptability, and practicability.	18 Participating healthcare workers	The research investigated the acceptability, suitability, and feasibility of incorporating PCOT into ANC services among end users. While these innovations are desirable and valuable, Integrating testing for all four conditions and effectively

							perspective of appropriateness, acceptability and feasibility	managing them will require future scale-up efforts to address weaknesses in the healthcare system.
9	Indonesian Antenatal Nutrition Education: A Qualitative Study of Healthcare Professional Views/	Indonesia	To find out the views of Indonesian antenatal health workers on maternal nutrition education and the improvements needed to provide more effective antenatal nutrition education.	Qualitative research with a descriptive study	Semi-structured interview	24 health professional participants, including ten nutritionists, nine midwives, and 5 participants obstetricians	Four themes found they are:	<ol style="list-style-type: none"> 1. Health workers recognize the importance of providing antenatal nutrition education in addition to supporting targeted deliveries 2. Differences in views according to midwives and obstetricians who must provide nutrition education are nutritionists. Still, nutritionists report that only a few women come to the health centre for nutritional counselling. 3. There are several obstacles in providing nutrition education, namely the limited number of nutritionists and the need for more professional nutrition knowledge. 4. Should strengthen collaboration and develop guidelines for improving

							antenatal nutrition education.
10	Women's and healthcare providers' perceptions of long-term complication associated with hypertension and diabetes in pregnancy: a qualitative study	India	To investigate the perspectives of rural Indian women and health care providers on the long-term risk of hypertension during pregnancy and gestational diabetes in pregnant women.	General Qualitative Research	Interview	Seven discussion groups were formed: community health workers, primary care doctors, obstetricians, laboratory technicians, health workers, and 11 pregnant women who receive antenatal care.	Antenatal care includes routine blood pressure checks. Limited information exists regarding postpartum monitoring and long-term complications. Gestational diabetes is not regarded as a typical issue, and clinicians generally have little knowledge of the long-term side effects of gestational diabetes, including an increased risk of type 2 diabetes and cardiovascular disease.

Characteristics of articles by country can be seen in the figure below:

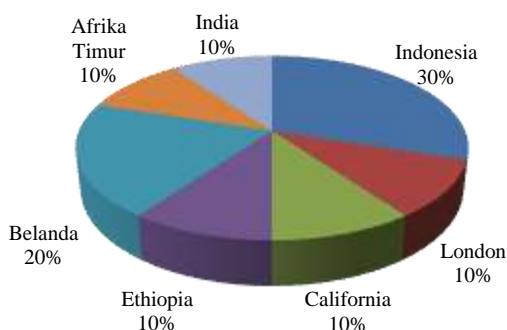


Figure 2. Characteristics of Country Names

The diagram above explains the characteristics of articles from several developing countries, including reports from Indonesia with the theme Integrated Antenatal Services by Midwives in Surabaya. Next is East Africa with the theme Integrated Point of Care Test (PCOT) for HIV. Ethiopia with the theme of Benefits perceived by service providers and barriers to fully complying with guidelines for antenatal care in public health facilities. India with the theme Perceptions of women and health care providers regarding long-term complications related to hypertension and diabetes in pregnancy. And several developed countries, including articles from the

Netherlands with the theme The need for parents and professionals to improve shared decision making. California with the theme Interprofessional collaboration and smartphone use as promising strategies to increase utilization of prenatal oral health services among underserved women in the US, and an article from London with the theme Multi-method evaluation of interprofessional education for health professionals caring for women during and after pregnancy. The characteristics of articles based on the research design used can be seen in Figure 3. Of the ten research articles, there are qualitative and quantitative research articles.

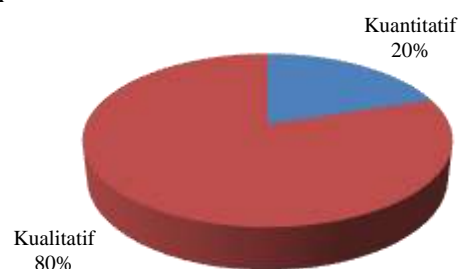


Figure 3. Characteristics of Research Data

The critical appraisal results for five articles,^{21, 22, 23, 24, and 25}, with the answer "YES" on all question items in the Joanna, Brings Critical Appraisal Tools (JBI), were answered perfectly. Apart from that, the advantages of this article are data sources in the full article. Each article's sample, data collection methods, and instruments have been

validated to minimize the error rate. Unsatisfactory results are found in articles^{26, 27, 28, 29, and 30}, with the drawbacks of not explaining the influence of researchers on their research and not explaining cultural and theoretical researchers not described in the article.

Result of Individual Sources of Evidence

The following are some of the themes that emerged from the Scoping Review conducted by the researcher:

Table 3. Maps theme

Theme	Subtheme	Article
The Role of Interprofessional Collaborative Practice	1. Responsibilities of Each Profession	3,4,5,9 & 10
	2. Health HR Development & Empowerment	1 & 5
Barriers to Interprofessional Collaborative Practices	1. Supporting Facilities	2
	2. Skills	4
	3. KesHealth Worker Awareness	8, 6 & 4
	4. Communication By Health Workers	7

The role of interprofessional collaboration practices in integrated ANC services

Integrated Antenatal Care services must be provided comprehensively and with quality to mothers undergoing pregnancy to ensure that pregnant women can undergo pregnancy and childbirth safely and give birth to healthy and safe babies³¹. Apart from that, integrated Antenatal Care services aim to provide emotional and psychosocial support to mothers, monitor fetal growth and development, detect fetal abnormalities early and provide appropriate treatment to mothers who have abnormalities early on to avoid unwanted pregnancy complications³².

One of the most essential benefits of interprofessional collaboration in health services is improving the quality of patient care and increasing patient satisfaction. Implementing interprofessional collaboration in health services can reduce the number of complications, patient length of stay, and conflicts between health workers and reduce patient mortality²⁶. Meanwhile, in the mental health sector, interprofessional collaboration is considered capable of increasing patient

satisfaction, shortening the duration of treatment, reducing treatment costs, reducing the number of patient suicides, reducing the frequency of outpatient visits, and reducing the possibility of overlapping functions. Health workers who have different professional backgrounds³³.

Good interprofessional collaboration will benefit patients by increasing the success of therapy and providing benefits to practitioners by increasing the effectiveness and efficiency of communication between professions and between professions and patients, resulting in satisfactory patient service³⁴. Patients will assess the quality of health service facilities through services provided by doctors and nurses. Patients will feel satisfied if doctors and nurses can build good cooperation and partnerships in providing patient services. The better the collaboration between doctors and patients in providing services, the greater patient satisfaction will increase. On the other hand, if interprofessional collaboration goes well, it will help patient comfort and satisfaction, especially in aspects of interprofessional communication that do not go well, resulting in delays in service delivery and

shortening consultation times ²² with patients and lack of respect for patients. Patients will feel that they need to be cared for by health workers and will feel more satisfied with the services provided by health workers ³⁵.

Responsibilities of Each Profession.

Doctor or Obstetrician

The role of the doctor or obstetrician in Article ³² states that obstetricians provide antenatal care through counselling to pregnant women. The article confirms that senior obstetricians' responsibility in Educational Health facilities is committed to training their students, i.e., interns, to provide routine ANC services by increasing the number of focused ANC visits to at least four is a top priority to reduce maternal death and improve maternal health, which is a top priority ³⁶.

Midwife

The role of midwives in article ⁵ states that midwives are health workers, mainly in ANC examinations. Article ³⁴ states that ANC is accessed through a clinic led by a midwife who identifies pregnant women with a 10 T examination.

Nutritionists

The role of the nutritionist in Article ³⁷ is to provide antenatal nutrition education. It is one of the necessary elements for an effective ANC program to alleviate the three burdens of malnutrition: overweight/obesity, malnutrition, and micronutrient deficiency, which will increase the risk of various health problems for the mother and fetus.

Laboratory Staff

The role of the laboratory assistant in Article ³³ is tasked with carrying out tests for anemia, HIV, and syphilis, which are the leading causes of preventable problems in pregnancy and are essential components of antenatal care (ANC). Article ³⁵ states that laboratory testing is an interview with laboratory staff who must focus on ensuring quality.

Community Health Workers

The role of public health workers in article ¹⁰ is essential to connect women with

health services and provide access to quality antenatal care (ANC) at community health centres free of charge, including diagnostic examinations. In article ³⁸, Public health professionals act as mediators between the community, including expectant mothers and their families, and healthcare providers because public health has high social sensitivity and actively supports the community.

HR Development and Empowerment

Article ⁵ stated that the results of HR development greatly influenced integrated ANC services. There was no special training on integrated ANC, so Health HR needed to receive information or updated knowledge about integrated ANC. Article ³⁹ states that the interprofessional health team's attitude has improved after interprofessional collaborative practice training. Increased policy awareness, the capacity to discuss how interprofessional collaboration can be improved, and the capacity to form networks with other health professionals.

Barriers Interprofessional collaboration practices in integrated ANC services

Supporting Facilities

In article ⁴⁰, some obstacles are found, namely dental and oral health examination facilities, which are highly specialized and not developed for staff, so the facility does not function to provide oral health care to pregnant women.

Skills

In article ⁴¹, caregivers' skills, knowledge, and attitudes were identified as obstacles that hinder health workers from following ANC guidelines. Poor attitudes, behaviours, and skills were the most frequently identified barriers to using and fully implementing ANC guidelines.

Health Worker Awareness

Article ⁴² The biggest obstacle is the weakness and awareness of the Health system, inadequate training and supervision, retaining an unskilled and unmotivated workforce, and not adequately supported with adequate commodities will not provide integrated antenatal services effectively. In article ⁴³,

health workers' awareness is seen to be different in providing services, namely the practice led by midwives of small, medium, and large sizes.

There are differences in carrying out care measures for pregnant women. Article ⁴⁴ states that midwives are pretty busy with other MCH services while excluding several essential things in ANC services, such as counselling, because of this limited time, which causes midwives to experience poor performance.

Communication by Health Workers

Article ⁴⁵ states that poor communication barriers by health workers will not build relationships and personal approaches in antenatal care and will not understand the importance of training that can develop and improve ANC services.

Research Limitations

This scoping Review obtained an incomplete review, where the term integrated ANC was only used in Indonesia. Hence, researchers needed help finding articles that discussed in-depth interprofessional collaboration practices for integrated ANC services in developed countries.

CONCLUSION

Ten journals met the inclusion criteria based on a search of 1,534 selected papers. Of the ten articles reviewed, it was found that the role of interprofessional collaborative practice among various health workers had yet to carry out their duties according to responsibility. Every profession, as well as developing and empowering human resources. Obstacles were found in supporting facilities, skills, awareness and communication by Health workers, which must be overcome to obtain integrated ANC services to increase visits and obtain quality pregnancy checks, thereby reducing cases of maternal and neonatal deaths. Integrated Antenatal Care services must be provided comprehensively and with quality to mothers undergoing pregnancy to ensure that pregnant women can go through the pregnancy and delivery period safely and give birth to healthy and safe babies. One of the most essential benefits of interprofessional collaboration in Antenatal Care health services is improving the quality of patient services and increasing patient satisfaction. Implementing interprofessional collaboration in health services can reduce

complication rates, duration of patient hospitalization, conflicts between health professionals, and patient mortality rates.

ACKNOWLEDGEMENTS

Thanks to 'Aisyiyah University Yogyakarta for providing support and the opportunity to conduct this scoping Review.

CONFLICTS OF INTEREST

There is no conflict of interest in this Review.

REFERENCE

1. Davidson P, Ross T, Castor C. Academy of Nutrition and Dietetics: Revised 2017 Standards of Practice and Professional Performance for Registered Dietitian Nutritionists (Competent, Proficient, and Expert) in Diabetes Care. *J Acad Nutr Diet.* 2018;118(5):932-946.e48. doi:10.1016/j.jand.2018.03.007
2. Carpenter S. Ten Steps in Scale Development and Reporting: A Guide for Researchers. *Commun Methods Meas.* 2018;12(1):25-44. doi:10.1080/19312458.2017.1396583
3. Cioffi CE, Ph., Figueroa J, Biostatistician, Welsh JA. *Title: Added Sugar Intake among Pregnant Women in The.*; 2017.
4. Young N, Achieng F, Desai M, et al. Integrated point-of-care testing (POCT) for HIV, syphilis, malaria and anaemia at antenatal facilities in western Kenya: A qualitative study exploring end-users perspectives of appropriateness, acceptability and feasibility. *BMC Health Serv Res.* 2019;19(1):1-15. doi:10.1186/s12913-018-3844-9
5. Seyoum T, Alemayehu M, Christensson K, Lindgren H. Provider-perceived benefits and constraints of complete adherence to antenatal care guideline among public health facilities, Ethiopia: A qualitative study. *PLoS One.* 2021;16(8 August):1-16. doi:10.1371/journal.pone.0255297
6. Tewksbury C, Nwankwo R, Peterson J. Academy of Nutrition and Dietetics: Revised 2022 Standards of Practice and Standards of Professional Performance for Registered Dietitian Nutritionists (Competent, Proficient, and Expert) in Adult Weight Management. *J Acad*

- Nutr Diet.* 2022;122(10):1940-1954.e45.
doi:10.1016/j.jand.2022.06.008
7. Rahmawati W, van der Pligt P, Worsley A, Willcox JC. Indonesian antenatal nutrition education: A qualitative study of healthcare professional views. *Women's Health.* 2021;17. doi:10.1177/17455065211066077
 8. Blake H, Bermingham F, Johnson G, Tabner A. Mitigating the psychological impact covid-19 on healthcare workers: A digital learning package. *Int J Environ Res Public Health.* 2020;17(9). doi:10.3390/ijerph17092997
 9. Giorgi G, Lecca LI, Alessio F, et al. COVID-19-related mental health effects in the workplace: A narrative review. *Int J Environ Res Public Health.* 2020;17(21):1-22. doi:10.3390/ijerph17217857
 10. Kabamba Nzaji M, Kabamba Ngombe L, Ngoie Mwamba G, et al. <p>Acceptability of Vaccination Against COVID-19 Among Healthcare Workers in the Democratic Republic of the Congo</p>. *Pragmat Obs Res.* 2020;Volume 11:103-109. doi:10.2147/por.s271096
 11. Rivett L, Sridhar S, Sparkes D, et al. Screening of healthcare workers for SARS-CoV-2 highlights the role of asymptomatic carriage in COVID-19 transmission. *Elife.* 2020;9. doi:10.7554/eLife.58728
 12. Abawollo HS. Health facilities' readiness to provide basic antenatal care laboratory test services and client satisfaction in Ethiopia. Published online 2021. doi:10.21203/rs.3.rs-1099800/v1
 13. Vilaplana EG, Petignat P, Benski AC, et al. Description of maternal morbidities amongst 1000 women during pregnancy in Ambanja, Madagascar – opportunities and challenges of using a health system. *Int J Womens Health.* 2020;12:823-833. doi:10.2147/IJWH.S260894
 14. Ibworo V, Ibworo AA. Assessment of Focused Antenatal Care Compliance Predictors in Kisumu East District Hospital, Kenya. *International Journal of Healthcare Sciences.* 2020;8:21-29. doi:10.13140/RG.2.2.26487.16804
 15. Fealy GM, Casey M, O'Leary DF, et al. Developing and sustaining specialist and advanced practice roles in nursing and midwifery: A discourse on enablers and barriers. *J Clin Nurs.* 2018;27(19-20):3797-3809. doi:10.1111/jocn.14550
 16. Hansson M, Lundgren I, Dencker A, Taft C, Hensing G. Work situation and professional role for midwives at a labour ward pre and post-implementation of a midwifery model of care–A mixed method study. *Int J Qual Stud Health Well-being.* 2020;15(1). doi:10.1080/17482631.2020.1848025
 17. Attwell K, Yusuf A, Frawley J. Is immunization education in midwifery degrees adequate? *Hum Vaccin Immunother.* 2019;15(1):109-112. doi:10.1080/21645515.2018.1515448
 18. Hajri S, Belhadj H. The role of midwives in first-trimester abortion care: A 40-year experience in Tunisia. *International Journal of Gynecology and Obstetrics.* 2020;150(S1):43-48. doi:10.1002/ijgo.13010
 19. Olander E, Coates R, Brook J, Ayers S, Salmon D. A multi-method evaluation of interprofessional education for healthcare professionals caring for women during and after pregnancy. *J Interprof Care.* 2018;32(4):509-512. doi:10.1080/13561820.2018.1437124
 20. Kuipers Y (Fontein), van Beeck E, van den Berg L, Dijkhuizen M. The Comparison of the interpersonal action component of woman-centred care reported by healthy pregnant women in different sized practices in the Netherlands: A cross-sectional study. *Women and Birth.* 2021;34(4):e376-e383. doi:10.1016/j.wombi.2020.08.002
 21. Coates D, Foureur M. The role and competence of midwives in supporting women with mental health concerns during the perinatal period: A scoping review. *Health Soc Care Community.* 2019;27(4):e389-e405. doi:10.1111/hsc.12740
 22. Schot E, Tummers L, Noordegraaf M. Working on working together. A systematic review of how healthcare professionals contribute to

- interprofessional collaboration. *J Interprof Care*. 2020;34(3):332-342. doi:10.1080/13561820.2019.1636007
23. Mainey L, O'Mullan C, Reid-Searl K, Taylor A, Baird K. The role of nurses and midwives in providing abortion care: A scoping review. *J Clin Nurs*. 2020;29(9-10):1513-1526. doi:10.1111/jocn.15218
 24. Bisaccia G, Ricci F, Gallina S, Di Baldassarre A, Ghinassi B. Mitochondrial dysfunction and heart disease: Critical appraisal of an overlooked association. *Int J Mol Sci*. 2021;22(2):1-19. doi:10.3390/ijms22020614
 25. Denckla CA, Cicchetti D, Kubzansky LD, et al. Psychological resilience: An update on definitions, a critical appraisal, and research recommendations. *Eur J Psychotraumatol*. 2020;11(1). doi:10.1080/20008198.2020.1822064
 26. Truong VD, Saunders SG, Dong XD. Systems social marketing: a critical appraisal. *J Soc Mark*. 2019;9(2):180-203. doi:10.1108/JSOCM-06-2018-0062
 27. Menon V, Kar S, Suthar N, Nebhinani N. Vitamin D and depression: A critical appraisal of the evidence and future directions. *Indian J Psychol Med*. 2020;42(1):11-21. doi:10.4103/IJPSYM.IJPSYM_160_19
 28. Nha Hong Q, Pluye P. *A Conceptual Framework for Critical Appraisal in Systematic Mixed Studies Reviews*.
 29. El-Awaisi A, Joseph S, El Hajj MS, Diack L. A comprehensive systematic review of pharmacy perspectives on interprofessional education and collaborative practice. *Research in Social and Administrative Pharmacy*. 2018;14(10):863-882. doi:10.1016/j.sapharm.2017.11.001
 30. Nagelkerk J, Thompson ME, Bouthillier M, et al. Improving outcomes in adults with diabetes through an interprofessional collaborative practice program. *J Interprof Care*. 2018;32(1):4-13. doi:10.1080/13561820.2017.1372395
 31. Cosentino F, Grant PJ, Aboyans V, et al. 2019 ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed with the EASD. *Eur Heart J*. 2020;41(2):255-323. doi:10.1093/eurheartj/ehz486
 32. Gardner L, Campbell JM, Gilcrest C, McClain MB, Shahidullah JD. Identification of autism spectrum disorder and interprofessional collaboration between school and clinical settings. *Psychol Sch*. 2022;59(7):1308-1318. doi:10.1002/pits.22673
 33. Alsumait A, Amin M, Raine K, Rgokiart R. Implementation and Maintenance Evaluation of the School Oral Health Program in Kuwait, *International Journal of Qualitative Methods*. 2018;17. doi:10.1177/1609406917748701
 34. Gusenbauer M, Haddaway NR. Which academic search systems are suitable for systematic reviews or meta-analyses? Evaluating retrieval qualities of Google Scholar, PubMed, and 26 other resources. *Res Synth Methods*. 2020;11(2):181-217. doi:10.1002/jrsm.1378
 35. Langley A, Lindberg K, Mørk BE, Nicolini D, Raviola E, Walter L. Boundary work among groups, occupations, and organizations: From cartography to process. *Academy of Management Annals*. 2019;13(2):704-736. doi:10.5465/annals.2017.0089
 36. Jain AR, Nallaswamy D, Ariga P, Ganapathy DM. Determination of correlation of width of maxillary anterior teeth using extraoral and intraoral factors in Indian population: A systematic review. *World Journal of Dentistry*. 2018;9(1):68-75. doi:10.5005/jp-journals-10015-1509
 37. Gaur A, Kumar M. A systematic approach to conducting review studies: An assessment of content analysis in 25 years of IB research. *Journal of World Business*. 2018;53(2):280-289. doi:10.1016/j.jwb.2017.11.003
 38. Heen E, Størdal K, Abdi A, Walmann F V, Lundeby KM. Facility-based care of tiny and sick newborns: experiences with establishing a neonatal special care unit in Somaliland. *J Glob Health Rep*. 2022;6. doi:10.29392/001c.33619
 39. Gathoni Njau F, Owuor DE, Juma Oyoo J. *International Journal of*

Advanced Research and Review
Www.Ijarr.in Effect Of Project Team
Management On Implementation Of
County Government Health Funded
Projects In Mombasa County. Vol 5.;
2020. www.ijarr.in

40. Meheret T. Comment: Attesting Representation through Power of Attorney: The Ethiopian Approach. *Mizan Law Review*. 2021;15(1):227-262. doi:10.4314/ml.v15i1.8
41. Sanghvi T, Nguyen PH, Ghosh S, et al. Process of developing models of maternal nutrition interventions integrated into antenatal care services in Bangladesh, Burkina Faso, Ethiopia and India. *Matern Child Nutr*. 2022;18(4). doi:10.1111/mcn.13379
42. Lattof SR, Moran AC, Kidula N, et al. Implementing the new WHO antenatal care model for a positive pregnancy experience: A monitoring framework. *BMJ Glob Health*. 2020;5(6). doi:10.1136/bmjgh-2020-002605
43. Neupane B, Rijal S, G.c. S, Basnet TB. Andersen's model on determining the factors associated with antenatal care services in Nepal: An evidence-based analysis of Nepal demographic and health survey 2016. *BMC Pregnancy Childbirth*. 2020;20(1). doi:10.1186/s12884-020-02976-y
44. Mekonnen T, Dune T, Perz J, Ogbo FA. Trends and determinants of antenatal care service use in Ethiopia between 2000 and 2016. *Int J Environ Res Public Health*. 2019;16(5). doi:10.3390/ijerph16050748
45. Morón-Duarte LS, Ramirez Varela A, Segura O, Freitas Da Silveira M. Quality assessment indicators in antenatal care worldwide: a systematic review. *International Journal for Quality in Health Care*. 2019;31(7):497-505.

Article Review

Healthcare Failure Mode and Effect Analysis (HFMEA) in Reducing Patient Safety Incidents Risk at Hospital: Literature Review

Anggika Yelzi Pratiwi^{1*}, Masyitoh Basabih¹

¹ Faculty of Public Health, Universitas Indonesia, Depok, West Java, Indonesia

(Correspondence author's email, anggika.yelzi@ui.ac.id/0812-6882-8887)

ABSTRACT

Patient safety is a priority in hospital services, but patient safety incidents such as adverse events frequently occur in hospitals. Healthcare Failure Mode and Effect Analysis (HFMEA) is one of the hospital's strategies to reduce patient safety incident risks through risk management. This study aims to describe the use of the HFMEA method in various countries and its role in reducing patient safety incident risks. This study began with searching data using four databases and selecting scientific article sources using the Preferred Reporting Items for Systemic Reviews and Meta-Analysis (PRISMA) method, where 15 articles were found that met the research objectives, inclusion, and exclusion criteria. The result shows that HFMEA has been applied in hospital services and management in various countries. HFMEA reduced the risk of failure and patient safety incidents in the hospital. However, this can be effective if the hospital implements all steps of HFMEA and routine monitoring and evaluation of interventions to prevent the occurrence of patient safety incident risk.

Keywords: *Healthcare Failure Mode and Effect Analysis (HFMEA), Patient Safety, Risk Management, Literature Review*

<https://doi.org/10.33860/jik.v17i2.2336>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Healthcare tends to develop rapidly with the development of science and technology. Therefore, hospitals are competing to provide better, high-quality, and modern health services to increase patient satisfaction and win the competition between hospitals ¹. However, hospitals must ensure patient safety and security amid the possible risk of incidents from various advanced technologies, complex diagnostic procedures, and hospital therapeutic service².

Patient safety is a priority in hospital services and has become a patient need in healthcare ¹. Patient safety incidents can cause death and disability. Harm to patients due to unsafe hospital care is a major and growing global public health challenge, which is one of the leading causes of death and disability worldwide. Patients are harmed and even dead every year due to medication error and unsafe

healthcare. They are major contributors of high burden of death and disability worldwide, especially in middle and low-income countries, namely around 2.6 million deaths yearly. The Ministry of Health summarized that Indonesia patient safety incident reports show 1489 incidents in 2018 and increased to 7465 incidents in 2019. Incidents included 38% near misses, 31% non-injury incidents and 31% unexpected incidents (adverse event) ³. However, recent national patient safety incidents reports are not publicly available and difficult to access.

From a financial and economic perspective, the cost of handling patient safety incidents is quite high. The annual cost of medication error estimated by WHO is around US\$ 42 billion ⁴ Public confidence and trust in the local health system are often diminished when incidents are publicized. The health workers involved also suffer psychological impact and feeling guilty.

The world's seriousness towards patient safety is again proven by the establishment of the Global Patient Safety Action Plan 2021-2030 by the World Health Organization (WHO) in August 2021, which the aim is to achieve the maximum possible reduction in harms that can be avoided due to unsafe healthcare globally ⁵. Patient safety strategies in hospitals are expected to minimize the risk of unexpected medication errors, events (adverse event), minimize conflicts between officers, avoid lawsuits, and legal processes as well as allegations of malpractice in hospitals ⁶. Identifying and managing potential risks of patient safety incident is one of strategy that can be applied. Risk identification is divided into proactive and reactive assesment. Proactive risk assessment is applied by determining risks that have the potential to occur so that risks not occur such as healthcare failure mode and effect analysis (HFMEA) ⁷.

HFMEA is a development of the Failure Mode and Effect Analysis (FMEA) method which is a systematic process to help identify a risk of failure in the process before the failure occurs. FMEA is one of the methods widely used in the automotive, industrial and aviation fields for proactive risk assessment ⁸. In 2001, The Department of Veterans Affairs (VA) National Center for Patient Safety (NCPS) adopted the FMEA for healthcare implementation ⁹.

HFMEA helps health services to identify potential failures, their impact and calculate the magnitude of the impact through the severity and likelihood of the risk occurring ¹⁰. The Joint Commission (JCI) requires JCI accredited hospitals to regularly perform risk assessment using the HFMEA method for 18 months ⁶. Indonesian Ministry of Health Accreditation Standards 2022 Edition shows that HFMEA is required to be carried out by the hospital at least once in 1 year ⁷.

In previous studies showed that HFMEA used to analyze risks in the medical service process ¹¹, nursing ¹², laboratory ^{13,14}, radiology ^{15,16}, hemodialysis ^{17,18}, inpatient ¹⁹, ICU ²⁰, surgery ^{21, 22}, anesthesia ²³, blood transfusion procedure ²⁴, chemotherapy ^{25,26}, radiotherapy^{11,27}, medication management ^{28,29}, and medical waste management ³⁰. In addition, several studies using systematic literature review methods related to FMEA and HFMEA discussed their role in the quality of service in hospitals ^{14,19}. Reviewing previous studies, no

published studies discuss the role of HFMEA as a strategy to reduce the risk of patient safety incidents in hospitals. Hence, this study focuses on describing the application of HFMEA in hospitals of various countries and its role in reducing the risk of patient safety incidents.

METHOD

This study was literature review which began with determining the questions and research objectives as the main focus of the research. PRISMA tools applied in this article to improve the reporting of literature review. Articles were collected from Pubmed, Science Direct, SpringerLink, and Taylor & Francis Online databases. Articles searched by suitable keywords due to reach specific studies such as *healthcare failure mode and effect analysis*, HFMEA, healthcare, failure mode and effect analysis, FMEA, patient safety incident, risk, and hospital. Keywords combined using Boolean or AND.

Selection of scientific article sources using the PRISMA method (Figure 1) adapted to the research objectives, inclusion and exclusion criteria. Filtered scientific articles by the language, publication period, free full text, journal article type, and open access journal. Inclusion criteria such as publication period around 2013 to 2023, language in English, hospital as studies population area, and journals academic as type of publication. Exclusion criteria such as grey literature and systematic literature review publication.

RESULTS

The search was conducted through four databases and 627 scientific studies (Figure 1). Sixty-two publications screened and 565 excluded that did not meet the inclusion criteria such as other than English language, publication period above ten years, and review studies. 58 publication assessed for full text eligibility. 15 scientific articles were obtained which were determined by researchers as research sources.

Relevant data extracted by author, year, country, research topic and unit area, and research objectives and conclusion. Due to facilitate reader on highlighting differences on each selected articles, data synthesize by monitoring evaluation of HFMEA and impact HFMEA of patient safety of every included

studies.

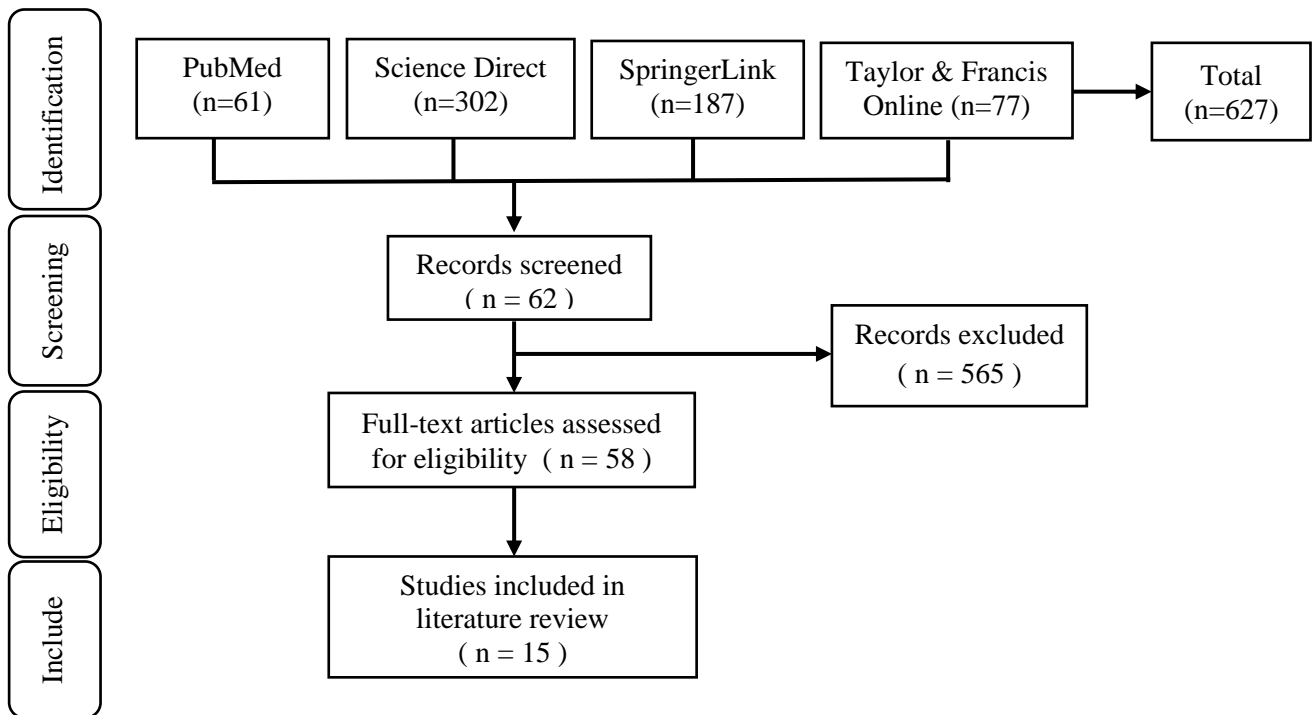


Figure 1. PRISMA Flow Diagram

Selected scientific articles discuss the use of HFMEA in hospital risk management in United States of America, Ethiopia, Belgium, Iran, Israel, Italy, Sierra Leone, Sri Lanka, China, Jordan, Spain, New Zealand, Seoul, and Sweden.

Hospitals applied HFMEA by every step on HFMEA process such as define the HFMEA topic, assemble team, risk identification, assessment, analysis, decide

intervention to prevent patient safety incident risk, monitor, and evaluate of the outcome after implemented intervention. Previous studies result (Table 1) show gaps on the last steps of HFMEA, which some hospitals unimplemented the monitoring and evaluation of the outcome of intervention. Therefore, uncomplete process affected the impact of HFMEA on patient safety incident.

Table 1. Data extraction

No	Author (Year)	Country	HFMEA topic	Monitoring & Evaluation	HFMEA impact on patient safety incident
1	Fanny Ofek et al. (2016)	Israel	A change in hospital policy: switching of KCl infusion solution to KCl ready to use solutions	Monitoring & evaluation of interventions based on HFMEA results have been completed. Routine monitoring with one-day survey method (every 3 to 4 months)	Before interventions implemented, several adverse events or unexpected events were reported that related to the highest risk score. However, after the intervention was applied for 2 years,

No	Author (Year)	Country	HFMEA topic	Monitoring & Evaluation	HFMEA impact on patient safety incident
					no adverse event founded
2	Zhila Najafpour et al. (2017)	Iran	Blood transfusion	Monitoring & evaluation of interventions based on HFMEA results have been completed. Corrective actions are evaluated after 6 months implementing the intervention	Error rates in blood transfusions decreased and adverse events not occur after the implementation of risk prevention interventions
3	Andy Yuanguang Xu et al. (2017)	United States	Gamma Knife radiosurgery	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented
4	J.A.L. Anjalee et al. (2021)	Sri Lanka	Drug dispensing	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented
5	Viviane Van Hoof et al. (2022)	Belgia	POCT blood gas analysis (BGA)	Monitoring of interventions based on HFMEA results have been completed by using key performance indicators (KPI) to monitor corrective actions in order to prevent risks from occurring. But evaluation unimplemented yet	Unanswered because monitoring and evaluation unimplemented
6	M.A. Rosen et al. (2014)	Sierra Leone	Testing new device : The Universal Anesthesia Machine (UAM)	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented
7	Clemente Ponzetti et al. (2016)	Italia	Administrative risk of subcutaneous and intravenous therapies	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented
8	Berhanetsehay Teklewold et al. (2023) Ethiopia	Etiopia	Admission of asymptomatic Covid-19 patients to the adult emergency department	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented

No	Author (Year)	Country	HFMEA topic	Monitoring & Evaluation	HFMEA impact on patient safety incident
9	Jiuling Shen et al. (2019)	China	Application of Helical Tomotherapy – Total Marrow Irradiation (HT-TMI)	Monitoring of interventions based on HFMEA results have been completed by conducting HFMEA after 1 year of implementing the intervention and plan-do-check-action (PDCA) cycle after the second FMEA intervention was implemented	In the second HFMEA, the highest 5 risk score in the first HFMEA decreased and didn't being the highest score. However, the impact on patient safety incident risks related to FMEA 1 and 2 is unexplained
10	Anas Haroun et al. (2021)	Jordan	The nursing blood sampling process	Monitoring and evaluation of interventions based on HFMEA results have been completed after 3 months of implementing the intervention	There was a significant reduction of 58% of the the risk assessment result and incidents of blood sampling errors was reduced by 70% after the intervention was implemented.
11	Maria Dolores et al. (2017)	Spain	Hemodialysis process	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented
12	XuXia Yu et al. (2020)	China	HFMEA for improving the qualification rate of disinfection quality monitoring process	Monitoring and evaluation of HFMEA results have been completed from July 2017 to March 2018	The overall qualification rate in disinfection quality monitoring increased from 16.5% to 78.7% (p< 0.001). However, the impact on patient safety incident is unexplained
13	Ehsan Ullah et al. (2022)	New Zealand	Use of Rapid Response System (RRS)	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented
14	Howard Lee et al.(2023)	Seoul	Clinical trials	Monitoring & evaluation of interventions based on HFMEA results have been completed	A significant reduction of 80% in post-intervention risk assessment results was performed.

No	Author (Year)	Country	HFMEA topic	Monitoring & Evaluation	HFMEA impact on patient safety incident
					However, the impact on patient safety incident was unexplained
15	Claudia Sabate Martinez et al. (2023)	Sweden	Protein drug supply chain	Monitoring & evaluation of the intervention unimplemented	Unanswered because monitoring and evaluation unimplemented

DISCUSSION

Risk identification and assessment

HFMEA processes begin with determining the topic and establishing a multidisciplinary team. The team consists of functional and managerial hospital workforce related to the selected topic. Some hospitals involved representatives from the hospital quality team to lead the HFMEA process^{12,24,31}. The next step is to clearly describe and identify the process and sub-process flow of the topic selected. Hospitals need competent HFMEA team members who are proficient in selecting topics and HFMEA concepts. The HFMEA team needs to hold regular meetings in several times until the overall risk has been identified. Based on the selected articles, discussion take around 3 to 6 months to identify, assess and define risk interventions^{32,33}. This process will take much time, resources and requires organizational commitment, but it is effective for identifying and prioritizing potential risks of blood transfusion service process in China hospitals²⁴

HFMEA conducted in a Sri Lanka hospital has proved successful in identifying and prioritizing the potential risks that may occur in the drug dispensing process²⁹. The HFMEA method help hospitals in identifying hazards and implementing mitigation strategies in order to establish emergency hospitals during the COVID-19 pandemic³⁴. Potential risks in the use of universal anesthesia machines occur due to the availability and conditions of the tools, drugs, environmental factors, workload and knowledge of health workers²³.

The next process is causes and impacts analysis of risks. The highest risk ranking can be determined from the scoring results obtained from severity, frequency, and impact of those risks which help hospitals to prioritize the failure mode. Risk identification to risk

assessment is carried out in several discussions to determine the risk list from the process and sub-process flows of the selected topic. In gamma knife radiosurgery procedures in the United States, which found 86 potential risks, the risk assessment helped hospitals prioritize the 9 highest risk scores²⁷.

In addition, the HFMEA process involving team collaboration has succeeded in forming and increasing understanding and awareness of strengths and weaknesses on a healthcare process among the healthcare workforce^{29,35}. Increasing patient safety and potential risks awareness of pharmacists, apothecarist, and intensive care unit staff who involved in HFMEA process^{29,14}. This is in line with Simamora's theory³⁶ which states that education and training for staff can increase and strengthen good performance as well as improve poor performance.

Intervention to prevent patient safety incident risk

The next step is determining the action or intervention of the highest risk in order to prevent the risk from occurring. Development of action plans from selected studies show various plan that hospital implemented, such as developing protocol or standard operating procedure (SOP)³⁷, education and training for hospital workforce^{12,31}, supervision³⁸ redesign dispensing area with patient waiting facilities, reorganize the dispensing process²⁹, increasing internal and external audit³³, increase communication with patients, and advocate for additional human resources²³.

Interventions are not always affordable, but hospitals had their own consideration of their ability to carry out interventions both in terms of human resources and costs. Intervention cost were estimated lower than the social cost of patient harm which can be valued at US\$ 1 to 2 trillion a year⁵. In addition,

interventions can be considered based on previous research showing significant error reduction.

Monitoring and evaluation of risk prevention

The HFMEA process does not end at the intervention steps, routine monitoring and evaluation of the intervention implementation of the intervention are needed. Monitoring is carried out to monitor the implementation of interventions. Meanwhile, evaluation requires data from monitoring process to find out whether the specified intervention is successful and effective in reducing risk. The risk reduces, reducing patient safety incidents shown on patient safety incidents report. Therefore, HFMEA will provide maximum results.

Following step after determining intervention is monitoring and evaluating of interventions to prevent risks from occurring. Based on the 15 selected articles, 5 studies conducted monitoring and evaluation of risk prevention interventions, 2 studies each conducted monitoring but did not evaluate, while the other 8 not conducted monitoring and evaluation.

Monitoring and evaluation can be measure in the form of a plan-do-study-action (PDSA) method³⁵, plan-do-check-action (PDCA) and key performance indicators (KPI)¹¹. KPI aims to evaluate whether the objectives for performance are met. KPIs were used to monitor interventions routinely through KPIs from laboratory units and staff³⁹. KPI is also used to reduce clinical laboratory pre-analytic errors⁴⁰.

Studies of Fanny Ofek et al show that interventions from 6 potential risks have been carried out, since it was implemented for 2 years, adverse events were not found³¹. The error rate in blood transfusions decreased after the intervention in preventing the risk of errors in patient blood transfusion procedures. If necessary, the HFMEA can be repeated in the following year to monitor if the risk score has decreased as was done in the study by Jiu Ling et al.,¹¹.

The application of HFMEA followed by consistent monitoring and evaluation which can reduce patient safety incidents. It also bring impact on improving the quality of hospital services in quality dimensions of safety, effectiveness and efficiency¹⁴. Studies in hospital operating rooms states that HFMEA

can improve service quality in the quality dimensions of safe, effective, efficient, fair, timely, patient-centered, and integrated⁴¹.

Impact of HFMEA implementation in reducing patient safety incidents

Applying the HFMEA method requires long process and cost for interventions, but by doing so resulting in cost effective, quality improvement, medication safety, health worker safety, and patient safety. The integration of the Value Stream Map with HFMEA in improving the specimen handling processes as found that the application of HFMEA was able to reduce specimen rejection cases from 0.92% to 0% in 2010–2013⁴². In oncology and hematology cases, subcutaneous injection is better than intravenous injection because it can reduce the risk of medication errors in patients. From the hospital perception, it shows cost and resource savings⁴³.

Several studies have shown the role of HFMEA in reducing the risk of nursing care in pre-surgery³⁷. The impact of reducing adverse event of blood sampling errors reduced by 70% and no adverse events after intervention in the use of ready-to-use KCl solutions and blood transfusions^{12,24}. Thus, proactive method of risk management use to identify potential risks that cause errors or failures in the process and useful in improving patient safety²⁹.

CONCLUSION

Based on 15 articles that have been reviewed, HFMEA application has an impact on reducing patient safety incident risk. However, the hospital requires commitment and precision to apply each steps in the HFMEA process. HFMEA is a continuous and multiphase proactive risk assessment method, which if implemented optimally at every step and supported by competent human resources and hospital commitment, it will lower the risk of patient safety incidents occurring in the hospital. Apart from being a form of learning and routine monitoring in the context of reducing patient safety incident, the application of HFMEA is effectively applied in hospital services to create effectiveness and efficiency by maximizing existing resources in the hospital, avoiding waste, and increasing efficiency in the healthcare service process. In addition, it can reduce the cost of handling a relatively high patient safety incident.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCE

1. Ismainar H. Keselamatan Pasien Di Rumah Sakit [Internet]. Deepublish. 2019 [cited 2023 May 11]. Available from: https://books.google.co.id/books?id=EISYDwAAQBAJ&printsec=frontcover&hl=id&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. Nur Sa'adah Nashifah, Agus Aan Adriansyah. Analisis Pelaporan Insiden Keselamatan Pasien: Studi Kasus di RS Islam Jemursari Surabaya. *MOTORIK Journal Kesehatan*. 2019; [Internet]. 2019 [cited 2023 May 23]; Available from: <http://ejournal.stikesmukla.ac.id/index.php/motor/article/view/218/168>
3. Pertiwiwati E, Wibowo H, Fakhrudin M, Arif MN, Pratiwi AA, Akmal MF. Efektifitas Penggunaan Metode Health Care Failure Mode And. 2023;8(April):101–9.
4. Jain K. Use of failure mode effect analysis (FMEA) to improve medication management process. *Int J Health Care Qual Assur* [Internet]. 2017 [cited 2023 Sep 3];30(2):175–86. Available from: <https://pubmed.ncbi.nlm.nih.gov/28256927/>
5. World Health Organization. Towards eliminating avoidable harm health care [Internet]. Global patient safety action plan 2021–2030. 2021. 1689–1699 p. Available from: <https://www.who.int/teams/integrated-health-services/patient-safety/policy/global-patient-safety-action-plan>
6. Joint Commission International (JCI). Survey Process Guide for Hospitals [Internet]. 2021. 424 p. Available from: <https://www.jointcommissioninternational.org>.
7. Komisi Akreditasi Rumah Sakit. Instrumen Survei Akreditasi KARS sesuai Standar Akreditasi RS Kemenkes RI 2022. 2022. 317.
8. Raymond J. Mikulak, Robin McDermott MB. The Basics of FMEA 2nd Edition [Internet]. CRC Press. 2008 [cited 2023 May 11]. Available from: https://books.google.co.id/books?id=rM5Vi_0K9bUC&printsec=frontcover&hl=id&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
9. VHA National Center for Patient Safety (NCPS). Healthcare Failure Modes and Affects Analysis (HFMEA) Guidebook. 2021.
10. Liu HC, Chen XQ, Duan CY, Wang YM. Failure mode and effect analysis using multi-criteria decision making methods: A systematic literature review. *Comput Ind Eng*. 2019 Sep 1;135:881–97. Available from DOI: 10.1016/J.CIE.2019.06.055
11. Shen J, Wang X, Deng D, Gong J, Tan K, Zhao H, et al. Evaluation and improvement the safety of total marrow irradiation with helical tomotherapy using repeat failure mode and effects analysis. *Radiation Oncology* [Internet]. 2019 [cited 2023 Apr 5]; Available from: <https://doi.org/10.1186/s13014-019-1433-7>
12. Haroun A, AL- Ruzzieh M, Hussien N, Masa'ad A, Hassoneh R, Abu Alrub G, et al. Using Failure Mode and Effects Analysis in Improving Nursing Blood Sampling at an International Specialized Cancer Center. *Asian Pacific Journal of Cancer Prevention* [Internet]. 2021 Apr 1 [cited 2023 Apr 5];22(4):1247–54. Available from: DOI:10.31557/APJCP.2021.22.4.1247
13. Zhafirah Salsabila, Masyitoh, Amal C Sjaaf LP. Healthcare Failure Mode And Effect Analysis Design For Indonesia Hospital Laboratories: A Literature Review. *Jurnal Administrasi Kesehatan Indonesia*. 2021; Available from: <https://doi.org/10.20473/jaki.v9i1.2021.33-54>
14. Utami AS, Fahmy R, Putri ZM. Peran Metode Failure Mode and Effect Analysis (FMEA) terhadap Mutu Pelayanan Rumah Sakit: Systematik Review. *Jurnal Ilmiah Universitas Batanghari Jambi*. 2020;20(3):2549–4236. Available from doi : 10.33087/jiubj.v20i3.1080
15. Scorsetti M, Signori C, Lattuada P,

- Urso G, Bignardi M, Navarria P, et al. Applying failure mode effects and criticality analysis in radiotherapy: lessons learned and perspectives of enhancement. *Radiother Oncol*. [Internet]. 2010 Mar [cited 2023 May 15];94(3):367–74. Available from: <https://pubmed.ncbi.nlm.nih.gov/20116118/>
16. Thornton E, Brook OR, Mendiratta-Lala M, Hallett DT, Kruskal JB. Application of Failure Mode and Effect Analysis in a Radiology Department 1. DOI: 10.1148/rg311105018. 2011 Jan 19;31(1).
 17. Bonfant G, Belfanti P, Paternoster G, Gabrielli D, Gaiter AM, Manes M, et al. Clinical risk analysis with failure mode and effect analysis (FMEA) model in a dialysis unit. *J Nephrol*. 2010;23(1):111–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/20091494/>
 18. Arenas Jiménez MD, Ferre G, Álvarez-Ude F. Strategies to increase patient safety in Hemodialysis: Application of the modal analysis system of errors and effects (FEMA system). *Nefrologia*. 2017 Nov 1;37(6):608–21. Available from DOI: 10.1016/j.nefro.2017.04.007
 19. Dastjerdi HA, Khorasani E, Yarmohammadian MH, Ahmadzade MS. Evaluating the application of failure mode and effects analysis technique in hospital wards: a systematic review. *J Inj Violence Res*. 2017 [cited 2023 May 13];9(1):51–60. Available from: <http://www.jivresearch.org>
 20. Asefzadeh S, Yarmohammadian MH, Nikpey A, Atighechian G. Clinical Risk Assessment in Intensive Care Unit. *Int J Prev Med*. [Internet]. 2013 [cited 2023 May 15];4(5). Available from: www.ijpm.ir
 21. Alba Mesa F, Angel Sanchez Hurtado M, Miguel Sanchez Margallo F, Gomez Cabeza de Vaca V, Komorowski AL. Application of Failure Mode and Effect Analysis in Laparoscopic Colon Surgery Training. *World J Surg*. 2014;
 22. Wardhani V, Andarini S, Sakit Al Huda Banyuwangi R, Timur J, Ilmu Kesehatan Masyarakat B, Kedokteran F, et al. Healthcare Failure Mode And Effect Analysis: Proses Pelayanan Operasi Di Rumah Sakit Healthcare Failure Mode And Effect Analysis: Surgery Care Procedures In Hospital. *Jurnal Manajemen Pelayanan Kesehatan*. 2012;15(4).
 23. Rosen MA, Sampson JB, Jackson E V., Koka R, Chima AM, Ogbuagu OU, et al. Failure mode and effects analysis of the universal anaesthesia machine in two tertiary care hospitals in Sierra Leone. *Br J Anaesth*. 2014;113(3):410–5. <https://doi.org/10.1093/bja/aeu096>
 24. Najafpour Z, Hasoumi M, Behzadi F, Mohamadi E, Jafary M, Saeedi M. Preventing blood transfusion failures: FMEA, an effective assessment method. Available from: <https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-017-2380-3>
 25. Cheng CH, Chou CJ, Wang PC, Lin HY, Kao CL, Su CT. Applying HFMEA to prevent chemotherapy errors. *J Med Syst*. [Internet]. 2012 Jun 11 [cited 2023 May 16];36(3):1543–51. Available from: <https://link.springer.com/article/10.1007/s10916-010-9616-7>
 26. Ashley L, Dexter R, Marshall F, McKenzie B, Ryan M, Armitage G. Improving the Safety of Chemotherapy Administration: An Oncology Nurse-Led Failure Mode and Effects Analysis. Number 6 / November 2011. [Internet]. 2011 Oct 29 [cited 2023 May 16];38(6):E436–44. Available from: <http://onf.ons.org/onf/38/6/improving-safety-chemotherapy-administration-oncology-nurse-led-failure-mode-and-effects>
 27. Xu AY, Jagdish Bhatnagar |, Bednarz G, Flickinger J, Arai Y, Vacsulka J, et al. Failure modes and effects analysis (FMEA) for Gamma Knife radiosurgery. *J Appl Clin Med Phys* [Internet]. 2017 [cited 2023 Apr 5];18(6):152–68. Available from: <https://aapm.onlinelibrary.wiley.com/doi/10.1002/acm2.12205>
 28. Martínez CS, Amery L, De Paoli G, Elofsson U, Fureby AM, Kwok S, et al. Examination of the Protein Drug Supply Chain in a Swedish University

- Hospital: Focus on Handling Risks and Mitigation Measures. *J Pharm Sci*. [Internet]. 2023 May [cited 2023 May 10]; Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0022354923001910>
29. Anjalee JAL, Rutter V, Samaranayake NR. Application of failure mode and effects analysis (FMEA) to improve medication safety in the dispensing process-a study at a teaching hospital, Sri Lanka. *BMC Public Health* [Internet]. 2021 [cited 2023 Apr 5]; Available from: <https://doi.org/10.1186/s12889-021-11369-5>
 30. Liao CJ, Ho CC. Risk management for outsourcing biomedical waste disposal - using the failure mode and effects analysis. *Waste Manag*. 2014 Apr 13 [cited 2023 May 16];34(7):1324–9. Available from: <https://europepmc.org/article/med/24726188>
 31. Ofek F, Magnezi R, Kurzweil Y, Gazit I, Berkovitch S, Tal O. Introducing a change in hospital policy using FMEA methodology as a tool to reduce patient hazards. 2016; DOI: 10.1186/s13584-016-0090-7
 32. Teklewold B, Anteneh D, Kebede D, Gezahegn W. Use of failure mode and effect analysis to reduce admission of asymptomatic covid-19 patients to the adult emergency department: An institutional experience. *Risk Manag Healthc Policy* [Internet]. 2021 [cited 2023 Apr 5];14:273–82. Available from: <https://www.tandfonline.com/action/journalInformation?journalCode=drmh20>
 33. Ullah E, Baig MM, GholamHosseini H, Lu J. Failure mode and effect analysis (FMEA) to identify and mitigate failures in a hospital rapid response system (RRS). *Heliyon*. 2022 Feb 1;8(2). DOI: 10.1016/j.heliyon.2022.e08944
 34. Levy N, Zucco L, Ehrlichman RJ, Hirschberg RE, Hutton Johnson S, Yaffe MB, et al. Development of Rapid Response Capabilities in a Large COVID-19 Alternate Care Site Using Failure Modes and Effect Analysis with In Situ Simulation. *Anesthesiology* [Internet]. 2020 Nov 1 [cited 2023 May 18];133(5):985–96. Available from: <https://pubs.asahq.org/anesthesiology/article/133/5/985/110313/Development-of-Rapid-Response-Capabilities-in-a>
 35. Sorrentino P. Use of failure mode and effects analysis to improve emergency department handoff processes. *Clinical Nurse Specialist* [Internet]. 2016 [cited 2023 May 18];30(1):28–37. Available from: https://journals.lww.com/cns-journal/Fulltext/2016/01000/Use_of_Failure_Mode_and_Effects_Analysis_to.8.aspx
 36. Simamora H. Manajemen Sumber Daya Manusia. Bagian Penerbitan STIE YPKN; 2018.
 37. Lee H, Lee H, Baik J, Kim HJ, Kim R. Failure mode and effects analysis drastically reduced potential risks in clinical trial conduct. *Drug Des Devel Ther*. 2017 Oct 19;11:3035–43. doi: 10.2147/DDDT.S145310
 38. Yu X, Gan T, Zhu Y, Cao J, Yang X, Jin B, et al. Healthcare failure mode and effect analysis (HFMEA) for improving the qualification rate of disinfection quality monitoring process. *J Infect Public Health*. 2020 May 1;13(5):718–23. <https://doi.org/10.1016/j.jiph.2020.02.040>
 39. Van Hoof V, Bench S, Soto AB, Luppia PP, Malpass A, Schilling M, et al. Failure Mode and Effects Analysis (FMEA) at the preanalytical phase for POCT blood gas analysis: proposal for a shared proactive risk analysis model. *Clin Chem Lab Med* [Internet]. 2022 [cited 2023 May 5];60(8). Available from: <https://doi.org/10.1515/cclm-2022-0319>
 40. Plebani M, Sciacovelli L, Aita A, Pelloso M, Chiozza ML. Performance criteria and quality indicators for the pre-analytical phase. *Clin Chem Lab Med* [Internet]. 2015 May 1 [cited 2023 May 18];53(6):943–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/25719322/>
 41. Imani B, Jalal SB. Surgical Technologists' Live Experiences of Professionalization: A Phenomenological Study. *Journal of Qualitative Research in Health*

- Sciences. [Internet]. 2022 Dec 1 [cited 2023 May 18];11(4):231–6. Available from:
https://jqr1.kmu.ac.ir/article_92085.html
42. Hung SH, Wang PC, Lin HC, Chen HY, Su CT. Integration of Value Stream Map and Healthcare Failure Mode and Effect Analysis into Six Sigma Methodology to Improve Process of Surgical Specimen Handling. *Journal of Healthcare Engineering* . 2015;6(.):377–98. DOI: 10.1260/2040-2295.6.3.377
 43. Clemente F, Faiella G, Rutoli G, Bifulco P, Romano M, Cesarelli M. Critical failures in the use of home ventilation medical equipment. *Heliyon*. 2019 Dec 1;5(12). doi: 10.1016/j.heliyon.2019.e03034

Original Article

Knowledge and Attitudes Relating to Barotrauma Incidents, Fishermen Communities in Buko Village, Banggai District, Central Sulawesi Islands

Yulianus Sudarman^{1*}, H. Melangka¹

¹ Department of Nursing, Poltekkes Kemenkes Palu, Palu, Indonesia

(Correspondence author's email, sudarmanyulianus18@gmail.com / 0821-9414-6065)

ABSTRACT

Exclusive breastfeeding begins within one hour after birth until the baby is six months old. Early initiation of Diving is a technique that is often carried out by fishermen in Batangono village with traditional techniques without using tools, from their knowledge that diving is obtained from generation to generation so that the consequences of diving activities have an impact on health, and the attitude shown in the Barotroma incident is also still lacking in handling. The aim of the research is to know the relationship between knowledge and attitudes, the incidence of Barotrauma in the community in Batangono Village, Buko District, Banggai Islands Regency. This research method uses a cross sectional approach. A sample of 42 respondents was selected from the Islands using purposive sampling. Data collection was carried out in January 2023. Data analysis used the Mann Whitney test. The results of this study show that the incidence of barotrauma is 68.4%. The results of the analysis show that there is a relationship between knowledge and events of barotrauma in the community with a p-value = 0.05. The attitude variable obtained a p-value = 0.02, meaning that there is a relationship between attitude and barotrauma events in society. The conclusion is that there is a significant relationship between knowledge and attitudes with the incidence of barotrauma in the community, suggestions for standard diving procedures to prevent barotrauma, and health agencies play a role in disseminating information about diving health.

Keywords: Knowledge, Attitude, Barotrauma.

<https://doi.org/10.33860/jik.v17i2.2242>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Barotrauma is tissue damage resulting from the direct effects of pressure. Pressure imbalance occurs when a person is unable to equalize the air pressure in the middle ear space when the water pressure increases or decreases. Extreme changes or imbalances between environmental pressures and internal pressures associated with body cavities can cause physical damage to the tissue lining of the cavities. The body cavities most at risk of experiencing barotrauma are the middle ear, paranasal sinuses, and lungs¹. The incidence of barotrauma in Indonesia in 2019 reached 54%, in 2020 it increased to 62%, and in 2021 it experienced a slight increase reaching 64%, this shows that the incidence of barotrauma is an

important focus of attention for the community and health facilities in handling barotrauma so as not to cause focus of problems that do not become an increase in cases every year². Traditional divers generally pay little attention to matters related to occupational safety and health, so they have the potential to be exposed to middle ear barotrauma, middle ear barotrauma occurs in 30% when diving for the first time and 10% in divers who have often dived³.

Banggai Islands Regency is a large sea area in the province of Central Sulawesi, which has a large population, the majority work as fishermen, both fishing and some catching fish by diving, the incidence of barotrauma in this district has also greatly increased every year, recorded from In 2020 there were 19 cases of

barotrauma, and in 2021 it increased to 22 cases, 1 of them died, and until June 2022 there were 8 patients with barotrauma cases (Banggai Islands District Health Office, 2021). The aim of the study was to determine the relationship between knowledge and attitudes with the incidence of barotrauma in the people of Batangono Village, Buko District, Banggai Islands Regency.

METHOD

This research is a type of analytical research. This research is to see the relationship between knowledge, attitudes and actions with the incidence of barotrauma in the people of Batangono Village, Buko District, Banggai Islands Regency. Data collection was carried out in a cross-sectional way where data collection was carried out by looking at the independent variables and the dependent variable at the same time. This research was conducted in Batangono Village, Buko District, Bangkep Regency. The population is all people who work as fishermen in Batangono Village, Buko District, Banggai Islands Regency, totaling 42 people. The sampling technique is the total population. Data collection, primary data, data sourced from fishermen, and secondary data, data obtained from incident reports at the Puskesmas. Processing data in an univariate way, namely analysis of proportions or percentages by comparing the cross distribution between the two variables concerned and bivariate analysis of the results of the chi square statistical test with a confidence level of 95% where if the P value $< \alpha$ (0.05).

RESULTS

Table 1. Characteristics Respondents in Batangono Village, Buko District, Banggai Islands Regency.

Gender	Frequency (f)	Percentage (%)
Man	42	100
Age		
30 – 38 Year	11	26,3
39 – 47 Year	8	19,0
48 – 56 Year	15	35,7
57 – 64 Year	8	19,0
Education	Frequency	Percentage (%)
Elementary	29	69,0

Junior high	13	31,0
Income	Frequency (f)	Percentage (%)
Rp. 500.000	30	71,4
Rp. 800.000	7	16,7
Rp. 700.000	5	11,9
Rp.1.000.000>	0	0
Diving Depth	Frequency (f)	Percentage (%)
2 – 5 M	12	28,6
6 – 10 M	28	66,6
10 > M	2	4,8
Pain in the ear	Frequency (f)	Percentage (%)
Never	4	9,5
Once	38	90,5
Knowledge	Frequency (f)	Percentage (%)
Good	23	54,8
No Good	19	45,2
Attitude	Frequency (f)	Percentage (%)
Good	24	57,1
No Good	18	42,9
Incident Barotrauma	Frequency (f)	Percentage (%)
Ever Experienced (Yes)	16	38,1
Haven't Experienced (no)	26	61,9

Source: Primary data processed

Based on table 1 of the 42 respondents, all were male or (100%) and seen from the age of the 42 respondents, the youngest age 30-38 years was 11 people or (26.3%), aged 39-47 years were 8 people or (19.0%), aged 48-56 years as many as 15 people or 35.7%), while aged 57-64 years as many as 8 people or (19%). Furthermore, judging from the education level of the 42 respondents, the lowest level of elementary school (SD) was 29 people or (69.0%) while the highest level of education was junior high school with 11 people or (31.0%). The average respondent's income is Rp. 500,000/month or (71.4%). The depth of diving made by the majority of respondents was 6-8 meters 28 (66.6%), and depths of more than 10 m 2 of respondents (4.7%). The majority of respondents had experienced ear pain as many as 38 (90.5%). Based on table 1 of 42 respondents, there were 23 people with good knowledge (54.8%), and there were 19 respondents who had poor knowledge (45.2%). Based on table 1 shows that of the 42 respondents who have the highest attitude, namely respondents who have a

good attitude as many as 24 respondents (57.1%). Based on table 1, out of 42 respondents, 16 people had experienced barotrauma or 38.1%, while 26 people had never experienced barotrauma or 61.9%.

Table 2. Relationship between knowledge and barotrauma events in the community in Batangono Village, Banggai Islands Regency

Knowledge	Barotrauma				Total (f)	p-Value
	Yes		No			
	f	%	f	%		
Good	10	43,5	13	6,5	23	0,00
Not good	6	31,6	13	8,4	19	
Total	16	38,1	26	1,9	42	

Source: Primary data processed

Table 2 above shows that of the 42 respondents who have good knowledge and understand related to barotrauma as many as 10 respondents (43.5%), who have good knowledge but do not know about barotrauma as many as 13 respondents (56.5%), knowledge is not good 6 respondents (31.6%) understood barotrauma, 13 respondents (68.4%) had poor understanding of barotrauma. Statistical test results with the Chi-Square test obtained a value of $p = 0.00$ ($P < 0.05$) means that there is a relationship between knowledge and barotrauma events in the people of Batangono Village, Banggai Islands Regency. The contingency coefficient test results obtained 0.673 results indicating that there is a relationship between knowledge with the incidence of barotrauma in the community in Batangono Village, Islands Regency.

Table 3. The relationship between attitude and barotrauma in the people of Batangono Village, Banggai Islands Regency.

Attitude	Barotrauma				Total (f)	p-Value
	Yes		No			
	f	%	f	%		
Good	10	41,7	14	58,3	26	0,02
Not good	6	33,3	12	66,7	14	
Total	16	38,1	26	61,6	42	

Source: Primary data processed

Based on table 3 shows that of the 42 respondents who have a good attitude and understand barotrauma as many as 10 respondents (41.7%), and respondents who have a good attitude who do not understand barotrauma as many as 14 respondents (58.3%),

who have a bad attitude and 6 respondents (33.3%) understood barotrauma, and 12 respondents (66.7%) had a bad attitude and understood barotrauma. The results of the static test with the Chi-Square test obtained a value of $p = 0.006$ ($P < 0.02$) meaning that there is a relationship between attitudes and the incidence of barotrauma in the people of Batangono Village, Banggai Islands Regency. The results of the Contingency Coefficient test obtained the result of 0.682 indicating that there was a relationship between attitude and the incidence of barotrauma in the community in Batangono Village, Islands Regency.

RESULTS AND DISCUSSION

This study explores knowledge, attitudes, and barotrauma incidents in fishing communities in Batangono Village, Buko District, Islands Regency. Preliminary findings in this study indicate that most fishing communities in Batangono village have good knowledge and attitudes towards Barotrauma incidents. Ardiansyah et al. (2021) and Herman et al. (2020) who identified a good increase in knowledge from fishing communities. Besides that, this study identified a relationship between variables that were considered related to the incidence of barotrauma⁵. The results of the univariate analysis showed that out of 42 respondents who had good knowledge and understood related to barotrauma as many as 10 respondents (43.5%), who had good knowledge, but did not know about barotrauma as many as 13 respondents (56.5%), poor knowledge that 6 respondents (31.6%) understood barotrauma, 13 respondents (68.4%) had poor understanding of barotrauma. After the analytical test was carried out using the Chi-Square statistical test, a value of < 0.05 was obtained. The p-value < 0.05 . This shows that there is a significant relationship between knowledge and the incidence of barotrauma for respondents in the village of Batangono, Buko District, Islands Regency. In the research that has been done, the results obtained from the 42 respondents who had more elementary school (SD) education than those with higher education. The level of education influences the formation of a mindset that is open to new things. The most important knowledge is knowledge about equalizing techniques for underwater workers, because it greatly influences hearing loss⁶. Knowledge of the respondents includes knowledge about the use of

personal protective equipment, equalizing techniques, how to know the situation, sea conditions around the object of work, and unsafe work attitudes⁷. According to the results of research by Dharmawirawan and Modjo (2012), among traditional fishermen in the Thousand Islands, one of the things included in the identification of occupational safety and health hazards is the low knowledge of fishermen about safety diving⁴. Diving activities at a depth of more than 20m have a considerable risk to the safety and health of divers⁸. Diseases related to diving activities require special attention because diving activities can pose a risk to health⁹. This knowledge has an impact on occupational disorders and diseases on dives¹⁰. Tradition (culture) affects knowledge because someone who has a good culture will have good knowledge, but if the social culture is not good then the knowledge will be poor¹¹. When viewed from the age of the respondents, it can be said that they are still productive, have higher enthusiasm, will, and abilities¹². Education is one of the factors that will shape and increase fishermen's knowledge about barotrauma. The level of education can affect the quality of human resources. The higher the level of education, the pattern of thinking is also more advanced so that it will be faster in accepting innovation¹³. Knowledge is a very important domain for the formation of open behavior and the formation of a behavior based on the existence of knowledge that encourages someone to take an action¹⁴. 10 respondents (41.7%) had a good attitude and understood barotrauma, and 14 respondents (58.3%) had a good attitude who did not understand barotrauma, 6 respondents (33.3%) had a bad attitude and understood barotrauma (%), as well as respondents who had a bad attitude and understood barotrauma as many as 12 respondents (66.7%). Table 7 above shows the analysis of the relationship between attitudes and barotrauma events. The statistical test results using the Mann Whitney alternative test in the table above obtained a p-value = 0.006 (p-Value = <0.05). Means that attitude is related to barotrauma events in the community in Batangono village, Islands Regency, which means that there is a significant relationship between attitude and barotrauma events. The results of this study prove that attitudes can influence a person's health behavior¹⁵. The attitude is not good and does not understand the highest barotrauma because most respondents have less knowledge, the less knowledge a

person has, the less the way to respond to something he does not know¹⁶. This can also be seen from the low level of education, as a result of low knowledge can affect attitudes in handling barotrauma. Attitude is a response to a person's readiness or tendency to take action, be it accepting or rejecting a change¹⁷. A positive attitude is a person's tendency to accept the recommended behavior, while a negative attitude is a person's tendency to reject the recommended behavior¹⁸. The attitude of fishermen can be formed from experience through the learning process¹³. The end result of an attitude cannot be seen immediately but can only be interpreted from the behavior of someone who is extroverted. Attitudes can also shape innovation in changing society to take actions that are considered good¹⁹. Barotrauma events in society are more likely to avoid problems because things that are felt can be self-defeating²⁰.

CONCLUSION

Knowledge and attitude have a relationship with the incidence of barotrauma in the community in Batangono Village, Buko District, Bangai Islands Regency. It is recommended to carry out standard diving procedures to prevent barotrauma, and health agencies play a role in disseminating information about diving health.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Mashitoh MY, Fasya AH. Analisis Hubungan Karakteristik Individu Dengan Risiko Barotrauma Telinga Nelayan Tradisional Kampung Cumpat Surabaya. *J Sos Sains*. 2022;2(10):1115–32.
2. Fransina M, Prodi P, Tual K, Kesehatan P, Maluku K, Prodi JK. Hubungan Pengetahuan dan Sikap Masyarakat terhadap Timbulnya Penyakit Dekompresi pada Nelayan Tradisional di Desa Tamedan. *Glob Heal Sci [Internet]*. 2021;6:1055–2622. Available from: <http://jurnal.csdforum.com/index.php/ghs>
3. Farida I, Arini D, Astuti NM. Aplikasi Tehnik Equalisasi Untuk Mencegah Barotrauma Pada Penyelam Tradisional. *GEMASSIKA J Pengabdian Kpd Masy*. 2020;4(2):155.

4. Dharmawirawan DA, Modjo R. Identifikasi Bahaya Keselamatan dan Kesehatan Kerja pada Penangkapan Ikan Nelayan Muroami. *Kesmas Natl Public Heal J*. 2012;6(4):185.
5. Harisa A, Yodang Y, Mifta IS. Pengetahuan, Sikap, dan Praktik Pencegahan Dekompresi dan Barotrauma oleh Masyarakat di Kampung Nelayan Untia, Kota Makassar: Studi Observasional. *Heal Inf J Penelit* [Internet]. 2023;15(1):49–57. Available from: <https://myjournal.poltekkes-kdi.ac.id/index.php/hijp/article/view/755>
6. Rahman Z, Kurniawati D, Apriani R. Hubungan Pengetahuan dengan Gangguan Pendengaran Akibat Penyemaman Pada Penyelam Tradisional di Kampus Bugis: Case Report. *J Ilm Keperawatan Stikes Hang Tuah Surabaya* [Internet]. 2020;15(2):172–85. Available from: <https://journal.stikeshangtuah-sby.ac.id/index.php/JIKSHT/article/view/114>
7. Koesdianasari ES. Hubungan Antara Pengetahuan Menyelam Dengan Gangguan Pendengaran Pada Pekerja Bawah Air Di Perusahaan Konstruksi Bawah Laut. *Indones J Occup Saf Heal*. 2019;7(3):348.
8. Tafui MA, Roga AU, Tedju Hinga IA. Faktor yang Berhubungan dengan Kecelakaan Kerja dan Penyakit Akibat Kerja pada Nelayan Pencari Teripang di Kelurahan Namosain Kota Kupang. *Media Kesehat Masy*. 2021;3(3):322–30.
9. Russeng SS, Muhammad Saleh L, Rum Rahim M, Mallongi A. Intervention Model for Barotrauma Diseases to Improve Health and Safety Diving Behaviors in Traditional Fishermen in Small Islands in Makassar, Indonesia. *Syst Rev Pharm*. 2020;11(9):597–600.
10. Singal HIV, Kandou GD, Rumayar AA. Hubungan Antara Pengetahuan, Sikap Dan Pendapatn Dengan Pemanfaatan Puskesmas Oleh Masyarakat Desa Kima Bajo Kecamatan Wori. *J Kesmas* [Internet]. 2018;7(5):1–8. Available from: <http://ejournal.unsrat.ac.id>
11. Melangka YSH, Masudin M, Iwan I, Hasan SM, Sahe T. Increasing mothers' knowledge of infant and young child feeding through booklets in Banggai Regency, Central Sulawesi Province, Indonesia. *Open Access Maced J Med Sci*. 2021;9:924–30.
12. González Acero C, Martínez S, Pérez-Expósito A, Winters S. Effect of an innovative behavioural change strategy and small-quantity lipid-based nutrient supplements on stunting and obesity in children in Baja Verapaz, Guatemala: Protocol for a randomised control trial. *BMJ Open*. 2020;10(7).
13. Ardiyaningrum I, Budiastuti S, Komariah. Hubungan Antara Tingkat Pendidikan dan Pengetahuan Terhadap Sikap Masyarakat dalam Konservasi Lahan Kering di Kecamatan Selo. *Seminar Nasional Pendidikan Biologi dan Saintek ke-V*. 2020. 114–118 p.
14. Ayu A D, Prodalima Sinulingga. Pengetahuan Remaja Putri Tentang Menarche. *J Ilm Keperawatan Imelda*. 2020;6(2):123–7.
15. Pinto EA, Indriastuti D, Mien M, Tahiruddin T, Narmawan N. Hubungan pengetahuan dan sikap dengan kejadian Barotrauma pada penyelam Suku Kadatua tanpa scuba. *Jurnal Wawasan Promosi Kesehatan*. 2020;1(1):7-12. Available from: <http://ojs.uho.ac.id/index.php/winsj>
16. Suprayitno E, Rahmawati S, Ragayasa A, Pratama MY. Pengetahuan dan Sikap Masyarakat dalam Pencegahan COVID-19. *J Heal Sci (Jurnal Ilmu Kesehatan)* [Internet]. 2020;5(2):68–73. Available from: <https://ejournalwiraraja.com/index.php/JIK/article/view/1123/914>
17. Gunawan S, Sinsin I, Zani AYP. Hubungan Antara Pengetahuan dan Sikap dengan Perilaku Pencegahan COVID-19 Pada Peserta Seminar Online STIKes Raflesia 7 April 2020. *Perilaku dan Promosi Kesehat Indones J Heal Promot Behav*. 2021;3(1):47.
18. Hasim A, Usman AN, Riu DS, Saleh A. Effects of Educational Videos to Increase Knowledge , Attitudes , and Sleep Quality of Pregnant Women with Chronic Energy Deficiency. 2023;17(1):57–66. Available from: <https://jurnal.poltekkespalu.ac.id/index.php/JIK>
19. Muliadi A. Sikap Entrepreneur Mahasiswa Pendidikan Biologi. *JISIP (Jurnal Ilmu Sos dan Pendidikan)* [Internet]. 2020;4(3):286–91. Available from:

<https://ejournal.mandalanursa.org/index.php/JISIP/article/view/1208/1117>

20. Darmawan D, Miharja D, Waluyajati RSR, Isnaeniah E. Sikap Keberagamaan Masyarakat Menghadapi Wabah COVID-19. *Relig J Stud Agama-Agama dan Lintas Budaya* [Internet]. 2020;4(2):115–24. Available from: <https://journal.uinsgd.ac.id/index.php/Religious/article/view/8596>

Original Article

Effect of E-WoHealth on Perceived Body Image, Self Confidence, and Body Mass Index (BMI) among Female Adolescents

Rizkiati Nurdin^{1*}, Saidah Syamsuddin², Yusring Sanusi Baso³, Andi Wardihan Sinrang⁴, Werna Nontji⁵, Deviana Soraya Riu⁴

¹Department of Midwifery, Graduate School, Universitas Hasanuddin, Makassar, Indonesia

²Department of Psychiatry, Faculty of Medicine, Universitas Hasanuddin, Makassar, Indonesia

³Head of Center for Media, Learning Resources and E-Learning Universitas Hasanuddin, Makassar, Indonesia

⁴Department of Obstetrics and Gynecology, Universitas Hasanuddin, Makassar, Indonesia

⁵Departement of Nursing, Universitas Hasanuddin, Makassar, Indonesia

(Correspondence author's e-mail, nurdinr21p@student.unhas.ac.id / 082154973696)

ABSTRACT

Low acceptance of body image can lead to behavioral changes and disorders such as depression, excessive desire to lose weight and dieting, eating disorders, as well as low self-esteem. This study aims to analyze the effect of using E-WoHealth on perceived body image, self-confidence, and Body Mass Index (BMI) among female adolescents. This study has obtained ethical approval issued by the Faculty of Public Health, Hasanuddin University No.105/UN4.14.1/YP.01.02/2023 3.01.2023. This was a Quasi-Experimental quantitative study with the R&D (Research and Development) approach and two-group Pre-test-Post-test design. The current study was conducted at State SHS 4 of Palopo City from February 20 to March 30, 2023. A sample size consisted of 108 students, who were selected through a total sampling technique and were assigned into 2 groups, namely the intervention group and the control group consisted of 54 respondents, respectively. The study design developed and validated learning media called Education Woman Health, later abbreviated as E-WoHealth, as a website containing animated videos, text videos and e-booklets to be applied as educational media. The study findings indicated a significant increase in the post-test perceptions of respondents with a p-value of 0.000 <0.05, which means there are differences in perceptions of female adolescents after being given education using E-WoHealth. Furthermore, there was a significant difference between the intervention group and the control group with a p-value 0.000 <0.05. It can be concluded that there was an effect of using web-based E-WoHealth on perceived body image, self-confidence and body mass index among female adolescents. Animated videos and e-booklets can be used as alternative educational medium to increase adolescents' perceptions for self-assessment to create self-confidence and a positive body image.

Keywords: *E-WoHealth, Perception, Body Image, Self-Confidence, Body Mass Index (BMI).*

<https://doi.org/10.33860/jik.v17i2.2210>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

During early adolescence, a period of physical development, changes in the body

shape becomes a concern of individuals¹. Body image is a subjective assessment based on self-

perception of physical shape. Female adolescents who are dissatisfied with their physical appearance may take various steps to shape it as desired so as to increase their self-confidence and self-esteem². Such action can affect general health, well-being, body image, and other characteristics in adulthood². Low acceptance of body image or so called body image dysfunction can also cause reproductive health problems, namely irregular menstruation, abnormal weight, anemia and CED in the future³.

Low acceptance of body image can lead to behavioral changes and disorders such as depression, excessive desire to lose weight, eating disorders, and low self-esteem⁴. Threats such as Chronic Energy Deficiency and anemia during pregnancy have the potential to occur if adolescents still think that being thin and small is a beautiful and ideal. Consequently, pregnant women with CED have the opportunity to give birth to children with low birth weight (LBW), while anemia can contribute to Maternal Mortality Rate since they are prone to bleeding during childbirth. Nutritional status must be considered to ensure the optimal growth and development of the future life of adolescents⁵. The incidence of anemia during adolescence is very closely related to the incidence of anemia during pregnancy⁶.

One of the important aspects in the development of personality in female adolescents is having a positive body image and self-confidence. The importance of self-confidence can provide positive encouragement for adolescents. Adolescents who have the attitude of being able to accept their body as it is will show their confidence. A previous study revealed that 25% of adolescents had a moderate level of self-esteem and 75% of adolescents had a low level of self-esteem⁷. Furthermore, a study conducted by Tehzeeb, et al., 2021 proved that the role of culture on the development of eating patterns, physical activity, and socialization with the surrounding environment⁸.

Adolescents who had an ideal body mass index or overweight with a positive body image tended to be more confident, were able to accept their body type and avoid deviant behavior. In contrast, adolescents with a negative body image with overweight or underweight body mass index tended to have a poor diet, often ate fast food, and lacked of exercise⁹. Based on another previous study, it

was found that 23.3% of high school students aged 13-16 years were involved in poor dietary practices¹⁰. Another study conducted by Joanna Sadowska, et al., 2020 showed that adolescents with a low body mass index often felt dissatisfied¹¹.

Efforts made by the government regarding the prevention of underweight and overweight among adolescents have been running but have not obtained good outcomes, causing the high incidence of underweight and overweight among female adolescents. Therefore, the researcher designed a learning media in the form of Education Woman Health which was then abbreviated as E-WoHealth¹²⁻¹³. E-WoHealth is an electronic learning medium which involves e-booklets and animated videos. Such website can be accessed by students to obtain information about body image, self confidence, and Body Mass Index. It is in line with a study conducted by Zhonggen Yu, et al., which found that video and its duration had a significant effect on the perceptions and abilities of female students due to its strong function¹⁴. This study aims to analyze the effect of web-based E-Health on perceived body image, self-confidence and body mass index (BMI) among female adolescents.

METHOD

This study applied the Combined Method namely Research and Development (R&D) developed by Borg and Gall as well as a Quasi Experimental method with a two group Pretest-Posttest design, which involved 108 respondents of students at State SHS 4 of Palopo City. This study was conducted at State SHS 4 of Palopo City. The study design developed and validated learning media called Education Woman Health, later abbreviated as E-WoHealth with several stages namely analysis of learning media needs, development of learning media design, expert test validation, TAM test and test for the final product of learning media. Development stage was initiated with analysis on the needs of female students at State SHS 4 of Palopo City, which was used as a basis for initial product development. At the initial development stage, the researcher conducted an initial study to assess students' perceptions towards the material contained in E-WoHealth, namely body image, self-confidence and Body Mass

Index (BMI). Based on these results, the researcher compiled materials to be involved on the Web. In the next stage, the product was developed by conducting preliminary study on knowledge. After the web product containing videos and e-booklets (E-WoHealth) was completed, a validation and revision tests were performed by involving 2 media or IT experts on November 30, 2022 as well as 2 material experts namely nutritionist and psychologist on December 7, 2022. After the E-WoHealth website was validated and revised, the next step was to conduct a one-on-one trial involving 2 Master of Obstetrics students to assess several things that still need to be improved, including the language of instructions and writing errors on January 25, 2023. Afterwards, small group trial involving 10 female students were conducted on January 26, 2023 as well as large group trial on January 27, 2023 by using almost the same characteristics.

The control group was observed to determine the effectiveness of using web-based E-WoHealth on the increase in perceived body image and Body Mass Index (BMI) among female adolescents. The control group in the study was given an intervention using a web-based E-WoHealth with the contents in the form of an e-booklet and text video regarding body image, self-confidence and Body Mass Index (BMI). On the other hand, the experimental group was given an intervention using a web-based E-WoHealth with the contents in the form

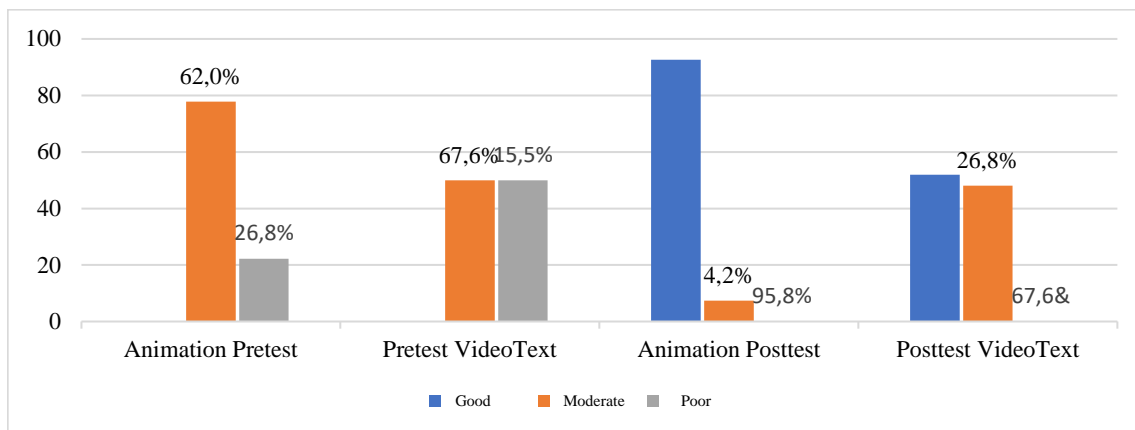
of e-booklets and animated videos regarding body image, self-confidence and Body Mass Index (BMI). The outcomes were further assessed using a questionnaire.

The next steps was to conduct research on February 20 – March 30, 2023. The initial stages of this study involved explanation of the objectives and steps during the study process and asking for approval. If the respondent agreed to be a study sample, informed consent was delivered to be filled in and an account was created to access the web. Furthermore, the researcher provided an explanation regarding the material contained in E-WoHealth and how to use it to make it easier for students in the process of learning material on the web. User name and password were further shared through the WhatsApp Group, and the respondents were asked to fill out the pre-test questionnaire before studying the material on the web. The study lasted for 8 meetings, respondents were given 2x a week to open the web to study the material contained in E-WoHealth. Monitoring was performed through the WhatsApp group and E-WoHealth. After studying education for 4 weeks, the respondents were asked to fill out the post-test questionnaire. After that, the post-test final assessment was carried out. The effect of E-WoHealth was accurately known by comparing the assessment results between before and after being given E-WoHealth based on the per-test and post-test questionnaires.

RESULTS

Table 1. Perceptions Before and After Health Education Using E-WoHealth.

Variable	Pre-Test				Post-Test			
	Intervention		Control		Intervention		Control	
	n	%	n	%	n	%	n	%
Perception								
Good	0	0	0	0	50	92.6	28	51.9
Moderate	42	77.8	27	50.0	4	7.4	26	48.1
Poor	12	22.2	27	50.0	0	0	0	0
Total	54	100	54	100	54	100	54	100



Graph 1. Perceptions Before and After Health Education Using E-WoHealth

Based on the table and graph above, a total sample of 108 people was assigned into 2 groups, namely the intervention group and the control group consisted of 54 respondents, respectively. The intervention group got health education using the E-Wohealth video animation and the control group got health education using E-Wohealth text video. During the pre-test, most of respondents both in the intervention group and the control group were involved in the moderate category by 42 respondents (77.8%) and 27 respondents (50.0%), respectively. Based on the results of the pre-test, it was shown that respondents had moderate level of perception.

After giving the intervention in the form of E-WoHealth video animation and text video, there were changes in perception,

especially in the intervention group of video animation, wherein 50 respondents (92.6%) were involved in the good category, and the remaining 4 respondents (7.4%) were involved in the moderate category. In contrast in the control group of text video, 21 respondents (51.9%) were involved in the good category, and the remaining 26 respondents (48.1%) were involved in the moderate change of perception.

Bivariate analysis was conducted to determine the effect of the independent on dependent variable of changes in perceived body image, self-confidence and Body Mass Index (BMI) of female adolescents. In general, the use of E-WoHealth could affect perceived body image, self-confidence and Body Mass Index (BMI) of female adolescents.

Table 2. Effect of E-WoHealth on Perceived Body Image, Self Confidence and Body Mass Index (BMI).

Variable	N	Negative Rank	Positive Rank	Ties	Sig.
Animated Video Intervention	54	0	54	0	0.000
Pre-Test-Post-Test					
Text Video Intervention	54	0	51	3	0.000
Pre-Test-Post-Test					

*Wilcoxon Test

The table above revealed that of 54 samples in the animated video group, all (100%) respondents experienced positive changes, and no respondent experienced negative changes in perception. Meanwhile in the control group of text video, there were 51 (94.4%) respondents who experienced positive changes in perception and

3 respondents (5.5%) experienced no changes. In general, providing animated videos could influence perceived body image and body mass index of female adolescents.

DISCUSSION

Malnutrition among adolescents is no less

important than obesity and underweight at the age of 16-19 years¹⁵. Interviews conducted with several students revealed that many of them did not know the ideal Body Mass Index, and those who thought that their bodies were not in the ideal category would do various ways to look ideal according to their version. They did various ways, namely diet by reducing their portions at meals. Such finding is reinforced by a study conducted by Ilmi, et al (2021) that one of the nutritional problems in Indonesia was underweight. Female adolescents are involved in the group that is vulnerable to underweight, especially those who live far from their parents. In addition, obesity is also a nutritional problem influenced by fast food consumption which is significantly associated with various emotional and behavioral problems which include somatic symptoms, attention problems, and aggressive behavior among adolescents with overweight problems¹⁶. Many celebrities become role models among adolescents. In fact, many people believe that beautiful people are those who are slim, have white skin, beautiful hair and other physical beauties. In order to get it, adolescents are willing to go on a strict diet without sufficient knowledge of nutrition, resulting in poor eating behavior that is not in accordance with nutritional principles. If such condition is continued, it will affect the health and nutritional quality of adolescents who should be prepared carefully as prospective mothers¹⁷. Adolescent concern for their bodies is also one of the causes of poor intake of nutrients. The results pre-test showed that most of respondents both in the intervention group and the control group were involved in the moderate category by 42 respondents (77.8%) and 27 respondents (50.0%), respectively. Based on the results of the pre-test, it was shown that respondents had moderate level of perception.

During the transition period, female adolescents become more sensitive and always feel dissatisfied with their appearance. So, they pay special attention to their physical appearance¹⁸. Negative body image is very common among adolescence and certainly has negative impacts on health such as increased risk of low self-esteem, depression, impaired physical activity and eating patterns. Preventive effort for the emergence of a negative body image among adolescents can be performed through education about the harmful effects of

unhealthy weight control, and management of healthy weight gain using the appropriate principles of nutrition, diet and physical activity¹⁹. Nutrition education is one of the interventions that can be done to overcome such problems²⁰.

After conducting intervention using video animation, 50 students in the intervention group experienced positive changes, and 4 respondents experienced no changes in perception. On the other hand, 28 respondents in the text video group experienced positive changes in perception and 26 respondents experienced no changes in perception. The results of Wilcoxon test found a p value of $0.000 < 0.05$, meaning that H_0 was accepted. Such finding indicated a change in perception before and after the intervention. Such finding is in line with previous study conducted by Asmawati, et al. which found that counseling using video media had a significant effect on students' knowledge and attitudes regarding anemia with p values for knowledge and attitude of 0.000 ($p < 0.05$) and 0.001 ($p > 0.05$), respectively. It can be concluded that there was an effect of education using video media on perceptions and knowledge on anemia among female adolescents at State JHS 1 of Turikale in 2020.

CONCLUSION

Based on the study findings, it can be concluded that there was an effect of using web-based E-WoHealth on perceived body image, self-confidence and body mass index among female adolescents.

Web-based e-Wohealth, which includes animated videos and e-booklets, can be used as an alternative educational medium in an effort to prevent health problems among adolescents, especially balanced nutrition, good body mass index (BMI), as well as improving their habit or behavior in assessing themselves to not compare themselves with other people so as to create self-confidence or a positive body image.

ACKNOWLEDGMENT

We would like to deliver sincere gratitude to the supervisors, examiners, respondents, parents and other parties for their participation and support during the completion of this study.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Komang N, Sasmita A, Made N, Wilani A. Pengaruh citra tubuh terhadap penyesuaian diri pada remaja awal di SMPN 1 Denpasar. *psikologi*. 2019;12–21.
2. Agustina et all. Hubungan Body Image Dengan Harga Diri Pada Remaja Putri Usia 16-18 Tahun. *Ilmu Kesehatan*. 2020;8(2):1–7.
3. Meiriza W, Satria O. Hubungan Berat Badan Tidak Normal Dengan Kejadian Amenore Pada Remaja Putri. *J Kesehatan Perintis*. 2017;4(2):102–8.
4. Eisenberg ME, Ward E, Linde JA, Gollust SE, Neumark-Sztainer D. Exposure to teasing on popular television shows and associations with adolescent body satisfaction. *J Psychosom Res* [Internet]. 2017;103(May):15–21. Available from: <http://dx.doi.org/10.1016/j.jpsychores.2017.09.014>
5. Indrasari OR, Sutikno E. Faktor Yang Mempengaruhi Status Gizi Remaja Usia 16-18 Tahun. *J Kesehatan Indones*. 2022;X(3):128–32.
6. Danefi T, Agustini F. Hubungan Status Gizi Dan Pola Menstruasi Dengan Kejadian Anemia Pada Remaja Di Sman 2 Singaparna Kecamatan Singaparna Kabupaten Tasikmalaya Tahun 208. *J Kesehatan Bidkesmas Respati*. 2018;1(1):9–18.
7. Ifdil, Denich Unzilla A, Asmidir I. Hubungan Body Image dengan Kepercayaan Diri Remaja Putri. 2017;2(3):107–13.
8. Zulfiqar T, Strazdins L, Banwell C. How to Fit In? Acculturation and Risk of Overweight and Obesity. Experiences of Australian Immigrant Mothers From South Asia and Their 8- to 11-Year-Old Children. *SAGE Open*. 2021;11(3).
9. Mutmainnah, Aunurrahman, Warneri. Efektivitas Penggunaan E-Modul Terhadap Hasil Belajar Kognitif Pada Materi Sistem Pencernaan Manusia di Madrasah Tsanawiyah. *J basicedu*. 2021;5(3):1625–31.
10. Abu-baker NN, Eyadat AM, Khamaiseh AM. Heliyon The impact of nutrition education on knowledge , attitude , and practice regarding iron deficiency anemia among female adolescent students in Jordan. *Heliyon*. 2021;7(December 2020):e06348.
11. Sadowska J, Dziaduch I, Bruszkowska M, Ziółkowska K. BMI, Body Perception, and Approach to Eating and Diet in Adolescent Girls. *SAGE Open*. 2020;10(4).
12. Tubuh C, Image B, Penatalaksanaan DAN, Gultom L, Saragih HS, Bangun S. Penyuluhan Pada Remaja Tentang Gizi , Harga Diri (Self Pengukuran Imt Pada Remaj Putri Di Panti Asuha Simpang Tiga Kecamatan Medan Barat Tahun 2020 Abstrak “ Kontribusi Perguruan Tinggi Dalam Pemberdayaan Masyarakat di Masa Pandemi ” “ Kontribusi Perguru. 2020;(November):23–5.
13. Febrina T, Astriani MM. Pengembangan Modul Elektronik Matematika Berbasis Web. *J Kaji Pendidik Mat*. 2020;6(1):27–36.
14. Yu Z, Gao M. Effects of Video Length on a Flipped English Classroom. *SAGE Open*. 2022;12(1).
15. Kemenkes RI. Injeksi 2018 [Internet]. Health Statistics. 2019. 207 p. Available from: <https://www.kemkes.go.id/downloads/resources/download/pusdatin/profil-kesehatan-indonesia/profil-kesehatan-indonesia-2018.pdf>
16. Ishak Z, Fin LS, Wan Ibrahim WAH, Md. Zain F, Yahya A, Selamat R, et al. Fast Food Intake, Emotional and Behavioral Problems among Adolescents with Overweight and Obese Problems Participating in MyBFF@school Intervention Program. *SAGE Open*. 2022;12(1).
17. Setyawati VAV, Herlambang BA. Model Edukasi Gizi Berbasis E-booklet untuk Meningkatkan Pengetahuan Gizi Ibu Balita. *J Inform Upgris* [Internet]. 2015;1(1 Juni):86–94. Available from: <http://journal.upgris.ac.id/index.php/JIU/article/view/810>
18. Wati CR, Lidiawati M, Bintoro Y. Hubungan Indeks Massa Tubuh Dengan Body Image Pada Remaja Putri Kelas I

- Dan Kelas II SMAN 4 Banda Aceh. Pros
Semin Nas Multi Disiplin Ilmu
UNAYA). 2019;3(1):849–57.
19. Ilmi VYA, Maharani N, Dieny FF,
Fitranti DY. Asupan protein, zink, dan
defisiensi zink pada santriwati
underweight. *J Gizi Klin Indones*.
2021;18(2):69.
 20. Nurul Azzahra Putri SA. Pengaruh
Pendidikan Gizi dengan Video Animasi
Terhadap Persepsi Body Image Remaja
di SMK Al-Muhadjirin 2 Kesehatan
Bekasi Timur Tahun 2022. *J Pendidik
dan Konseling [Internet]*. 2022;4(4):79.
Available from:
[https://core.ac.uk/download/pdf/322599
509.pdf](https://core.ac.uk/download/pdf/322599509.pdf)

Original Article

The Influence of Group Therapy on Personal Hygiene Improvement for Grade 7 Students

Rani Ardina^{1*}, Nuria Muliani¹

¹ Study Program of Nursing, Universitas Muhammadiyah Pringsewu, Lampung, Indonesia

(Correspondence author's e-mail, ummuzaid201012@gmail.com, 0823-7675-3316)

ABSTRACT

Efforts need to be made to improve personal hygiene behavior with the end result of reducing the number of infectious diseases. Human IT Middle School Mulia Boarding School is an IT Middle School with a dormitory concept where students live together to improve their religious skills and memorize the Koran. Personal hygiene problems have become commonplace among students. Health education has been done a lot, but not yet effective. One effort that can be done is with a therapy group. Therapy groups can influence other individuals to improve better behavior. This study uses a quasi-experimental design. This study used a purposive sampling technique in selecting subjects. The technique used to collect data is interview. This research will be conducted in July 2022, Islamic Boarding School at Insan Mulya Pringsewu Lampung. This research has received ethical recommendations from KEPK Muhammadiyah University of Pringsewu. Data analysis used the T test. The purpose of this study was to determine the effect of group therapy on improving the personal hygiene of 7th grade students of SMP IT Insan Mulia Islamic Boarding School. The results showed that the average increase in personal hygiene of students in the intervention group was higher than that of the control group (32.15 ± 14.65 ; 11.30 ± 9.32). The results of statistical tests showed that there was a significant effect of the therapy group on improving the personal hygiene of grade 7 students at SMP It Insan Mulia Boarding School (p value = 0.000). It is recommended to do group activity therapy for students to improve students' personal hygiene.

Keywords: *Group Activity Therapy, Personal Hygiene.*

<https://doi.org/10.33860/jik.v17i2.1777>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Health is a healthy state, both physically, mentally, spiritually and socially which enables everyone to live a productive life. The most important factors affecting public health are the environment, behavior, health services and heredity because it is in the environment that humans interact and interrelate in their life processes, both in the physical, psychological, socio-cultural, economic environment, where these conditions

are strongly influenced by individual behavior, families, groups and communities, which are closely related to the habits, norms, customs that apply in society¹.

Personal hygiene is self-care that affects human health where personal hygiene is carried out as an activity of daily life. Personal hygiene behavior can be influenced by individual values and habits, in addition to cultural, social, family norms, educational

level, economic status and so on. Having problems with personal hygiene will have an impact on a person's health condition. When someone is sick, one of the causes is a lack of personal hygiene. This should be our concern, because cleanliness is an important factor in maintaining individual health status².

The main problem of personal hygiene that often occurs in Islamic boarding schools is scabies. This is due to poor personal hygiene and the incidence of scabies³. Personal hygiene includes the habit of washing hands, using the same towel, the frequency of bathing, the frequency of changing clothes, the frequency of changing bed linen, and the habit of direct contact with scabies sufferers, other habits as well as using bar soap together. Habits like the above often occur in Islamic boarding schools⁴.

Another problem arising from poor personal hygiene is Pediculosis capitis in Islamic boarding schools or dormitories. Pediculosis capitis can be transmitted in two ways, namely by direct contact and indirectly. Direct contact occurs when there is contact with sufferers, for example giving directly by friends who are suffering and sleeping together next to sufferers. While indirect contact through objects that have been used by sufferers such as clothes, towels, pillows, mattresses and others².

Health education on personal hygiene therapy for diseases sometimes fails or treatment cannot reach optimally so that cases of infection still exist. If there are no preventive measures to improve personal hygiene, it will increase the incidence of infection caused by scabies and can eventually lead to endemic scabies. From the description above, it shows that health promotion about personal hygiene has a positive impact on increasing knowledge which indirectly changes behavior or actions in good self-care, so that the incidence of scabies can be reduced³.

According to research by Triasmari & Kusuma (2019), it shows that the factors that affect personal hygiene in children 9-12 years are influenced by knowledge, attitudes and access to promotional media. Knowledge, and access to social media are related to personal hygiene attitudes in children aged 9-12 years. Children aged 9-12 years who are exposed to social media have a higher proportion of doing personal hygiene compared to children who are not exposed.

The limitations of these health promotion media can have an impact on the

level of student knowledge, so there is a need to increase knowledge. Increasing knowledge can be done in various ways, including by way of education and outreach through both print and non-print media. Social health education media is very effective as a media for educating and outreach to the public about the importance of health in general.

Perceptual stimulation Group Activity Therapy (GAT) is one of the modality therapies performed by nurses on a group of patients who have the same nursing problem by training the patient to prepare for the stimulus provided or the stimulus experienced. Provision of effective perceptual stimulation GAT is supported by the environment in which the therapy is given, and the client's willingness to participate in activities, the client is expected to be able to overcome low self-esteem. Clients can also perceive what is described properly and appropriately⁶.

In research Widyawati, (2022), it shows that most of them are happy with the GAT technique provided and hope that activities like this are carried out continuously so that they are motivated to move forward⁷. The effectiveness of GAT can be seen from the many changes in the number of adolescents who originally had negative self-esteem abilities to positive self-esteem. The GAT given to adolescents aims to facilitate the ability of adolescents to socialize with a number of friends who are around them with problems of social relations, as well as to gradually improve social relations within the group. Also supported by personality and developmental stages.

In Chalifatiyanti's research (2017), it shows that group therapy can significantly reduce bullying behavior⁸. The openness of one of the respondents will influence the mindset of other group therapy members so that other group members will do the same thing, namely revealing the reasons/causes of the respondent bullying his schoolmates. Participation of group members eliminates feelings of isolation within each member and the uniqueness of the cause of bullying behavior occurs. The togetherness and openness of each member of the group can be lost. anxiety and encourage each member of the group to discuss inner feelings/emotions wholeheartedly.

Many studies support behavior change through group therapy. Therapeutic group therapy of school-age children affects the

ability of psychomotor development of school-age children. Therapeutic group therapy can help school-age children meet their needs (developmental tasks) positively. So it can be concluded that therapeutic group therapy has an effect on psychomotor abilities and industrial development of school-age children⁹.

In the pre-survey, research showed that there were 45% of grade 7 students who had personal hygiene problems due to the adaptation process from moving house to dormitory compared to grade 8 and 9 students who had already adapted to dormitory activities. Group therapy research alone has never been used in personal hygiene. Group therapy has never been introduced to humans Mulya Boarding School Pringsewu. This Study Aimed to effect of group therapy on improving the personal hygiene of grade 7 students at SMP It Insan Mulia Boarding School.

METHOD

This study uses a quantitative method with the type of quasy experiment in the form of pre -post test designs. Subjects were divided into 2 groups, namely the control group and the treatment group¹⁰. This research will be conducted in July 2022, Islamic Boarding School at Insan Mulya Pringsewu Lampung. The type of activity group therapy given is perceptual stimulation. perceived stimulation is one of the modalities of therapy performed by a nurse on a group of clients with the same involvement problem in this case the problem of personal hygiene Treatment Group activity therapy for students is used as a provision for students to improve personal hygiene. Therapy This group's activities continue to implement the covid 19 protocol during this pandemic. Before and after the study, the subjects were given a questionnaire to find out their personal hygiene skills. The educational method used in the control group used leaflets to improve personal hygiene for students. Education is given three times during the study.

Researchers used the calculation of the average sample of two. The subjects of this study consisted of 40 normal students in the intervention group and 40 normal students in the control group. The research instrument uses a personal hygiene questionnaire from previous research⁴ which has been tested for validity and reliability. Data collection was carried out using

primary and secondary data. Secondary data was obtained by looking at groups of grade 7 students at school. The primary data is directly through the intervention of group activity therapy which begins with a pre-test, then an evaluation (*post - test*) is carried out to find out the results of research on personal hygiene. .

The data collection process was carried out by researchers directly using questionnaires in each group. In the first week, they were given a pretest and in the second week, research subjects were asked to fill out a *post-test questionnaire*. Researchers strive to uphold a scientific attitude and research ethics. This Study get ethical clearance from Muhammadiyah University Pringsewu with number 010/ KEPK/ FKes /2022.

RESULTS

Table 1. Personal Hygiene in Grade 7 Middle School Students at Insan Mulya Boarding School Pringsewu before research in both groups.

Group	Mean±SD	Median	Range	p-value
Control	54.85±12.90	58.0	23-77	0.408
Intervention	52.93±11.54	54.0	31-69	

Table 1 shows that the average personal hygiene of students prior to the study in the control group was higher than that of the intervention group (54.85 ± 12.90; 52.93 ± 11.54). However, the statistical test results showed no significant differences in personal hygiene before the study in the intervention group and the control group (p value = 0.408).

Table 2. Personal Hygiene in Grade 7 Middle School Students at Insan Mulya Boarding School Pringsewu before research in both groups

Group	Mean±SD	Median	Range	p-value
Control	66.15±10.26	69.0	38-92	0.000
Intervention	85.10±10.15	85.0	54-100	

Table 2 shows that the average personal hygiene of students after the study in the intervention group was higher than that of the control group (85.10 ± 10.15; 66.15 ± 10.26). The statistical test results showed that there was a significant difference in personal hygiene after the study in the intervention group and the control group (p value = 0.000).

Table 3. The Influence of Group Therapy on Personal Hygiene Improvement for Grade 7 Students of SMP It Insan Mulia Boarding School

Group	Mean±SD	Median	Range	p-value
Control	11.30±9.32	8.0	0.0 – 31.0	0.000
Intervention	32.15±14.65	31.0	0.0 - 61	

Table 3 shows that the average increase in personal hygiene of students in the intervention group was higher than that of the control group (32.15 ± 14.65 ; 11.30 ± 9.32). The results of statistical tests showed that there was a significant effect of group therapy on improving the personal hygiene of grade 7 students at SMP It Insan Mulia Boarding School (p value = 0.000).

DISCUSSION

1. Personal Hygiene in Grade 7 Middle School Students at Insan Mulya Boarding School Pringsewu before research in both groups.

In this study it was found that the average personal hygiene of students before the study in the control group was higher than the intervention group (54.85 ± 12.90 ; 52.93 ± 11.54) and there was no difference in the two groups (*p value* = 0.408) .

Personal hygiene is important because good personal hygiene will minimize the *entry* of microorganisms that are everywhere and ultimately prevent a person from getting sick. Personal hygiene is self-care, where a person takes care of certain functions such as bathing, toileting , general body hygiene and decoration. Personal hygiene or personal hygiene is necessary for one's comfort, safety and health. Personal hygiene is the first step to realizing personal health. Having a clean body minimizes one's risk of contracting a disease, especially diseases associated with poor personal hygiene. Improved personal hygiene will make it easier for the body to get various diseases, such as skin diseases, infectious diseases, oral diseases, and gastrointestinal diseases or can even eliminate the function of certain body parts, such as the skin ¹¹ .

The main problem of personal hygiene in students who live in dormitories is generally skin hygiene. The skin is the outermost layer of the body and is in charge of protecting the underlying body tissues and other organs

against injury, and the entry of various kinds of microorganisms into the body. For this reason, care for the health and cleanliness of the skin is needed. Maintaining skin cleanliness and skin care aims to keep the skin well cared for and maintained so that it can minimize any threats and disturbances that will enter through the skin. It is important for nurses as health workers to inform clients in health services about the importance of maintaining cleanliness and skin care. Any condition that affects the skin (for example: humidity, damage to the epidermal layer, prolonged pressure on the skin, etc.) is sufficient to disrupt the function of the skin as a protective organ ¹² .

Just like the skin, hands and feet and nails must be cared for and this is inseparable from the cleanliness of the surrounding environment and the habits of daily life. Besides being beautiful to the eyes, clean hands, feet and nails also prevent us from various diseases. Dirty fingernails and hands can be dangerous for contamination and cause certain diseases.

According to the research of Khotimah et al., (2021) , it shows that the problem of personal hygiene is the main problem for the impact of scabies on students¹³. This can be caused by students making skin contact with other students. Bathing tools are also often used alternately as a means of exchanging infections among students. The next problem is the behavior of changing clothes, but most students don't do it. Poor personal hygiene will cause scabies. Of course, it can cause learning disorders and sleep patterns of students.

Supported by the research of Qomariyah et al (2022), it shows that before health education was carried out, the students' personal hygiene was not good. The aspect that looks less good is the cleanliness of the towels¹⁴. The students do not have good personal hygiene on the cleanliness of the bed. The students are used to sleeping together in one bed. This is what makes scabies contagious at this Islamic boarding school. In contrast to the research by Tosepu et al (2019) , it shows that the personal hygiene of students at *the Islamic Boarding School of the Metropolitan Ummushabri* Kendari in Kendari is in the good category¹⁵. They clean regularly, do not change clothes and always use dry and clean towels.

Factors that influence personal hygiene include internal factors and external factors. Internal factors include knowledge, attitudes and information. External factors that influence

the behavior of young women regarding personal hygiene during menstruation include support and facilities. The dominant factor that most influences the behavior of young women regarding personal hygiene during menstruation is the availability of facilities.

According to the assumptions of researchers, by understanding the factors that influence personal hygiene behavior. So health education is needed by involving facilities and the role of schools so that personal hygiene can increase. One way is to use group therapy.

2. Personal Hygiene in Grade 7 Middle School Students at Insan Mulya Boarding School Pringsewu before research in both groups.

In this study after research in the intervention group was significantly higher than the control group (85.10 ± 10.15 ; 66.15 ± 10.26 ; p-value 0.000). These results indicated that at the end of the study the intervention group had better behavior than the control group. The intervention group received group activity therapy. In this study, 40 intervention respondents were divided into 8 small groups and then combined into a large group. The intervention group received one session of 45-60 minutes meeting per week.

Group Activity Therapy (GAT) is a therapy that uses activity as a stimulus and is related to experience or life to be discussed in groups. Perception stimulation group activities are carried out to increase self-esteem which is characterized by self-recognition, self-respect, not hostility to oneself, positive and rational thinking. In addition, group activity therapy has benefits, namely: getting information on the expectations of group members, increasing the expectations of group members, providing awareness about the existence of similar thoughts, feelings, and problems⁷.

According to research by Widyawati & Dewi (2022), group activity therapy provides positive experiences aimed at knowing the importance of self-esteem identifying positive things about oneself, practicing positive self-esteem, the importance of positive things from others, identifying the importance of positive things about others and can train positive things in others⁷. In contrast to the research by Sutejo & Sulistiyawati (2017), it showed that there was no significant difference in the aggressive attitudes of students at SMAN 1 Ngaglik Sleman in the Province of DIY who were given

therapeutic group therapy for adolescents¹⁷.

In line with Zakiudin's research (2016), it shows that personal hygiene behavior in students can increase if it is supported by adequate facilities and infrastructure¹⁸. This support is also in the form of increasing the knowledge of the students which can improve the behavior of the students in personal hygiene. It shows that personal hygiene can prevent the occurrence of scabies in students and pediculosis capitis. This shows that health education for students improves their personal hygiene.

According to the researchers' assumptions, group activity therapy can increase personal hygiene behavior. This is because group activities can make respondents open to each other to improve personal hygiene.

3. The Influence of Group Therapy on Personal Hygiene Improvement for Grade 7 Students of SMP IT Insan Mulya Boarding School.

In this study, the increase in personal hygiene of students in the intervention group was significantly higher than that of the control group (32.15 ± 14.65 ; 11.30 ± 9.32). This means that Group Therapy has a significant effect on improving the personal hygiene of 7th grade students of SMP IT Insan Mulya Boarding School (p value = 0.000).

In this study the intervention group received a higher increase in personal hygiene. Giving group therapy can support each other in each group in improving personal hygiene behavior. Fellow friends can motivate each other and make corrections to each other when behavior is inappropriate.

Researchers conduct health education to research subjects. Health education can be done with various methods such as educational education using group activity therapy. Group activity therapy is able to channel emotions, is an opportunity that is needed by someone to maintain their mental health. In the group there will be time for each member to channel his emotions to be heard and understood by other group members. Perceptual stimulation group activity therapy improves social relations skills for everyday life, there are opportunities for group members to communicate with each other which allows for increased social relations in their daily life⁷.

In line with research by Bintang Agustina Pratiwi et al (2021), it shows that

there is an effect of health education on the personal hygiene behavior of students at the Pancasila Islamic Boarding School¹⁹. Knowledge of Student Pondok Boarding school Nurul Guidance Kebumen has changed after education. On Chalifatiyanti's research (2017) , shows that group therapy can significantly reduce bullying behavior. Participation of group members eliminates feelings of isolation within each member and the uniqueness of the cause of bullying behavior occurs⁸. The togetherness and openness of each member of the group can be lost. anxiety and encourage each member of the group to discuss inner feelings/emotions wholeheartedly.

According to the research of Yusuf et al (2017) , it shows that children with mental retardation will be able to work together through group activity therapy²⁰. The method used is playing together in groups starting with the preparation stage, the working stage and ending with the termination stage. RM's children take part in this activity on an ongoing basis so that this activity can be easily remembered and repeated at each subsequent meeting. Children who are more capable are directed to help children who are less able so that a collaboration is created between them to complete a game. In this game it also begins to appear adaptive social behavior of each child.

In this study, the control group also experienced an increase in personal hygiene behavior. The control group received an intervention in the form of a leaflet about improving personal hygiene. This leaflet was given to the control group every week. In the first week the leaflet discussed the importance of personal hygiene. In the second week the leaflet discussed ways to improve personal hygiene. In the third week, leaflets were given about maintaining good personal hygiene.

In the research of Resnayati et al (2022) , it shows that giving students healthy books can increase students' knowledge, attitudes and personal hygiene behavior in preventing scabies²¹. Giving this book is one of the media for health education so that students can improve their personal awareness. This is also a means for students to monitor personal hygiene.

According to the researchers' assumptions, giving group therapy can significantly improve personal hygiene behavior in the intervention group. The increase in personal hygiene was higher when compared to the control group. This group activity therapy

provides support to each respondent so that they can motivate and remind each other to improve the personal hygiene of the respondents.

CONCLUSION

This study showed that the group that received group activity therapy had a higher increase in personal hygiene behavior when compared to the control group. It is recommended to make group activity therapy a compulsory nursing curriculum in improving personal hygiene. It is recommended to conduct health education in the form of group activity therapy in improving the personal hygiene of students at Islamic boarding schools.

ACKNOWLEDGMENT

The researcher would like to thank Pringsewu Muhammadiyah University for the research support provided.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Kementerian Kesehatan Republik Indonesia. Undang-Undang Republik Indonesia nomor 36 tahun 2009 tentang Kesehatan. Jakarta: Kementerian Kesehatan Republik Indonesia; 2009.
2. Ansyah, A. N., Pramungtyas R., Kariosentono H. Hubungan antara Personal Hygiene dengan Angka Kejadian Pediculosis Capitis pada Santri Putri Pondok Pesantren Modern Islam Assalaam Surakarta. Skripsi thesis, Universitas Muhammadiyah Surakarta; 2013.
3. Marga MP. Pengaruh Personal Hygiene Terhadap Kejadian Penyakit Skabies. *Jurnal Ilmiah Kesehatan Sandi Husada*. 2020 Dec 31;9(2):773-8.
4. Desmawati, Dewi AP, Hasanah O. Hubungan personal hygiene dan sanitasi lingkungan dengan kejadian skabies di Pondok Pesantren Al-Kautsar Pekanbaru. *Jurnal Online Mahasiswa (JOM) Bidang Ilmu Keperawatan*. 2015 Feb 14;2(1):628-37.
5. Triasmari U, Kusuma AN. Determinan Personal Hygiene Pada Anak Usia 9–12 Tahun. *Faletahan Health Journal*. 2019

- Apr 19;6(1):37-44.
6. Tuasikal H, Siauta M, Embuai S. Upaya Peningkatan Harga Diri Rendah Dengan Terapi Aktivitas Kelompok (Stimulasi Persepsi) di Ruang Sub Akut Laki RSKD Provinsi Maluku. *Window of Health: Jurnal Kesehatan*. 2019 Oct 25;345-51.
 7. Widyawati W, Dewi BP. Studi Literatur : Penerapan Upaya Peningkatan Harga Diri Rendah Dengan Terapi Aktifitas Kelompok (Stimulasi Presepsi). *Jurnal Kesehatan dan Pembangunan*. 2022;12(23):124–36.
 8. Chalifatiyanti I. Terapi Kelompok untuk Menurunkan Kecenderungan Perilaku Bullying Pada Siswa SMP. *Persona: Jurnal Psikologi Indonesia*. 2018 Oct;6(1):1-10.
 9. Widyaningrum DA, Priyoto P, Anjarini AD. Upaya Peningkatan Perkembangan Mental Anak Melalui Terapi Kelompok Terapeutik Pada Siswa SDN 3 Sukowinangun Magetan. *Journal of Community Engagement in Health*. 2020 Sep 1;3(2):295-9.
 10. Creswell JW, Poth CN. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications; 2016 Dec 19.
 11. Laily II, Sulisty A. *Personal Hygiene. Konsep, Proses dan Aplikasi dalam Praktik Keperawatan*. Yogyakarta. Graha Ilmu. 2012.
 12. Puspita S, Rustanti E, Wardani MK. Hubungan Personal Hygiene Dengan Kejadian Skabies Pada Santri. *Jurnal keperawatan*. 2018 Aug 31;11(2):33–8.
 13. Khotimah H, Andayani SA, Maulidah R. Pengalaman Personal Hygiene Pada Santri Putra Dengan Penyakit Scabies Di Pondok Pesantren Darullughah Wal Karomah Sidomukti Kraksaan Probolinggo. *Jurnal Keperawatan Profesional*. 2021 Mar 23;9(1):70-95.
 14. Qomariyah A, Kawitantri OH, Faizah M. Edukasi Kesehatan Tentang Penyakit Scabies dan Personal Hygiene pada Santri Putra Pondok Pesantren Safinatul Huda Banyuwangi. *Dharma*. 2022 Jun 30;2(2):27-39. Available from: <http://ejournal.kopertais4.or.id/madura/index.php/dharma/article/view/5678>
 15. Tosepu R, Yasnani Y, Ismail N. Personal Behavior of Hygiene Santri in Islamic Boarding School of The Metropolitan Ummushabri Kendari. *International Conference on Environmental Awareness for Sustainable Development in conjunction with International Conference on Challenge and Opportunities Sustainable Environmental Development, ICEASD & ICCOSED 2019*; 2019.
 16. Suryani L. Faktor-faktor yang mempengaruhi perilaku remaja putri tentang personal hygiene pada saat menstruasi di SMP Negeri 12 Kota Pekanbaru. *JOMIS (Journal of Midwifery Science)*. 2019 Jul 10;3(2):68-79.
 17. Sutejo S, Sulistiyawati S. Terapi Kelompok Terapeutik Remaja Menurunkan Sikap Agresif Siswa Di Sman 1 Ngaglik Sleman Daerah Istimewa Yogyakarta. *Konferensi Nasional (Konas) Keperawatan Kesehatan Jiwa*. 2020 May 15;4(1):183-9.
 18. Zakiudin A, Shaluhiah Z. Perilaku kebersihan diri (personal hygiene) santri di pondok pesantren wilayah Kabupaten Brebes akan terwujud jika didukung dengan ketersediaan sarana prasarana. *Jurnal Promosi Kesehatan Indonesia*. 2016;11(2):64-83.
 19. Pratiwi BA, Oktarianita O, Febriawati H, Wati N, Kartini N. Pendidikan Kesehatan Terhadap Personal Higiene Santri. *Jurnal Kesmas Asclepius*. 2021 Jun 29;3(1):17-24.
 20. Yusuf A, Bahiyah K, Ola YB. Group Activity Therapy (Gat) Socialization Session 6 Increase Socialization Ability on Child of Mental Retardation. *Jurnal Ners.*;3(2):115-20.
 21. Resnayati Y, Ekasari MF, Maryam RS. *Buku Santri Sehat Meningkatkan Pengetahuan, Sikap dan Perilaku Terkait Personal Hygiene Santri dalam Pencegahan Skabies di Pesantren*. JKEP. 2022 May 31;7(1):54-66.

Original Article

The Effect of Using E-WoHealth on Knowledge, Attitudes and Behaviors About Body Image and Anemia in Young Women

**Fadlun Ishak^{1*}, Yusring Sanusi Baso², Mardiana Ahmad¹, Andi Nilawati Usman¹,
Deviana Soraya Riu³, Muhammad Tamar⁴**

¹ Departement of Midwifery, Postgraduate School, Hasanuddin University, Indonesia

² Learning Media Center, Learning Resources and E-Learning, Hasanuddin University, Indonesia

³ Obstetric and Gynecologic Department, Hasanuddin University, Makassar, Indonesia

⁴ Department of Psychology, Universitas Hasanuddin, Makassar, Indonesia

(Correspondence author's e-mail, ishakf21p@student.unhas.ac.id)

ABSTRACT

The prevalence of anemia in adolescents in Indonesia has increased by 32%, meaning that 3-4 out of 10 adolescents suffer from anemia in the age group 15-24 years is the largest proportion who experience anemia. This research uses the Combined Method (Research and Development), and the research design uses pre-experimental. The research design develops and validates learning media, namely E-WoHealth, in several stages: analysis of learning media needs, learning media development, design, expert test validation, TAM test, and tininal product of media. The development stage starts with an analysis of the needs of students at Junior High School, Six Gorontalo City. The findings show that the pre-test and post-test values for knowledge, attitudes, and behavior of young women have increased significantly, with a p-value of $0.000 < 0.05$, meaning that there are differences in the knowledge, attitudes, and behavior of young women before and after being educated using E-WoHealth. In conclusion, web-based E-WoHealth has an effect on the knowledge, attitudes, and behavior of young women regarding body image and anemia. Video and e-modules can be used as alternative educational media to prevent health problems in adolescents, especially anemia. They can improve the habits or behavior of adolescents by assessing themselves by comparing themselves with others to create self-confidence or body image. Positive for teenagers. It is hoped that schools can apply various methods, one of which is the use of animated videos and e-modules that can be accessed using smartphones.

Keywords: *E-Wohealth, Knowledge, Attitude and Behavior, Body Image, Anemia.*

<https://doi.org/10.33860/jik.v17i2.2204>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Adolescence is a period of physical growth and psychological development that starts from puberty and ends in adulthood^{1,2,3}. Puberty is a period of physical maturation in adolescents that is related to hormonal changes in the body. The psychological aspect of puberty is that adolescents begin to pay

attention to body shape⁴. Apart from paying attention to body shape, the puberty phase for girls is the occurrence of menstruation. Anaemia is a serious global health problem affecting children, adolescents and adults⁵. Approximately one-third of the world's population is affected by anaemia⁶ making it

the second leading cause of disability in the world⁷.

Anaemia is relatively easier to occur in women (23.90%) than men (18.40%) and is prone to attack children to adolescents⁸. Adolescent girls are more susceptible to anaemia than male adolescents because female adolescents lose iron during menstruation so they need more iron intake⁷. Anaemia affects almost a third of the world's population and is still found in several countries including Indonesia, the most common type of anaemia is iron deficiency anaemia⁹.

The prevalence of anemia in adolescents in Indonesia has increased by 32%, meaning that 3-4 out of 10 adolescents suffer from anemia in the age group 15-24 years is the largest proportion who experience anemia. Micro micronutrient deficiencies in developing countries generally affect adolescents, which can cause anemia¹⁰. The nutritional needs of adolescents must be considered because they are prone to iron deficiency due to their nutritional habits that are less than optimal due to their lifestyle and diet to obtain an ideal body image according to the criteria they want^{11,12}. According to research conducted by¹³, it was found that 23.3% of high school students aged 13-16 years were involved in poor dietary practices. Most young women think that the ideal body for a woman is to have a slim, small and thin body¹⁴.

Body image is a subjective assessment based on self-perception of the physical body¹⁵. Body image is important for teenagers to pay attention to¹⁶. Based on this, it is in line with research conducted by¹⁷ who states that there is a significant relationship between body image and nutritional status in adolescents, so adolescents are susceptible to iron deficiency anemia. This is in line with the research¹⁸ that states that 32% of perceptions of negative body image can increase anemia in young women aged 15-18 years because body image affects nutritional status in adolescents¹⁹. Adolescent eating habits, including nutritional status, significantly impact health. Nutritional status must be sufficient to ensure the growth and development of adolescent life later¹² because the incidence of anemia in pregnant women is closely related to the incidence of anemia in adolescence²⁰. Young women have the view

that a thin and small body image like a pencil is considered beautiful²¹. In connection with this problem, anaemia has a negative impact on the growth and development of school-age children²². This is in line with research²³ 69.7% of adolescents experience anemia due to irregular eating patterns, causing symptoms such as fatigue due to insufficient production of red blood cells, which reduces the distribution of oxygen throughout the body.

Efforts made by the government in dealing with anemia in young girls have been running, but anemia in young women is still high²⁴. The researcher designed the learning medium in the form of e-WoHealth. E-WoHealth is an electronic learning media which contains e-modules, animated videos and video texts that students can access to gain knowledge, attitudes and behaviour about body image and anaemia in young women. The developed web-based module has received an assessment from experts and can display text, images, and animated videos that have reached the very feasible category; thus, the product developed can be used in learning^{25,24}.

The importance of this research is done because of a problem students do not know about good body image. To achieve the desired body criteria, they consume a bad diet. Often, young women feel weak, dizzy, and lack enthusiasm for studying; they do not know what they are experiencing are signs of anemia due to irregular eating patterns. This is of particular concern; therefore, it is necessary to provide education to adolescents. The novelty of this research is that there is no previous research using web-based media to increase students' knowledge, attitudes, and behavior regarding body image and anemia. This study aims to examine the effect of e-health on knowledge, attitudes, and behavior regarding body image and anemia in young women.

METHOD

Research and development is carried out by research and data collection, planning, developing product drafts, initial field trials, revising trial results, field trials, product improvement from field tests, and field implementation trials. this is done to achieve the goals that have been targeted. This research

was conducted at Junior High School 6 Gorontalo City from February 15 to March 26, 2023, after receiving ethical recommendations from the ethical committee of the Faculty of Public Health, University of Hasanuddin Makassar (number 7001/UN4.20.1/PT.01.04/2022). This study used a Combined Method. The combined method used is Research and Development (R&D) developed by Borg and Gall, and the research design uses pre-experimental. By combining these two methods, it is expected to be able to find out in more depth the effect of using animated videos in changing behavior, knowledge and attitudes towards anemia.

The research design develops and validates learning media namely Education Woman Health (E-WoHealth) with several stages namely analysis of learning media needs, learning media development design, expert test validation, TAM test and the final product of learning media. The development stage starts by analyzing the needs of female students at Junior High School 6 Kota Gorontalo, which can be used as a basis for developing the initial product. At the initial developmental stage, the researcher conducted an initial study to measure students' knowledge of body image and anemia. From these results, the researcher compiled the material that would be included on the web.

After the web product is completed, the next step is to conduct an expert validation test conducted by four experts, involving two IT/media experts on November 30, 2022, and two material experts, conducted on December 7, 2022. After the validation test, the next step was to conduct a trial one-on-one involving two female colleagues of the Masters of Midwifery to see things that still need to be improved, including the language of instruction and the author's errors carried out on January 10, 2023, and continued with a small group trial involving 10 female students that were carried out on the 12th January 12, 2023, and a large group trial on January 24, 2023, using almost the same characteristics and carried out in different places to avoid bias.

Based on the assessment of experts and trials conducted using the TAM Test, the next step is to conduct research that will be conducted on February 15 – March 26, 2023.

The initial stage of this research is to explain the objectives and steps of the research process; if the respondent agrees to be for the research sample, informed consent will be obtained and an account will be created to access the web.

Next, we explained to students at a glance about the material to be studied on the web and how to use the web to make it easier for students later in the process of learning material on the web. Two days later, the researcher distributed user names and passwords through WhatsApp Group, after which the respondents first completed the pretest before studying the material on the web. The research lasted four 4 weeks, and respondents were given 2x a week to open the web, study the material contained in the e-module, and watch educational videos. Monitoring was carried out in the WhatsApp group and on the Web, namely E-WoHealth. After the learning was carried out, the respondents completed a posttest to obtain the results of learning using E-WoHealth.

Analysis of the differences in pretest and posttest results using the Wilcoxon Test showed that there was an effect of using web-based Education Woman Health (E-WoHealth) on the knowledge, attitudes, and behavior of young women regarding body image and anemia at Junior High School 6 Gorontalo City.

RESULTS

Table 1 Knowledge, Attitudes and Behaviors Before and After Being Given Education Using E-WoHealth.

Variable	Pre-Test		Post-Test	
	n	%	n	%
Knowledge				
Good	0	0	52	94.5
Moderate	4	7.3	3	5.5
Less	51	92.7	0	0
Total	55	100	55	100
Attitude				
Good	0	0		10.9
Moderate	2	3.6	35	63.6
Less	53	96.4	14	25.5
Total	55	100	55	100
Behaviour				
Good	0	0	6	10.9
Moderate	0	0	40	72.2
Less	55	100	9	16.4
Total	55	100	55	100

Based on the table above, the knowledge of young women before being educated using web-based E-WoHealth, namely the less category (92.7%) experienced an increase to 94% good, for the less category attitude (96.4%) increased to sufficient (63.6%) and good (10.9%), while the behavior of young women before being given the intervention (100%) was in the less category, after being educated, it changed to less (16.4), sufficient (40%), and good (10.9%).

Bivariate analysis was conducted to determine the influence of the independent and dependent variables on changes in knowledge, attitudes, and behavior regarding anemia and body image in young women.

Table 2. Analysis of the influence between variables.

Variable	N	Negatif Rank	Positive Rank	Ties	Sig.
Knowledge Pretest-posttest	55	0	55	0	0.000
Attitude Pretest-posttest		0	53	2	0.000
Behaviour Pretest-posttest		0	55	0	0.000

Based on the table above, shows that based on the pretest and posttest values for the knowledge, attitudes, and behavior of young women experienced a significant increase with a p-value of $0.000 < 0.05$, indicating that there were differences in the knowledge, attitudes, and behavior of young women before and after being educated using E-WoHealth.

DISCUSSION

The emergence of assessments among young women today's body standards is concerned with physical appearance with a proportional body shape, has made today's young women feel less confident; young women always judge themselves through the eyes of other people, namely their friends²⁶, so that with the assessment of other people, young women want a perfect assessment of their bodies so diets and irregular eating patterns and consuming drugs or herbs are a way to get an ideal body without paying attention to the intake of nutrients consumed so that things This

will have an impact on the health of the adolescents themselves, in particular, will have an impact on anemia due to a lack of iron and other vitamins and minerals that adolescents do not consume.

The social media most often used by respondents are Instagram and Tiktok, both of which are social media that highlight visual content. Research²⁷ shows that there is a negative relationship between body image and the use of social media that displays photos of peers. This means that the use of social media that displays photos of peers can negatively affect adolescents' body image.

Knowledge is the result of human curiosity regarding anything through certain methods and tools. This knowledge is of various types and nature; some are direct and some are indirect; some are variable, subjective, and specific; and some are fixed, objective and general²⁸. Therefore the researcher applied the learning process to increase adolescent knowledge through web-based E-WoHealth. The results of the study showed that all respondents experienced an increase in knowledge about body image and anemia (p-value of $0.000 < 0.05$). This is because the learning process using E-WoHealth contains e-modules that vary between images and explanatory materials to minimize boredom during the learning/education process, while the animated videos contained in E-WoHealth, apart from providing education, can also provide entertainment to students because the content contained in the video is adjusted to the age that respondents can accept. The advantages of video media include being more interesting and easier to understand, learning on your own, directly achieving goals and displaying detailed content, and comparing two different scenes at once²⁹.

This is in line with the research conducted by¹¹, who stated that education with video media can increase knowledge about balanced nutrition in young women. Audiovisual media can stimulate the senses of hearing and sight during the process of delivering educational material; the more senses are used in receiving something, the clearer the knowledge that can be received^{30,31}. In addition, the results of this study are also in line with research conducted by³², who stated

that giving e-modules had an effect on nutritional knowledge in adolescents.

Knowledge is a factor that can influence individual health behavior, but it is not the only factor that supports health behavior change. Based on the results of the study, it was found that there were differences in knowledge before and after being given education about body image and anemia in young girls; in addition to providing videos, it was also supported by providing e-modules in E-WoHealth that could provide the potential for an increase in knowledge scores to continue to increase every week with the correct answer provided by the respondent.

Information about nutritional status and factors for the occurrence of anemia can be explained through learning at school because the high prevalence of knowledge and attitudes in adolescents who lack anemia is the cause of the high incidence of anemia in adolescents². This is in line with research conducted by³³ the results ($p < 0.05$) showed that nutrition education interventions could increase knowledge, attitudes, and health practices about anemia in adolescents. Lack of knowledge of, history of not consuming iron supplements can increase the risk of anaemia so this needs to be considered in developing policies to reduce the incidence of anaemia in young women¹⁸.

Based on the results of the research data in the Wilcoxon test, it was found that web-based E-WoHealth had an effect on the attitudes of young women with a p-value of $0.000 < 0.05$, which means that there was a significant difference between the respondents' scores before and after being given education using the E-WoHealth-based web.

This is in line with previous research conducted by²⁹ that counselling using video media had a significant effect on students' knowledge and attitudes about anaemia with the results of knowledge $p = 0.000$ ($p < 0.05$) and attitude 0.001 ($p > 0.05$). There is an effect of education using video media on knowledge and attitudes about anaemia in young women

Teenagers often feel insecure about their appearance. Assessment of themselves becomes negative when adolescents see their physical appearance as not ideal or not beautiful, according to society's assessment in

general. Thus, it is an exalted physical beauty. In the past, what was popular in society as a beautiful person was someone slender, had fair skin, beautiful hair, and other physical beauty for women. People who have a beautiful physical appearance tend to be judged as having many opportunities here and there compared to people whose appearance is "mediocre." Therefore, teenagers, whose souls are still unstable, tend to see that appearance is everything. Those who will become popular are those with beautiful physical appearances³⁴.

Knowledge, thoughts, beliefs, and emotions determine attitudes. This shows that there is a relationship between the changes in knowledge and attitudes. The higher a person's knowledge, the better his attitude will be³⁵.

Furthermore, the researcher conducted a significance test on the acquisition of scores before and after being given education using E-WoHealth to adolescents and found the results of the Wilcoxon test with a p-value of $0.000 < 0.05$; therefore, it can be concluded that the use of web-based E-WoHealth for young women is significant in improving the behavior of evaluating body image so that it can foster self-confidence in adolescents and the behavior of consuming healthy food to prevent anemia. In line with Azhari's research, et al. showed that there were significant differences in changes in category vegetable consumption behavior in the group given education using video with a value ($p < 0.001$) before and after treatment³⁶. The phenomenon of physical changes that occur has the potential to affect self-confidence in adolescents because it is related to body image or body image possessed by these adolescents.

Assessment of the body in young women that focuses on appearance is the main factor that can affect their body image of young women. Young women more often desire an attractive body, following the public's perception of the ideal female body image. Teenagers have a view of themselves about who differentiates them from others. Entering the transitional stage into adolescence, if a teenager does not have the confidence to build and accept an interaction, then he will experience difficulties in forming social relations later; therefore, adolescence is the right time to provide education about body

image and anemia due to the desire to obtain an ideal body so that it affects the diet of adolescents by reducing nutritional intake will have an impact on the health of adolescents themselves, which can lead to iron deficiency anemia due to lack of iron, vitamins, and other minerals that adolescents do not consume.

In the current era of globalization, with the increasingly rapid use of information technology, the concept of organizing learning has shifted to follow modern learning. Audiovisual media is better at providing information, but this depends on the type of information provided. Information in the form of practices or sequences of procedures can have a more visible effect than other materials^{37,38}. The advantages of video media include being more interesting, easier to understand, and able to learn on your own, directly achieving goals and displaying detailed content to achieve learning goals²⁹.

CONCLUSION

Based on the results of research and data analysis conducted by researchers, it can be concluded that web-based Education Woman Health influences young women's knowledge, attitudes, and behavior regarding body image and anemia. Video and e-modules can be used as alternative educational media to prevent health problems in adolescents, especially anemia, and can improve the habits or behavior of adolescents by assessing themselves by comparing themselves with others to create self-confidence or body image. positive for teenagers. The impact of this research in the future is that it can provide knowledge to the public that using animated videos can increase knowledge about how to avoid anemia, and anemia in general more easily. For workers in the service sector, it can provide convenience in educating about the dangers of anemia and how to avoid it.

It is hoped that schools can apply various methods, one of which is the use of animated videos and e-modules that can be accessed using students' smartphones as a new medium in the learning process to increase knowledge and habits of good behavior and foster student self-confidence. In addition, it is necessary to socialize parents about good eating

patterns so that they can pay more attention to balanced nutritional intake to prevent iron deficiency anemia.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Agarwal S, Srivastava R, Jindal M, Rastogi P. Study Of Adolescent Stage And Its Impacts On Adolescents. *Eur J Mol Clin Med* [Internet]. 2020;7(6):1369–75.
2. Jalambo Mo, Sharif R, Naser Ia, Karim Na. Improvement In Knowledge, Attitude and Practice Of Iron Deficiency Anaemia Among Iron-Deficient Female Adolescents After Nutritional Educational Intervention. *Glob J Health Sci*. 2017;9(7):15–23.
3. Agustiningsih N. Gambaran Body Image Pada Remaja Usia 16 – 18 Tahun. *J Kesehatan Mesencephalon*. 2019;5(1):48–52.
4. Iswari NKAS, Wilani NMA. Pengaruh Citra Tubuh Terhadap Penyesuaian Diri Pada Remaja Awal Di Smpn 1 Denpasar. *J Psikol Udayana*. 2019;Edisi Khusus:12–21.
5. Abdulkadir A, Abubakar B, Tela U, Ahmed M, Bello A, Ahmad M. Prevalence Of Enuresis Among Children And Adolescents: A Systematic Review And Meta-Analysis. *Sahel Med J*. 2019;22(4):157.
6. Chaparro CM, Suchdev PS. Anemia Epidemiology, Pathophysiology, And Etiology In Low- And Middle-Income Countries. *Ann N Y Acad Sci*. 2019;1450(1):15–31.
7. Priyanto LD. Hubungan Umur, Tingkat Pendidikan, Dan Aktivitas Fisik Santriwati Husada Dengan Anemia. *J Berk Epidemiol*. 2018;6(2):139–46.
8. Arya NP, Pratama YAAGW. Anemia Defisiensi Besi: Diagnosis Dan Tatalaksana. *Ganesha Med J*. 2022;2(1):49–56.
9. Putri, PH, Hasanah LN. Rancangan Sistem Informasi Anemia Pada Platform Online “Srikandi Health” Berbasis

- Progressive Web Apps. *J Sehat Mandiri*. 2021;16(1):143–50.
10. Krishnan V, Zaki RA, Nahar AM, Jalaludin MY, Majid HA. The Lancet Regional Health - Western Pacific The Longitudinal Relationship Between Nutritional Status And Anaemia Among Malaysian Adolescents . *Lancet Reg Heal - West Pacific* [Internet]. 2021;15(July):100228. Available From: <https://doi.org/10.1016/J.Lanwpc.2021.100228>
 11. Hidayah MS. Faktor-Faktor Yang Berhubungan Dengan Kejadian. *J Ilm Ilmu Keperawatan Dan Ilmu Kesehatan Masy Fakt*. 2018;13(1):51–6.
 12. Indrasari OR, Sutikno E. Faktor Yang Mempengaruhi Status Gizi Remaja Usia 16-18 Tahun. *J Kesehatan Indones*. 2022;X(3):128–32.
 13. Abu-Baker Nn, Eyadat Am, Khamaiseh Am. Heliyon The Impact Of Nutrition Education On Knowledge , Attitude , And Practice Regarding Iron De Fi Ciency Anemia Among Female Adolescent Students In Jordan. *Heliyon*. 2021;7(December 2020):E06348.
 14. Vianita F Al, Kurniawati D, Juliningrum Pp. Description Of Knowledge , Attitude , And Behavioral Breastfeeding On Working Mother In The Arjasa Community Health Center Working. *J Ilmu Keperawatan J Nurs Sci*. 2020;8(1):1–9.
 15. Paans Npg, Bot M, Brouwer Ia, Visser M, Penninx Bwjh. Contributions Of Depression And Body Mass Index To Body Image. *J Psychiatr Res* [Internet]. 2018;103(May):18–25. Available From: <https://doi.org/10.1016/J.Jpsychires.2018.05.003>
 16. Senín-Calderón C, Rodríguez-Testalb Jf, Perona-Garcelán S, Perpiñád C. Body Image And Adolescence: Behavioral Impairment Model. *Psychiatry Res*. 2017;248(Feb):121–6.
 17. Ripta F, Siagian M, Wau H, Manalu P. Persepsi Body Image Dan Status Gizi Pada Remaja. *Ikesma J Ilmu Kesehatan Masy*. 2023;19(1):19–26.
 18. Agus K, Putra D, Cintya P, Yuliyatni D, Sutiari Nk. The Relationship Between Body Image And Tea Drinking Habits With Anemia Among Adolescent Girls In Badung District , Bali , Indonesia. *Public Heal Prev Med Arch*. 2020;8(1):24–31.
 19. Febriani RT. Analisis Faktor Yang Mempengaruhi Status Gizi Lebih Remaja Di Kota Malang. Universitas Jember; 2018.
 20. Danefi T, Agustini F. Hubungan Status Gizi Dan Pola Menstruasi Dengan Kejadian Anemia Pada Remaja Di Sman 2 Singaparna Kecamatan Singaparna Kabupaten Tasikmalaya Tahun 208. *J Kesehatan Bidkesmas Respati*. 2018;1(1):9–18.
 21. Kemenkes. Pencegahan Dan Penanggulangan Anemia Pada Remaja Putri Dan Wanita Usia Subur. Jakarta; 2018. 1–59.
 22. Kapil U, Kapil R, Gupta A. Prevention And Control Of Anemia Amongst Children And Adolescents : Theory And Practice In India. *Indian J Pediatr*. 2019;86(June):523–31.
 23. Wandasari Dy. Faktor-Faktor Yang Memengaruhi Kejadian Anemia Pada Remaja Putri Di Wilayah Kerja Puskesmas Wonosalam 1. Universitas Islam Sultan Agung Semarang; 2022.
 24. Mutmainnah, Aunurrahman, Warneri. Efektivitas Penggunaan E-Modul Terhadap Hasil Belajar Kognitif Pada Materi Sistem Pencernaan Manusia Di Madrasah Tsanawiyah. *J Basicedu*. 2021;5(3):1625–31.
 25. Febrina T, Astriani Mm. Pengembangan Modul Elektronik Matematika Berbasis Web. *J Kaji Pendidik Mat*. 2020;6(1):27–36.
 26. Denich Au, Ifdil. Konsep Body Image Remaja Putri. *J Konseling Dan Pendidik*. 2015;3(Juni):55–61.
 27. Hogue J V, Mills Js. The Effects Of Active Social Media Engagement With Peers On Body Image In Young Women. *Body Image* [Internet]. 2019;28(November):1–5. Available from: <https://doi.org/10.1016/J.Bodyim.2018.11.002>
 28. Darsini, Fahrurrozi, Cahyono EA.

- Pengetahuan; Artikel Review. *J Keperawatan*. 2019;12(1):95–107.
29. Asmawati N, Nurcahyani Id, Yusuf K, Wahyuni F, Mashitah S. The Influence Of Contributors Uses Video Media Against Knowledge And Attitudes About Anaemia In Teenage Daughter Smpn 1 Turikale 2020. *Jgk*. 2021;13(2):22–30.
 30. Imran FA, Hasnah. Pengaruh Penyuluhan Kesehatan Melalui Media Video Terhadap Peningkatan Pengetahuan Remaja Putri Tentang Dampak Abortus Provokatus Kriminalis Di Kelas X Sman 2 Gowa. *Jf Fkik Uinam*. 2017;li(Desember):61–7.
 31. Waryana, Sitasari A, Febritasanti Dw. Intervensi Media Video Berpengaruh Pada Pengetahuan Dan Sikap Remaja Putri Dalam Mencegah Kurang Energi Kronik. *J Action Aceh Nutr J*. 2019;4(4):58–62.
 32. Ardita SK, Prihatin S, Tursilowati S. Pengaruh Edukasi Gizi Dengan Media E-Modul Terhadap Pengetahuan, Sikap, Dan Perilaku Gizi Pada Remaja Overweight Dan Obesitas. *J Ris Gizi*. 2021;X(1):1–11.
 33. Poudel A, Mubashir A, Vijaya N. Impact Of Nutritional Education On Knowledge , Attitude And Practice Regarding Anemia Among School Children In Belgaum , India. *Glob Heal J [Internet]*. 2022;6(2):91–4. Available From: <https://doi.org/10.1016/J.Glohj.2022.04.001>
 34. Anindita SM. Model Remaja Putri : Body Image Dan Bulimia Nervosa Teen Model : Body Image And Bulimia Nervosa. *Muqoddima J Pemikir Dan Ris Sociol*. 2021;7168(1):19–36.
 35. Rahmad AH Al, Almunadia. Pemanfaatan Media Flipchart Dalam Meningkatkan Pengetahuan Ibu Tentang Konsumsi Sayur Dan Buah. *J Kedokt Syiah Kuala*. 2017;17(3):140–6.
 36. Azhari MA, Fayasari A. Pengaruh Edukasi Gizi Dengan Media Ceramah Dan Video Sarapan Serta Konsumsi Sayur Buah. *J Action Aceh Nutr J*. 2020;5(1):55–61.
 37. Rahman J, Fatmawati I, Syah Mnh, Sufyan Dl. Hubungan Peer Group Support, Uang Saku Dan Pola Konsumsi Pangan Dengan Status Gizi Lebih Pada Remaja. *Action Aceh Nutr J*. 2021;6(1):65.
 38. Martos-Cabrera Mb, Mota-Romero E, Martos-García R, Gómez-Urquiza Jl, Suleiman-Martos N, Albendín-García L, Et Al. Hand Hygiene Teaching Strategies Among Nursing Staff: A Systematic Review. *Int J Environ Res Public Health*. 2019;16(17):1–13.

Original Article

The Influence of Animated Video on Knowledge and Compliance of Pregnant Women About Tetanus Toxoid Immunization

Ruliyanti¹, Andi Wardihan Sinrang², Mardiana Ahmad¹, Ariyanti Saleh³, Sharvianty Arifuddin¹, Stang⁴

¹ Department of Midwifery, Graduate School, Hasanuddin University, Makassar, South Sulawesi, Indonesia

² Department of Physiology, Faculty of Medicine, Universitas Hasanuddin, Makassar, Indonesia

³ Department of Nursing, Faculty of Medicine, Universitas Hasanuddin, Makassar, Indonesia

⁴ Department of Environmental Health, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

(Correspondence author's e-mail, ruliyanti21p@student.unhas.ac.id)

ABSTRACT

Pregnant mothers who are unaware of the risks of tetanus during pregnancy are more likely to die giving delivery or have their children die at birth. This study aimed to analyze the effect of sinusoidal runaway animation on the knowledge and adherence of pregnant women regarding tetanus toxoid immunization at the Tabongo Health Center. This study uses the Research and Development method with the Borg and Galt development model which will be used to develop and validate an animated video product. In combination with the quasi-experimental design, quantitative method using a nonequivalent control group design approach to determine the condition of the subjects in the intervention group and the control group before and after treatment. The study population comprised 265 pregnant women in the Tabongo Health Center area. A sample of 74 pregnant women was divided into two groups: intervention and control. The mothers' knowledge before being given Rumawa Sinusoid Animation education in the majority intervention group averaged 59.14. Mothers' knowledge after receiving Rumawa Sinusoid Animation education in the majority intervention group averaged 79.43. Mothers' knowledge before being given Text Animation education in the majority of the control group averaged 63.95. Mothers' knowledge after being given Text Animation education in the majority of the control group averaged 82.24. In Conclusion, Rumawa Sinusoid Animation Education's influence on increasing pregnant women's knowledge and compliance regarding Tetanus Toxoid immunization. It is hoped that further research using sound and images will also be investigated to provide varied results.

Keywords: *Animated Video, Knowledge, Compliance, Tetanus Toxoid, Immunization.*

<https://doi.org/10.33860/jik.v17i2.2190>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

In 1989, the World Health Assembly called for the elimination of neonatal tetanus in 1995. By 2000, 104 of 161 developing countries had achieved the elimination of neonatal tetanus

^{1,2}. As of February 2012, Pakistan is one of 34 countries that have yet to achieve elimination of maternal and neonatal tetanus¹. The Elimination of Maternal Neonatal Tetanus Initiative,

launched by the United Nations Children's Fund, the World Health Organization, and the United States Nations Population Fund, has continued to spearhead efforts to eliminate maternal neonatal tetanus after 2005³. However, progress in global elimination has been delayed due to slow implementation of the recommended strategy⁴.

The causes of Tetanus Neonatorum in Indonesia are various, namely due to childbirth assistance, care for the baby's umbilical cord, cutting the umbilical cord without using recommended or sterile tools, and as a result of unclean wounds, besides that, it is also caused by failure of antenatal care. Care (ANC) for pregnant women in TT immunization services⁵. Tetanus occurs due to handling labor and umbilical cord that is not clean. The initial symptoms of patients infected with tetanus are characterized by pain with stiffness in the muscles caused by a neurotoxin in closed wounds produced by the bacteria that cause tetanus, namely *Clostridium Tetani*⁶.

The cause is a type of germ called *Clostridium Tetani*, a type of spore whose seeds are in the surrounding environment. *Bacillus clostridium tetani* is widely distributed in spore-forming soils. Tetanus germs in their lives do not require large amounts of oxygen (anaerobic). Tetanus toxoid immunization is a process that builds immunity in an effort to prevent tetanus infection. The tetanus vaccine is a weakened and purified tetanus toxin that is administered to someone during immunization^{7,8}.

Reducing the incidence of tetanus in mothers and infants is a key area of global public health policies. Although much progress has been made in reducing the incidence of maternal and neonatal tetanus over the past two decades, tetanus remains a major cause of preventable disease^{9,10,11}. Without medical treatment, the mortality from neonatal tetanus approaches 100%^{12,13,14}. Neonatal tetanus is a fatal infection caused by the bacterium *Clostridium tetani* in the neonatal period. Neonatal tetanus develops when the umbilical cord is contaminated with *C. tetani* spores because of unhygienic delivery or cord care practices after delivery^{9,15}. This disease usually occurs in rural areas with poor access to health facilities^{16,17}. Neonatal tetanus is a disease that always exists¹⁸ and remains a major cause of infant and neonatal mortality in many developing countries^{19,20}.

Immunization programs are an important part of the health sector. This program aims to reduce morbidity, disability, and death from diseases that immunization can prevent. One of the important immunization programs recommended by the government is TT immunization (Tetanus Toxoid), which is a process to build immunity in an effort to prevent tetanus infection²¹. Tetanus Toxoid Immunization is a process used to build immunity to prevent tetanus infection²².

One of the efforts to introduce and disseminate public knowledge about health is audiovisual media, which can be used to convey health messages to achieve counselling goals. Audiovisual media is a type of media which besides audio elements also contains visual elements such as video recordings, and audio slides. The ability of this audiovisual media is considered superior and interesting because it contains two elements, namely hearing and seeing²³.

The low level of knowledge and adherence to TT immunization in the working area of Tabongo Health Center has made researchers interested in conducting education through new techniques using video. Researchers have designed educational videos by using R&D methods. This educational video in the form of animation can help health workers and midwives educate pregnant women not only during ANC but also during pregnancy class activities and integrated service post activities.

This study aimed to analyze the effect of sinusoidal rumawa animation on pregnant women's knowledge and adherence to tetanus toxoid immunization at Tabong Health Center. The novelty of this research is that researchers will conduct educational videos for pregnant women to see increased knowledge and adherence in carrying out tetanus immunization

METHOD

The design of this study uses Research and Development (R&D) method with the Borg and Galt development model which will be used to develop and validate an animated video product²⁴. In combination with the quasi-experimental design, the reason for using a quasi experiment is because the sample was taken using a purposive sampling technique. quantitative method using a nonequivalent control group design approach to determine the

condition of the subjects in the intervention and control groups before and after treatment. The study population comprised 265 pregnant women in the Tabongo Health Center area. A sample of 74 pregnant women was divided into two groups: intervention and control. Bivariate and univariate analyses were performed on the studied variables. Wilcoxon test analysis was used to determine the knowledge and compliance of pregnant women in carrying out TT immunizations against the use of animated and text videos. The Mann-Whitney test was used to determine differences in knowledge of pregnant women and compliance with TT immunization between the intervention and control groups. The ethical merit of the research was obtained from the ethical commission of the Faculty of Public Health, Hasanuddin University with number 606/UN4.14.1/TP.01.02/2023.

RESULTS

The univariate analysis aimed to obtain an overview of the distribution of respondents and describe the Effect of Rumawa Sinusoid Animation on the Knowledge and Compliance of Pregnant Women About Tetanus Toxoid Immunization. The respondents in this study were pregnant women who had never received TT immunization, and pregnant women who had completed TT 1 and TT 2 in the Tabongo Health Center Work Area.

Table 1. Knowledge of Mothers Pre Test and Post Test Before being given the text animation video (Control Group) and Rumawa Sinusoid animation video (Intervention Group)

Knowledge	N	Mini mum	Maxi mum	Average ± SD
Intervention Group	37	30	85	59,14 ± 14,718
Control Group	37	38	86	63,95 ± 13,281

The average knowledge of mothers before being given animated video education in the intervention group was 59.14 with a minimum score of 30 and a maximum score of 85, with a standard deviation of 14.718. Meanwhile, the 37 respondents in the control group before being given animated video education had an average score of 63.95 with a

minimum score of 38 and a maximum score of 68, with a standard deviation of 13.281.

Table 2. Knowledge of Mothers' Pre Test and Post Test after being given a text animation video (Control Group) and Rumawa Sinusoid animation video (Intervention Group)

Knowledge	N	Mini mum	Maxi mum	Average ± SD
Intervention Group	37	67	100	79,43 ± 8,656
Control Group	37	67	100	82,24 ± 7,729

Table 2 shows that the average knowledge of mothers after being given animated video education in the intervention group was 79.43 with a minimum value of 67 and a maximum value of 100, with a standard deviation of 8.656. Meanwhile, the 37 respondents in the control group after being given animated video education had an average score of 82.24 with a minimum score of 67 and a maximum score of 100 with a standard deviation of 7.729.

Bivariate analysis in this study aimed to determine the effect of Rumawa Sinusoid Animation on the Knowledge and Compliance of Pregnant Women on Tetanus Toxoid Immunization at Tabongo Health Center. If the data were normally distributed, a Paired T-Test was used.

The Paired T-Test was used to determine the difference between two variables that are still in one group, or it can also be interpreted to measure differences in the same sample but also in two measurements, the first pre-test and the second post-test. If the data were not normally distributed, the alternative was the Wilcoxon test. Based on the results of the data normality test, it was found that the significant results on the output of the SPSS knowledge scale before being given educational videos in the intervention group were 0.151 and in the control group were 0.112. If a decision is made with the applicable scale value, it is found that the value in the intervention group and the control group is > 0.05 , which means that the data are normally distributed; therefore, the paired sample t-test was used.

Table 3. The Effect of Providing Educational Videos on Knowledge of Pregnant Women.

Knowledge	N	Mean	SD	p-value
Pre Intervention	37	59,14	14,718	0,000
Post Intervention		79,43	8,656	
Pre Control	37	63,95	13,281	0,000
Control Post		82,24	7,729	

Table 3 explains that in the intervention group, the average value of knowledge before being given the Rumawa Sinusoid Animation educational video was 59.14 with a standard deviation of 14.718. After being given an animated educational video, the Rumawa Sinusoid rose to 79.43, with a standard deviation of 8.656. In the control group, the average knowledge before being given animated educational videos and text was 63.95 with a standard deviation of 13.281. After being given animated educational videos and text, it increased to 82.24, with a standard deviation of 7.729.

Based on the paired t-test of the mother's knowledge before and after being given educational videos in the intervention group (given Rumawa Sinusoid educational videos) and the Control Group (given text videos), it was found that the p-value of the two groups was 0.000 ($p < 0.05$). This shows that there was an effect of counselling on animation and text videos in the control group, and there was an effect of counselling on animated educational videos of Rumawa Sinusoid in the intervention group on increasing pregnant women's knowledge about Tetanus Toxoid immunization.

Table 4. The Effect of Educational Videos on Compliance with TT Injections in Pregnant Women

Obedience	N	Mean	SD	P-value
Pre Intervention	37	1,00	0,000	0,000
Post Intervention		1,32	0,475	
Pre Control	37	1,00	0,000	0,000
Control Post		1,49	0,507	

According to table 4, in the intervention group, the average value of knowledge before being given the Rumawa Sinusoid Animation educational video was 1.00, with a standard

deviation of 0.000. After being given an animated educational video, the Rumawa Sinusoid rose to 1.32 with a standard deviation of 0.475. In the control group, the average value of knowledge before being provided animated educational videos and text was 1.00, with a standard deviation of 0.000. After being given animated educational videos and text, it rose to 1.49 with a standard deviation of 0.507.

Based on the paired t-test of the mother's knowledge before and after being given educational videos in the intervention group (given Rumawa Sinusoid educational videos) and the Control Group (given text videos), it was found that the p-value of the two groups was 0.000 ($p < 0.05$). This shows that there was an effect of counselling on animation and text videos in the control group. There was an effect of counselling on animated educational videos of Rumawa Sinusoid in the intervention group on increasing compliance of pregnant women to carry out Tetanus Toxoid immunization, which shows that counseling had an effect on animation and text videos in the control group. There was an effect of counselling on animated educational videos of Rumawa Sinusoid in the intervention group on increasing pregnant women's compliance to Tetanus Toxoid immunization. Knowledge of tetanus toxoid immunization in pregnant women means that the pregnant mother understands and can apply it during pregnancy. This knowledge can be in the form of benefits obtained when carrying out immunizations, schedules for implementation, possible side effects and so on²⁵. table 4.8 explains that in the intervention group, the average value of knowledge before being given the Rumawa Sinusoid Animation educational video was 59.14 with a standard deviation of 14.718. After being given an animated educational video, the Rumawa Sinusoid rose to 79.43, with a standard

deviation of 8.656. In the control group, the average knowledge before being given animated educational videos and text was 63.95 with a standard deviation of 13.281. After being given animated educational videos and text, it increased to 82.24, with a standard deviation of 7.729.

Based on the paired t-test of the mother's knowledge before and after being given educational videos in the intervention group (given Rumawa Sinusoid educational videos) and the Control Group (given text videos), it was found that the p-value of the two groups was 0.000 ($p < 0.05$). This shows that there was an effect of counselling on animation and text videos in the control group, and there was an effect of counselling on animated educational videos of Rumawa Sinusoid in the intervention group on increasing pregnant women's knowledge about compliance with Tetanus Toxoid immunization. This research is in line with ^{26,27} knowledge will increase after counselling or education.

Another research that is in line with this research is the research conducted by ²⁸. The statistical test using the Wilcoxon test obtained a p-value of 0.000, meaning that p is less than 0.05 ($0.000 < 0.05$), so it can be concluded that H_a is accepted and H_0 is rejected, meaning that health education media animated videos affect adolescents knowledge of HIV/AIDS at SMK Negeri 2 Makassar.

Other research that is in line is research conducted by ²⁹ with a value of $p = 0.001$, which is less than 0.05 ($0.001 < 0.05$) therefore, it can be concluded that there is a difference in PHBS between the experimental group and the control group. Based on the research analysis results, both in the intervention and control groups before and after counselling, there was an increase in knowledge, where the pre-test to post-test distance was two weeks. The results obtained show a change in knowledge, because within two weeks, the researcher monitors the progress of the respondent through group discussion, where in this group the researcher always reminds, guides, and discusses with the respondent regarding matters related to tetanus toxoid immunization, so that the respondent understands the training material better. The use of media in health education can have a significant impact on the acceptance of the

information conveyed. Media in the health education process is based on the principle that all human knowledge is received or based on the five senses ³⁰.

One strategy to change one's knowledge about the important benefits of TT immunization is to provide information through health education or health promotion that can increase knowledge about TT immunization itself ³¹. Video is an educational method that is expected to provide innovation in changing counselling methods ³². The use of health videos can increase knowledge, awareness, understanding, and change behavior regarding the importance of TT immunization in pregnant women ³³. Health education can be run effectively when using educational media. One of the media that can be used is animated video. According to the results of research conducted by ³⁴ states, health education using audio-visual information increases knowledge, attitudes, and actions more than leaflet media ³⁴.

In addition, even though the appearance of the counselling material between the intervention group and the control group was different, the material provided was sufficient to attract the attention of the control group and the intervention group respondents because the media used was rarely used by local health workers and was different from the counselling that was often given. Another factor that influences is the technology that is developing in society, which makes it easier for respondents to find information other than the counselling material provided by researchers.

With the existence of educational videos for the two groups, both control and intervention, text animation videos, and educational videos for Rumawa Sinusoid, the average mother's knowledge about Tetanus Toxoid Immunization increased. Even though the increase in knowledge was significant, some only increased a few points of knowledge or even some did not experience an increase at all. The results obtained from the two intervention groups revealed that the knowledge of pregnant women increased after being given different interventions in each group.

Animated videos about health were created by presenting a combination of pictures with words that respondents could understand. A series of pictures and words that, when

combined, are more effective in retaining memory than using only pictures or words. According to ³⁵, animation is a series of images arranged sequentially or known as frames. Each frame consisted of one image. Animation can explain concepts or processes that are difficult to explain using other media. Animation also has aesthetic appeal, and an attractive and eye-catching appearance motivates users to engage in the learning process.

According to Table 4, in the intervention group, the average value of knowledge before being given the Rumawa Sinusoid Animation educational video was 1.00, with a standard deviation of 0.000. After being given an animated educational video, the Rumawa Sinusoid rose to 1.32 with a standard deviation of 0.475. In the control group, the average value of knowledge before being provided animated educational videos and text was 1.00, with a standard deviation of 0.000. After being given animated educational videos and text, it rose to 1.49 with a standard deviation of 0.507.

Based on the paired t-test of the mother's knowledge before and after being given educational videos in the intervention group (given Rumawa Sinusoid educational videos) and the Control Group (given text videos), it was found that the p-value of the two groups was 0.000 ($p < 0$). This shows that there is an effect of counselling on animation and text videos in the control group and on animated educational videos of Rumawa Sinusoid in the intervention group on increasing compliance of pregnant women to carry out Tetanus Toxoid immunization.

From the statistical test results, it can be seen that the average at the beginning of the research, namely before being given counselling using educational media in both the intervention group and the control group, it was seen that all new respondents received the first tetanus toxoid immunization but there was a change in the number of respondents who carried out immunizations at intervals 2 weeks from the pre-test to the post-test, this according to the researchers that the provision of education or outreach using the media either by using the Rumawa Sinusoid animation video in the control group or videos in the form of text in the control group can increase adherence to

injecting tetanus toxoid in pregnant women, p. This was because the respondents understood the impact of immunization on the health of mothers and babies.

In this study, it was also seen that even though educational videos had been given to the intervention and control groups, not all respondents increased their adherence to performing immunizations. The family, in this case, the husband, and the service flow sometimes makes patients reluctant to take advantage of existing health facilities.

CONCLUSION

The impact of Rumawa Sinusoid Animation Education can increase knowledge and compliance of pregnant women regarding Tetanus Toxoid immunization, as evidenced by the results of the analysis of the p-value (0.000) < alpha value (0.05). It is hoped that staff can provide health information about the importance of Tetanus Toxoid immunization, especially for pregnant women, as a follow-up to prevent tetanus disease by using video animation media. The limitation of this research is that it was not examined in depth regarding intermediary factors. Further research should be carried out by looking at deeper variables such as intermediary factors for TT immunization compliance in pregnant women.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. WHO. *Weekly Epidemiological Record Relevé Épidémiologique Hebdomadaire*. Switzerland; 2020.
2. WHO, UNICEF, UNFPA. *Maternal And Neonatal Tetanus Elimination By 2005: Strategies For Achieving And Maintaining Elimination*. Accessed. Geneva, Switzerland; 2000.
3. WHO. Validation Of Neonatal Tetanus Elimination In The Congo By A Lot Quality-Assurance Cluster Sample Survey. Vol. 6, *Weekly Epidemiological Record*, No. 2009.
4. WHO. Protecting All Against Tetanus [Internet]. Geneva, Switzerland:

- Expanded Programme On Immunization (Epi) of The Department of Immunization; 2019.
5. Sugiharto M. Profil Tetanus Neonatorum Dalam Rangka Kebijakan Eliminasi Tetanus Maternal Dan Neonatal Di Kabupaten Bangkalan Provinsi Jawa Timur , Tahun 2012 – 2014 (Neonatal Tetanus Profiles For Support The Of Policy Maternal And Neonatal Tetanus Elimination In Bang. 2016;2014(17):149–56.
 6. Blencowe H, Lawn J, Vandelaer J, Roper M, Cousens S. Tetanus Toxoid Immunization To Reduce Mortality From Neonatal Tetanus. 2010;102–9.
 7. Przedpelski A, Tepp Wh, Pellett S, Johnson Ea, Barbieri Jt. A Novel High-Potency Tetanus Vaccine. *Mbio*. 2020;11(4):1–12.
 8. World Health Organization. Manual For Quality Control Of Diphtheria, Tetanus And Pertussis Vaccines. Immunization, Vaccines And Biologicals. Geneva, Switzerland: Department Of Immunization, Vaccines And Biologicals; 2013. 300 P.
 9. Roper MH, Vandelaer JH, Gasse FL. Maternal And Neonatal Tetanus. *Lancet*. 2007;370(9603):1947–59.
 10. Lambo JA, Nagulesapillai T. Neonatal Tetanus Elimination In Pakistan: Progress And Challenges. *Int J Infect Dis [Internet]*. 2012;16(12):E833–42. Available From: [Http://Dx.Doi.Org/10.1016/J.Ijid.2012.07.015](http://dx.doi.org/10.1016/j.ijid.2012.07.015)
 11. Black RE, Cousens S, Johnson HI, Lawn JE, Rudan I, Bassani DG, ET AL. Global, Regional, And National Causes Of Child Mortality In 2008: A Systematic Analysis. *Lancet [Internet]*. 2010;375(9730):1969–87. Available From: [Http://Dx.Doi.Org/10.1016/S0140-6736\(10\)60549-1](http://dx.doi.org/10.1016/S0140-6736(10)60549-1)
 12. Rai R, Singh Dk. Neonatal Tetanus: A Continuing Challenge. *Indian J Pediatr*. 2012;79(12):1648–50.
 13. Aba Yt, Cissé L, Abalé Ak, Diakité I, Koné D, Kadiané J. Morbidité Et Mortalité Du Tétanos Des Nouveau-Nés Et Des Enfants Dans Les Centres Hospitaliers Universitaires D’abidjan, Côte D’ivoire (2001-2010). *Bull La Soc Pathol Exot*. 2016;109(3):172–9.
 14. Nagata, Bertrand, Baliyan, Kochav, Kagan, UJKA. Abnormal Mechanics Relate To Myocardial Fibrosis And Ventricular Arrhythmias In Patients With Mitral Valve Prolapse. *Circ Cardiovasc Imaging*. 2023;16(April):327–39.
 15. Schofield F. Selective Primary Health Care: Strategies For Control Of Disease In The Developing World. Xxii. Tetanus: A Preventable Problem. *Rev Infect Dis*. 1986;8(1):144–56.
 16. Vandelaer J, Birmingham M, Gasse F, Kurian M, Shaw C, Garnier S. Tetanus In Developing Countries: An Update On The Maternal And Neonatal Tetanus Elimination Initiative. *Vaccine*. 2003;21(24):3442–5.
 17. Oruamabo RS. Neonatal Tetanus In Nigeria: Does It Still Pose A Major Threat To Neonatal Survival? *Arch Dis Child*. 2007;92(1):9–10.
 18. WHO. Weekly Epidemiological Record Relevé Épidémiologique Hebdomadaire. Switzerland; 2016.
 19. Fikree Ff, Azam Si, Berendes Hw. Time To Focus Child Survival Programmes On The Newborn: Assessment Of Levels And Causes Of Infant Mortality In Rural Pakistan. *Bull World Health Organ*. 2002;80(4):271–6.
 20. Quddus A, Luby S, Rahbar M, Pervaiz Y. Neonatal Tetanus: Mortality Rate And Risk Factors In Loralai District, Pakistan. *Int J Epidemiol*. 2002;31(3):648–53.
 21. Syahputra R. Gambaran Tingkat Pengetahuan Ibu Hamil Tentang Imunisasi Tetanus Toxoid (Tt) Di Puskesmas Bungus Tahun 2016. 2016;
 22. Carolina AR, Efendi D, Maria Dyah Kurniasari. Determinant Factor Of Childhood Basic Immunization Compliance During The Covid-19 Pandemic In Jambi City, Jambi Province, Indonesia. *J Nurs Pract*. 2021;5(1):77–88.
 23. Wijayanti N, Triyanta T, Ani N.

- Efektifitas Penyuluhan Kesehatan Sadari Dengan Media Video Terhadap Pengetahuan Pada Remaja Putri Di Smk Muhammadiyah Cawas Klaten. *J Ilmu Kesehat Masy Berk.* 2020;2(1):49.
24. Baso YS. Model Aplikasi Aksara Lontara Berbasis Html Sebagai Salah Satu Solusi Pemertahanan Bahasa Daerah. *J Kata.* 2018;2(1):1.
 25. Kajungu D, Muhoozi M, Stark J, Weibel D, Sturkenboom Mcjm. Vaccines Safety And Maternal Knowledge For Enhanced Maternal Immunization Acceptability In Rural Uganda: A Qualitative Study Approach. *Plos One* [Internet]. 2020;15(12 December):1–17.
 26. Abdi F, Simbar M. The Peer Education Approach In Adolescents. *Iran J Publ Heal.* 2013;42(11):1200–6.
 27. Sluijs EMF VAN, Ekelund PU, Crochemore-Silva I. Europe Pmc Funders Group Physical Activity Behaviours In Adolescence : Current Evidence And Opportunities For Intervention. *Lancet.* 2022;398(10298):429–42.
 28. Aspiawati. Pengaruh Pendidikan Kesehatan Berbasis Media Video Animasi Terhadap Pengetahuan Remaja Tentang Hiv/Aids Di Smk Negeri 2 Makassar [Internet]. Fakultas Kedokteran Dan Ilmu Kesehatan Universitas Islam Negeri Alauddin Makassar 2018. 2018.
 29. Mulyadi MI, Warjiman., Chrisnawati. Efektivitas Pendidikan Kesehatan Dengan Media Video Terhadap Tingkat Pengetahuan Perilaku Hidup Bersih Dan Sehat. *J Keperawatan Stikes Suaka Insa.* 2018;3(2):1–9.
 30. Fajri UN, Sari DN. Faktor-Faktor Yang Mempengaruhi Kejadian Hipertensi Pada Kehamilan Trimester Iii Di Kabupaten Banjarnegara. *J Midwifery Public Heal.* 2019;1(2).
 31. Mulyani S, Shafira NNA, Haris A. Pengetahuan Ibu Tentang Kelengkapan Imunisasi Dasar Pada Bayi. *Jambi Med J “Jurnal Kedokt Dan Kesehatan.”* 2018;6(1):45–55.
 32. Putri A, Kuswandi D, Susilaningsih S. Pengembangan Video Edukasi Kartun Animasi Materi Siklus Air Untuk Memfasilitasi Siswa Sekolah Dasar. *Jktp J Kaji Teknol Pendidik.* 2020;3(4):377–87.
 33. Ampofo AG, Adumatta AD, Owusu E, Awuviry-Newton K. A Cross-Sectional Study Of Barriers To Cervical Cancer Screening Uptake In Ghana: An Application Of The Health Belief Model. *Plos One* [Internet]. 2020;15(4):1–16. Available From: [Http://Dx.Doi.Org/10.1371/Journal.Pone.0231459](http://dx.doi.org/10.1371/journal.pone.0231459)
 34. Ulfa HI, Falahiyah R, Singgih S. Uji Osmosis Pada Kentang Dan Wortel Menggunakan Larutan Nacl. *Sainsmat J Ilm Ilmu Pengetah Alam.* 2020;9(2):110.
 35. Kurniawan MP. Pembuatan Film Animasi 2d Menggunakan Metode Frame. *J Ilm Dasi.* 2013;14(04):10–3.

Original Article

The Impact of Organochlorine Pesticides (OCPs) on Environment Health

Saiful Jamal^{1*}, Indang Dewata¹, Abdul Razak¹, Nurhasan Syah¹

¹Master of Environmental Science, Postgraduate, Universitas Negeri Padang, Indonesia

(Correspondence author email, farajanail@gmail.com)

ABSTRACT

Pesticides are toxic chemicals used mainly in agriculture to control pests and increase production. The use of pesticides is increasing with the development of special agricultural areas in the Nagari Sungai Nanam Solok district. Organochlorine pesticides are still used to control diseases on agricultural land, while the use of organochlorine pesticides has been prohibited due to the persistent effects they produce. The research aims to look at the potential environmental impacts caused by the use of specialized organochlorines on public water resources that are vital to daily life. The study used random purposive sampling techniques to determine respondents' characteristics and the water sources used. This study's respondents comprised 85 people obtained from the village group in the Nagari Sungai Nanam district of Solok. In contrast, the water samples were obtained from Galian wells and Pamsimas facilities. The results of the study showed that the level of risk of 8 (eight) means used by society could be determined by using the IKL form: there are two means (25%) at the high-risk level, three means (37.5%) at the medium-risk level, and three means (37.5%) at the low-risk level. As a result of the water sample testing, eight sampling sites found a concentration of lindane that exceeded the threshold of 0.45 ug/L lindane in the sample L.2771 (a water well in Jorong Pasa) and 0.62 ug/LL in the L.2775 sample (well water in Jorong Taratak Pauh). This condition describes the potential for higher pollution of wells due to organochlorine-like pesticides or other types that can harm health and the environment. The high use of pesticides, if not limited, will be a danger in the future for the surrounding community, which can lead to death, so an in-depth study is needed regarding the effect of pesticide use on the health conditions of the community and its environment.

Keywords: *Pesticide, Organochlorine, Environment*

<https://doi.org/10.33860/jik.v17i2.2601>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Pesticides are generally defined as toxic chemicals used to control intruders that harm human interests. The use of pesticides in agriculture provides benefits in increasing production. Today, pesticides are an indispensable tool, especially in protecting plants and crop products from losses caused by various pests and diseases. Even some farmers have a paradigm towards pesticides as a "savior god," which is very vital. This belief tends to increase the use of pesticides from time to time. Pesticides consist of various types, including insecticides, herbicides, fungicides, rodenticides, and fumigants¹.

Pesticides, especially insecticides, are divided into several groups based on their chemical properties: organochlorines, organophosphates, carbamates, and pyrethroids. One of the pesticides commonly used in Indonesia is the organochlorine group. Several organochlorine pesticides belong to this group of persistent organic pollutants (POPs), which are being questioned worldwide due to their chronic, persistent, and bioaccumulative nature. Organochlorine pesticides are persistent pesticides, namely DDT, Aldrin, Dieldrin, Endrin, Chlordane, Hexachlorobenzene, Mirex, Toxaphene, and Heptachlor². In general, organochlorines are used as a spray. After spraying, organochlorines can be in the air and

soil environment³. Based on the phenotype and plant species density, an average of 35-50% of the pesticide is estimated to be deposited on the soil immediately after spraying through direct use. Meanwhile, the leaching process due to rain or precipitation can cause organochlorine pesticides to enter the aquatic environment⁴.

According to research by Rahardrian (2016), the Citarum River, as one of the watersheds in West Java Province, often receives water runoff from human activities, including agriculture. Several studies have shown that organochlorines are still detectable in the water and sediments of the Citarum River, including Organochlorine residues detected in water, sediment, fish, and liver are linden, aldrin, heptachlor, dieldrin, DDT, and endosulfan³—pesticide residues in the environment risk impacting health and the environment itself. Based on research conducted by Noerdin (2015) at the Bandung Plantation Center, the results showed that pesticide residues were still present in both samples, namely river water and well water. The pesticide residues observed corresponded to the active ingredients of the pesticides used by the farmers, namely cypermethrin for the Lembang plantation area, abamectin for the Ciwidey plantation area, and chlorothalonil for the Pangalengan plantation area⁵.

Accumulating pesticides at a certain threshold can cause adverse effects on the body; among others, brain disorders, tumors, and cancer, even in pregnant women, can cause congenital disabilities. If the exposed pesticides are mostly heavy metals, they can interfere with the nervous system. Data from the Department of Fisheries and Food of Solok Regency in 2017 stated that there were pesticide residues in several agricultural products in Lembah Gumanti District, the profenofos type (22.122 mg/kg) in the red chili sample and the methidathion type (0.063 mg/kg) in the green chili sample. In Rizki's research results, it is known that the levels of pesticide residues in spinach vegetables in Maharatu Village are relatively high, where out of 18 samples tested, only seven samples were below the pesticide residue threshold, namely <0.1 mg/kg, two samples were not detected and nine samples above the pesticide residue threshold, namely > 0.1 mg/kg⁶.

Solok Regency is one of the main production centers for horticulture, especially for vegetable commodities, which has quite

basic problems related to the use of pesticides in eradicating plant pests. It is no longer a secret that all farmers are now dependent on using pesticides to cultivate vegetable crops. Using pesticides that comply with applicable regulations and regulations will not be harmful to consumers or farmers. However, many farmers now need to follow the rules for using pesticides, which will negatively affect consumers and their farmers.

Based on several research results shows that the use of pesticides has an impact on the health of farmers, consumers, and also the environment. Seeing the high potential for agricultural development in Lembah Gumanti District, especially in Nagari Sungai Nanam, will potentially increase the negative impact on public health and the environment due to the many pesticides farmers use. This study aims to assess the impact on the environment and public health caused by using organochlorine-type pesticides in Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency.

METHOD

This research took place in Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency, and was carried out from October to December 2022. Data collection techniques were filling out a questionnaire instrument to obtain primary data on measuring levels of organochlorine pesticide contaminants in community water sources in Nagari Sungai Nanam using a form IKL. The IKL (Environmental Health Inspection) was observed from 85 respondents in Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency.

The sampling method used is random purposive sampling to see the level of risk of contamination of community water sources; where in this study, there were 5 (five) dug wells and 3 (three) piping facilities sourced from Pamsimas, each facility taken 2 liters for testing, and observing organochlorine contaminants in the Laboratorium Kesehatan Daerah Provinsi Sumatera Barat. In this study, Testing for organochlorine presence used the parameters BHC, op-DDT, pp-DDT Aldrin, Lindane, and Endrin. Samples were examined at the Laboratorium Kesehatan Daerah Provinsi Sumatera Barat with the specification method SNI.06.6990.1-2004. Pollution risk level categories with observations using the IKL

form are grouped based on the following:

- a. Very high: If the answer is "Yes" > 75%
- b. High: If the answer is "Yes," 51% - 75%
- c. Currently: If the answer is "Yes," 25% - 50%
- d. Low: If the answer is "Yes" < 25%

Data analysis was carried out in a qualitative descriptive manner which was interpreted in the form of sentences, tables, and numbers, which were obtained from the results of processing and testing samples through the Laboratorium Kesehatan Daerah Provinsi Sumatera Barat.

RESULTS

Table 1. Organochlorine Distribution in Nagari Sungai Nanam Community Water.

No	Parameter	Result								Unit	Method
		L.2768	L.2769	L.2770	L.2771	L.2772	L.2773	L.2774	L.2775		
1.	BHC	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	ug/L	SNI.06.6990.1 - 2004
2.	op – DDT	<0,20	<0,25	<0,20	<0,20	<0,25	<0,20	<0,25	<0,20	ug/L	SNI.06.6990.1 - 2004
3.	pp – DDT	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	ug/L	SNI.06.6990.1 - 2004
4.	Aldrin	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	ug/L	SNI.06.6990.1 - 2004
5.	Lindane	<0,15	<0,15	<0,15	0,45	<0,15	<0,15	<0,15	0,62	ug/L	SNI.06.6990.1 - 2004
6.	Endrin	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	ug/L	SNI.06.6990.1 - 2004

Sources: UPTD Laboratory of Office Health of West Sumatera Province, 2022

Sampling:

L. 2768 : Pamsimas Water in Jorong Lekok
 L. 2769 : Pamsimas Water in Jorong Limpur
 L. 2770 : Well Water in Jorong Limpur
 L. 2771 : Well Water in Jorong Pasa

The results of measuring the risk level of facilities using the IKL form for 8 (eight) facilities used by the community obtained: High-risk level there are two facilities (25%), moderate risk level 3 facilities (37.5%) and low-risk level 3 facilities (37.5%). And then, water sampling is carried out to support the results of observing the level of risk of pollution to community water sources.

L. 2772 : Pamsimas Water in Jorong Koto
 L. 2773 : Well Water in Jorong Aie Sanam
 L. 2774 : Well Water in Jorong Pakan Sabtu
 L. 2775 : Well Water in Jorong Taratak Pauh

DISCUSSION

Solok Regency has an area of 3,738 km² consisting of 14 districts with 74 Nagari and 414 Jorong. The district with the largest land area is in Lembah Gumanti District, which is located at coordinates 01°57'18" and 01°13'32" South Latitude, 100°44'48" and 100°55'45" East Longitude, with an area of 439 km². The Lembah Gumanti sub-district has four villages: Alahan Panjang, Salimpat, Aie Cold, and Sungai Nanam. Nagari Sungai Nanam has the largest land area, 164.54 km², making it a center for horticultural production with high pesticide-intensity use. This problem is fundamental because the current trend of all farmers is to eradicate pests instantly through pesticides; in addition to making them easier to apply, they are also easy and cheap to get. However, these farmers do not realize that their exposure to pesticides can occur through various activities such as the process of bringing pesticides to agricultural land, the process of mixing pesticides, the process of spraying pesticides on agricultural land, and washing

tools that have been used to spray, all of these activities have the potential to cause exposure to both farmers, through the skin or inhalation⁸.

Pesticides are chemical substances, microorganisms, viruses, and other substances farmers use to protect crops⁹. There are many types of pesticides, but the most commonly used are the organophosphate, carbamate, and pyrethroid groups. Pesticides are categorized using many criteria, including chemical classes, functional groups, modes of action, and toxicity levels¹⁰. Pesticides are categorized based on the specific pests they are designed to target. These classifications encompass fungicides, insecticides, herbicides, and rodenticides. As an illustration, fungicides are employed to eradicate fungi, insecticides are utilized to eliminate insects, and herbicides are employed to eradicate weeds^{11,12}. The use of pesticides in the agricultural environment greatly affects the existence of biota in the soil. In addition to threatening environmental conditions, the continuous use of pesticides also threatens health conditions because of the toxic nature of pesticides. Based on the phenotype and plant

species density, it is estimated that an average of 35-50% of pesticides are deposited on the soil immediately after spraying through direct use, while leaching due to rain or precipitation can cause organochlorine pesticides to enter the aquatic environment⁴.

Based on data on water sources that are used by the community for their daily needs from the Puskesmas Sungai Nanam, Lembah Gumanti District, in 2021, 39.26% of the community has used water from pipes (PDAM, BPSAM, PAMSIMAS) the rest use water from land. Whether in the form of dug wells or pump wells. Meanwhile, based on the results of observations made from 85 respondents, most of them use water sources that come from the Pamsimas program, namely Pamsimas Jorong Lekok, Pamsimas Jorong Lumpur, and Pamsimas Jorong Koto, and only 5 (five) respondents who still use well water. This water source determines the health status of the community; water is a vital need used by the community to meet their daily needs such as cooking, drinking, washing, and bathing. Thus, the need for clean water is the first point that must be considered so that people avoid various diseases. Observation data shows that 80 respondents (94%) have realized the importance of clean water sources to support their daily needs; it is just that there are still five respondents (6%) who still use the potential of dug well water. This condition worries that if the dug well water is contaminated with pesticides, it will certainly be a factor causing disease transmission.

Pesticides have four groups: organophosphates, organochlorines, carbamates, and pyrethroids. In general, organochlorines are used as a spray. After spraying, organochlorines can be in the air and soil environment. Organochlorine Pesticides (OCPs) consist of carbon, chlorine, and hydrogen atoms and are apolar and lipophilic¹³. Organochlorines (OC) are a group of chlorinated compounds widely used as pesticides. These chemicals belong to the class of persistent organic pollutants (POPs) with high persistence in the environment¹⁴. They are harmful to health because they are persistent, not easily decomposed, have chronic effects, and cause bioaccumulation in the food chain¹⁵. This can endanger human health and the environment because these chemicals can cause cancer, allergies, and damage to the nervous system (both central and peripheral) and can

also disrupt the endocrine system causing damage to the reproductive system and the immune system. OCPs have the potential to be introduced into the aquatic ecosystem through multiple pathways, such as runoff originating from non-point sources, the release of industrial and sewerage wastes, and wet or dry deposition. Due to their persistent nature, Organochlorine Pesticides (OCPs) have the potential to undergo transfer into the food chain via water, after that accumulating in aquatic species such as plankton, so entering the food chain¹⁶.

The results of the water sample tests conducted from 8 water sampling locations, lindane concentrations that exceeded the threshold were found to be 0.45 ug/L lindane in sample L.2771 (well water in Jorong Pasa) and 0.62 ug/L in sample L. 2775 (Water well in Jorong Taratak Pauh). Meanwhile, the other parameters are below the threshold. Lindane is a chronological mixture of hexachlorocyclohexane (HCH) whose main component (99%) is the isomer γ -BHC, HCH, and BHC, although isomers are different substances¹⁷. Lindane is used primarily in the treatment of seeds, soil for transplanting tobacco, leaves on fruit trees, nuts, vegetables, and wood¹⁸. Although the levels of lindane detected in the water samples did not exceed the WHO limit, exposure to large amounts of lindane has been reported to have negative effects on the nervous system, with symptoms from headaches and dizziness to convulsions and, more rarely, death¹⁹.

Research Fosu-Mensah (2016) in his research found residues of organochlorine pesticides that were detected in water samples with lindane (0.01–0.03 $\mu\text{g/l}$), alpha-endosulfan (0.01–0.03 $\mu\text{g/l}$), endosulfan-sulfate (0.01–0.04 $\mu\text{g/l}$), dieldrin (0.01–0.03 $\mu\text{g/l}$) and p,p'-DDT (0.01–0.04 $\mu\text{g/l}$). The presence of organochlorine pesticide residues found in water samples in the study area indicates that these chemicals are still being used illegally in some cocoa plantations in Ghana. The same study with a location in a densely populated Jabodetabek area conducted by Shoiful (2015) found that out of a total of 21 OCPs compounds, only a few OCPs compounds were detected in water samples, namely HCH and Lindane with concentrations of each in the range of ND-0.25 ng /L and 0.083 – 0.82 ng/L; meanwhile, interesting results were also found in the Ciliwung river where HCB was detected at a relatively high concentration of 688.28 ng/L²⁰.

Organochlorine pesticide residues in the samples may be attributed to farmers' illegal use of pesticides in the study area or their historic use since organochlorine pesticides are prohibited from agricultural use²¹. On the other condition, the utilization of OCPs within the agricultural sector has yielded an augmentation in crop productivity, leading to a decline in the cost of food grains. Consequently, this has been pivotal in mitigating hunger issues in densely populated nations, principally attributable to reduced food prices²².

The basic characteristics of organochlorine pesticides are high persistence, low polarity, low water solubility, and high-fat solubility¹⁹. Organochlorine pesticides can enter the environment following the use of pesticides, polluted waste dumped in landfills, and discharges from industrial units that synthesize these chemicals. They are volatile and stable; some can attach to soil and air, thus increasing the possibility of high persistence in the environment, and are identified as agents of chronic exposure to animals and humans²³. Thus, the ban on the use of organochlorine pesticides is a real step to stop the chain of disease in the future.

Organochlorines are renowned for their extreme persistence and toxicity. These pesticides cause neurotoxicity, endocrinopathies, and acute and chronic adverse health effects. Therefore, contamination with organochlorine pesticides has a devastating effect on the ecosystem. Farmworkers, their families, and those passing through a pesticide-treated area can all absorb a quantifiable amount of pesticides. Pesticide residues have been detected in the blood plasma of agricultural farm employees. Whether direct or indirect, pesticide exposure causes neuromuscular disorders and stimulates the metabolism of drugs and steroids²⁴. Many organochlorine molecules are neurotoxic and carcinogenic²⁵. Several examples were used to illustrate the perilous nature of organochlorines. The threat posed by endosulfan is extremely alarming. Endosulfan persists for extended periods in the environment and bioaccumulates in plants and animals, leading to contamination of human food²⁵.

CONCLUSION

The high potential for agricultural development in Nagari Sungai Nanam is

directly proportional to the increase in the use of pesticides by farmers with lindane concentrations that exceeded the threshold, namely 0.45 ug/L lindane in samples L.2771 (well water in Jorong Pasa) and 0.62 ug /L in sample L.2775 (well water in Jorong Taratak Pauh). This condition illustrates that the potential for contamination of dug well facilities is higher due to the use of organochlorine-type pesticides or other types that can endanger the health and environment of the people of Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency.

REFERENCE

1. Swacita IBN. Pestisida dan Dampaknya Terhadap Lingkungan. SimdosUnudAcId [Internet]. 2017;5. Available from: https://simdos.unud.ac.id/uploads/file_pendidikan_1_dir/85b4ff189dadfdad360ee6200603c0ad.pdf
2. Suhartono S, Kartini A, Subagio HW, Budiyo, Utari A, Suratman S, et al. Pesticide exposure and thyroid function in elementary school children living in an agricultural area, Brebes District, Indonesia. *Int J Occup Environ Med*. 2018;9(3):137–44.
3. Prananditya R, Oginawati K. Pertanian Hulu Sungai Citarum Identification and Distribution of Organochlorine Pollutant in the Ambient Air of Agricultural Area of Citarum River Upstream. *J Tek Lingkung*. 2016;22(April):73–82.
4. Jayashree R, Vasudevan N. Persistence and distribution of endosulfan under field condition. *Environ Monit Assess*. 2007;131(1–3):475–87.
5. Noerdin D, Hardian A, Herlina H, Astuti W, Pramuditha L. Residu Pestisida pada Air Sungai dan Air Sumur di Sentra Perkebunan Bandung. In: *Seminar Nasional Ilmu Pengetahuan dan Teknologi (IPTEK) Jendral Achmad Yani*. 2015. p. 382–7.
6. Novera Yenita R, Amin B, Jose C. Analisis Kadar Residu Pestisida Organofosfat dan Antioksidan Pada Bayam (*Amaranthus sp*) di Perkebunan Kartama Kecamatan Marpoyan Damai Pekanbaru. *J Ilmu Lingkung*. 2012;6(2):1978–5283.

7. Kiloes AM, Hardiyanto N, Sulsityaningrum A, Anwarudin Syah MJ. Strategi Pengembangan Agribisnis Bawang Merah di Kabupaten Solok (Shallot Agribusiness Development Strategy in Solok Regency). *J Hortik*. 2019 May 17;28(2):269.
8. Pratama DA, Setiani O, Darundiati YH. Studi Literatur: Pengaruh Paparan Pestisida Terhadap Gangguan Kesehatan Petani. *J Ris Kesehat Poltekkes Depkes Bandung*. 2021;13(1):160–71.
9. Ulfa EF. Mahasiswa KKN-T Undip Laksanakan Program “GEMBADA” Melalui Sosialisasi Dampak Pestisida terhadap Kesehatan di Desa Gempol, Klaten – KKN UNIVERSITAS DIPONEGORO [Internet]. 2022 [cited 2023 Jul 19]. Available from: <http://kkn.undip.ac.id/?p=367545>
10. Garcia FP, Ascencio SYC, Oyarzun JCG, Hernandez AC, Alavarado PV. Pesticides: classification, uses and toxicity. Measures of exposure and genotoxic risks. *J Res Environ Sci Toxicol* [Internet]. 2012;1(11):2315–5698.
11. Kim KH, Kabir E, Jahan SA. Exposure to pesticides and the associated human health effects. *Sci Total Environ* [Internet]. 2017;575:525–35.
12. Tudi M, Ruan HD, Wang L, Lyu J, Sadler R, Connell D, et al. Agriculture development, pesticide application and its impact on the environment. *Int J Environ Res Public Health*. 2021;18(3):1–24.
13. Alfiah S. Dikloro Difenil Trikoloetan (DDT). *J Vektora* [Internet]. 2011;III(2):149–56. Available from: <https://media.neliti.com/media/publications/125404-ID-dikloro-difenil-trikoloetan-ddt.pdf>
14. Aktar W, Sengupta D, Chowdhury A. Impact of pesticides use in agriculture: Their benefits and hazards. *Interdiscip Toxicol*. 2009;2(1):1–12.
15. Ihsan T. Dasar Epidemiologi Analisis Host dan Lingkungan Pada Agent Kimia. Vol. 6, *Angewandte Chemie International Edition*. 2020. 274 p.
16. Sarkar SK, Bhattacharya BD, Bhattacharya A, Chatterjee M, Alam A, Satpathy KK, et al. Occurrence, distribution and possible sources of organochlorine pesticide residues in tropical coastal environment of India: An overview. *Environ Int*. 2008;34(7):1062–71.
17. Edward. Bioaccumulation Of Organochlorines Pesticides (Ocp) Compound In Green Mussells (Perna Viridis) In Jakarta Bay. *J Ilmu dan Teknol Kelaut Trop*. 2016;8(1):85–97.
18. Akan J. Organochlorine and Organophosphorus Pesticide Residues in Fish Samples from Lake Chad, Baga, North Eastern Nigeria. *Int J Innov Manag Technol*. 2014;5(2).
19. Fosu-Mensah BY, Okoffo ED, Darko G, Gordon C. Assessment of organochlorine pesticide residues in soils and drinking water sources from cocoa farms in Ghana. *Springerplus* [Internet]. 2016 Dec 1 [cited 2023 Jul 18];5(1):869.
20. Shoiful A, Nugroho R, Fujita H, Honda K. Pestisida Organoklorin dalam Air dari Daerah Jabodetabek: Studi Pada Daerah Padat Penduduk. *J Air Indones*. 2018;8(2).
21. Ashesh A, Singh S, Linthoingambi Devi N, Chandra Yadav I. Organochlorine pesticides in multi-environmental matrices of India: A comprehensive review on characteristics, occurrence, and analytical methods. *Microchem J*. 2022 Jun 1;177:107306.
22. Jayaraj R, Megha P, Sreedev P. Review Article. Organochlorine pesticides, their toxic effects on living organisms and their fate in the environment. *Interdiscip Toxicol*. 2016;9(3–4):90–100.
23. Subramaniam K, Solomon RJ. Organochlorine pesticides BHC and DDE in human blood in and around Madurai, India. *Indian J Clin Biochem*. 2006;21(2):169–72.
24. Kaiser J. Panel Cautiously confirms Low-Dose Effects Does a Climate Clock Get a Noisy Boost ? 2000;290(October).
25. Briz V, Molina-Molina JM, Sánchez-Redondo S, Fernández MF, Grimalt JO, Olea N, et al. Differential estrogenic effects of the persistent organochlorine pesticides dieldrin, endosulfan, and lindane in primary neuronal cultures. *Toxicol Sci*. 2011;120(2):413–27.

Original Article

**Phytochemicals, Nutrient Levels and Antioxidants of Various Types of Sweet Potatoes
(*Ipomoea batatas L.*)**

Nurdin Rahman^{1*}, Nurhanifah Muthmainnah Nurdin¹

¹ Nutrition Study Program, Faculty of Public Health, Tadulako University, Palu, Indonesia

(Correspondence author's: nurdinrahman.untad@gmail.com)

ABSTRACT

This study aims to identify the phytochemical compounds, including flavonoids, tannins, phenols, beta-carotene, anthocyanins, and fiber, as well as the antioxidant capacity of various types of sweet potatoes. Method: The research followed a descriptive observational design with laboratory-based testing. The identification of phytochemical compounds utilized specific reagents. One Way ANOVA was employed to assess the differences in average levels of phytochemicals, nutrients, and antioxidant capacity (IC50) among the different types of sweet potatoes with normally distributed data. The determination of flavonoid, tannin, phenol, beta-carotene, and anthocyanin levels was carried out using UV/Vis Spectrophotometry at specific wavelengths. Crude fiber content was determined using the gravimetric method, while the antioxidant capacity was measured using the DPPH (2,2-Diphenyl-1-Picrylhydrazyl) method. Results: The findings indicated that all types of sweet potatoes contain alkaloids, while some lack steroids. Purple sweet potatoes showed the highest levels of flavonoids, tannins, and phenols at 627.27, 1727.27, and 1507.14 mg/100 g, significantly differing from other types of sweet potatoes ($p = 0.00$). Besides, purple sweet potatoes exhibited the highest anthocyanin content (18.35 mg/100 g) compared to other types, showing a significant difference ($p = 0.00$). Orange sweet potatoes exhibited the highest levels of beta-carotene and fiber, at 15.49 and 5.63 mg/100 g, respectively, although the difference was not statistically significant ($p = 0.83$). The antioxidant capacity (IC50) of purple, orange, white, and yellow sweet potatoes were 45.13, 266.59, 190.01, and 210.73 ppm, respectively. Conclusion: Different varieties of sweet potatoes exhibit variations in phytochemical composition and antioxidant capacity. Purple sweet potatoes are rich in flavonoids, tannins, phenols, and anthocyanins, with significant antioxidant potential. Orange sweet potatoes show high levels of beta-carotene and fiber but have comparable antioxidant activity to white and yellow varieties.

Keywords: *Phytochemical, Sweet Potatoes, Flavonoids, Antioxidant Capacity, Purple Sweet Potatoes.*

<https://doi.org/10.33860/jik.v17i2.2701>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Antioxidants are found in many plants, fruits, vegetables, and herbs. One of the plants that contains many antioxidants is sweet potato (*Ipomoea batatas L.*). Research results from Safari et al. (2019) ¹ showed that purple sweet potato extract has a strong antioxidant with an IC50 value of 41.1 ± 7.3 ppm. Research results from Surya (2017) ², the antioxidant activity of yellow sweet potato was obtained with an IC50 value of $158.6726 \mu\text{g/mL}$.

Sweet potato also has high non-

digestible oligosaccharides (NDOS) carbohydrates (poly- and oligosaccharides [NDOS]) in the host tract. However, it has a beneficial effect on the host because it selectively stimulates the growth of bacteria in the colon to improve host health, so sweet tubers function as prebiotics ³. Nutrients that are abundant in sweet potatoes are water, energy, protein, fat, starch, dietary fiber, glucose, and several vitamins found in sweet potatoes, including vitamin A (found in the form of β -carotene), vitamin B6 (pyridoxine), and vitamin C where these nutrients play an important role

in immunity ^{4,5}. The mineral content in sweet potatoes, such as phosphorus, calcium, iron, and soluble fiber, absorbs excess fat or cholesterol in the blood. These natural fibers are oligosaccharides mainly consisting of raffinose, stachyose, and verbacose ⁶.

This study aimed to identify the phytochemicals present in purple, white, yellow, and orange sweet potatoes as well as quantitative tests (flavonoids, tannins, phenolics, beta-carotene, anthocyanins, crude fiber) and their antioxidant.

METHOD

This type of research was a laboratory test-based descriptive observational research. This research was carried out in September 2021 at the Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Tadulako University.

The tools used were a knife, oven, beaker (250 ml; 500 ml), Erlenmeyer, pipette, digital scale, bowl, baking dish, blender, measuring cup (5 ml; 10 ml; 500 ml), glass stirrer, funnel Buchner, rotary evaporator, spray bottle, petri dish, test tube, tube rack, UV-Vis Spectrophotometer, 5 ml volumetric flask, spatula, and fume hood. The materials used were purple, orange, white, and yellow sweet potatoes, tissue, distilled water, ethanol, aluminum foil, filter paper, concentrated H₂SO₄ solution, metal powder, 5% FeCl₃ solution, Dragendorff, HNO₃, chloroform, acetone anhydride, concentrated HCl, and DPPH solution.

The sweet potato samples were removed from the skin until clean, cut into pieces, then heated in an oven at 50 °C for 3×24 hours. After baking, grind it using a blender to make it into flour/powder. Sweet potato samples (flour) were macerated at a certain ratio with ethanol solvent three times 24 hours. After that, the mixture was filtered to separate the filtrate obtained; then, the solvent was evaporated using a rotary evaporator. The extract obtained was freeze-dried using a freeze-dryer.

The phytochemical screening was the

flavonoid test ⁷, saponin test ⁷, Polyphenol and Tannin Test ⁷, alkaloid test ⁷, and Steroids test ⁷. Then, the quantitative test of phytochemical substances, namely the determination of total flavonoid levels by the colorimetric method, refers to the procedure ^{8,9} with some modifications with quercetin (QE) as standard. Phenol analysis was carried out spectrophotometrically using the Folin-Ciocalteu method ^{10,11}, and as a comparison used, gallic acid. The total phenolic content in the extract was expressed in gallic acid equivalent (GAE). Total Tannin Test with the Folin-Ciocalteu Method. Monomeric anthocyanin analysis refers to the method ¹², on the method used by ¹³. This method was based on the differences in anthocyanin structures at pH 1 and pH 4.5. Determination of beta-carotene levels carried out in this study followed the procedure ¹⁴. Analysis of Antioxidant Activity Power using the DPPH Method.

Quantitative data such as assay results and antioxidant activity tests would be tested for normality first to see whether the data were normally distributed. If the data were normally distributed, use the One Way Anova test if there were differences followed by the Post Hoc test, namely the LSD (Least Significance Different) test, but if the data were not normally distributed, then use the Kruskal Wallis test. This test was a non-parametric test from the one-way ANOVA test, while qualitative data such as phytochemical profiles were analyzed descriptively.

RESULTS

Phytochemical Screening of Various Types of Sweet Potatoes

Table 1 shows that the purple and white sweet potato samples contained flavonoid compounds except for yellow and orange sweet potato. All types of sweet potatoes contain alkaloids. Purple and yellow sweet potatoes contain polyphenol and tannin compounds, saponin compounds are only found in yellow sweet potatoes, and all sweet potatoes do not contain steroid compounds.

Table 1. Results of Phytochemical Screening of Various Types of Sweet Potatoes

Type of Sweet Potato (flesh color)	Phytochemical Substances				
	Flavonoid	Alkaloid	Saponin	Steroid	Polyphenols & Tannin
Purple	+	+	-	-	+

Orange	-	+	-	-	-
White	+	+	-	-	-
Yellow	-	+	+	-	+

Note: (+) contained in the sample, (-) not contained in the sample

Table 2. Results of Phytochemical Levels, Nutrients, and Antioxidant Activities

Types of Sweet Potatoes	Level (mg/100g)					
	Flavonoid	Tannin	Phenolic	Anthocyanin	Beta-caroten	Fiber (%)
Purple	627.27 ± 19.28 ^a	1727.27±77.13 ^a	1507.14±40.41 ^a	18.35±0.46 ^a	15.49±0.39 ^a	5.63 ± 0.11 ^a
Orange	270.45 ± 16.07 ^c	1254.54±12.86 ^b	1089.28±25.25 ^b	11.76±0.34 ^a	402.09±9.06 ^a	5.84 ± 0.05 ^a
White	243.18 ± 3.21 ^c	950.00±32.14 ^c	871.42±101.02 ^c	3.80±0.23 ^a	18.49±0.17 ^a	4.09 ± 0.01 ^a
Yellow	450.00 ± 30.30 ^b	877.25±19.30 ^c	753.57±5.05 ^c	3.33±0.34 ^a	21.31±0.22 ^a	4.34 ± 0.07 ^a
p-value	0.00	0.00	0.01	0.83	0.83	0.83

Note: Different letter notation in the same column indicates a significant difference in the Post Hoc test, and the same letter notation in the same column indicates no significant difference

Table 2 shows differences in flavonoids, tannins, and total phenol ($\alpha < 0.05$). Purple sweet potato contained the highest

flavonoids, tannins, total phenols, and anthocyanins of 627.27, 1727.27, 1507.14, and 18.35 mg/100g, respectively.

Table 3. Results of Antioxidant Power of various types of Sweet Potatoes

Type of Sweet Potatoes	IC ₅₀ (ppm)	Note
Purple	45.13±0.26 ^a	Very strong
Orange	266.59±1.64 ^a	Very weak
White	190.01±1.60 ^a	Weak
Yellow	210.73±1.61 ^a	Very weak
p-value	0.83	

Note: Notation of the same letter in the same column indicates no significant difference

Table 3 shows no significant difference $p = 0.83$ (> 0.05), but the strongest antioxidant power was a purple sweet potato with an IC₅₀ of 45.13 ppm.

DISCUSSION

Qualitative chemical (food) analysis tests aim to identify the types of secondary metabolite compounds using certain reagents which the presence of a precipitate or a change in the color of the solution can mark. Secondary metabolites are chemical compounds that are found in almost all plants. This compound is also an active chemical compound that provides physiological and pharmacological effects for the health sector. The most common compounds found in plants are alkaloids, flavonoids, saponins, tannins, phenols, and steroids¹⁵.

Table 1 shows that after the phytochemical screening on purple, orange, white, and yellow sweet potato extracts, there were flavonoids, alkaloids, saponins, polyphenols, and tannins, but all sweet potato extracts did not contain steroid compounds.

Purple sweet potato contained the highest tannin content, about 1727.27 mg/100 g, and was significantly different from other types of sweet potato $p = 0.00$ (< 0.05); there was a difference in tannin levels between sweet potato groups with $p = 0.000$ (< 0.05). If we compare the tannin content between the two groups, the tannin content of purple sweet potato was significantly different from that of orange sweet potato $p = 0.000$ (< 0.05), white sweet potato $p = 0.000$ (< 0.05), and yellow sweet potato $p = 0.000$ (< 0.05). The orange sweet potato was significantly different from the white sweet potato $p = 0.002$ (< 0.05) and

yellow sweet potato $p = 0.001 (<0.05)$, while the white sweet potato was not significantly different from the yellow sweet potato $p = 0.169 (>0.05)$. The results of this study are not in line with Satiti, (2015)¹⁶, which stated that these four sweet potatoes did not contain tannin active compounds after being tested by Thin Layer Chromatography (TLC). Chronic treatment with tannic acid can reduce blood glucose levels in rats forced into diabetes¹⁷.

Purple sweet potato contained the highest flavonoids, about 627.27 mg/100g, and was significantly different from other types of sweet potato, $p = 0.00 (<0.05)$. When comparing the levels of flavonoids between the two groups, it can be described as follows: purple sweet potato flavonoid levels were significantly different from orange sweet potatoes $p = 0.000 (<0.05)$, white sweet potatoes $p = 0.00 (<0.05)$, and white sweet potatoes yellow creeper $p = 0.001 (<0.05)$. However, orange sweet potato was not significantly different from white sweet potato $p = 0.239 (> 0.05)$, orange sweet potato was significantly different from yellow sweet potato $p = 0.001 (<0.05)$, while white sweet potato was significantly different from yellow sweet potato $p = 0.000 (<0.05)$. Calculating flavonoid levels (mg/100g) in various types of sweet potato extract using the linear regression equation obtained was $y = 0.0227x - 0.0872$ with a correlation coefficient (R) of 0.998. The results of this study are relevant to¹⁸, which states that purple sweet potato contains the highest flavonoid content compared to white, yellow, and orange sweet potatoes. The content of flavonoids in purple sweet potato is 13 times higher than in orange or yellow sweet potato¹⁹.

Purple sweet potato contained the highest phenolic content, namely 1507.14 mg/100 g, and there was a difference in phenolic levels between the sweet potato groups ($p = 0.001 <0.05$). When comparing the phenolic levels between the two groups, it is described as follows: yellow $p = 0.00 (<0.05)$. The orange sweet potato was significantly different from the white sweet potato $p = 0.018 (<0.05)$ and yellow sweet potato $p = 0.004 (<0.05)$, while the white sweet potato was not significantly different from the yellow sweet potato $p = 0.103 (>0.05)$. This is under the research of Teow et al., (2006)²⁰, who stated that those containing the highest phenolics were sweet potatoes with purple flesh and sweet potatoes with white flesh containing the lowest

phenolics, while in this study, yellow sweet potatoes contained the lowest levels of phenolics. The nature of easily oxidized phenol can be the reason for the reduced phenol content in the sample. When the sweet potato sample interacts with air, phenol will easily oxidize. Oxidation results are indicated by a change in color to brown. This oxidation can reduce the total phenol content in sweet potato samples²¹.

The results of the beta-carotene analysis for various types of sweet potatoes can be seen in Table 3. Based on this, it shows that orange sweet potatoes have the highest levels of beta-carotene, namely 402.09 mg/100g, then yellow sweet potatoes at 21.31 mg/100g, then sweet potatoes white sweet potatoes at 18.49 mg/100g, and purple sweet potato has the lowest beta-carotene level, namely 15.49 mg/100g. This seems relevant to the research of Kemal et al. (2013)²², orange sweet potato has the highest beta-carotene content, and purple sweet potato has the lowest beta-carotene content. According to Sabulantika & Ayustaningwarno (2014)²³, the purple sweet potato snack bar mixed with black soybeans contained a higher beta-carotene content than the yellow sweet potato snack bar mixed with black soybeans. Beta-carotene is a provitamin A that gives plants a yellow to orange color and can act as an antioxidant that protects cells from damage caused by free radicals. The content of beta-carotene has the benefit of preventing cancer, various cardiovascular diseases, and cataracts (Rahayu et al., 2012). The use of non-polar n-hexane aims to maximize the beta-carotene extraction process. Beta-carotene is a non-polar compound that will be easily attracted when dissolved in a non-polar solvent. This is based on the principle of like dissolves like, where compounds will dissolve in solvents with similar properties²¹.

The highest anthocyanin content was purple sweet potato, namely 18.35 mg/100 g, while the lowest anthocyanin level was yellow sweet potato, about 3.33 mg/100 g, but not significantly different from other types of sweet potato, $p = 0.83 (> 0.05)$. The anthocyanin content of sweet potato depends on the color intensity of the tuber. The more purple the color of the tubers, the higher the anthocyanin content²⁵. This is following the research of Sabaluntika & Ayustaningwarno, (2014)²³, which states that the anthocyanin content of purple sweet potato is higher than red sweet potato, but yellow sweet potato does not contain

anthocyanin or is relatively small. Purple sweet potato is due to the presence of anthocyanin pigments. The anthocyanin content of purple sweet potatoes is higher than white, yellow, and orange sweet potatoes. This is relevant to the results of Suprpta's research (2016)²⁶ that the anthocyanin content in white sweet potato was 0.06 mg/100 g, yellow sweet potato was 4.56 mg/100 g, and purple sweet potato was 110.51 mg/100 g. The high anthocyanin content in sweet potatoes can provide good benefits for health because it can function as an antioxidant.

Comparison of purple, orange, white, and yellow sweet potatoes was not significantly different ($p = 0.83$) (>0.05) related to fiber content. Orange sweet potato has the highest fiber content (5.84%); after that, purple sweet potato (5.63%), then yellow sweet potato (4.34%), and yellow sweet potato has the lowest crude fiber content (4.09%). The presence of fiber in the ingredients can impact the health of the human body such as preventing coronary heart disease, and colon cancer, lowering cholesterol levels, controlling weight, and facilitating the digestive process²⁷. Fiber can retain water and make a thick liquid in the digestive tract, so there will be a reduction in the absorption of food nutrients in the proximal part. This mechanism causes a decrease in the process (absorption) of amino acids, fatty acids, and other nutrients so that the formation of glucose is also inhibited²⁷.

Based on Table 3 it shows that purple sweet potato has the lowest IC₅₀ (45.13 ppm). This means that purple sweet potato has a very strong antioxidant power compared to other types of sweet potato based on classification²⁸. The lower the IC₅₀ value, the more effective the compound inhibits free radical activity (DPPH) by 50%. Thus the order of the effectiveness of the four types of sweet potatoes in inhibiting free radicals (DPPH) is based on the IC₅₀ value from the most effective in inhibiting to the least effective, such as purple, white, yellow, and orange sweet potatoes.

Antioxidant levels can be affected by the color of the type of sweet potato contained in it. The various colors in all types of plants, especially sweet potatoes, are caused by the presence of flavonoid compounds, especially anthocyanins, which are plant pigments that play an important role after chlorophyll and carotene²⁵. Based on the research results, purple sweet potato has the highest antioxidant

value compared to other sweet potatoes. This shows that the purple pigment in sweet potatoes affects antioxidant power, which means that the darker the color of the tubers, the higher the antioxidant power contained. This is the same as research from Sabulutika & Ayustaningwarno, (2014)²³ that purple sweet potato and black soybean snack bars had the highest antioxidant activity compared to yellow and red sweet potato snacks.

CONCLUSION

All types of sweet potatoes contain alkaloids but do not contain steroids. Purple sweet potato contains flavonoids, alkaloids, and polyphenols/tannins and does not contain saponins and steroids. Orange sweet potato contains alkaloids and does not contain flavonoids, saponins, steroids, and polyphenols/tannins. White sweet potato contains flavonoids, alkaloids and does not contain flavonoids, saponins, steroids, and polyphenols/tannins. Yellow sweet potato contains alkaloids, saponins, and polyphenols/tannins and does not contain flavonoids and steroids. Purple sweet potato contains the highest flavonoids, tannins, phenolics, and anthocyanins at 627.27; 1727.27; 1507.14; 18.35 mg/100 g. However, the anthocyanin levels were not significantly different from other sweet potatoes ($p = 0.083$). Orange sweet potato contains the highest β -carotene and fiber, respectively: 15.49 and 5.63%. The strongest antioxidant power was purple sweet potato extract, with the lowest IC₅₀ of 45.13 ppm, but not significantly different from other sweet potatoes ($p = 0.83$).

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Safari A, Rahayu SD, Fadhlillah M, Saadah, Rachman, Nenden I, et al. Ekstraksi dan Penentuan Aktivitas Antioksidan Ubi Jalar Ungu (*Ipomoea batatas* L). *Al-Kimia: Universitas Padjajaran*. 2019;6 No. 2:46–51.
2. Surya A. Uji Aktivitas Antioksidan pada Ubi Jalar Kuning (*Ipomoea batatas* L.) dengan Metode DPPH (1,1-Difenil-2-Pikrilhidrazil). *Akademi Analis Kesehatan: Pekanbaru*. 2017;

3. Lesmanawati W, Widanarni, Sukenda, Purbiantoro W. Potensi Ekstrak Oligosakarida Ubi Jalar Sebagai Prebiotik Bakteri Probiotik Akuakultur. Institut Pertanian Bogor. 2013;3 (1):16–20.
4. K'osambo LM, Carey EE, Misra AK, Wilkes J, Hagenimana V. Influence of Age, Farming Site, and Boiling on Pro-Vitamin A Content in Sweet Potato (*Ipomoea batatas* (L.) Lam.) Storage Roots. *J Food Tech Afr.* 1999;4(3).
5. Meludu NT. Proximate Analysis of Sweet Potato Toasted Granules. *Afr J Biomed Res.* 2010;13:89–91.
6. Nurdjanah S, Yuliana N. Ubi Jalar Teknologi Produksi Dan Karakteristik Tepung Ubi Jalar Ungu Termodifikasi. 2019;85.
7. Harborne JB. Metode Fitokimia, Penuntun Cara Modern Menganalisis Tumbuhan terjemahan K. Padmawinata dan Soediro, I. Edisi II. Bandung: Institut Pertanian Bogor; 1987.
8. Ahmad A, Waode A. Study of Antioxidant Activity and Determination of phenol and Flavonoid Content of Pepino's Leaf Extract (*Solanum muricatum* Aiton). *International Journal of PharmTech.* 2014;600-606.
9. Chang C, Yang M, Wen Hand CJ. Estimation of Total Flavonoid Content in Propolis by Two Complementary Colorimetric Method. *J Food Drug Anal.* 2002;
10. Mu'nisa A, Wresdiyati T, Kusumorini N, Manalu. Aktivitas Antioksidan Ekstrak Daun Cengkeh. *Jurnal Veteriner.* 2012;13(3):272–7.
11. Nurhayati SK, Harjono. Pengaruh Konsentrasi Natrium Benzoat dan Lama Penyimpanan pada Kadar Fenolat Total Pasta Tomat. *Indonesian Journal of Chemistry Science.* 2012;1(2):158–63.
12. Jie L, Xiao-ding L, Yun Z, Zheng-dong Z, Zhi-ya O, Meng L, et al. Identification and thermal stability of purple-fleshed sweet potato anthocyanins in aqueous solutions with various pH values dan fruit juices. *Food Chemistry.* 2013;136:1429–34.
13. Lee J, Durst W, Wrolstad RE. Determination of total monomeric anthocyanin pigment content of fruit juices, beverages, natural colorants, and wines by the pH differential method. Collaborative study *Journal of AOAC International.* 2005;88:1269–78.
14. Ritter ED, Purcell AE. Carotenoids Analytical Methods. Academic Inc London. 2009;
15. Herbert RB. Biosintesis Metabolit Sekunder. Semarang: IKIP Press; 1995.
16. Satiti W. Uji Aktivitas Antioksidan dan Skrining Fitokimia Ekstrak Metanol Empat Variasi Umbi Jalar (*Ipomoea batatas* (L.) Lam) dengan Metode DPPH (2,2-Diphenyl-1-Picrylhydrazyl) [Skripsi]. [Surakarta]: Program Studi Biologi, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Sebelas Maret; 2015.
17. Babby A, Elanchezhyan C, Suhasini S, Chandirasegaran G. Antihyperglycemic Effect Of Tannic Acid In Streptozotocin Induced Diabetic Rats. *International Journal Current Research.* 2014 Mar;6(03):5386–98.
18. Wang A, Li R, Ren L, Gao X, Zhang Y, Ma Z, et al. A comparative metabolomics study of flavonoids in sweet potato with different flesh colors (*Ipomoea batatas*(L.) Lam. *Food Chemistry.* 2018;260:124–34.
19. Grace MH, Yousef GG, Gustafson SJ, Truong VD, Yencho GC, Lila MA. Phytochemical changes in phenolics, anthocyanins, ascorbic acid, and carotenoids associated with sweetpotato storage and impacts on bioactive properties. *Food Chemistry.* 2014;145 (4):714–24.
20. Teow CC, Truong VD, McFeeters RF, Thompson RL, Pecota K, Craig Yencho G. Antioxidant activities, phenolic and b-carotene contents of sweet potato genotypes with varying flesh colours. *Food Chemistry.* 2006;103 (2007):828–38.
21. Sriarumtias FF. Pengukuran Kadar Betakaroten Dan Fenol Total Buah Pepino Kuning (*Solanum muricatum* Aiton) Pada Tingkat Kematangan Yang Berbeda. *Jurnal Farmako Bahari.* 2016;7 No. 2:12–21.
22. Kemal NN, Karim A, Asmawati,

- Seniwati. Analisis Kandungan B-Karoten Dan Vitamin C Dari Berbagai Varietas Ubi Jalar (*Ipomoea batatas*). Indonesia Chimica Acta, Jurusan Kimia FMIPA, Universitas Hasanudin. 2013;
23. Sabuluntika N, Ayustaningwarno F. Pengaruh variasi pemberian Snack bar ubi jalar kedelai hitam terhadap Kadar uperoksida Dismutase (SOD) darah. *Jurnal Gizi Indonesia*. 2014 Desember;3 Nomor 1:20–5.
24. Rahayu P, Fathonah S, Meddiati F. Daya Terima dan Kandungan Gizi Makanan Berbahan Dasar Ubi Jalar Ungu. *FSCE*. 2012;1(1):2252–6587.
25. Winarno FG. *Kimia Pangan dan Zat Gizi*. Jakarta: Gramedia Pustaka Utama; 2004.
26. Suprpta DN. Aqueous extract of purple sweet potato increased sod-2, and sod-3 expression on human umbilical vein endothelial cells in vitro. *Journal of Biology, Agriculture and Healthcare*. 2016;6 (2):103–10.
27. Muchtadi D, Astawan M, Palupi NS. *Metabolisme Zat Gizi Pangan*. Tangerang: Universitas Terbuka; 2016.
28. Blois MS. Antioxidant determination by the use of stable free radical. *Nature*. 2005;181:1191–200.

Original Article

Evaluation of the Climate Village Program to Improve Environmental Health

Ismike Suci^{1*}, Nurhasan Syah¹, Indang Dewata¹, Iswandi¹

¹Environmental Science Study Program, Graduate School, Padang State University, Padang City, West Sumatera, Indonesia

(Correspondence author's email: ismike.suci@yahoo.com)

ABSTRACT

Climate change has a wide impact on the lives of people who are vulnerable to multidimensional disasters. Government efforts in tackling the impacts of climate change through the climate village program as implemented in Korong Pasa Surau Nagari Guguk, Padang Pariaman Regency. The study intends to measure the degree of success achieved in implementing community-based solutions for adaptation and mitigation in response to the challenges posed by climate change. The current investigation is a qualitative descriptive study conducted between March and April 2023. The participants for this study were recruited using a random chance sampling technique to verify that the selected individuals could adequately represent their respective groups. A cohort of five individuals was engaged as informants. The study's findings suggest evaluating the implementation of the climatic village program (Proklim) in Nagari Guguk Korong Pasa Surau. The assessment was carried out by considering the several elements of the climate village program activities, which encompassed adaptation activities aimed at addressing climate change (74.33%), climate change mitigation actions (17.33%), and an evaluation of the institution's sustainability and support (14.50%). The circumstance above demonstrates that the proklim in Nagari Guguk Korong Pasa Surau falls inside the moderately effective classification. In the future, to increase the success and sustainability of Proklim in the area, multisector support is needed so that Proklim can make its people able to adapt and mitigate climate change and create good environmental health..

Keywords : *Climate Change, Adaptation, Mitigation, Environmental Health*

<https://doi.org/10.33860/jik.v17i2.2803>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Human beings inhabit and engage with the surrounding environment, interacting with its various components¹. From a legal standpoint, the definition of the environment, as outlined in Law No. 32 of 2009 on Environmental Protection and Management (UUPPLH), encompasses the entirety of physical space. This includes all entities, forces, conditions, and organisms, including human beings and their actions, that impact nature, the sustainability of life, and the well-being of both humans and other living organisms².

The environment has a very close relationship with human life. Human dependence on the environment requires humans to know important things that must be

done to protect it through efforts called environmental management. Environmental management is a collaborative endeavor to foster relationships among diverse stakeholders, including governmental entities, the corporate sector, community-based organizations, and local communities. Environmental management plays a crucial role in mitigating environmental issues and preventing potential damage, such as the adverse impacts of climate change³.

Climate change is an event that has a broad impact on people's lives. People are increasingly vulnerable to multidimensional disasters such as floods, landslides, rob or coastal abrasion, drought, hurricanes, and other disasters that occur in the same period or not too long⁴. The Regional Disaster Management

Agency (BPBD) of West Sumatra Province (West Sumatra) recorded that at least 684 natural disasters occurred throughout 2021 in various regions in West Sumatra. Tornadoes and floods dominated the series of disasters due to extreme weather and high rainfall, with 400 events⁵.

The Ministry of Environment and Forestry (KLHK) has adopted a strategy to address climate change by promoting collaboration among multiple stakeholders. This strategy aims to enhance the ability of communities to adapt to and mitigate the impacts of climate change at the local level⁴. Implementing this strategy is facilitated through the Climate Village Programme (Proklim), governed by Minister of Environment Regulation No. 19 of 2012. The Proklim program is implemented at the regional level and has nationwide coverage. The program, known as Proklim, was established by the Ministry of Environment and Forestry (KLHK) to implement environmental management and preservation strategies while also harnessing the potential within the local area. Its primary goal is to mitigate the effects of climate change by empowering local populations to participate in adaptation and mitigation activities actively³. Climate change adaptation efforts encompass various activities to address climate change's impacts. These activities include the management of drought, floods, and landslides, as well as initiatives to enhance food security and control climate-related diseases⁶. On the other hand, climate change mitigation efforts involve waste management, both in solid and liquid forms, promoting renewable energy sources and sustainable agricultural practices. The topic of discussion pertains to the concepts of vegetation cover and fire protection⁷.

While the climate village program has successfully implemented climate change adaptation and mitigation measures, further action is required to address the issue of climate change effectively. According to the findings of Faedlulloh's (2019) study, the adoption of the climate village program has favorable outcomes. Nonetheless, there remains a need for further refinement in the community's efforts to devise adaptation and mitigation initiatives, raising concerns about the potential challenges of addressing the increasingly intricate consequences of climate change⁸. Furthermore, the research conducted by Rifiyanti (2018) demonstrated that the

community's adaptation actions yielded a significant effectiveness rate of 94%, whereas the mitigation activities only achieved a success rate of 49.09%. During of this study, it was seen that disparities in the comprehension of mitigation between the community and the government had an impact on the efficacy of the program. Nevertheless, when considering the program, the climate village initiative demonstrates a significant reduction in the likelihood of adverse climate change consequences, amounting to a 71.55% decrease⁹.

The efficacy of a program is inherently intertwined with the active engagement and collaboration of various community constituents, stakeholders, and private entities, all of whom contribute collectively to the smooth operation and desired outcomes of the program. The success of the initiatives above can be observed through their effective implementation of sustainable programs, exemplified by the accomplishments of Jorong Rejosari Nagari Tiumang in Tiumang District, Dharmasraya Regency, and Jorong Batu Kadurang Nagari Andaleh in Batipuh District, Tanah Datar Regency. These commendable efforts were recognized with the esteemed Proklim 2022 award. This specific Jorong is internationally acknowledged for its effective implementation of climate change adaptation and mitigation techniques sustainably. To limit the potential negative impacts of climate change, it is crucial to strategically leverage the opportunities that arise from it and adequately address the ensuing consequences.

Padang Pariaman Regency proposed a Proklim location in Korong Pasa Surau Nagari Guguak. The reason for appointing the area is because the village is still very beautiful, and many green open spaces can be a staple of crops that produce and have economic value, such as vegetables. So, with Proklim the village can strive for greening in addition to community empowerment which aims to increase awareness of the rate of climate change and add aesthetic value so that the village looks more beautiful, beautiful, and beautiful¹⁰. Proklim will be successful if the community sustainably implements the principles that have been proclaimed in the Road Map of the Climate Village Program. To measure the level of proklim implementation that has been implemented in Padang Pariaman Regency, an evaluation is needed to measure and describe

the development of the implementation of the climate village program to improve environmental health for the future. So that it can be taken into consideration in making a policy and applying the concepts contained in the Road Map of the Climate Village Program.

METHOD

The present study adopts a qualitative research approach. The study was carried out from March to April 2023 in the locality of Korong Pasa Surau Nagari Guguak. The dataset utilized in this research comprises both secondary and primary data sources. Secondary data is acquired through relevant organizations and other sources of written information, such as books and journals, as mentioned in the preceding discourse. On the other hand, primary data is acquired through observation, interviews, and gathering relevant documents. The research methodology involved conducting interviews and administering questionnaires to selected resource persons possessing the expertise and knowledge to represent their respective groups effectively. This approach followed the Regulation of the Director General of Climate Change Control No guidelines. P.1/PPPI/SET/Kum.1/2/2017 provides specific instructions for implementing the Climate Village Programme.

Interviews with selected informants for in-depth interviews about the implementation process. The informants in this study were recruited by the random probability sample method. A total of five informants were included, namely the wali Nagari guguak, bundo kanduang, head of korong pasa surau, head of disaster preparedness group, and head of the proklim holder. The researchers employed source triangulation techniques to assess the validity of the data in this study. Using the source triangulation method in qualitative research entails examining and

validating data from several sources and at various time intervals. The primary objective is to evaluate and establish the reliability and credibility of the collected data¹¹.

Data analysis involves a qualitative descriptive approach, wherein the data is organized into categories, described in units, and analyzed to identify significant findings. The results are then presented in sentences, tables, and numbers, focusing on addressing the research problem. This facilitates clear comprehension and enables the drawing of conclusions.

RESULTS

The issue of climate change, which is widely recognized as a significant worldwide concern, is currently ascribed to the adverse effects imposed on the environment. The conservation of the ecosystem requires the use of adaptation and mitigation methods. Implementing the climate village program is a strategic approach to bolster community involvement and strengthen diverse stakeholders' ability to effectively address climate change's impacts. Moreover, this program's primary objective is to effectively decrease greenhouse gas release into the atmosphere. It also seeks to recognize and appreciate the efforts made to alleviate and adjust to the impacts of climate change. Ultimately, the program intends to enhance the overall welfare of society¹².

The components assessed in Proklim are adaptation, mitigation, community institutional activities, and sustainability support. An initial evaluation will be conducted as part of the assessment process to identify climate villages and climate village program categories according to the criteria to be used. The pro-climate assessment of Nagari Guguk Korong Pasa Surau is presented in Table 1.

Table 1. Performance of the Climate Village Program (Proklim) Nagari Guguk Korong Pasa

No.	Component of Proklim Village	Component that relevant		Proklim Value
		Total	Maximum	
1.	Adaptation	15	120	74,33
2.	Mitigation	6	48	17,33
3.	Institutionalization and Sustainability Support	46	46	14,50
Percentage of Final Proklim Score				45,35%

The achievement of 74.33% was acquired based on observations and the results of completing

the Nagari Guguk Korong Pasa Surau pro-climate evaluation questionnaire, indicating the

effectiveness of the community's adaptation activities. Nevertheless, mitigation measures resulted in a 17.33% accomplishment rate. Through the course of this study, it was discovered that disparities existed in comprehending the mitigation concept between the community and the government, hence impacting the program's efficacy. However, when considered in its entirety, the climate village program demonstrates a reduction in the likelihood of climate change impacts by 45.35%. The current implementation rate for the climate village program's adaptation to environmental health stands at 17.7%. However, the implementation rate for mitigation measures for environmental health is somewhat lower at 17.33%.

DISCUSSION

Padang Pariaman is a regency in the province of West Sumatra, Indonesia. The district has an area of 1,328.79 km² and a population of 430,626¹³. The district is characterized by the motto "Saiyo Sakato." Parit Malintang serves as the administrative center of Padang Pariaman Regency. According to Government Regulation (PP) no 79 of 2008, issued on December 30, 2008, there is a provision for the relocation of the capital city of Padang Pariaman district from Pariaman city to Nagari Parit Malintang in Kecamatan Enam Lingsung. The geographical coordinates of Padang Pariaman Regency are between 0°11'-0°49' South latitude and 98° 36' - 100° 28' East longitude. The regency spans an approximate area of 1,328.79 km², with a length of 60.50 km². The land area of the region in question corresponds to approximately 3.15% of the total land area of West Sumatra Province.¹⁴

The topography of Padang Pariaman Regency includes a large tropical climate with a very short dry season, and sea breezes strongly influence the ocean area. The hottest temperature falls in May, while the lowest is in September. Judging from the region's topography, Padang Pariaman Regency consists of the mainland area of Sumatra Island and 6 small islands, with 40% of the lowlands in the western part leading to the coast. The lowland area is located in the west along the coast with an altitude between 0-10 meters above sea level,

and 60% of the eastern area is an undulating area located in the east with an altitude of 10-1000 meters above sea level.

Padang Pariaman Regency Government chose Korong Pasa Surau as the location of pro-climate activities to improve community food security and reduce GHG emissions. This adaptation mitigation action for reforestation is associated with activity and reforestation programs. Because this hamlet is still quite beautiful and has many green places that can be planted with vegetables and other economically valuable products. So that the community can be empowered through Proklim to green the area, increase awareness of the rate of climate change and beautify the environment.

Implementing Environmental Health within the worldwide threat of climate change is undertaken to safeguard public health and the environment from the adverse effects of climate change on health. This is achieved through the implementation of climate change mitigation and adaptation programs. Mitigation measures are implemented to decrease greenhouse gas emissions, carbon sequestration, and carbon reserve storage to address the consequences of climate change. Climate change adaptation strategies are implemented to enhance the capacity to adapt by mitigating potential adverse effects and capitalizing on the advantageous effects of climate change to safeguard public health.

Implementing measures to reduce and adapt to climate change is carried out within the context of completing the health sector's assigned responsibility in achieving the Nationally Determined Contribution, as required by legislative regulations. Furthermore, the central aim of the proklim initiative is to promote active participation of the community in solving a wide range of issues, thereby strengthening their capacity to mitigate the impacts of climate change and reduce greenhouse gas emissions.

The Climate Village Programme, commonly referred to as Proklim, seeks to facilitate community involvement to strengthen the adaptive capacity of communities, particularly at the grassroots level, in response to climate change's impacts and to limit greenhouse gas emissions. Proklim also provides recognition to commend efforts in climate change adaptation and mitigation following regional conditions. The term

"climate village" denotes a particular geographic region situated at the lowest level of administrative division, commonly covering a neighborhood or small settlement and extending up to the sub-district or village level. The phenomenon is distinguished by the persistent efforts of the community to adjust to and alleviate the consequences of climate change. The definition adheres to the guidelines in the paper by the Director General of Climate Change Control, especially Regulation Number P.1/PPI/SET/KUM.1/2/2017.

The execution of problem-based activities is conducted by a meticulously devised plan aimed at attaining certain objectives. The success of an activity is contingent upon the completion of all set objectives by established rules. This study examines the implementation of the climate village flagship program based on three indicators outlined in the Regulation of the Minister of Environment and Forestry Number P.84/MENLHK-SETJEN/KUM.1/11/2016, which are: (1) adaptation, (2) mitigation, and (3) community support.

Additionally, the discipline of environmental health significantly contributes to the overall welfare of individuals. A favorable environment facilitates the generation of valuable resources, while an unfavorable environment promotes the spread of many diseases. Environmental health is a comprehensive endeavor to mitigate diseases and health issues from various environmental risk factors. Its primary objective is to achieve optimal environmental quality by addressing the environment's physical, chemical, biological, and social dimensions. The Minister of Environment and Forestry offers a set of indicators that can be utilized to evaluate the state of environmental well-being. The need for regulatory measures. According to the document labeled P.84/MENLHK-SETJEN/KUM.1/11/2016, the key factors for effective disease prevention and control include vector control, sanitation practices, access to clean water, and the adoption of a clean and healthy lifestyle known as PHBS.

Evaluation of the Implementation of Climate Change Adaptation to Environmental Health

Climate change adaptation refers to the deliberate actions taken to enhance the capacity to cope with the impacts of climate change,

encompassing both variations in climate patterns and extreme weather events. The primary objective of such efforts is to minimize the potential harm caused by climate change, capitalize on the opportunities it presents, and effectively address the challenges arising from it.

Adapting to climate change in human cultures includes both reactive responses to climate-related events that have already occurred, as well as proactive measures involving prediction and preparation for anticipated future changes. This holds special significance in instances of discernible early signs of climate change¹⁵. Societal self-preservation is deliberate efforts to mitigate the adverse outcomes of a society's activities. It necessitates critically evaluating and interrogating the prevailing norms and practices to effect essential transformations¹⁶. In this context, adaptation pertains to a significant and comprehensive alteration in response to environmental circumstances. It involves making adjustments that preserve or enhance the system's sustainability¹⁷.

The optimal functioning of social, ecological, and institutional systems is crucial for human societies to adapt to climate change successfully. This process involves diverse human endeavors to boost well-being and improve the overall quality of life.

The present analysis revealed that the community's level of achievement in adjusting to pro-climate measures was 74.33%. The situation above aligns with the findings of Sudarwanto's (2021) study, which revealed that the climate change adaptation achievement in Poleonro Village falls into the moderately effective category, with a recorded value of 70.12%. The Poleonro Village community has undertaken various climate change adaptation initiatives in response to the need for various activity efforts to adapt to climate change¹⁸. Rifyanti (2018), in her research, also found a very high achievement in the adaptation efforts of the Nglegi Village Community, Patuk District, Gunungkidul Regency, to climate change, namely 94%⁹. Rosnaeni, in her research, describes the implementation of climate change adaptation activities carried out in Bulukumba Regency such as a) on community land, there are infiltration wells and ponds to collect water; b) Farmers use irrigation systems to rice fields; c) Organic and non-organic waste is disposed of in the Waste

Bank¹⁹, while the form of climate change adaptation activities carried out in Nagari Guguk Korong Pasa Surau as follows.

1. Vector control

The Nagari Guguk Korong Pasa Surau community has undertaken several activities to mitigate the proliferation of vectors. These activities include;

- a) Implementing the 3M approach, which involves draining, hoarding, and covering mosquito breeding sites such as bathtubs and gutters in residential areas;
- b) implementing measures to control the breeding of mosquitoes and rats;
- c) enhancing the local environment to prevent the accumulation of stagnant water;
- d) introducing fish into ponds or plant pots to deter vector breeding; and
- e) Establishing a Jumantik Team (Juru Pemantau Jentik) to monitor and address vector-related issues.

Based on the findings about indicators of adaptation efforts in implementing the climate village program on environmental health, the author concludes that the adaptation efforts have proven to be considerably effective in mitigating the prevalence of climate change-induced diseases. Furthermore, the activities undertaken to alleviate the impact of such diseases have been executed with commendable proficiency. The sustainable implementation of the Climate Village Programme could further enhance the effectiveness of this condition.

2. Sanitation and clean water

Activities carried out by the Guguk Korong Pasa Surau community include clean and safe water supply, animal waste disposal, food protection, and clean and safe air. To anticipate the occurrence of water scarcity due to climate change, the Guguk Nagari community has provided clean water, both individually. Individual water supply facilities include dug wells and rainwater harvesting tanks.

The water sector holds significant importance in the formulation of adaptation strategies, particularly in the context of sustaining livelihoods through the use of underground water recharge methods. Additional focus areas encompass water resource management, namely irrigation, water

supply enhancements, and sanitation²⁰. Water harvesting from rainwater and other sources is essential for community and household use²¹.

3. Clean and Healthy Living Behavior (PHBS)

Activities carried out by the Nagari Guguk Korong Pasa Surau community to maintain environmental health are disease control related to climate change. Some activities are still carried out, such as washing hands before and after carrying out activities, using healthy latrines, and using clean water. Activities such as gotong-royong or community service, washing hands with soap, and other behaviors have been implemented to maintain cleanliness and health in the community.

Evaluation of Climate Change Mitigation Implementation on Environmental Health

Climate change mitigation comprises a variety of efforts to reduce the emission of greenhouse gases, serving as a strategy to mitigate the effects of climate change. The enhancement of environmental health in Nagari Guguk is achieved by implementing climate mitigation methods, with a primary emphasis on solid waste management. This encompasses a range of strategies, including implementing waste containerization and collection systems, promoting composting practices, and encouraging 3R (reduce, reuse, recycle) activities. According to the Regulation of the Director General of Climate Change Control Number:

P.1/PPI/SET/KUM.1/2/2017 concerning Guidelines for Implementing the Climate Village Program. The achievement of the mitigation capability of the Nagari Guguk Korong Pasa Surau Community in mitigating climate change is only 17.33%. The amount of accomplishment presented opposes the outcomes of Sudarwanto's (2021) study, which suggests that the endeavors to mitigate climate change in Poleonro Village exhibit a moderate level of effectiveness, as evidenced by a score of 66.06%¹⁸.

Research conducted by Rosnaeni (2020) outlines the form of implementation of mitigation activities carried out by communities in Bulukumba Regency to mitigate climate change through a). creating a Waste Bank to process waste into crafts and fertilizers; b) Increasing vegetation cover/tree planting to make the soil more fertile and make the village greener; c) Reducing pesticides on plants and

using organic fertilizers¹⁹, while in Nagari Guguk Korong Pasa Surau there are no waste management facilities in this area, the community disposes of their waste in the open once collected. Communities where waste is disposed of directly into open spaces, yards, or rivers rather than collected in landfills. For solid waste management, the community utilizes plastic waste to make handicrafts. The crafts made are plastic flowers and plastic bags. However, this activity is only sometimes carried out every time there is free time from the community.

Institutional Evaluation and Proklim Sustainability Support

As per the Regulation of the Minister of Environment and Forestry Number P.84 MENLHK- SETJEN/KUM.1/11/2016 about the Climate Village Programme, the provision of institutional and sustainability support in the execution of said program encompasses community institutions, policy backing, community dynamics, community capacity, government engagement, and the advantages derived from climate change adaptation and mitigation endeavors. The successful implementation of the Climate Village Programme necessitates collaboration with governmental entities, community organizations, and external stakeholders while also emphasizing the importance of substantiating the undertaken initiatives through evidential documentation. The ease of program implementation and the widespread advantages several individuals see are key reasons for advocating this approach. They have the potential to serve as a model for other regions that have yet to adopt the initiatives outlined in the Climate Village Programme. The level of institutional support for proklim sustainability initiatives in Nagari Guguk Korong Pasa Surau is currently at 14.50%. This finding contradicts the research conducted by Sudarwanto (2021), which indicates that sustainability support in Poleonro Village is relatively effective, with a score of 72.77%¹⁸.

The district environmental office provided institutional and sustainability support for implementing the climate village program, as elucidated by the findings from observations and interviews. However, it is important to note that the advantages experienced by the community are significant, particularly in terms of economic and environmental benefits. The

community expresses its aspiration for the widespread implementation of the climate village program, wherein other regional communities collaborate with enterprises to establish environmentally sustainable areas. The implementation of the climate village program is influenced by various elements, one of which is the inclination of individuals to participate, primarily driven by the prospect of receiving immediate personal advantages²². In addition, there are community culture, norms, cooperation attitudes, leadership factors at the local level, and the seriousness of leaders to become community mobilizers²³.

The results of observations of proklim inhibiting factors in Nagari Guguk are the level of community self-sufficiency, namely, there are no residents who contribute funds for proklim sustainability, the funding system is minimal because it does not have independent funds from membership fees, there is no sponsor assistance (external), none or smaller than members' independent fees.

In the event of an external sponsor, it is necessary to record the sponsor's details in the description column. Additionally, it should be noted that there currently needs to be more technological diversity in the realm of adaptation and mitigation of change, specifically about the absence of suitable technology for compost management. To effectively implement the climate village program, the designated area must allocate a sufficient budget through household contributions or independent means to cover the expenses associated with program activities. This is necessary as the financial support provided by the government is limited. Additionally, the program's success is contingent upon the community's awareness, participation, and comprehension of the climate village program.

The extent of collaboration between the government and the public in the climate village program is seen through community engagement. Involvement or participation refers to the active engagement of all parties throughout the various stages of development activities²⁴. However, in this study, the level of community self-reliance in implementing the pro-climate village is low, coupled with the limitations of not yet utilizing technology to adapt-mitigate environmental change. The active involvement of both the community and the government can contribute to mitigating

climate change impacts^{25,26}. The predicted effectiveness of the Climate Village Programme in addressing climate change through adaptation and mitigation measures is expected to be significant in the future.

CONCLUSION

Evaluation of the Implementation of the Climate Village Program (Proklim) in Nagari Guguk Korong Pasa Surau is included in the moderately effective category, there is still a low level of local community self-sufficiency, coupled with limitations in the use of technology in overcoming adaptation-mitigation of environmental change. The success of the Climate Village program cannot be separated from the involvement of all levels of society, stakeholders and the private sector who work hand in hand to support proklim so that it can be sustainable.

REFERENCE

1. Dewata I, Dahnas YH. Toksikologi Lingkungan (Konsep & Aplikatif) [Internet]. 1st ed. Vidyafi I, editor. Vol. 1. Depok: PT. Rajagrafindo Persada; 2021 [cited 2023 Mar 9]. 1–354 p. Available from: http://repository.unp.ac.id/32784/2/IN-DANG_DEWATA_Toksikologi_Lingkungan.pdf
2. Ismelina M, Rahayu F, Susanto AF. Paradigma Relasi Manusia Dan Lingkungan Hidup Berbasis Kearifan Lokal Di Masa Pandemi Covid-19. *Bina Huk Lingkung* [Internet]. 2021 Jul 12 [cited 2023 Mar 9];5(3):483–93. Available from: <https://bhl-jurnal.or.id/index.php/bhl/article/view/bhl.v5n3.6>
3. Ismiartha GR, Santoso RS, Hanani R. Analisis Stakeholders dalam Kegiatan Pengelolaan Sampah Program Kampung Iklim (Proklim) sebagai Upaya Mitigasi Perubahan Iklim Dusun Soka. *J Public Policy Manag Rev* [Internet]. 2021;12(4):1–18. Available from: <https://ejournal3.undip.ac.id/index.php/jppmr/article/view/30591/25219>
4. Ramdani J, Resnawaty R. Kolaborasi Multi Pihak Pada Program Kampung Iklim Di Kabupaten Cilacap. *J Kolaborasi Resolusi Konflik*. 2021;3(2):191.
5. Adams DO. BPBD Sumbar Tanggulangi 684 Bencana Sepanjang 2021 [Internet]. Padang; 2022 [cited 2023 Aug 12]. Available from: <https://sumbarprov.go.id/home/news/21736-bpbd-sumbar-tanggulangi-684-bencana-sepanjang-2021>
6. Albar I, Emilda A, Tray CS, Sugiatmo, Aminah, Haska H. Road Map Program Kampung Iklim (ProKlim) [Internet]. 2017. 2017. 5 p. Available from: <http://jkpl.ppj.unp.ac.id/index.php/JKPL/article/view/5>
7. Oktaviana RF. Analisis Jejaring Aktor Dalam Program Kampung Iklim Kelurahan Bukit Cermin Kota Tanjungpinang. *JIANA (J Ilmu Adm Negara)*. 2021;19(3):73.
8. Faedlulloh D, Irawan B, Prasetyanti R. Program unggulan kampung iklim (proklim) berbasis pemberdayaan masyarakat. *Publisia J Ilmu Adm Publik*. 2019;4(1):28–44.
9. Rifiyanti R, Roychansyah MS. Evaluasi Program Kampung Iklim Dalam Mengurangi Risiko Dampak Perubahan Iklim Desa Nglegi, Kecamatan Patuk, Kabupaten Gunungkidul [Internet]. Universitas Gajah Mada. 2018 [cited 2023 Aug 12]. Available from: <https://etd.repository.ugm.ac.id/penelitian/detail/156848>
10. Ismike S. Analisis implementasi program kampung iklim untuk meningkatkan derajat kesehatan masyarakat di korong pasa surau kabupaten padang pariaman tahun 2018 [Internet]. Universitas Andalas; 2019. Available from: <http://scholar.unand.ac.id/41770/>
11. Sholiha H. Pemanfaatan Aplikasi Plickers Dalam Evaluasi Pembelajaran Ips Di Smp Negeri 1 Dukuhturi Tahun Ajaran 2018/2019 [Internet]. Universitas Negeri Semarang; 2020. Available from: <https://lib.unnes.ac.id/41167/>
12. Sufi W. Assistance for the Climate Village Program in Pekanbaru City. *ETHOS Penelit dan Pengabd Kpd Masy* [Internet]. 2023;11(1):1–9. Available from: <https://repository.unilak.ac.id/2771/1/>

- Assistance for the Climate Village Program in Pekanbaru City.pdf
13. Badan Pusat Statistik Kabupaten Padang Pariaman. Data Jumlah Penduduk Tahun 2019 - 2021 [Internet]. Padang Pariaman; [cited 2023 Aug 12]. Available from: <https://padangpariamankab.bps.go.id/indicator/12/29/1/jumlah-penduduk.html>
 14. Busyra N. KEBANGKITAN PEMERINTAHAN NAGARI (Studi pada Pemerintah Daerah Kabupaten Padang Pariaman) [Internet]. Universitas Muhammadiyah Malang; 2022 [cited 2023 Aug 12]. Available from: <https://eprints.umm.ac.id/86207/>
 15. Smit, Barry B and RJTK. An Anatomy of Adaptation to Climate Change and Variability. *Clim Change* [Internet]. 2000;45:223–51. Available from: <https://link.springer.com/article/10.1023/a:1005661622966>
 16. Bennet JW. The Ecological Transition : Cultural Anthropology and Human Adaptation [Internet]. 1st ed. Vol. 6, *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*. New York: Routledge; 2005. 128 p. Available from: <https://www.taylorfrancis.com/books/mono/10.4324/9781351304726/ecological-transition-john-bennett>
 17. Smithers J, Smit B. Human adaptation to climatic variability and change. *Glob Environ Chang*. 1997;7(2):129–46.
 18. Sudarwanto S, Tjoneng A, Suriyanti S. Efektivitas Pelaksanaan Program Kampung Iklim (Proklam) Di Desa Poleonro Kecamatan Lamuru Kabupaten Bone Provinsi Sulawesi Selatan. *AGROTEK J Ilm Ilmu Pertan*. 2021;4(2):52–64.
 19. Rosnaeni R. Implementasi Program Unggulan Kampung Iklim di Kabupaten Bulukumba [Internet]. Vol. 21. Universitas Muhammadiyah Makassar; 2020. Available from: https://digilibadmin.unismuh.ac.id/upload/16184-Full_Text.pdf
 20. Awuni S, Adarkwah F, Ofori BD, Purwestri RC, Huertas Bernal DC, Hajek M. Managing the challenges of climate change mitigation and adaptation strategies in Ghana. *Heliyon* [Internet]. 2023 May 1 [cited 2023 Aug 12];9(5). Available from: <http://www.cell.com/article/S2405844023026981/fulltext>
 21. Owusu S, Asante R. Rainwater harvesting and primary uses among rural communities in Ghana. *J Water, Sanit Hyg Dev* [Internet]. 2020 Sep 1 [cited 2023 Aug 12];10(3):502–11. Available from: <http://iwaponline.com/washdev/article-pdf/10/3/502/841902/washdev0100502.pdf>
 22. Krisnawansyah Y. Partisipasi Masyarakat Dalam Pengelolaan Sampah Reuse Reduce Recycle Di Kabupaten Solok. *Dialekt Publik* [Internet]. 2019 Mar 5 [cited 2023 Aug 12];3(2):46–53. Available from: <https://ejournal.upbatam.ac.id/index.php/dialektikapublik/article/view/1021>
 23. Mardika PA, Sarwadi A, Pramono RWD. Community Empowerment In Serut Village On Climate Change Adaptation And Mitigation. *J Teknosains* [Internet]. 2018 Dec 28 [cited 2023 Aug 12];6(2):22–2017. Available from: <https://jurnal.ugm.ac.id/teknosains/article/view/37167>
 24. Elhaq, I. H., & Satria, A. (2011). Persepsi pesanggem mengenai hutan mangrove dan partisipasi pesanggem dalam pengelolaan tambak mangrove ramah lingkungan model empang parit. *Sodality: Jurnal Sosiologi Pedesaan*. 2011;5(1):97–103.
 25. Tompkins EL, Eakin H. Managing private and public adaptation to climate change. *Glob Environ Chang* [Internet]. 2012;22(1):3–11. Available from: <http://dx.doi.org/10.1016/j.gloenvcha.2011.09.010>
 26. McNeeley SM. Examining barriers and opportunities for sustainable adaptation to climate change in Interior Alaska. *Clim Change*. 2012;111(3):835–57.

Original Article

Relationship between Side Effects of Anti-tuberculosis Drugs (ATDs) and Adherence to Medication in Elderly Patients with Tuberculosis

Joko Sapto Pramono^{1*}, Riana Sudding¹, Tini¹

¹Politeknik Kesehatan Kemenkes Kalimantan Timur, Samarinda, East Kalimantan, Indonesia

(Correspondence author's email: jokospramono@gmail.com)

ABSTRACT

One of the obstacles to the treatment of tuberculosis (TB) patients is the side effects of anti-tuberculosis drugs (ATDs) which cause patients to be reluctant to continue the medication. The elderly experience various physical and physiological changes in the body system, including susceptibility to drug side effects, decreased knowledge and memory, resulting in non-compliance with taking the medication. This study aims to determine the relationship between ATDs side effects and compliance with taking medication for elderly patients at the Tanjung Selor Health Center, Bulungan Regency, North Kalimantan Province. This study used a quantitative *cross-sectional* approach. The sample was taken by total population, namely elderly tuberculosis patients undergoing tuberculosis treatment as many as 30 respondents. The research instrument was a questionnaire of drug side effects and ATDs compliance. Statistical test used *Fisher's Exact*. The results showed that most patients (76.7%) complained of OAT side effects and the rest without OAT side effects (23.3%). Treatment compliance was 20% compliant, and 80% were non-compliant. *Fisher's Exact* statistical test obtained $p\text{-value} = 0.016 (< \alpha = 0.05)$. It was concluded that there was a significant relationship between OAT side effects and treatment compliance in elderly patients with tuberculosis. Recommendations for health workers to give special attention to elderly patients with medication monitoring and compliance motivation. Future researchers should identify the involvement of family and health workers to monitor the side effects of anti-tuberculosis drugs.

Keywords : Drug Side Effects, Anti-Tuberculosis Drugs (ATDS), Medications Adherence, Elderly People.

<https://doi.org/10.33860/jik.v17i2.2020>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Tuberculosis is a major serious public health problem, and be included in one of the top 10 causes of death worldwide ¹, and is one of the top 10 causes of death worldwide ². Even WHO estimates that the death rate from tuberculosis is twice as high as HIV/AIDS, estimated in 2021 due to to HIV / AIDS as much as 0.47 million ³.

In 2021, the number of people with TB worldwide is estimated to be 10.6 million, an increase of about 600,000 cases compared to 2020. Of these, 6.4 million (60.3%) people have been reported and are receiving treatment and

another 4.2 million (39.7%) are undetected/undiagnosed, at least 6 million adult men and 3.4 million productive women, and the remaining children, 1.2 million cases².

The number of tuberculosis patients in Indonesia in 2021 increased by 12.9% from 2020. Most TB cases were found in the age group of 45 - 54 years (17.5%), followed by the age group of 25 - 34 years (17.1%) and 15 - 24 years (16.9%).⁴. The *Case Detection Rate (CDR)* of tuberculosis in North Kalimantan Province in 2020 was 64% of the 1,607 cases found, while in 2021 it decreased to 33% of people with a cure rate or *Succes Rate (SR)* of 75% and *Drop Out (DO)* in treatment as many

as 226 people (14%), in 2022 there was a decrease in case finding with 338 people with a *Succes Rate* (SR) of 63% there were 67 people who *dropped out*^{4,5}.

The elderly are vulnerable to various infectious diseases such as tuberculosis due to the degeneration process which has an impact on the decline in body system function and immunity⁶. In addition, comorbid factors such as diabetes miletus, which commonly occurs in the elderly, become a risk factor for contracting tuberculosis infection^{7,8}. The number of elderly people with tuberculosis in Bulungan Regency in 2021 was 64 people with an average of 4 people / month. In 2022 at Puskesmas Tanjung Selor from January to June 2022 there were 24 people, the most new positive *pap smear* cases were recorded at Puskesmas Tanjung Selor. Of the total number of patients at Puskesmas Tanjung Selor, no less than 45 people were diagnosed and treated, 24 of them were elderly, the rest were productive age and children⁵.

Anti-Tuberculosis Drugs (OAT) are a combination of drugs consisting of Isonozid (H) Rifampicin (R) Pyrazinamide (Z) and Ethambutol (E) each of which has side effects such as nausea, decreased appetite, abdominal pain, tingling, joint pain, and redness of urine⁹. Some patients complain of itchin, redness of the skin, hearing loss, visual disturbances, balance disorder dan yellowing of the skin¹⁰.

The patients undergoing ATD treatment are susceptible to experiencing side effects, particularly during the initial intensive phase due to daily medication intake¹¹, these side effects may include nausea and red urine, which are associated with rifampicin⁹. Additionally, fatigue, fever, runny nose, and bone pain or ostealgia may arise as side effects of isoniazid^{12,13}. The side effects of the medication are experienced by the patient, even causing the patient to feel apathetic towards the symptom experienced during therapy¹³. In order to ensure compliance with medication ingestion and achieve the optimal treatment outcomes, it is essential to provide monitoring and education regarding the potential adverse effects of ATDs (anti-tuberculosis drugs).¹⁴.

Non-compliance should not exceed 10% as it leads to a higher proportion of relapse in the future due to ineffective tuberculosis control. Therefore, it is crucial to monitor patients' symptom conditions during tuberculosis treatment, especially to prevent patients from non-compliance, which can result

in serious side effects¹⁴.

The preliminary study results from healthcare providers in Tanjung Selor Primary Health Center, Bulungan Regency, indicate the presence of complaints regarding medication side effects, leading to non-compliance among elderly individuals in taking their medication daily. In fact, some elderly individuals have discontinued medication intake due to a lack of understanding regarding the importance of regular medication adherence and managing medication side effects.

The author assumes that elderly individuals, who have specific characteristics such as age, physical changes, physiological changes in the body systems, memory capacity, social and psychological status, are vulnerable to non-adherence in tuberculosis treatment. The presence of side effects from various types of tuberculosis medication increases the risk of medication discontinuation or reluctance to visit the community health center (Puskesmas), requires special attention.

This study aims to analyze the relationship between the side effects of anti-tuberculosis drugs (ATDs) and treatment adherence among elderly patients at the Tanjung Selor Community Health Center in Bulungan Regency.

METHOD

This study used a quantitative correlational design with a cross-sectional approach. The data was collected and conducted at the Tanjung Selor Community Health Center, Bulungan Regency, from September 1st to September 30th 2022. The population of this study consisted of all elderly individuals with tuberculosis who were undergoing tuberculosis medication at the Tanjung Selor Community Health Center, Bulungan Regency. The total sample size was 30 people, selected through a total sampling method.

The research instrument consisted of a questionnaire on medication adherence using the Medication Adherence Rating Scale (MARS), which was adopted from Rob Horne. The MARS-5 comprises 5 items to assess non-adherence (forgetting, changing doses, stopping, deciding to take a lower dose, and taking less medication than prescribed)¹⁵. Meanwhile, the questionnaire on medication side effects utilized the Naranjo algorithm form for Monitoring Adverse Drug Reactions

(MESO), consisting of 10 items.¹⁶.

Univariate analysis was conducted to determine the frequency and percentage distribution of each variable, while bivariate analysis utilized Fisher's Exact test to examine the relationship between the variables of

medication side effects and treatment

RESULTS

Table 1. Characteristics of Respondents (n=30).

Characteristic of Respondents	f	%
Age		
1-60 years old	21	70
1-70 years old	9	30
Gender		
Male	19	63.3
Female	11	36.7
Marital Status		
Married	16	53.3
Widow	4	13.3
Widower	10	33.3
Educational Background		
No Formal Education	11	36.7
Elementary School	6	20
Junior High School	5	16.7
Senior High School	7	23.3
Higher Education	1	3.3
Occupation		
Housewives	9	30
Farmers	8	26.7
Civil Servants (PNS)	6	20
Labourer	4	13.3
Retiree	1	3.3
Self-employed	2	6.7
Time of TB Affliction		
1-12 Months	29	96.7
>12 Months	1	3.3

Table 1 shows the characteristics of the respondents, consisting of 30 respondents aged 51-60 years, with 21 individuals (70%) falling within this age range, while the remaining respondents were above 61 years old. Among the respondents, 19 individuals (63.3%) were male, 11 individuals (36.7%) had no formal

adherence. This research has undergone ethical clearance from the Research Ethics Commission of Health (KEPK) at the Health Polytechnic of the Ministry of Health in East Kalimantan and has obtained the Ethical Clearance Certificate No. LB.02.01/77.1/16170/2022.

education, 9 individuals (30%) worked as housewives, and almost all of them had experienced tuberculosis for a duration of 1-12 months (96.7%). Only one respondent had been suffering from tuberculosis for more than 12 months.

Table 2. Side Effects of Medication and Adherence to Anti-Tuberculosis Medication (n=30)

Side Effects	f	%
Present	23	76.7
Absent	7	23.3
Adherence to Medication		
Non-adherent	24	80
Adherent	6	20

Table 2 demonstrates the side effects of

anti-tuberculosis medication, where 23

respondents (76.7%) reported experiencing side effects, while 7 respondents (23.3%) did not complain of any side effects. The majority of respondents (80%) were identified as non-

adherent in taking the medication, while the remaining 20% were adherent in taking the anti-tuberculosis medication.

Table 3. Relationship between the Side Effects of the Medication and Medication Adherence

ATDs Side Effects	Medication Adherence				Total		<i>p-value</i>
	Non-adherent		Adherent		f	%	
	f	%	f	%			
Present	21	70	2	6,7	23	76,7	0,016*
Absent	3	10	4	13,3	7	23,3	
Total	24	80	6	20	30	100	

Table 3 presents the results of the Fisher's Exact test, yielding a *p*-value of 0.016, which is lower than the significance level $\alpha = 0.05$. This indicates a statistically significant relationship between the side effects of anti-tuberculosis medication (ATDs) and treatment compliance among elderly patients with pulmonary tuberculosis at the Tanjung Selor Health Center, Bulungan Regency.

DISCUSSION

The study findings indicate that tuberculosis mostly affects individuals in the pre-elderly age group, with a higher prevalence among males compared to females. Only a small proportion of individuals have attained high school and higher education, while the majority of elderly patients did not complete their education. On average, elderly individuals suffer from tuberculosis for an extended period, requiring prolonged treatment processes.

Previous studies largely depict the characteristics of tuberculosis patients as predominantly found in the productive age group, predominantly affecting males, those with lower educational attainment, commonly engaged in labor-intensive or unemployed occupations, and having low socioeconomic status.¹⁷⁻¹⁹

The increase in age may influence the dose-response relationship and the occurrence of mild and severe side effects²⁰. The risk of medication side effects is affected by age, as the liver's drug metabolism function declines with advancing age, leading to a higher risk of side effects²¹. In contrast, when individuals are younger, their body systems are more efficient in drug metabolism and controlling various medication side effects²².

Elderly individuals who still live with

their partners will mutually remind each other about their treatment. However, in this study, it was found that among the elderly age group, there were more married individuals who suffered from tuberculosis compared to widowed individuals. The risk factors for tuberculosis transmission include household contact,^{23,24} due to physical proximity, duration of contact, and inadequate preventive behavior²⁵.

Low education is generally associated with a higher prevalence of tuberculosis, as indicated by the findings of this study. The majority of respondents had a basic education, specifically elementary and junior high school, with some even lacking formal education. The lack of formal education serves as a contributing factor to the insufficient understanding and ability of individuals to absorb the importance of tuberculosis treatment¹⁰.

On the other hand, occupational, social, and economic conditions are also parts of the respondents' characteristics. In order to meet their daily needs, patients are also engaged in work and other social activities, which often leads to neglecting their treatment adherence, especially when patients start feeling better. The findings of this study align with the fact that younger individuals are more compliant with medication intake compared to older respondents²⁶. However, this differs from the results of the study conducted by Liang Du et al., which stated that treatment adherence increases with age, possibly because older patients exhibit more socially conscious behavior and have more life experiences and ideologies²⁷, it can be said that there are multiple response characteristics that influence patient adherence to medications.

1. *ATDs Side Effects*

The results of this study illustrate that the side effects of medication are mostly experienced by elderly tuberculosis patients, which generally occur in other tuberculosis patients as stated in previous research. Complaints of medication side effects such as nausea, vomiting, tingling sensation, reddish urine color, decreased appetite, weakness, and bone pain are the expected consequences of drug interactions in tuberculosis patients. However, these effects can be prevented and modified to avoid health problems and treatment program issues^{11,13,28,29}.

The side effects of anti-tuberculosis drugs need to be monitored, and if necessary, multiple alternatives and recommended management of side effects should be employed to ensure the continuity of tuberculosis treatment³⁰. Inappropriate tuberculosis treatment, such as low or high dosage and improper treatment duration, can lead to ineffective treatment outcomes, relapse, and drug resistance in tuberculosis patients³¹. The use of rational drug therapy is defined as meeting the specific needs of patients, including appropriate indications, drug types, dosages, diagnoses, administration methods, timing, and providing patients with accurate information regarding the efficacy of the medication¹².

2. Medication Adherence

The medication adherence variable among the elderly is predominantly non-compliant, indicating that the elderly population differs from other adult groups. Previous research on treatment adherence in tuberculosis patients has shown mixed results, with the majority of studies conducted in the past five years reporting a relatively high level of treatment adherence to tuberculosis³²⁻³⁴.

Patient adherence to medical appointments is a manifestation of the patient's compliance with regular check-up schedules or healthy behaviors, highlighting the significant role of health behavior in treatment adherence³⁵.

The author assumes that age plays a crucial role in medication adherence behavior among tuberculosis patients. This is proven by the fact that the majority of elderly respondents were non-compliant in taking anti-tuberculosis medication, which differs from previous studies that focused on the general population. Education serves as a means for individuals to

acquire knowledge and broaden their insights, thereby influencing patients' level of understanding. Employment supports the family's economy and can encourage patients' awareness of seeking treatment and preventing tuberculosis. In this study, the majority of respondents had a basic education level (elementary and junior high school), and some had no formal education, implying a lack of understanding of treatment and consequently leading to non-adherence. The higher the level of education, the greater the individual's communication skills, facilitating the management of the treatment process.

The level of education and knowledge determine health behaviors, the higher levels of education associated with better health behaviors. The education level of the community influences the overall health status³⁶. Despite the advanced improvement, access to healthcare services does not seem to be aligned with the progress. Meanwhile, elderly patients encounter obstacles in local conditions, a significant proportion of whom face difficulties in accessing healthcare facilities in contrast to adults³⁷.

The statistical analysis results indicate a significant relationship between the side effects of anti-tuberculosis drugs (ATDs) and medication adherence in elderly patients with pulmonary tuberculosis. The relationship between the type of drug, dosage, and frequency of medications and the body's response to the occurrence of mild to severe side effects may vary with age. The probability of drug side effects depends on age, because liver function in drug metabolism decreases with age, leading to an increased risk of various drug-related adverse effects²¹.

On the other hand, in younger individuals, their body systems are still functioning well to metabolize various substances and minimize the occurrence of drug side effects²².

The findings of this study are supported by previous research which states that the more severe the side effects of anti-tuberculosis drugs, the more patients tend to experience fear of swallowing or non-adherence to medication. Conversely, if the side effects of anti-tuberculosis drugs are mild, patients are more likely to be compliant in completing their treatment¹⁰.

The research conducted by Nyorong et al. (2021) reveals that the pharmacological side

effects variable has the most significant value ($p=0.000$)³⁸. Patients and their families should be supported by the Primary Health Center or healthcare professionals who are responsible for implementing the tuberculosis treatment program. This support enables them to oversee the medication adherence of their loved ones and prevent drug withdrawal and resistance. As part of the health education provided by healthcare professionals, they explain the side effects of tuberculosis drugs and encourage patients to continue taking them until they are sufficiently healthy to do so.

Medication adherence is a condition that influences a patient's behavior in making decisions regarding their treatment. The severity of side effects from anti-tuberculosis drugs (ATDs) commonly experienced by tuberculosis patients affects their adherence to treatment, leading to patient reluctance to continue tuberculosis treatment³⁹.

The author assumes that the presence of drug effects is undoubtedly concerning and unpleasant for tuberculosis patients, thus influencing the adherence of individuals with tuberculosis. There may be different levels of severe, moderate, or mild side effects experienced by each elderly patient, which consequently reduces treatment adherence among elderly patients with pulmonary tuberculosis.

The limitations of this study include the possibility of other factors contributing to patient non-compliance, such as family support and the role of healthcare providers. The author did not conduct direct observation, and the data was collected based on questionnaires filled out by the respondents. The number of respondents was only 30 individuals, and it is possible that a larger sample size would yield more varied analysis results.

CONCLUSION

From the results of this study, it can be concluded that there is a significant relationship between the side effects of anti-tuberculosis drugs (ATDs) and medication adherence among the elderly at the Tanjung Selor Community Health Center in Bulungan Regency. This is supported by the Fisher's Exact statistical test, which yielded a p-value of 0.016, lower than $\alpha = 0.005$. It is recommended that healthcare professionals give a special attention to elderly patients undergoing tuberculosis treatment by

monitoring and providing motivation to both the patients and their families. Future researchers are advised to identify the involvement of family members and healthcare providers in monitoring the side effects of anti-tuberculosis drugs.

REFERENCE

1. Cavalhiero AP. Tuberculosis. In: *Hunter's Tropical Medicine and Emerging Infectious Diseases*. Elsevier. 2020.
2. WHO. *Global TB Report 2022*. World Health Organization (WHO); 2022. Retrieved from https://reliefweb.int/report/world/global-tuberculosis-report-2022?psafe_param
3. World Health Organization (WHO). TB Mortality. Published 2019. Retrieved from <https://www.who.int/es/emergencies/diseases/novel-coronavirus-2019/advice-for-public/q-a-coronaviruses#:~:text=sintomas>
4. Kemenkes RI. *Profil Kesehatan Indonesia 2021*. Kementerian Kesehatan RI; 2022. <https://ebooks.gramedia.com/id/buku/profil-kesehatan-indonesia-2021>
5. Dinas Kesehatan Provinsi Kalimantan Utara. Jumlah Kasus Penyakit 2020. Badan Pusat Statistik Kalimantan Utara. Published 2020. Toegang verkry Maart 21, 2023. <https://kaltara.bps.go.id/indicator/30/107/1/jumlah-kasus-penyakit.html>
6. Pramono JS. *Menemukan kasus baru penderita tuberculosis dengan pendekatan investigasi kontak pedoman bagi Kader Kesehatan*. 1st ed. Madza Media; 2022.
7. Caraux-Paz P, Diamantis S, de Wazières B, Gallien S. Tuberculosis in the Elderly. *Journal of Clinical Medicine*. 2021 Dec 15;10(24):5888.
8. Manggasa DD, Suharto DN. Riwayat Pengobatan dan Komorbid Diabetes Mellitus Berhubungan Dengan Kejadian Tuberculosis Resisten Obat. *Poltekita J Ilmu Kesehat*. 2022;15(4):403–408. doi:10.33860/jik.v15i4.659
9. Kemenkes RI. *Permenkes RI No. 67/2016 tentang Penanggulangan*

- Tuberkulosis*. Kemenkes RI; 2017. www.Kemkes.go.id
10. Seniantara IK et al. Pengaruh efek samping obat anti tuberculosis terhadap kepatuhan minum. *J Keperawatan Suaka Insa*. 2018;3(2). doi:10.51143/jksi.v3i2.98
 11. Pramono JS, Noorma N, Gandini AL, Fitriani S. The Effect of Side Effects Tuberculosis Treatment in the Early Stage Towards Compliance with Tuberculosis Patients. *Health Notions*. 2021 Jan 11;5(01):29-32.
 12. Fraga AD, Oktavia N, Mulia RA. Evaluasi Penggunaan Obat Anti Tuberculosis Pasien Baru Tuberculosis Paru Di Puskesmas Oebobo Kupang. *Jurnal Farmagazine*. 2021 Feb 27;8(1):17-24.
 13. Mustaming M. Efek Obat Antituberculosis Fase Intensif dan Konsumsi Purin Terhadap Kadar Asam Urat Pasien Tuberculosis. *The Journal of Muhammadiyah Medical Laboratory Technologist*. 2022 Jun 29;5(1):15-23.
 14. Utukaman KA, Laksmiawati DR, Sumarny R, Tomaso E. Peran Apoteker Terhadap Keberhasilan Pengobatan Tahap Intensif Pasien Tuberculosis. *Poltekita: Jurnal Ilmu Kesehatan*. 2021 Nov 27;15(3):263-73.
 15. Chan AH, Horne R, Hankins M, Chisari C. The medication adherence report scale: a measurement tool for eliciting patients' reports of nonadherence. *British journal of clinical pharmacology*. 2020 Jul;86(7):1281-8.
 16. BPOM. *Farmakovigilans (Keamanan Obat): Panduan Deteksi dan Pelaporan Efek Samping Obat Untuk Tenaga Kesehatan*. (Andyani D et al., eds). Balai Pengawasan Obat dan Makanan (BPOM) Kemenkes RI; 2019.
 17. Fransiska M, Hartati E. Faktor resiko kejadian tuberculosis. *Jurnal Kesehatan*. 2019 Nov 1;10(3).
 18. Sterlikov SA., Galkin VB., Maliev BM., Shirokova AA., Khorotetto VA., Mayzhegishева AS. Impact of Active Case Finding on Treatment Outcomes in Adult Pulmonary Tuberculosis Patients. *Tuberculosis and Lung Diseases*. 2021;99(7):33-40. (In Russ.) <https://doi.org/10.21292/2075-1230-2021-99-7-33-40>
 19. Saunders MJ, Tovar MA, Collier D, Baldwin MR, Montoya R, Valencia TR, Gilman RH, Evans CA. Active and passive case-finding in tuberculosis-affected households in Peru: a 10-year prospective cohort study. *The Lancet Infectious Diseases*. 2019 May 1;19(5):519-28.
 20. Wahyudin E. *Buku Ajar Farmakokinetik*. PT. Nasya Expanding Management; 2020.
 21. An Q, Song W, Liu J, Tao N, Liu Y, Zhang Q, Xu T, Li S, Liu S, Li Y, Yu C. Primary drug-resistance pattern and trend in elderly tuberculosis patients in Shandong, China, from 2004 to 2019. *Infection and Drug Resistance*. 2020 Nov 13:4133-45.
 22. Rochimah SE. *Farmasi Klinik*. Penerbit Deepublish; 2018.
 23. Kemenkes RI. *Petunjuk Teknis Investigasi kontak Pasien TBC bagi Petugas Kesehatan dan Kader*. Dirjen Pencegahan dan Pengendalian Penyakit Menular; 2019.
 24. Velayutham B, Jayabal L, Watson B, Jagadeesan S, Angamuthu D, Rebecca P, Devaleenal B, Nair D, Tripathy S, Selvaraju S. Tuberculosis screening in household contacts of pulmonary tuberculosis patients in an urban setting. *Plos one*. 2020 Oct 15;15(10):e0240594.
 25. Ragonnet R, Trauer JM, Geard N, Scott N, McBryde ES. Profiling Mycobacterium tuberculosis transmission and the resulting disease burden in the five highest tuberculosis burden countries. *BMC medicine*. 2019 Dec;17(1):1-12.
 26. Susilo R, Maftuhah A, Hidayati NR. Kepatuhan Pasien TB Paru Terhadap Penggunaan Obat TB Paru di RSUD Gunung Jati Kota Cirebon Tahun 2017. *Medical Sains: Jurnal Ilmiah Kefarmasian*. 2018 Apr 3;2(2):83-8.
 27. Du L, Chen X, Zhu X, Zhang Y, Wu R, Xu J, Ji H, Zhou L, Lu X. Determinants of medication adherence for pulmonary tuberculosis patients during continuation phase in Dalian, Northeast China. *Patient preference and adherence*. 2020 Jul 7:1119-28.
 28. Anam AK. tuberculosis, efek samping, Ota Keluhan Penderita Tuberculosis

- Tentang Efek Samping Obat Anti Tuberculosis Dan Faktor Yang Mempengaruhinya Di Uptd Kesehatan. *Jurnal Keperawatan Malang*. 2018;3(2):85-93.
29. Asriati A, Kusnan A. Faktor Risiko Efek Samping Obat dan Merasa Sehat Terhadap Ketidapatuhan Pengobatan Penderita Tuberculosis Paru. *Jurnal Kesehatan Perintis*. 2019 Dec 31;6(2):134-9.
 30. Adrian MM, Purnomo EP, Agustiyara A. Implementasi Kebijakan Pemerintah PERMENKES NO 67 Tahun 2016 Dalam Penanggulangan Tuberculosis di Kota Yogyakarta. *Jurnal Kebijakan Kesehatan Indonesia: JKKI*. 2020;9(2):83-8.
 31. Mashidayanti A, Nurlily N, Kartinah N. Faktor Risiko Yang Berpengaruh Pada Kejadian Tuberculosis dengan Multidrug-Resistant Tuberculosis (MDR-TB) di RSUD Ulin Banjarmasin. *Jurnal Pharmascience*. 2020 Oct;7(2):139-48.
 32. Farlinza SV, Lestari F, Choernia R. Studi Kepatuhan Penggunaan Obat Anti Tuberculosis pada Pasien Tuberculosis di Puskesmas Kalibangan Lampung Utara. In *Bandung Conference Series: Pharmacy 2022* Aug 10:1116–1122.
 33. Ambarwati SC, Perwitasari DA. Kepatuhan minum obat anti tuberculosis pasien tuberculosis di beberapa Puskesmas di Kabupaten Sleman , Yogyakarta. *J Farm Klin dan Sains*. 2022;2(April 2020):59–65. doi:10.26753/jfks.v2i1.732
 34. Chebet NA, Kirui J, Otieno G, Sanga D, Wanjau G, Yoos A. Tuberculosis Treatment Adherence among Patients Taking Anti-TB Drugs in Kilifi County, Kenya. *African Journal of Health Sciences*. 2022 Jun 20;35(2):210-23.
 35. Mahwati Y. Kajian naratif: intervensi untuk meningkatkan kepatuhan pengobatan tuberculosis. *Kesmas Indones*. 2022;14(2):213–225.
 36. Pakpahan M, Siregar D, Susilawaty A, Tasnim T, Ramdany R, Manurung EI, Sianturi E, Tomponu MR, Sitanggang YF, Maisyarah M. Promosi kesehatan dan perilaku kesehatan. Yayasan Kita Menulis; 2021.
 37. Bea S, Lee H, Kim JH, Jang SH, Son H, Kwon JW, Shin JY. Adherence and associated factors of treatment regimen in drug-susceptible tuberculosis patients. *Frontiers in pharmacology*. 2021 Mar 15;12:625078.
 38. Nyorong M, Nadapdap TP, Yanthy L. Analysis of Factors Associated with Compliance with Taking Medicines for Pulmonary Tuberculosis Patients at Lut Tawar Health Center, Central Aceh Regency. *Journal of Asian Multicultural Research for Medical and Health Science Study*. 2021 Dec 30;2(4):82-94.
 39. Sutarto S, Fauzi YS, Indriyani R, RW DW, Wibowo A. Efikasi Diri pada Kepatuhan Minum Obat Anti Tuberculosis (OAT). *Jurnal Kesehatan*. 2019 Nov 30;10(3):405-12.

Original Article

Evaluation of the Implementation of the Mining Safety Management System (SMKP) and Safety Culture in the Maintenance Department of PT Bumi Suksesindo

Sukadi¹, Isa Ma'rufi^{2*}, Hairrudin³

¹ Postgraduate Program in Public Health Sciences, Universitas Jember, Jember, Indonesia

² Lecturer of Postgraduate Program in Public Health Science, Universitas Jember, Jember, Indonesia

³ Faculty of Medicine, Universitas Jember, Jember, Indonesia

(Correspondence author's email: isa.marufi.fkm@unej.ac.id)

ABSTRACT

Occupational accidents in Indonesia's Mineral and Coal (Minerba) mining sector are still quite high. In 2022, there were 11 of 93 cases of fatality accidents. Organizational factors that often become the basic cause of accidents are the non-optimal implementation of the work safety management system and the low level of Safety Culture. The mining safety management system (SMKP) has been implemented at PT Bumi Suksesindo, but the number of accidents was still high, namely 16 accidents in the Maintenance department in 2022. This study aims to evaluate the implementation of SMKP and the maturity level of OSH culture (safety culture) in the Maintenance department. This was an evaluation study with a descriptive approach. Data were collected using a questionnaire and document review. The number of samples was 140 of 214 population of field workers. A 5-point Likert scale was applied to analyze workers' perceptions of the implementation of SMKP. The causal factors were analyzed using Incident Cause Analysis Methodology (ICAM), while the evaluation of the Safety Culture level was performed through a frequency distribution based on the 5 levels of OSH culture in accordance with UK CoalJourney, namely Basic, Reactive, Planned, Proactive, Resilient. The implementation rate of the Mining Safety Management System (SMKP) in the Maintenance department of PT Bumi Suksesindo was 67%, which was included in the Good category. However, there were 16 occupational accident cases, and the organizational factor was the most common cause (45 findings). Furthermore, the OSH culture maturity level was 60.5%, included in the Resilient level. It can be concluded that the implementation of SMKP in the Maintenance department was still sub-optimal, and the OSH culture maturity level had not yet covered 100% of workers. Such a finding implies a high number of occupational accidents. It is necessary to supervise the implementation of the SMKP and plan an OSH culture improvement program by involving all workers to achieve the SMKP goal of preventing occupational accidents.

Keywords: SMKP, Minerba, OSH culture, Safety Culture

<https://doi.org/10.33860/jik.v17i2.2307>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Global data released by the International Labor Organization (ILO) revealed that there were 270 million (62.8%) cases of Occupational Accidents and 160 million (37.2%) cases of Occupational Diseases in the world per year, which caused 2.78 million deaths of workers every year ¹. Based on National Social Security Agency for Employment (BPJSTK) data, the number of occupational accidents in Indonesia continues to increase. In 2021, 234,370 occupational

accident cases were recorded, with 6,552 worker deaths, an increase of 5.6% compared to 2020¹. Furthermore, based on the Ministry of Energy and Mineral Resources performance report, there were 93 accidents involving 36 minor injuries, 57 serious injuries, and 11 accidents with fatalities in the Mineral and Coal mining sector (Minerba) in 2022².

One of the efforts to prevent accidents is implementing the Occupational Safety and Health Management System (SMK3). The government issued guidelines for implementing OSH through Regulation of the Minister of

Manpower and Transmigration Number 5 of 1996 concerning SMK3 and Government Regulation Number 50 of 2012 concerning SMK3³. In addition, the Ministry of Energy and Mineral Resources issued Decree of the Director General of Mineral and Coal No. 185k/30/DJB/2019 concerning technical instructions for implementing the Mining Safety Management System (SMKP) in the context of controlling mining safety risks including Mining OSH and Mining Operational Safety^{4,5}.

PT Bumi Suksesindo, a gold mineral mining company in Indonesia, has implemented SMKP and conducts annual internal audits. The internal audit in 2021 achieved conformity of 68% accompanied by a record of 88 occupational accidents. The highest number of accidents occurred in the Maintenance Department by 12 cases, with 4 cases in the injury category for workers. In addition, there were 16 occupational accidents in 2022. According to James Reason in the Reason model on systems safety, accidents are not always caused by individual errors (active errors) but are also found in systemic and broader organizational factors (latent conditions), namely factors within the organization such as the implementation of a management system and the level of maturity of the OSH culture within an organization^{6,7}.

Previous study conducted by Gito Sumarno, et al regarding analysis on the implementation of SMKP at the Plant Support Equipment Department of PT Pama Persada in 2018, it was revealed that the implementation of SMKP reached 88.9%, but the level of OSH culture maturity was only 45% in the low category. Such two achievement values seemed contradictory and indicated that the implementation of SMKP was only of a formal administrative nature. A low level of OSH culture maturity leads to the potential of an increase in the frequency of occupational accidents⁸.

Since the beginning of the implementation of the SMKP at PT Bumi Suksesindo in 2016, there has never been an initial review of the level of OSH culture maturity as mandated in the SMKP planning elements. So, the established OSH program only referred to the analysis of the causes of accidents and general best practices carried out in mining companies in Indonesia.

This study aims to evaluate the

implementation of the mining safety management system (SMKP) and the level of safety culture maturity in the Maintenance department of PT Bumi Suksesindo. The evaluation results are intended to be used as a basis for more targeted OSH program planning to decrease the occupational accident rate.

METHOD

This was an evaluation study with a quantitative descriptive approach. The study was conducted in March -April 2023 at the Maintenance Department of PT Bumi Suksesindo, Banyuwangi Regency, East Java. A sample size of 140 workers was selected using a purposive random sampling technique from a population of 214 field workers, by using the Slovin formula (margin error of 0.05). Primary data were obtained using a questionnaire instrument that had been tested for validity and reliability (0.94), and secondary data were obtained through document review. Univariate data analysis was performed using Microsoft Excel. Description and comparison with theories and or similar research findings were further applied for the results of data analysis.

This study applied a 5 point Likert scale to analyze workers' perception regarding the implementation of SMKP. The causal factors of accidents were analyzed using Incident Cause Analysis Methodology (ICAM), while the evaluation of OSH culture levels applied a frequency distribution based on 5 OSH culture levels according to UK Coal Journey: Basic, Reactive, Planned, Proactive, Resilient.

RESULTS

Table 1 presents the characteristics of 140 respondents. 28.6% of respondents were aged 31-40 years, 77% had been working for 1-5 years, 80.7% had an education level of Senior High School, and 95% had a non-managerial position.

Table 1. Characteristics of Respondents

Characteristic	Number	%
(n=140)		
Age (years)		
<=20	0	0
21-30	40	28.6
31-40	54	38.6
41-50	35	25.0

>51	11	7.9
Education		
Elementary	0	0
JHS	4	2,9
SHS	113	80.7
Diploma/ Bachelor	23	16.4
Years of Service (years)		
<1	0	0
1-5	108	77.1
6-10	27	19,3
>10	5	3.6
Position		
Managerial	7	5
Non-Managerial	133	95

Figure 1 revealed 16 accident cases in the Maintenance Department in 2022, which consisted of 2 near misses, 1 injury, and 13 equipment damage. This figure showed an increase compared to 2021 by 12 accident cases.

Figure 1 revealed 16 accident cases in the Maintenance Department in 2022, which consisted of 2 near misses, 1 injury, and 13 equipment damage. This figure showed an increase compared to 2021 by 12 accident cases.

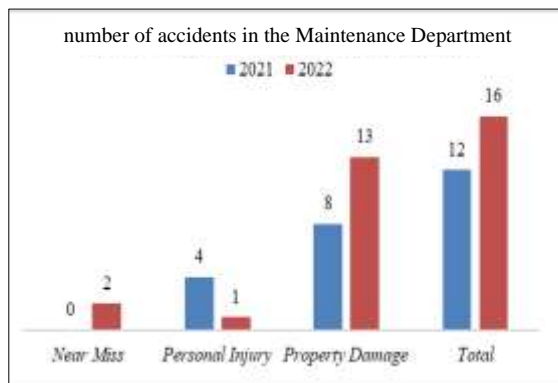


Figure 1. Graph on Accident Cases in 2021 and 2022 in the Maintenance Department
Causal Factors of Accidents

Based on Table 2, analysis of the causal factors of accidents using the Incident Cause Analysis Method (ICAM) identified Absent or Failed Defense by 21 findings, Individual/Team Action by 22 findings, Task/Environmental Conditions by 21 findings, and Organizational Factor became the most common cause of accidents by 45 findings, with the most sub-factors of risk management by 8 findings.

Table 2. Causal Factors of Accidents

Causal Factor	Total
Absent or Failed Defence	21
Detection system/ procedure	1
Protection system/ procedure	5
Guards or barriers	2
Recovery system/ procedure	1
Hazard identification	10
Safe work procedure	2
Individual / Team Action	22
Supervision	2
Operating speed	1
Equipment use	2
Work procedure	4
Safety compliance	1
Training for task	2
Change Management	2
Hazard recognition and perception	7
Work method	1
Task/ Environmental Condition	21
Weather	2
Surface gradient/ conditions	3
Workspace access	1
Housekeeping	1
Tools/ equipment condition/ availability	4
Task planning/ preparation	1
Routine/ nonroutine	1
Abnormal operational	1
Work procedures - availability and suitability	1
Time pressure	1
Peer pressure	1
Confidence level	2
Personality	1
Distraction/ pre-occupation	1
Organizational Factor	45
Training	5
Communication	1
Procedures	7
Maintenance Management	6
Design	5
Risk management	8
Management of change	2
Contractor management	1
Organizational learning	7
Vehicle management	3

Table 3. Perceived Implementation Elements of SMKP

Implementation Sub-Element	Score (n=140)	%
1. Implementation of Operational Management	357	68
2. Implementation of Work Environment Management	370	66
3. Implementation of Occupational Health Management	369	66
4. Implementation of Mining Operational Safety Management	383	70
5. Determination of Design and Engineering Systems	386	69
6. Determination of Purchasing System	369	66
7. Monitoring and Management of Mining Services Companies	383	68
8. Emergency Management	405	64
9. Provision and Preparation of First Aid	369	66
10. Implementation of off-the-job safety	383	68
Mean		67

Information:

0-24.99%: Very Poor
25-49.99%: Poor
50-74.99%: Good
75-100%: Very Good

Table 3 revealed that the highest score of perceived SMKP implementation (70%) was for the sub-element of mining operational safety management, and the lowest score (64%)

was for the sub-element of emergency management. The mean score of workers' perceptions regarding the implementation of SMKP was 67%, categorized as Good.

Table 4. The Level of OSH Culture Maturity in the Maintenance Department

Elements	Basic	Reactive	Planned	Proactive	Resilient
1. Leadership & Accountability	0%	3%	14%	23%	60%
2. Policy and Commitment	0%	2,1%	10%	29%	59%
3. Risk and Change Management	0%	1%	6%	28%	65%
4. Legal Requirements	0%	1%	8%	23%	68%
5. Objectives & Performance Measurement	0%	4%	8%	22%	67%
6. Training, Competence & Awareness	0%	3%	10%	24%	64%
7. Communication & Consultation	0%	1%	7%	32%	60%
8. Control of Documents	0%	2%	4%	38%	56%
9. Operational Control	0%	1%	9%	27%	63%
10. Emergency Procedures	1%	1%	16%	41%	40%
11. Incident Investigation	0%	3%	7%	32%	58%
12. Monitoring, Auditing & Reviews	0%	2%	7%	25%	66%
Average	0%	2%	9,3%	28,2%	60,2%

Table 4 presents the distribution of the level of OSH culture maturity based on the UK Coal Journey model. It was shown that the mean level of OSH culture maturity was 60.2%,

including the Resilient level. The emergency procedures element showed the lowest response score at the Resilient level (40%) and a response at the Basic level (1%).

DISCUSSION

Implementation of SMKP in the Maintenance Department

Based on the characteristics of respondents, the majority (77%) of respondents had been working for 1-5 years. Years of service provide experience to a person and proficiency in completing work faster and more precisely. Based on data derived from the Bureau of Labor Statistics (BLS), most work accidents are experienced by new workers due to lack of experience, not being properly trained or not understanding the applicable OSH policies. BLS data states that almost a third of the total non-fatal work-related injuries or illnesses are experienced by workers with less than one year experience⁹. Workers with long years of service also have the risk of accidents when they are too confident and underestimate existing risks so as to ignore hazard controls. Table shows that the confidence level factor became a causal factor for accidents by 2 times. It is indicated that experienced workers with a high level of confidence tended to ignore the hazard identification process because they thought that they were used to it and assumed they would definitely not make mistakes. Such a finding is in accordance with a study conducted by Sah, (2019) which concluded that one of the basic causes of accidents in industry was workers who took shortcuts, they were too confident and neglected the OSH aspects¹⁰.

Optimal control of hazard factors is very important to prevent the risk of becoming an actual accident. There were 16 accident cases in the Maintenance Department in 2022 which consisted of 2 near misses, 1 injury and 13 equipment damage. Analysis of the causal factors of accidents using the Incident Cause Analysis Method (ICAM) identified Organizational Factor as the most common cause of accidents by 45 findings (Table 2). Three organizational sub-factors that often caused accidents were failure of risk management (8 findings), organizational learning (7 findings), and procedures (7 findings).

Risk management sub-factor is an effort to identify, assess, control, and mitigate hazards. A failure in risk management means placing workers or organizations at higher and unanticipated risk, leading to an accident. Based on the results of the investigation regarding accidents that occurred in the maintenance department, inadequate risk management

factors involved the goals, objectives, scope, and boundaries of risk management activities that were not clearly defined, the level of risk analysis that was not in accordance with actual conditions in the field, and the hazard identification process that did not cover all operations and equipment, inappropriate selection or implementation of risk control measures, and inadequate monitoring of the effectiveness of implemented risk controls. According to Gerry Gibb in the ICAM guidebook (2016), inadequate risk management can lead to risk level of above tolerance limit, inappropriate risk levels and allocation of risk control resources, and incomplete risk lists, that may lead to uncontrolled dangers and consequences which can further increase the incidence of accidents. Findings regarding the organization learning sub-factor in the investigation towards accidents that occurred in the Maintenance department involved failure in implementing and monitoring recommendations from previous similar accident investigation and failure to convey learning points to workers, so that similar accidents might re-occur. This is in accordance with Drupsteen's statement in 2018, that the high number of accidents was due to the failure of organizations to learn from past accidents.

The next sub-factor finding was related to procedures. Identified procedural failures included procedures that were not updated and reviewed after modifications or changes in the field, to create irrelevant work procedures.

Such irrelevant procedures led to certain assumptions among workers that gave rise to a lack of control over hazards, which in the end could become accidents. Periodic evaluation of procedures and monitoring their implementation is very important to perfect things considered vulnerable or can trigger work accidents¹¹. This is in accordance with James Reason's theory in *Managing The Risks Of Organizational Accidents* that latent conditions such as lack of supervision, maintenance failure, and inadequate procedures will defeat accident prevention defenses¹². A study conducted by Nur Azizah (2017) concluded that there was a relationship between work procedures and work accidents. Procedures that were inadequate and not adhered to by workers had the possibility of an increase in the accident rate¹³.

Based on Table 3, the achievement of SMKP implementation in the Maintenance

department was 67% or in the Good category. Such a good category contrasted the 16 accident cases during 2022. Good implementation of SMK3 should be in accordance with its objectives of reducing the number of occupational accidents and diseases⁴.

A previous study conducted by Andy Lay Wirawan and Mega Wati in 2020 concerning the Analysis of the Relationship between SMK3 and the Accident Rate concluded that the implementation of SMK3 positively correlated with the accident rate. Such findings indicated that implementing SMK3, both administratively and in the field, might reduce the number of accidents¹⁴. The current study finding indicated that the implementation of K3 in the Maintenance department was still administrative to meet statutory regulations and had not yet become a value and culture for all elements of management and workers to be practiced in daily work activities. The OSH philosophy states that Safety is a culture, not a program. Therefore, the implementation of OSH should not be just a program run by the company to meet laws or obligations and to obtain awards and certificates, despite becoming a reflection of the culture within the organization¹¹.

The Level of OSH Culture Maturity

The level of OSH culture maturity (safety culture) in the Maintenance department still showed that workers' perception was at the 2 lowest levels, namely Basic and Reactive. The emergency procedure element obtained the lowest level, wherein 1% of workers had the Basic level.

Emergency procedures emphasize detailed plans for managing mining areas' hazards, risks, and accidents. Based on the result of field observations, it was found that the access of several Light Fire Fighting Equipment (APAR) was blocked by materials, resulting in potential delays in response if a fire occurred in the workplace. The Maintenance department appointed 11 worker representatives to become volunteer members of the Voluntary Emergency Response Team. Still, there should be an improvement in the consistency of the appointed workers by participating in the emergency response training program.

Operational activities and the work environment that often change also challenge emergency response. In addition, plans that were too complicated and untested could be

ineffective, thus endangering workers and potentially leading to an emergency situation¹⁵. Leadership support is certainly needed to improve this consistency by allocating special time for training within so many work operational activities.

Emergency management was also the sub-element in implementing SMK3 in the Maintenance department with the lowest score. Such finding confirms a previous study conducted by Dharmayanti and Pramana, (2018), which revealed that the lack of OSH culture and discipline was one of the obstacles to implementing OSH¹⁶.

The Leadership and Accountability elements need more concern because there were still 3% at the Reactive level. Safety leadership and responsibility have a role in achieving the goal of building a safety culture and successful OSH performance¹⁷. A leader's success will depend on his understanding of organizational culture. Leaders are considered successful when their solutions are realized and become values expressed as shared assumptions within the organization. Such assumptions become the organization's identity and character and the culture being hold¹⁸.

Furthermore, the Policy and Commitment element also still obtained a response at the Reactive level (2.2%). This element is closely related to the Leadership and Accountability element because a good and responsible leader will formulate and establish a strict OSH policy. A strict OSH policy must be accompanied by a strong commitment initiated by the leader. The OSH program should ideally start from the top level of the organization (top management) through the formulation of a policy that shows commitment to OSH which is applied in OSH programs that involve all elements of the organization¹¹. A study conducted by Putri and Assidiq, (2022) concluded that one of the factors that inhibited the implementation of OSH system and culture was weak commitment to OSH policy¹⁹.

The Objectives and Performance Assessment element obtained a response of 4% at the Reactive level. Such element is related to planning and setting goals for the implementation of OSH as well as monitoring and assessing OSH performance. Failure in planning and setting goals and inappropriate monitoring can fail to achieve good OSH performance. Benjamin Franklin says, "If you fail to plan, you plan to fail." OSH planning

failure will impact subsequent safety system elements. OSH objectives and performance can be assessed using a combination of lag (output) and lead (input) indicators. Assessment of OSH performance can improve an organization's ability to reduce the risk of accidents. OSH performance information reflects the effectiveness of OSH program implementation. The development of OSH culture is an important element to ensure good OSH performance²⁰.

The Reactive level was further identified for the elements of Training, Competence, and Awareness (3%). In the assessment of SMK P implementation, discrepancies were also found regarding worker competence. Some workers had not obtained appropriate training and certification, for example, welders in the Maintenance department. A person is considered competent if they are adequately qualified, properly trained, and has sufficient experience to perform the assigned tasks correctly and safely^{21,22}. A study conducted by Putri (2022) concluded that there was an effect of training (30.6%) and competence (78%) on worker performance (productivity, reduced levels of errors and accidents)²³.

The analysis results regarding the level of OSH culture maturity in the Maintenance department generally appeared to be almost comparable to the achievement level of SMK P implementation (64% compared to 60.2%). Therefore, improving the OSH culture among workers will certainly positively impact the successful implementation of the OSH management system. The implementation of the OSH management system reflects the OSH culture (safety culture) within the organization, which must become the values adopted and the basis for organizational development²⁴.

OSH culture is not something that can be bought. An organization or company will find it difficult to build an OSH culture without high commitment and priority from the leaders or top management. Commitment and integrity to safety start from management, but management alone cannot drive the entire OSH culture without the commitment of all organizational components. Generally, a strong safety culture is more effective in preventing occupational accidents and injuries²⁴. The importance of OSH culture becomes a concern of the Regulation of the Minister of Manpower number 135 of 2022 concerning National OSH

Month 2023. It set the main theme of "Making Decent Work with an OSH Culture to Support Business Sustainability in Every Workplace"²⁵.

CONCLUSIONS

The implementation rate of the Mining Safety Management System (SMKP) in the Maintenance department of PT Bumi Suksesindo was 67%, which was included in the Good category. Furthermore, the level of OSH culture maturity was 60.2%, which was included in the Resilient level. These two achievements contradicted the still high number of occupational accidents in the Maintenance department. This indicated that the implementation of SMK P was still administrative to meet regulations. In addition, the implementation of OHS programs was still a formality and had not been on target, nor had it become a culture of all workers.

Based on the results of the study and conclusions, recommendations can be delivered to the Maintenance department of PT Bumi Suksesindo to form an internal departmental supervision team for the implementation of SMK P, perform periodic reviews of risk management, especially at extreme and high risks and monitor the effectiveness and suitability in the workplace. Furthermore, PT Bumi Suksesindo needs to carry out an initial study in the form of an assessment of the OSH culture maturity level and KP performance so that the results can be used to plan OHS programs that are more targeted toward the main goal of the prevention of occupational accidents.

ACKNOWLEDGEMENTS

The author would like to sincerely thank the University of Jember for facilitating the permission process and PT Bumi Suksesindo for granting permission to conduct this study.

REFERENCE

1. Kemenaker. Profil Keselamatan dan Kesehatan Kerja Nasional Indonesia Tahun 2022. Jakarta: Kemenaker RI; 2022.
2. ESDM. Tingkat Kecepatan dan Keparahannya Kecelakaan Tambang 2022 [Internet]. 2023 [cited 2023 Apr 20]. Available from: <https://modi.esdm.go.id/kecelakaantam>

- bang
3. PP RI. Nomor 55 Tahun 2012. Penerapan Sistem Manajemen Keselamatan dan Kesehatan Kerja. Jakarta; 2012.
 4. ESDM. Kepdirjen ESDM No. 185.K/30/DJB/2019 Petunjuk Teknis Pelaksanaan Keselamatan Pertambangan dan Pelaksanaan Penilaian dan Pelaporan Sistem Manajemen Keselamatan Pertambangan MINERBA. Jakarta; 2019.
 5. ESDM. Keputusan Menteri Energi dan Sumber Daya Mineral Nomor 1827 Tahun 2018. Pedoman Pelaksanaan Kaidah Pertambangan yang Baik. Jakarta; 2018.
 6. Othman I, Majid R, Mohamad H, Shafiq N, Napih M. Variety of Accident Causes in Construction Industry. MATEC Web Conf. 2018;203:1–9.
 7. Tannya A, Pingkan, Mangare JB. Faktor-Faktor Penghambat Penerapan Sistem Manajemen K3. J Sipil Statik ISSN 2337-6732. 2017;5(4):187–95.
 8. Sumarno G, Winarso A, Fardhan M. Analisis Implementasi Sistem Manajemen Keselamatan Pertambangan Batubara di Plant Support Equipment Departement. Pros Nas Rekayasa Teknol Ind dan Inf XIII Tahun 2018. 2018;51–5.
 9. Safety Sign. Pekerja Baru Rentan Mengalami Kecelakaan Kerja. Safety Sign [Internet]. 2017. Available from: <https://safetysignindonesia.id/pekerja-baru-rentan-mengalami-kecelakaan-kerja-ini-yang-harus-dilakukan-perusahaan/>
 10. Sah DP. Occupational Accidents in Cement Industries of Nepal. J Adv Res Altern Energy, Environ Ecol. 2019;6(3&4):22–8.
 11. Hasibuan A, Purba B, Mahyuddin IM, Sianturi E, Armus R, Gusty Muhammad Chaerul S, et al. Teknik Keselamatan dan Kesehatan Kerja. Cetakan1, November 2020. 2020. 1–240.
 12. Reason J. Managing The Risk of Organizational Accident. New York: Taylor & Francis; 2016.
 13. Azizah N, Setiawan S, Silaban G. Hubungan Antara Pengawasan, Prosedur Kerja Dan Kondisi Fisik Dengan Terjadinya Kecelakaan Kerja Pada Perawat Di Ruang Rawat Inap Rumah Sakit Permata Bunda Medan Tahun 2017. JUMANTIK (Jurnal Ilm Penelit Kesehatan). 2019;4(1):125.
 14. Wirawan AL, Waty M. Kesehatan kerja terhadap tingkat kecelakaan pada proyek. JMITS J Mitra Tek Sipil [Internet]. 2020;3(4):1363–72. Available from: <https://journal.untar.ac.id/index.php/jmits/article/view/8365/6562>
 15. Arsyad M. Modul manajemen penanggulangan bencana pelatihan penanggulangan bencana banjir 2017. Pusat Pendidikan Dan Pelatihan Sumber Daya Air Dan Kontruksi. 2017. 77 p.
 16. Dharmayanti GAPC, Pramana GNPS. Kendala Penerapan Sistem Manajemen Keselamatan dan Kesehatan Kerja (SMK3) pada Kontraktor di Bali. J Tek Sipil. 2020;15(1):12–8.
 17. Sukwika T, Sutrisno G. Kepemimpinan Keselamatan, Komitmen Ahli K3, Akuntabilitas Terhadap Kepuasan Kerja dan Kinerja Keselamatan. J Ecodemica J Ekon Manaj dan Bisnis. 2021;5(2):164–74.
 18. OGP. Shaping safety culture through safety leadership. 2013;(452):32. Available from: www.ogp.org.uk
 19. Putri K, Assidiq FM. Analisis Faktor Penghambat Penerapan Sistem Manajemen K3 Serta Langkah Menciptakan Safety Culture Terhadap PT. Gunanusa SENSISTEK Ris Sains dan Teknol ... [Internet]. 2022;(November):78–83. Available from: <https://journal.unhas.ac.id/index.php/SENSISTEK/article/view/19385%0Ahttps://journal.unhas.ac.id/index.php/SENSISTEK/article/view/19385/7824>
 20. Mohammed G, Naji A, Shahrul A, Isha N, Saleem MS, Ajmal M. The Importance of Safety Culture with Safety Performance Measures. Int J Public Heal Saf. 2023;7(December 2022):2020–2.
 21. Marhavilas PK, Pliaki F, Koulouriotis D. International Management System Standards Related to Occupational

- Safety and Health: An Updated Literature Survey. *Sustain.* 2022;14(20).
22. ISO. International Standard International Standard (ISO) 45001:2018. Switzerland; 2018.
23. Putri SAN, Hidayat W, Jumpakita Pinem R. Pengaruh Pelatihan dan Kompetensi terhadap Kinerja Karyawan Pabrik PT Indonesia Steel Tube Works Semarang. *J Ilmu Adm Bisnis.* 2022;11(3):483–91.
24. Dihartawan D. Budaya Keselamatan (Kajian Kepustakaan). *J Kedokt dan Kesehat.* 2018;14(1):98.
25. Kemenaker RI. Keputusan Menteri Ketenagakerjaan Republik Indonesia Nomor 135 Tahun 2022 [Internet]. Nomr 135 2022. Available from: <https://jdih.kemnaker.go.id/katalog-2261-Keputusan Menaker.html>

Original Article

***Drinking Water Fluor Levels and The Event of Dental Carries
in The Community of Tondo Village Mantikulore District Central Sulawesi***

Sapriana Sapriana¹, Hanum Sasmita^{1*}, Dedi Mahyudin Syam¹

¹ Poltekkes Kemenkes Palu, Palu, Central Sulawesi, Indonesia

(Correspondence author's: hanumsasmita.drg@gmail.com, +62 813-1629-9915)

ABSTRACT

According to WHO, the level of fluorine in water that is safe for consumption is 0.7-1.5 ppm. The Indonesian population's prevalence of problems with teeth and mouth is 25.9%. The average Indonesian population has experienced tooth decay as much as 5 teeth per person. Central Sulawesi is a province with the largest dental health problems, namely 75.3% and only 8.2% has received services from dental medical personnel. This study aimed to know the fluorine level of drinking water and the proportion of dental caries in Tondo Village, Mantikulore District, Palu City, Central Sulawesi. This research is descriptive research. The population in this study were people in Tondo Village, Mantikulore District, Palu City, Central Sulawesi. The sample used in this study were part of the community who consumed groundwater (wells) used for drinking and lived in Tondo Village for about 2 years. There were 20 samples of drinking water, and the respondents who had their drinking water samples were also tested for their teeth. Sampling was done by means of non-random sampling, namely by purposive sampling. The results showed that of the 20 respondents, most of the respondents had very low water fluorine levels (95%). The smallest fluorine level was 0.00 mg / l, the highest was 0.40 mg / l, with a median of 0.20 mg / l. or if categorized most (94.7%) had very low fluorine levels, and all respondents experienced dental caries (100%). It is suggested to the public to brush their teeth regularly at least twice a day, that is, after each meal and go to bed at night with fluorine toothpaste.

Keywords: Dental Caries, Fluoride, Drinking Water

<https://doi.org/10.33860/jik.v17i2.2080>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Fluoride is a micromineral that the body needs in smaller amounts but is still needed. These microminerals help metabolize calcium (Ca) and phosphorus (P), components of the matrix of bones and teeth, and inhibit the formation of tartar. According to WHO, the level of fluorine in water that is safe for consumption is 0.7-1.5 ppm¹. Fluorine is a mandatory parameter related to health.

Consumption of fluorine in drinking water can affect the state of tooth enamel, namely to inhibit demineralization (formation of dental caries). Fluoride deficiency can cause tooth decay. the incidence of dental caries is related to the consumption of drinking water

except for the type of drinking water from refill water².

The prevalence of dental caries by age is 81.5% for 3-4 years, 92.6% for 5-9 years, 73.4% for 10-14 years, 75.3% for 15-24 years, 25-34 years 87.0%, aged 35-44 years 92.2%, aged 45-54 years 94.5%, aged 55-64 years 96.8% and aged 65+ years 95.0%. Central Sulawesi is the province with the most dental health problems, namely 75.3% and only 8.2% receive services from dental medical personnel³.

The DMF-T index (Decayed, Missing, Filled Teeth) can measure dental caries status for permanent teeth in individuals or communities. This index is used to see the condition of a person's teeth that have

experienced damage or untreated caries (Decayed), have been removed or absent due to caries (Missing), teeth that have been filled or filled due to caries (Filled) on permanent teeth. Puspa Dewi's research found that DMF-T for children aged 12 years who used river water as drinking water was high, and the average fluoride content of the river water used was very low ⁴.

The drinking water used by the community can differ in fluorine levels, depending on the type of water source. The close proximity of the sea can cause high fluoride and well water which in turn causes seawater intrusion which causes well water to taste salty ⁵. The results of examination of fluoride levels in coastal areas obtained an average of 0.11870 ppm, this value is very low criteria ⁶, river water fluorine levels <0.05 ppm, including very low criteria (4). Refill bottled water 0.43 mg/l and <0.06 mg/l, below the quality standards ⁷ and river water that is precipitated 0.18 mg/l, including very low criteria ⁸.

Prevention so that the oral cavity is not too acidic, either produced by bacteria or food or drink, so as to prevent the release of calcium ions from tooth enamel. Reducing the demineralization process can be done by stopping the diffusion of acids, namely reducing acid contact with teeth, for example reducing acid intake or drinking soft drinks by using a straw, Another way is by stopping the formation of calcium phosphate complex compounds by increasing enamel resistance through fluoridation of drinking water or topical applications with fluoride or the addition of fluoride ions in drinks, as well as using fluoride toothpaste ⁹.

Based on this description, a study was conducted which aimed to determine the level of fluorine in drinking water and the incidence of dental caries in the community in Tondo Village, Mantikulore District, Central Sulawesi.

METHOD

This research is a descriptive research. The population in this study is the people in the Tondo Village, Mantikulore District, Palu City, Central Sulawesi. The sample is part of the community that consumes ground water (wells) that is used for drinking and has lived in the Tondo Village for approximately 2 years. The number of samples was 20 samples of water for

drinking, and the respondents whose water samples were taken were also subjected to dental examinations. Sampling was carried out by means of non-random sampling, namely by purposive sampling.

Research data was collected after obtaining Ethical Approval from the Health Research Ethics Commission of the Health Polytechnic of the Ministry of Health Palu No: LB.01.01/KE/0011/IV/2020.

Data on fluorine content were obtained by examining water samples at the Tadulako University Chemistry Laboratory using spectrophotometry, while data on the incidence of dental caries used the DMF-T index. The DMF-T index is obtained in the following way: DMF-T value = D + M + F then the sum of the DMF components is divided by the number of respondents to get the average DMF-T index. The method used for measuring dental caries is by drying the tooth surface and then examining the caries by a dentist using a probe and a mouth mirror to see if there is caries on the teeth. The research instrument is in the form of a checklist. Furthermore, the data were analyzed descriptively.

RESULTS

The results showed that of the 20 respondents, the youngest was 13 years old and the oldest was 63 years old, the average age was 33.25 years.

Most of the respondents are over 33 years old (55%). Respondents who were female (70%) were more than male. The distribution of respondents based on age and gender can be seen in table 1. below:

Table 1. Distribution of Respondents by Age and Gender

Characteristics of respondents	Amount	%
Age		
≤33 years old	9	45
>33 years	11	55
gender		
Man	6	30
Woman	14	70

Source: Primary Data, 2020

The results showed that of the 20 respondents, most of the respondents had very low water fluoride levels (95%). The lowest fluorine content was 0.00 mg/l, the highest was 0.40 mg/l, with a median of 0.20 mg/l. or if the

majority (95%) are categorized as having very low levels of fluorine, it can be seen in table 2. below:

Table 2. Category of Fluorine Content in Water in Tondo Village, Mantikulore District, Palu City, Central Sulawesi

No.	Fluorine Level	Amount	(%)
1	Very low	19	95,0
2	Low	1	5,0
Total		20	100

Source: Primary Data, 2020

Table 3. Caries Examination Results with the DMF-T Index in Tondo Village, Mantikulore District, Palu City, Central Sulawesi

Statistic	Decay	Missing	Filling
Maks.	3	0	0
Min.	8	8	1
Median	3	1	0

Source: Primary Data, 2020

Furthermore, the value of the DMF-T Index is searched in the following way: $DMF-T \text{ value} = D + M + F$ then the sum of the DMF components is divided by the number of respondents to obtain the average DMF-T index. The total value of $D = 74$, $M = 22$, $F = 1$, and divided by the number of respondents is 20 and the results obtained are 4.85 or are included in the high category based on the DMFT Index categorization according to WHO.

DISCUSSION

The results showed that all respondents experienced dental caries, and all water samples did not meet the requirements (low and very low categories) based on Permenkes No. 492 of 2010 concerning Drinking Water Quality Requirements. This shows that there is a relationship between the incidence of dental caries and fluorine levels in the drinking water of the Tondo Village, Mantikulore District.

Researchers assumed the incidence of dental caries experienced by respondents as one of the effects of low fluoride in the water used for drinking. The risk of dental caries is known to be associated with low fluoride intake¹⁰. This study is in line with research conducted by A. Leondra, et al., in which the degree of caries was calculated using the DMF-T index and a fluorine test using a spectrophotometer with a wavelength of 525 nm. It was concluded that the degree of caries in Wiau Lapi Barat Village was in medium status. and very low fluorine content¹¹.

In another study, DMF-T for children aged 12 years who used river water as drinking water was classified as high and the average fluoride level in river water in the Pedado River was very low⁴. Research on coastal communities in Watu Ulo Hamlet, Sumberejo Village, Jember Regency showed that the fluorine level of well water used for drinking was classified as very low, and the DMF-T index was classified as medium⁶.

Low or very low levels of fluoride in the water used by the community can result in excessive tooth decay, teeth become brittle, in addition to the teeth becoming brittle, a lack of fluorine can cause teeth to be susceptible to caries (caries dentist), discolouration of children's teeth, and bone thinning may occur. On the other hand, high or very high fluoride levels can cause tooth decay. Consumption of 2 ppm fluoride can cause mottled enamel, 5 ppm can cause osteosclerosis, 50 ppm can cause thyroid gland disorders, 120 ppm can cause mental retardation, 125 ppm can cause kidney disease, and 2.5 grams to 5 grams can cause acute doses and death⁵.

Caries is an interaction of four major factors: microorganisms, carbohydrate substrates, susceptible tooth surfaces (hosts), and time factors. Low fluorine levels have an impact on the vulnerability of the tooth surface. Vulnerable tooth surfaces supported by an acidic environment in the mouth increase the risk of caries.

Therefore, it prevents the atmosphere in the oral cavity from becoming too acidic, either produced by bacteria or food or drink, so as to prevent the release of calcium ions from tooth enamel. Reducing the demineralization process can be done by stopping the diffusion of acids, namely reducing acid contact with teeth, for example, reducing acid intake or drinking soft drinks by using a straw. Another way is by stopping the formation of calcium phosphate complex compounds by increasing enamel resistance through fluoridation of drinking water or topical applications with fluoride or the addition of fluoride ions in drinks, as well as using fluoride toothpaste⁹.

The good fluoride content for consumption (optimum level), according to the American Dental Association (ADA) ranges from 0.7 ppm to 1.2 ppm. The presence of fluoride in bottled water is thought to contribute to the low DMF-T value¹². Therefore, water fluoridation is the most sustainable community-

level caries prevention method. Water fluoridation should be the intervention of choice in caries prevention ¹³.

Increase in fluoride levels in drinking water (clear treated water) can be done by passing it through a fluorine-containing stone medium. Preliminary study, By immersion method, Peat-Liang Anggang white stone contains fluorine of 2.12 mg/l. Treated water that is passed through fluoridated rocks has the highest fluoride content increase in rocks with a thickness of 50 cm, where the fluorine content is from 0.08 mg/l (initial) to 0.24 – 0.69 mg/l within 6-72 hours, and the lowest increase in stones with a thickness of 10 cm from 0.08 mg/l (initial) to 0.31 – 0.056 mg/l within 6-72 hours ¹⁴.

Socioeconomic differences also play a role in the incidence of dental caries. The study of Soffi et al aimed at measuring dental caries based on socioeconomic status in middle-aged adults in Iran and identifying these determinants, showing that there are dissimilarities/differences in dental caries in middle-aged adults based on status. socioeconomic, which means that the prevalence of dental caries is more concentrated in individuals with low socioeconomic status, the prevalence of caries is higher in women, older age groups, individuals with low socioeconomic status, smokers, rural residents and people who use alcohol and drugs - medicine ¹⁵.

High caries prevalence was found in underweight and non-obese adolescents (46.7% vs 34.5%) ¹⁶. The relationship between underweight and obesity and caries, respectively (OR [95% CI]), was 1.91 (0.87, 4.18) and 0.34 (0.18, 0.63). The logistic regression model showed that consumption of sugar more than once a day led to a 2.87-fold more significant likelihood of caries (AOR [95% CI] = 2.87 [1.68, 4.88]) ¹⁵. Likewise, after consuming soft drinks, there is a change in the degree of acidity in the mouth ¹⁷.

In children, based on an oral health survey conducted in Taiwan, it was found that the prevalence of dental caries in children aged 8-9 years was 85.9%. Children who live in rural areas tend to have a lower percentage in the category of receiving fluoride varnish application services. Children with highly educated parents received significantly more fluoride varnish application services than children with lower educated parents

($p < 0.0001$). Children who received fluoride varnish application services were associated with caries risk, with a significant 36% reduction in caries risk. Untreated and unrestored caries can negatively impact general health, development, school performance, or even quality of life among school children ¹³.

Poor oral hygiene has an impact on a poor quality of life as well. School-based interventions can form positive behaviors that can reduce the likelihood of dental caries in the future. Tooth brushing interventions day and night improve oral hygiene in children in Nigeria and reduce the likelihood of cavities, loss or fillings in Indonesian children ¹⁸.

Oral hygiene was significantly worse in boys, and levels of bacteria in dental plaque were significantly higher in boys. Analysis of the relationship between risk indicators and dental caries showed that frequency of brushing teeth, how to brush teeth, daily rinse habits, visits to the dentist, consumption of sweet and light foods and dental and oral hygiene status were risk factors for dental caries ¹⁹ in ²⁰. Based on the cariogram the risk factors that influence caries are bacteria (22.90%), susceptibility (19.39%), eating habits (12.09%), and others (7.55%) ²¹.

Water fluoridation has been widely applied worldwide for decades and research results show that water fluoridation reduces the prevalence of dental caries. Salt or milk fluoridation is another collective fluoride intervention that prevents dental caries in children. Early childhood fluoride supplement intake and fluoride levels of 0.7 ppm in drinking water are associated with a risk of dental fluorosis, ranging from mild to severe esthetic problems. As for research on the effects of various levels of fluoride concentrations in toothpaste is still limited. Topical fluorides (gels and varnishes) effectively prevent dental caries and are especially recommended for children at high risk of dental caries ¹⁵.

In addition to fluoride, dentifrices containing 10% hydroxyapatite are effective in remineralizing early caries and preventing demineralization ²².

CONCLUSIONS

The results showed that of the 20 respondents, 95% of the respondents had very low water fluoride levels. The lowest fluorine content was 0.00 mg/l, the highest was 0.40

mg/l, with a median of 0.20 mg/l. All respondents experienced dental caries (100%). It is recommended to the public to brush their teeth regularly at least twice a day, namely every time after eating and going to bed at night with fluoride-containing toothpaste, and conducting water fluoridation at the community level

ACKNOWLEDGMENT

Acknowledgements are extended to Mr. Nasrul, SKM, M.Kes as the Director of the Poltekkes Kemenkes Palu, Mr. Head of the Tondo Village for his approval and good cooperation during the implementation of the research.

REFERENCE

1. Permenkes RI. Permenkes R.I Nomor 492/Menkes/Per/IV/2010. Permenkes R.I. 2010.
2. Suratri MAL, Jovina TA, Notohartoyo IT. Hubungan Kejadian Karies Gigi dengan Konsumsi Air Minum pada Masyarakat di Indonesia (The Relationship of Dental Caries with Drinking Water Consumption on Community in Indonesia). *Media Penelit dan Pengemb Kesehat*. 2018;28(3):211–8.
3. Riskesdas. *Laporan_Nasional_RKD2018_FINAL*. pdf. 2018.
4. Puspa Dewi SR, Safitri Y, Lany LE, Dwi RS. Gambaran Kadar Fluorida Dalam Air Minum Dan Skor Dmf-T Anak 12 Tahun Di Sungai Pedado Palembang. *J Ris Kesehat*. 2019;8(1):68.
5. Dewi NMCK. Kandungan Fluorida Dan Kualitas Bakteriologis Pada Air Sumur Yang Dikonsumsi Secara Langsung Di Desa Adat Bualu, Kecamatan Kuta Selatan Tahun 2016. Universitas Udayana; 2016.
6. Larasati puspitaningrum. Hubungan Kadar Fluor Air Minum Dengan Karies Gigi Pada Masyarakat Pesisir Dusun Watu Ulo Desa Sumberejo Kecamatan Ambulu Kabupaten Jember. Universitas Jember. Jember; 2018.
7. Triwuri Nurlinda Ayu, Hazimah. Kandungan Fluoride Dalam Air Minum Isi Ulang Di Kota Batam. *J Rekeyasa Sist Ind*. 2018;4(1).
8. Utami Naning K. Perbedaan Rata-Rata DMF-T Pada Masyarakat yang Mengonsumsi Air Minum Kemasan Isi Ulang dan Air Sungai yang Diendapkan. 2020;17(1):43–8.
9. Rahma A, Dewi N, Dentin DP-, 2020 U. Pengaruh Aplikasi Sodium Fluoride 2% Terhadap Ph Plak Dan Ph Saliva Anak Usia 7-9 Tahun. *PpjpUlmAcId*. 2020;4(3):69–74.
10. Aoun A, Darwiche F, Al Hayek S, Doumit J. The fluoride debate: The pros and cons of fluoridation. *Prev Nutr Food Sci*. 2018;23(3):171–80.
11. Leondra A, Paulina G, Dinar W. Status Karies Dan Kadar Fluor Yang Dikonsumsi Penduduk Usia 12 – 14 Tahun Di Desa Wiau Lapi Barat. *e-GIGI*. 2014;2(1).
12. Tanumihardja M, Daniel D, Rehatta F. Gambaran status karies pada anak usia 12-15 tahun yang mengonsumsi air minum kemasan di SMP Nusantara, Tahun 2016. *Makassar Dent J*. 2017;6(3):149–56.
13. Ashley P, Duane B, Johnstone M, Lyne A. The environmental impact of community caries prevention - part 2: toothbrushing programmes. *Br Dent J*. 2022;233(4):295–302.
14. Rahmawati I, Said F, Haris A. Perancangan Alat Peningkatan Kadar Fluor Air Sungai Planning Of River Water Fluoride Improvement Equipment Using Contact Method Of Fluorine-Containing Rocks In Mekar Sari. *An-Nadaa J Kesehat Masy* [Internet]. 2021;8(2):131–5. Available from: <https://ojs.uniska-bjm.ac.id/index.php/ANN/article/view/5663>
15. Jullien S. Prophylaxis of caries with fluoride for children under five years. *BMC Pediatr* [Internet]. 2021;21(Suppl 1):1–11. Available from: <http://dx.doi.org/10.1186/s12887-021-02702-3>
16. Gudipani RK, Albilasi RM, HadiAlrewili O, Alam MK, Patil SR, Saeed F. Association of Body Mass Index and Waist Circumference With Dental Caries and Consequences of Untreated Dental Caries Among 12- to 14-Year-old Boys: A Cross-Sectional

- Study. *Int Dent J.* 2021;71(6):522–9.
17. Santoso TLA, Wicaksono DA, Gunawan PN. Effects of Carbonated Soft Drink on Saliva pH in the Occurrence of Dental Caries. *e-GiGi.* 2022;10(1):66.
 18. Melo P, Fine C, Malone S, Taylor S. Impact of the Brush Day & Night Programme on Well-Being, Plaque, and Dental Caries in Children. *Int Dent J.* 2021;71:S15–30.
 19. Nugraheni H, Sadimin S, Sukini S. Determinan Perilaku Pencegahan Karies Gigi Siswa Sekolah Dasar Di Kota Semarang. *J Kesehat Gigi.* 2019;6(1):26.
 20. Kyaw Myint ZC, Zaitsu T, Oshiro A, Ueno M, Soe KK, Kawaguchi Y. Risk indicators of dental caries and gingivitis among 10–11-year-old students in Yangon, Myanmar. *Int Dent J.* 2020;70(3):167–75.
 21. Widyagdo A, Priyono B, Hanindriyo L. Caries risk factors based on cariogram among male smokers aged 15-24 years in Temanggung, Central Java, Indonesia. *Maj Kedokt Gigi Indones.* 2022;8(1):24.
 22. Amaechi BT, AbdulAzees PA, Alshareif DO, Shehata MA, Lima PP de CS, Abdollahi A, et al. Comparative efficacy of a hydroxyapatite and a fluoride toothpaste for prevention and remineralization of dental caries in children. *BDJ Open.* 2019;5(1).

Original Article

The Relationship Among Exclusive Breastfeeding, Complementary Feeding (MP-ASI), and Infectious Diseases in Children Aged 7 to 24 Months

Aliyah Rosalina¹, Tonny Cortis Maigoda^{1*}, Emy Yuliantini¹

¹Department of Nutrition, Poltekkes Kemenkes Bengkulu, Bengkulu City, Bengkulu Province, Indonesia

(Correspondence author's e-mail, tony@poltekkesbengkulu.ac.id, 085267167398)

ABSTRACT

Stunting is the state of height of a person, not by age. Numerous risk factors, such as complementary feeding, viral illnesses, and exclusive breastfeeding, contribute to the high prevalence of stunting. Breast milk consists of fats, carbohydrates, calories, proteins, and vitamins that can support the development and growth of a healthy child. Complementary feeding must be adequate, nutritious, and appropriate in the type, time, frequency, portion, and menu variations in addition to breast milk. These variations that are not quite right will cause growth failure and infectious diseases. This study aimed to ascertain the relationship between exclusive breastfeeding, complementary feeding, infectious diseases, and the incidence of stunting in children between the ages of 7 and 24 months at the Sawah Lebar Health Center in Bengkulu City in 2023. This study used a cross-sectional method. The population in this study were all children aged 7-24 months in Sawah Lebar Public Health Center, while the sample for this study was 52 people taken by random sampling. The study finds a relationship among exclusive breastfeeding, complementary feeding, infectious diseases, and the prevalence of stunting in children aged 7 to 24 months at the Sawah Lebar Public Health Center in Bengkulu City with a p-value (<0,05). This study is recommended to continue by adding any variable such as a variety menu, texture, and appropriate time giving complementary feeding.

Keywords: Exclusive Breastfeeding, Complementary Feeding, Infectious Diseases, Stunting

<https://doi.org/10.33860/jik.v17i2.2305>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Stunting is the most typical dietary issue in children. The issue of short toddlers illustrates the persistent dietary issues that are impacted by the health of the expecting woman, the fetus, and the time of infancy and toddlerhood, as well as illnesses experienced during childhood and other issues that indirectly negatively impact health¹.

When a person's height (TB) and age (TB/U), which are established by computing the Z-index score for Height by Age (TB/U), do not

Match is referred to as stunting. If a child's Z-index score for TB/U is less than -2 SD, they are said to be stunted. 2018's Boucot & Poinar Jr. Toddler stunting requires special attention since it might impede a child's physical and mental development².

Stunting is linked to a higher risk of mortality and delayed brain and body development. Additionally, it increases the chance of developing degenerative illnesses and lowers productivity and intellectual capacity. Additionally, because stunted children are more likely to contract infectious infections, their learning may suffer over time, costing Indonesia money in the long run³.

According to the data from 2020, Asia has the largest percentage of stunted children worldwide (53%), followed by Africa (41%). The largest percentage, 30.7%, came from South Asia, followed by Southeast Asia, with 27.4%, and East Asia, with 4.9%, with the smallest percentage. Timor Leste had the top spot in the south-eastern Asia Regional in 2005–2007, with a prevalence of 48.8%, followed by Indonesia in second place with a frequency of 31.8%⁴.

The prevalence of stunting in children under five is 30.8% according to the 2018 Riskesdas findings (Ministry of Health, 2018); the prevalence is 21.6% according to the 2022 Indonesian Toddler Nutrition Status Survey (SSGI) statistics (RI Ministry of Health, 2022). According to the results of the 2022 SSGI, the prevalence of stunting in children under the age of five (TB/U) in Bengkulu Province was 19.8%, while in Bengkulu City, it was 12.9%⁵.

The high prevalence of stunting is caused by various risk factors, both directly, including history of maternal intake during pregnancy, birth weight, infectious diseases, parental education, exclusive breastfeeding, and early complementary breastfeeding and indirectly such as income factors and economic inequality, food system, and others⁶.

Parenting has a significant role in avoiding stunting in order to stop this from happening. Exclusive breastfeeding is a practical part of parenting. Nutrition increased physical stamina, improved mental and emotional intelligence, healthy social development, immunity to infectious illnesses, and allergy prevention are all advantages of nursing exclusively for infants. Antibodies found in breast milk stimulate the brain and nerves, enhancing health and intellect to their full potential. Additionally, the composition of breast milk includes fats, carbs, calories, proteins, and vitamins that can support healthy development and growth³.

Another influential factor in the growth of children is the provision of food or drink without paying attention to the frequency of administration, nutritional quality, type, and texture of food and inappropriate feeding methods will result in growth failure and infectious diseases⁷.

One of the direct causes of stunting is infectious illness. Stunting is more likely to occur in kids who have infectious infections for a longer period of time. Toddlers who consume

food handled carelessly have a greater risk of contracting infectious illnesses. This contagious illness is typically marked by nausea and vomiting, which prevents the youngster from getting enough to eat. Such circumstances will subsequently have detrimental effects on children's development⁸.

Based on this background and phenomenon, researchers are interested in the correlation between exclusive breastfeeding, MP-ASI, and infectious diseases with stunting in children aged 7-24 months in Bengkulu, particularly in Sawah Lebar Health Center in Bengkulu.

METHOD

A cross-sectional design with a descriptive methodology was employed in this investigation. This investigation will take undertaken in March 2023 at the Sawah Lebar Public Health Center in Bengkulu. Total of 52 kids make up the sample, and the sampling method employed is random sampling. Interviews and questionnaires were employed as the data-gathering methods in this study. In this study, both univariate and bivariate data analysis were employed. To as certain the significance of the association between the independent factors and the dependent variable, the Chi-Square test with a 95% confidence level was utilized in bivariate analysis. This research has met the ethical requirements dated May 14, 2023 No.KEPK.BKL/208/05/2023.

RESULTS

Table 1. Distribution of Individual Characteristics by Frequency

Characteristic	Variables	Frequency	
		n	%
Child Age	7-12 month	22	42,3
	13-19 month	26	50,0
	20-24 month	4	7,7
Childbirth length	Normal	5	9,6
	Short	47	90,4
Child gender	Man	23	44,2
	Woman	29	55,8
Mother's job	Doesn't work (IRT)	48	92,3
	Work	4	7,7

Mother's education	Low	10	19,2
	Intermediate	30	57,7
	Tall	12	23,1
Family income	IDR<2500.000	13	25,0
	IDR	39	75,0
	>2500.000		

Table 1 above shows the results for children aged 7-12 months (42.3%), aged 13-19 months as many as 26 children (50.0%) aged 20-24 months (7.7%). Pbl normal children as many as 47 children (90.4%). The sex of the boys was 23 children (44.2%) and the girls were 29 children (55.8%). Meanwhile, the characteristics of mothers based on their work were mostly unemployed (92.3%) and only (7.7%) working mothers. In terms of mother's education, there were (19.2%) mothers with low education, (57.7%) middle education and (23.1%) mothers with high education. In terms of family income, there are (25%) families whose income is below the UMR and (75%) families whose income is above the UMR.

Table 2. Overview of exclusive breastfeeding with the incidence of stunting

Variable	Frequency	
	n	%
Exclusive breastfeeding	No	9 17,3
	Yes	43 82,7

Table 2 It is known that out of 52 children, (82.7%) are exclusively breastfed, and (17.3%) are children who are not receiving breastfed.

Table 3. Overview of complementary feeding with the incidence of stunting

Variable	Frequency	
	n	%
Complementary Feeding	Incompatible	12 23,1
	In accordance	40 76,9

Table 3 shows that out of 52 children, there were (76.9%) children whose complementary feeding was appropriate and (23.1%) children whose complementary feeding was not appropriate.

Table 4. Overview of infectious diseases with stunting

Variable	Frequency	
	n	%
Infectious Disease	No	47 92,3
	Yes	4 7,7

Table 4 shows that out of 52 children, there were (92.3%) children with no history of infectious diseases and (7.7%) children with a history of infectious diseases.

Table 5. Description of the incidence of stunting

Variable	Frequency	
	n	%
Stunting	No	47 90,4
	Yes	5 9,6

Table 5 above shows that out of 52 children, there are (90.4%) children who are not stunted and (9.6%) children who are stunted.

Table 6. The relationship between the prevalence of stunting in children aged 7 to 24 months at the Sawah Lebar Public Health Center in Bengkulu City and exclusive breastfeeding

Exclusive Breastfeeding	Stunting		Total	Or (95% CT)	p-value
	No	Yes			
ng	n	%	n	%	
No	6	11.5%	3	5.7%	9 17.3%
Yes	41	78.%	2	3.8%	43 82.6%
					10.25 (1.4-74.5)

Fisher's Exact Test.

Based on table 6 above, The study's findings revealed that exclusively breastfed infants had a stunting prevention rate of 78.8%, whereas nonexclusively breastfed children had a stunting prevention rate of 5.7%. This demonstrates a connection between the prevalence of stunting and exclusive breastfeeding in the Sawah Lebar Health Center in Bengkulu, where the value ($p < 0.05$) supports the validity of the H_a hypothesis that such a connection exists. According to the OR value (95% CT), children who do not get exclusive breastfeeding are 10.2 times more likely to have stunting than those who do

Table 7. The relationship between the prevalence of stunting and complementary feeding in infant children aged 7-24 months in Sawah Lebar Public Health Center, Bengkulu City

Complementary feeding	stunting		Total	Or (95% CT)	p-value
	No	Yes			
	n	%	n	%	
It is not in accordance with	8	15.3%	4	7.6%	12 23%
					9.5(1.9-98.3)

In accordance	39	75%	1	1.9%	40	76.9%	0.08
---------------	----	-----	---	------	----	-------	------

Fisher's Exact Test.

Based on Table 7 above, the study's findings revealed that 7.6% of kids with unsuitable MP ASI were at risk for stunting, whereas 75% of kids with unsuitable MP ASI were not. The statistical analysis produced a value of $p = 0.08$ as a result. This demonstrates that there is a correlation between MP ASI and the prevalence of stunting in the Sawah Lebar Health Center in Bengkulu, where the value ($p = 0.05$) demonstrates the acceptance of the Ha Hypothesis. Children whose MP ASI is unsuitable are 19.5 times more likely to experience stunting than children whose MP ASI is acceptable, according to the OR value (95% CT).

Table 8. The relationship between the prevalence of stunting and infectious disease in infant children aged 7-24 months Sawah Lebar Community Health Center, Bengkulu City

Infectious Diseases	stunting				Total		Or (95% CT)	P-values
	No		Yes		n	%		
	n	%	n	%				
There isn't any	45	86%	2	3.8%	4	7.6%	5.0(1.5-46.9)	0.42
There is	2	3.8%	3	5.7%	48	92.3%		

Fisher's Exact Test.

Based on Table 8 above, the study's findings revealed that children with no history of infectious illnesses were not stunted by 86%, and those who did were by 3.8%, according to the statistical test results, which were achieved with a p-value of 0.42. In the Sawah Lebar Health Center in Bengkulu, this demonstrates a relationship between infectious diseases and the incidence of stunting, where the value ($p = 0.05$) indicates that the Ha Hypothesis is accepted. Children with a history of infectious infections are 15 times more likely to experience stunting, according to the OR value (95% CT).

DISCUSSION

The relationship between the prevalence of stunting in children aged 7 - 24 months at the Sawah Lebar Public Health Center in Bengkulu City and exclusive breastfeeding

Chi-square is used in statistical testing. According to the study, 78.8% of exclusively breastfed infants did not experience stunting, compared to 5.7% of nonexclusively breastfed

children at risk for stunting. The findings of the statistical analysis yielded a value of $p = 0.31$. Demonstrates a connection between the prevalence of stunting and exclusive breastfeeding in the Sawah Lebar Health Center, Bengkulu City, where the value ($p = 0.05$) supports the validity of the Ha hypothesis that such a connection exists. According to the OR value (95% CT), children who do not get exclusive breastfeeding are 10.2 times more likely to have stunting than those who do.

According to this study, 9 children (11.5%) still received non-exclusive nursing while avoiding stunting. According to a study by Wardani YS et al. 9, the improper diet of moms who exclusively breastfeed can produce inadequate amounts and qualities of breast milk, which can affect the baby's growth and development. A newborn that does not receive enough breast milk is in danger of malnutrition, which manifests as a short, thin physique⁹. Breast milk consists of a mixture of whey, casein, and various peptides that provide crucial amino acids necessary for babies' growth and development, as well as bioactive proteins and important peptides with many functions¹⁰. The amount and quality of breast milk produced as a result of the mother's poor nutritional intake when nursing is one of the variables that affect newborn malnutrition¹¹.

One of the factors affecting neonatal malnutrition is the quantity and quality of breast milk produced as a result of the mother's inadequate nutritional intake while breastfeeding¹².

The relationship between the prevalence of stunting and complementary feeding in infant children aged 7-24 months in Sawah Lebar Public Health Center, Bengkulu City

According to the study's findings, Chi-square is a statistical test that shows 7.6% of kids with unsuitable complementary feeding were at risk of stunting, compared to 75% of kids with suitable complementary feeding. The statistical analysis produced a value of $p = 0.08$ as a result. This demonstrates a correlation between complementary feeding and the prevalence of stunting in the Sawah Lebar Health Center in Bengkulu, where the value ($p = 0.05$) demonstrates the acceptance of the Ha Hypothesis. Children whose complementary feeding is unsuitable are 19.5 times more likely to experience stunting than children whose

complementary feeding is acceptable, according to the OR value (95% CI).

Complementary feeding is a variety of foods and drinks specifically given to babies. Complementary feeding is divided into two: those made at home (family complementary feeding) and ready-to-eat complementary feeding (manufacturers)¹³. Breast milk can only satisfy one-third of a baby's demands between 6 and 9 months and half between 12 and 18 months. The aim is to supplement the lack of nutrients because the need for nutrients increases with age, developing the ability of toddlers to accept a variety of foods with various shapes, textures, and tastes¹⁴.

The findings of this study are consistent with those of Khasanah et al.¹⁵ studies, which found a significant correlation ($p=0.002$) between the timing of the introduction of MP-ASI and the nutritional status of infants aged 6 to 23 months as measured by body length about age (PB/U) (OR=2.867, 95% CI:1.453-5.656). Stuntedness is 2.8 times more likely to occur in children who get MP-ASI when it is not recommended that they do so (z score -2). This implies that the onset of MP-ASI administration is closely connected to the prevalence of stunting.

The reason for the relationship between the provision of complementary feeding (MP-ASI) and the incidence of stunting is that the provision of complementary feeding (MP-ASI) is too early, the frequency of providing complementary feeding (MP-ASI) is also not scheduled, and the variety of complementary feeding (MP-ASI) no more than two consisting only of carbohydrates and protein in one menu given to toddlers. As for other possible factors that lead to stunting in this study, namely the non-implementation of exclusive breastfeeding and early cessation of breastfeeding consumption, this may also be due to the low awareness of mothers about the importance of providing breastfeeding to their toddlers, which is influenced by knowledge about health and socio-cultural issues, as well as limited health workers in provide counseling¹⁴.

The relationship between the prevalence of stunting and infectious disease in infant children aged 7-24 months Sawah Lebar Community Health Center, Bengkulu City

A chi-square statistical test discovered a significant correlation between a history of

infectious diseases and the incidence of stunting of 3.8% and 15 times greater risk of stunting. The results also revealed that children who did not have a history of infectious diseases were not stunted by 86%, and those who did were at risk of stunting by 3.8%.

Stunting has several direct causes, including infectious illnesses. It is impossible to separate the relationship between dietary needs and infectious illnesses. Infectious illnesses will worsen the condition if there is a shortage of nutritional intake. Children who are undernourished are more likely to get infectious infections. Therefore, managing infectious infections as soon as feasible will aid in improving nutrition by balancing the fulfillment of intake by children's under-five nutritional demands¹⁶.

This research is in line with Sutriyawan et al.,¹⁶ which says there is a relationship between infectious diseases and stunting, as 62.2% of children have a history of infectious diseases. This is because some children have a history of infectious diseases. Stunting has a relationship where infectious diseases can affect toddlers' nutritional intake, and if toddlers' nutritional intake decreases, it can occur. This study is consistent with earlier studies conducted at the Kerkap Community Health Center in the North Bengkulu Regency. Quantitative research of this kind. Analytical cross-sectional survey technique. Sampling approach with a purpose. The statistical analysis's findings showed a connection between environmental sanitation and the prevalence of stunting, with a p value of (0.008) (OR=3.8; 95% CI=1.5-10.04), and a connection between a history of infectious diseases and the prevalence of stunting, with a p value of (0.000) (OR=15.21; 95% CI=4.6-49.4)¹⁷. Researchers believe that one of the main contributing reasons to the prevalence of stunting in toddlers is a history of viral illnesses. A toddler's intake or appetite will be affected by an infectious sickness, and food loss from vomiting or diarrhea might impact how the body processes food. The findings of this study are consistent with studies done at Nusa Penida III Public Health Center on the impact of protein and zinc consumption, as well as a history of infectious infections, on the occurrence of stunting in toddlers. The findings of this study indicated that one of the main variables impacting child stunting was a history of viral illnesses¹⁸.

CONCLUSION

In conclusion, there is a connection between the frequency of stunting at Sawah Lebar Public Health Center in Bengkulu City and MP-ASI, infectious illnesses, and exclusive breastfeeding. Complementary and exclusive breastfeeding and a child's history of infectious infections at 24 months of age are necessary to lower the risk of stunting in toddlers. Therefore, it is anticipated that health professionals and services will pay close attention to moms to prevent stunting. This study is recommended to continue by adding any variable such as a variety menu, texture, and appropriate time giving complementary feeding.

REFERENCE

1. Anggryni M, Mardiah W, Hermayanti Y, Rakhmawati W, Ramdhanie GG, Mediani HS. Faktor pemberian nutrisi masa golden age dengan kejadian stunting pada balita di negara berkembang. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*. 2021 Jan 9;5(2):1764-76.
2. Suryani L. Hubungan Pemberian Asi Eksklusif Dengan Kejadian Stunting Pada Balita Di Wilayah Kerja Puskesmas Limapuluh Kota Pekanbaru. *Jurnal Midwifery Update (MU)*. 2021 Oct 1;3(2):126-31.
3. Louis SL, Mirania AN, Yuniarti E. Hubungan Pemberian ASI Eksklusif dengan Kejadian Stunting pada Anak Balita. *Maternal & Neonatal Health Journal*. 2022 Jan 26;3(1):7-11.
4. World Health Organization. Prevalence of stunting. World Health Organization; 2021.
5. Kementerian Kesehatan Republik Indonesia. Prevalensi di Stunting Indonesia. Jakarta: Kementerian Kesehatan Republik Indonesia; 2021.
6. Kementerian Kesehatan Republik Indonesia. Faktor-Faktor Stunting. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018.
7. Fitri L, Ernita E. Hubungan Pemberian Asi Eksklusif dan Mp-asi Dini dengan Kejadian Stunting pada Balita. *Al-Insyirah Midwifery: Jurnal Ilmu Kebidanan (Journal of Midwifery Sciences)*. 2019 Feb 13;8(1):19-24.
8. Subroto T, Novikasari L, Setiawati S. Hubungan Riwayat Penyakit Infeksi Dengan Kejadian Stunting Pada Anak Usia 12-59 Bulan. *Jurnal Kebidanan Malahayati*. 2021 Apr 30;7(2):200-6.
9. Wardani YS, Megawati G, Herawati DM. Asupan Gizi Dan Pola Makan Ibu Menyusui Asi Eksklusif Di Wilayah Kerja Upt Puskesmas Ibrahim Aji Kota Bandung. *Gizi Indonesia*. 2021 Mar 31;44(1):65-76.
10. Yi DY, Kim SY. Human breast milk composition and function in human health: from nutritional components to microbiome and microRNAs. *Nutrients*. 2021 Sep 2;13(9):3094.
11. Campos AP, Vilar-Compte M, Hawkins SS. Association between breastfeeding and child stunting in Mexico. *Annals of global health*. 2020;86(1). 145. <https://doi.org/10.5334/aogh.2836>
12. Rahmawati W, Wirawan NN, Wilujeng CS, Fadhilah E, Nugroho FA, Habibie IY, Fahmi I, Ventyaningsih AD. Gambaran Masalah Gizi pada 1000 HPK di Kota dan Kabupaten Malang (Illustration of Nutritional Problem in the First 1000 Days of Life in Both City and District of Malang, Indonesia). *Indonesian Journal of Human Nutrition*. 2016 Jul 1;3(1):20-31.
13. Widiastity W, Harleli H. Hubungan Pemberian MP-ASI Terhadap Kejadian Stunting Pada Balita Usia 6–24 Bulan di Puskesmas Soropia. *Nursing Care and Health Technology Journal (NCHAT)*. 2021 Sep 25;1(2):81-6.
14. Resti E, Wandini R, Rilyani R. Pemberian Makanan Pendamping ASI (MP-ASI) Berhubungan Dengan Kejadian Stunting Pada Balita. *Jurnal Kebidanan Malahayati*. 2021 Apr 30;7(2):274-8.
15. Khasanah DP, Hadi H, Paramashanti BA. Waktu pemberian makanan pendamping ASI (MP-ASI) berhubungan dengan kejadian stunting anak usia 6-23 bulan di Kecamatan Sedayu. *Jurnal Gizi dan Dietetik Indonesia (Indonesian Journal of Nutrition and Dietetics)*. 2016 Aug 30;4(2):105-11.
16. Sutriyawan A, Kurniawati R, Rahayu S, Habibi J. Hubungan Status Imunisasi

Dan Riwayat Penyakit Infeksi Dengan Kejadian Stunting Pada Balita: Studi Retrospektif. JM [Internet]. 11Nov.2020 [cited 12Sep.2023];8(2):1-. Available from:

<https://jurnal.unived.ac.id/index.php/JM/article/view/1197>

17. Wulandari WW, Rahayu F. Hubungan sanitasi lingkungan dan riwayat penyakit infeksi dengan kejadian stunting di wilayah kerja puskesmas kerkap kabupaten bengkulu utara tahun 2019. Avicenna: Jurnal Ilmiah. 2019 Sep 18;14(02):6-13.
18. Picauly I. Relationships between Exclusive Breastfeeding, and History of Illness, and Stunting in Children Under Five. Journal of Maternal and Child Health. 2023 Jan 16;8(1):116-24.

Original Article

Community Behavior in The Use of Jampersal in Jember Regency (Phenomenological at Puskesmas Gladak Pakem and Puskesmas Mumbulsari)

Ita Roosinta^{1*}, Sebastiana Viphindrartin², Iwan Dewanto³

¹ Public Health Program, Jember University, Jember, East Java, Indonesia

² Economic Science Program, Faculty of Economics and Business, Jember University, Jember, East Java, Indonesia

³ Dentistry Program, Faculty of Dentistry, Muhammadiyah University Yogyakarta, Yogyakarta, Indonesia

(Correspondence author's e-mail, roossinta79@gmail.com, +62 811-3672-700)

ABSTRACT

Based on data on the high maternal mortality rate in Jember from 2016-2020 and the lack of utilization of Jampersal in Jember district. This study aimed to determine the predisposing characteristics in the utilization of jampersal in Jember Regency among postpartum women. This study used qualitative research with a phenomenological approach conducted in Jember Regency. Thirty-four research subjects were obtained from the general population of Jember Regency, consisting of maternity women and married men aged 18-45. Research data collection with in-depth interviews. Data analysis using Interpretative Phenomenological Analysis technique. Triangulation of sources was used to obtain the validity of research data. The results showed high predisposing characteristics were associated with jampersal utilization in postpartum women based on demographic, cultural, knowledge, and perception perspectives. The demographic perspective found differences in the selection of health facilities in urban and rural areas. Furthermore, from a cultural perspective, it was found that the practice of traditional birth attendance was related to beliefs. The knowledge perspective found that good knowledge can be optimized in the early detection of emergencies. Furthermore, it was found that there was a misperception in the community when managing the Jampersal requirements. Future researchers need to examine other aspects related to the Jampersal program.

Keywords: Public Cultural, Jampersal, Maternal Health Services.

<https://doi.org/10.33860/jik.v17i2.2387>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

The breakthrough efforts made by the Indonesian government as a commitment to accelerate the achievement of SDGs, one of which is launching a maternity insurance program (Jampersal) in 2011 with funds amounting to Rp.1.223 Trillion. The SDGs goal of good health and well-being ensures healthy lives and promotes prosperity for all ages¹. The Jampersal program aims to: (1) increase the coverage of pregnancy check-ups, delivery

assistance, and postpartum services by health workers; (2) increase the coverage of newborn services by health workers; (3) increase the coverage of postpartum family planning (KB) services; (4) increase the coverage of handling complications of pregnant women, delivery, postpartum, and newborns; and (5) the implementation of efficient, effective, transparent, and accountable financial management².

According to data from the Jember District Health Office, the absorption of Jamkesmas. Jampersal funds by all puskesmas in Jember District in 2020 amounted to Rp. 7,796,438,250, or 69.19% of the total Jamkesmas. jampersal funds of Rp. 11,268,362,000. The coverage of maternal services in Jember District, from 2020 to 2022, is reported to have increased for the coverage of pregnant women's services, delivery by health personnel, and fetal care services. However, the increase in coverage was not followed by a significant decrease in the number of maternal death cases. The increase in the number of deaths in Jember Regency, when viewed based on the time of death, occurred during childbirth or maternal death cases actually increased in 2020. Maternal deaths in 2020 amounted to 174 cases compared to 133 cases in 2019³.

Other factors that influence the timely utilization of jampersal services are at the time of delivery⁴. Maternal health status is not only related to health services and health insurance provided by public and private organizations, but also to a woman's ability as a mother including her education, environment, and culture⁵. Barriers to timely access to maternal health services include: (1) level of knowledge about pregnancy, childbirth emergencies, and maternal health insurance; (2) socio-cultural factors/beliefs, including family decision-making culture and trust in the ability of health providers; (3) distance and travel time to reach health services; (4) transportation, including the availability of vehicles to reach health services; (5) cost, including the cost of delivery, transportation, and food while in the hospital. This is because distance and time are considered indirect costs that often increase the cost of accessing maternal health services even when free maternal health services are officially provided⁶.

The people of Jember District have diverse cultures. This cultural diversity allows for different perspectives and knowledge about maternal health. This study aims to examine the perceptions, knowledge, and culture of the community in Jember District towards maternity insurance and its utilization, especially during childbirth and emergencies.

METHOD

This research was conducted in Jember District, East Java. Jember District was chosen

as the research location due to several reasons: a) maternal deaths amounted to 174 cases, b) the community comes from various tribes (Javanese, Madurese, Osing, Pandalungan), c). transportation is easily accessible by researchers, d). The majority of people live in the agriculture, plantation and fisheries sectors.

This study is included in qualitative research, where the approach used is phenomenology, referring to previous research⁷. Qualitative research involves researchers so that they will understand the context with the situation and the setting of natural phenomena according to what is being researched⁸. The phenomenological approach focuses on the subjective meaning of objective reality in the consciousness of people who live their daily life activities⁹.

In-depth interviews carried out data collection in this study. In-depth interviews are used to deepen the main issues and examine interpretations¹⁰. Interviews were open-ended using interview guidelines, and voice recordings were saved using a smartphone. 34 research subjects were obtained from the general population of Jember Regency, consisting of maternity women and married men aged 18-45 years. Determination of subjects in this study was carried out by purposive technique, where the number of subjects in this study was based on data saturation. The inclusion criteria of the subjects include a) postpartum women who use jampersal when giving birth using trained personnel, b) non-jampersal postpartum women when giving birth using trained health workers, c) mothers with limited education who give birth in health services with jampersal and are referred, d) mothers during the postpartum period with the help of traditional birth attendants, e) willing to agree to inform consent. The information obtained in this study is predisposing characteristics consisting of aspects of demographic structure, culture, knowledge, and perception.

The data that has been obtained is transcribed and analyzed. Data analysis in this qualitative research uses interpretative phenomenological analysis (IPA)^{9,11}. The IPA approach aims to explore the meaning of events experienced by the subject from experiences that have been experienced¹². The concept of IPA is that the researcher lives the experience or meaning of the facts in the subject's experience of the research¹³.

The credibility of the data obtained in this qualitative research concerns researchers. The source triangulation method is used for the internal validity of the data obtained ⁷. The triangulation process involves collecting information through in-depth interviews with significant or supporting informants and then checking it with observation using an observation sheet ¹⁴. In qualitative research, data validity tests include the Credibility Test (internal validity), Transferability (external validity), Dependability (reliability) and Confirmability (objectivity) ¹⁵.

RESULTS

This study obtained 34 subjects with the purposive technique, and the data obtained from these subjects had reached saturation. The characteristics of the research subjects are shown in Table 1.

Table 1. Characteristics of Research Subjects

Research Subject	Total
Main Subject	
Criteria:	
- Jampersal maternity mothers	2 people
- Non-Jampersal maternity mothers	3 people
- Maternity mothers in shaman	2 people
- Jampersal maternity mothers and referred	2 people
- Jampersal maternity mothers and referred	5 people
- Jampersal maternity mothers and referred	1 people
Significant Other	
- Father (Male, 18 - 45 years old, married, not the spouse of the postpartum respondent)	2 people
- Father with postpartum mother died	2 people
- Father with postpartum mother died	2 people
- Father with postpartum mother died	5 people
- Parents/in-laws living in the same house	
- Baby Shaman	
- Jampersal program manager	
- Doctor	
- Midwife Coordinator of MCH Clinic	
- Cadres	
Ethnicity :	
- Madurese Tribe	18 people
- Javanese Tribe	16 people

Education :

- Elementary School	7 orang
- Junior High School	12 orang
- Senior High School	10 orang
- College	5 orang

Predisposing Characteristics in Jampersal Utilization

High predisposing characteristics related to the utilization of the Jampersal program are based on four aspects including: 1). demographic structure aspect, 2). cultural aspect, 3). knowledge aspect, and 4). perception aspect ¹⁶.

1. Demographics in Jampersal Utilization

Respondents' views on pregnancy were divided into two groups, namely (1) rural groups who considered pregnancy a natural or normal condition and (2) urban groups who considered pregnancy a different condition from conditions without pregnancy. This study was conducted at Puskesmas Mumbulsari, a rural area, and Puskesmas Gladak Pakem, an urban area. The absorption of the Jampersal program in urban areas, namely Puskesmas Gladak Pakem, is higher than in rural areas, namely Puskesmas Mumbulsari.

2. Culture of Jampersal Utilization

These views on pregnancy and puerperium influence the choice of place and birth attendant. Respondents from rural groups who considered pregnancy natural or normal conditions preferred TBAs. The reasons for this are that traditional healers are considered more painstaking than midwives, traditional healers are cheaper, mothers can give birth at home and pregnant women refuse to be told that their pregnancies are problematic by midwives. Meanwhile, respondents from the urban group who considered pregnancy unusual preferred midwives or health workers for ANC (antenatal care) and used jampersal when giving birth Table 2.

Table 2. Reasons for choosing a midwife or traditional birth attendant for delivery

Reasons for choosing a midwife	Reasons for Choosing a Shaman
Shaman's ability is limited	Shamans are more painstaking
"I am afraid. Because if there is anything during childbirth like bleeding, the traditional healer cannot handle it." (Bulin jampersal-referred, 32 years old, junior high school, Gladak pakem) Educated and experienced midwives	"Yes, I was massaged, yes, I was waited on. Even though the baby is screaming, it is left alone." (TBA, 50 years old, elementary school, Gladak Pakem) Shaman are cheaper "If you have 10 [10,000] after giving birth, you give 10 [10,000 to reward the traditional healer]." (In-depth interview, father) Can meternity at home
"Midwives have gone to school...they are experienced." (Bulin health worker-non jampersal, 25 years old, junior high school, Gladak Pakem)	"I [Midwife] take comfort at home. While watching the child]." (Bulin dukun, 30 years old, junior high school, Gladak Pakem) The pregnant mother refused to be told that her pregnancy was problematic by the midwife. "When she was pregnant. Being told by the midwife that she was at high risk, she was afraid to visit the midwife again. She goes to a traditional healer." (Jember District Health Office staff)

This study found that the decision-makers in the family are very diverse, namely the husband, wife, parents, in-laws or extended family. Several factors were found in this study that determine the decision maker: the independence of a family, ethnicity, the status or position of the husband/wife in the family, and the age of the pregnant wife/mother.

Families with independent husbands and wives are more free to decide on their birth attendants. Whereas those who still live with parents and in-laws, the decision is still determined by the in-laws. Long negotiations to agree on a referral are common in Madurese families.

"Madura it is. Yes, rembugan [negotiation] first. Rembugan kari suwi [negotiation for a long time])...this one wants to bring it quickly. Sik rembugan [still negotiating] this and that...even though there is already jampersal." (Subject 15, 50 years old)

3. Knowledge in Jampersal Utilization

Researchers found that people who were late in realizing the signs of puerperal emergencies were generally those who considered the puerperium as a normal thing, so when midwives or health workers informed puerperal women, their husbands, and families that there were signs of puerperal emergencies that required referral to advanced health services, they did not immediately respond well to the information. They preferred to go to traditional healers, even though health workers had also explained that the cost of treatment would be covered by jampersal. As revealed by subject 2 as follows.

"She [the mother] is pregnant with high risk and has been told... "mom, it will be very dangerous if you give birth at home, especially if a traditional healer helps you. The mother, her husband and family should prepare themselves to be referred to the hospital with the costs covered by Jampersal." But with conditions like this, they run to the traditional healer again when signs of labour occur. That's why there are still deaths of mothers who traditional healers help. The officers have done their best." (Subject 21, 54 years old)

This study found that the jampersal program reduced community trust in traditional healers and increased trust in midwives or health workers. However, the jampersal program has not been able to bridge social barriers between midwives or health workers and the community. Midwife respondents suggested that the jampersal program could not

overcome the community's low knowledge of childbirth emergencies and the importance of immediate referral to the most appropriate health service.

4. Perceptions on Jampersal Utilization

Respondents from the healthcare group and the PKK activist team in in-depth interviews stated that the community was happy to use the jampersal program because it was not restricted to certain groups. Unpleasant experiences when using previous health insurance such as jamkesmas can lead to unfavourable perceptions of subsequent health insurance including jampersal. Lengthy procedures and the need to give money to administrative staff to speed up the process are the main causes of their difficulties in utilizing health insurance. Subject 3 expressed this as follows.

"Sometimes you have to go to the village hall...to sign. Going to the puskesmas to refer, it's still difficult. It depends on the village officials, Mbak. If there is no tip, sometimes it is not done quickly." (Subject 22, 45 years old)

DISCUSSION

Predisposing Characteristics in Jampersal Utilization

Different predisposing characteristics about pregnancy, childbirth and postpartum care create gaps in the uptake of Jampersal. This finding is in line with research showing that maternal health status is also related to demographic factors, culture, knowledge and perceptions.

a. Demographic Structure in Jampersal Utilization

Based on the research that has been conducted, the community's awareness to check themselves and the baby after giving birth to a midwife or health worker is strongly influenced by the understanding of the postpartum condition itself. As the results obtained, the Madurese are more likely to go to traditional healers than the Javanese. This is because the understanding itself is influenced by the strong belief of the Madurese in the traditions that are still believed. This finding is supported by

Yuliyani's research which shows that maternal health status is also related to the mother's own education, environment and culture ¹⁷.

From the results of the study it was also found that in some communities decision making is still influenced by prevailing cultural values, where there are factors that influence these conditions, namely ethnicity factors (Madurese in Jember Regency generally involve extended family in decision making) and factors of husband-wife independence (living with parents / economically dependent). Suppose you look at the belief or culture that is still strong, especially in the Madurese community in Jember Regency. In that case, it is very necessary to have a counselling process aimed at this community/group of poor people who need jampersal assistance the most.

b. Culture in Jampersal Utilization

The existence of a tendency to tradition, such as more trust in traditional healers and the assumption that pregnancy and childbirth are natural or normal conditions, as well as a culture of decision-making that is less favourable to the authority of pregnant women/maternity, is very unfavourable for programs to improve maternal health status. There is a diversity of perspectives on postpartum conditions found in this study related to the support provided by husbands, parents, and families, to postpartum women. The results showed that support or assistance to postpartum mothers/wives was not obtained from community groups who considered the postpartum period as a normal condition. This is in line with the research of Kurniasih et al. (2021), which shows that the postpartum period is often considered a normal, natural process after childbirth, so many do not seek maternal health services because they do not know that there are postpartum problems ¹⁸.

c. Knowledge in Jampersal Utilization

The postpartum period is a risky period and needs special attention to avoid conditions that can threaten the mother's life. The best way to avoid risk is to provide fast and appropriate health services, especially during emergencies. As mentioned in the specific objectives of the jampersal program, the jampersal program aims to increase the coverage of assistance by health workers ¹⁹.

This study found that people still trust

traditional healers more than midwives or health workers¹⁷. The results of the study showed four main reasons for maintaining the tradition of going to traditional healers, namely that traditional healers are considered more painstaking, cheaper than midwives, treatment can be done at home, and refusing to be said to be serious by health workers. The helper's painstakingness, patience, and emotional closeness are indeed very helpful for mothers through the postpartum period¹⁹.

d. Perceptions of Jampersal Utilization

Generally, their perception of jampersal is that it is a free or cheap maternal and child program from the government and is intended for all groups of society. Financial reasons encourage them to take advantage of the jampersal program.

The misunderstanding that occurs in the community about the jampersal program is an indicator of disharmony in coordination between the health sector and local government to communicate the use and benefits of the jampersal program²⁰. Based on the results of this study, health professionals, as well as local government at the lowest level, should use every opportunity to promote the use, understanding and benefits of health insurance to the community. The limitations of this study is, this study could not measure the amount of community behavior in the utilization of jampersal. The research site was limited to two puskesmas, namely umbulsari puskesmas and gladak pakem puskesmas and the theoretical approach is limited to Anderson's theory.

CONCLUSION

Predisposing factors based on aspects of demographic factors, behavioral factors, knowledge factors and perception factors are related to the utilization of Jampersal in Jember District. The community did not utilize Jampersal due to lack of socialization and occurred in mothers with low education levels. The lack of maternal knowledge about Jampersal, symptoms and signs of labor and safe delivery led to delays in decision-making to deliver at health facilities. There are differences in decision-making in rural areas determined by parents while in ordinary areas determined by husbands, labor generally takes

place in the parents' home.

Enabling factors based on aspects of access to facilities and infrastructure related to the utilization of Jampersal in Jember district. This study found that distance and availability of transportation were not the main barriers to using the Jampersal program.

Need factors based on perceived needs at the time of delivery emergencies related to using Jampersal in Jember District. This study found the inability of Jampersal to eliminate the economic burden that the community must bear as a whole related to pregnancy and childbirth because the costs that need to be incurred are not only the costs for the delivery process, but also other costs after childbirth, and the costs of supporting family members who are left behind.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Fadhlorrohman MI, Purnomo EP, Malawani AD. Analysis of sustainable health development in Indonesia (sustainable development goal's). *Jurnal Kesehatan Lingkungan Indonesia*. 2020;19(2):133-43. <https://doi.org/10.14710/jkli.19.2.133-143>
2. Mittelmark MB. Millenium Development Goals. *Glob Health Promot*. 2009;16(4):3-89. <https://doi.org/10.1177/1757975909348140>
3. Dinas Kesehatan Kabupaten Jember. *Profil Kesehatan Kabupaten Jember 2020*. Dinas Kesehatan Kabupaten Jember; 2020.
4. Pitrianti L, Syakurah RA. Analisis Program Pelayanan Kesehatan pada Ibu Hamil dan Melahirkan Dinas Kesehatan Rejang Lebong. *JAMBI MEDICAL JOURNAL" Jurnal Kedokteran dan Kesehatan"*. 2022 May 30;10(1):81-100.
5. Isabela M. Evaluasi Pemanfaatan Jaminan Persalinan Di Kabupaten Rote Ndaoprovinsi Nusa Tenggara Timur. *Jurnal Kebijakan Kesehatan Indonesia: JKKI*. 2018 Sep;7(3):140-6.
6. Mulyadi M. Peran Pemerintah Dalam Mengatasi Pengangguran Dan Kemiskinan Dalam Masyarakat.

- Kajian. 2017 May 21;21(3):221-36.
7. Rokhmah F, Muniroh L, Nindya TS. Hubungan Tingkat kecukupan energi dan zat gizi makro dengan status gizi siswi SMA di Pondok pesantren Al-Izzah Kota batu. *Media Gizi Indonesia*. 2016 Jun;11(1):94-100.
 8. Fadli MR. Memahami desain metode penelitian kualitatif. *Humanika, Kajian Ilmiah Mata Kuliah Umum*. 2021 Apr 30;21(1):33-54.
<https://doi.org/10.21831/hum.v21i1.38075>
 9. Langdridge D. Phenomenology and critical social psychology: Directions and debates in theory and research. *Social and personality psychology compass*. 2008 May;2(3):1126-42.
<https://doi.org/10.1111/j.1751-9004.2008.00114.x>
 10. Nurdiani N. Teknik sampling snowball dalam penelitian lapangan. *ComTech: Computer, Mathematics and Engineering Applications*. 2014 Dec 1;5(2):1110-8.
<https://doi.org/10.21512/comtech.v5i2.2427>
 11. Nizza IE, Farr J, Smith JA. Achieving excellence in interpretative phenomenological analysis (IPA): Four markers of high quality. *Qualitative Research in Psychology*. 2021 Jul 3;18(3):369-86.
 12. Pramana NA, Masykur AM. Cosplay Adalah “Jalan Ninjaku” Sebuah Interpretative Phenomenological Analysis. *Jurnal Empati*. 2020 Jan 21;8(3):646-54.
<https://doi.org/10.14710/empati.2019.26508>
 13. Purnamasari AP, La Kahija YF. Mengajar Sembari Belajar: Sebuah Interpretative Phenomenological Analysis Tentang Pengalaman Pengajar Muda Gerakan Indonesia Mengajar. *Jurnal Empati*. 2020 Jun 27;7(3):1020-30.
<https://doi.org/10.14710/empati.2018.21849>
 14. Nurdiah RS, Iman AT. Analisis penyebab unclaimed berkas BPJS rawat inap di RSUD Dr. Soekardjo Tasikmalaya. *Jurnal Manajemen Informasi Kesehatan Indonesia*. 2016 Oct 1;4(2), 23–28.
<https://doi.org/10.33560/v4i2.128>
 15. Sugiyono. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta; 2017.
 16. Mahmud Y. Studi Pemanfaatan Antenatal Care Pada Ibu hamil di Puskesmas Aeng-Towa. *Jurnal Ilmiah Kesehatan Sandi Husada*. 2020 Jun 30;9(1):505-11.
<https://doi.org/10.35816/jiskh.v11i1.337>
 17. Yuliyani Y. Karakteristik Ibu Dan Post Natal Treatment (PNT) Berhubungan Dengan Terjadinya Postpartum Blues Ibu Nifas. *Care: Jurnal Ilmiah Ilmu Kesehatan*. 2019 Jul 19;7(2):69-75.
<https://doi.org/10.33366/jc.v7i2.1319>
 18. Kurniasih NI, Heriana C, Soviyati E, Apriyanti R. Hubungan Lama Kala Iii Persalinan Dengan Kejadian Perdarahan Pada Ibu Post Partum Di RSUD 45 Kuningan. *Journal of Public Health Innovation*. 2021 Jun 21;1(2):142-8.
<https://doi.org/10.34305/jphi.v1i2.302>
 19. Hasanah H. Teknik-teknik observasi (sebuah alternatif metode pengumpulan data kualitatif ilmu-ilmu sosial). *At-Taqaddum*. 2017 Jan 5;8(1):21-46.
<https://doi.org/10.21580/at.v8i1.1163>
 20. Mukhlisa MN, Yoga I, Tristiana N, Estetika R, Haryani W. Evaluasi Implementasi Jaminan Persalinan (Jampersal) di Indonesia. *Jurnal Ekonomi Kesehatan Indonesia*. 2021 May 31;5(2), 89–101.
<https://doi.org/10.7454/eki.v5i2.4902>

Original Article

Engklek as Media Edugames to Improve Knowledge and Attitudes About Waste Classification and Management of Students

Elvi Sandra Widarto¹, Heru Subaris Kasjono^{1*}, Sri Haryanti¹

¹Department of Environmental Health, Politeknik Kesehatan Kementerian Kesehatan Yogyakarta, Yogyakarta, Indonesia

(Correspondence author's e-mail, heru.subarisk@poltekkesjogja.ac.id, +6282136677760)

ABSTRACT

Low knowledge and attitudes related to awareness of waste classification and management in children aged 10-12 years. One of the efforts to increase knowledge and attitudes in waste classification and management is the engklek media. This study aims to determine how using engklek as educational media increases knowledge and attitudes about waste classification and management. This study uses a research design, a non-equivalent control Group. The population studied was all SD Keputran 1 Yogyakarta students, as many as 59 students in collecting data using Non-Random Sampling. The data analysis used was quantitative data analysis using the Microsoft Excel 2016 program and the IBM SPSS Statistik 23 program. From this univariate analysis, an average knowledge score was obtained. The pre-test was 4.42, and the post-test was 8.07. While the average attitude score pre-test obtained 36.96, the post-test obtained 47.54 with a p-value of 0.000. Based on the study's results, it can be concluded that the crank game is more effective for increasing knowledge and attitudes about waste classification and management.

Keywords: Crank, Edugames Media, Waste, Knowledge, Attitudes

<https://doi.org/10.33860/jik.v17i2.2056>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

In Yogyakarta, the amount of waste produced by the community in 2022 is 1,133.94 tons/day¹. Based on data on waste generation generated by sources of waste in public facilities such as educational facilities, it reaches 6.8%. The amount of waste that has not been managed properly is 10,116,203.57 tons/day with a percentage of 35.3%². Judging from these data, it can be concluded that many residents still have not managed the waste they produce every day properly and correctly, so the amount of waste generated is still very large.

Health problems that occur from accumulated waste can be transmitted through animals and disease-carrying vectors that carry pathogenic bacteria that cause disease, one of which is diarrhea. This problem is also often found in elementary school education facilities, this is due to the habits of students who do not

maintain personal hygiene and low awareness of environmental cleanliness. Data on cases of diarrhea for the age group 5-14 years occurred as many as 182,338 with a percentage of 6.2%³.

According to previous research, it has been proven that there is an influence between the level of knowledge about sustainable waste management and the behavioral intention of waste management. Therefore efforts are needed to increase knowledge from an early age to elementary school regarding waste classification and management⁴. Counseling can be done by providing material with various media to make it easier to accept new knowledge conveyed by extension workers⁵.

Engklek is a traditional game that is drawn in checkers and has several forms, one of which is a mountain crank, where the highlight of this game is a semicircular shape resembling a mountain⁶. Edugames are learning media in

the form of games to make it easier for students to absorb new knowledge. The use of counseling media, in addition to arousing enthusiasm, willingness, and desire to learn, also affects student psychology⁷.

This game is done together so that it is required to socialize directly and therefore can also improve good socialization. This hopscotch game aims to develop gross motor skills such as standing on one leg, climbing, running, jumping, kicking, and somersaults. In addition, to train body balance, agility, strength, speed, flexibility, and accuracy of body coordination with the eyes⁸.

Based on the results of a preliminary survey conducted on Tuesday, 6 September 2022, at SD Negeri Keputran 1 Yogyakarta, it is known that there is still trash that has not been disposed of in the trash and is still scattered in front of the classroom. The trash cans provided by the school management are only trash cans without lids, trash baskets that are not watertight, and only one waterproof trash can with a lid. There is only one trash can at several points in the school environment. The trash found on average is plastic waste used for snacks, used snacks, milk boxes. The results of interviews with students found that they still like to litter. The school principal also revealed that he had never given all of his students material on waste classification and management.

This study aims to determine the effect of using crank games as medium *edugames* to increase knowledge and attitudes in managing and classifying waste in class V SD Keputran 1 Yogyakarta.

METHODS

This type of research uses *Quasy Experience* with research design *Non Equivalent Control Group* which used two groups, namely the control group and the experimental group with two treatments, namely before and after treatment. The samples

taken in this study were 59 children who were taken using the Non-Random technique with a total sampling system, which means using the entire class V sample population. The control and experimental groups were also directly selected by the researcher taking into account the number of students in the class.. There were 31 students in class 5 A as the control group and 28 students in class 5 B as the experimental group.

The control group was given an explanation regarding the classification and management of waste using poster media, while the control group used engklek media which contained material on waste classification and management. Then the researcher can compare the results of *the test & post-test* in each group as well as know the effectiveness of using engklek media.

This research was conducted in September 2022 – February 2023 at SD Keputran 1 Yogyakarta. Data collection techniques in this study used direct interviews with school principals and observation. The dependent variable in this study is knowledge and attitude towards waste classification and management.

The instrument for measuring the level of knowledge and attitudes used in this study is a questionnaire, which has been tested for validity and reliability. Question naires to measure the level of knowledge using a multiple choice questionnaire and while using an attitude questionnaire *checklist*. The results of the validity testr-count0.534 – 0.813 can be seen so that it is declared valid. While the results of the reliability test are known as *Cronbach's Alpha* of 0.814 – 0.888 so that it is declared reliable.

Univariate analysis in this study used frequency distribution tables and bivariate analysis to determine the effect of using a crankshaft as a medium *edugames* to increase knowledge and attitudes using the Paired Sample T and Mann Whitney tests. This research was conducted after obtaining approval from the principal of SD Keputran 1 Yogyakarta.

RESULTS

Table 1. Characteristics of Research Respondents Based on Gender and Age in the Control and Experiment Groups.

Characteristics	Control Group		Experiment Group		p-Value
	Amount	Presentase	Amount	Percentage	
Gender					
Man	17	54,8%	15	53,6%	0,851
Woman	14	45,2%	13	46,4%	

Age					
10 years	2	6,5%	2	7,1%	0,772
11 years old	29	93,5%	24	85,7%	
12 years old	0	0%	2	7,1%	

The homogeneity test based on the table above shows that in the control and experimental groups the sex characteristics are known to have a p-value of 0.851 while age characteristics are known to have a P value of 0.772. Significance p-value > 0.05, in the control and experimental groups p > 0.05, which means there is no significant difference in the characteristics of sex and age. It can be concluded that the characteristics of the sex and age of the control and experimental group respondents are homogeneous.

The results of the measurement values of knowledge and attitudes are entered into *dummy table* to find out the difference in the results of *pre-test* & *post-test*. After being treated with crank game media in the experimental group, it can be seen that there are 8 students with sufficient knowledge with a percentage of 28.57%, and students with good knowledge as many as 20 with 71.42%. In the

treatment with crank game media in the experimental group can be seen that there are 28 students with a good attitude with a percentage of 100%.

Based on the results of calculations using *dummy table* in excel, the average post test value of knowledge in the control group was 5.68, which was higher than the average pre test knowledge value of 4.35 with an increase rate of 25.18. Meanwhile, the average post-test score is 38.52, higher than the average pre-test practice value of 32.45 with an increase rate of 15.6.

Whereas in the experimental group, the average post-test value of knowledge was 8.0.7, which was higher than the average pre-test knowledge score of 4.42 with an increase rate of 45.37. Meanwhile, the average post-test value for attitude is 47.54, which is higher than the average pre-test value for practice, which is 36.96 with an increase rate of 22.2.

Table 2. Test Results for Differences in Pre-Test and Post-Test Values for Knowledge with Tests Paired Sample T-Test

Group	p-value	Information
Poster Media (Control)	0,000	There is a significant difference
Media Crank (Experiment)	0,000	There is a significant difference

In the table above, the value of knowledge in the control group and the experimental group is Sig (p-value) 0.000. From these results, sig (p-value) < 0.05 means

that there is a significant difference between the pre-test and post-test differences in knowledge about waste classification and management in SD Keputran 1 Yogyakarta students.

Table 3. Test Results for Different Pre-Test and Post-Test Values for Attitudes with Tests Paired Sample T-Test

Group	p-value	Information
Poster Media (Control)	0,000	There is a significant difference
Media Crank (Experiment)	0,000	There is a significant difference

In the table above, the value of knowledge in the control group and the experimental group is Sig (p-value) 0.000. From these results it can be seen that sig (p-value) < 0.05 means that there is a significant

difference between the pre-test and post-test differences in attitudes about waste classification and management in SD Keputran 1 Yogyakarta students

Table 4. Test Results for Differences in Pre-Test and Post-Test Values on Knowledge Between Groups with Tests Mann Whitney

Group	Sig. (2-tailed)	Information
Poster Media (Control)	0,000	H ₀ rejected H _a accepted
Media Crank (Experiment)		

In the table above the control group and the experimental group obtained sig. (2-tailed) < 0.05, which is equal to 0.00, this means that H₀ is rejected, H_a is accepted. This means that there is a significant difference between the

control group using poster media and the experimental group using the crank game media as an educational medium to increase knowledge about waste classification and management.

Table 5. Test Results for Differences in Pre-Test and Post-Test Values Against Attitudes Between Groups with Tests *Independent Sample T-Test*

Group	Sig. (2-tailed)	Information
Poster Media (Control)	0,000	H ₀ rejected H _a accepted
Media Crank (Experiment)		

In the table above the control group and the experimental group obtained sig. (2-tailed) < 0.05, which is equal to 0.00, this means that H₀ is rejected, H_a is accepted. This means that there is a significant difference between the control group using poster media and the experimental group using the crank game media as an educational medium to increase knowledge about waste classification and management. This is because respondents prefer games, have enthusiasm and appear enthusiastic in participating in crank games as educational media. In the crank game there is writing that looks big and clear, pictures that are more varied about waste classification and management and are more colorful.

respondents to understand the information. The use of poster media also has an influence on the activity of providing information or learning materials, this is because poster media can help overcome problems in understanding and receiving information in children⁸.

When compared with engklek media, the increase in the value of knowledge and attitudes in counseling with media posters is lower than counseling using engklek game media⁶. This is because the respondents only received information in a sitting manner that they felt was boring, lacking interaction and approach with researchers and attracted less attention.

DISCUSSION

The Effect of Providing Poster Media on the Level of Knowledge and Attitudes of Students in Waste Classification and Management

The use of poster media on waste classification and management to increase knowledge and attitudes shows an increase in the results of the difference in value *pre test* and *post test* before and after being given treatment. Based on the statistical test results, it is known that the p-value is 0.000. In this group there was an increase in the value of knowledge by 25.18% and the value of attitude by 15.6%. This study's results align with research by Nurcahyani, which shows the results of increasing the value of knowledge by 52.3% by using poster media⁶.

The Influence of Giving Cenglek Game Media to the Level of Knowledge and Attitudes of Students in Waste Classification and Management

The use of engklek media as media *edugames* regarding the classification and management of waste in increasing knowledge and attitudes shows an increase in the results of the difference in value *pre test* and *post test* before and after being treated with known value *p-value* 0.000. It is known that the increase in the value of knowledge is 45.37% and the increase in the value of attitude is 22.2%. This is due to the use of appropriate media so that it can make it easier for respondents to capture and understand the information provided quickly during counseling⁹.

Posters are visual media that involve 30% of the senses of sight, so that more respondents receive counseling information because they involve the senses of sight a lot⁷. The poster also contains the essence of the information to be conveyed, making sentences more efficient and making it easier for

The results of this study align with research conducted by Agustina which shows that there is an increase in the ability to explore new student knowledge and teacher teaching skills, indicating an increase from cycle I to 64% and cycle II to 92%¹⁰.

All respondents enthusiastically participated in the crank game about waste classification and management during the game. Before starting the game the researcher

gave an explanation of the ways and rules of the game, then the respondents began to play the game alternately and cooperatively. Respondents who can throw the gacuk on the plot can continue the game by jumping on one foot and passing through a plot that has the gacuk. Then take the quiz paper to be discussed in the group and answer the quiz questions. Respondents were judged to be quicker in understanding waste classification and management material using the engklek game as media. Thus, this hopscotch game can increase respondents' enthusiasm so that respondents are also seen to be active in information delivery activities. So that these findings also support previous research related to means of conveying information or learning materials with traditional games, this is because traditional games can involve respondents more actively in participating in these activities¹¹.

It is known that several factors influence the increase in knowledge and attitudes of students by using crank games as edugames media, namely play media that are fun and liked by children and are designed to be more attractive because there are many colors and varied images. This can lead to a sense of excitement so that students' interest in participating in counseling also increases. In addition, the engklek game media uses the senses of sight (30%) and the sense of hearing (10%), where while playing they will read and answer questions and see the design of the pictures and writing contained in the game. Basically, humans learn through what is seen and heard, humans are said to learn as much as 50%. If the more senses of the body are used, the more messages and information the brain receives¹². In addition, the hopscotch game media is designed to be bigger using banners and has a different color, so that it raises the curiosity and interest of the respondents.

The Effectiveness of Cenglek Game Media and Posters on Differences in Average Values of the Level of Knowledge and Attitudes Before and After the Intervention of Each Group

In the test results, the average difference in knowledge and attitude with the pre-test and post-test questionnaires in the control group and the experimental group obtained a p-value of 0.000 so that it can be concluded that the engklek game as an

educational media about waste classification and management is considered more effective than poster media. in increasing the knowledge and attitudes of elementary school students. This is because learning while playing is preferred by children.

When the researcher explained how to play and the playing rules, the respondents immediately became interested in this modified crank game, this was due to their curiosity about the shape and design of the crank game. In general, every child has a high curiosity, where his curiosity begins by asking questions about things he sees, hears, observes, and so on¹³.

The results of this study are in line with the research conducted by Herawati which obtained the results from the percentage of the experimental group I, namely by playing crank games increasing students' knowledge experienced an increase in scores where the difference in the post test was higher than the pre test. The hopscotch game with an average of 33.30 is the most effective increase in knowledge. Based on the results of the pre-test and post-test, the average attitude score in the experimental group I increased. It is known that the results of the statistical analysis of differences in the pre-test and post-test attitudes in the experimental group I obtained a p value <0.05, which means there is a significant difference. The respondents' interest occurred in children who had an interest in traditional games. So it can be concluded that the hopscotch game is effective for increasing students' knowledge and attitudes. This is because when playing it is very possible for repetition of questions to occur because pawns in the crank game that fall right on the same box can occur more than once¹⁴.

The results of this study align with research conducted by Irbah who used the crank game which showed differences in knowledge and behavior scores before and after being given treatment¹⁵. This is because the hopscotch game is included in learning by providing simulations, where this method has the advantage of increasing the participation of respondents in an activity. This method also provides a more relaxed atmosphere and is able to understand problems in everyday life.

The sensory organs of the human body are factors that can affect the level of knowledge and attitude, one of which is the use of the crank game media because when the respondent plays the crank media using his eyes

and ears, where in this game the respondent will see pictures and writing on the crank game design and read and answer questions provided by the researcher¹².

The hopscotch game can also develop children's logical intelligence, this is because the child who plays the hopscotch media must be able to count and determine the steps that must be passed in the game¹⁶. The material for classifying and managing waste uses appropriate methods and media for respondents, so that respondents can receive and capture the information conveyed by researchers properly. The use of poster media was also considered boring because the respondents only sat and listened to the delivery of information.

The use of traditional game media such as hopscotch can have a major influence on the development of psychology, character and social life in the future. This game moves and uses the muscles of the body such as the leg muscles in jumping, flexibility of the limbs and maintaining body balance, stimulating the senses of the body and exploring the surrounding environment. Apart from that, the angklek also provides training in the skills and agility of the players¹⁷.

Compared to the use of poster media as a means of conveying information about waste classification and management, the engklek game is used as a medium *edugames*. This has other benefits, namely training gross motor skills such as running, jumping, walking. This gross motor uses the muscles of all body parts and large body parts such as moving activities. Children who have good motor skills will have good mental development too¹⁸. It can be seen that respondents who were given the hopscotch game treatment had higher scores because the gross motor system worked well and this game could make it easier to understand the material.

CONCLUSIONS

Based on the results of the research that has been done, it can be concluded that there is an effect of using the crank game as a media for educational games about waste classification and management to increase knowledge and attitudes.

This media can be played anywhere and anytime as waste classification and management information for other students. This media requires someone who understands waste classification and management as a game

facilitator and assessor.

ACKNOWLEDGMENTS

Acknowledgments are given to the Principal of SD Keputran 1 Yogyakarta who has given permission to carry out this research and the respondents of class V SD Keputran 1 Yogyakarta who also contributed to this research.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Hijriani H, Agustini A, Karnila A. Knowledge of Healthy Clean Living Behavior (PHBS) in Children with Diarrhea at Class B General Hospital, Subang Regency. *J Heal Science* [Internet]. 2020;1(5):1–7. Available from: <https://media.neliti.com/media/publications/330916-knowledge-perilaku-life-clean-health-fb5d7430.pdf>
2. Astriani M, Angraini E, Kholillah. Counseling on Waste and its Processing Techniques in Kelurahan 14 Ulu Palembang. *J SOLMA* [Internet]. 2020;9(2):361–6. Available from: <https://journal.uhamka.ac.id/index.php/solma/article/view/3084/1981>
3. Annur MN, Sumarwiyah, Purbasari I. Media Engklek Gunung to Improve Learning Outcomes of Grade V Students at Public Elementary School 1 Payaman. *EduBase J Basic Educ* [Internet]. 2020;1(2):102–13. Available from: <http://journal.bungabangsacirebon.ac.id/index.php/edubase/article/view/134/117>
4. Fitriyah A, Khaerunisa I. The Effect of Using the Modified Crank Game Assisted Drill Method on the Problem Solving Ability of Class VII Students. *J Medives J Math Educ IKIP Veterans Semarang* [Internet]. 2018;2(2):267–77.
5. Wiranti DA, Mawarti DA. The Effectiveness of Crank Playing in Developing Gross Motor Skills in Early Children. *J Science Education* [Internet]. 2018;9(1):66–74. Available

- from:
<http://jurnal.umk.ac.id/index.php/RE>
6. Nurcahyani WF, Rizka M, Rismayan R, Pradani SA, Astuti D, Haryani F, et al. Empowerment of the Sonorejo Village Community in the Context of Increasing Knowledge of Hypertension with Media Posters. *J War LPM* [Internet]. 2021;24(4):656–66. Available from: <https://journals.ums.ac.id/index.php/warta/article/view/14730/6985>
 7. J H, Oktavidiati E, Astuti D. Effect of Health Education Media Videos and Posters on Children's Knowledge and Attitudes in Diarrhea Prevention. *J Kesmas Asclepius* [Internet]. 2019;1(1):75–85. Available from: <https://journal.ipm2kpe.or.id/index.php/JKA/article/view/747/424>
 8. Caesar DL, Prasetya BA. The Effectiveness of Poster Media in Increasing Basic Sanitation Knowledge at Wonosoco Undaan Kudus Sdn 01. *J-KESMAS J Public Health* [Internet]. 2020;6(1):83–91. Available from: <https://journal.lppm-unasman.ac.id/index.php/jikm/article/view/655/532>
 9. Nikhayah S, Murtono, Roysa M. Application of Numbered Head Together Assisted by Engklek Media to Improve Learning Outcomes of Elementary School Students. *J Educ FKIP UNMA* [Internet]. 2021;7(3):785–90. Available from: <https://ejournal.unma.ac.id/index.php/educatio/article/view/1284/812>
 10. Agustina E, Purbasari I, Ristiyani. Crankshaft Teaching Aid as an Effort to Increase Students' Ability to Explore New Knowledge. *J Science Educator* [Internet]. 2020;1(2):93–8. Available from: <https://jurnal.umk.ac.id/index.php/wasis/article/view/5082/2332>
 11. Mulyasari DW, Abdussakir, Rosikhoh D. The Effectiveness of Ethnomatematics Learning "Crank Game" on the Understanding of Elementary School Students' Geometry Concepts. *J Tadris Mat* [Internet]. 2021;4(1):1–14. Available from: <https://ejournal.uinsatu.ac.id/index.php/jtm/article/view/3478/1553>
 12. Arifin NF, Febriany M, Aldilawati S, Pamewa K, Masriadi, Khaeriah Y. Differences in Knowledge Levels Before and After 8-11 Years Old Crank Game Modification. *Sinnun Maxillofac J* [Internet]. 2020;02(01):18–25. Available from: <http://103.133.36.86/index.php/sinnunmaxillofacial/article/view/51/18>
 13. Wariyanti, Nur W, Ananda R. The Development of Social Emotional Aspects and Early Childhood Science Through Traditional Engklek Games. *J Basicedu* [Internet]. 2022;6(3):5351–61.
 14. Herawati V, Kasjono HS, Windarso SE. Engklek and Monopoly as Media to Improve DHF Vector Control Behavior in Karangjati Elementary School Students, Bantul. *J Environmental Health* [Internet]. 2018;10(1):21–31. Available from: <http://ejournal.poltekkesjogja.ac.id/index.php/Sanitas/article/download/779/544>
 15. Irbah N, Yuhandini DS, Vimala D. Health Education Through the Media of Crank Games on Reproductive Health Knowledge and Behavior in Grade 5 Students at Jagasatru I 2020. *J Ilm Pannmed (Pharmacist, Anal Nurse, Nutr Midwifery, Environment, Dent Hyg)* [Internet]. 2020;15(2):313–20. Available from: <http://ojs.poltekkes-medan.ac.id/pannmed/article/view/750/569>
 16. Ayuningtyas EE, Hidayat S, Nur L. The Influence of Traditional Engklek Games on Students' Self Control in Elementary Schools. *J Abmas* [Internet]. 2022;22(1):1–14.
 17. Rozana S, Pillow A. Stimulation of Early Childhood Development Through Traditional Engklek Games [Internet]. 1st ed. Kholik N, editor. Tasikmalaya, West Java: Edu Publisher; 2020.
 18. Indriyani D, Muslihin HY, Mulyadi S. Benefits of Traditional Angklek Games in Children's Gross Motor Aspects. *J Undiksha Early Childhood Educator* [Internet]. 2021;9(3):349–54.

Original Article

Health Education and Assistance as an Empowerment Model in Improving the Quality of Family Latrines

Omo Sutomo^{1*}, Yayah Rokayah¹, Wasludin²

¹ Department of Midwifery, Poltekkes Kemenkes Banten, Rangkasbitung, Banten Province, Indonesia

² Department of Nursing, Poltekkes Kemenkes Banten, Serang, Banten Province, Indonesia

(Correspondence author's, e-mail, utamaraja65@gmail.com /+62 821-1213-3747)

ABSTRACT

There are still many areas in Indonesia that do not have adequate access to sanitation facilities, including family latrines. Especially in rural and suburban areas, sanitation infrastructure is poor, so people still rely on open defecation practices. This research aims to determine the effect of Health Education through assistance and Community Empowerment in increasing the use of family latrines that fulfil sanitation requirements. The research design uses a quasi-experiment with a multiple time series design (pre-test and post-test with control group design). The research was conducted in the working area of the Mekarsari Public Health Center, Lebak-Banten Regency. The intervention group comprised 88 families, and the control group had 88 families. The test used t-test statistical analysis to determine the differences before and after treatment about the quality of family latrines. The study results showed an increase in the average family latrine quality score and minimum and maximum score in the control group after being given health education about healthy latrines. There was a significant increase in the average family latrine quality score and minimum score in the intervention group after being given health education about healthy latrines. There was a difference increase in the deviation (after-before) in the family latrine quality score between the control group (1.51) and the intervention group (3,30). Likewise, the minimum and maximum scores were higher than the difference in family latrine quality scores in the intervention group. Statistically, there is a difference in the average difference (after-before) in the latrine quality scores between the control group and the intervention group. In other words, there is an influence of the community empowerment model for the quality of family latrines (p=0,000).

Keywords: *Health Education, Assistance, Empowerment, Healthy Latrine*

<https://doi.org/10.33860/jik.v17i2.2791>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Indonesia is an archipelagic country with a large population, so sanitation problems become more complex and impact various aspects of life. The good sanitation is an important element that supports human health^{1,2}. The basic sanitation which still has many problems in a number of regions in Indonesia is the provision of healthy latrines for families. Many areas in Indonesia, especially in rural and isolated areas, still have limited access to proper toilet facilities^{2,3}. This condition can give a negative impact on public health and the environment.

The challenges that need to be overcome in improving sanitation include public awareness, education, and behavior change. The lack of public awareness and education about the importance of sanitation and hygienic practices. This can contribute to poor sanitation. The other challenges is by changing community behavior related to healthy sanitation and defecation habits with the culture and traditions that may not support good sanitation practices^{4,5}.

The poor sanitation quality can affect the level of public health. The poor sanitation conditions will negatively impact many aspects of life, starting from decreasing the quality of

the community's living environment, contamination of drinking water sources for the community, and increasing in several environmental-based diseases such as diarrhea and worms ⁶. This condition is certainly very concerning, considering its complex impact on the health of families and society ^{7,8}.

The various efforts have been done and continued by the government and the community, but the results still need continuous effort and hard work. One effort that can be made to improve environmental quality, including improving facilities for disposing of human waste, is through community empowerment ^{9,10}. With community empowerment, it is hoped that the community will increase their ability, motivation and participation in supporting community welfare efforts through the using of available community resources. Based on the description above, the problem of this research is how community empowerment affects the quality of family latrines in the Mekarsari Community Health Center area, Lebak Regency. To determine the influence of the community empowerment model on the quality of family latrines in the Mekarsari health center area, Lebak district.

METHOD

This research is quasi-experimental, with a multiple time series experimental design, pre-test and post-test with control group design. The population is all 3,875 families who have a family latrine (goose neck), with a sample of 176 (88 intervention group samples and 88 control group samples). This research is done in Mekarsari Lebak Regency in 2022. The empowerment model is carried out through health education about healthy latrines using pocket books and assistance four times in a month for the intervention group. Meanwhile, only health education regarding healthy latrines was carried out in the control group without assistance.

To obtain information on latrine quality, a pre-test was carried out on the latrine quality of all latrines in the research sample using an observation sheet. Then the measurements were carried out again (post-test) after treatment in the intervention group and control group. Statistical test with t test at alpha 0.05.

The research protocol received approval from the health ethics commission of the Ministry of Health Semarang Health Polytechnic with registration number 0305/EA/KEPK/2022. Written informed consent was obtained from all respondents.

RESULTS

Table 1. Average Family Latrine Quality Scores

Group	Average Score	
	Pre-test	Post-test
Control	5,90	7,41
Intervention	6,00	9,30

Table 1 above shows that the average scores of the control group and the intervention group before being given treatment (pre-test) were not much different, that is 5.90 in the control group and 6.00 in the intervention group. Meanwhile, the average scores in the control and intervention groups (post-test) were different, 7.41 in the control group and 9.30 in the intervention group.

Table 2. Differences in Average Latrine Quality Scores Before and After Treatment in the Control Group

Time	Mean	Min - Max	Change			p-value
			+	-	0	
Pre-test	5.90	4 - 7	80	0	8	0.000
Post-test	7.41	5 - 9				

Table 2 above shows an increase in the average score for family latrine quality and the maximum minimum score in the control group. After being given health education/counseling about healthy latrines, the assessment results showed that 80 latrines have an increasing score, while 8 latrines did not change in score. Statistically, there is a difference in the average score of latrine quality before and after being given education about healthy latrines (p= 0.000).

Table 3. Differences in Average Latrine Quality Scores Before and After Treatment in the Intervention Group

Time	Mean	Min - Max	Change			p-value
			+	-	0	
Pre-test	6.00	3 - 7	88	0	0	0.000
Post-test	9.30	8 - 10				

The test results of the difference in the average score of family latrine quality before and after treatment in the control group (table 3) show an increase in the mean latrine quality score and the maximum minimum score in the

intervention group. After being given health education/health counseling about healthy latrines and assistance for four weeks. The assessment results found that all (88) latrines have an increasing latrine quality scores after being given health education/health counseling about healthy latrines and assistance. Statistically, there is a difference in the average score of latrine quality before and after being given education about healthy latrines ($p = 0.000$).

Table 4. Difference in Average Deviation in Family Latrine Quality Scores (After-Before) Treatment Between the Control Group and the Intervention Group

Group	Mean	Min - Max	p value
Control	1.51	0 – 3	0.000
Intervention	3.30	2 – 5	

Table 4 above, it shows that there is a difference in increasing in the average deviation (after-before) in the latrine quality score between the control group (1.51) and the intervention group (3.30), as well as the minimum maximum score being higher, there is a difference in the latrine quality score in the intervention group. Statistically, there is a difference in the average deviation (after-before) in the latrine quality scores between the control and intervention groups ($p = 0.000$).

DISCUSSION

The assistance and empowerment showed an increase in the average quality score of family latrines used by the community. Mentoring and empowerment carried out systematically and planned contributes to family knowledge in understanding the form of a healthy family latrine and fosters a willingness to make changes to the quality of the latrine they own. Knowledge has an important role in fostering understanding and shaping a person's or family member's behaviour. Knowledge is a predisposing factor for the formation of behavior, in this case maintaining the quality of the family latrines^{11,12}. The better the family's knowledge and practices about healthy latrines will provide a better understanding, and furthermore it will encourage the formation of behavior to maintain the quality of the family's latrines. Behavior that is based on knowledge will be more lasting than behavior that is not based on knowledge^{13,14}.

The families who had latrines in the control and intervention groups before receiving treatment had low knowledge and understanding of quality family latrines. It is possible that the family has a latrine without adequate understanding and experience, so there is a low average score when the initial observation is carried out. This differs from the average score obtained after treatment, especially in the intervention group, where the increase was higher than the control group. This research also shows that families receiving counselling and assistance had very high average scores. This is possible because families receive knowledge about healthy latrines and are assisted by cadres. Cadres, especially Posyandu cadres, are currently very necessary considering their closeness to families which can be used as a means to encourage the achievement of environmental health programs, especially about family latrines, both in quantity and quality. So it is very clear how important the role of cadres is in assisting families in maintaining the quality of family latrines. The role of cadres in mentoring can be as a motivator, facilitator and catalyst^{15,16}.

To obtain behavior in maintaining latrine quality, the role of health education and mentoring is very important. The families not only gain understanding but also receive awareness efforts and encouragement so that they recognize the potential and problems they face and develop their potential to solve these problems. The mentoring will create harmonious conditions and mutual learning within the group, and families can connect with institutions outside the group and other technical institutions, such as skills services and network development¹⁷.

CONCLUSION

Testing the educational model through a mentoring and empowerment approach in improving the quality of family latrine utilization in the Mekarsari Community Health Center area, Lebak Regency, increased the average family latrine quality score and the minimum score in the intervention group after being given health education about healthy latrines. The difference in average deviation (after-before) latrine quality scores between the control and intervention groups. In other words, there is an influence of the community

empowerment model to the quality of family latrines. The increase that occurs still needs continuous assistance and supervision by the community health center so that the use of healthy latrines becomes a community culture.

ACKNOWLEDGMENTS

This research was funded by the Banten Health Ministry's Poltekkes budget.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Tarlani T, Nurhasanah H, Destiani AT. Challenges and efforts for sanitation access growth in Indonesia. In: IOP Conference Series: Materials Science and Engineering. IOP Publishing; 2020. p. 32069.
2. Triasari D. Right to Sanitation: Case Study of Indonesia. *J Hum Rights, Cult Leg Syst.* 2021;1(3).
3. Odagiri M, Muhammad Z, Cronin AA, Gnilo ME, Mardikanto AK, Umam K, et al. Enabling factors for sustaining open defecation-free communities in rural Indonesia: a cross-sectional study. *Int J Environ Res Public Health.* 2017;14(12):1572.
4. Ganing A, Chairani M. Perilaku masyarakat terhadap sanitasi total berbasis masyarakat di kabupaten majene. *J Kesehat Manarang.* 2016;2(2).
5. Erna E, Yusuf A, Azis R. Analisis Perilaku Masyarakat Dalam Penggunaan Jamban. *J Ilm Kesehat Sandi Husada.* 2021;10(2):440–6.
6. Kurniawati DP, Arini SY, Awwalina I, Pramesti NA. Poor basic sanitation impact on diarrhea cases in toddlers. *J Kesehat Lingkung.* 2021;13(1):41.
7. Semba RD, Kraemer K, Sun K, De Pee S, Akhter N, Moench-Pfanner R, et al. Relationship of the presence of a household improved latrine with diarrhea and under-five child mortality in Indonesia. *Am J Trop Med Hyg.* 2011;84(3):443.
8. Chanda Shimi A, Ara Parvin G, Biswas C, Shaw R. Impact and adaptation to flood: A focus on water supply, sanitation and health problems of rural community in Bangladesh. *Disaster Prev Manag An Int J.* 2010;19(3):298–313.
9. Rahman H, La Patilaiya H. Pemberdayaan Masyarakat Melalui Penyuluhan Perilaku Hidup Bersih dan Sehat untuk Meningkatkan Kualitas Kesehatan Masyarakat. *JPPM (Jurnal Pengabdian Dan Pembedaya Masyarakat).* 2018;2(2):251–8.
10. Novitry F, Agustin R. Determinan Kepemilikan Jamban Sehat di Desa Sukomulyo Martapura Palembang. *J Aisyah J Ilmu Kesehat.* 2017;2(2):107–16.
11. Supadi S, Widjijati W, Prasetyo H. Pendampingan Keluarga Dengan Kartu PHBS Tatanan Rumah Tangga Untuk Meningkatkan Status Kesehatan Keluarga. *Edukasi Masy Sehat Sejah J Pengabdian Kpd Masy.* 2022;4(1):8–14.
12. Zainab Z, Marlinda E. Pengaruh Pendampingan Kader Kesehatan Terhadap Peningkatan Kesehatan Keluarga Di Wilayah Kerja Puskesmas Astambul Kabupaten Banjar. *J Citra Keperawatan.* 2020;8(1):1–6.
13. Sumiarni L. Hubungan Pengetahuan Dan Status Ekonomi Dengan Kepemilikan Jamban Sehat Di Desa Talang Segegah Kecamatan Renah Pembarap Tahun 2018. *J Kesehat dan Sains Terap.* 2019;5(2):51–60.
14. Jinan RR, Dewi W. Pengetahuan, Sikap dan Perilaku Ibu Tentang Jamban Sehat Di RW 05 Kelurahan Sukajaya Wilayah Kerja PKM Pembangunan Tahun 2020. *J Mitra Kencana Keperawatan Dan Kebidanan.* 2021;5(1):36–41.
15. Siregar EZ. Peran Kader Posyandu (Pos Pelayanan Terpadu) Sebagai Upaya Peningkatan Kesejahteraan Ibu dan Anak. *J at-Taghyir J Dakwah dan Pengemb Masy Desa.* 2021;3(2):171–86.
16. Pawitaningtyas I, Puspasari HW. Peran Serta Masyarakat dalam Meningkatkan Status Kesehatan Ibu di Kabupaten Timor Tengah Selatan. *Bul Penelit Sist Kesehat.* 2018;21(1):41–7.
17. Asmawi D. Efektivitas Peran Pendamping Program Keluarga Harapan (PKH) Di Kecamatan Jetis, Bantul. UIN Sunan Kalijaga Yogyakarta; 2018.

Original Article

Risk Factors of Stunting in Children Under Two Years of Age in Donggala District Central of Sulawesi

Fahmi Hafid^{1*}, Nasrul², A Bungawati³, Kadar Ramadhan⁴

¹ Department of Nutrition, Poltekkes Kemenkes Palu, Palu, Central of Sulawesi, Indonesia

² Department of Nursing, Poltekkes Kemenkes Palu, Palu, Central of Sulawesi, Indonesia

³ Department of Sanitation, Poltekkes Kemenkes Palu, Palu, Central of Sulawesi, Indonesia

⁴ Department of Midwifery, Poltekkes Kemenkes Palu, Palu, Central of Sulawesi, Indonesia

(Correspondence author's, e-mail, hafid.fahmi79@gmail.com/085255530999)

ABSTRACT

Stunting is a critical public health issue, with multifactorial risk factors that can include a child's gender, birth length, low birth weight, and unhealthy snack consumption. The aim of this research is to analyze the risk factors for stunting in toddlers in Donggala District. This study employed an analytical approach with a cross-sectional design. The research was conducted in Donggala District, with the target population being children aged 6-23 months. A sample of 397 toddlers was obtained through cluster simple random sampling. The respondents were mothers of the toddlers. Data collection took place in August 2023. The independent variables included in the study were the characteristics of mothers and households, child characteristics, disease history, healthcare access, and dietary intake. The dependent variable was stunting status. Stunting data were obtained by measuring the child's length using Length Board Measuring (LMB) and determining age by reading the birth certificate or the child's KIA book. Other data were collected through the Kobocollect questionnaire. Data analysis was conducted using SPSS version 22.00, with Z-Score values based on WHO-Antro 2005 standards. Multivariate analysis employed backward logistic regression. The research results indicated that significant factors contributing to the risk of stunting in toddlers in Donggala District included the child's gender, birth length, low birth weight, and consumption of unhealthy snacks. Birth length (AOR=1.8, 95% CI: 1.1-3.1), child gender (AOR=1.7, 95% CI: 1.0-2.7), low birth weight (AOR=2.3, 95% CI: 1.0-5.2), and unhealthy snack consumption (e.g., chips, cheese balls) (AOR=2.0, 95% CI: 1.0-3.8) were all significant factors. Policies addressing aspects such as nutrition, maternal and child healthcare services, supervision of unhealthy snacks, and monitoring and evaluation would help reduce the risk of stunting and improve the quality of life for children in Donggala District.

Keywords : *Stunting, Child's Gender, Birth Length, Low Birth Weight, Unhealthy Snack Consumption*

<https://doi.org/10.33860/jik.v17i2.3045>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Stunting, as assessed anthropometrically, refers to a child's height in relation to their age, with a Z-score <-2 SD according to WHO standards¹⁻⁴. Stunting is recognized as one of the most critical public health issues^{2,3,5,6}. It typically manifests early in life, presenting as a long-term hindrance to linear growth and often proving difficult to recover from in subsequent growth stages⁶⁻⁹. The risk factors for stunting are multifactorial^{3,4,10-14}. can vary across variables, such as a child's gender, birth length, low birth weight, and unhealthy snack consumption.

Boys have a higher risk of experiencing stunting compared to girls^{11,14,15}. Shorter children have a higher risk of experiencing stunting compared to taller ones¹⁶⁻²². Children with a history of low birth weight have a higher risk of experiencing stunting compared to those with normal birth weight^{4,6,10,14,23-25}. Children who consume unhealthy snacks have a higher risk of experiencing stunting compared to those who do not consume them²⁶⁻²⁸.

Prevalence trends of stunting show a decrease²⁹⁻³². Nasrul et al.'s research indicates a 6.2% decrease in the last 9 years or an average of 0.6% per year³³. Although several studies have been conducted, the prevalence of stunting

cannot be estimated³⁴. In 2023, Donggala Regency has 41 stunting locus villages. The results of this research are expected to provide recommendations for the academic study of stunting prevention in Donggala Regency. The unknown risk factors for stunting in toddlers in Donggala Regency are the basis for conducting this research. The aim of this study is to analyze the risk factors for stunting in toddlers in Donggala Regency.

METHOD

This is an analytic research with a cross-sectional study design. The research was conducted in Donggala Regency. The population consisted of toddlers aged 6-23 months. A sample of 397 toddlers was obtained through cluster simple random sampling. The respondents were mothers of the toddlers. Data collection was carried out in August 2023. The variables included in the study were characteristics of mothers and households, characteristics of children, medical history, healthcare access, and dietary intake as independent variables, while stunting status was the dependent variable. Stunting data were obtained by measuring the length of the toddlers using a Length Board Measuring (LMB) and determining their age by reading their birth certificates or child's Integrated Health Post (Posyandu) book. Other data were collected through Kobocollect questionnaire. Data analysis was conducted using SPSS version 22.00. To determine the Z-Score for TB/U, WHO-Anthro 2005 software was used. Data analysis involved three stages. First, univariate analysis was conducted to describe the frequency distribution of each variable. Second, bivariate analysis was performed to assess the relationship between the dependent and independent variables and to calculate the odds ratio (OR), which represents the relative risk between the stunting group and the normal group using the chi-square test with significance set at $p < 0.05$. Third, multivariate analysis was conducted using backward logistic regression. Ethical approval was obtained from the Ethics Commission of Poltekkes Kemenkes Palu with approval number 0014/KEPK-KPK/I/2023 dated February 14, 2023, and Research Permit was obtained from the Central Sulawesi Provincial Government, Regional Unity of Nationality and Politics, with permit number 070/4006/Bid.III-BKBPD/2023.

RESULTS

The research had a total of 397 respondents, consisting of 45.8% males and 54.2% females. The majority (78.6%) of the children were aged between 7 and 23 months. Most children (60.7%) had a birth length greater than 48 cm, and the majority (91.2%) had a normal birth weight. Early breastfeeding initiation was practiced by 37.0% of the mothers. The majority of mothers (60.7%) provided exclusive breastfeeding to their children, and most children (75.6%) were still receiving breast milk. A significant portion of the children (77.3%) had experienced illness in the past 12 months, with a small number having a history of respiratory infections (11.3%), diarrhea (14.1%), pulmonary tuberculosis (0%), measles (1.8%), and parasitic infections (0.2%).

The majority of the respondents utilized healthcare facilities (84.1%). Approximately half of the mothers provided stimulation to their children (52.4%), and only a small proportion received supplementary feeding (14.9%). Most respondents had access to clean drinking water sources (93.4%) and family latrines (78.1%). A significant portion of the families had members who smoked (68.0%).

Characteristics of the Respondent Mothers: The majority of the mothers were aged 20 years and above (94.2%). Most had experienced normal childbirth (83.9%). The majority of mothers had three or fewer children (82.8%). The majority had an inter-birth interval of more than 3 years (82.9%). The majority of mothers had at least 9 years of education (75.8%).

Water was the most common complementary food (65.0%), while foods like crackers and cheese balls were less common (13.1%). Many respondents did not provide vitamin A-rich complementary foods such as orange/red-colored vegetables and fruits to their children. In 2023, the prevalence of stunting in Donggala Regency was 26.7%, while 73.3% of children had normal nutritional status.

Table 1. The prevalence of stunting in children under two years of age in Donggala Regency.

Nutritional Status	n (397)	%
Stunting	106	26,7
Normal	291	73,3

Table 2. The distribution of stunting in children under two years of age among districts in Donggala Regency

Sub-District	Nutritional Status				p-value
	Normal		Stunting		
	n (291)	%(73,3)	n (106)	%(26,7)	
Rio Pakava	16	80,0	4	20,0	0,000
Pinembani	8	80,0	2	20,0	
Banawa	56	84,9	10	15,6	
Banawa Selatan	44	73,3	16	26,7	
Banawa Tengah	6	60,0	4	40,0	
Labuan	6	60,0	4	40,0	
Tanantovea	18	85,7	3	14,3	
Sindue	24	80,0	6	20,0	
Sindue Tombusabora	15	75,0	5	25,0	
Sirenja	6	60,0	4	40,0	
Balaesang	7	77,8	2	22,2	
Balaesang Tanjung	3	15,0	17	85,0	
Dampelas	23	74,2	8	25,8	
Sojol	43	71,7	17	28,3	
Sojol Utara	16	80,0	4	20,0	

Cross-tabulation provides a deeper insight into the relationship between specific risk factors and the nutritional status of toddlers in Donggala Regency. In this table, we can observe how the proportions of children experiencing stunting and those with normal nutritional status vary based on various factors. Ownership of a family latrine significantly influences the prevalence of stunting. Children from families with latrines have a lower prevalence of stunting compared to those from families without latrines (very low p-value, <0.003).

Children with a birth length ≥ 48 cm have a lower prevalence of stunting compared to those with a birth length < 48 cm (p-value=0.002). Children with normal birth weight have a lower prevalence of stunting compared to those with low birth weight (p-value=0.008). The provision of supplementary feeding (PMT) has a significant impact on the prevalence of stunting. Children receiving PMT have a lower prevalence of stunting compared to those who do not receive PMT (very low p-value, 0.000). There is no significant difference in the prevalence of stunting between children who receive stimulation and those who do not. The p-value (0.142) is not significant. There is no significant difference in the prevalence of stunting between children from families with smokers and those without. The p-value (0.479)

is not significant.

There is no significant difference in the prevalence of stunting between children with a history of illness and those without. The p-value (0.780) is not significant. There is no significant difference in the prevalence of stunting between children with a history of respiratory infections (ISPA) and those without. The p-value (0.471) is not significant. There is no significant difference in the prevalence of stunting between children with a history of diarrhea and those without. The p-value (0.504) is not significant. No children have a history of pulmonary tuberculosis. A history of measles does not significantly influence the prevalence of stunting (p-value=0.454).

Children with a history of parasitic infections have a higher prevalence of stunting than those without, although the p-value (0.097) has not reached a high level of significance. From the analysis of this table, we can see that several factors such as family latrine ownership, birth length, birth weight, and PMT provision have a significant relationship with the prevalence of stunting. Children who do not consume plain water have a higher prevalence of stunting (18.71%) compared to those who do (31.0%). The p-value (0.008) indicates that this difference is significant. Children who consume sweetened beverages like syrup, honey, tea, coffee, sugary water, fruit juice, or sweetened

condensed milk have a much higher prevalence of stunting (78.6%) compared to those who do not (24.8%). This difference is highly significant with a very low p-value (0.000). There is no significant difference in the prevalence of stunting between children who consume these foods and those who do not. The p-value (0.152) is not significant. There is no significant difference in the prevalence of stunting between children who consume legumes, tofu, or tempeh and those who do not. The p-value (0.234) is not significant.

There is no significant difference in the prevalence of stunting between children who consume milk other than breast milk and those who do not. The p-value (0.284) is not significant. There is no significant difference in the prevalence of stunting between children who consume beef, chicken, fish, or organ meats and those who do not. The p-value (0.198) is not significant. There is no significant difference in the prevalence of stunting between children who consume eggs and those who do not. The p-value (0.791) is not significant. There is no significant difference in the prevalence of stunting between children who consume these vegetables and those who do not. The p-value (0.776) is not significant. There is no significant difference in the prevalence of stunting between children who consume dark green leafy vegetables and those who do not. The p-value (0.143) is not significant. There is no significant difference in the prevalence of stunting between children who consume these fruits and those who do not. The p-value (0.342) is not significant. There is no significant difference in the prevalence of stunting between children who consume these vegetables and those who do not. The p-value (0.154) is not significant. Children who do not consume other fruits have a higher prevalence of stunting (41.5%) compared to those who do (23.8%). This difference is significant with a p-value (0.003).

From the analysis of this table, we can conclude that the consumption of certain types of food and beverages, such as plain water and sweetened drinks like syrup, honey, tea, coffee, sugary water, fruit juice, and sweetened condensed milk, has a significant correlation

with the prevalence of stunting. Therefore, promoting a healthy and balanced diet can be a crucial step in reducing stunting in Donggala Regency.

The analysis from the multivariate analysis identifying factors contributing to the risk of stunting in toddlers in Donggala Regency:

Child's Gender: The p-value for child's gender is 0.035, indicating a significant relationship between child's gender and the risk of stunting. The Adjusted Odds Ratio (AOR) for boys is 1.7, meaning that boys have a 1.7 times higher risk of experiencing stunting compared to girls. The 95% Confidence Interval (95% CI) for the AOR of child's gender ranges from 1.0 to 2.7.

Birth Length: The p-value for birth length is 0.020, suggesting a significant relationship between birth length and the risk of stunting. The AOR for birth length less than 48 cm is 1.8, implying that children with a birth length less than 48 cm have a 1.8 times higher risk of experiencing stunting compared to those with a birth length greater than 48 cm. The 95% Confidence Interval (95% CI) for the AOR of birth length ranges from 1.1 to 3.1.

Low Birth Weight: The p-value for low birth weight is 0.043, indicating a significant relationship between low birth weight and the risk of stunting. The AOR for low birth weight is 2.3, meaning that children with low birth weight have a 2.3 times higher risk of experiencing stunting compared to those with normal birth weight. The 95% Confidence Interval (95% CI) for the AOR of low birth weight ranges from 1.0 to 5.2.

Unhealthy Snack Consumption (Kerupuk, Cheese Ball): The p-value for unhealthy snack consumption is 0.047, suggesting a significant relationship between the consumption of unhealthy snacks like kerupuk and cheese ball and the risk of stunting. The AOR for unhealthy snack consumption is 2.0, indicating that children who consume unhealthy snacks have a 2.0 times higher risk of experiencing stunting compared to those who do not consume them. The 95% Confidence Interval (95% CI) for the AOR of unhealthy snack consumption ranges from 1.0 to 3.8.

Table 3. Cross-tabulation of Risk Factors for Stunting in Children Under Two Years of Age in Donggala Regency

Variable	Nutritional Status				p-value
	Normal		Stunting		
	n (291)	% (71,8)	n (106)	%(28,2)	
Mother's Age					
<20 years	16	69,6	7	30,4	0,677
≥20 years	275	73,5	99	26,5	
Mother's Education					
<9 years	255	74,8	76	25,2	0,247
≥9 years	66	68,8	30	31,2	
Child's Gender					
Male	128	70,3	54	29,7	0,218
Female	163	75,8	52	24,2	
Type of Delivery					
Normal	238	71,5	95	28,5	0,060
Cesarean Section	53	82,8	11	17,2	
Child's Age					
0-6 Months	68	80,0	17	20,0	0,115
7-23 Months	223	71,5	89	28,5	
Source of Drinking Water					
Not Improved	18	69,2	8	30,8	0,628
Improved	273	73,6	98	26,4	
Family Latrine Ownership					
No	53	60,9	34	39,1	<0,003
Yes	238	76,8	72	23,2	
Early Breastfeeding Initiation					
No	102	69,4	45	30,6	0,177
Yes	189	75,6	61	24,4	
Birth Length					
<48 cm	99	64,3	55	35,7	0,002
≥48 cm	187	78,6	51	21,4	
Birth Weight					
Low	19	54,3	16	45,7	0,008
Normal	272	75,1	90	24,9	
Exclusive Breastfeeding					
Not exclusive	117	75,0	39	25,0	0,538
Exclusive	174	72,2	67	27,8	
Exclusive Breastfeeding (During the Study)					
No	71	73,2	26	26,8	0,979
Yes	220	73,3	80	26,7	
Food Insecurity					
Yes	20	62,5	12	37,5	0,150
No	271	74,3	94	25,7	
Number of Children					
>3 Children	51	75,0	17	25,0	0,728
≤3 Children	240	72,9	89	27,1	
Birth Interval					
≤3 years	51	75,0	17	25,0	0,728
>3 years	240	72,9	89	27,1	
Healthcare Facility Utilization					
No	44	69,8	19	30,2	0,499
Yes	247	73,9	87	26,1	
Supplementary Feeding (PMT)					
No	266	78,7	72	21,3	0,000
Yes	25	42,4	34	57,6	
Stimulation Provision					

No	145	76,7	44	23,3	0,142
Yes	146	70,2	62	29,9	
Family Smoking					
No	96	75,6	31	24,4	0,479
Yes	195	72,2	75	27,8	
History of Illness					
No	67	74,4	23	25,6	0,780
Yes	224	73,0	83	27,0	
History of Respiratory Infections (ISPA)					
No	256	72,7	96	27,3	0,471
Yes	35	77,8	10	22,2	
History of Diarrhea					
No	252	73,9	89	26,1	0,504
Yes	39	69,7	17	30,3	
History of Measles					
No	285	73,1	105	26,9	0,454
Yes	6	85,7	1	14,3	
History of Parasitic Infections					
No	291	73,5	105	26,5	0,097
Yes	0	0	1	100	
Consumption of Unhealthy Snacks					
No	258	74,8	87	25,2	0,085
Yes	33	64,5	19	36,5	

Table 4 Multivariate Analysis of Risk Factors for Stunting in Children Under Two Years of Age in Donggala Regency

Variables	p-value	AOR	95%CI	
			Lower	Upper
Child's Gender				
Male	0,035	1,7	1,0	2,7
Female		1,0		
Birth Length				
<48 cm	0,020	1,8	1,1	3,1
≥48 cm		1,0		
Low Birth Weight				
Yes	0,043	2,3	1,0	5,2
No		1,0		
Unhealthy Snack Consumption				
No	0,047	1,0	1,0	3,8
Yes		2,0		

DISCUSSION

Efforts to reduce stunting in Donggala Regency are a complex challenge that requires careful strategies. Research data shows significant variations in stunting rates among villages and districts in this region. Local factors such as access to resources, dietary patterns, and social environments influence the stunting rates in each location. Therefore, prevention and intervention programs need to be tailored to the specific needs of each village and district.

Differentiation by Location: High stunting rates in some villages, like Malino and Malei, require more intensive interventions.

Stunting prevention programs should prioritize these villages, focusing on improving access to nutrition and healthcare. Villages with low stunting rates or even no stunting cases, such as Ganti and Loli Dondo, can serve as best practices. Good practices from these villages should be shared and replicated elsewhere.

Attention to Specific Risk Factors: Factors such as child's gender, birth length, and low birth weight are significant risk factors. Stunting prevention programs should consider these risks when determining intervention targets. Unhealthy snack consumption like kerupuk and cheese ball is also associated with stunting risk. Nutrition campaigns should include education on balanced diets and

promote the replacement of unhealthy snacks with nutritious foods.

Family Latrine Ownership: Family latrine ownership has a significant impact on stunting prevalence. Sanitation programs prioritizing the construction of family latrines in villages with high stunting rates should be accelerated. While there's no significant difference in stunting prevalence between mothers under 20 years old and those 20 years and older, nutrition education and prenatal and postnatal care remain essential. Pregnant mothers need special attention in this program. Children who do not consume clean water or consume unhealthy beverages are at higher risk of stunting. Nutrition programs should include campaigns to increase clean water consumption and promote exclusive breastfeeding.

Collaboration with Local Stakeholders: Collaboration with local stakeholders such as community groups, health workers, and village leaders is crucial. They can help support the implementation of stunting prevention programs. **Continuous Monitoring and Evaluation:** To measure program success, a strong monitoring and evaluation system should be implemented. Collected data can be used to identify emerging issues and direct resources to areas needing further attention.

Comprehensive Approach: Ultimately, efforts to reduce stunting in Donggala Regency should focus on a comprehensive approach, considering aspects of health, nutrition, sanitation, and education. Local governments, in collaboration with the Ministry of Health of Indonesia, should work with NGOs, international organizations, and the private sector to achieve better outcomes in addressing the issue of stunting and improving the quality of life for children in this region, in line with the vision of health transformation set by the Ministry of Health of Indonesia.

The findings of this research indicate that child's gender, birth length, low birth weight, and consumption of unhealthy snacks are significantly associated with the risk of stunting in toddlers in Donggala Regency.

These research findings are consistent with those of Quamme (2022) in Sub-Saharan Africa, as well as the findings of Beckmann et al. (2021) in South Africa and Liang et al. (2020) in China, which all show that boys have a higher risk of experiencing stunting compared to girls^{11,14,15}.

Anak yang terlahir pendek memiliki

risiko lebih tinggi untuk mengalami stunting dibandingkan dengan anak yang terlahir tidak pendek relevan dengan temuan Krebs NF et al (2022) penelitian dari Madinar M dkk (2021) di Central Jakarta dan penelitian dari Hastuti et al (2020), penelitian Pimenta JRR (2020). Penelitian Dhaded SM et al (2020) in South Asia. Demikian juga hasil penelitian ini relevan dengan temuan Christian P et al (2022) dan demikian juga temuan penelitian Beal T, Tumilowicz A et al (2018) di Indonesia¹⁶⁻²².

Children with a history of low birth weight have a higher risk of experiencing stunting compared to those with normal birth weight. The findings of this study are relevant to the research findings of Suratri MAL et al. (2023) in East Nusa Tenggara (NTT)⁴. This finding is also relevant to the research findings of Ejigu H et al (2023) in the Sidama region, Ethiopia⁶. It aligns with the findings of Halli SS et al (2022) in India¹⁰, Beckmann J et al (2021) in South Africa, Harper A, et al (2023) in South Africa, Mtongwa RH et al (2021) in Tanzania, and Abbas F et al (2021) in the Sindh province of Pakistan.

Children who consume unhealthy snacks have a higher risk of experiencing stunting compared to those who do not. This finding is consistent with the research of Pries AM et al (2019) in Kathmandu Valley, Nepal²⁶. and is also relevant to the findings of Vanderkooy A et al (2023) in Senegal²⁷ It is further supported by the research of Pries AM et al (2019) in Nepal²⁸.

To address the significant issue of stunting in Donggala Regency, we propose three policy recommendations that can be implemented by the local government and various stakeholders. **Specific Intervention Programs for Villages and Districts with High Stunting Rates:** It is crucial to identify villages and districts with high stunting rates, such as Tawiora Village, Malino, Malei, and Rano B. Subsequently, specific intervention programs tailored to the characteristics and needs of each village and district should be developed. The local government should collaborate with NGOs, healthcare organizations, and local communities to design and implement programs that prioritize the provision of nutritious food, access to clean water, sanitation improvements, and nutritional education for mothers and children.

Emphasis on Specific Significant Risk Factors: The second recommendation

emphasizes focusing on risk factors that have been proven to have a significant correlation with stunting, such as low birth weight, birth length, child's gender, and the consumption of unhealthy snacks. Programs for maternal health check-ups and maternal healthcare services need to be strengthened, with an emphasis on early detection and management of low birth weight. Active awareness campaigns should educate pregnant women and the general public about the importance of balanced nutrition, improving healthy eating habits, and the role of exclusive breastfeeding in child growth.

Increased Access to Clean Water and Nutritious Food: Policies should prioritize increasing access to clean water and promoting the consumption of nutritious food within families. Programs for providing safe sources of clean water in needy areas and educational campaigns on water hygiene and sanitation should be enhanced. The local government should collaborate with relevant institutions to ensure the availability and accessibility of nutritious food, especially for economically vulnerable families. By implementing these recommendations, it is hoped that Donggala Regency can reduce the prevalence of stunting and improve the long-term quality of life for children. The local government, healthcare sector, and the community, together, can actively mitigate the impact of stunting and ensure optimal growth and development for future generations.

CONCLUSION

Factors significantly contributing to the risk of stunting in toddlers in Donggala Regency are Child's Gender, Length at Birth, Low Birth Weight, and Consumption of Unhealthy Snacks.

Boys have a 1.7 times higher risk of experiencing stunting compared to girls. Children with a birth length of less than 48 cm have a 1.8 times higher risk of experiencing stunting compared to those with a birth length greater than 48 cm. Children with low birth weight have a 2.3 times higher risk of experiencing stunting compared to those with normal birth weight. Children who consume unhealthy snacks have a 2.0 times higher risk of experiencing stunting compared to those who do not.

We recommend that the Donggala Regency government routinely monitor the

growth and development of children, especially those with risk factors such as low birth weight and short birth length. This will allow for early identification and timely interventions. Education programs for pregnant women need to be enhanced, particularly in terms of nutrition during pregnancy. Pregnant women should receive proper prenatal care to reduce the risk of low birth weight and short birth length. Nutrition campaigns should promote a balanced diet and reduce the consumption of unhealthy snacks. Nutrition education should be provided to families to ensure that children receive adequate nutritional intake. Efforts to improve access to healthcare services, especially for child growth monitoring, maternal care, and infant development monitoring, need to be enhanced in the region. Local governments, non-governmental organizations, and the private sector need to collaborate in implementing holistic stunting prevention programs. This collaboration can enhance the effectiveness of these efforts.

ACKNOWLEDGMENTS

To the Director General of Health Human Resources Ministry of Health, Director of the Health Polytechnic Ministry of Health Palu, to the Health Department, and the local government of Donggala Regency, as well as to all respondents.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Abdulla F, Rahman A, Hossain MM. Prevalence and risk predictors of childhood stunting in Bangladesh. Kumar M, editor. PLoS One [Internet]. 2023 Jan 26;18(1):e0279901. Available from: <https://dx.plos.org/10.1371/journal.pone.0279901>
2. Gusnedi G, Nindrea R, Purnakarya I, Umar H, Susilowati A, Lipoeto N. Risk factors associated with childhood stunting in Indonesia: A systematic review and meta-analysis. *Asia Pac J Clin Nutr* [Internet]. 2023;32(2):184–95. Available from: https://api.elsevier.com/content/abstract/scopus_id/85163663892
3. Nuzul Z. A. R, Renjani RS, Parahdiba

- M, Maliya E. Risk factors for stunting incidence in toddlers ages 2-5 years at Lampisang public health center Peukan Bada Aceh Besar. In: AIP Conference Proceedings [Internet]. 2023. p. 030012. Available from: <http://aip.scitation.org/doi/abs/10.1063/5.0116432>
4. Suratri MAL, Putro G, Rachmat B, Nurhayati, Ristrini, Pracoyo NE, et al. Risk Factors for Stunting among Children under Five Years in the Province of East Nusa Tenggara (NTT), Indonesia. *Int J Environ Res Public Health* [Internet]. 2023 Jan 16;20(2):1640. Available from: <https://www.mdpi.com/1660-4601/20/2/1640>
 5. Danty IP. Nutritional Fulfillment of Children under Three in Stunting Area of Kepung Public Health Center, Besowo, Kediri. *Malaysian J Med Heal Sci* [Internet]. 2023;19:49–50. Available from: https://api.elsevier.com/content/abstract/scopus_id/85154601131
 6. Ejigu H, Tafese Z. Stunting at birth: linear growth failure at an early age among newborns in Hawassa city public health hospitals, Sidama region, Ethiopia: a facility-based cross-sectional study. *J Nutr Sci* [Internet]. 2023 May 30;12:e63. Available from: https://www.cambridge.org/core/product/identifier/S2048679023000460/type/journal_article
 7. Perry HB, Stollak I, Llanque R, Blanco S, Jordan-Bell E, Shindhelm A, et al. Reducing inequities in maternal and child health in rural Guatemala through the CBIO+ Approach of Curamericas: 4. Nutrition-related activities and changes in childhood stunting, wasting, and underweight. *Int J Equity Health* [Internet]. 2023 Feb 28;21(S2):197. Available from: <https://equityhealthj.biomedcentral.com/articles/10.1186/s12939-022-01756-8>
 8. Maulina R, Qomaruddin M, Prasetyo B, Indawati R, Alfritri R. The Effect of Stunting on the Cognitive Development in Children: A Systematic Review and Meta-analysis [Internet]. Vol. 17, *Studies on Ethno-Medicine*. 2023. p. 19–27. Available from: https://api.elsevier.com/content/abstract/scopus_id/85153240206
 9. Haque MA, Choudhury N, Wahid BZ, Ahmed ST, Farzana FD, Ali M, et al. A predictive modelling approach to illustrate factors correlating with stunting among children aged 12–23 months: a cluster randomised pre-post study. *BMJ Open* [Internet]. 2023 Apr 26;13(4):e067961. Available from: <https://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2022-067961>
 10. Halli SS, Biradar RA, Prasad JB. Low Birth Weight, the Differentiating Risk Factor for Stunting among Preschool Children in India. *Int J Environ Res Public Health* [Internet]. 2022 Mar 22;19(7):3751. Available from: <https://www.mdpi.com/1660-4601/19/7/3751>
 11. Quamme SH, Iversen PO. Prevalence of child stunting in Sub-Saharan Africa and its risk factors. *Clin Nutr Open Sci* [Internet]. 2022 Apr;42:49–61. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S2667268522000092>
 12. Anismuslim M, Pramoedyo H, Andarini S. Modeling of Risk Factors of Childhood Stunting Cases in Malang Regency using Geographically Weighted Regression (GWR). *Open Public Health J* [Internet]. 2023;16. Available from: https://api.elsevier.com/content/abstract/scopus_id/85163825974
 13. Hidayanti L, Rahfiludin MZ, Nugraheni SA, Murwani R. Association of malnutrition and main-meal- and snack-predominant intake among female adolescent students in boarding schools in Tasikmalaya, Indonesia. *Nutr Health* [Internet]. 2023 Mar 27;026010602311662. Available from: <http://journals.sagepub.com/doi/10.1177/02601060231166224>
 14. Beckmann J, Lang C, du Randt R, Gresse A, Long KZ, Ludyga S, et al. Prevalence of Stunting and Relationship between Stunting and Associated Risk Factors with Academic Achievement and Cognitive Function: A Cross-Sectional Study with South African Primary School Children. *Int J Environ Res Public Health* [Internet]. 2021 Apr

- 16;18(8):4218. Available from: <https://www.mdpi.com/1660-4601/18/8/4218>
15. Liang W, Wang B, Shen G, Cao S, Mcswain B, Qin N, et al. Association of solid fuel use with risk of stunting in children living in China. *Indoor Air* [Internet]. 2020 Mar 6;30(2):264–74. Available from: <https://onlinelibrary.wiley.com/doi/10.1111/ina.12627>
 16. Krebs NF, Hambidge KM, Westcott JL, Garcés AL, Figueroa L, Tshetu AK, et al. Birth length is the strongest predictor of linear growth status and stunting in the first 2 years of life after a preconception maternal nutrition intervention: the children of the Women First trial. *Am J Clin Nutr* [Internet]. 2022 Jul;116(1):86–96. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0002916522000120>
 17. Madinar M, Andina E, Achadi EL. Fulfilment of minimum acceptable diet (MAD), short birth length and family income level are associated with stunting in children aged 6-23 months in Central Jakarta. *Malays J Nutr* [Internet]. 2021 Aug 20;27(2):259–70. Available from: [https://www.nutriweb.org.my/mjn/publication/27-2/Vol 27\(2\) 7. mjn.2020.0045 Madinar \(online first\) final.pdf](https://www.nutriweb.org.my/mjn/publication/27-2/Vol 27(2) 7. mjn.2020.0045 Madinar (online first) final.pdf)
 18. Hastuti, Hadju V, Citrakesumasari, Maddeppungeng M. Stunting prevalence and its relationship to birth length of 18–23 months old infants in Indonesia. *Enfermería Clínica* [Internet]. 2020 Jun;30:205–9. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1130862120301807>
 19. Pimenta JRR, Grandi C, Aragon DC, Cardoso VC. Comparison of birth weight, length, and head circumference between the BRISA-RP and Intergrowth-21st cohorts. *J Pediatr (Rio J)* [Internet]. 2020 Jul;96(4):511–9. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0021755718310799>
 20. Dhaded SM, Hambidge KM, Ali SA, Somannavar M, Saleem S, Pasha O, et al. Preconception nutrition intervention improved birth length and reduced stunting and wasting in newborns in South Asia: The Women First Randomized Controlled Trial. Wieringa F, editor. *PLoS One* [Internet]. 2020 Jan 29;15(1):e0218960. Available from: <https://dx.plos.org/10.1371/journal.pone.0218960>
 21. Christian P. Starting life right: birth length matters. *Am J Clin Nutr* [Internet]. 2022 Jul;116(1):1–2. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0002916522000016>
 22. Beal T, Tumilowicz A, Neufeld LM. A review of child stunting determinants in Indonesia. *Matern Child Nutr.* 2018;14(October 2017):1–10.
 23. Harper A, Rothberg A, Chirwa E, Sambu W, Mall S. Household Food Insecurity and Demographic Factors, Low Birth Weight and Stunting in Early Childhood: Findings from a Longitudinal Study in South Africa. *Matern Child Health J* [Internet]. 2023 Jan 28;27(1):59–69. Available from: <https://link.springer.com/10.1007/s10995-022-03555-7>
 24. Mtongwa RH, Festo C, Elisaria E. A comparative analysis of determinants of low birth weight and stunting among under five children of adolescent and non-adolescent mothers using 2015/16 Tanzania Demographic and Health Survey (TDHS). *BMC Nutr* [Internet]. 2021 Dec 4;7(1):64. Available from: <https://bmcnutr.biomedcentral.com/articles/10.1186/s40795-021-00468-6>
 25. Abbas F, Kumar R, Mahmood T, Somrongthong R. Impact of children born with low birth weight on stunting and wasting in Sindh province of Pakistan: a propensity score matching approach. *Sci Rep* [Internet]. 2021 Dec 7;11(1):19932. Available from: <https://www.nature.com/articles/s41598-021-98924-7>
 26. Pries AM, Rehman AM, Filteau S, Sharma N, Upadhyay A, Ferguson EL. Unhealthy Snack Food and Beverage Consumption Is Associated with Lower Dietary Adequacy and Length-for-Age z-Scores among 12–23-Month-Olds in Kathmandu Valley, Nepal. *J Nutr* [Internet]. 2019 Oct 1;149(10):1843–51. Available from:

- <https://academic.oup.com/jn/article/149/10/1843/5530103>
27. Vanderkooy A, Ferguson EL, Sy NY, Kane R, Diagne M, Mbodji A, et al. High unhealthy food and beverage consumption is associated with poor diet quality among 12–35-month-olds in Guédiawaye Department, Senegal. *Front Nutr* [Internet]. 2023 Jun 19;10. Available from: <https://www.frontiersin.org/articles/10.3389/fnut.2023.1125827/full>
 28. Pries AM, Sharma N, Upadhyay A, Rehman AM, Filteau S, Ferguson EL. Energy intake from unhealthy snack food/beverage among 12-23-month-old children in urban Nepal. *Matern Child Nutr* [Internet]. 2019 Jun 21;15(S4). Available from: <https://onlinelibrary.wiley.com/doi/10.1111/mcn.12775>
 29. Karlsson O, Kim R, Sarwal R, James KS, Subramanian S V. Trends in underweight, stunting, and wasting prevalence and inequality among children under three in Indian states, 1993–2016. *Sci Rep* [Internet]. 2021 Jul 8;11(1):14137. Available from: <https://www.nature.com/articles/s41598-021-93493-1>
 30. Ezeh OK, Abir T, Zainol NR, Al Mamun A, Milton AH, Haque MR, et al. Trends of Stunting Prevalence and Its Associated Factors among Nigerian Children Aged 0–59 Months Residing in the Northern Nigeria, 2008–2018. *Nutrients* [Internet]. 2021 Nov 29;13(12):4312. Available from: <https://www.mdpi.com/2072-6643/13/12/4312>
 31. Sahiledengle B, Mwanri L, Kumie A, Beressa G, Atlaw D, Tekalegn Y, et al. The coexistence of stunting and overweight or obesity in Ethiopian children: prevalence, trends and associated factors. *BMC Pediatr* [Internet]. 2023 May 5;23(1):218. Available from: <https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-023-04037-7>
 32. Berti C, La Vecchia A. Temporal trend of child stunting prevalence and Food and Nutritional Surveillance System. *J Pediatr (Rio J)* [Internet]. 2023 Mar;99(2):99–100. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0021755722001206>
 33. Nasrul, Maudu R, Hafid F. Trend and Prevalence of Stunting in Children Under Two Years From 2007- 2016 In Central Sulawesi. *Prev J Kesehat Masy* [Internet]. 2017;8(2):73–8. Available from: <http://jurnal.untad.ac.id/jurnal/index.php/Preventif>
 34. Aychiluhm SB, Tadesse A woday, Mare KU, Abebaw D, Worku N. A systematic review and meta-analysis protocol on stunting and its determinants among school-age children (6-14years) in Ethiopia. Ghazy S, editor. *PLoS One* [Internet]. 2021 Mar 18;16(3):e0248390. Available from: <https://dx.plos.org/10.1371/journal.pone.0248390>

Character Formation of Nutrition Aware Adolescents in an Effort to Prevent Triple Burden in Students of the Civil Integrated Model High School in Palu City

Putu Candriasih^{1*}, Sri Restu Tempali², Wijianto³, Taslim¹

¹ Department of Nutrition, Politeknik Kesehatan Kementerian Kesehatan Palu, Palu, Central Sulawesi, Indonesia

² Department of Midwifery, Politeknik Kesehatan Kementerian Kesehatan Palu, Palu, Central Sulawesi, Indonesia

³ Department of Nursing, Politeknik Kesehatan Kementerian Kesehatan Palu, Palu, Central Sulawesi, Indonesia

(Correspondence author's e-mail, putucandriasih@yahoo.co.id)

ABSTRACT

Teenagers are one of the determinants of quality and highly competitive human resources (HR). Improving nutrition is not only focused on the first 1000 HPK but also during adolescence. From RISKESDAS data (2018), adolescents aged 13-18 years have a short and very short nutritional status of 51.6%. thin and very thin 16.8%, overweight and obese 29.5%. And 32% aged 15-24 years are anemic. There are three burdens of nutritional problems (triple burden), namely stunting, wasting, obesity and micronutrient deficiencies, namely anemia. Another problem is that 65% of teenagers do not eat breakfast, 97% do not consume enough vegetables and fruit, lack physical activity and. For this problem, it is necessary to build the character of nutritionally aware teenagers through the implementation of local balanced nutrition. The aim is to see changes in adolescent behavior regarding local balanced nutrition. Research method Type of experimental research, with a quasi-experimental approach to pre-post-test one group design using the Accidental Sampling technique, a sample of 63 students at Madani High School, Palu City. The research results showed that the majority of respondents had good knowledge, but there were still some who did not know enough about balanced nutrition. Most attitudes show good positive results and good positive behavior assessment results. Knowledge is good, but implementation is still lacking, so it is necessary to build character in teenagers by implementing balanced nutrition through regular plate contents.

Keywords: Character, Awareness of Balanced Nutrition, Triple Burden, Teenagers

<https://doi.org/10.33860/jik.v17i2.2558>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Junk food is widely available in schools, middle schools and high schools through various outlets in British Columbia¹. Dietary habits are a risk factor for disease in teenagers². Teenagers are

one of the determinants of quality and empowered human resources (HR). Competitive. For this reason, improving nutrition is not only focused on the first 1000 days of life (HPK), but also on adolescence³.

2018 RISKESDAS data shows that 51.6% of adolescents aged 13-18 years have short and very short nutritional status, in addition there are 16.8% of adolescents aged 13-18 years who are thin and very thin, while the prevalence of overweight and obesity is 29.5% in adolescents aged 13-18 years aged 16-18 years, and 13.5% in adolescents⁴. RISKESDAS data also shows that 65% of teenagers do not eat breakfast, 97% do not consume enough vegetables and fruit, lack physical activity and consume excessive amounts of sugar, salt and fat. If this problem continues into adulthood, health problems will arise for the unborn fetus so that the chain of intergenerational nutritional problems will not stop⁴.

The results of the 2017 UNICEF Survey found changes in eating patterns and physical activity in adolescents. increased consumption of unhealthy foods such as instant foods and also foods high in GGL content⁵. Research results Emilia, (2017) show that the problem of nutritional deficiency and excess in adolescents is caused by eating patterns that do not refer to nutritional balance⁶. Eating a varied and nutritionally balanced diet is not always expensive, but it is available around the house or yard. Indonesia is famous for its various kinds of local food which are rich in nutrients to meet the nutritional needs of teenagers⁶.

Building adolescent character regarding awareness of balanced nutrition by using local food ingredients is very necessary at this time⁷. There is a phenomenon of a gap between expectations (healthy and intelligent teenagers) and reality (triple burden problem in teenagers), so it is necessary to solve nutritional problems in teenagers by involving multidisciplinary and multisectoral sciences such as education and health services. services, schools, teachers, parents and the community^{8,9}.

Building the character of nutritionally aware adolescents by implementing local balanced nutrition can form individuals with character and break the chain of nutritional problems in adolescents in a sustainable manner¹⁰. It is necessary to carry out research to find out how effective the character formation of nutritionally aware adolescents is through implementing balanced nutrition based on local food in high schools throughout the country. Palu

City and the value of knowledge, attitudes and behavior of balanced nutrition.

METHOD

The type of research used is applied experimental research, which was previously included in quasi (almost experimental) research with a pre-post-test control group design. The two groups were matched based on school status, student age, education, and parental occupation. and the aim of explanatory research is to try to explain the relationship between variables based on empirical reality, by providing a qualitative analysis explanation. The sampling technique used Accidental Sampling so that 63 respondents were obtained. This research uses a mixed-methods approach which combines quantitative and qualitative approaches. This research was conducted in January 2022 to 2023. The questionnaire used in collecting pre and post test data is a questionnaire regarding balanced nutrition in accordance with the 2014 balanced nutrition guidelines from the Ministry of Health and has been tested for validity and reliability.

RESULTS

The results of initial data analysis of 63 students at Madani Integrated Model High School showed that the majority of respondents, namely 52.3% were female and the other 47.7% were male (figure 1).

Distribution of respondents based on religionIts adherents can be seen in Figure 1. The respondents with the largest number of respondents were Muslim at 65.1%, Protestant Christians at 19%, Catholic Christians at 4.8%, and Hindus at 11.1%.

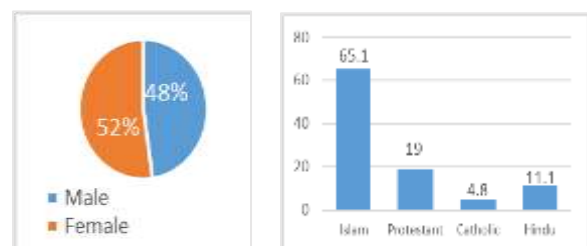


Figure 1. Distribution of Respondents Based on Gender and Religion

The level of education of the respondent's parents ranges from no school to college. Education levels are categorized into 3, namely basic education (junior high school and below), secondary education (high school) and higher education (diploma, bachelor's degree, master's degree and above). The research results showed that 63.5% of the parents of the respondents had a high level of education and 57.2% of the fathers. The parents of respondents with secondary education were 19% mothers and 36.5% fathers, while those with low education were 17.5% mothers and 6.3% fathers.

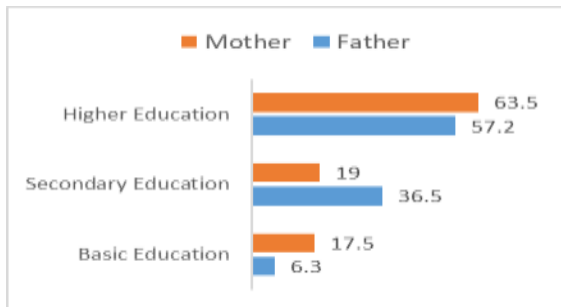


Figure 2. Distribution of Respondents' Parental Education

Work is an activity that must be carried out by every person for the sake of survival or to fulfill various needs. The type of work of the parents of respondents in this study was that 41.3% of fathers worked as civil servants/Military/Police, 9.5% private employees, 30.2% self-employed, 12.7% farmers and did not have a permanent job. /not working as much as 6.3%. For work, 20.6% of mothers do not have jobs, 42.9% work as civil servants/Military/Police, 4.8% as private employees, 9.5% as self-employed and 22.2% as farmers (figure 3).

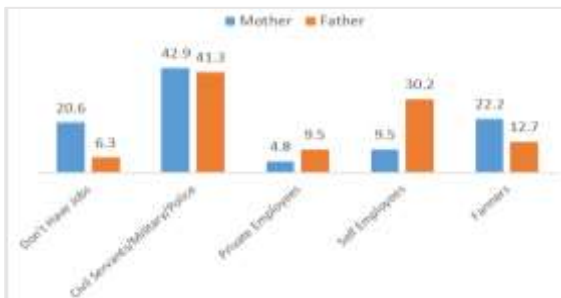


Figure 3. Distribution of Occupation of Respondents' Parents

2. PUGS Media Exposure

To obtain information on respondents' exposure to PUGS, this research was categorized into: two categories, namely having seen media containing PUGS and never seeing media containing PUGS. Table 1 describes the respondents' exposure to PUGS.

In research regarding exposure to PUGS in adolescents, they were asked whether respondents had ever seen/read and heard the term PUGS, it turned out that 74.6% of respondents answered yes and 25.4% never. This shows that the majority of respondents have been exposed to/heard of PUGS. If the respondent answers never, then the respondent will not ask again regarding PUGS exposure questions.

Researchers asked further about the type of media/information sources that respondents saw, so that from these results it was known that the majority of respondents (46.8%) received PUGS messages from the internet and from health workers (17%), while from poster media it was 8.5 %, television 8.5%, and from parents 6.4%, teachers 4.3%, books 4.3% and brochures 4.3%.



The results of questions/studies regarding the logo on PUGS launched by the Ministry of Health, the majority of respondents (80.9%) had seen the logo, and 19.1% had never seen the logo. Respondents who already knew the name of the logo which means Balanced Nutrition Tumpeng were 68.1% and 31.9% did not know the name of the logo.

In the image or logo of food consumption guidelines (Contents of My Plate), 76.6% had seen the image and 23.4% said they had never seen it. The results of questions about the meaning of images that answered eating guidelines were 24.4%, those that filled my plate were 20% and those that answered my dinner plate were 55.6%.

On the question regarding food that is diverse, nutritionally balanced and safe, all respondents (100%) answered what they meant by a variety of food, debt Balanced and safe food is food that contains sources of energy, protein, vitamins and minerals.

RESULTS

Table 1. Respondents' exposure to PUGS

No	Variable	Outcome Measurement	Amount	
			n	%
1	Have seen, read/heard PUGS messages	1. Forever	47	74.6
		2. Never	16	25.4
		Total	63	100
2	Media sources know about PUGS	1. Books	2	4,3
		2. Brochure	2	4,3
		3. Poster	4	8,5
		4. Television/radio	4	8,5
		5. Internet	22	46,8
		6. Teacher	2	4,3
		7. Parents/Friends	3	6,4
		8. Health workers	8	17
Total	47	100		
3	Have seen the following logo/image	1. Forever	38	80.9
		2. Never	9	19.1
		Total	47	100
4	What is the name of the picture 	1. Balanced nutrition	5	7.9
		2. Balanced nutritional menu	2	3.2
		3. Balanced nutritional cone		
		00. Don't know	32	50.8
		Total	8	12.7
			47	100
5	Have you seen the following image/logo: 	1. Forever	36	76.6
		2. Never	11	23.4
		Total	47	100
		1. Eating guidelines	11	23,4
6	What is the name of the picture	2. My dinner plate	25	53,2
		3. Fill my bamboo	9	19,1
		00. Don't know	2	4,3
		Total	47	100
7	What is meant by food is diverse, nutritionally balanced and safe	1. Foods that contain sources of energy, protein, vitamins and minerals	47	100
		2. Food with large portions	0	0
		3. Clean and delicious food	0	0

3. Friends of the same age

Peers have an important role to play in this regard influence behavior eating habits in adolescents. Behavior of buying food or eating

together often done with peers. In this study, those who most often accompanied respondents in buying food were peers, 50.8%, 25.4% who bought their own food and 23.8% who were accompanied by family (Table 2).

Table 2. Food Consumption Habits of Peers and Respondents

No	Variable	Outcome Measurement	Amount	
			n	%
1	Who do you most often buy food with?	1. Friends	32	50.8
		2. Alone	16	25.4
		3. Parents	10	15.9
		4. Sister/sister/sister	5	7.9
		Total	63	100
2	When buying food with friends, do you buy the same type of food?	1. From	41	65.1
		2. Never	22	34.9
		Total	63	100
3	When buying food with friends, who determines the type of food purchased	1. Yourself	59	93.7
		2. Friends	4	6.3
		Total	63	100

When buying food with friends, 65.1% of respondents bought the same type of food and 34.9% different types of food. The most dominant person in determining the type of food purchased with peers is the respondent himself (93.7%).

4. PUGS knowledge

Students' knowledge about General Guidelines for Balanced Nutrition (PUGS) was collected using the interview method using a questionnaire¹¹. Knowledge about PUGS includes B2SA counseling, various foods, frequency of eating vegetables, frequency of eating fruit, functions of various nutrients, sources of nutrients, fat consumption and the consequences of excess fat consumption. If the respondent's knowledge regarding nutritional knowledge was assessed as a whole, 56.9% of them answered correctly. The results of the PUGS knowledge study regarding B2SA extension showed that 48 students (76.2%) answered

correctly, namely Variety, Balanced and Safe Nutrition and respondents who answered incorrectly and did not know B2SA represented 15 students (23.8%).

A diverse diet is a diet consisting of rice, vegetables, fruit, vegetable side dishes and animal seafood. In this study, respondents answered correctly about diversity food was 58.7%, while respondents who answered incorrectly and did not answer were 41.3%.

The recommended frequency of vegetable consumption for PUGS every day is 3-4 times, while the recommended frequency of fruit consumption is 2-3 times per day. In this study, respondents who had the knowledge to consume vegetables according to PUGS recommendations (3-4 times) were 4.8%, and respondents who answered incorrectly and did not know were 95.2%.

Table 3. Distribution of Respondents According to PUGS Knowledge

No	Variable	Outcome Measurement	Amount	
			n	%
1	B2SA is an abbreviation of	1. A variety of balanced and safe nutrition	48	76.2
		2. Nutritious, varied, balanced and safe	7	11.1
		3. Don't know	8	12.7
		Total	63	100
2	A wide variety of food consisting of...	1. Rice, vegetables, fruit, vegetable side dishes, animal side dishes	37	58.7
		2. Rice, vegetables, side dishes, fruit, eggs	6	9.5
		3. Rice, vegetables, vegetable side dishes, animal side dishes, milk	15	23.9
		4. Don't know	5	7.9
		Total	63	100
3	In your opinion, how many times should we eat vegetables every day?	1. 1-2 times a day	18	28.6
		2. 2-3 times a day	37	58.7
		3. 3-4 times a day	3	4.8
		4. Don't know	5	7.9
		Total	63	100
4	In your opinion, how many times should we eat fruit every day?	1. 1-3 times a day	36	57.1
		2. 2-3 times a day	20	31.7
		3. 3-5 times a day	1	1.6
		4. Don't know	6	9.5
		Total	63	100
5	The following food groups can be used as a source of energy, namely:	1. Bread, noodles, cassava, rice, vermicelli	21	33.3
		2. Cassava, rice, vermicelli, eggs, fish	15	23.8
		3. Bread, rice, vermicelli, meat, eggs	24	38.1
		4. Don't know	3	4.8
		Total	63	100
6	Continuous consumption of food sources of energy that exceeds needs will cause...	1. Excess weight	59	93.7
		2. Malnutrition	1	1.6
		3. Stamina increases	1	1.6
		4. Don't know	2	3.2
		Total	63	100
7	The main function of carbohydrates is...	1. Source of energy for the body	61	96.8
		2. Maintain health	1	1.6
		3. Don't know	1	1.6
		Total	63	100
8	Food sources of carbohydrates include...	1. Sago, banana, honey	1	1.6
		2. Sweet potatoes, bananas,	43	68.3

		rice	17	27.0
		3. Rice, potatoes, sugar	2	3.2
		4. Don't know	63	100
		Total		
9	The daily recommendation is to consume as much sugar as...	1. 3-4 tablespoons	42	66.7
		2. 5-6 tablespoons	8	12.7
		3. Don't know	13	20.6
		Total	63	100
10	Oil consumption using oil...	1. Saturated fat	8	12.7
		2. animal	2	3.2
		3. Vegetables	38	60.3
		4. Don't know	15	23.8
		Total	63	100
11	If someone consumes excessive fats and oils it will result in...	1. Other nutritional needs are not met	43	68.3
		2. Other nutritional needs are met by fats and oils	4	6.3
		3. Other nutritional requirements have no effect	1	1,6
		4. Don't know	15	23,8
		Total	63	100

Based on the recommendation to consume fruit every day, knowledge As many as 31.7% of respondents regarding fruit consumption according to PUGS recommendations, namely 2-3 times a day, 68.2% of respondents who chose the wrong answer and didn't know it.

Variations in food consumption principal is one of the messages in PUGS. Staple food is the main source of energy for the body. In this study, respondents' knowledge about various foods that contain energy sources, among others, came from: 21 students (33.3%) answered bread, noodles, cassava, rice and vermicelli, then those who answered came from cassava, rice, vermicelli, eggs and fish as much as 23.8%, those who answered came from bread, rice, vermicelli, meat, eggs as much as 38.1% and those who didn't know 4.8%. so 33.3% of respondents answered correctly and 66.7% incorrectly.

Respondents' knowledge regarding the impact of consuming food that contains energy sources in excess of their needs over a long period

of time can be seen in table 4. The impact of consuming food that contains excessive energy sources continuously will cause excess body weight. As for those who...answer, overweight is 93.7%. Those who answered stamina increased by 1.6%, those who answered malnutrition by 1.6% and those who answered they did not know by 3.2%.

One of the nutrients that is really needed by the human body is carbohydrates (KH), where carbohydrates in the body act as a source of energy for the body. Respondents' knowledge regarding the main function of KH was: 96.8% of respondents answered as a source of energy for the body, 1.6% answered maintaining health and 1.6% did not know.

KH nutrition can be obtained from various types of food ingredients. Knowledge respondents regarding various sources of food that contain KH nutrients, including: the majority of respondents (68.3%) answered that it came from sweet potatoes, bananas and rice, 27% answered that it came from rice, potatoes and

granulated sugar and those who didn't know 3.2%.

One of PUGS's 10 messages is to limit consumption of oil, sugar and salt. The recommended limit for using granulated sugar is 4 tablespoons, the recommended limit for consuming oil a day is 5 tablespoons and it is recommended to use vegetable oil. In this study, it was recommended to consume granulated sugar a day, most respondents (66.7%) answered 3-4 times, 12.7% answered 5-6 tablespoons, and 20.6% answered they didn't know. . In the question of daily oil consumption, it is best to use oil: 8 respondents (12.7%) saturated fat, 3.2% animal oil, 60.3% vegetable oil and 23.8% who don't know.

On the question of the consequences if

someone consumes fats and oils excessively: 68.3% answered that the need for other nutrients is not met, 6.3% answered that the need for other nutrients is met, 6.3% answered that the need for other nutrients. Nutrients had no effect as much as 1.6% and those who answered they didn't know were 23.8%.

5. B2SA attitude

The respondent's attitude is a description of feelings, a person's view of an object. The manifestation of this attitude cannot be seen directly, but can only be interpreted first from closed behavior. Data about attitudes was collected by interview using an attitude questionnaire. The results of research regarding respondents' attitudes can be seen in table 4.

Table 4. Distribution of Respondents based on B2SA attitude

No	Statement	Outcome Measurement	Amount	
			n	%
1	Every day I have to eat various kinds of food	1. Strongly agree	23	36.5
		2. Agree	38	60.3
		3. Don't agree	2	3.2
		4. Strongly disagree	0	0
		Total	63	100
2	If my weight is normal, that means it's necessary I have enough energy	1. Strongly agree	12	19.0
		2. Agree	38	60.3
		3. Don't agree	13	20.7
		4. Strongly disagree	0	0
		Total	63	100
3	Food sources of carbohydrates should be limited to around 50-60% of energy needs	1. Strongly agree	5	7.9
		2. Agree	45	71.4
		3. Don't agree	13	20.7
		4. Strongly disagree	0	0
		Total	63	100
4	Excessive consumption of fats and oils will not reduce consumption of other foods	1. Strongly agree	1	1.6
		2. Agree	13	20.6
		3. Don't agree	37	58.8
		4. Strongly disagree	12	19.0
		Total	63	100
5	I will not eat food that is not salted with iodized salt	1. Strongly agree	6	9.5
		2. Agree	13	20.6
		3. Don't agree	35	55.6
		4. Strongly disagree	9	14.3
		Total	63	100

6	Not having breakfast is a problem that will happen harming my health	1.Strongly agree	24	38.2
		2.Agree	22	34.9
		3.Don't agree	12	19.0
		4.Strongly disagree	5	7.9
		Total	63	100
7	I will drink only when I feel thirsty	1.Strongly agree	7	11.1
		2.Agree	14	22.2
		3.Don't agree	19	30.2
		4.Strongly disagree	23	36.5
		Total	63	100
8	Drinking habitsalcoholic won't interfere with my liver function	1.Strongly agree	4	6.4
		2.Agree	0	0
		3.Don't agree	15	23.8
		4.Strongly disagree	44	69.8
		Total	63	100
9	Cooked food will be more covered so as not to be attacked by flies	1.Strongly agree	43	68.3
		2.Agree	19	30.1
		3.Don't agree	1	1.6
		4.Strongly disagree	0	0
		Total	63	100
10	I will always read the labels on packaged foods even when I buy them That	1.Strongly agree	9	14.3
		2.Agree	43	68.3
		3.Don't agree	11	17.4
		4.Strongly disagree	0	0
		Total	63	100
11	Every day I will exercise diligently not the time to practice	1.Strongly agree	8	12.7
		2.Agree	44	69.8
		3.Don't agree	10	15.9
		4.Strongly disagree	1	1.6
		Total	63	100
12	To build muscle, I will eat as many eggs as I can without any other food	1.Strongly agree	1	1.6
		2.Agree	7	11.1
		3.Don't agree	25	39.7
		4.Strongly disagree	30	47.6
		Total	63	100

The statement "every day I have to eat a variety of foods" 36.5% of respondents strongly agreed, 60.3%

agreed, and 3.2% disagreed. In the statement "If my weight is normal it means my energy needs are met" 19% of respondents chose to strongly agree with this statement, 60.3% agreed and 20.7% disagreed.

Respondents' attitudes towards the statement "Food sources of carbohydrates should be limited to around 50-60% of energy requirements" were 7.9% who strongly agreed, 71.4% agreed and 20.7% disagreed. Respondents' attitudes towards the statement "Excessive

consumption of fats and oils will not reduce consumption of other foods" stated that 1.6% strongly agreed, 20.6% agreed, 58.8% disagreed and 19% strongly disagreed.

Respondents' attitudes towards the statement "I will not eat food that is not salted with iodized salt" stated that 9.5% strongly agreed, 20.6% agreed, 55.6% disagreed and 14.3% strongly disagreed. Respondents' attitudes towards the statement "Not having breakfast is a problem that will harm my health" stated that

38.2% strongly agreed, 34.9% agreed, 19.0% disagreed and 7.9% strongly disagreed.

Respondents' attitudes towards the statement "I will drink when I feel thirsty" were 11.1% strongly agree, 22.2% agree, 30.2% disagree and 36.5% strongly disagree. Respondents' attitudes towards the statement "The habit of drinking alcohol beverages will not damage my liver function" which stated that 6.4% strongly agreed, 23.8% disagreed and 69.8% strongly disagreed.

Respondents' attitudes towards the statement "Food that is already cooked should be covered so that flies do not attack it" were 68.3% who strongly agreed, 30.1% agreed, and 1.6% disagreed.

Respondents' attitudes towards the statement "I will always read the labels on packaged food even though I have bought the food" stated that 14.3% strongly agreed, 68.3% agreed, and 17.4% disagreed.

Respondents' attitudes towards the statement "Every day I will exercise diligently even though it is not yet time to practice" which stated that 12.7% strongly agreed, 69.8% agreed, 15.9% disagreed and 1.6% strongly disagreed.

Respondents' attitudes towards the statement "To build muscle, I will eat as many eggs as possible without other food" stated that 1.6% strongly agreed, 11.1% agreed, 39.7% disagreed. and strongly disagree as much as 47.6%.

Based on several questions and statements Regarding respondents' attitudes towards B2SA, strongly agree and agree describe a good attitude for B2SA questions number 1,2,3,5,6,9,10,11. And those who chose to disagree and strongly disagree expressed a good attitude on B2SA question no. 4,7,8 and 12, so to speak that part large (78.9%) respondents have your own good attitude and the other 21.1% have a bad attitude.

CONCLUSION

Based on the results of data collection in the form of a questionnaire, most respondents have good knowledge, but there are still those who lack balanced nutrition, most have a good attitude with a percentage of 78.9% and those who lack B2SA. attitude is 21.1%. Media

production that has been completed is a banner on guidelines for balanced nutrition and the contents of my plate as well as a banner about joint action with teenagers to prevent stunting and awareness among teenagers about balanced nutrition. Socialization about balanced nutrition to teachers and administrative staff and some of them already know about balanced nutrition, but there are also those who don't know about balanced nutrition.

Good knowledge but not accompanied by implementation that requires further intervention by building character in teenagers through implementing balanced nutrition, such as using the contents of my plate so that school teenagers can bring provisions according to balanced nutrition guidelines.

REFERENCE

1. Rideout K, Levy-Milne R, Martin C, Ostry AS. Food outlets, food availability, and the extent of implementation of nutrition policies in schools in British Columbia. *Can J Heal Society*. 2007;98(4):246–50.
2. Berg C, Larsson C. Diet, weight problems and health: Trends and associations in Swedish schoolchildren. *BMC Public Health*. 2020;20(1):1–9.
3. Shidiq AF, Raharjo ST. The Role of Character Education in Adolescents as Prevention of Juvenile Delinquency. *Excess Researcher and Dedicated to the Community*. 2018;5(2):176.
4. Kementerian Kesehatan Republik Indonesia. Hasil Riset Kesehatan Dasar 2018. Kementerian Kesehatan Republik Indonesia; 2019.
5. UNICEF. Social and Behavior Change Communication Strategy: Improving Adolescent Nutrition in Indonesia. UNICEF Jakarta. 2021.
6. Emilia E. Nutritional Knowledge, Attitudes and Practices in Adolescents and Their Implications for Increasing Healthy Behavior. *Educational, Nutritional and Culinary Media*. 2017;1(1):1–9.
7. Setyawati VA, Setyawati M. Karakter gizi remaja putri urban dan rural di

- provinsi Jawa Tengah. *KEMAS: Jurnal Kesehatan Masyarakat*. 2015 Sep 11;11(1):43-52.
8. Fernandez JC. Guaranteeing a Young Generation of Nutrition Awareness Through School-Based Interventions: Experience of the SEAMEO RECFON Goes to School Nutrition Program. 2020;491(Ijcah):4-7.
 9. Kementerian Perencanaan Pembangunan Nasional/Bappenas. Studi Sektor Kesehatan tentang Pembangunan Gizi di Indonesia. Kementerian Perencanaan Pembangunan Nasional; 2019
 10. Khaerani A, Sitoayu L, Melani V, Gifari N, Nuzrina R. The Role of Giving Eat Reminder Application Media to Changes in Knowledge, Attitude, Behavior, and Eat Pattern of Adolescent Age 13-15 Years Old. *Journal of Health Education*. 2020 Aug 31;5(1):29-38.
 11. Kementerian Kesehatan Republik Indonesia. PMK No. 41. Pedoman Gizi Seimbang. Kementerian Kesehatan Republik Indonesia; 2014.

Dietary Care Lots of Vegetables in Weight Loss Obesity Women of Reproductive Age

Hikmawati Mas'ud^{1*}, Sitti Sahariah Rowa¹

¹ Department of Nutrition, Politeknik Kesehatan Kementerian Kesehatan Makassar,
Makassar, South Sulawesi Province, Indonesia

(Correspondence author's e-mail, hikmawatimasud@gmail.com, +62 812-4230-834)

ABSTRACT

Obesity is one of the issues contributing to the rise of non-communicable diseases such as hypertension and stroke. One of the preventive measures against obesity is the consumption of vegetables and fruits high in fiber, which is used as a strategy for weight reduction. This study aims to establish a dietary care model for reducing weight and blood lipid levels in obese Women of Reproductive Age (WRA). The research was conducted in the urban area of Makassar, specifically in the Berua sub-district, and in the suburban area of Untia sub-district, Biringkanaya district, Makassar city. The research follows a quasi-experimental design known as the 'Non-Equivalent Control Group Pretest-Posttest Design.' Data analysis utilized paired t-tests conducted before and after a 2-month education period using flipcharts and examples of vegetable portions. The research findings revealed that there were 39 samples in obesity category 1 and 21 samples in obesity category 2. Regarding risk factors, there was a significant change in knowledge ($p = 0.000$). The average weight of the samples decreased by 1.8 kg after a 2-month education period, with a significant effect ($p = 0.000$). Protein intake showed no significant impact based on statistical tests, whereas energy, fat, and carbohydrate intake demonstrated significant effects, particularly with a 300g intake of vegetables and the most common energy range being 1750-2077 kcal. The proposed model design suggests that consuming 4 portions of vegetables and a total of 1750 kcal can lead to a weight reduction of 1.8 kg over a 2-month period.

Keywords : Vegetable-Rich Diet, Women of Reproductive Age (WRA), Obesity

<https://doi.org/10.33860/jik.v17i2.2883>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Obesity is one of the nutritional problems in Indonesia that occurs in all age groups and all socioeconomic strata. Existing data shows that the prevalence of obesity has increased every year from 2013 to 2018. The prevalence of central obesity by sex, women \geq 15 years old was 46.7%. Meanwhile, the prevalence by province in South Sulawesi is 31.6%¹.

One of the causes of obesity is the habit of eating instant foods low in fiber, sweet foods, fried foods and lack of vegetables and fruits which have provided a great opportunity for high energy intake². Obesity experienced in women of childbearing age (WUS) will interfere with their reproductive cycle and menstruation due to the influence of hormones. Another impact is infertility due to anovulation which is at risk of miscarriage and fetal death.

Factors causing obesity in WUS in addition to genetics, hormones as well as excess calories, nutritional knowledge and physical activity³.

Efforts to overcome overweight and obesity can be done in several ways, one of which is with diet care. Dietary care is a systematic activity starting from the assessment of needs, diagnosis, intervention, monitoring and evaluation for weight loss. Limiting energy intake by reducing the consumption of staple foods, especially rice, and increasing vegetable consumption⁴. Found efforts to reduce energy intake by choosing the consumption of complex carbohydrates and unsaturated fats to lose weight for people with obesity.

Education efforts and their provision are important for increasing consumption of fruit vegetables⁵. The behavior of the population in consuming fruits and vegetables is measured based on the frequency and portion

of fruit and vegetable consumption. Categorized as 'sufficient' consumption of vegetables and fruits when consuming a combination of vegetables and fruits at least 5 servings per day for 7 days a week.

The first year of research was a study to get a diet model of many vegetables that can lose weight to obese women of childbearing age. The second year of research is to apply the most vegetable multi-vegetable diet care model for weight loss in obese women of childbearing age (WUS).

METHOD

This study is quasi-experimental in the form of a diet of many vegetables to lose weight for obese LUS. The implementation time is 2

years. The first year, *obeservational* research found factors causing observations in WUS, particularly those related to consumption and activity, and designed a dietary care model and measured blood lipid levels. The second year, research into multi-vegetable diet care interventions for weight loss WUS is obese. Dessay research: "*Non Equivalent control group pretest-post test design*".

The first year's research activity is to find factors that cause obesity in women of childbearing age (WUS), by analyzing the type, nutritional value and composition of food in daily dishes from the results of 2x24-hour consumption recall, food frequency and lipid profile. Furthermore, a draft of the diet care model was then carried out trials and improvements.

RESULTS

Table1. Characteristics of WUS Samples in Berua and Untia Villages

Aspects	Category	Berua		Untia		Total	
		n	%	n	%	n	%
Age	15-24 years	3	10	6	17	9	15
	25-34 years	9	27	11	33	20	33,3
	35-44 years	12	36	10	30	22	36,7
	45 years old	6	18	3	9	9	15
Sum		30	100	30	100	60	100
IMT	Obesity 1 (BMI 25-29.9)	19	63	20	67	39	65
	Obesity 2 (BMI >=30)	11	37	10	33	21	35
Sum		30	100	30	100	60	100

The characteristics of the WUS sample include gender, namely all samples are female and age according to the village. In the table above, it is obtained that there are four age categories based on the *World Health Organization* (WHO). Berua Village with the highest proportion was in the age group of 35-44 years as many as 12 samples, while Untia Village the highest proportion was in the age group of 25-34 years as many as 11 samples. s edangkan for the lowest proportion in the age group of 15-24 years in Berua Village as much as 3 to 1, in Untia Village the lowest proportion

in the 45 year age group was 3 samples.

Based on the aspect of Body Mass Index (BMI) or nutritional status of WUS samples, two categories of obesity were obtained, namely obesity 1 and obesity 2. Obesity 1 is a sample that has a BMI of 25-29.9, while obesity 2 is a sample that has a BMI of >30. Berua Village with the highest proportion is in obesity group 1 as many as 18 samples, while for Untia Village with the highest proportion, namely in obesity group 1 as many as 28 samples.

Table2. Knowledge Table of WUS samples in Berua and Untia Villages

Knowledge	PreTest		PostTest		p-value
	n	%	n	%	
Good	23	38,3	60	100,0	0,000
Less	37	61,7	0	0,0	
Total	60	100,0	60	100,0	

Knowledge of WUS obesity samples in Berua and Untia Villages based on the table above, before education there were 37 samples or 61.7% had knowledge of less than 60 samples. After education using the media of backsheets and examples of vegetable portions, there was a significant change, namely that all samples of 60 people had good knowledge or 100%.

This research is a study on changes in knowledge before and after nutrition education is carried out on obese WUS samples using backsheet media and examples of vegetable portions. However, previously measurements of sample food intake were carried out using *the food recall* method and food frequency calculations were also carried out using *food frequency*.

The level of knowledge of WUS samples before nutrition education was given and examples of more vegetable portions that had less knowledge, both in Berua Village and in Untia Village, this was due to several factors such as lack of exposure to samples with information and knowledge about nutrition and health. In a study conducted by Simbolon, et al, 2018 which stated that there was an influence of nutrition education on increasing adolescent knowledge in the intervention group regarding obesity.

The level of knowledge in the two villages was educated through the media of

backsheets and examples of vegetable portions and two months after being given nutritional knowledge there was a significant change, namely all samples had good knowledge, namely 100% which was previously 61.7%. The media used is a backsheet media, lembar balik is used because it is classified as the most effective media as a health promotion media and the scope of messages conveyed is quite wide. The backsheet, which is used as a nutrition education medium, is able to interactively meet the aspects of protecting the community and making it easier for officers to convey messages. This is what makes the sample knowledge increase after being given nutrition education specifically discussing obesity and health, in addition to being given an example of a portion of vegetables that use household sizes so that WUS samples are easily applied at home for consumption according to the amount needed.

Nutrition education was carried out in two different places, namely in Berua Village and Untia Village with the number of all samples as many as 60 samples. The results of the *Paired T-test statistical test* were carried out to see the statistical significance at both research sites. This shows that in this study there is a meaningful influence of knowledge, namely from the results after education through the feedback sheet and the example of the portion of vegetables given, namely $p = 0.000$.

Table3. Weight Table of WUS samples in Berua and Untia Villages

	Average weight	Total		<i>p</i>
		<i>n</i>	%	
Pre test	70.7 kg	60	100	0,000
Post test	68.9 kg	60	100	

The weight aspect of WUS before being given education the average body weight of 60 samples was 70.7 kg, after being given a backsheet media education and an example of a portion of vegetables two months later measured the average body weight of 68.9 kg. It can be seen from the measurement results after education that there was a weight loss of 1.8 kg, as well as the results of the *Paired T-test statistical test*, there was a significant influence, namely $p = 0.000$.

There are several ways to regulate the mechanism of weight loss including behavior, genetic and physiological factors. In obesity, between food intake and energy expenditure

there is an imbalance in which there will be a state of excessive fat accumulation and consequently have a bad influence on health. One of the main factors that cause the increasing incidence of obesity around the world is inappropriate and inappropriate food intake as well as energy use and lack of physical activity⁶.

Based on the results of this study, data on the weight aspects of WUS who are obese there is weight loss before and two months after being given education through a backsheet and an example of a portion of vegetables that decreased by 1.8 kg. It can be seen that there is a contribution to the role of providing education

and examples of vegetable portions to WUS obesity and there is a significant influence based on statistical tests⁷. In their study also

found a weight loss of 1 kg after 5 weeks of nutritional education interventions⁷.

Table4. Energy and Nutrient Intake of WUS Samples in Berua and Untia Villages

Intake	Category	Pre		Post		p
		n	%	n	%	
Energy	More	0	0	0	0	0,042
	Enough	44	73,3	31	51,7	
	Less	16	26,7	29	48,3	
Total		60	100	60	100	
Protein	More	0	0	0	0	0,519
	Enough	18	30	16	26,6	
	Less	42	70	44	73,4	
Total		60	100	60	100	
Fat	More	0	0	0	0	0,008
	Enough	42	70	32	53,3	
	Less	18	30	28	46,7	
Total		60	100	60	100	
Carbohydrates	More	0	0	0	0	0,000
	Enough	53	88,3	13	21,6	
	Less	7	11,7	47	78,4	
Total		60	100	60	100	

Description: More >110% AKG, Enough: 80-110% AKG, Less: <80% AKG

Energy and nutrient intake is divided into three categories (proteins, fats and carbohydrates) based on the percentage of nutritional intake. The process of calculating nutrient intake uses the 24-hour *food recall* consumption survey method or measurement of individual nutrient intake is carried out twice. In the results of *recall* before (pre) and after (post) education and examples of vegetable portions in Berua and Untia Villages for all energy and nutrient intake with more than none or 0% category. In the proportion of energy intake before education using the feedback sheet and example portion of vegetables category enough as many as 44 samples or as much as (73.3%) and there was a decrease after education and examples of vegetable portions, namely 31 samples or (51.7%). Meanwhile, the proportion of protein intake with less categories was 42 samples (70%) before education and examples of vegetable portions and post-education increased by 44 samples (73.3%). Pre-educational fat intake and sample vegetable portions with sufficient categories were 42

samples (70%) and there was a decrease of 32 samples (53.3%) after education and examples of vegetable portions. The highest proportion of carbohydrate intake with the moderately pre-educational category and the example of vegetable portions was 53 samples (88.3%) and there was a decrease in post-education and examples of vegetable portions by 13 samples (21.6%). Protein intake can be seen from the results of statistical tests that there is no meaningful change while the intake of energy, fats and carbohydrates has a meaningful change, namely $p < 0.005$. In line with the research of⁸ that for fat and carbohydrate intake there is a significant relationship with central obesity, but for protein intake it is seen that there is no significant relationship⁸. Carbohydrates are macronutrient components that provide energy as well as fats that contribute a large amount of energy in the composition of the diet so that it is a contribution to excess energy intake which can become weight gain.

Table5. WUS Sample Diet in Berua and Untia Villages

Diet	n	%
Good	33	55
Less	27	45
Total	60	100

Description: Good \geq average FFQ score, Less \leq average FFQ score

Based on the diet table of all WUS samples, the obese ones had more good categories than those with less categories. Samples from 60 WUS had a good category of 33 samples or 55%. WUS obesity diet is obtained through recording food intake using a semi-quantitative *food frequency* questionnaire (FFQ), namely filling in the questionnaire fields available for each type, number of and the

frequency of food intake in the past two months. Research by ⁹ illustrates that there is a relationship between diet and the incidence of obesity in college students where good dietary arrangements can lose weight⁹. Obesity in WUS has become a very important problem because it can make complications of concomitant diseases, besides that an unbalanced diet will cause nutritional status in a person to be excessive.

Table6. Lipid Profile of WUS samples

Profile Lipids	Usual		Not Usual		Total	
	n	%	n	%	n	%
LDL	59	98,3	1	1,7	60	100
HDL	25	41,7	35	58,3	60	100
Triglycerides	56	93,3	4	6,7	60	100
Total Cholesterol	51	85,0	9	15,0	60	100

Descrption: LDL<130mg/dl, HDL<45-65mg/dl, Triglycerides<200mg/dl, Total Cholesterol<200mg/dl

The results of the blood lipid profile examination show LDL levels, Triglycerides and Cholesterol total average samples showed normal values of 98.3%, 93.3% and 85%, respectively, while HDL examination of normal sample numbers was 41.7% lower than the number of abnormal samples where the results were 58.3%.

Lipid profile is a state of blood fats in terms of LDL, HDL, Triglycerides and

total cholesterol content in the blood. The normality of the body always maintains a good balance, so it is not easy for atherosclerosis to occur. This study showed that obese WUS samples were seen as the result of blood lipid profiles such as cholesterol, triglyceride and LDL more normal but HDL levels more WUS samples tend to be low or abnormal values, this situation will cause the coronary vessel walls to thicken.

Table7. Vegetable Intake WUS Obesity

Total Vegetable Intake /day	Pre		Post		p
	n	%	n	%	
Enough	0	0	38	63	0,000
Less	60	100	22	37	
Total	60	100	60	100	

Desc. Enough ≥ 300 gr/day, less < 300 gr/day

The vegetable intake table shows that the daily vegetable intake in the WUS sample before being educated on the backsheet media and the vegetable portion example, there were all samples with the less category, namely 60 WUS samples and after being educated and the vegetable portion example there was an increase with a sufficient category of 38 samples or 63%. Likewise, the results of the *Paired T-test* show a significant change in vegetable intake, namely $p = 0.000$.

Vegetable intake is measured based on the amount of vegetables consumed per one meal, namely one bowl of 75-100 grams without vegetable water, so that in one day you can consume as much as 300 grams of vegetables / day. So that the intake of vegetable consumption is divided into two categories, namely enough if it is ≥300 grams / day and less if it is <300 grams / day. The measurement of vegetable consumption intake is carried out 2 times, namely before and after providing education using a backsheet and examples of vegetable portions.

Table8. WUS Vegetable Portion

Portion of Vegetable Intake an/Day	Pre		Post	
	n	%	n	%
4 Servings (>300gr)	0	0	32	53
3 Servings (300gr)	0	0	6	10
2 servings (200<300gr)	0	0	0	0
1 Serving (100<200gr)	60	100	22	37
Total	60	100	60	100

Based on the portion of vegetable consumption in the pre, as many as 60 samples or 100% only consumed 1 serving of vegetables per day. After an evaluation, 32 samples or 53% consumed vegetables in 4 servings per day.

Table 8 shows that WUS samples who were obese after education using backsheet media and given examples of vegetable portions, mostly consumed 4 servings of vegetables, indicating that the sample was able to meet PUGS recommendations with the

provision that the frequency of vegetable intake was at least 3 times / day according to the portion, but there are still those who consume vegetables 1 serving / day, this is because there is no motivation to change the habit of eating vegetables. The results of statistical tests in the research of Henu Bey showed that the number of vegetable consumption frequencies in female students is a risk factor for overweight events with less frequency of vegetable consumption.

Table9. Total Energy with BB

Total Energy (kcal)/day	Weight				Total	
	Climb		Go Down		n	%
	n	%	n	%		
1750 - 2077	1	1.7	30	50	31	51.7
1698 - 1745	2	3,3	27	45	29	48,3
Sum	3	5	57	95	60	100

Table 9 illustrates that energy input of 1750-2252 kcal/day, which is a sufficient category of 80-110% AKG (Nutritional Adequacy Figure) in the WUS sample that is obese is associated with Weight Loss (BB) the value drops by 30 samples or by 50%, although it appears that Total Energy is sufficient, but

weight loss is because the portion of vegetables also contributes energy. It can also be seen that the Total Energy of 1698-1745 kcal with a category of less than <80% AKG value weight loss by 27 samples, this is in line because it is clear that the energy input is less than it should be.

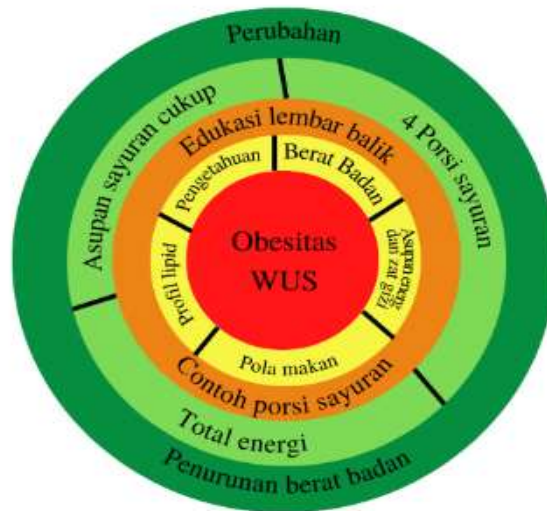
Table10. BB with Vegetable Portion Intake

BB	Vegetable Portion								Sum	
	4		3		2		1		n	%
	n	%	n	%	n	%	n	%		
Climb	1	1,7	0	0	0	0	2	3,3	3	5
Go down	31	51.7	6	10	0	0	20	33.3	57	95
Total	32	53.4	6	10	0	0	22	36,6	60	100

The portion of vegetables seen based on weight loss and weight gain was the highest value for 4 servings of vegetables with weight loss of 31 samples or 53.4%, but there was 1 sample (1.7%) that rose even though the vegetable intake was 4 servings, while the

lowest weight loss was found in 3 servings of vegetables, namely 6 samples (10%). It can be seen that overall based on the portion of vegetables consumed, it will lose weight by 57 samples or by 95% even though there is only 1 serving of vegetables consumed.

Based on the results of research and analysis of WUS samples obesitas so Was one type Upbringing Diet many vegetables as next:



Figures 1. Model of Vegetable Diet

Description:

- Layer 1 → Obesity WUS
- Layer 2 → WUS obesity risk factors
- Layer 3 → Education backsheet media and examples of vegetable portions
- Layer 4 → Sufficient Vegetable Intake, vegetable portion (4 servings) and total energy (1750 kcal)
- Layer 5 → Changes in Weight Loss (1.8 kg)

CONCLUSION

From the results of the study, it was concluded that the average body weight of the sample after 2 months of education decreased by 1.8 kg. the largest diet of WUS samples that are obese in the good category was 33 samples (55%). There is a significant influence on vegetable intake and the most vegetable portion in portion 4, which is >300 gr of vegetables while the highest total energy is 1750-2077 kcal. HDL examination of normal sample count was 41.7% lower than the number of abnormal samples where the result was 58.3%. Subsequent studies were conducted with a larger number of samples compared to previous studies to improve the accuracy and validation of the research.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Kementerian Kesehatan Republik

- Indonesia. *Hasil Riset Kesehatan Dasar 2018*. Jakarta: Kementerian Kesehatan Republik Indonesia, 2019.
2. Burhan FZ, Sirajuddin S, Indriasari R. Pola konsumsi terhadap kejadian obesitas sentral pada Pegawai pemerintahan di kantor bupati kabupaten Jeneponto. *Jurnal Media Kesehatan Masyarakat Indonesia*. 2013;9(1):1-4.
 3. Hutasoit ES. Faktor Yang Mempengaruhi Obesitas Pada Wus di Wilayah Kerja Puskesmas Payung Sekaki Kota Pekanbaru 2019. *JOMIS (Journal of Midwifery Science)*. 2020 Jan 24;4(1):25-33. <https://doi.org/10.36341/jomis.v4i1.1117>
 4. Faizah I, Muniroh L. Analisis Perubahan Berat Badan, Indeks Massa Tubuh dan Persentase Lemak Tubuh Klien Pasca Pemberian Diet South Beach pada My Meal Catering Surabaya. AMNT [Internet]. 2018 Mar.

- 12 [cited 2023 Sep. 16];2(1):52-8. Available from: <https://e-journal.unair.ac.id/AMNT/article/view/7840>
5. Afif PA, Sumarmi S. Peran Ibu sebagai Edukator dan Konsumsi Sayur Buah pada Anak. AMNT [Internet]. 2017 Oct. 23 [cited 2023 Sep. 16];1(3):236-42. Available from: <https://e-journal.unair.ac.id/AMNT/article/view/6250>
6. Mutia A, Jumiati J, Kusdalinah K. Pola Makan Dan Aktivitas Fisik Terhadap Kejadian Obesitas Remaja Pada Masa Pandemi Covid-19. Journal of Nutrition College [Online]. 2022 Jan;11(1):26-34. <https://doi.org/10.14710/jnc.v11i1.32070>
7. Simbolon D, Tafrieani W, Dahrizal D. Edukasi Gizi dan Perubahan Berat Badan Remaja Overweight dan Obesitas. Jurnal Kesehatan. 2018 Sep 30;9(2):289-94.
8. Purbowati, Afiatna P. Hubungan Asupan Zat Gizi Makro Dengan Obesitas Sentral Pada Tenaga Kerja Laki-Laki: The Relation Between Macro Nutrition With Central Obesity of Man Employes. JGK [Internet]. 2018 Jan. 4 [cited 2023 Sep. 16];10(23):80-6. Available from: <https://jurnalgizi.unw.ac.id/index.php/JGK/article/view/46>
9. Evan E, Wiyono J, Candrawati E. Hubungan antara pola makan dengan kejadian obesitas pada mahasiswa di Universitas Tribhuwana Tungadewi Malang. Nursing News: Jurnal Ilmiah Keperawatan. 2017 Dec 5;2(3).

Original Article

The Effect of Baby Massage Stimulation Learning E-Module on The Skills of Students in D-III Midwifery

**Sitti Nurjannah¹, Andi Agussalim^{2*}, Elizabet C Jusuf³, Martira Maddepungeng⁴,
Sharvianty Arifuddin⁵, Andi Nilawati Usman¹**

¹ Master of Midwifery Study Program, Graduate School, University of Hasanuddin, Makassar, Indonesia

² West Asian Literature Study Program, Faculty of Cultural Sciences, University of Hasanuddin, Makassar, Indonesia

³ Department of Obstetrics and Gynecology, Faculty of Medicine, University of Hasanuddin, Makassar, Indonesia

⁴ Department of Pediatrics, Faculty of Medicine, Makassar, Indonesia

⁵ Department of Obstetrics and Gynecology, Gynecology Oncology, Faculty of Medicine, University of Hasanuddin, Indonesia

(Correspondence author's: agussalim@fs.unhas.ac.id/0852-5527-5226)

ABSTRACT

Baby massage offers many benefits, especially for the growth and development of babies. Baby massage skills are very important in supporting the success of stimulating the baby's growth and development. Therefore, it is very important to improve the skills of midwifery students. One of the efforts to improve the skills is providing web-based e-modules on infant massage stimulation learning. This research aims to determine the effect of infant massage stimulation learning e-module on the skills of DIII midwifery students. The research employed the quasi-experiment. The sampling technique was total sampling. The sample included 76 midwifery students in semester 4. The study was conducted in two locations. The intervention group comprised 36 students and the control group consisted of 40 students. Using McNemar and Mann Whitney, the research found that there was a significant effect baby massage stimulation pre test and posttest skills (p -values $0.00 < 0.05$) and there is also a significant effect on the comparison of baby massage stimulation skills between the intervention and control groups (p -values $0.00 < 0.05$). The conclusion is there is an effect of the use of e-modules on increasing the skills of DIII midwifery student.

Keywords: *Baby Massage Stimulation, E-module, Midwifery*

<https://doi.org/10.33860/jik.v17i2.2276>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Midwives have an important responsibility in providing individual, group, and community health services. They must have the knowledge, skills and attitudes required for providing services. Midwives are authorized to provide services to newborns/neonates, infants, toddlers and preschool children, as well as to mothers during pregnancy, during childbirth, and family planning services. In terms of

midwifery care for neonates, infants and toddlers, KEPMENKES is stated that midwifery experts and midwives must have various skills, one of which is infant massage¹. Law no 4, 2019 states that midwives also play an important role in monitoring the growth and development of infants and toddlers¹.

Every child goes through various phases of continuous growth and development. The period of infant growth and development Every child goes through various phases of

continuous growth and development. The period of infant growth and development is considered a golden age and a critical period, specifically for babies aged 0- 12 months. This age range is relatively short and cannot be repeated, hence it is referred to as a golden age². It is also considered a critical period because infants are particularly vulnerable to their environment during this time and require adequate nutrition and stimulation for optimal growth and development³. This phase is crucial for the development of language comprehension, creativity, intelligence, and emotional capacity, serving as the foundation for subsequent stages of development. Proper stimulation and care during this critical period are essential to ensure the physical, mental, and social development of children⁴.

According to the World Health Organization (WHO) report in 2018, the prevalence of children with impaired growth and development was 28.7%. Notably, Indonesia ranked third in the Southeast Asia/South-East Asia Regional (SEAR) in terms of prevalence⁵. A study conducted by Merida and Hanifa (2022) demonstrated that babies who receive regular and appropriate stimulation experience significant improvements in growth and development. Adequate fulfillment of infants' basic needs, such as a nurturing family environment, emotional affection, sound physical and mental health, balanced nutrition, and opportunities for stimulation, contributes to their optimal growth and development⁵. Providing early and suitable stimulation has been shown to foster the development of ethical values, positive personality traits, intelligence, independence, skills, and productivity⁶. Previous research has also highlighted the significant impact of regular touch, particularly through massage, on the growth and development of infants⁷.

Efforts to enhance development include engaging in stimulus activities such as baby massage⁸. Baby massage offers numerous benefits, such as promoting weight gain and growth, boosting immunity, improving baby's focus and sleep quality, reducing stress hormone levels, fostering parent-infant bonding, and enhancing milk production^{9,10,11}. Proficiency in baby massage skills is vital to effectively support the stimulation of a baby's growth and development. Hence, it is essential for midwives, who are professionals in the field, to possess expertise in its application. Errors in

performing massages can have adverse effects, including swelling, bruising, pain, irritability, vein displacement, and injury in infants. These complications arise from a lack of knowledge regarding proper infant massage techniques¹².

Considering the significance of infant massage and the responsibility of midwifery students to monitor infant growth and development, stimulating baby massage becomes an essential aspect. Web-based modules serve as a type of printed material designed in a systematic, appealing, and comprehensible manner to cater to specific needs. These modules can be utilized autonomously or with guidance from educators.

Wiryanti et al. (2020) conducted research demonstrating an improvement in students' skills in second-generation care through the use of web-based e-modules¹³. These modules offer enhanced clarity, making them more accessible to students, thus increasing their motivation to actively engage in studying. Additionally, the inclusion of video displays in the e-modules supports laboratory practicum activities. Web-based e-modules cater to students with alternative learning resources, enabling independent study and facilitating a more thorough grasp of the provided material. The integration of various applications, such as text, images, audio, and video, in the presentation of web-based e-modules makes learning topics more captivating and less monotonous. Interactive tests and quizzes are also incorporated to provide feedback and enhance the learning process^{14,15}.

To adequately equip midwifery students with the necessary understanding and skills, it is crucial for them to receive this material during their college education. The aim is to prepare them for applying baby massage skills in the community, thereby contributing to optimal intellectual development in infants as part of stimulation efforts.

METHOD

This study employs a quasi-experimental design to investigate the impact of a specific treatment. The influence of massage stimulation e-module intervention was examined over a one-week period at STIK Makassar and Megarezky University Makassar in April-May 2023¹⁶. The sample consisted of all fourthsemester midwifery DIII students,

employing a total sampling technique with a sample size of 76 respondents. The research focused on assessing the effect of using baby massage stimulation e-modules on enhancing student skills. The respondents were divided into two groups: the intervention group comprising 36 students and the control group comprising 40 students. The intervention group received a baby massage stimulation emodule, while the control group received a baby massage stimulation module. Descriptive analysis was conducted to examine the

differences in pretest and posttest skills between the intervention and control groups. McNemar's alternative test was employed to determine any significant changes within each group, and the Mann Whitney test was used to assess the impact of the wedge massage stimulation e-module. Ethical approval for this study was obtained from the ethical committee of the Faculty of Public Health, Hasanuddin University, under number 15349/UN4.14.1/TP.01.02/202.

RESULTS

Table 1 Characteristics of Respondents Based on Age, Grade-point Average (GPA) and Origin

Characteristic of Respondents		Intervention		Control		p value
		n	%	n	%	
Age	<20 years	12	33.3	16	40.0	0.000
	>19 years	24	66.7	24	60.0	
GPA	Satisfying	5	13.9	6	15.0	0.000
	Very satisfactory	31	86.1	34	85.0	
Origin	Sul-Sel	19	52.8	22	55.0	0.000
	Sul-Tra	7	19.4	5	12.5	
	Maluku	6	16.7	8	20.0	
	Papua	4	11.1	5	12.5	

Table 1 presents the distribution of respondent characteristics based on age groups. The control group had a higher percentage (40.0%) of respondents below 20 years compared to the intervention group (33.3%). Conversely, the intervention group had a higher percentage (66.7%) of respondents above 19 years compared to the control group (60.0%). Regarding GPA satisfaction, the control group had a slightly higher percentage (15.0%) of respondents who were satisfied, while the intervention group had a slightly lower percentage (13.9%). In terms of very satisfying GPA, the intervention group had a higher percentage (86.1%) compared to the control

group (85.0%). Considering the origin of the respondents, the control group had a higher percentage (55.0%) of respondents from South Sulawesi compared to the intervention group (52.8%). The intervention group had a higher percentage (19.4%) of respondents from Southeast Sulawesi compared to the control group (12.5%). Moreover, the control group had a significantly higher percentage (20.0%) of respondents from Maluku compared to the intervention group (16.7%). Finally, the control group had a considerably higher percentage (12.5%) of respondents from Papua compared to the intervention group (1.1%).

Table 2. Pretest and Posttest Differences in the Intervention Group and the Control Group on Infant Massage Skills

Group	Intervention				Control Intervention				p-value
	No skilled		Skilled		No skilled		Skilled		
	n	%	n	%	n	%	n	%	
Pretest	36	100	0	0	40	100	0	0	0.000
Posttest	3	8.3	33	91.7	24	60	16	40	0.000

Table 2 presents the skills of respondents in the intervention and control groups during the pretest and posttest phases. None of the respondents were skilled during the

pretest in either group. However, in the posttest, the intervention group had 8.3% unskilled respondents and 91.7% skilled respondents. In contrast, the control group had 60% unskilled

respondents and 40% skilled respondents. The statistical analysis revealed a p-value of 4.67,

while in the control group, the average posttest score was 77.30 with an SD of 5.35.

Table 3. Comparison of Pretest and Posttest in the Intervention and Control Groups on Infant Massage Skills

Variable	Pretest		p-value	Posttest	
	n	Mean±SD		Mean±SD	p-value
Intervention	36	58.13±6.83	0.000	87.19±4.67	0.000
Control	40	49.87±6.89		77.30±5.35	

Table 3 presents the average pretest scores in the intervention group, which were 58.13 with a standard deviation (SD) of 6.83, while in the control group, the average pretest score was 49.87 with an SD of 6.89. On the other hand, the average posttest score in the intervention group was 87.19 with an SD of 4.67, while in the control group, the average posttest score was 77.30 with an SD of 5.35.

The results of the Mann Whitney test indicated a significant difference in the pretest scores between the intervention and control groups, with a p-value of <0.000. Additionally, in the posttest, the use of emodules and modules had a significant effect in both the intervention and control groups, as reflected by p-values of <0.000. Therefore, based on the data analysis results, a significant comparison can be observed between the intervention and control groups, both in the pretest and posttest phases.

DISCUSSION

The learning process is an essential activity within educational institutions aimed at encouraging students in achieving their predetermined goals. In the context of health education, the learning process necessitates the development of media and learning concepts that can enhance students' knowledge, skills, and interests. As stated by Aritonang and Safitri (2021), the growing emphasis on technological advancements has prompted an increasing focus on the development of teaching media to captivate student interest and motivation¹⁷.

The use of e-modules is highly suitable for teaching baby massage and can serve as a reference for creating and developing teaching materials. Modules, as learning media, encompass materials, learning methods, limitations, instructions for activities, exercises, and evaluations designed in an engaging manner to attain desired competencies. They are systematically organized teaching materials that are easily comprehensible and can be used

independently or with the guidance of educators.

To enhance the effectiveness of learning, one effective approach is to combine module teaching materials with interactive multimedia in the form of emodules. This approach is supported by Siregar and Safitri, (2020) and Dari, et al. (2020), who note that e-modules incorporate images, audio, video, animation, and formative assessments, thereby providing feedback to facilitate the learning process^{18,15}.

E-modules serve as independent teaching materials designed systematically and cohesively in specific learning units, presented in an electronic format. Each lesson within the e-module is interconnected through hyperlinks, enhancing interactivity and enriched learning experiences by incorporating videos and audio elements to enhance student engagement. To facilitate access to learning, platforms that are easily accessible to educators and students, such as website-based learning media, can be utilized¹⁹.

E-modules, in the form of electronic modules, are anticipated to enhance student interest and motivation. Interactive emodules are teaching materials designed in an engaging and systematic manner, encompassing materials, methods, limitations, and evaluations. The aim is to achieve competencies and sub-competencies effectively. Therefore, e-modules hold significant value for teaching material developers, with the hope that they will be utilized and accessed by midwifery students according to their individual needs and interests, such as the infant massage learning e-module

Table 3 illustrates that both the intervention and control groups exhibited improved skills after utilizing modules and emodules, with a p-value of 0.000. This finding aligns with previous research indicating that the use of e-modules fosters student interest and motivation for independent learning, resulting

in a more effective and efficient learning process and subsequently leading to enhanced student learning²⁰. Furthermore, research conducted by Rosta Alannawa and Lutfiyah Hidayati demonstrates that e-learning modules significantly enhance the psychomotor test results and overall achievement scores of students during practical training, ultimately improving student learning outcomes²¹.

Table 4 shows a significant difference between the intervention and control groups in terms of pretest and posttest results, with a p-value of <0.000. This indicates that the intervention group, which utilized the e-module media, was more effective in enhancing baby massage stimulation skills compared to the group using the module media. This finding is consistent with the research conducted by Oktavia et al., which suggests that e-modules, equipped with appropriate teaching materials, maintain student interest and are considered interesting and affective for learning²².

E-modules are independent digital learning resources designed to achieve learning competencies and promote student interactivity. Several experts agree that e-modules serve as comprehensive and efficient independent learning, providing students with guidelines for self-directed learning even without direct supervision from educators. Furthermore, electronic learning modules possess certain characteristics such as user-friendliness, adaptability, and consistency, as highlighted by²³.

This perspective aligns with the research conducted by Dari and Nasih, which indicates that the use of e-modules increases students' proficiency in practical activities and assists educators in fostering student skills during the learning process¹⁵.

CONCLUSION

Based on the results of the study, it can be concluded that the use of e-module learning to stimulate baby massage for one week affects the skills of DIII midwifery students. The use of e-module media has a higher value than the use of the module after the intervention. Further research needs to be carried out and developed regarding monitoring the use of e-modules so that research results are more effective.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Presiden Republik Indonesia. Undang-undang (UU) Nomor 4 Tahun 2019 tentang Kebidanan. Presiden Republik Indonesia; 2019.
2. Kusumawaty I, Yunike Y, Hartati S. Optimalisasi Kemampuan Kader Kesehatan Dalam Melaksanakan Hipnosis Lima Jari Pada Masa Adaptasi Covid-19. *Journal of Community Engagement in Health*. 2021 Mar 1;4(1):14-21.
3. Hidayanti M, Lita L, Jatisunda MG. Pelatihan Keterampilan Baby Spa Bagi Ibu-Ibu Muda Sebagai Upaya Meningkatkan Kualitas Pertumbuhan Dan Perkembangan Bayi. *Bernas: Jurnal Pengabdian Kepada Masyarakat*. 2021 Aug 5;2(3):707-13. <https://doi.org/10.31949/jb.v2i3.1325>
4. Melinda P, Santi E, FD EA. Metode Demonstrasi, Booklet, Dan Video Terhadap Perilaku Ibu Melakukan Pijat Bayi. *Nerspedia*. 2019;1(1):47-52.
5. Merida Y, Hanifa FN. Pengaruh Pijat Bayi Dengan Tumbuh Kembang Bayi. *Jurnal Kesehatan*. 2022 May 31;11(1):27-32.
6. Pamungkas CE, Rofita D, WD SM, Maharani AB, Gustiana Y, Annisa A. Edukasi Manfaat Pijat Bayi, Upaya Meningkatkan Kesehatan Pada Bayi Selama Masa Pandemi Covid-19 Di Desa Telagawaru Lombok Barat. *SELAPARANG: Jurnal Pengabdian Masyarakat Berkemajuan*. 2021 Dec 8;5(1):376-81.
7. Damayanti FN, Absori A, Wardiono K. Legal Protection of Midwives Based on Professional Justice in Midwifery Practices. *Indian Journal of Public Health*. 2019 Apr;10(4), 437-441.
8. Priyadarshi M, Kumar V, Balachander B, Gupta S, Sankar MJ. Effect of whole-body massage on growth and neurodevelopment in term healthy newborns: A systematic review. *Journal of Global Health*. 2022;12. <https://doi.org/10.7189/jogh.12.12005>
9. Field T. Massage therapy research

- review. *Complementary therapies in clinical practice*. 2016 Aug 1;24:19-31. <https://doi.org/10.1016/j.ctcp.2016.04.005>
10. Khuzaiyah S, Adnani QE, Chabibah N, Khanifah M, Lee KY. A qualitative study on mothers' experiences attending an online infant massage class: "It is funny! I feel close to my baby!". *BMC nursing*. 2022 Jul 4;21(1):175.
 11. Kulkarni A, Kaushik JS, Gupta P, Sharma H, Agrawal RK. Massage and touch therapy in neonates: the current evidence. *Indian pediatrics*. 2010 Sep;47:771-6.
 12. Sulistiani A, Wijayanti T. Efektifitas Pendidikan Kesehatan Terhadap Keterampilan Ibu Dalam Melakukan Pijat Bayi. *jurkeb [Internet]*. 2020 Jun. 14 [cited 2023 Sep. 17];12(01):93-102. Available from: <https://ejurnal.stikeseub.ac.id/index.php/jkeb/article/view/368>
 13. Wiriyaniti M, Syarif S, Ahmad M, Prihartini SD, Wahyuni IS. Pengaruh media pembelajaran berbasis WEB terhadap peningkatan keterampilan praktikum asuhan kala II persalinan mahasiswa DIII kebidanan. *Jurnal Keperawatan Muhammadiyah*. 2020 Apr 5;5(2):77–81.
 14. Pratiwi R, Sulandjari S, Astuti N, Miranti MG. Pengembangan Modul Elektronik Berbasis Website Pada Kompetensi Dasar Kue Indonesia Dari Ketan Dan Tepung Ketan. *Jurnal Online Program Studi S1 Tata Boga*, 2021; 10(2).
 15. Dari RW, Nasih NR. Analisis Keterampilan Proses Sains Mahasiswa Pada Praktikum Menggunakan E-Modul. *Edu Sains: Jurnal Pendidikan Sains dan Matematika*. 2020 Dec 26;8(2):12-21.
 16. Hastjarjo TD. Rancangan eksperimen-kuasi. *Buletin psikologi*. 2019 Dec;27(2):187-203. <https://doi.org/10.22146/buletinpsikologi.38619>
 17. Aritonang I, Safitri I. Pengaruh blended learning terhadap peningkatan literasi matematika siswa. *Jurnal Cendekia: Jurnal Pendidikan Matematika*. 2021 Mar 26;5(1):735-43. <https://doi.org/10.31004/cendekia.v5i1.555>
 18. Siregar AD, Harahap LK. Pengembangan e-modul berbasis project based learning terintegrasi media komputasi hyperchem pada materi bentuk molekul. *JPPS (Jurnal Penelitian Pendidikan Sains)*. 2020 Nov 28;10(1):1925-31.
 19. Fahmi MS, Aribowo D, Irwanto I. Development Of Webapps-Based E-Learning AT SMK Miftahul Anwar Menes. *JUPI (Jurnal Ilmiah Penelitian dan Pembelajaran Informatika)*. 2023 Feb 25;8(1):51-8.
 20. Sidiq R. Pengembangan e-modul interaktif berbasis android pada mata kuliah strategi belajar mengajar. *Jurnal Pendidikan Sejarah*. 2020 Jan 31;9(1):1-4.1
 21. Alannawa R, Hidayati L. Analisis Pengembangan E-Modul Pada Pembelajaran Bidang Keterampilan Tata Busana. *Jurnal Online Tata Busana*. 2021 Jun 19;10(02):1-0.
 22. Oktavia B., Zainul R., Guspatni, & Putra, A. Introduction And Development Of E- Module for Teachers of Chemistry and Biology MGMP Members of Padang Panjang City. *INA-Rxiv*, 2018; 1–9. <https://doi.org/10.31227/osf.io/yhau2>
 23. Widiana FH, Rosy B. Pengembangan e-modul berbasis flipbook maker pada mata pelajaran teknologi perkantoran. *Edukatif: Jurnal Ilmu Pendidikan*. 2021 Aug 24;3(6):3728-39.

Analysis of Factors Associated with Decreased Body Temperature in the Redistribution Phase, Linear Phase, and Plateau Phase in Spinal Anesthesia Patients in the Central Surgery Installation of Jombang Hospital

Heffy Maulidiyah Wardah¹, Tri Johan Agus Yuswanto^{2*}, Imam Subekti²

¹Bachelor of Applied Nursing, Poltekkes Kemenkes Malang, Malang, East Java, Indonesia

²Departement of Nursing, Poltekkes Kemenkes Malang, Malang, East Java, Indonesia

(Correspondence author's email, denbagusjohan@yahoo.co.id/0813-3391-9293)

ABSTRACT

Perioperative procedures have the potential to reduce body temperature. Many factors influenced this incident. The study aimed to analyze the factors associated with a decrease in body temperature, analyze the relationship between several factors and a decrease in body temperature, and analyze the factors most associated with a decrease in body temperature in the redistribution phase, linear phase, and plateau phase in spinal anesthesia patients in IBS Jombang Regional Hospital. The research used a Cross-Sectional approach with 70 respondents using the Accidental Sampling technique. The independent variables in the study were age, gender, BMI, type of surgery, duration of surgery, irrigation fluid, ASA score, and comorbidities. The dependent variable includes body temperature in the redistribution, linear, and plateau phases of patients after spinal anesthesia. Data was taken through observations of respondents before surgery and ERM data. Data collection was carried out from February – April 2023. Analysis of the relationship between variables used bivariate Chi-Square analysis with an α value set at <0.05 . Analysis of the most related variables uses Multivariate Multiple Linear Regression analysis. The majority of patients experience mild hypothermia in the redistribution phase, linear phase, and plateau phase with a temperature of $34^{\circ}\text{C} - <36^{\circ}\text{C}$. Factors associated with a decrease in body temperature were age ($p = 0.005$), type of surgery ($p = 0.015$), duration of surgery ($p = 0.000$), ASA score ($p = 0.000$), and type of irrigation fluid ($p = 0.031$). The factors gender ($p = 0.333$), BMI ($p = 0.081$), and comorbidities ($p = 0.494$) did not have a significant relationship with decreasing body temperature. The most dominant factors related were the duration of surgery in the redistribution phase (24.2%), linear phase (32.7%), and plateau phase (27.7%). The factors of age, type of surgery, duration of surgery, ASA score, and type of irrigation fluid were related to a decrease in body temperature. In contrast, gender, BMI, and comorbid factors were not related to a decrease in body temperature, and the most dominant factor was the duration of surgery.

Keywords: *Decrease in Body Temperature, Factors, Operating Room, Spinal Anesthesia*

<https://doi.org/10.33860/jik.v17i2.2473>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Surgical procedures are a phenomenon that is often found in healthcare settings. The surgical procedure is carried out by making an incision in the area to be operated on. As time goes by, there are developments in the world of health, namely anesthesia. Anesthesia is aimed at minimizing pain and optimizing the patient's

condition during surgery ¹. One type of anesthesia is spinal anesthesia. Anesthesia can cause side effects in patients, one of which is hypothermia ². Perioperative hypothermia is a clinical challenge for health workers in providing care to post-anesthesia patients. This is because hypothermia often occurs in hospital patients and occurs accidentally ³.

From data from anesthesiologists,

obtained over the last two decades, the incidence of perioperative hypothermia has increased². In a 2021 study in Korea, it was stated that the prevalence of perioperative hypothermia reached 8-90%. The study also stated that 40.6% (268 people) of the 660 respondents in the study experienced hypothermia. Mild hypothermia was experienced by 264 of 268 respondents, and 4 of 268 respondents experienced moderate hypothermia⁴. In Indonesia, the incidence of perioperative hypothermia is not yet known with certainty regarding the incidence. However, several studies state that the incidence of perioperative hypothermia ranges from 50% - 90% in all patients undergoing surgical procedures⁵. The results of a preliminary study by researchers at IBS RSUD Jombang revealed that the average number of patients experiencing hypothermia per month reached 79 patients. So it can be concluded that there are still many cases of hypothermia in patients undergoing surgical procedures. The incidence of hypothermia can be caused by many factors such as age, gender, BMI, type of surgery, duration of surgery, type of irrigation fluid, ASA (American Society of Anesthesiologists) score, and comorbidities⁶.

The data above shows the importance of early prevention before hypothermia occurs so as not to cause wider complications such as poor drug metabolism, delayed recovery after anesthesia, longer wound recovery, and decreased body metabolism⁷. This study aimed to determine what factors are associated with a decrease in body temperature in the redistribution phase, linear phase, and plateau phase of spinal anesthesia patients in the Jombang Regional Hospital operating room.

METHOD

This research is a type of quantitative research with a cross-sectional approach where the observation procedure is carried out at one specific time only⁸. The population in this study were patients who underwent surgical procedures with spinal anesthesia at IBS Regional Hospital Jombang from February to

April 2023 with an average of 73 patients per month. The research sample was 70 people who were calculated based on the Krejcie and Morgan formula with a sampling technique using non-probability sampling, precisely using the Accidental Sampling method⁹. Samples that are suitable for research are those that meet the inclusion criteria, such as patients who are willing to take part in the study from start to finish, patients who underwent surgery with spinal anesthesia, and patients who experienced hypothermia in the redistribution phase, linear phase, and plateau phase. The criteria for respondents who could not carry out research were respondents who quit or withdrew so they could not continue the research. The independent variables in this study were age, gender, BMI, type of surgery, duration of surgery, irrigation fluid, ASA score, and comorbidities. Meanwhile, the dependent variable in this study is body temperature in the redistribution phase, linear phase, and plateau phase of patients after spinal anesthesia. The instrument needed in this research is an observation sheet to document observation data. Data collection in this study used the method of direct observation of patients when the patient was being weighed before being taken to the operating room. Other data collection is carried out through documentation studies via Electronic Medical Records. Data on age, gender, BMI, duration of surgery, irrigation fluid, ASA score, and comorbidities were measured once. Specifically, the patient's body temperature was measured three times, namely during the redistribution phase, linear phase, and plateau phase. The data collected is then recorded on a research observation sheet.

The analysis in this study used univariate, bivariate, and multivariate analysis. The test for univariate analysis uses frequency distribution data in the form of percentages¹⁰. Tests for bivariate analysis on eight factors associated with the three phases of decreasing body temperature used the Chi-Square test with an α value set at <0.05 . Multivariate test to find out which one is the most influential and the percentage using the Multiple Linear Regression test.

RESULTS

Table 1. Frequency Distribution Table of Respondent Characteristics based on Age, Gender, BMI, Type of Operation, Duration of Operation, ASA Status, Type of Irrigation Fluid, and Comorbidities at IBS RSUD Jombang in February – April 2023

Factor	Frequency (f)	Percentage (%)
Age		
Extreme	49	70 %
Non-Extrem	21	30 %
Gender		
Man	42	60 %
Women	28	40 %
BMI		
Malnutrition	29	41,4 %
Good Nutrition	33	47,1 %
More Nutrition	8	11,4 %
Operation Type		
Major	47	67,1 %
Minor	23	32,9 %
Operation Duration		
Long	20	28,6 %
Currently	41	58,6 %
Fast	9	12,9 %
ASA Score		
ASA 1	33	47,1 %
ASA 2	31	44,3 %
ASA 3	6	8,6 %
Type of Irrigation Fluid		
Ringer Acetate	12	17,1 %
Ringer Lactate	58	82,9 %
Comorbid		
There are comorbid	30	42,9 %
There are no comorbid	40	57,1 %
Total	70	100%

Based on Table 1 above, the results show that the majority of respondents were of extreme age, namely 49 people (70%) with the majority being male, 42 people (60%). Body Mass Index: Nearly half of the respondents, 33 people (47.1%) had good nutritional status. The type of surgery that was most frequently performed was major surgery, 47 people (67.1%), and the most frequent duration was 1

- 2 hours or medium duration with the number of respondents being 41 people (58.6%). Nearly half of the respondents' physical status had an ASA score of 1, 33 people (47.1%). The type of irrigation fluid that is often given is Ringer's lactate fluid with a total of 58 respondents (82.9%), and patients who will undergo surgery do not have comorbid diseases with the number of respondents reaching 40 people (57.1%).

Table 2. Frequency Distribution of Specific Body Temperature Data in the Redistribution Phase, Linear Phase, and Post-Spinal Anesthesia Plateau Phase at IBS RSUD Jombang February – April 2023

Phase	Frequency (f)	Percentage (%)
Redistribution Phase		
Mild Hypothermia	62	88,6 %
Moderate Hypothermia	8	11,4 %
Linear Phase		
Mild Hypothermia	53	75,7 %
Moderate Hypothermia	17	24,3 %
Plateu Phase		
Mild Hypothermia	56	80 %
Moderate Hypothermia	14	20 %
Total	70	100%

Based on Table 2 above, it is known that in the first phase, namely the redistribution phase, the majority of respondents experienced a decrease in body temperature until they experienced mild hypothermia with a temperature of 34°C – <36°C, namely 62 people

(88.6%). In the linear phase, more respondents experienced a decrease in body temperature, namely 53 people (75.7%). During the plateau phase, almost all respondents experienced mild hypothermia with 56 people (80%).

Table 3. Tabulated Results of Chi-Square Test of Factors with Decrease in Body Temperature in the Redistribution Phase Post Spinal Anesthesia at IBS Jombang Regional Hospital February – April 2023

Variable	Hypothermia Event				Total		p-value
	Mild		Moderate				
	(f)	(%)	(f)	(%)	(f)	(%)	
Age							
Ektrem	41	58,6%	8	11,4%	49	70%	0,095
Non Extrem	21	30%	0	0	21	30%	
Gender							
Man	38	54,3%	4	5,7%	42	60%	0,705
Women	24	34,3%	4	5,7%	28	40%	
BMI							
Malnutrition	24	34,3%	5	7,1%	29	41,4%	0,384
Good Nutrition	31	44,3%	2	2,9%	33	47,2%	
More Nutrition	7	10%	1	1,4%	8	11,4%	
Operation Type							
Major	39	55,7%	8	11,4%	47	67,1%	0,046
Minor	23	32,8%	0	0	23	32,8%	
Operation Duration							
Long	12	17,1%	8	11,4%	20	28,6%	0,000
Currently	41	58,6%	0	0	41	58,6%	
Fast	9	12,9%	0	0	9	12,9%	
ASA Score							
ASA 1	30	42,9%	3	4,3%	33	47,1%	0,008
ASA 2	29	41,4%	2	2,9%	31	44,3%	
ASA 3	3	4,3%	3	4,3%	6	8,6%	
Type of Irrigation Fluid							
Ringer Acetate	12	17,1%	0	0	12	17,1%	0,335
Ringer Lactate	50	71,4%	8	11,4%	58	82,9%	
Comorbid							
There are komorbid	26	37,1%	4	5,7%	30	42,9%	0,717
There are no komorbid	36	51,4%	4	5,7%	40	57,1%	

Based on Table 3, it was found that in the redistribution phase, the p-value was > 0.05 including the factors age, gender, BMI, type of fluid, and comorbidities meaning that Ha was rejected and H0 was accepted. Other factors such as type of operation, duration of operation, and ASA score have a p-value <0.05, so H0 is

rejected and Ha is accepted. It can be concluded that there is a significant relationship between the factors of type of operation, duration of operation, and ASA score with a decrease in body temperature in the redistribution phase of spinal anesthesia patients in the IBS Room at Jombang Regional Hospital.

Table 4. Tabulated Results of Chi-Square Test between Factors and Decrease in Body Temperature in the Linear Phase Post Spinal Anesthesia at IBS RSUD Jombang Month February – April 2023

Variable	Hypothermia Event				Total		p-value
	Mild		Moderate		(f)	(%)	
	(f)	(%)	(f)	(%)	(f)	(%)	
Age							
Ektrem	32	45,7%	17	24,3%	49	70%	0,005
Non Ekstrem	21	30%	0	0	21	30%	
Gender							
Man	34	48,6%	8	11,4%	42	60%	0,333
Women	19	27,1%	9	12,9%	28	40%	
BMI							
Malnutrition	18	25,7%	11	15,7%	29	41,4%	0,081
Good Nutrition	28	40%	5	7,1%	33	47,1%	
More Nutrition	7	10%	1	1,4%	8	11,4%	
Operation Type							
Major	31	44,3%	16	22,9%	47	67,1%	0,015
Minor	22	31,4%	1	1,4%	23	32,9%	
Operation Duration							
Long	5	7,1%	15	21,4%	20	28,5%	0,000
Currently	39	55,7%	2	2,9%	41	58,6%	
Fast	9	12,9%	0	0	9	12,9%	
ASA Score							
ASA 1	28	40%	5	7,1%	33	47,1%	0,000
ASA 2	25	35,7%	6	8,6%	31	44,3%	
ASA 3	0	0	6	8,6%	6	8,6%	
Type of Irrigation Fluid							
Ringer Acetate	12	17,1%	0	0	12	17,1%	0,031
Ringer Lactate	41	58,6%	17	24,3%	58	82,9%	
Comorbid							
There are komorbid							0,494
There are no komorbid	21	30%	9	12,9%	30	42,9%	
	32	45,7%	8	11,4%	40	57,1%	

Based on table 4, it was found that in the redistribution phase, the p-value was > 0.05 including gender, BMI and comorbid factors, meaning that Ha was rejected and H0 was accepted. Other factors such as age, type of operation, duration of operation, type of irrigation fluid and ASA score have a p-value <0.05 so that H0 is rejected and Ha is accepted.

It can be concluded that the factors that are significantly related to a decrease in body temperature in the linear phase of spinal anesthesia patients in the IBS Room at Jombang Regional Hospital are age, type of surgery, duration of surgery, type of irrigation fluid, and ASA score.

Table 2. Frequency Distribution of Specific Body Temperature Data in the Redistribution Phase, Linear Phase, and Post-Spinal Anesthesia Plateau Phase at IBS RSUD Jombang February – April 2023

Variable	Hypothermia Event				Total		p-value
	Mild		Moderate		(f)	(%)	
	(f)	(%)	(f)	(%)			
Age							
Extrem	35	50%	14	20%	49	70%	0,007
Non Extrem	21	30%	0	0	21	30%	
Gender							
Man	35	50%	7	10%	42	50%	0,583
Women	21	30%	7	10%	28	40%	
BMI							
Malnutrition	21	30%	8	11,4%	29	41,4%	0,405
Good Nutrition	28	40%	5	7,1%	33	47,1%	
More Nutrition	7	10%	1	1,4%	8	11,4%	
Operation Type							
Major	33	47,1%	14	20%	47	67,1%	0,003
Minor	23	32,9%	0	0	23	32,9%	
Operation Duration							
Long	7	10%	13	18,6%	20	28,6%	0,000
Currently	40	57,1%	1	1,4%	41	58,5%	
Fast	9	12,9%	0	0	9	12,9%	
ASA Score							
ASA 1	28	40%	5	7,1%	33	47,1%	0,000
ASA 2	28	40%	3	4,3%	31	44,3%	
ASA 3	0	0	6	8,6%	6	8,6%	
Type of Irrigation Fluid							
Ringer Acetate	12	17,1%	0	0	12	17,1%	0,107
Ringer Lactate	44	62,9%	14	20%	58	82,9%	
Comorbid							
There are komorbic	23	32,9%	7	10%	30	42,9%	0,763
There are no komorbid	33	47,1%	7	10%	40	57,1%	

Based on Table 5, it was found that in the redistribution phase, the p-value was > 0.05 , including the factors gender, BMI, type of fluid, and comorbidities with the meaning that H_a was rejected and H_0 was accepted. Other factors such as age, type of operation, duration of operation, and ASA score have a p-value < 0.05

so that H_0 is rejected and H_a is accepted. It can be concluded that the factors that are significantly related to a decrease in body temperature in the plateau phase of spinal anesthesia patients in the IBS Room at Jombang Regional Hospital are age, type of operation, duration of operation, and ASA score.

Table 6. Table of Multiple Linear Regression Test Results on Factors Associated with Reducing Body Temperature in the Redistribution Phase of Spinal Anesthesia Patients at IBS RSUD Jombang in February – April 2023

Model Summary						
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate		
1	.531 ^a	.282	.188	.28877		
ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.999	8	.250	2.996	.007 ^b
	Residual	5.087	61	.083		
	Total	7.086	69			

Coefficients							
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Zero Order
		B	Std. Error	Beta			
1	(Constant)	1,244	0.405		3.067	0.003	
	(X1) Age	-0.046	0.087	-0.066	-0.530	0.598	-0.235
	(X2) Gender	0.071	0.080	0.110	0.892	0.376	0.073
	(X3) BMI	-0.049	0.056	-0.102	-0.882	0.381	-0.108
	(X4) Operation Type	0.104	0.089	0.155	1.160	0.251	0.251
	(X5) Operation Duration	0.254	0.075	0.499	3.389	0.001	0.485
	(X6) Type of Irrigation Fluid	0.026	0.100	0.031	0.260	0.796	0.163
	(X7) ASA Score	0.069	0.076	0.139	0.912	0.365	0.217
	(X8) Comorbid	0.053	0.099	0.083	0.539	0.592	0.052

a. Dependent Variable: Redistribution Phase Patient Temperature

From Table 6 it is known that the Sign value shows 0.007 (< 0.05) and the calculated F value is 2.996 ($> F$ table, namely 2.092), meaning that the eight factors are simultaneously related to a decrease in body temperature. The R-Square value is 0.282, which means the relationship between eight factors simultaneously is 28.2%. Coefficients It is known that the lowest p-value (0.001) and

the highest beta coefficient value (0.254) are for the operation duration factor. So it can be concluded that the duration of surgery is the most dominant factor related to reducing body temperature in the redistribution phase with a percentage of the relationship of 24.2% of spinal anesthesia patients at IBS Jombang Regional Hospital.

Table 7. Table of Multiple Linear Regression Test Results on Factors Associated with Decrease in Body Temperature in the Linear Phase of Spinal Anesthesia Patients at IBS RSUD Jombang in February – April 2023

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.779 ^a	.607	.556	.28790	

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.815	8	.977	11.786	.000 ^b
	Residual	5.056	61	.083		
	Total	12.871	69			

Coefficients							
Model		Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.	Zero Order
		B		Beta			
1	(Constant)	1.195	0.404		2.957	0.004	
	(X1) Age	-0.147	0.087	-0.157	-1.691	0.096	-0.371
	(X2) Gender	0.228	0.080	0.261	2.859	0.006	0.150
	(X3) BMI	-0.169	0.055	-0.261	-3.045	0.003	-0.246
	(X4) Operation Type	0.025	0.089	0.028	0.285	0.777	0.325
	(X5) Operation Duration	0.342	0.075	0.497	4.568	0.000	0.658
	(X6) Type of Irrigation Fluid	0.075	0.100	0.066	0.752	0.455	0.258
	(X7) ASA Score	0.231	0.076	0.345	3.052	0.003	0.394
	(X8) Comorbid	0.185	0.099	0.213	1.874	0.066	0.115

a. Dependent Variable: Linear Phase Patient Temperature

From Table 7 it is known that the Sign value shows 0.000 (< 0.05) and the calculated F value is 11.786 ($> F$ table) meaning that these eight factors are simultaneously related to a decrease in body temperature. The R-Square value is 0.607, which means the relationship between eight factors simultaneously or together is 60.7%. Coefficients are known to have the lowest p-value (0.000) and the highest

beta coefficient value (0.342), namely the operation duration factor. So it can be concluded that the duration of surgery is the most dominant factor related to decreasing body temperature in the linear phase with a percentage of the relationship of 32.7% of spinal anesthesia patients at IBS Jombang District Hospital.

Table 8. Table of Multiple Linear Regression Test Results on Factors Associated with Decreasing Body Temperature in the Plateau Phase of Spinal Anesthesia Patients at IBS RSUD Jombang in February – April 2023

Model Summary							
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate			
1	.699 ^a	.489	.422	.30640			
ANOVA ^a							
Model		Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	5.473	8	.684	7.288	.000 ^b	
	Residual	5.727	61	.094			
	Total	11.200	69				
Coefficients ^a							
Model		Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.	Zero Order
		B		Beta			
1	(Constant)	1.176	0.430		2.733	0.008	
	(X1) Age	0.109	0.092	-0.125	1.184	0.241	0.327
	(X2) Gender	0.137	0.085	0.168	-1.615	0.111	0.102
	(X3) BMI	-0.090	0.059	-0.150	-1.535	0.130	-0.151
	(X4) Operation Type	0.034	0.095	-0.041	0.362	0.719	0.350
	(X5) Operation Duration	0.288	0.080	0.449	3.612	0.001	0.618
	(X6) Type of Irrigation Fluid	0.031	0.106	0.030	0.296	0.769	0.227
	(X7) ASA Score	0.220	0.081	0.352	2.731	0.008	0.358
	(X8) Comorbid	0.185	0.105	0.229	1.767	0.082	0.072

a. Dependent Variable: Plateu Phase Patient Temperature

From Table 8 it is known that the Sign value shows 0.000 (< 0.05) and the calculated F value is 7.288 ($> f$ table) meaning that these eight factors are simultaneously related to a decrease in body temperature. The R-Square value is 0.489, which means the relationship between eight factors simultaneously is 48.9%. Coefficients It is known that the lowest p-value (0.001) and the highest beta coefficient value (0.288) are the duration of operation factor which is the most dominant factor associated with a decrease in body temperature in the plateau phase with a relationship percentage of 27.7%.

DISCUSSION

Relationship between Age and Decrease in Temperature

The results of the study show that there is a relationship between age and a decrease in body temperature. The results of this study are in line with Widiyono's research in 2020 regarding the existence of a significant relationship between age and the incidence of hypothermia. This research is also by the theory put forward by ³ regarding extreme age, namely in toddlers, children, and elderly patients who are the age group at risk of experiencing hypothermia in the perioperative period. This is because almost all people in extreme age

categories, one of which is old age, will experience a decline in body condition, whether sick or healthy ¹¹. The body's strength in carrying out metabolic processes will decrease. Physical conditions such as reduced subcutaneous fat, weakened muscle strength, and thinner skin surface are factors that trigger a decrease in the body's effectiveness in regulating and maintaining the body's thermoregulation.

Relationship between Gender and Decrease in Temperature

Gender and decreased body temperature in spinal anesthesia patients at IBS Jombang Hospital did not have a significant relationship. The results of this study contradict research conducted by Putri Prastiti Mubarokah in 2017 which stated that more women experienced hypothermia than men ¹².

Heat absorption from the environment is processed through muscle, skin, fat, and nerve tissue. So if the function of the tissue that is useful for producing body heat is damaged, then body heat production will not be optimal ¹³. This damage can occur in both men and women. Another factor that can influence this is the metabolic process. The body's metabolism in women after ovulation can experience an increase marked by an increase in the hormone progesterone, which triggers an increase in basal body temperature.

Relationship between BMI and Temperature Drop

BMI and decreased body temperature in spinal anesthesia patients at IBS Jombang Regional Hospital did not have a significant relationship. The results of this study contradict the theory put forward ¹ regarding a low BMI value that will lose heat more easily because it is influenced by thin fat and vice versa. The results of this study also contradict Syulce Luselya Tubalawony's 2023 research regarding the effect of spinal anesthesia on the incidence of post-operative BMI, which shows that BMI is related to the incidence of hypothermia ¹⁴.

Patients with a high BMI or body condition with more body weight who have more fat reserves can process fat into body heat energy so they can control cold temperatures. However, in the body, other components can maintain body heat when it is cold, one of which is muscle. Someone with large muscle mass does more physical activity. Muscle mass

is not only owned by someone with a high BMI value. A person with a sufficient BMI can also have high muscle mass. These muscles will produce body heat energy to control cold temperatures. Likewise, when someone with large muscle mass experiences hypothermia, their body mechanisms will indirectly direct the muscles to contract like a shivering reflex so that they can produce heat energy to reduce hypothermia ¹⁵.

Relationship between Type of Operation and Temperature Drop

The results of this study are by the theory that opening a body cavity such as the stomach during a surgical procedure has an effect on reducing the patient's body temperature ⁵ and is in line with Dewi Fitriani's 2020 research regarding the type of surgery or type of surgery associated with the incidence of hypothermia. Patients with major surgery will experience more hypothermia than minor surgery ¹⁶. A large enough incision on the surface of the body will cause the skin to lose its role as a temperature controller ¹⁷. Major surgery with a large incision wound means the risk of bleeding will be greater and trigger hypovolemic shock ¹⁸. This results in the blood's ability to absorb and distribute heat throughout the body and the homeostasis process is disrupted. The room temperature in the operating room is quite low, so wide open body surfaces will be exposed to the cold temperature of the room. So body temperature will decrease ¹⁹. Washing the surgical area with unwarmed fluids will increase skin surface contact and cold temperatures which further accelerate the occurrence of hypothermia ²⁰.

Relationship between Operation Duration and Temperature Drop

The duration of surgery and the decrease in body temperature in spinal anesthesia patients at IBS Jombang Regional Hospital have a significant relationship. The results of this study are in line with Syulce Luselya Tubalawony's research in 2023 which stated that the duration of surgery is related to the incidence of hypothermia ¹⁴. Likewise, Heru Nurmansah's research in 2021 also showed that there was a significant relationship between hypothermia and a long duration of surgery ²¹. The duration of the operation is calculated from the time the patient is transferred to the operating table and anesthetized until the

patient has finished the operation and will be moved to the recovery room²¹. Hypothermia is caused by the patient being in the operating room with a low temperature. The longer the patient is inside, the more likely changes in body temperature will occur¹⁹.

Relationship between ASA Status and Decrease in Body Temperature

ASA status and decreased body temperature in spinal anesthesia patients at IBS Regional Hospital Jombang have a significant relationship. The results of this study are in line with Suleyman Sari's research in 2020 regarding the ASA score which significantly increases the risk of hypothermia, so it is necessary to monitor temperature during surgery²².

Unfavorable body conditions will be in the ASA status range 2 and 3. A decline in body condition due to illness or surgical procedures will be followed by a decrease in metabolic rate which makes it easier to reduce body temperature.

Relationship between type of irrigation fluid and decrease in body temperature

Irrigation fluid and decreasing body temperature during spinal anesthesia at IBS at Jombang District Hospital have a significant relationship. Based on the results of Bram's research (2016), Ringer's acetate solution is more effective in preventing hypothermia and shivering in patients undergoing surgery with spinal anesthesia. The metabolic process of ringer acetate occurs in muscles. Muscles are a source of body heat energy which burns more energy than other body organs. Collaboration between metabolic processes and the muscle system, which both play a major role in controlling cold temperatures from outside and processing heat energy within the body, can strengthen the work of Ringer acetate fluid in preventing a decrease in body temperature.

Comorbid Relationship with Decrease in Temperature

Comorbidities and the incidence of decreased body temperature in the redistribution, linear, and plateau phases of spinal anesthesia patients at IBS RSUD Jombang did not have a significant relationship. The results of this study contradict the theory put forward by³ regarding comorbidities being one of the trigger factors for hypothermia.

The decrease in body temperature that occurs is stronger from internal factors than external factors such as the temperature in the room because almost 80% of people who enter the operating room will experience a decrease in body temperature. Likewise, if other internal factors are added, such as the area of the incision, length of operation, and temperature of the fluid given. This further accelerates the decline in body temperature without distinguishing the characteristics of each person.

Factors Most Associated with Decreased Body Temperature

Based on the results of the analysis, the operation duration factor has a significant influence on reducing body temperature in the redistribution, linear, and plateau phases. Long surgery will affect the preparation for anesthesia and the drugs injected. Of course, the accumulation of drugs with anesthetic agents also increases in the body, which triggers hypothermia. Apart from that, the longer the operation time, the longer the patient stays in the operating room so the time the body is exposed to the low-temperature environment in the operating room will further trigger a decrease in body temperature.

CONCLUSIONS

It can be concluded that there is a relationship between age, type of surgery, duration of surgery, type of irrigation fluid, and the incidence of a decrease in body temperature with the most dominant factor related to this being the duration of surgery. There was no relationship between the factors of gender, BMI, and ASA score with a decrease in body temperature in the redistribution phase, linear phase, and plateau phase in the IBS Room at Jombang Regional Hospital. Suggestions for future researchers are to examine factors related to other post-anesthesia complications such as PONV (Post Operative Nausea Vomiting).

ACKNOWLEDGMENT

The author would like to thank the lecturers who helped guide this writing, as well as the health workers at IBS RSUD Jombang who were willing to help run this research smoothly.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Kaet S., Senaphati, TA. *Anaesthesia on The Move*. Jakarta: PT Indeks, 2013.
2. Rauch S, Miller C, Bräuer A, Wallner B, Bock M, Paal P. Perioperative hypothermia—a narrative review. *International Journal of Environmental Research and Public Health*. 2021 Aug 19;18(16):8749.
3. Giuliano KK, Hendricks J. Inadvertent perioperative hypothermia: current nursing knowledge. *Aorn Journal*. 2017 May 1;105(5):453-63.
4. Cho CK, Chang M, Sung TY, Jee YS. Incidence of postoperative hypothermia and its risk factors in adults undergoing orthopedic surgery under brachial plexus block: A retrospective cohort study. *International journal of medical sciences*. 2021;18(10):2197.
5. Pratiwi NK, Raya NA, Puspita LM. Manajemen Hipotermia dalam Keperawatan Perioperatif pada Pasien yang Menjalani Pembedahan Abdomen: A Literature Review. *Community of Publishing in Nursing (COPING)*. 2021;9(5):497-506.
6. Rothrock J.C. *Care of the Patient in Surgery 16th Edition*. Elsevier, 2019.
7. Yoo JH, Ok SY, Kim SH, Chung JW, Park SY, Kim MG, Cho HB, Song SH, Cho CY, Oh HC. Efficacy of active forced air warming during induction of anesthesia to prevent inadvertent perioperative hypothermia in intraoperative warming patients: comparison with passive warming, a randomized controlled trial. *Medicine*. 2021 Mar 26;100(12):e25235.
8. Syamsuni, Rantisari AM. *Statistik dan Metodologi Penelitian Edisi 2*. Yogyakarta: KBM Indonesia, 2021.
9. Eryando T, Sipahutar T, Pratiwi D. *Teori dan Aplikasi Pengumpulan Data Kesehatan*. Yogyakarta: Rapha Publishing, 2017.
10. Siyoto S, Sodik MA. *Dasar Metodologi Penelitian*. Yogyakarta: Literasi Media Publishing, 2015.
11. Malisa, N., Damayanti, D., Z. P. Perdani, YH. Damayanti, Marongka, Suwarno, T., & Nomp RS. *Proses Keperawatan dan Pemeriksaan Fisik*. Medan: Yayasan Kita Menulis, 2021.
12. Putri PM, Titik E, Sari CD. *Faktor-faktor yang berhubungan dengan hipotermi pasca general anestesi di Instalasi Bedah Sentral RSUD Kota Yogyakarta* (Skripsi, Poltekkes Kemenkes Yogyakarta), 2017.
13. Kurniati A, Trisyani Y, Theresia SI. *Keperawatan Gawat Darurat dan Bencana Sheehy*. Jakarta: Elsevier. 2018.
14. Tubalawony SL, Siahaya A. Pengaruh Anestesi Spinal terhadap Kejadian Hipotermi pada Pasien Post Operasi. *Jurnal Keperawatan*. 2023 Feb 12;15(1):331-8.
15. Veterini AS, Hamzah H, Semedi BP. *Buku Ajar Teknik Anestesi Umum*. Surabaya: Airlangga University Press, 2021.
16. Sjahdeini SR. *Hukum Kesehatan Tentang Hukum Malapraktik Tenaga Medis*. IPB Press; 2020.
17. Yulianto NI. *Hubungan Lama Operasi Dengan Kejadian Shivering Pada Pasien Post Operative Dengan Spinal Anestesi Di IBS Rumah Sakit Pku Muhammadiyah Yogyakarta*, Skripsi thesis, Universitas 'Aisyiyah Yogyakarta.
18. PPNI, *Standar Diagnosis Keperawatan Indonesia Edisi 1*. Jakarta: DPP PPNI, 2017.
19. Black JM, Hawks JH. *KMB: Dasar-Dasar Keperawatan Medikal Bedah*. Elsevier Health Sciences; 2022 Dec 20.
20. Rehatta NM, Hanindito E, Tantri AR. *Anestesiologi dan Terapi Intensif: Buku Teks KATI-PERDATIN*. Gramedia pustaka utama; 2019 Sep 16.
21. Nurmansah H, Widodo D, Milwati S. Hubungan Indeks Massa Tubuh, Durasi Operasi Dan Dosis Anestesi Inhalasi Dengan Suhu Tubuh Pada Pasien Post Operasi Dengan General Anestesia Di Recovery Room Rsud Bangil. *Journal of Applied Nursing (Jurnal Keperawatan Terapan)*. 2021;7(2):104-15.
22. Sari S, Aksoy SM, But A. The incidence of inadvertent perioperative hypothermia in patients undergoing general anesthesia and an examination of risk factors. *International journal of clinical practice*. 2021 Jun;75(6):e14103.

Original Article

The Effect of Physical Activity on the Muscle Strength of Obese People' Backs

Wendra^{1*}, Elly Noer Rochmah², Wisnu Fadhlurrohman³

¹Department of Anatomy, Faculty of Medicine, Universitas Jenderal Achmad Yani, Cimahi, West Java, Indonesia

²Department of Pediatric, Faculty of Medicine, Universitas Jenderal Achmad Yani, Cimahi, West Java, Indonesia

³Bachelor of Medicine Program, Faculty of Medicine, Universitas Jenderal Achmad Yani, Cimahi, West Java, Indonesia

(Correspondence author's email, wendrarasyad@gmail.com)

ABSTRACT

In the last decade, the number of obese young adults has been increasing. Faculty of Medicine students tend to have low activity due to the busy learning schedule. Low activity is one of the risk factors for obesity and muscle strength, one of which is the back muscles that play a role in maintaining posture and supporting the body. This study aims to determine the level of physical activity and back muscle strength, as well as to examine the differences in back muscle strength between students at the Unjani Medical Faculty who suffer from obesity and low and high levels of physical activity. This study employs a cross-sectional design for its analysis. The ASAQ (Adolescent Sedentary Activity Questionnaire), the BMI (Body Mass Index) formula, and a back dynamometer are measuring instruments used to assess physical activity levels. Using a doctor's scale and a calibrated microtome, height and weight measurements were taken. To determine differences in muscle strength between study groups, the Mann-Whitney test ($\alpha = 95\%$) was utilized. The results demonstrated that 33% of respondents had low levels of physical activity, with the majority of respondents being male (30.3%). As many as 28.1% of male respondents had low levels of back muscle strength and were inactive. There was a statistically significant difference ($p < 0.05$) between the two groups in terms of back muscle strength, as determined by statistical tests. The results showed that obesity had an effect on reducing the back muscle strength of respondents.

Keywords: Obesity, Physical Activity, Back Muscle Strength

<https://doi.org/10.33860/jik.v17i2.2522>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Obesity in the adolescent age group has become a world health problem in recent decades¹. The World Health Organization (WHO), defines obesity as abnormal fat accumulation or excess fat accumulation due to an imbalance between energy intake and energy used². Measurement of the level of obesity in Indonesians is based on the Body Mass Index (BMI) value for Asia-Pacific countries³. A person is said to be obese if the BMI is 25.0 kg/m^2 ⁴. RISKESDAS data in 2007, 2013, and 2018 show that obesity sufferers in Indonesia tend to increase, namely 10.5%, 14.8%, and

21.8% respectively. Likewise, the prevalence of obese people in West Java Province tends to increase, namely 15.2% in 2013 and 23% in 2018⁵.

Faculty of Medicine students have busy activities, causing them to rarely do sufficient physical activity, such as exercising⁶. Research by Zulhamidah et al, in 2018 stated that most (41.7%) YARSI medical faculty students had low physical activity. This will certainly increase the risk of obesity⁷. KEMENKES RI defines Sedentary lifestyle or low physical activity as all activities outside of sleep, with very little calorie expenditure characteristics, namely <1.5 (METs)⁸. One method of

assessment is using ASAQ (Adolescent Sedentary Activity Questionnaire).

One of the many problems caused by obesity is a loss of muscle strength due to stress on the musculoskeletal system^{9,10}. Chooi et al. found similar results, concluding that obesity negatively affects virtually all physiological systems of the body and poses a serious threat to public health, one of which is a wide variety of musculoskeletal problems¹¹. Musculoskeletal diseases, like osteoarthritis, can make it hard to walk. When other factors are taken into account, this makes the chance of all-cause death and cardiovascular events much higher^{12,13}. This shows that idle behavior can make MetS worse for people who have problems with their muscles and joints.

Back muscles have the main function of supporting the trunk, maintaining body posture and assisting the movement of the trunk, limbs, shoulders and neck used in human activities. Based on anatomy, the back muscles consist of superficial, intermedius, and profundus muscle groups. In obesity, there is not only an increase in intermuscular fat tissue but also impaired glucose intake by muscle cells due to insulin resistance in muscle cells. Glucose is needed as an energy source for muscle contraction so that the decrease in intake causes a decrease in muscle strength including back muscles. Decreased back muscle strength will cause health problems such as muscle strain, back pain, and impaired mobility. In chronic pain can also cause psychological disorders in the form of anxiety and stress^{14,15}. Hence, engaging in physical activity is imperative in order to mitigate the potential health issues arising from diminished strength in the muscles of the back. Haider et al. (2019) conducted a study which yielded findings suggesting that engagement in physical activity has the potential to enhance muscle strength and overall physical performance¹⁶.

Obesity has received much attention in relation to long-term heart and circulatory diseases and conditions, as well as diabetes. However, musculoskeletal complications due to obesity are rarely discussed or studied in depth. Therefore, this research will discuss the relationship between obesity, back muscle strength, and physical activity. The aim of this research is to determine the effect of physical activity level on the back muscle strength of Unjani Medical Faculty students who suffer from obesity. Determining obesity's nutritional

status does not include body fat percentage. Measuring muscle mass needs to be considered to see the relationship between decreased muscle strength and muscle mass, as well as other factors that influence muscle strength.

METHOD

This research is an analytic study with a cross sectional approach. The inclusion criteria in this study were active students of the undergraduate stage of the Faculty of Medicine, Unjani, 2019-2021 with BMI criteria of 25 kg/m², age 18-24 years, and willing to take part in the study and fill out an informed consent sheet. Exclusion criteria include a history of steroid drug consumption, a history of surgery, fracture, or trauma to the back area, there is an anatomical abnormality of the spine based on a doctor's diagnosis. A total of 64 students who met the research criteria were sampled and divided into 2 groups, namely obese students with low physical activity (n = 33) and obese students with high activity (n = 31) taken by purposive sampling technique.

The level of physical activity was measured using the Adolescent Sedentary Activity Questionnaire (ASAQ) and categorized as low if physical activity was <5 hours/day and high if ≥ 5 hours/day¹⁵. Obesity was determined based on the BMI formula⁴. Back muscle strength was measured using a back dynamometer with 3 repetitions and the measurement results taken were the highest value and categorized as excellent, good, moderate, poor, and very poor based on male and female reference values^{17,18}.

Bivariate data analysis using the Mann-Whitney test (dk = 95%). The Mann-Whitney (or Wilcoxon-Mann-Whitney) test is occasionally employed in clinical trials to assess the comparative effectiveness of two treatments. The use of nonparametric tests is frequently advocated as a viable alternative to the t-test when the underlying data does not conform to a normal distribution¹⁹.

Research Procedure

The study began with the measurement of TB and BW to assess the BMI of the research subject, if $BMI \geq 25$ and other research criteria were met, the subject was taken as a research sample. The sample then filled out the ASAQ questionnaire to get data on the level of physical activity. Based on BMI and ASAQ data,

respondents were grouped into 2 groups, namely obese with low physical activity and obese with high physical activity. Each group member measured back muscle strength using a back dynamometer for 3 repetitions and the highest value was taken. Data on the value of back muscle strength of the two research groups were analyzed with the Mann Whitney test because the data were not normally distributed. The test is to see the difference between the two groups. Data collection has paid attention to the ethical aspects of research.

RESULTS

Characteristics of Respondents' Physical Activity Level Based on Gender

From the analysis of the ASAQ questionnaire scores completed by 64 respondents, 33% of respondents had low physical activity levels. When viewed by gender, the number of female respondents had a low level of activity more (69.7%) than men (30.3%), as shown in table 3.

Table 3 Characteristics of Respondents' Physical Activity Level Based on Gender (n=64).

Gender	Physical Activity Level				Total	
	High		Low		n	%
	n	%	n	%		
Male	19	61.29	10	30.3	29	45.31
Female	12	38.71	23	69.7	35	54.69
Total	31	100	33	100	64	100

Physical activity plays a role in the process of burning calories in the body and if combined with calorie reduction will have an impact on calorie deficits so that it can lose weight. Research by Faiq et al. (2018) states that most (41.7%) YARSI medical faculty students have low physical activity⁷. This will increase the risk of obesity. The percentage of pre-obese and obese patients in the study of respondents was quite high at 33.2%. Research by Liando et al. (2021), explained that adolescents, especially in women, spend more time playing gadgets, watching TV than doing physical activity²⁰.

Overview of Respondents' Back Muscle Strength

The results showed that most respondents (43.75%) had poor back muscle strength, and there were even students in the very poor category (6.25%) as shown in Table 4.

Table 4 Overview of Back Muscle Strength in Undergraduate Students of FK Unjani who suffer from Obesity (n = 64).

Back Muscle Strength (kg)	F	Percentage
Very good	1	1,56
Good	8	12,50
Moderate	23	35,94
Less	28	43,75
Very less	4	6,25
Total	64	100,00

In addition, the results showed that 1.56% of respondents had excellent back muscle strength, 12.50% of respondents had good back muscle strength, as many as 35.94% had moderate back muscle strength.

Obesity characterized by BMI ≥ 25 is one of the factors causing impaired function of the musculoskeletal system with an increase in intramyocellular fat and accompanied by causing insulin resistance in muscle cells and blocking glucose intake which is a source of energy for muscle contraction. This is supported by the research of Susilawati et al (2019) which states a significant relationship between body fat percentage and back muscle strength²¹.

Overview of Back Muscle Strength Based on Gender

Based on table 5, it can be seen that the number of female respondents who have a level of back muscle strength of less than very less is less (21.9%) than male respondents (28.1%).

Table 5. Overview of Back Muscle Strength Based on Gender (n=64).

Back Muscle Strength	Gender				Total	
	Male		Female		n	%
	n	%	n	%		
Very good	0	0.0%	1	1.6%	1	1.6%
Good	2	3.1%	6	9.4%	8	12.5%
Moderate	9	14.1%	14	21.9%	23	35.9%
Less	15	23.4%	13	20.3%	28	43.8%
Very less	3	4.7%	1	1.6%	4	6.3%
Total	29	45.3%	35	54.7%	64	100

Male respondents tended to have a lower level of back muscle strength (23.4%) when compared to female responses (20.3%). Likewise, for the level of back muscle strength less once men (4.7%) more than women (1.6%). However, research by Torik et al, stated that there was no significant difference between the back muscle strength of young men and women²².

Overview of Back Muscle Strength Based on Level of Physical Activity

Table 6 shows that the percentage of respondents who have a very low level of back muscle strength occurs in respondents with low physical activity (6%).

Table 6. Back Muscle Strength by Physical Activity Level (n=64).

Back Muscle Strength	Level Physical Activity					
	High		Low		Total	
	n	%	n	%	n	%
Very good	0	0%	1	2%	1	2%
Good	6	9%	2	3%	8	13%
Moderate	10	16%	13	20%	23	36%
Less	15	23%	13	20%	28	44%
Very less	0	0%	4	6%	4	6%
Total	31	48%	33	52%	64	100%

Lack of physical activity affects muscle strength, which is one of the components of a person's physical fitness. A person with BMI \geq 25 has a risk of decreased muscle strength due to the accumulation of fat in the muscles. The more trained the muscle, the greater the muscle strength (23–25).

DISCUSSION

To see the relationship between the effect of physical activity level on back muscle strength in both research groups, a mann-whitney statistical test was conducted. Before the test was carried out, the data normality test was carried out and it was found that the data was not normally distributed. The results of the mann-whitney test showed that there was a significant difference in back muscle strength ($p < 0.05$) between the group of respondents with low physical activity and the group of students with high physical activity.

Table 7. Mann-whitney Test Results

Level Physical Activity	Mean	Mann-Whitney	p-Value
High	31	39,82	0,002
		284,50	0,002
Low	33	25,62	

The function of the back muscles is to support the trunk and maintain body posture, as well as the movement of the trunk, helping the muscles of the limbs, shoulders, and neck move. The imbalance of energy intake and use causes blood sugar levels to increase and results in insulin resistance in skeletal muscle cells and reduces the ability of glucose intake to skeletal muscle cells. The glucose in skeletal muscle

cells will undergo glycogenesis to produce glycogen which is an energy source for muscle contraction. So that the lack of glycogen in muscle cells causes a decrease in muscle strength, especially back muscles. In addition, excess sugar in the blood will be converted in the form of fat which is deposited as visceral fat and ectopic fat, such as in the intermyocellular skeletal muscle which can cause an inflammatory response and reduce muscle mass. Overall, it will cause muscle disorders in the form of sarcopenia which is characterized by impaired muscle function such as muscle strain, pain, and impaired mobility. Chronic pain can also cause psychological disorders such as anxiety and stress^{11,12}.

CONCLUSION

Based on the research results, it can be concluded that 33% of respondents have low levels of physical activity, and this is mostly experienced by male respondents at 30.3%. Most of the male respondents (28.1%) had low levels of back muscle strength, and this generally occurs in respondents with low physical activity. There is a significant difference in back muscle strength ($p < 0.05$) between students at the Unjani Faculty of Medicine who suffer from obesity with low physical activity and those with high physical activity. The conclusion obtained is that obesity has a negative impact on back muscle strength. For further research, researchers suggest determining nutritional status, apart from BMI, by also considering body fat percentage. Measuring muscle mass is also recommended to see the relationship between decreased muscle strength and muscle mass, as well as age, BMR, and hormonal factors.

ACKNOWLEDGMENTS

The author expresses gratitude to the Head of the Physiology Laboratory at FK Unjani and the staff members who have provided support for the research. Additionally, appreciation is extended to all individuals who have contributed to the progress of this study.

CONFLICTS OF INTEREST

The authors declare no conflict of interest

REFERENCE

1. Sawamura LS, Souza GG de, Santos JDG dos, Suano-Souza FI, Gessullo ADV, Sarni ROS. Albuminuria and glomerular filtration rate in obese children and adolescents. *Brazilian J Nephrol.* 2018;41:193–9.
2. World Health Organization. *World Health Organization Obesity and Overweight.* 2011.
3. Kementerian Kesehatan RI. *Epidemi Obesitas.* Jurnal Kesehatan. 2018.
4. Rath D, Amlinger L, Rath A, Lundgren M. The CRISPR-Cas immune system: Biology, mechanisms and applications. *Biochimie.* 2015;117:119–28.
5. Riskesdas. *Laporan Riskesdas Provinsi Jawa Barat.* 2018.
6. Syaury A. Hubungan indeks massa tubuh dengan kebugaran jasmani mahasiswa prodi kedokteran UNJA. *JAMBI Med JOURNAL" J Kedokt dan Kesehatan".* 2017;5(1).
7. Faiq AR, Zulhamidah Y, Widayanti E. Gambaran sedentary behaviour dan indeks massa tubuh mahasiswa Fakultas Kedokteran Universitas YARSI di masa pendidikan tahun pertama dan kedua. *Maj Sainstekes.* 2018;5(2).
8. Direktorat P2PTM Kemenkes RI. *Yuk, mengenal apa itu kegiatan Sedentari?* 2019.
9. Sizoo D, de Heide LJM, Emous M, van Zutphen T, Navis G, van Beek AP. Measuring muscle mass and strength in obesity: a review of various methods. *Obes Surg.* 2021;31:384–93.
10. Kemenkes. *Dengan Melakukan Latihan Fisik Dapat Meningkatkan Kekuatan dan Daya Tahan Otot.* Direktorat P2PTM. 2022.
11. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. *Metabolism.* 2019;92:6–10.
12. Collins KH, Herzog W, MacDonald GZ, Reimer RA, Rios JL, Smith IC, et al. Obesity, metabolic syndrome, and musculoskeletal disease: Common inflammatory pathways suggest a central role for loss of muscle integrity. *Front Physiol.* 2018;9:112.
13. Hawker GA, Croxford R, Bierman AS, Harvey PJ, Ravi B, Stanaitis I, et al. All-cause mortality and serious cardiovascular events in people with hip and knee osteoarthritis: A population based cohort study. *PLoS One.* 2014;9(3):e91286.
14. Ramadas DR. Karakteristik Kekuatan Otot, Kelenturan Tubuh, Komposisi Tubuh Dan Indeks Massa Tubuh Siswa Smk Negeri 5 Denpasar Tahun Ajaran 2014/2015. *Intisari Sains Medis.* 2016;5(1):36–42.
15. Valenzuela PL, Maffiuletti NA, Tringali G, De Col A, Sartorio A. Obesity-associated poor muscle quality: prevalence and association with age, sex, and body mass index. *BMC Musculoskelet Disord.* 2020;21(1):1–8.
16. Haider S, Grabovac I, Dorner TE. Effects of physical activity interventions in frail and prefrail community-dwelling people on frailty status, muscle strength, physical performance and muscle mass—a narrative review. *Wien Klin Wochenschr.* 2019;131:244–54.
17. FKIP U. *Petunjuk Pengoperasian Back and Leg Dynamometer.* Universitas Lambung Mangkurat; 2017.
18. Lubis MY, Hermawan D, Febriani U, Farich A. Hubungan antara faktor Keturunan, Jenis Kelamin dan tingkat sosial ekonomi orang tua dengan kejadian obesitas pada mahasiswa di Universitas Malahayati tahun 2020. *Hum Care J.* 2020;5(4):891–900.
19. Hickey GL, Dunning J, Seifert B, Sodeck G, Carr MJ, Burger HU, et al. Statistical and data reporting guidelines for the European Journal of Cardio-Thoracic Surgery and the Interactive CardioVascular and Thoracic Surgery. Vol. 48, *European journal of cardiothoracic surgery.* Oxford University Press; 2015. p. 180–93.
20. Liando LE, Amisi MD, Sanggelorang Y. Gambaran aktivitas fisik mahasiswa semester IV fakultas kesehatan masyarakat unsrat saat pembatasan sosial masa pandemi Covid-19. *KESMAS J Kesehat Masy Univ Sam Ratulangi.* 2021;10(1).
21. Susilawati I, Primayanti I, Yundarwati S. Pengaruh Latihan Penguatan Otot Punggung (Back Exercise) Untuk

- Mencegah Nyeri Punggung (Back Pain) Pada Dosen Dan Karyawan Ikip Mataram. *JISIP (Jurnal Ilmu Sos dan Pendidikan)*. 2019;3(1).
22. Torik T, Tahap RN. Hubungan Berat Badan terhadap Kekuatan Otot Punggung (Kasus: pada Lab. Sistem Kerja & Ergonomi). *SINERGI*. 2013;17(3):300–6.
 23. Dewi KIM, Widiastuti IAE, Wedayani AAAN. Hubungan Antara Indeks Massa Tubuh Dengan Kekuatan Otot Pada Mahasiswa Fakultas Kedokteran Universitas Mataram. *J Kedokt*. 2020;9(1):63–72.
 24. Listiarini A, Widjasena B, Wahyuni I. Hubungan Kekuatan Otot Punggung Dengan Keluhan Nyeri Punggung Pada Porter Di Stasiun Tawang Semarang. *J Kesehat Masy*. 2016;4(4):636–44.
 25. Suhada PD, Widyastuti N, Candra A, Syauqy A. Korelasi Aktivitas Fisik dan Persen Lemak Tubuh dengan Indikator Sarkopenia. 2021.

Original Article

**Mini Mobile Filtration with Activated Carbon Adsorbent and Powder of Bidara Leaf
(*Ziziphus mauritiana*) Leaf as Room Air Purifier**

Nurul Amaliyah^{1*}, Taufik Anwar², Slamet Wardoyo³

¹Department of Environmental Health, Poltekkes Kemenkes Semarang, Semarang, Central Java, Indonesia

²Department of Environmental Health, Poltekkes Kemenkes Pontianak, Pontianak, West Kalimantan, Indonesia

³Department of Environmental Health, Poltekkes Kemenkes Surabaya, Surabaya, East Java, Indonesia

(Correspondence author's email, amaliyah760@gmail.com)

ABSTRACT

Forest fires have been a major threat for decades. Forest fire smoke can trigger high levels of highly toxic carbon-containing particles that are the source of carbon monoxide (CO), nitrogen monoxide (NO_x), sulfur dioxide (SO₂), and PM_{2.5}. Exposure to CO_x, especially CO and SO_x, can be detrimental to human health. To reduce exposure to toxins in smoke, researchers want to make a mini-mobile filtration system of activated carbon and bidara leaf powder. This study is quasi-experimental, where both groups were measured to determine the initial condition. The experimental group was treated, and the comparison group was not. After the completion of treatment, both groups were measured as a posttest to determine the final condition. The result is there was a decrease in CO_x, SO_x, and particulate matter values by 57%, 51%, and 37%. The conclusion is mini mobile filtration with a mixture of activated carbon and bidara leaf powder can reduce CO_x, SO_x, and particulate matter values.

Keywords: *Activated Carbon, Toxic Gas, Ziziphus Mauritiana*

<https://doi.org/10.33860/jik.v17i2.2929>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Air pollution is a major environmental problem that negatively impacts the health and well-being of people. Especially in urban areas, where people spend most of their time indoors, the issue of polluted indoor air is becoming more and more of a concern¹⁻³. The critical effects of pollution on human health give rise to an urgent need to reduce indoor pollutant concentrations by implementing effective measures⁴. Indoor air purification is the most commonly adopted intervention strategy to reduce exposure to indoor PM_{2.5}, which commonly uses high-efficiency particulate air

(HEPA), which is generally owned by the upper middle class^{4,5}. Apart from using ions, there is also the use of photocatalysts for air purification, which can be used effectively in rooms without people in them or the source of the pollution itself⁶.

Using air purifiers is an efficient method for improving the air quality inside a building. The innovative Mini Mobile Filtration with Activated Carbon Adsorbent and Powder of Bidara Leaf (*Ziziphus Mauritiana*) Leaf Powder is an air purifier that removes pollutants from the air by utilizing activated carbon adsorbent and bidara leaf powder. The bidara leaf powder comes from the *Ziziphus*

Mauritiana plant.

The activated carbon adsorbent is a highly porous material that can effectively remove pollutants from the air. It accomplishes this by attracting airborne contaminants to its surface, which are then extracted from the surrounding atmosphere. Bidara leaf powder is an all-natural substance that has been used to treat various medical conditions for centuries. Because it contains compounds with antimicrobial and anti-inflammatory properties, it is an excellent material for use in air purification.

Activated carbon adsorbent and bidara leaf powder have both been the subject of investigation in a number of studies regarding their potential to clean the air. For instance, Zhang et al.⁷ researched the effectiveness of activated carbon adsorbent in removing volatile organic compounds (VOCs) from the atmosphere. The researchers concluded that an adsorbent made of activated carbon successfully removed volatile organic compounds from the air. In a separate piece of research, Kurniawan et al.⁸ investigated the use of bidara leaf powder to sterilise the air and remove bacteria. The researchers discovered that the powdered form of the bidara leaf was successful in preventing the growth of bacteria in the air.

These ideas are used in air filtration by a Mini Mobile Filtration device with activated carbon adsorbent and Bidara Leaf (*Ziziphus Mauritiana*) Leaf Powder. This device is designed to eliminate pollutants from the air. This system is able to effectively remove contaminants from the air, including volatile organic compounds (VOCs) and bacteria, thanks to the utilization of activated carbon adsorbent and bidara leaf powder. A portable air purifier that can be used in a variety of settings, such as homes, offices, and hospitals, is known as mini mobile filtration with activated carbon adsorbent and powder of Bidara Leaf (*Ziziphus Mauritiana*) leaf powder. Because of the system's small size and intuitive operation, it is an excellent choice for addressing the issue of polluted indoor air.

METHOD

This quasi-experimental research is intended to determine whether or not there is an effect of "treatment" carried out on the investigated subject. The approach used in this

experiment is a Pretest-posttest control group design with one kind of treatment. In this model before starting treatment both groups are measured to determine the initial condition (O1). Furthermore, the experimental group was given treatment (X) and the comparison group was not given treatment. After completion of the treatment both groups were measured as a posttest to determine the final condition (O2) with a variation of 3 time variations of 30, 60 and 90 minutes at medium speed.

Design for mobile mini filtration device. Mini mobile filtration equipment is made with the working principle of filtering air or smoke (CO_x, SO_x, and air particles) with activated carbon mixed with bidara leaf powder in the form of 1 cm diameter briquettes having a composition of activated carbon. Extra bidara leaves as an adsorbent 3:1. The design of this tool weighs 7kg with a length of 80cm, width of 40cm and height of 40cm using acrylic glass and aluminium with three chambers. The adsorbent container has a volume of 30cm x 40cm x 40cm with a fan and adsorbent distance of 20cm, as shown in Figure 1.



Figure 1. Design of the mobile mini filtration device

On the right side, there is an air outlet after going through air filtration with activated carbon adsorbent and bidara leaf powder, complete with an air flow speed button (medium 1500 rpm). On the left side is the air inlet into the air filtration room with activated carbon adsorbent and bidara leaf powder, equipped with a medium air flow speed setting button (1500 rpm). On the inside, there is a middle room or a place to put activated carbon adsorbents and bidara leaf powder, which is an air filter from the outside or inlet and then issued through the outlet.

Data analysis in this study used descriptive analysis with a percentage of

average and effectiveness.

RESULTS

Laboratory test results of CO_x, SO_x and particulate air levels before going through the filter can be seen in Table 1.

Table 1. Average air CO_x, SO_x and particulate before using mini mobile filtration with activated carbon adsorbent and bidara leaf powder.

Variable	Air content	*Threshold value
CO _x	358 ppm	250 ppm
SO _x	433 μgram/m ³	365 μgram/m ³
Particulate	435 μgram/m ³	230 μgram/m ³

Table 1 shows that the overall air levels of CO_x, SO_x and particulate are above the threshold value. The average effectiveness of reducing CO_x, SO_x and particulate air levels after going through mini mobile filtration with activated carbon adsorbents and bidara leaf powder can be seen in Table 2.

Table 2. Mean effectiveness of mini mobile filtration with activated carbon adsorbent and bidara leaf powder.

Variable	Air content	Maen After	Effectiveness (%)
CO _x	358 ppm	153 ppm	57,3
SO _x	433 μgram/m ³	212 μgram/m ³	51
Particulate	435 μgram/m ³	265 μgram/m ³	39

Based on Table 2, it can be seen that the measurement results of CO_x, SO_x and particulate gas parameters before and after going through the air filter obtained there is a decrease in all parameters. However, particulate is still above the threshold value.

DISCUSSION

Purifying the air is one of the most important things that can be done to keep the air quality inside a building healthy. It is the process of removing contaminants and pollutants from the air in order to create a living environment that is cleaner and more comfortable for people. Air purification systems in a room are intended to remove potentially hazardous particles from the air, such as dust, pollen, pet dander, and smoke, while mitigating odours and enhancing the air's quality.

An example of an air purification system is a mini mobile filtration system that uses activated carbon adsorbent and powder of bidara leaf (also known as powder of ziziphus mauritiana leaf). The Mini Mobile Filtration With Activated Carbon Adsorbent is an example of a system that purifies the air. This cutting-edge system, which uses activated carbon adsorbent and bidara leaf powder, can successfully remove pollutants from the air. This is made possible by the combination of these two components. An activated carbon adsorbent is a highly porous material that efficiently removes pollutants by adsorbing them onto its surface. Activated carbon adsorbents are typically made from activated charcoal. Activated carbon is the primary component of the adsorbent known as activated carbon. On the other hand, because the powder made from the bidara leaf contains compounds with antimicrobial and anti-inflammatory properties, it is an excellent candidate for use in applications that involve air purification.

Activated carbon adsorbent and bidara leaf powder have both been the subject of investigation in a number of studies regarding their potential to clean the air. For example, Zhang et al¹ investigated the feasibility of employing activated carbon adsorbent to extract volatile organic compounds (VOCs) from the atmosphere. According to the study's findings, activated carbon adsorbent was effective in removing volatile organic compounds (VOCs), which improved air quality. In a separate piece of research, Kurniawan et al.² investigated the use of bidara leaf powder to sterilise the air and remove bacteria. According to the study results, bidara leaf powder can effectively inhibit the growth of bacteria, which further highlights its potential for using it as an air purifier.

The term "room air purification" refers to reducing the number of pollutants found in indoor air by employing devices that remove or filter said pollutants. Depending on their mechanism, several different types of air purifiers can be used in a room. Some of these mechanisms include mechanical filtration, electrostatic precipitation, ionization, photocatalysis, and plasma. The use of room air purifiers has become increasingly common for a variety of reasons, including the enhancement of health and well-being as well as the improvement of indoor air quality, the reduction of allergens, and the prevention of infections. However, there is ongoing debate

regarding the efficiency and safety of room air purifiers, and these claims need to be investigated using rigorous scientific research.

Patients with allergic rhinitis, a common inflammatory condition of the nasal mucosa that is caused by exposure to allergens, have been the subjects of a number of randomized controlled trials (RCTs), which have been conducted to evaluate the effects of room air purifiers on those patients⁹. In addition to raising the risk of asthma and other respiratory conditions, allergic rhinitis can reduce one's overall quality of life. Dust mites, pollens, molds, and animal dander are the most common allergens that can cause allergic rhinitis to flare up. The use of air purifiers in a room has the potential to lessen the patient's exposure to the allergens in the air and relieve some of the symptoms of allergic rhinitis.

In patients with house dust mite-induced allergic rhinitis, Li et al.¹ carried out a randomized controlled trial (RCT) that was multicenter and double-blind to assess the clinical efficacy of a high-efficiency air purifier⁹. The air purifier removed Particles and volatile organic compounds from the air by combining mechanical filtration and photocatalysis. 240 participants were included in the study and assigned to one of two groups: an active or a mockup air-purification group. Each home environment had two air purifiers running continuously for a period of six weeks¹⁰. A group of sixty young adults in generally good health participated in a study that found that using an air purifier significantly reduced the total nasal symptom score (TNSS) in comparison to using a placebo. The active group demonstrated statistically significant improvements in individual nasal symptom scores, as well as improvements in quality of life and medication scores. The findings of this study led the authors to conclude that using an air purifier was both effective and safe in alleviating the symptoms of patients suffering from house dust mite-induced allergic rhinitis and enhancing their overall quality of life.

Another randomized controlled trial was carried out by Li *et al.* to investigate the clinical usefulness of a high-efficiency air purifier for patients suffering from Artemisia pollen-allergic rhinitis⁹. Pollen from artemisia plants is a significant contributor to seasonal allergic rhinitis in China. The previous research was used to develop the mechanism that was used in the air purifier. Within the scope of the

study, there were a total of 120 participants who were randomly assigned to either an actual or a simulated air-purification group. Each home environment had two air purifiers running continuously for a period of four weeks¹⁰. The most important result was the shift in TNSS from the beginning of the study to week 4. The changes in the individual nasal symptom scores, the quality of life score, the medication score, the serum specific IgE level, and the nasal eosinophil count were included in the secondary outcomes. According to the findings, the active air-purification group experienced a reduction in TNSS that was statistically significant higher than the one seen in the mockup group (mean difference of -1.32, 95% confidence interval (CI): -1.75 to -0.89, p 0.001). In addition, the active group saw significant improvements in their individual scores for nasal symptoms, quality of life, medication scores, serum specific IgE levels, and nasal eosinophil counts. The authors concluded that using an air purifier was both effective and safe in improving the symptoms of patients suffering from Artemisia pollen-allergic rhinitis and the patients' overall quality of life.

Yoda et al. carried out a randomized controlled trial in order to investigate the effects of an ionization air purifier on the respiratory systems of healthy adults and the indoor environment¹¹. Ionization air purifiers generate negative air ions (NAI), which are able to bind to airborne particles and cause them to precipitate when they come into contact with them. NAI might also have some biological effects on the respiratory system, like increasing the activity of cilia, lowering inflammation, and modulating neurotransmitters. Twenty adults in good health participated in the study and were each given a chance to be a part of either the real or the fake air-purification group. During the course of the experiment, one air purifier was utilized in each domestic setting for a period of two weeks¹⁰. An ionization air purifier was found to significantly reduce the indoor particle concentration compared to a sham treatment in a study involving sixty young adults in good health. However, there was no discernible difference between the groups regarding pulmonary function, fractional exhaled nitric oxide (FeNO) levels, cytokines in the nasal lavage fluid (NLF), or subjective symptoms. The authors came to the conclusion that the use of an ionization air purifier, despite the fact that

it effectively lowered the indoor particle concentration, did not improve the respiratory health of adults who were otherwise healthy^{11,12}.

The effects of room air purifiers on the cardiorespiratory responses to fine particulate matter (PM_{2.5}) air pollution have also been the subject of several randomized controlled trials (RCTs) that have been carried out. Particulate matter with a particle size of 2.5 micrometers or less is a major contributor to outdoor air pollution. This pollutant can move indoors and has been linked to various negative effects on human health, including oxidative stress, inflammation, endothelial dysfunction, thrombosis, and arrhythmia. There is some evidence that using an air purifier in your home can cut your exposure to particulate matter (PM) 2.5 and lessen its negative impact on your cardiovascular and respiratory systems.

Wang and colleagues conducted a randomized controlled trial (RCT) to investigate the cardiorespiratory responses in healthy young adults following indoor airborne phthalates (PAEs) exposure. Phthalates are a class of semi-volatile organic compounds that are frequently utilized as plasticizers and can be emitted from a variety of indoor sources.¹³ The use of a HEPA air purifier was found to significantly reduce the concentration of PM_{2.5} inside the home, when compared to the use of a sham treatment, in a study that involved sixty young adults who were in good health. Additionally, the real group demonstrated enhancements in blood pressure, heart rate variability, electrocardiogram parameters, blood biomarkers, and urine metabolites, all of which pointed to a reduction in oxidative stress, inflammation, platelet activation, and respiratory inflammation. The findings of this study led the authors to conclude that using a HEPA air purifier was both effective and safe in improving the cardiorespiratory health of young adults who participated in PPWs^{14,15}.

Another randomized controlled trial (RCT) was carried out by Zhao et al. to investigate the cardiorespiratory responses in healthy young adults during PM (2.5) pollution waves (PPWs). PM (2.5) pollution waves are severe air pollution events characterized by extremely high levels of ambient PM (2.5)¹⁶. A study involving sixty young adults in good health found that using a HEPA air purifier significantly reduced the indoor PM_{2.5} concentration compared to a sham treatment. The real group also showed improvements in

blood pressure, heart rate variability, electrocardiogram parameters, blood biomarkers, and urine metabolites, indicating a reduction in oxidative stress, inflammation, platelet activation, and respiratory inflammation. The authors concluded that using a HEPA air purifier effectively and safely lowered indoor PM_{2.5} concentration and improved the cardiorespiratory health of young adults participating in PPWs.

A portable air purifier that can be used in a variety of settings, such as homes, offices, and hospitals, is referred to as the Mini Mobile Filtration With Activated Carbon Adsorbent And Powder of Bidara Leaf (Ziziphus Mauritiana) Leaf Powder. This purifier combines activated carbon with powder made from the bidara leaf of the ziziphus mauritiana tree. Because of the system's small size and intuitive operation, it is an excellent choice for addressing the issue of polluted indoor air. In conclusion, the use of air purification systems in rooms is an essential component in preserving the high quality of air inside buildings. Innovative and effective at removing pollutants from the air, the Mini Mobile Filtration With Activated Carbon Adsorbent And Powder of Bidara Leaf (Ziziphus Mauritiana) Leaf Powder is an air purification system that uses powder of bidara leaf (ziziphus mauritiana). Activated carbon adsorbent and bidara leaf powder have been shown to be effective in several studies in the process of cleaning the air. Additional research in this field may result in the creation of air purification systems that are more effective and may also contribute to the development of environmentally responsible practices.

CONCLUSION

Mobile filtration of a mixture of activated carbon and bidara leaf powder can reduce CO_x, SO_x, and particulate values by 57%, 51%, and 31%. Even though there was a decrease in the particulate value, it was still above the specified threshold value.

ACKNOWLEDGMENTS

This research was funded by the Pontianak Health Ministry's Poltekkes budget.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Ming Y, Deng H, Wu X. The negative effect of air pollution on people's pro-environmental behavior. *J Bus Res.* 2022;142:72–87.
2. Gu H, Cao Y, Elahi E, Jha SK. Human health damages related to air pollution in China. *Environ Sci Pollut Res.* 2019;26:13115–25.
3. Afroz R, Hassan MN, Ibrahim NA. Review of air pollution and health impacts in Malaysia. *Environ Res.* 2003;92(2):71–7.
4. Dubey S, Rohra H, Taneja A. Assessing effectiveness of air purifiers (HEPA) for controlling indoor particulate pollution. *Heliyon.* 2021;7(9).
5. Duan M, Wang L, Meng X, Fu L, Wang Y, Liang W, et al. Negative ion purifier effects on indoor particulate dosage to small airways. *Int J Environ Res Public Health.* 2021;19(1):264.
6. Kolarik J, Wargocki P. Can a photocatalytic air purifier be used to improve the perceived air quality indoors? *Indoor Air.* 2010;20(3):255–62.
7. Askur A, Adiningsih R, Ganning A. Utilization of bidara leaf (*Ziziphus mauritiana* L.) extract as a natural larvacide. *Urban Health.* 2021;3(1).
8. Pabisa M. Uji Aktivitas Antibakteri Ekstrak Daun Bidara Arab (*Ziziphus Spina-Christi* (L.) Desf.) Terhadap Beberapa Bakteri Patogen Dengan Metode KLT Bioautografi. Universitas Hasanuddin; 2020.
9. Li L, Zhang L, Mo JH, Li YY, Xia JY, Bai XB, et al. Efficacy of indoor air purification in the treatment of *Artemisia* pollen-allergic rhinitis: A randomised, double-blind, clinical controlled trial. *Clin Otolaryngol Off J ENT-UK ; Off J Netherlands Soc Oto-Rhino-Laryngology Cerv-fac Surg.* 2020 May;45(3):394–401.
10. Park KH, Sim DW, Lee SC, Moon S, Choe E, Shin H, et al. Effects of Air Purifiers on Patients with Allergic Rhinitis: a Multicenter, Randomized, Double-Blind, and Placebo-Controlled Study. *Yonsei Med J.* 2020 Aug;61(8):689–97.
11. Yoda Y, Tamura K, Adachi S, Otani N, Nakayama SF, Shima M. Effects of the Use of Air Purifier on Indoor Environment and Respiratory System among Healthy Adults. *Int J Environ Res Public Health.* 2020 May;17(10).
12. Undated EPA. What are Ionizers and Other Ozone Generating Air Cleaners? US Environ Prot Agency <https://tinyurl.com/y4br2zwa>.
13. Wang J, Shi J, Zhao Y, Xue L, Li G, Wang B, et al. Cardiorespiratory responses in healthy young adults with exposure to indoor airborne PAEs: A randomized, crossover trial of air purification. *Environ Int.* 2021 Nov;156:106761.
14. Chen CF, Hsu CH, Chang YJ, Lee CH, Lee DL. Efficacy of HEPA Air Cleaner on Improving Indoor Particulate Matter 2.5 Concentration. *Int J Environ Res Public Health.* 2022;19(18):11517.
15. Fazlzadeh M, Hassanvand MS, Nabizadeh R, Shamsipour M, Salarifar M, Naddafi K. Effect of portable air purifier on indoor air quality: reduced exposure to particulate matter and health risk assessment. *Environ Monit Assess.* 2022;194(9):638.
16. Zhao Y, Xue L, Chen Q, Kou M, Wang Z, Wu S, et al. Cardiorespiratory responses to fine particles during ambient PM(2.5) pollution waves: Findings from a randomized crossover trial in young healthy adults. *Environ Int.* 2020 Jun;139:105590.

Original Article

Qualitative Study of the Incidence of Autism among Students at State Special School (SLB) 1 Parepare City

Rahmi Amir^{1*}, Risdianti¹, Nurlinda¹, Rasidah¹, Abd Farid Lewa²

¹ Faculty of Health Sciences, Universitas Muhammadiyah Parepare, Parepare City, South Sulawesi Province, Indonesia

² Department of Nutrition, Poltekkes Kemenkes Palu, Palu City, Central Sulawesi Province, Indonesia

(Correspondence author's email, ammiandjala@gmail.com/0852-4691-3430)

ABSTRACT

This research explores the risk factors for the occurrence of autism among students at Special Needs School (Sekolah Luar Biasa or SLB) Negeri 1 in the city of Parepare. Autism is a developmental disorder that affects a child's social interaction, communication, and behavior. The exact cause of autism is still unknown, but several factors such as genetics, environment, and prenatal factors have been identified as possible causes. This study used a qualitative method, conducting in-depth interviews with parents of autistic students, therapy counselors, and teachers of autistic students. Results of the research indicate that traditional factors such as a history of medication during pregnancy, viral infections, and the birth weight of the baby do not have a significant association with autism among students at SLB Negeri 1 Parepare. However, other factors such as imbalances in the nervous system, exposure to chemicals, and exclusive breastfeeding for less than six months may contribute to the occurrence of autism. This research emphasizes the need for a deeper understanding of the risk factors for autism that may vary in different populations. Recommendations include avoiding the consumption of non-prescribed medications during pregnancy, reducing exposure to harmful chemicals, and promoting exclusive breastfeeding for a minimum of six months. The government also needs to raise awareness about autism and provide appropriate facilities for children with this disorder. This research contributes to a better understanding of the risk factors for autism at SLB Negeri 1 Parepare.

Keywords: *Autism, Children, Qualitative, Risk Factors*

<https://doi.org/10.33860/jik.v17i2.2460>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

Autism in children is a pervasive developmental disorder that affects social interaction, communication and behavior and is recognized before the age of 3 years ¹. Until now the cause of autism is not known for certain. There are several factors that are thought to cause autism ². Among them are genetic, environmental, metabolic and central nervous disorders, infections during pregnancy

(rubella), digestive disorders to heavy metals, abnormal brain structures such as hydrocephalus can also cause autistic children ³.

Based on data from *the Center for Disease Control and Prevention (CDC)* in 2018 it was explained that the incidence of people with autism has increased, from 1:150 population in 2000 to 1:59 in 2014. Autism itself mostly affects boys. with a prevalence of 1:37, while in girls it is 1:151. The prevalence of autism in Brazil is around 0.3% in school-

aged children, and the majority in boys is 80% with a ratio of 4:1⁴.

In line with that, the results of a study conducted by *the Center for Disease Control and Prevention* in 2013 stated that the prevalence of autism in the world currently ranges from 0.15-0.20%, including Indonesia⁴. Meanwhile, the Statistics Data Center for Special Schools noted that the number of students with autism in Indonesia in 2018 was 128,510², while for the Province of South Sulawesi itself in recent years it has been known that no less than 1,000 children under the age of five (toddlers) have autism⁵.

The Special School Statistical Data Center recorded the number of autistic students in Indonesia in 2018 as many as 128,510⁵, while for the Province of South Sulawesi itself in recent years it has been known that no less than 1,000 children under the age of five (toddlers) suffers from autism⁶.

Based on an initial survey conducted by researchers at the State Special School (SLB) in Parepare City, it is known that there are 16 people with autism. With ages 7 to 17 years with different characteristics. There were 12 boys and 4 girls.

The risk of autism in children is divided into three, namely during pregnancy or prenatal, postpartum or perinatal, and infancy or neonatal. This is in line with the results of previous research which stated that perinatal and neonatal factors are still susceptible to causing autism⁷.

Factors such as a history of bleeding during pregnancy, a history of seizures experienced by children, and a history of low birth weight (<2500 grams) have a relationship with the incidence of autism in children. Meanwhile, a history of drug use and a history of infection during the child's pregnancy did not show a significant relationship with the incidence of autism in children¹.

This statement is not in line with research⁸ which states that preeclampsia, gestational diabetes, bleeding during pregnancy, consumption of drugs during pregnancy, and infection during pregnancy are also prenatal risk factors for autism^{8,9,10}.

Several studies have found that there is a relationship between the incidence of prenatal and perinatal complications in cases of autism, compared to the non-autistic group. Complications that are often reported related to autism are bleeding during pregnancy,

meconium in amniotic fluid, use of drugs, including hormonal drugs. In addition, a relationship was also found between autism and central nervous system disease as a result of viral infection, measles in the mother (maternal rubella, especially with deaf or blind babies), senileconuria, encephalitis, meningitis, metabolic disorders, and tuberous sclerosis¹¹.

Seeing the frequency of occurrence of autism which continues to increase from year to year which has an impact on the life and development of children and their families, and because autism is a multifactorial problem and is also related to epigenetic factors, the researcher is interested in conducting research. Qualitative research regarding the incidence of autism in students at SLB Negeri 1 Parepare City.

The purpose of this study was to describe how a history of autism risk occurs in students at the State Special School (SLB) 1 Parepare City

METHOD

Qualitative research design with a phenomenological approach understand the phenomena experienced by research subjects holistically and through descriptions in the form of words and language in a special natural context⁹.

The research location which was also the object of this research was carried out at the State Special School (SLB) 1 in the city of Parepare. At the time of the research it was used for approximately one month.

The selection of informants in this study was carried out based on certain criteria, by selecting individuals who met the following criteria: having the characteristics of an autism disorder which was strengthened by an expert diagnosis; permitted by parents and expert teachers to be studied; and is an autistic student at SLB Negeri 1 Parepare City. Two autistic boys aged 12 years and one autistic girl aged 11 were successfully recruited as informants represented by their parents. Supporting informants are important people other than the three subjects, namely the therapist and the therapist in charge.

Research data was collected using interview, observation and document techniques. The interviews conducted were in-depth interviews with general instructions. This type of interview requires the interviewer to

create an outline and elaborate on the points being asked . This interview framework contains a list of questions containing the theme and flow of discussion as a control guide. Data collection can be done by applying the triangulation method.

The data from the study were analyzed using qualitative techniques, specifically thematic analysis. Responses from interviews were transcribed, coded, and categorized to identify recurring themes and patterns related to autism risk factors. Triangulation was used to cross-reference data from various sources, ensuring robust and credible findings. Ethical considerations and participant validation were integral to maintaining data integrity, resulting in meaningful conclusions and recommendations for addressing autism risk factors among students at SLB Negeri 1 Parepare.

The data analysis used in this research is deductive analysis, in which the data obtained in the field is generally then described in the form of conclusions or of a specific nature. With three methods, namely data reduction, data presentation, and drawing conclusions.

RESULTS

Informant Characteristics

A total of 5 people who became informants in this study were divided into 3 types of informants, with the number of main informants namely 3 parents of autistic students, key informants namely 1 therapist supervisor and additional informants 1 teacher of autistic students at SLB Negeri 1 Parepare City . The characteristics of the informants can be seen in Table 1.

Table 1. Characteristics of Research Informants

Informant Type	Informant Characteristics	
	Age	Initials
Parent	39 Years	AH
Parent	39 Years	WE
Parent	46 Years	AL
Therapist's guide	40 years	H.J
Teacher	32 years	MI

Source: Primary Data , 2023

History of Drug Consumption

From the results of interviews conducted by researchers with informants, it can be described that the variables of drug consumption when the mother was pregnant with an autistic child indicated that all informants stated that they only consumed vitamins. This is reinforced by the results of interviews conducted by researchers with informants, as follows:

"If you are taking medication, you have been given blood-boosting tablets or vitamins according to the doctor's dosage" (AS, 39 years old)

"No, I have also never experienced an illness that required me to take long-term medication during pregnancy" (AL, 46 years old)

History of viral infection

The results of research conducted by researchers with informants stated that the majority of informants had no history of viral infections such as measles, rubella, herpes simplex, mumps, varicella, cytomegalovirus, toxoplasma, and syphilis. This is reinforced by the results of interviews conducted by researchers with informants, as follows:

"Thank God there were never any problems and the delivery process was normal. When I was pregnant I was injected with a vaccine" (AS, 39 years)

"Based on the information after the assessment of the parents, I have not found anyone who has a history of problems during pregnancy, let alone has a history of viral infections" (MI, 32 years)

History of Prenatal Bleeding

Based on interviews conducted by researchers with informants, it can be described that the variable history of bleeding when the mother was carrying a child with autism showed that all informants stated that they had no history of prenatal bleeding. Which is reinforced by the results of interviews conducted by researchers with informants, as follows:

"Not really, it's just that I gave birth by caesarean section with a gestational age of 9 months" (AL, 46 years)

"It's absolutely nothing, even when I was pregnant I didn't feel any heavy cravings (nausea/vomiting)" (AS, 39 Year)

"Nothing, just constant nausea because I can't eat" (AH, 39 years old)

"Based on the theory that has been mentioned, looking at the experience of the parents after the assessment was also said that they had never experienced bleeding during pregnancy" (HJ, 40 years)

History of Baby's Birth Weight

Based on the results of interviews conducted by researchers, it can be explained that the variable history of birth weight is not a factor in the history of autism in students at SLB Negeri 1 Kota Parepare. This is reinforced by the informant's statement which said:

"Normal, 3.5 kg" (AL, 46 Years)

"Normal 2.5 kg" (USA, 39 Years Old)

"Normal 3.5 kg and not premature" (AH, 39 years)

"Nothing, they were born with normal weight and their mother's age is also normal as far as I know" (MI, 32 years)

DISCUSSION

History of Drug Consumption

Consumption of drugs can selectively inhibit the release of Serotonin during pregnancy which will cause abnormal serotonin levels that cause autism.

The results of this study stated that the consumption of drugs when the mother was pregnant with an autistic child was not a factor in the history of autism in students at SLB Negeri 1 Parepare City. The same statement was also shared by all informants, namely they had no history of consuming drugs and only consumed vitamins given from the hospital or health center.

This research is in line with that research states that pregnant women have no history of taking drugs that are at risk of causing autism and all samples state that they take vitamins during pregnancy¹.

It is also supported by research⁷ which states that there is no relationship between a

history of drug consumption and the incidence of autism in children⁷.

Unlike the research conducted by⁸ which shows that mothers who have a history of drug consumption and give birth to autistic children are greater when compared to mothers who have children who do not experience autism⁵.

Some previous research results also show that drug consumption in pregnant women on the incidence of autism in children can affect brain development in the fetus¹⁰. Conversely, if the mother consumes vitamins, cod fish, vitamin A, vitamin D3, Omega-3, EPA, DHA, vitamin E, vitamin B12, folic acid, vitamin B6, calcium, magnesium and iron. During pregnancy it can maintain the health of the mother and fetus¹¹.

History of viral infection

Maternal infection mechanisms during pregnancy can lead to neurodevelopmental disorders such as autism. There is a direct effect through the passage of infectious organisms across the placenta and into the fetal environment, or an indirect effect through activation of the mother's immunity¹².

The results of the research conducted by the researchers stated that most of the informants had no history of viral infections such as measles, rubella, herpes simplex, mumps, varicella, cytomegalovirus, toxoplasma, and syphilis¹³. So it can be illustrated that a history of viral infection is not a history of autism in students at SLB Negeri 1 Kota Parepare.

This research is in line with research conducted by¹ which stated that pregnant women who were not infected with the virus also had autistic children so that it did not have a significant effect on the incidence of autism.

It is also supported by research¹⁴ which states that there are no cases due to viral infections that cause these disorders autism.

In contrast to research¹⁵ It is known that mothers who have a history of viral infections during pregnancy are at risk of 3.647 times greater for their children to experience autism than mothers who do not have a history of infection.

History of Prenatal Bleeding

Prenatal bleeding is considered a condition that has the potential to disrupt fetal

brain function. Bleeding during pregnancy is most often caused by complications in the placenta, including placenta previa and placental abruption. This condition results in disruption of the transport of oxygen and nutrients to the baby which results in disorders of the fetal brain¹⁶.

Based on the results of the study, it was stated that bleeding in mothers carrying autistic children was not a factor in the history of autism in students at SLB Negeri 1 Parepare City. All informants had the same statement, namely that they had no history of prenatal bleeding.

This research is in line with the results of research¹ which shows that a history of bleeding is not a cause of autism in children.

In contrast to several studies which state that pregnant women who experience bleeding can trigger autism in children. Bleeding will cause hypoxia in the fetus which results in brain abnormalities and increased dopaminergic activity¹⁵.

History of Infant Birth Weight

Polymorphisms in the insulin-like growth factor-I (IGF-I) gene were found to be associated with low birth weight (215 g weight loss compared to subjects without the polymorphism). This or other genes that influence low birth weight may also explain the link between SGA (*small gestational age*) and childhood autism. Similar to VLBW (*Very Low Birth Weight*), SGA is a marker of several prenatal risk factors that may be associated with autism such as *fetal hypoxia*, *placental pathology*, *preeclampsia*, or infection during pregnancy. Maternal risk behaviors, such as smoking, alcohol, drug use, or others have been associated with low birth weight, prematurity, and neuropsychiatric morbidity⁵.

Based on the results of interviews conducted by researchers, it can be explained that the baby's birth weight is not a factor in the history of autism, because most children with autism disorder have a history of normal birth weight, namely 2.5-4 kg.

This research is in line with research (Indah Sari, 2022) which states the results that the highest birth weight babies are 2.5-4 kg. this shows that the baby's birth weight is not a factor causing autism in children¹⁶.

In contrast to previous research which stated that children who have a history of Low Birth Weight (LBW) have a 3.98 times greater risk of experiencing Autism than children who

have Normal Birth Weight⁸.

History of febrile seizures

Febrile seizures are seizures that occur when the body temperature increases (rectal temperature above 38°C) caused by extracranial. Febrile seizures are the most common neurological disorder that occurs in children, especially in the age group 3 months to 5 years³.

Based on the results of the research, all informants stated that children with autism disorder in Parepare City¹ SLB students did not have a history of febrile seizures but often had tantrums, especially when they heard loud noises. Previously showed significant results between a history of febrile seizures and the incidence of autism¹.

Fever with a temperature increase of 1°C will result in an increase in basal metabolism by 10-15% and oxygen demand will increase by 20%. at a certain increase in body temperature there can be a change in the balance of the neuron cell membrane and in a short time there is a diffusion of Potassium ions and Sodium ions through the membrane resulting in an electrical discharge. The release of this electric charge can spread throughout the cell or to the cell membrane next to it with the help of neurotransmitters so that seizures occur, so that children who have febrile seizures can make children experience autism. The most important factor is circulatory disorders which result in hypoxia thereby increasing capillary permeability and brain edema arising which results in damage to brain neuron cells¹⁷.

The difference in the results of this study could be caused by the location of the study, where it was also seen that there were differences in the characteristics of the respondents at the socio-economic level which led to differences in their food consumption habits or culture. that apply during pregnancy in certain families or customs¹⁸. However, apart from these five variables, the researchers found information that the incidence of autism in SLB Negeri 1 Kota Parepare is also caused by the following factors:

Nervous System Imbalance

From the results of interviews it is known that autistic children's disorders are caused by an imbalance in the nervous system which is influenced by neuroimmunity. So that abnormal neuroimmunity can affect the work of

the nervous system so that it triggers neuroinflammation which is one of the factors causing autism disorders.

In a book entitled Autism Spectrum Disorder it is also stated that the risk factors associated with the occurrence of Autism Spectrum Disorder are genetic factors, brain factors, and digestive factors³.

History of Chemical Exposure

The rapid increase in the prevalence of autism spectrum disorders (ASD) suggests that exposure to chemicals may have an impact on the development of ASD¹⁹. chemicals that are suspected to be associated with ASD, namely: smoke/tobacco, alcohol, air pollution, pesticides, endocrine disrupting chemicals, heavy metals, micronutrients, and fatty acids²⁰.

Based on the results of interviews conducted by researchers, it can be explained that a history of exposure to chemicals is a history of autism in SLB Negeri 1 Parepare City.

This statement is supported by previous research which states that environmental factors also contribute to autistic disorders²¹. These factors include air pollution, nutrients, and mercury²². A mother in the first month to the third month of pregnancy who does not pay attention to her food intake or pregnancy nutrition is more likely to give birth to a child with autism²³.

Based on several previous research journals, it was stated that exposure to mercury contained in fish can cause slow neurodevelopment. As a result, it can reduce the fetus's IQ, disrupting language and motor development⁷.

History of Cigarette Exposure

From the results of interviews conducted by researchers, there is a history of exposure to cigarette smoke in pregnant women which causes autism in children. This research is in line with previous research which stated that exposure to secondhand smoke in pregnant women can increase the risk of autism through various mechanisms, such as placental insufficiency, decreased blood flow and oxygen to the brain, changes in gene expression in the fetal brain, changes in nicotine receptors, changes in neurotransmitter activity persistent, as well as increased amounts of *intrauterine testosterone*²⁴.

Previously, pregnant women who were

exposed to cigarettes increased the incidence of autism in their children. Because it can expose the fetus to thousands of chemicals that threaten health, and affect the growth of brain function in the fetus¹⁴.

Exclusive Breastfeeding

Based on the results of the interviews, it was found that there was a history of breastfeeding for less than 6 months in children with autism and had never even been given breast milk since birth and were only given formula milk.

This research is in line with previous research which stated that breastfeeding duration of less than 6 months is a risk factor for autism²⁵.

This is also supported by the statement that children who are breastfed for less than six months are at risk of suffering from autism two times greater than children who are breastfed for more than six months. Breastfeeding patterns are associated with risk of autism²⁶.

Giving Mother's Milk (ASI) provides many benefits for the growth and development of infants²⁷. Colostrum is a very important part of breast milk and forms the immune system, provides growth factors and other protective factors for the baby, and has secretory IgA which provides protection against gastrointestinal infections²⁵.

The lack of exclusive breastfeeding has a serious impact on the survival of infants to adulthood. Babies who are not exclusively breastfed are suspected of having a negative contribution to autism.

CONCLUSION

Based on the results of the analysis and discussion, it was found that a history of consumption of drugs, viral infections, prenatal bleeding, baby's birth weight (LBW) and febrile seizures, was not a risk history for autism in SLB Negeri 1 Kota Parepare. However, researchers found that the incidence of autism is also caused by several risk factors, namely an imbalance of the nervous system, a history of exposure to chemicals, a history of exposure to cigarettes, and exclusive breastfeeding for less than six months.

Based on the results of the study, it is recommended for pregnant women to avoid consuming drugs other than doctor's recommendations, avoid childbirth with action

by preventing pregnancy complication factors such as preeclampsia, infectious diseases, monitoring conditions during pregnancy, exercising diligently, attending classes for pregnant women. For those who haven't joined, in order to increase their knowledge and confidence to give birth normally, besides that they also need to pay attention to the environment and avoid areas that are prone to exposure to chemicals, avoid exposure to cigarettes and breastfeed for at least 2 years.

The main reason for not including numeric or statistical data in this article is because the research employs a qualitative methodology. Qualitative methods are designed to gain in-depth understanding of individual experiences and potential contributing factors to autism. In qualitative research, the focus is on interviews, observations, and narrative analysis rather than quantitative data that can be measured with numbers.

This study aims to explore potential risk factors that may play a role in autism at SLB Negeri 1 Parepare, Indonesia. Therefore, the information obtained is more descriptive and narrative in nature rather than numerical or statistical. Given the limitations of resources and field accessibility, it is challenging to collect statistically significant data to support the research findings.

Additionally, qualitative research is often used in the initial stages of research to identify potential factors that can be further investigated with quantitative research in the future. Thus, this study can serve as a foundation for future research that focuses more on gathering statistical data.

However, adding statistical data in the future could be a valuable addition to validate the research findings. By combining qualitative data obtained from interviews and observations with quantitative data involving a larger sample, future research can provide stronger evidence of the relationship between specific factors and autism in the context of SLB Negeri 1 Parepare. This would strengthen the basis for more effective intervention and policy measures to support children with autism and their families.

ACKNOWLEDGMENTS

The author would like to thank various parties who have helped complete this research, especially the supervisor Dr. Rahmi Amir, S.Si, M.Kes and Nurlinda, SKM, M.Kes and Head of

SLB Negeri 1 Parepare. (SLB), Mr. Faisal Syarif, S.Pd, M.Kes and his staff who have provided assistance and support, as well as contributed to the preparation of research journals.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Tinambunan DJ, Hastuty YD. Gambaran Faktor-Faktor Yang Berhubungan Dengan Autisme Anak Di Slb Negeri Autis Sumatera Utara. *Jurnal Ilmiah PANNMED (Pharmacist, Analyst, Nurse, Nutrition, Midwifery, Environment, Dentist)*. 2020 Dec 31;15(3):513-21.
2. Fombonne E, MacFarlane H, Salem AC. Epidemiological surveys of ASD: advances and remaining challenges. *Journal of autism and developmental disorders*. 2021 Dec;51:4271-90.
3. Baculu EP, Andri M. Faktor Risiko Autis Untuk Mengurangi Generasi Autis Anak Indonesia. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*. 2019 Feb 6;2(1):5-11.
4. Kementerian Kesehatan Republik Indonesia. Hari Peduli Autisme Sedunia: Pentingnya Pendampingan dan Edukasi bagi Anak Gangguan Spektrum Autisme ditengah Pandemi Covid-19. Kementerian Kesehatan Republik Indonesia; 2020. Retrieved from: <http://p2p.kemkes.go.id/hari-peduli-autisme-sedunia-pentingnya-pendampingan-dan-edukasi-bagi-anak-gangguan-spektrum-autisme-ditengah-pandemi-covid-19/>
5. Alfinna T, Santik YD. Kejadian autism spectrum disorder pada anak di Kota Semarang. *HIGEIA (Journal of Public Health Research and Development)*. 2019 Nov 25;3(4):635-45.
6. Faiqah S, Ristrini R, Irmayani I. Hubungan usia, jenis kelamin dan berat badan lahir dengan kejadian anemia pada balita di Indonesia. *Buletin Penelitian Sistem Kesehatan*. 2018;21(4):281-9.
7. Herdani PF, Purba FD, Hanami Y. Kualitas Hidup Pada Ibu dari Anak

- dengan Gangguan Spektrum Autisme. *jpsy* [Internet]. 2022 Feb. 3 [cited 2023 Sep. 24];15(1):19-24. Available from: <https://jpsy165.org/ojs/index.php/jpsy165/article/view/145>
8. Alfinna T. Faktor Risiko Kejadian Autism Spectrum Disorder Pada Anak Di Kota Semarang Tahun 2018. Universitas Negeri Semarang; 2019.
 9. Rousselon-Charles V, Angonin-Boucher C, Latfaoui K, Aytakin Z, Charles R. Étude descriptive des enfants porteurs de troubles du spectre de l'autisme soignés au CHU de Saint-Étienne. *Neuropsychiatrie de l'Enfance et de l'Adolescence*. 2023 Jun 1;71(4):178-85.
 10. Chocron M, Ponce E. Effects of sensory overload in autism: A psychoanalytical point of view. *Cliniques mediterraneennes*. 2019;100(2):51-63.
 11. McKeen DM, Valerie Z. Lack of evidence that epidural pain relief during labour causes autism spectrum disorder: a position statement of the Canadian Anesthesiologists' Society. *Canadian Journal of Anesthesia*. 2021 Feb 1;68(2):180-2.
 12. Hildawati. Penerapan Metode Aba (Applied Behavior Analysis) Dalam Meningkatkan Kemampuan Perilaku, Interaksi Sosial, Bahasa Dan Komunikasi Anak Autis. *Paedagogia: Jurnal Pendidikan*, 2019; 7(2), 39-60. <https://doi.org/10.24239/pdg.Vol7.Iss2.18>
 13. Di Pietrantonj C, Rivetti A, Marchione P, Debalini MG, Demicheli V. Vaccines for measles, mumps, rubella, and varicella in children. *Cochrane Database of Systematic Reviews*. 2020.
 14. Manalu AP, Ramayanti I, Arsyad KH. Faktor-Faktor Kejadian Penyakit Autisme Anak di Bina Autis Mandiri Palembang. *Syifa'MEDIKA: Jurnal Kedokteran dan Kesehatan*. 2013 Sep 7;4(1):16-21.
 15. Pangestu N, Fibriana AI. Faktor Risiko Kejadian Autisme. *HIGEIA (Journal of Public Health Research and Development)*. 2017 May 9;1(2):141-50.
 16. Sari AI, Yanis A, Koerniati I. Gambaran Faktor Risiko Anak dengan Gangguan Spektrum Autisme (GSA) di Sekolah Anak Berkebutuhan Khusus di Padang. *Syntax Literate; Jurnal Ilmiah Indonesia*. 2022 Nov 17;7(11):15549-65.
 17. Affandi A, Pratiwi UH. Faktor-Faktor Penyebab terjadinya Autisme pada Anak Di Kota Cirebon. *Tunas Medika Jurnal Kedokteran & Kesehatan*. 2014 Mar 19;1(2).
 18. Shanmugarajah K, Rosenbaum P, Di Rezze B. Exploring autism, culture, and immigrant experiences: Lessons from Sri Lankan Tamil mothers. *Canadian Journal of Occupational Therapy*. 2022 Jun;89(2):170-9.
 19. Bölte S, Girdler S, Marschik PB. The contribution of environmental exposure to the etiology of autism spectrum disorder. *Cellular and Molecular Life Sciences*. 2019 Apr 15;76:1275-97.
 20. Fujiwara T.) Chemicals, Nutrition and Autism Spectrum Disorders. National Institute for Environmental Studies, Japan; 2020.
 21. Lazarevic N, Barnett AG, Sly PD, Knibbs LD. Statistical methodology in studies of prenatal exposure to mixtures of endocrine-disrupting chemicals: a review of existing approaches and new alternatives. *Environmental health perspectives*. 2019 Feb 5;127(2):026001.
 22. Cuevas AG, Wang K, Williams DR, Mattei J, Tucker KL, Falcon LM. The association between perceived discrimination and allostatic load in the Boston Puerto Rican Health Study. *Psychosomatic medicine*. 2019 Sep;81(7):659.
 23. Sari AP, Amin M, Lukiati B. Penyebab Gangguan Autis Melalui Jalur Neuroinflamasi. *Bioeksperimen: Jurnal Penelitian Biologi*. 2017 Sep 11;3(2):1-9.
 24. Yarah S, Martina M, Benita M. Hubungan Informasi Konsumsi Junk Food dan Peran Teman Sebaya dengan Kejadian Obesitas pada Remaja Putri di SMA Abulyatama Kabupaten Aceh Besar. *Jurnal Aceh Medika*. 2021 Oct 31;5(2):87-94.
 25. Khaerina U, Herini S, Ismail D. Hubungan Status ASI Eksklusif dan Pemberian Kolostrum dengan Kejadian Autisme pada Anak di Bawah 10

- Tahun. *Jurnal Kesehatan Reproduksi*. 2019;6(3):99-105.
26. Bawono KD, Herini ES, Wandita S. ASI sebagai faktor protektif terhadap autisme. *J. Gizi Klinik Indones*. 2012 Apr;8:166-71.
27. Kay SI, Delgado S, Mittal J, Eshraghi RS, Mittal R, Eshraghi AA. Beneficial effects of milk having A2 β -casein protein: Myth or reality?. *The Journal of nutrition*. 2021 May;151(5):1061-72.

Original Article

Determinants of Stunting Among Children Under Two Years of Age in Batu Bara District, Indonesia

**Ivan Elisabeth Purba^{1*}, Leli Mariani Harahap², Rinawati Sembiring¹,
Toni Wandra¹, Donal Nababan¹**

¹ Directorate of Postgraduate, Sari Mutiara Indonesia University, Medan, Indonesia

² Faculty of Pharmacy and Health Science, Sari Mutiara Indonesia University, Medan, Indonesia

(Correspondence author's email, poerba.ivanelis@gmail.com/0813-6169-7808)

ABSTRACT

Batubara District is one of 33 districts/cities in North Sumatra Province with relatively high stunting prevalence. This study aimed to determine the determinants of stunting among children under two years of age in the Laut Tador Health Center work area of Batu Bara District in 2023. The design of this study was case-control. The number of samples was 154 (case), and control was 154 (non-stunting). Respondents were mothers of children under two years of age. Independent variables were chosen based on the preliminary study results in the study area, including the mother's education, mother's knowledge, family income, history of mother on ANC visits, history of mother taking iron tablets, history of child getting exclusive breastfeeding, and history of child getting complementary feeding. Trained health workers and members of the researcher team collected all data. Analysis data included univariate, bivariate analysis using chi-square and multivariate (logistic regression) analysis. The study showed that there were significant differences between family income ($p < 0.001$), history of mother on ANC visits ($p < 0.001$), history of a mother taking iron tablets ($p=0.043$), history of children under two years getting exclusive breastfeeding ($p < 0.001$), and history of children under two years of getting complementary feeding ($p < 0.001$) and stunting, respectively. The role of health posts (Posyandu) and village cadres should be improved to provide information about antenatal care, taking iron tablets during pregnancy, exclusive breastfeeding, and complementary feeding to pregnant women, including monitoring children's growth.

Keywords: Stunting, Children Under Two Years of Age, Laut Tador Health Center Work Area, Batu Bara District, North Sumatra, Indonesia

<https://doi.org/10.33860/jik.v17i2.3113>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

According to World Health Organization, stunting is defined as a height that is more than two standard deviations below the WHO child growth standards median. In early life, stunting can occur in the first 1000 days from conception until the child is under two years of age¹⁻³.

The short-term impacts of stunting include poor cognitive and educational performance, and the long-term impacts are low adult wages, lost productivity, and increasing susceptibility to degenerative diseases^{4,30-31}.

Globally, more than 162 million children under five have stunted growth⁹⁻¹⁰. In Africa, the prevalence of stunting was 37.2%, 34.6% and 33.6% in 2010, 2015 and 2017, respectively. This prevalence is similar to the prevalence in Southeast Asia, which was 39.5% (2010), 34.8% (2015), and 33.0% in 2017. However, in America, the prevalence is lower than in Africa and Southeast Asia, with a prevalence of 7.9% in 2010, and 6.3% in 2017².

In Indonesia, the prevalence of stunting among children under five years of age was 36.8%, 35.6%, 37.2%, and 30.8% in 2007, 2010, 2013, and 2018, respectively, 27.7% in 2019,

and 24.4% in 2021⁴⁻⁸.

In North Sumatra, the prevalence of stunting among children under five years of age was 28.7% in 2020 (E-PPGBM, 2020), and 25.8% (2021), and 21.2% in 2022 (SSGI, 2022).

Batubara District (Fig. 1) is one of 33 districts/cities in North Sumatra Province with relatively high stunting prevalence in children under five years of age. In 2018, 2019, and 2020, 2021, and 2022, the prevalence was 32.3%, 30.1%, 28.7%, 25.8%, and 21.2%, respectively⁶.

Based on the 2023 E-PPGBM data, the number of children under two years of age in the Laut Tador Health Center work area of Batu Bara District was 428, and 36.0% (154/428) among them were stunted.

Current stunting prevention programs in Indonesia include taking iron tablets during pregnancy (one tablet, minimum 90 tablets), ANC visits (at least six times), consume animal protein daily for babies over six months of age, monitoring growth and development, immunisation of children five years of age at the health post (Posyandu) every month, and exclusive breastfeeding for six months continued until two years of age including complementary feeding for complement breastfeeding (MP-ASI)⁸⁻⁹.

This study aimed to determine the determinants of stunting in the Laut Tador Health Center work area of Batu Bara District, North Sumatra in 2023.

METHOD

The Laut Tador Health Center work area of Batu Bara District had a 3060 population, with 1504 males and 1556 females. The number of heads of families was 978, and the population density was 215.71 people/km². The study was conducted in all (ten) villages (Tanjung Prapat Village, Laut Tador, Pelanggiran, Perk Tanjung Kasau, Dwi Sri, Tanjung Kasau, Tanjung Seri, Mekar Sari, Sei Simujur, and Kandangan) in the Laut Tador Health Center work area of Batu Bara District from May 11 to 20, 2023.

The design of this study was case-control. The case was all (154) stunting in children under two years of age found in the study area in 2023 (the minimum sample size was not calculated). Stunting is defined as described previously by WHO¹. The number of controls was 154 non-stunting among 274 (56.2%) children under two years in this area in 2013 that were selected by purposive sampling

(case vs. control was 1:1).

Respondents were mothers of children under two years of age. After obtaining informed consent, each respondent was asked to complete a questionnaire focusing on possible risk factors (determinants) for stunting (Fig. 2b, c). The multiple choice questionnaire was adapted from the SSGI (*Survei Status Gizi Indonesia*), 2021. Trained health workers and members of the researcher team collected all data.

Independent variables were chosen based on the preliminary study results of 40 mothers of children with stunting conducted in the study area in March 2023, included the mother's education, mother's knowledge of stunting, family income, history of mother on (frequently) ANC visits, history of mother taking iron tablets during pregnancy, history of child getting exclusive breastfeeding, and history of child getting complementary feeding.

Analysis data included univariate, bivariate, and multivariate (logistic regression) analysis. Bivariate analysis was conducted using Pearson's chi-square. Fisher's exact test was used if one or more of the values in a 2 × 2 contingency table was less than 5. Logistic regression analysis was performed to determine variables associated with stunting. Based on bivariate analyses results, all variables with *p*-values < 0,25 were selected for multivariate analysis. A *p*-value < 0.05 was considered statistically significant. Quantitative data analysis was conducted using SPSS program v.22 (IBM).

This study was approved by the Health Research Ethics Committee, Sari Mutiara Indonesia University, Medan (Number 2287F/KEP/USM/VII/2023 (dated July 31, 2023), and declared to be ethically appropriate in accordance with seven WHO 2011 standards, including social value, scientific assessment and benefits, risks, persuasion/exploitation, confidentiality and informed concern referring to the 2016 CIOMS Guidelines.

RESULTS

After obtaining informed consent, each child's mother was asked to complete a questionnaire focusing on possible risk factors for stunting in children under two years of age (Fig. 2b, c). A total of 248 respondents agreed to complete the questionnaire.

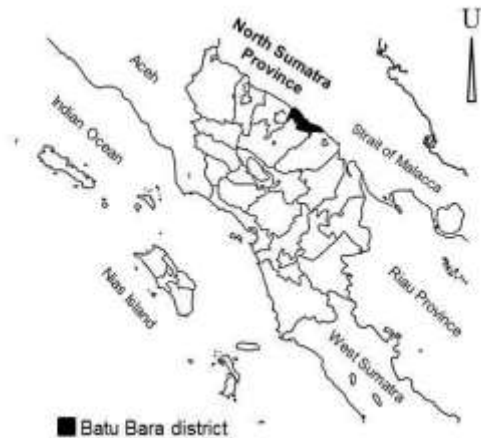


Fig. 1. Maps of North Sumatra Province showing the location of the study. North Sumatra Province consists of 25 districts and eight cities. The black square indicates the Batu Bara District.

Overall (case and control), the majority (89.9%; 223/248) of respondents had intermediate (junior and senior high schools) to low (no school or elementary school) education, 61.3% (152/248) had low knowledge of stunting (includes the definition, causes, characteristics and consequences), 66.9% (166/248) sufficient family income, 53.2% (132/248) visited ANC less than six times during pregnancy, 52.5% (130/248) took iron tablets less than 90 tablets during pregnancy, 85.2% (211/248) of the children did not get exclusive breastfeeding (up to 6 months), and 84.7% (210/248) of children did not get complementary feeding.

Table 1. Response to questionnaire administered to respondents regarding possible risk factors for stunting in the Laut Tador Health Center work area of Batu Bara District, 2023 (n=248)

Independent variable	n (%)
Mother's education	
Intermediate-low	223/248 (89.9)
High	25/248 (10.1)
Mother's knowledge of stunting	
Insufficient	152/248 (61.3)
Sufficient	96/248 (38.7)
Family income	
Insufficient	82/248 (33.1)
Sufficient	166/248 (66.9)
History of mother on ANC visits	
Inadequate	132/248 (53.2)
Adequate	116/248 (46.8)
History of mother taking iron tablets	
Insufficient	130/248 (52.5)
Sufficient	118/248 (47.5)
History of child getting exclusive breastfeeding	
Insufficient	211/248 (85.2)
Sufficient	37/248 (14.8)
History of child getting complementary feeding	
Insufficient	210/248 (84.7)
Sufficient	38/248 (15.3)

Based on bivariate analysis results, independent variables were selected that had a value of $p < 0.25$ into the multivariate model.

The final step of multivariate analysis (Table 3) showed that there were significant differences between family income ($p < 0.001$) (OR=5.98, 95%CI: 3.369 – 6.602), history of mother on ANC visits during pregnancy ($p < 0,001$) (OR=3.01, 95%CI: 4.369 – 6.602), history of a mother taking iron tablets during pregnancy ($p=0.043$) (OR=3.23, 95%CI: 2.379 – 6.512), history of children under two years getting exclusive breastfeeding ($p < 0.001$) (OR=2.45, 95%CI: 3.329 – 5.602), and history of children under two years of getting complementary feeding to complement breastfeeding between 6 months and 24 months of age ($p < 0.001$) (OR=9.77, 95%CI: 9.329 – 9.902) and stunting, respectively.

Table 2. The relationship between independent variables and stunting among children under two years of age in the Tador Laut Health Center work area of Batu Bara District, 2023

Independent variable	Dependent variable		p-value*
	Stunting n (%)	Non-stunting n (%)	
Mother's education			
Intermediate-low	112/124 (91.8)	111/124 (88.1)	0.910
High	12/124 (8.2)	13/124 (11.9)	
Mother's knowledge of stunting			
Insufficient	68/124 (54.8)	84/124 (67.7)	0.911
Sufficient	56/124 (45.2)	40/124 (32.3)	
Family income			
Insufficient	82/124 (66.1)	0/124 (0.0)	0.002
Sufficient	42/124 (33.9)	124/124 (100)	
History of mother on ANC visits			
Inadequate	77/124 (62.1)	55/124 (44.3)	0.004
Adequate	47/124 (37.9)	69/124 (55.7)	
History of mother taking iron tablets			
Insufficient	76/124 (61.2)	54/124 (43.5)	< 0.001
Sufficient	48/124 (38.8)	70/124 (56.5)	
History of child getting exclusive breastfeeding			
Insufficient	111/124 (89.5)	100/124 (80.6)	< 0.001
Sufficient	13/124 (10.5)	24/124 (19.4)	
History of child getting complementary feeding			
Insufficient	111/124 (89.5)	99/124 (79.8)	0.003
Sufficient	13/124 (10.5)	25/124 (20.2)	

The dominant variable associated with stunting among children under two years of age in the Laut Tador Health Center work area of Batu Bara District was the history of the child getting complementary feeding.

Table 3. The final stage of multivariate analysis on the relationship between independent variables and stunting among children under two years of age in the Tador Laut Health Center work area of Batu Bara District, 2023

Variable	coefficient	S.E.	DF	p-value	OR	95%CI
Family income	2.267	3.701	1	< 0.001	5.98	3.369 – 6.602
History of mother on ANC visits	-2.071	4.830	1	< 0.001	3.01	4.369 – 6.602
History of mother taking iron tablets	-0.121	0.586	1	0.043	3.23	2.379 – 6.512
History child getting exclusive breastfeeding	-1.717	1.295	1	< 0.001	2.45	3.329 – 5.602
History of child getting complementary feeding	1.840	1.295	1	< 0.001	9.77	9.329 – 9.902



Fig. 2. Images showing height measurement taken on a child (2a) and data collected using questionnaires (2b, c).

DISCUSSION

This study revealed a stunting prevalence of 36.0% (154/428) in the Laut Tador Health Center work area of Batu Bara District. The target for district-level stunting control programs in Indonesia is to decrease the prevalence of stunting to 18.4% (2022), 16.0% (2023), and 14.0% in 2024⁴⁻⁸.

The factors associated with stunting in this study area were family income, history of mother on ANC visits during pregnancy, history of mother taking iron tablets during pregnancy, history of children under two years getting exclusive breastfeeding, and history of children under two years of getting complementary feeding.

Family income

A study by Zhang et al, showed that household social and economic factors, including household income per capita and

maternal education, were significant predictors of stunting in children under five. Household income appeared to decrease the odds of undernutrition among children in a graded fashion (95% CI: 0.59 - 0.90)¹². The economic situation is one of the contextual causes of stunting¹³, and there was an association between stunting prevalence and income per capita in a country²². Children from poor households are at higher risk of stunting. There was an association between family wealth and stunting. Low-income families related to limited resources consuming high-quality nutritional foods and access to healthcare facilities^{14-15,18,20,22,28}.

History of mother on ANC visits during pregnancy

The frequency of pregnant women visiting ANC had a significant relationship with stunting in children under five years of age ($p=0.04$) because pregnant women can get health information on improving their health status and children during ANC. The information also related to breastfeeding and child-feeding practices²³⁻²⁴.

History of mother taking iron tablets during pregnancy

The risk of stunting in children 6-24 months of age increased in mothers who did not receive iron supplementation than of mothers who received iron supplementation during pregnancy (OR=3.889; 95%CI: 1.071-14.126) (Sari K. & Sartika RAD., 2023).

History of children under two years getting exclusive breastfeeding

Optimal breastfeeding prevents more than 823 thousand child deaths and 20 thousand maternal deaths yearly. Children who do not receive exclusive breastfeeding have a 2.6 times higher risk of stunting at 0-6 months and twice at the age of 6 to 23 months. However, in the last three years (from 2018 to 2020), the percentage of exclusively breastfeeding decreased from 68.7% in 2018 to 53.9% in 2020⁴⁻⁸.

History of children under two years of getting complementary feeding

In Indonesia, stunting increased during the complementary feeding period from 22% at 6 months of age to 38% at 24 months of age. Complementary feeding refers to the introduction of solid or semi-solid foods to

complement breastfeeding and take place between 6 months and 24 months of age⁹⁻¹⁰.

On the other hand, we assumed those significant factors in this study were also likely due to the contributions of COVID-19 pandemic since all mothers and children were pregnant and born during the pandemic. Since COVID-19 was declared a global pandemic in March 2020, social lives have been upended, and economic activities disrupted around the world, including in Indonesia²⁵. The Ministry of Health-UNICEF Rapid Survey 2020 results revealed a decline in essential health services at the start of the COVID-19 pandemic. More than 75% of Posyandu need to provide services, and more than 41% of home visits have stopped. Most health centres reported that less than 10% of their services had been disrupted. However, to confirm our assumption, further study is needed.

Maternal and child health challenges (the mortality and morbidity of mothers, newborns, infants, and toddlers) are closely related to nutritional problems. Therefore, the Indonesian government's strategy includes improving maternal, child and reproductive health, accelerating improvements of community nutrition to prevent and control nutritional problems, and accelerating stunting reduction by increasing the effectiveness of local area-specific and integrated interventions⁹⁻¹⁰.

In Batu Bara District, the local government has implemented complementary feeding (MP-ASI) activities and the local food menu for children under five years has been formulated by a nutritionist (Tenaga Gizi Pendamping) and Indonesian Nutrition Association²⁷.

In 2022, the head of the Batu Bara District provided regulation on convergence priority villages for integrated stunting reduction. Forty-one villages are included based on the distribution of stunting in children under five. This regulation is one of the local government's efforts to reduce the stunting in Batu Bara District²⁷.

CONCLUSION

The determinants of stunting in the Laut Tador Health Center work area in 2023 were family income, history of mother on ANC visits during pregnancy, history of mother taking iron tablets during pregnancy, history of children under two years getting exclusive breastfeeding,

and history of children under two years of getting complementary feeding. The dominant variable associated with stunting was the history of the child getting complementary feeding. Those significant factors were also likely due to the contributions of the COVID-19 pandemic. However, to confirm our assumption, further study is needed.

The Recommendation is that the commitment of multiple sectors is necessary to implement the Regulation on Convergence Priority Villages for Integrated Stunting Reduction that the head of Batu Bara District declared in 2022, particularly in complementary feeding programs for children under two years of age. In addition, the role of health posts (Posyandu) and village cadres should be improved to provide information about antenatal care, taking iron tablets during pregnancy, exclusive breastfeeding, and complementary feeding to pregnant women, including monitoring children's growth.

ACKNOWLEDGMENTS

We sincerely thank to Jojor Delima Siregar (Batu Bara District Health Office).

CONFLICTS OF INTEREST

The authors report no conflict of interest.

REFERENCE

1. World Health Organization. Global nutrition targets 2025: stunting policy brief. World Health Organization; 2023. <https://www.who.int/publications/i/item/WHO-NMH-NHD-14.3>
2. World Health Organization. The burden of malnutrition at a glance. World Health Organization; 2018 <https://globalnutritionreport.org/resources/nutrition-profiles/africa/>
3. World Health Organization. What is childhood stunting?. World Health Organization; 2022. <https://ourworldindata.org/stunting-definition>
4. MHRI-Riskesdas (Ministry of Health Republic of Indonesia). Basic Health Research Year 2018. Jakarta: Balitbangkes; 2018.
5. MHRI (Ministry of Health Republic of Indonesia). Survei Status Gizi Indonesia (Indonesian Nutrition Status Survey) 2021. Ministry of Health Republic of Indonesia; 2021.

6. MHRI (Ministry of Health Republic of Indonesia). Regulation of Minister of Health Republic of Indonesia Number 13 Year 2022 on Amendments to Health Minister Regulation Number 21 of 2020 Concerning the Strategic Plan of the Ministry of Health for 2020-2024 (in Indonesia). Ministry of Health Republic of Indonesia; 2022a.
7. MHRI (Ministry of Health Republic of Indonesia). Survei Status Gizi Indonesia (Indonesian Nutrition Status Survey) 2022. Ministry of Health Republic of Indonesia; 2022b.
8. MHRI (Ministry of Health Republic of Indonesia). Prevent stunting with ABCDE Ministry of Health Republic of Indonesia; 2023. <https://ayosehat.kemkes.go.id/cegah-stunting-dengan-abcde>
9. UNICEF (United Nations Children's Fund). *Indonesia Complment Feeding*. United Nations Children's Fund; 2019. <https://www.unicef.org/indonesia/media/2706/file/Framework-of-Action-Complementary-Feeding-2019.pdf>
10. UNICEF (United Nations Children's Fund). Stop Stunting Regional Conference 2014. United Nations Children's Fund; 2014. <https://www.unicef.org/rosa/stop-stunting-regional-conference-2014>.
11. BP-SSGBI [Badan Pusat Statistik (Central Bureau of Statistics)]. Survei Status Gizi Balita Indonesia (Indonesian Toddler Nutrition Status Survey). Badan Pusat Statistik; 2019.
12. Zhang N, Bécaries L, Chandola T. Patterns and determinants of double-burden of malnutrition among rural children: evidence from China. *PLOS ONE*. 2016;11:1--20, <http://dx.doi.org/10.1371/journal.pone.0158119>.
13. Randani, AI, Yayuk Farida Baliwati*, Dadang Sukandar, Ikeu Tanziha. Economic and Consumption Variables and Their Associations with stunting prevalence: A provincial analysis of the Indonesian Child Nutritional Status Survey 2019 J. Gizi Pangan, March 2022, 17(1):57-66
14. Fenta HM, Workie DL, Zike DT, Taye BW, Swain PK. Determinants of stunting among under-five years children in Ethiopia from the 2016 Ethiopia demographic and health survey: Application of ordinal logistic regression model using complex sampling designs. *Clin Epidemiol Glob Health*, 2020; 8(2):404–413. <https://doi.org/10.1016/j.cegh.2019.09.011>
15. Beal T, Tumilowicz A, Sutrisna A, Izwardy D, Neufeld LM. A review of child stunting determinants in Indonesia. Vol. 14, *Maternal and Child Nutrition*. Blackwell Publishing Ltd; 2018. <https://doi.org/10.1111/mcn.12617> PMID: 29770565
16. Semba RD, de Pee S, Sun K, Sari M, Akhter N, Bloem MW. Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. *The Lancet*. 2008 Jan 26; 371(9609):322–8. [https://doi.org/10.1016/S01406736\(08\)60169-5](https://doi.org/10.1016/S01406736(08)60169-5) PMID: 18294999
17. Bardosono S, Sastroamidjojo S, Lukito W. Determinants of child malnutrition during the 1999 economic crisis in selected poor areas of Indonesia. *Asia Pacific Journal of Clinical Nutrition*. 2007; 16(3):512–26. PMID: 17704034
18. Fernald LCH, Kariger P, Hidrobo M, Gertler PJ. Socioeconomic gradients in child development in very young children: Evidence from India, Indonesia, Peru, and Senegal. *Proceedings of the National Academy of Sciences*. 2012 Oct 16; 109(Supplement_2)
19. Mani S. Socioeconomic determinants of child health: Empirical evidence from Indonesia. *Asian Economic Journal*. 2014 Mar; 28(1):81–104.
20. Mulyaningsih T, Mohanty I, Widyarningsih V, Gebremedhin TA, Miranti R, Wiyono VH. Beyond personal factors: Multilevel determinants of childhood stunting in Indonesia *PLOS ONE*. 2021 <https://doi.org/10.1371/journal.pone.0260265>
21. Torlesse H, Cronin AA, Sebayang SK, Nandy R. Determinants of stunting in Indonesian children: Evidence from a cross-sectional survey indicate a prominent role for the water, sanitation and hygiene sector in stunting reduction.

- BMC Public Health. 2016 Jul 29; 16(1).
<https://doi.org/10.1186/s12889-016-3339-8>, PMID: 27472935
22. Al-Ateeq MA, Al-Rusaies AA. Health education during antenatal care: The need for more. *Int J Womens Health*. 2015;7:239–42.; Abeway S, Gebremichael B, Murugan R, Assefa M, Adinew YM. Stunting and its determinants among children aged 6-59 Months in Northern Ethiopia: A cross-sectional study. *J Nutr Metab*. 2018;2018.
 23. Rahayu HK, Kandarina BJI, Wahab A. Antenatal care visit frequency of short stature mother as risk factor of stunting among children aged 6 - 23 months in Indonesia (IFLS 5 Study Analysis) *Indonesian Journal of Nutrition and Dietetics*, 2019;7(3),107-113. [http://dx.doi.org/10.21927/ijnd.2019.7\(3\).107-113](http://dx.doi.org/10.21927/ijnd.2019.7(3).107-113).
 24. Sari K and Sartika RAD. The Impact of iron supplementation during pregnancy and change of consumption among stunting children aged 6-24 months during the COVID-19 pandemic in Indonesia. *Int J Prev Med*. 2023; 14 (18): 1 – 7.
 25. Wandra, T. (2020). Emerging zoonoses in Indonesia: implication for the future. *Universa Medicina*, 39(3), 151–152.
<https://doi.org/10.18051/UnivMed.2020.v39.151-152>
 26. Batu Bara District Government, 2022. Regulation on Convergence Priority Villages for Integrated Stunting Reduction in Batu Bara district, North Sumatra (in Indonesia).
 27. Beal T, Tumilowicz A, Sutrisna A, Izwardy D, Neufeld LM. A review of child stunting determinants in Indonesia. Vol. 14, *Maternal and Child Nutrition*. Blackwell Publishing Ltd; 2018. <https://doi.org/10.1111/mcn.12617> PMID: 29770565
 28. Dewey KG, Begum K. Long-term consequences of stunting in early life. *Matern Child Nutr*. 2011; 7:5–18
 29. Soliman A, Sanctis VD, Alaaraj A, Ahmed S, Alyafei F, Hamed N, Soliman N. Early and Long-term consequences of nutritional stunting: From childhood to adulthood. *Acta Biomed* 2021; 92, N.

1: e2021168
<https://doi.org/10.23750/abm.v92i1.113>
 46

The Influence of Selenium on Telomere Length and DNA Damage as Indicators of Age-Related Changes: A Systematic Literature Review

Bohari^{1,2*}, Fatimah Fitriani Mujahidah^{1,3}, Erna Susilowati^{1,4}, Marhamah^{1,5}, Rimbawan¹

¹ Department of Community Nutrition, IPB University, Bogor, Indonesia

² Department of Nutrition, Universitas Sultan Ageng Tirtayasa, Serang, Indonesia

³ Department of Nutrition, Universitas Megarezky, Makassar, Indonesia

⁴ Department of Nursing, Akademi Keperawatan Dharma Husada Kediri, Kediri, Indonesia

⁵ Department of Food Technology, Universitas Terbuka, Medan, Indonesia

(Correspondence author's email: bohari@untirta.ac.id)

ABSTRACT

The study aimed to analyze the relationship of selenium to telomere length and DNA damage that reflect aging-related changes at the genome and cellular level. This study used the Systematic Literature Review method to summarize evidence regarding the potential of selenium as an anti-aging agent. It was conducted in April and May 2023. The initial stage was to identify research questions consisting of PICO (Population, Intervention, Comparator, and Outcome). The population involved adults and intervened with selenium, did not use a comparator, and used non-epigenetic biomarker outcomes, namely telomere length and DNA damage which reflect aging-related changes at the genome and cellular level. The reviews were obtained from various countries, including Sweden, France, the United States, Australia, and Brazil. The research subjects used were also diverse and at wide intervals, ranging from young people (20-30 years) to adults (> 70 years). A total of 4 of the 7 studies used a cross-sectional study scheme, 1 case-control, and 2 used an experimental design. Adequate selenium intake can potentially affect telomere length and telomere length maintenance. However, the relationship between selenium and telomere length can be affected by other factors, such as the individual's age and health conditions. Selenium intake may be an important factor in maintaining telomere length and preventing age-related diseases. Selenium supplementation may be beneficial for people with low selenium levels or who are at risk of age-related diseases. Further research is needed to confirm the findings of this study and to determine the optimal dose of selenium for maintaining telomere length.

Keywords : *Selenium, Telomere Length, DNA Damage, Aging*

<https://doi.org/10.33860/jik.v17i2.2269>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

The aging process is an inevitable natural phenomenon. With increasing age, significant physiological changes occur in the human body, which decreases the quality of life and physical function¹. Aging increases the risk of chronic diseases such as heart disease, diabetes, cancer, neurodegenerative disorders, and cognitive problems².

Research on aging and its role in disease development is an exciting and relevant topic in nutrition and health sciences. One of the

interesting ingredients to study is selenium, an essential mineral that is found in various foods and is also widely developed as a supplement. Selenium has an important role in antioxidant selenoproteins for protection against oxidative stress initiated by excess reactive oxygen species (ROS) and reactive nitrogen species (NOS)³. Selenium has also been linked to a variety of potential anti-aging effects, including protection against oxidative damage⁴, immune system enhancement⁵, and regulation of important cellular functions⁶.

Previously, a review of articles

reviewing research developments and the role of selenium in aging and aging-related diseases was carried out in 2018 with the conclusion that the effects of selenium on human aging and aging-related diseases are still controversial ⁷. The determination and use of biomarkers to assess aging also vary, such as routine laboratory tests, epigenetic, non-epigenetic, also the physical ability and organ function, as well as senescence biomarkers (to assess changes in gene expression, enzyme activity, modifications to proteins, or increases in molecules production associated with oxidative stress and cellular damage) ⁸. Based on previous studies' results, non-epigenetic biomarkers are the most frequently used biomarkers, including telomere length, amount of DNA damage, and mitochondrial dysfunction, which can describe aging-related changes at the genome and cellular level⁸. Aging is characterized by telomere shortening caused by oxidative stress (OxS); other factors, such as lifestyle, can also cause damage to biomolecules, apoptosis, or cell aging, which is characterized by the emergence of age-related diseases, one of which is Metabolic Syndrome (MetS) ⁹.

Previous studies have shown that selenium has potential anti-aging effects, but the findings have been inconsistent. Some studies have found that selenium supplementation can increase telomere length and reduce DNA damage, while other studies have found no effect. This study aims to systematically review the literature on the relationship between selenium and telomere length and DNA damage. The goal is to clarify the role of selenium in aging and to identify the factors that may influence the effectiveness of selenium supplementation.

METHOD

This study used the Systematic Literature Review method to summarize evidence regarding selenium's potential as an anti-aging agent, conducted in April and May 2023. In the early stages of the study, research questions were identified consisting of PICO (Population, Intervention, Comparator, and Outcome). The population was adults with selenium intervention, did not use a comparator, and the outcome used non-epigenetic biomarkers, namely telomere length and DNA damage which reflect aging-related changes at the genome and cellular level.

To obtain the data results according to this stage, it began with a data search on the websites:

<https://www.scopus.com/>,
<https://www.mdpi.com/>,
<https://pubmed.ncbi.nlm.nih.gov/>,
<https://www.sciencedirect.com/>,
<https://www.nature.com/>,
<https://www.hindawi.com/journals/>.

The keywords included "Selenium and telomere length and aging" and "Selenium and DNA damage and aging". The article inclusion criteria, such as the result of research published in 2018 – 2023, in English, the population was human, selenium intervention, and the outcome was telomere length and DNA damage associated with aging.

Followed by data screening to filter and select the appropriate data based on the journal abstracts obtained and ended with an assessment of data quality using the website <https://rayyan.ai/>. The quality of the data was measured by the clarity of the research article methodology, which can provide a good chronological aspect starting from the selection of materials and study results that were in accordance with this article. The next step was to develop a protocol using Meta-analysis (PRISMA/Preferred Reporting Hans for Systematic Reviews and Meta-analysis) ¹⁰. The data extraction process included full-text articles and summarized information by systematic review (Figure 1).

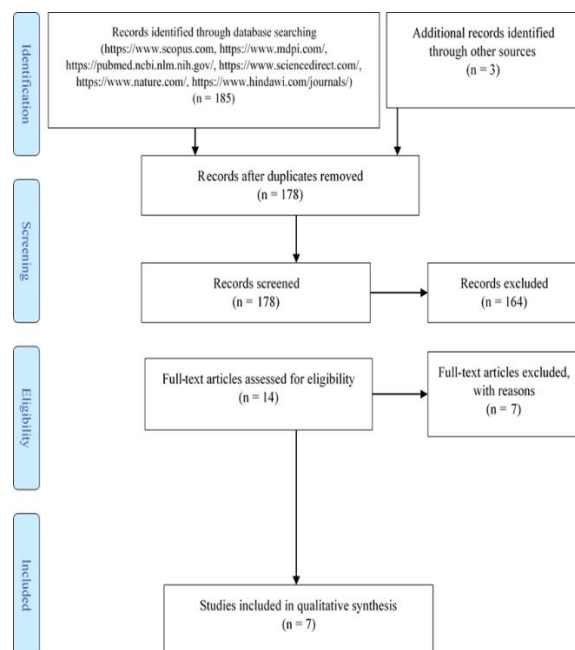


Figure 1. PRISMA Flow Diagram.

RESULTS

This review was obtained from various countries, including Sweden, France, the United States, Australia, and Brazil. The research subjects used were also diverse and at wide intervals, ranging from young people (20-30 years) to older people (> 70 years). A total of 4

of the 7 studies used a cross-sectional study scheme, 1 case-control, and 2 used an experimental design. The main variables observed were telomere length and DNA damage (Table 1).

Table 1. Tabulation of Data Extraction

No	Source	Country	Selenium	Research Subject	Research Design	Main Variabel	Main Finding
1	Opstad et al. 2022 ¹¹	Sweden	Supplements	Selenium-deficient Swedish elderly people aged over 70 years.	Randomized, double-blind, placebo-controlled clinical trial.	Telomere length	Supplementation with a combination of selenium and coenzyme Q10 for 42 months prevented telomere length reduction in an elderly population in Sweden that is deficient in selenium.
2	Favrot et al. 2018 ¹²	French	Supplements	Young age (20 – 30 y.o) Old age (60 -70 y.o)	Experimental	DNA Damage	<ul style="list-style-type: none"> • Low doses of selenium (30 nM) were effective in protecting keratinocytes in young individuals from damage from UVA exposure, • Higher doses (240 nM) were required to protect keratinocytes.
3	Shu et al. 2020 ¹³	United States	Food intake	Middle-aged and elderly people	Cross-sectional	Telomere length	<ul style="list-style-type: none"> • Increased dietary intake of selenium linked to longer telomeres in adults and elderly Americans. • Every 20 µg increase in dietary intake of selenium was associated with an increase in telomere length of 0.42%. • Dietary intake of selenium might play a role in telomere length maintenance.
4	Dhillon, Deo, and Fenech 2023 ¹⁴	Australia	Selenium level	The 2 groups were prostate cancer patients and	Case-control	DNA Damage	<ul style="list-style-type: none"> • Increased DNA damage could be caused by low levels of lycopene and selenium

				healthy people			<ul style="list-style-type: none"> Eating foods rich in lycopene and selenium could help reduce the risk of developing prostate cancer and DNA damage caused by ionizing radiation and/or oxidative stress.
5	de Lima-Reis et al. 2022 ¹⁵	Brazil	Food	Subjects were men and women between the ages of 20 and 59 y.o	Cross-sectional	DNA damage	<ul style="list-style-type: none"> Oxidative damage to DNA in individuals at cardiovascular risk was influenced by serum levels of vitamin A, selenium, and DTAC independently of other factors [F(6,110)=8,213; P<0.001; R2=0.330]. Nutritional factors such as total antioxidant capacity in food, vitamin A, and selenium might protect against oxidative damage to DNA in these individuals.
6	Liu et al. 2019 ¹⁶	United States	Food	Adults aged 20 years or older who participated in the National Health and Nutrition Examination Survey (NHANES) 1999-2002.	Cross-sectional	Telomere length	<ul style="list-style-type: none"> No significant association was found between dietary intake of selenium and telomere length in adults in the United States. There was a significant interaction with age (P = 0.02). In individuals aged 20–44 years, the β-coefficient of telomere length log, compared to the group with the lowest intake of dietary selenium, was -0.041 (SE 0.012, P = 0.002) and -0.033 (SE 0.018,

							<p>P = 0.07) for the middle group and the highest intake of selenium, respectively.</p> <ul style="list-style-type: none"> The relationship between dietary selenium intake and telomere length differed significantly by age group, suggesting that higher selenium intake may prevent telomere shortening in older adults but not in younger or middle-aged adults.
7	Gong et al. 2023 ¹⁷	United States	Food intake	Age ≥45 y.o and ≤45 y.o	Cross-sectional	Telomere length	<ul style="list-style-type: none"> Low (< 50 µg/day) and high (> 250 µg/day) selenium intake did not significantly associate with telomere length in diabetic patients. Selenium intake in the 0-250 µg/day range was associated with increased telomere length in diabetic patients, especially in the female population.

Selenium, Telomere Length, Aging

Telomere length is related to the aging process. Telomeres are protective structures at the ends of chromosomes that shorten each time somatic cells (body cells) replicate¹⁸. Short telomeres indicate that the cell has lost its ability to replicate¹⁹. As a result, cells enter the senescence (aging) stage or experience cell death. Telomere shortening indicates cell aging and can affect cell function and integrity²⁰. Telomere length decreases proportionally with age in humans, and fetal cells or tissues have longer telomeres than adult somatic cells²¹. In addition, telomere shortening is also associated with the risk of chronic age-related diseases, such as heart disease, diabetes, cancer, and neurodegenerative conditions²². Telomere shortening can accelerate the cellular aging

process²³, increases cell susceptibility to damage and stress²⁴, and interfere with normal cell function²⁵.

Telomere shortening can be inhibited by lifestyle modifications such as diet and physical activity with the potential to reduce the rate of telomere shortening or at least prevent excessive telomere reduction. An antioxidant-rich diet has been linked to longer telomeres. Antioxidants play an important role because they can slow down the aging process and prevent diseases caused by oxidative stress; besides, various nutrients such as vitamins B12, A, C, and E, selenium, zinc, magnesium, and PUFAs have been linked to DNA protection (telomere integrity). Subjects who followed a diet with higher intakes of fruits, vegetables, nuts, fish, poultry, and whole grains reported

lower markers of inflammation, oxidative stress, and longer telomeres²⁶.

One of the diet choices to inhibit the rate of telomere shortening is selenium intake. Several studies show a link between selenium and telomere length, namely: 1) Seleme supplementation research in an elderly population in Sweden shows that supplementation with a combination of selenium and coenzyme Q10 for 42 months prevents a decrease in telomere length in a population that is deficient in selenium¹¹. Dietary intake of selenium in adults and the elderly in America found that increased intake of selenium in the diet is associated with longer telomeres, and this study also suggests that adequate dietary intake of selenium may contribute to the maintenance of telomere length¹⁶. Additionally, other studies have shown that higher selenium intake appears to be more associated with telomere length maintenance in older adults but not in younger or middle-aged adults¹⁷. However, low (< 50 µg/day) and high (> 250 µg/day) selenium intake did not have a significant association with telomere length in diabetic patients¹⁷. Later, other studies have shown that proper selenium levels in the body can help reduce the risk of inflammation and improve adult survival²⁷. The average dietary intake of selenium in the United States ranges from 93 micrograms in women to 134 micrograms in men, compared to only 40 micrograms per day in Europe (the recommended daily amount for adults in the United States is 55 micrograms per day)²⁸.

Thus, telomere shortening is linked to cellular senescence and the risk of age-related diseases. Lifestyle modifications, including adequate selenium intake, can affect telomere length and maintenance. However, the relationship between selenium and telomere length can be affected by other factors, such as the individual's age and health conditions.

Selenium, DNA Damage, Aging

DNA damage is one factor contributing to the aging process, both natural aging and/or aging influenced by external factors. DNA damage can cause mitochondrial dysfunction, impaired autophagy, altered metabolism, and trigger cell aging²⁹. One mechanism related to DNA damage with aging is oxidative stress. Oxidative stress occurs when the balance between free radical production and the ability of cells to fight free radicals is disturbed. In aging, the body's antioxidant system tends to decrease so that the level of free radicals that damage DNA increases.

Figure 2 shows that selenium is required for the synthesis of selenoproteins, which are included in the cellular antioxidant system. Selenoprotein acts as an antioxidant enzyme that can inhibit the production of free radicals, thereby helping to protect cells from oxidative damage caused by free radicals. Adequate selenoprotein levels, selenium can help reduce the level of free radicals in cells, thereby reducing the risk of DNA damage caused by free radicals³⁰. Thus, selenium acts as a nutrient that protects DNA from oxidative damage.

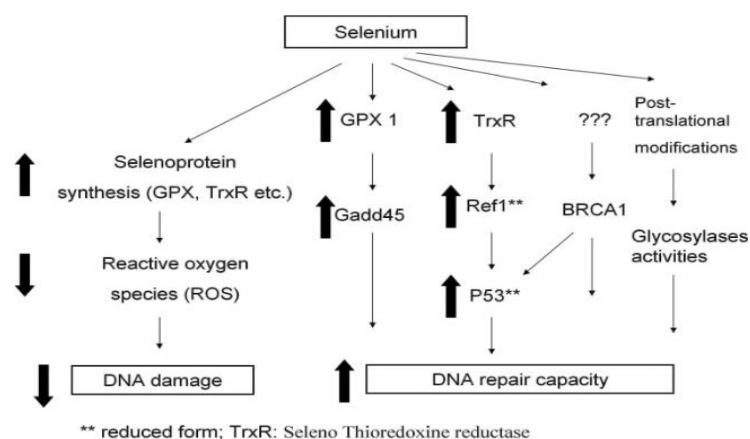


Figure 2. Mechanisms of selenium in DNA damage repair³⁰

The results showed that low doses of selenium (30 nM) were effective in protecting young keratinocytes from UVA damage,

whereas higher doses (240 nM) were needed to protect aged keratinocytes¹². Selenium supplementation is a strategy to fight aging and

signs of aging on the skin by protecting skin cells from DNA damage. Then, a deficiency of selenium and lycopene (carotenoids in tomatoes) can exacerbate DNA damage and increase the risk of prostate cancer¹⁴. In addition, there is a relationship between selenium levels in the body and the level of DNA damage caused by oxidative stress in individuals with different cardiovascular risks¹⁵.

CONCLUSION

Adequate selenium intake can potentially affect telomere length and telomere length maintenance. However, the relationship between selenium and telomere length can be affected by other factors, such as the individual's age and health conditions. Then, intake of selenium through food or supplementation is one effort to protect DNA from oxidative damage, slow the aging process, and reduce the risk of related diseases.

Selenium intake may be an important factor in maintaining telomere length and preventing age-related diseases. Selenium supplementation may be beneficial for people with low selenium levels or who are at risk of age-related diseases. Further research is needed to confirm the findings of this study and to determine the optimal dose of selenium for maintaining telomere length.

REFERENCE

1. Amarya S, Singh K, Sabharwal M. Ageing Process and Physiological Changes. In: Gerontology [Internet]. IntechOpen; 2018 [cited 2023 May 18]. Available from: <https://www.intechopen.com/chapters/60564>
2. Franceschi C, Garagnani P, Morsiani C, Conte M, Santoro A, Grignolio A, et al. The Continuum of Aging and Age-Related Diseases: Common Mechanisms but Different Rates. *Front Med (Lausanne)*. 2018 Mar 12;5:61.
3. Tinggi U. Selenium: its role as antioxidant in human health. *Environ Health Prev Med*. 2008 Mar;13(2):102–8.
4. Ruggeri RM, D'Ascola A, Vicchio TM, Campo S, Gianì F, Giovinazzo S, et al. Selenium exerts protective effects against oxidative stress and cell damage in human thyrocytes and fibroblasts. *Endocrine*. 2020 Apr;68(1):151–62.
5. Huang Z, Rose AH, Hoffmann PR. The Role of Selenium in Inflammation and Immunity: From Molecular Mechanisms to Therapeutic Opportunities. *Antioxid Redox Signal*. 2012 Apr 1;16(7):705–43.
6. McKenzie RC, Arthur JR, Beckett GJ. Selenium and the regulation of cell signaling, growth, and survival: molecular and mechanistic aspects. *Antioxid Redox Signal*. 2002 Apr;4(2):339–51.
7. Cai Z, Zhang J, Li H. Selenium, aging and aging-related diseases. *Aging Clin Exp Res*. 2019 Aug 1;31(8):1035–47.
8. Hartmann A, Hartmann C, Secci R, Hermann A, Fuellen G, Walter M. Ranking Biomarkers of Aging by Citation Profiling and Effort Scoring. *Frontiers in Genetics* [Internet]. 2021 [cited 2023 May 18];12. Available from: <https://www.frontiersin.org/articles/10.3389/fgene.2021.686320>
9. Gavia-García G, Rosado-Pérez J, Arista-Ugalde TL, Aguiñiga-Sánchez I, Santiago-Osorio E, Mendoza-Núñez VM. Telomere Length and Oxidative Stress and Its Relation with Metabolic Syndrome Components in the Aging. *Biology*. 2021 Apr;10(4):253.
10. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009 Jul 21;6(7):e1000097.
11. Opstad TB, Alexander J, Aaseth JO, Larsson A, Seljeflot I, Alehagen U. Selenium and Coenzyme Q10 Intervention Prevents Telomere Attrition, with Association to Reduced Cardiovascular Mortality—Sub-Study of a Randomized Clinical Trial. *Nutrients*. 2022 Jan;14(16):3346.
12. Favrot C, Beal D, Blouin E, Leccia MT, Roussel AM, Rachidi W. Age-Dependent Protective Effect of Selenium against UVA Irradiation in Primary Human Keratinocytes and the Associated DNA Repair Signature. *Oxidative Medicine and Cellular*

- Longevity. 2018;2018:1–9.
13. Shu Y, Wu M, Yang S, Wang Y, Li H. Association of dietary selenium intake with telomere length in middle-aged and older adults. *Clinical Nutrition*. 2020 Oct;39(10):3086–91.
 14. Dhillon VS, Deo P, Fenech M. Effect of Selenium and Lycopene on Radiation Sensitivity in Prostate Cancer Patients Relative to Controls. *Cancers (Basel)*. 2023 Feb 3;15(3):979.
 15. de Lima-Reis SR, Silva TA, Costa LSA, Volp ACP, Rios-Santos F, Reis ÉM, et al. Serum levels of vitamin A, selenium, and better dietary total antioxidant capacity are related to lower oxidative DNA damage: A cross-sectional study of individuals at cardiovascular risk. *The Journal of Nutritional Biochemistry*. 2022 Sep 1;107:109070.
 16. Liu B, Sun Y, Xu G, Rong S, Bao W. Association Between Dietary Selenium Intake and Leukocyte Telomere Length in a Nationally Representative Sample of US Adults (OR11-06-19). *Current Developments in Nutrition*. 2019 Jun 1;3:nzz044.OR11-06-19.
 17. Gong H, Yu Q, Guo D, Wang Y, Duan L, Huang W, et al. The relationship between dietary selenium intake and telomere length among diabetes. *British Journal of Nutrition*. 2023 Feb;129(4):610–6.
 18. Shammas MA. Telomeres, lifestyle, cancer, and aging. *Curr Opin Clin Nutr Metab Care*. 2011 Jan;14(1):28–34.
 19. Maestroni L, Matmati S, Coulon S. Solving the Telomere Replication Problem. *Genes (Basel)*. 2017 Jan 31;8(2):55.
 20. Ridout KK, Ridout SJ, Goonan K, Tyrka AR, Price LH. Chapter 18 - Telomeres and Early Life Stress. In: Fink G, editor. *Stress: Neuroendocrinology and Neurobiology* [Internet]. San Diego: Academic Press; 2017 [cited 2023 May 22]. p. 185–93. Available from: <https://www.sciencedirect.com/science/article/pii/B9780128021750000188>
 21. Purwaningsih E. Telomer, Aging Dan Karsinogenesis. *YARSI medical Journal*. 2010 Aug;18(2):137–43.
 22. Rossiello F, Jurk D, Passos JF, d’Adda di Fagagna F. Telomere dysfunction in ageing and age-related diseases. *Nat Cell Biol*. 2022 Feb;24(2):135–47.
 23. Lin J, Epel E. Stress and telomere shortening: Insights from cellular mechanisms. *Ageing Res Rev*. 2022 Jan;73:101507.
 24. Barnes RP, Fouquierel E, Opreško PL. The impact of oxidative DNA damage and stress on telomere homeostasis. *Mech Ageing Dev*. 2019 Jan;177:37–45.
 25. Ruiz A, Flores-Gonzalez J, Buendia-Roldan I, Chavez-Galan L. Telomere Shortening and Its Association with Cell Dysfunction in Lung Diseases. *Int J Mol Sci*. 2021 Dec 31;23(1):425.
 26. Ojeda-Rodriguez A, Morell-Azanza L, Alonso-Pedrero L, Del Moral AM. Aging, Telomere Integrity, and Antioxidant Food. In: *Obesity* [Internet]. Elsevier; 2018 [cited 2023 May 29]. p. 241–61. Available from: <https://linkinghub.elsevier.com/retrieve/pii/B978012812504500012X>
 27. Giovannini S, Onder G, Lattanzio F, Bustacchini S, di Stefano G, Moresi R, et al. Selenium Concentrations and Mortality Among Community-Dwelling Older Adults: Results from the SIRENTE Study. *J Nutr Health Aging*. 2018 May 1;22(5):608–12.
 28. Daniells S. Higher dietary selenium intakes linked to younger ‘biological age’: Telomere study [Internet]. *nutraingredients-usa.com*. 2022 [cited 2023 May 29]. Available from: <https://www.nutraingredients-usa.com/Article/2022/06/27/higher-dietary-selenium-intakes-linked-to-younger-biological-age-telomere-study>
 29. Yousefzadeh M, Henspita C, Vyas R, Soto-Palma C, Robbins P, Niedernhofer L. DNA damage—how and why we age? Simon M, Tyler JK, editors. *eLife*. 2021 Jan 29;10:e62852.
 30. Bera S, Rosa VD, Rachidi W, Diamond AM. Does a role for selenium in DNA damage repair explain apparent controversies in its use in chemoprevention? *Mutagenesis*. 2013 Mar;28(2):127–34.

Article Review

The Prone Position Improves the Oxygenation Status of Patients with COVID-19
(Systematic Review-Meta Analysis)

Rohmat Rohwandi¹, Hotma Rumahorbo^{2*}, Linlin Lindayani³, Susilawati⁴, Asep Badrujamaludin⁴

¹ RSUD Jampangkulon, Sukabumi, West Java, Indonesia

² Politeknik Kesehatan Kementerian Kesehatan Bandung, Bandung, West Java, Indonesia

³ Sekolah Tinggi Ilmu Keperawatan PPNI Bandung, Bandung, West Java, Indonesia

⁴ Universitas Jenderal Achmad Yani, Bandung, West Java, Indonesia

(Correspondence author's email: hotma_rumahorbo@yahoo.com)

ABSTRACT

Hypoxemia in Corona Virus 19 patients requires supportive and rehabilitative treatment. PP is a technique that is considered to be safe for improving patient oxygenation. This review aimed to determine a cumulative effect of PP on oxygenation status in COVID-19 patients. The method used The search was carried out independently and systematically on the ProQuest, PubMed, Science Direct, Google Scholar and Semantic Scholar databases from January 2020, until June 2022. Article screening was carried out through 3 stages: screening duplicate articles, titles and abstracts, and full-text screening by the expected criteria with preferred Items for PRISMA Standards. The quality assessment of the article uses the Joanna Briggs Institute (JBI) checklist form and the Review Manager software. The results A total of 323 articles were evaluated using an RCT or Quasi Experiment design with a control group. It was found that PP had an influence on changes in the value of the ROX index, PaO₂/ FiO₂ Ratio, SPO₂, and SaO₂ / FiO₂ Ratio with p-value 0.05. Qualitatively, several positive results were obtained from the synthesis of each research. PP was assessed using a ventilation-perfusion matching mechanism in increasing oxygenation and preventing lung injuries. It is concluded that PP was considered safe even though it caused side effects but it could still be done with good monitoring from health providers.

Keywords : Covid 19, Prone Position, Systematic Review, Meta-Analysis

<https://doi.org/10.33860/jik.v17i2.2294>



© 2023 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).

INTRODUCTION

The Corona Virus 19 pandemic that began in 2020 is a global problem. The WHO reported 425 million Corona Virus 19 cases and 5.89 million fatalities by February 2022¹. The Indonesian Ministry of Health reported 5.2 million confirmed cases and 146 thousand deaths until February 2022. Corona Virus 19 symptoms range from asymptomatic to mild discomfort without viral pneumonia or hypoxia². According to the CDC, Corona Virus 19 patients may experience loss of smell and taste (Anosmia), rapid decreases in oxygen saturation without shortness of breath, or

"happy hypoxia"³. Given the unique nature of this problem, the appropriate response from management must be quick and precise. The severity of the disease or the patient's clinical condition is used to determine how the disease should be managed. Patients with mild symptoms can live on their own with the help of some supportive treatments. Patients who have moderate to severe symptoms should be hospitalized and well-monitored¹. However, the patient's oxygenation situation worsens due to the extremely high rate of therapy failure^{4,5}.

COVID-19 with hypoxaemia require supportive and rehabilitative therapy to reduce the severity of their symptoms and the risk of

death. Rehabilitative supportive treatment for Corona Virus 19 individuals with severe symptoms involves posture management, breathing exercises, and Neuromuscular Electrical Stimulation (NMES), including Prone NMES. Positioning oxygen-boosting treatment⁶. Prone position (PP) has been the subject of numerous studies to see whether it improves the oxygenation levels in COVID-19. This is a constraint due to the fact that the measurement will be affected by the variety of study methods.

A study revealed a significant increase in oxygen saturation during days 1-3 ($P < 0.01$) and PaO₂: FiO₂ increased significantly on days 4-7 with a value of $P < 0.05$ ⁷. While another study reported that there was an increase in SPO₂ in the first 10 minutes from 91.09% to 95.30% and increased to 95.48% in the next 30 minutes⁸. Similar findings were obtained from studies that claimed that PP had an impact on the oxygenation of Corona Virus 19 patients⁹⁻¹¹. Numerous studies have shown positive effects on oxygenation status; however, practitioners face challenges in determining which evidence should be used as a reference basis for decision-making concerning health services for COVID-19 patients who experience oxygenation disorders due to the wide variation in the application of PP and the quality of diverse research and diverse methods. For this reason, a Systematic Literature Review (SLR) or Meta-Analysis of these studies is necessary to ascertain usage trends and the impact of prone positions on patient oxygenation. Some of the studies that have conducted SLR and meta-analysis include the research of Chua, *et al.*, Li, *et al.*, Reddy, *et al.*, and Tan, *et al.* including the types of Cohorts, RCT and Quasi-Experimental research¹²⁻¹⁵ Research of Barone-adesi, *et al.* and Pb, *et al.* only includes cohort studies while cohort research is observational^{16,17}. Thus, this review aimed to determine a cumulative effect of PP on oxygenation status in Corona Virus 19 patients.

METHOD

Design

Preferred Reporting Items for PRISMA standards for systemic reviews and meta-analyses criteria, the research employs a variety of systematic literature reviews and meta-analyses.

Study criteria and search strategies

The following keywords were used in the search on the databases of Proquest, Pubmed, Science Direct, Google Scholar, and Semantic Scholar.: (1) "Corona Virus OR nCoV-2 OR Covid-19 OR SARS-Cov2"; (2). (3) "Oxygenation Status OR Oxygenation OR Respiratory OR Respiration"; "Prone Position OR Prone Positions OR PP OR Awake Prone Position". The inclusion criteria for study articles are as follows: adult patient population with Corona Virus 19 and impaired oxygenation status; PP interventions; RCT or quasi-experimental design with a control group; publication between January 2020 and June 2022; and original research. Article screening was carried out through 3 stages: screening duplicate articles, titles and abstracts, and full-text screening by the expected criteria.

Data extraction

Two reviewers independently extracted the following data using a standard form created by the investigator, utilizing the unique code assigned to each eligible study.

Risk of Bias Assessment

Two reviewers critically appraised all included papers using the JBI standard critical appraisal checklist for experimental design (<http://www.joannabriggs.org/>).

Data analysis

Cochran's Q was used to test for heterogeneity, and the I² statistic was used to characterize it; values of 25%, 50%, and >75% indicate low, moderate, and high degrees of heterogeneity. When I² was greater than 75%, a random-effects model was chosen to summarize the results. To handle the diversity, we ran some subgroup analysis.

RESULTS

The search yielded 323 articles, which were then screened and subjected to a feasibility test. The results showed that all 25 articles were feasible. The 25 articles were then subjected to a qualitative and quantitative synthesis, with as many as 25 entering the qualitative synthesis stage and only 11 entering the quantitative synthesis stage due to 14 being ruled ineligible for the quantitative analysis stage (Figure 1).

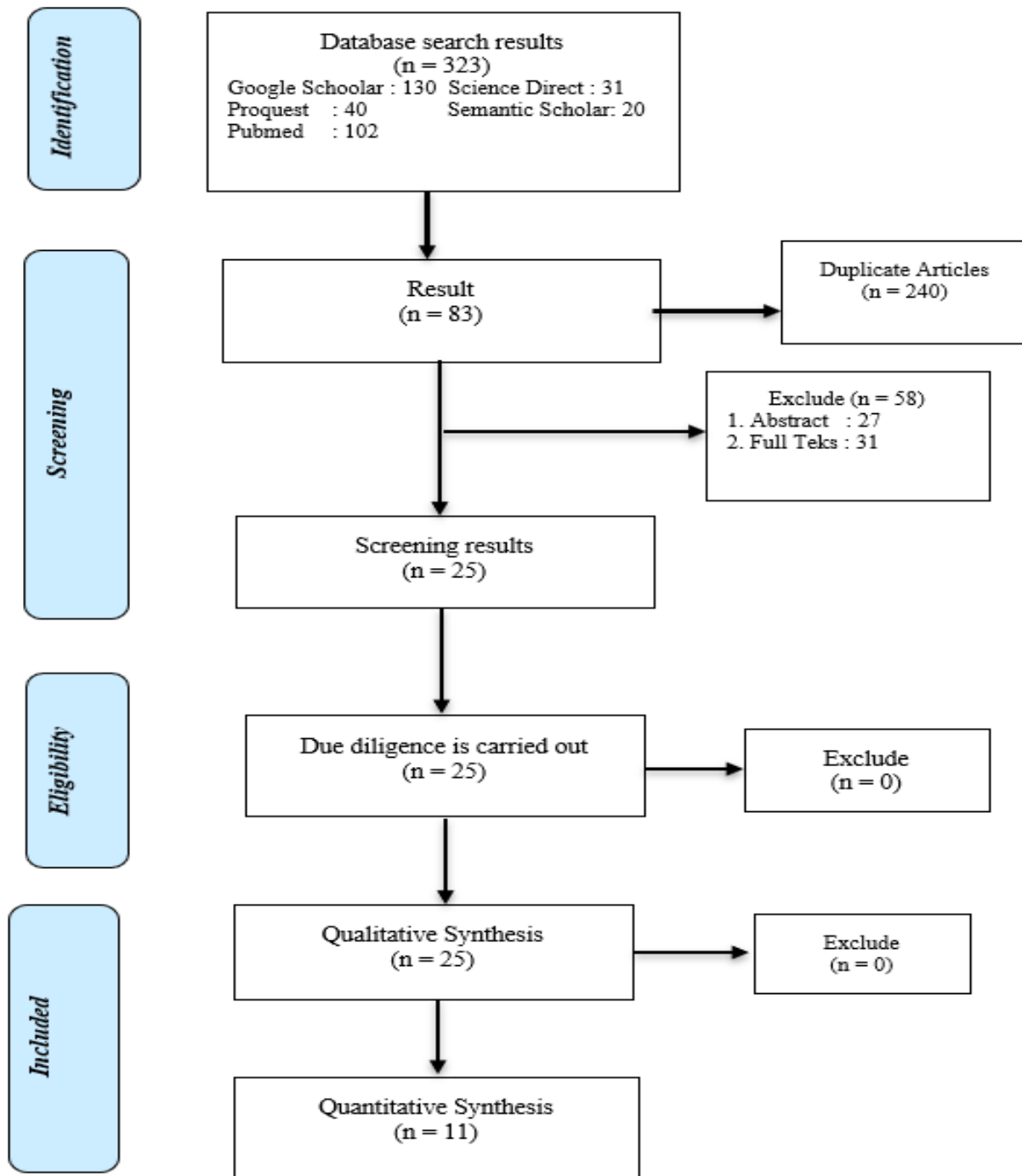


Figure 1. PRISMA Flow Chart

Study Characteristics

A total of 25 articles were screened and declared eligible for entry at the data analysis stage. A total of 15 (60%) research articles were RCT-designed and another 10 (40%) were quasi-experimental. Each study used a different sample size of 14 (56%), which used a sample size of <50 respondents. Based on the use of intubation, as many as 22 articles (88%)

intervened in the non-intubated population. For the duration of PP used, most studies applied PP >4 hours (36%) and unspecified (36%) in the sense of adjusting the ability of respondents, while the other 28% applied PP in a period of <4 hours. The oxygenation parameters found in each study were very diverse, but most used the oxygenation parameters SPO2/FIO2, SPO2, and PaO2 (Table 1).

Table 1. Characteristics of included study

Name of Researcher (Year)	Country	Study Design	Sample size	Intervention Group	Control Group	Characteristics of Respondents	Pronation Administration	Outcome
Erhmann, et al (2021)	Canada, Francis, Ireland, Mexico, USA, Spain	RCT	1126 Respondents	567 Respondents received a prone position	559 Respondents received standard care	Adult patients with acute hypoxaemic respiratory failure due to CORONA VIRUS 19 and requiring intubation	Patients were instructed and assisted to perform PP as long and as often as possible.	SpO ₂ , FiO ₂ , respiratory rate, and ROX index increased significantly during the first PP session.
Taylor, et al (2020)	United States	RCT	40 Respondents	27 Respondents received Awake PP	13 Respondents received standard care	Adult patients declared CORONA VIRUS 19 with oxygen saturation $\geq 93\%$ without requiring mechanical ventilation	PP is carried out for at least 48 hours or until there is an indication of intubation, transfer to the ICU unit, hospital discharge, or death.	SaO ₂ /FiO ₂ Intervention After Mean = 233% SD = 63% Control After Mean = 224% SD = 104% Patients in the UC group had a median S/F ratio of 216 compared to 253 in the APPS group.
Johnson, et al (2021)	United States	RCT	30 Respondents	15 Respondents performed PP	15 Respondents received standard care	Adult patients with confirmed Corona Virus 19 non-intubation	PP was performed during the day every 4 hours for 1-2 hours or as long as tolerated and at night. .	The change in PaO ₂ /FiO ₂ at 48 h was significantly worse in the PP group compared to the usual care group.
Rosen, et al (2021)	Sweden	RCT	75 Respondents	36 awake prone position (APP)	39 Respondents received standard care	Adults with confirmed Corona Virus19 were given a high-flow nasal cannula or non-invasive ventilation, as well as a PaO ₂ /ratio FiO ₂ of 20 kPa.	PP was performed 16 hours per day for 30 days.	PP technique improved posture but did not reduce intubation.
Kharat, et al (2020)	Switzerland and	RCT	27 Respondents	10 Respondents did Self-prone	Respondents 17 standard care respondents	Patients diagnosed with Corona Virus 19 and not using mechanical ventilation	PP is instructed every 4 hours as long as the respondent can and is measured every 24 hours.	PaO ₂ /FiO ₂ Ratio Intervention After Mean = 99% SD = 27.2% Control After Mean = 93.2% SD = 25% Coronavirus 19 patients on low-flow oxygen therapy had a clinically significant decrease in oxygen flow when lying self-prone. Median oxygen flow was 1.0 L min ⁻¹ and saturation/inspiration oxygen ratio fraction was 390 in the PP group

								ROX Intervention Before Mean = 3.2 SD = 0.8 After Mean = 7.3 SD = 1.4 Control Before Mean = 3.4 SD = 0.5 After Mean = 5.2 SD = 0.9	and 336 in the control group.
Jayakumar, et al (2021)	India	RCT	50 Respondents	30 Respondents self-prone for 6 hours per day	30 Respondents' standard care	Adults with non-intubated Corona Virus 19 pneumonia who have developed acute hypoxic respiratory failure.	Patients performing PP for at least 6 hours a day (cumulative)	PaO2/FiO2 Intervention Before Mean = 198.6% SD = 126.1% After Mean = 198.5% SD = 87.6% Control Before Mean = 201.4% SD = 118.8% After Mean = 171.7% SD = 100.6%	No significant difference in fluid balance, length of stay, respiratory escalation, drug use, or mortality between groups.
Gad, et al (2021)	Egypt	RCT	30 Respondents	15 Respondents prone position	15 Respondents using NIV	Adult patients (>18 years) diagnosed with CORONA VIRUS 19 without intubation	Both PP and NIV last for 1 to 2 hours according to patient tolerance in each session with 3 hours apart during waking hours	PaO2 intervention Pre Mean = 126 mmHg SD = 21 mmHg Mean = 107 mmHg SD = 12 mmHg Control Before Mean = 123.5	PP or NIV raised mean saO2 and paO2 to 93.9% and 107.12 mmHg, respectively, while NIV had a lower mean pacO2 and 20% ICU mortality.

								mmHg SD = 22.5 mmHg After Mean = 129 mmHg SD = 11 mmHg	
Fralick, et al. al (2022)	Canada	RCT	248 Respondents	126 Respondents prone to group	122 Respondents in the control group (standard care)	Adult patients with confirmed or diagnosed Corona Virus 19 and requiring supplemental oxygen (up to 50% inspired oxygen fraction) and non-intubation	PP was performed at 72 hours first and continued according to the patient's ability within 7 days	SaO2/FiO2 Intervention Before Mean = 300,7% SD = 21.6% After Mean = 331.5% SD = 64.1% Control Before Mean = 304% SD = 20.7% After Mean = 336 mmHg SD = 91 mmHg	The median (IQR) S/F ratio after 72 hours is 336 (216-438) PP and 336 (232-443) controls, with no difference between the two groups.
Garcia, et al (2021)	Spain	RCT	286 Respondents	173 Respondents doing self-prone position	113 respondents receiving usual care	Adult patients with confirmed or suspected CORONA VIRUS 19 being treated in a medical ward or planned to be treated in a medical ward.	Patients are recommended to be in PP for up to 12 hours per 24-hour period (up to four times a day for 1-2 hours at a time and at night for as long as possible.	The increased flow rate of oxygen supplementation but not known to be due to clinical deterioration or provided to facilitate increased activity (eg, physical therapy participation).	
Estarda, et al (2022)	Mexico	RCT	430 Respondents	216 respondents underwent APP	214 respondents received standard care	Patients ≥18 years of age with <i>reverse-transcriptase polymerase chain reaction</i> (RT-PCR) confirmed COVID-19, and pulse oximetry (SpO2) <90% despite receiving oxygen at 15 L/min via a <i>non-rebreather</i>	Patients in the intervention group were instructed to perform APP as best they could with a target of at least 1 hour/day for 28 days	Decreased pulmonary ultrasound score 2 in 3 the first day was associated with treatment success, with APP group having more treatment outcome and shorter length of stay.	

Rossi, et al (2022)	Italy	<i>Quasi-Experimental</i>	25 Respondents	25 Respondents underwent a change in supine and pronation position	No control group	Adult patients with confirmed COVID- 19, were admitted to the ICU and undergoing NIV	Patient was in supine position for 5 minutes, then pronation for 5 minutes.	PaO2/FiO2 increased from supine to prone, resulting in a balance between dorsal and ventral atelectasis.	
Sryma, et al (2021)	India	<i>Quasi-Experimental</i>	45 Respondents	30 Respondents in the prone position	15 respondents received standard care	Subjects with confirmed Corona Virus 19 RT-PCR nasopharyngeal swabs had oxygen saturation (SpO2) <94% non-intubated Prone	The position maintained at least 2 hours per session and with a target duration of 8 hours/day	Respiratory Rate Intervention Before Rox Intervention Before Mean = 8.5 SD = 2,3 After Mean = 12.4 SD = 4.5 Control Before Mean = 7.3 SD = 2.6 After Mean = 6.4 SD = 3.0 SPO2 Intervention Before Mean = 92.4% SD = 2.8% After Mean = 95 ,3% SD = 2.3% Control Before Mean = 94.1% SD = 4.3% After Mean = 93.9% SD = 8.1%	At 30 minutes of proning initiation, there was a significant difference in ROX index between cases and controls. At 12 hours, respiratory rates per minute and ROX index were significantly different between the two groups.
Page, et al (2022)	UK	<i>RCT</i>	52 Respondents	26 Respondents engaged in prolonged PP	26 Respondents engaged in traditional PP	Respondents were Adult patients with confirmed CORONA VIRUS 19 and endotracheal intubation	Patients were randomised to receive either 16-hour (traditional) or 24-hour (prolonged) PP for 96 hours	PaO2/FiO2 Intervention Before Mean = 99.0 SD = 27.2	There was no significant difference

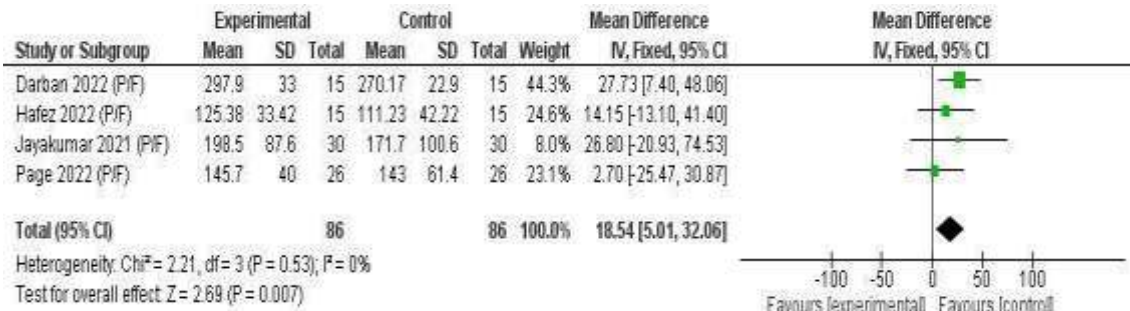
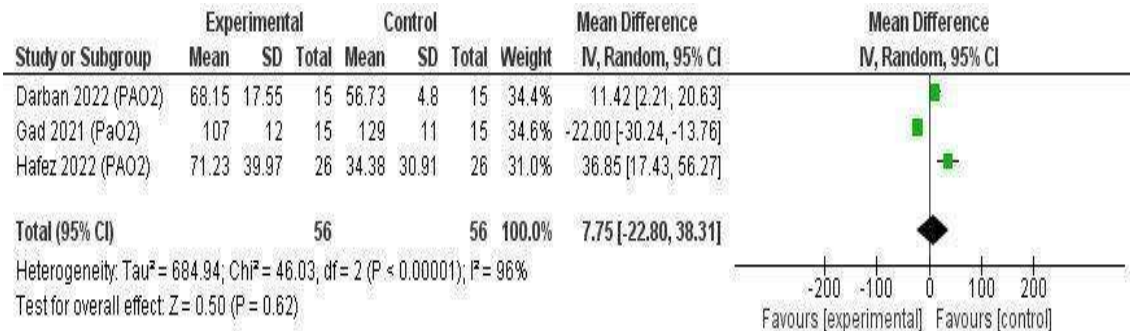
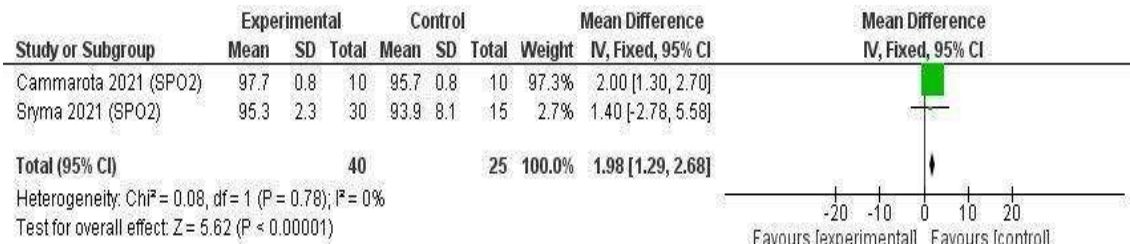
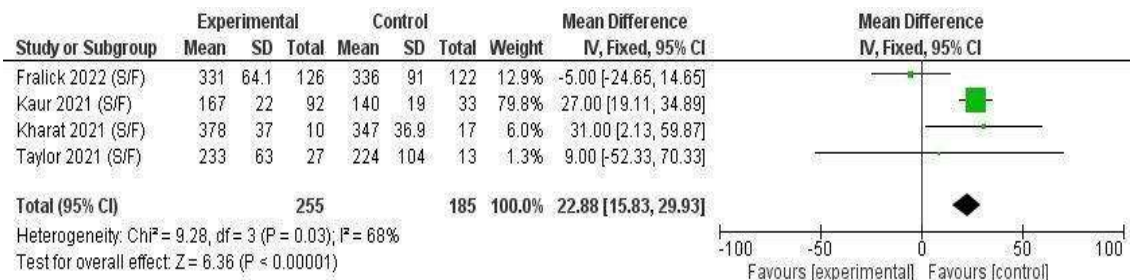
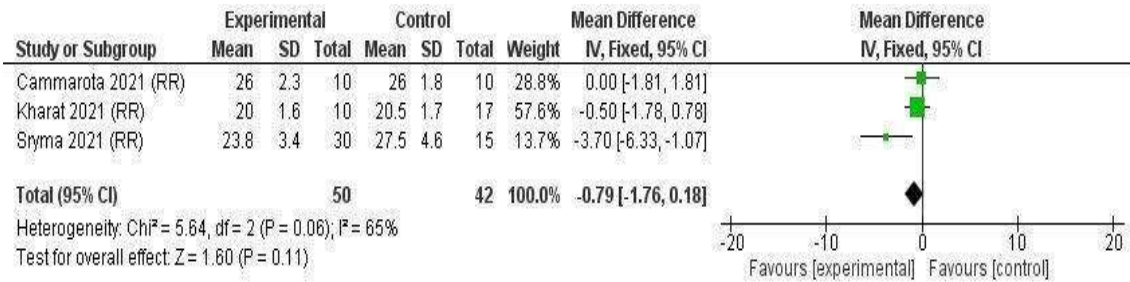
								After Mean = 145.7 SD = 40 Control Before Mean = 93.2 SD = 25 After Mean = 143 SD = 61.4	in respirator y mechanis m in the two groups after 96 hours
Kaur, et al (2021)	America	RCT	125 Respondents	92 Respondents' early awake positioning	33 Late Awake PP Confirmed	Adult patients with Corona Virus 19 and receiving high-flow nasal cannula (HFNC) oxygen therapy and non-intubation	The patient was instructed in a prone position as long as it could be tolerated, performed every day for 28 days	SaO ₂ /FiO ₂ Intervention Before Mean = 138.2 SD = 15 After Mean = 167.4 SD = 22 Control Before Mean = 157 SD = 16.4 After Mean = 140.1 SD = 19.5 ROX Intervention Before Mean = 3.2 SD = 0.8 After Mean = 7.3 SD = 1.4 Control Before Mean = 3.4 SD = 0.5 After Mean = 5.2 SD = 0.9	The late APP group had a lower ROX index than the early APP group, but no significan t difference in SpO ₂ /FiO ₂ ratio.
Friedman, et al (2021)	UK	RCT	18 Respondents	15 Respondents	3 Respondents	Adult patients ≥18 years with confirmed Corona Virus 19, requiring	Maintenance-PP during scheduled hours does not require awakening.	As many as 14% of patients in the intervention arm required some improvement	

						supplemental oxygen and not intubated		in respiratory-related care.	
Hafez, et al (2022)	Egypt	<i>RCT</i>	52 Respondents	26 Respondents in the 24-hour proning group	26 respondents in the 16-hour proning group	Respondents were adult patients with confirmed Corona Virus 19 and undergoing mechanical ventilation	Both groups with different durations of 16 hours and 24 hours	PaO2/FiO2 Intervention Before Mean = 78.9 SD = 30.8 After Mean = 125.38 SD = 33.42 Control Before Mean = 83.8 SD = 30.8 After Mean = 111.23 SD = 42.22 PaO2 Intervention After Mean = 71.23 SD = 39.97 Control After Mean = 34.38 SD = 30.91	Extending the duration of the PP from 16 hours to 24 hours was associated with an increase in PaO2, PaO2/FiO2 in static lung compliance and an insignificant change in extubation rate.
Darban, et al (2022)	Iran	<i>Quasi-Experiment</i>	30 Respondents	15 Respondents performed PP	15 Respondents were in the supine position	Adult patients aged 18-70 years diagnosed with Corona Virus 19 and experiencing acute hypoxaemia.	PP was performed 6 hours per day for 3 days.	PaO2 Intervention Before Mean = 59.13 SD = 12.53 After Mean = 68.15 SD = 17.55 Control Before Mean = 52.90 SD = 4.36 After Mean = 56.73 SD = 4.8 PaO2/FiO2	Intervention resulted in significant changes in PaO2 and PA/FiO2 values after 3 days, with mean + SD PaO2 56.73 + 4.80

								Intervention Before Mean = 59.13 SD = 12.53 After Mean = 68.15 SD = 17.55 Control Before Mean = 52.9 SD = 4.36 After Mean = 56.73 SD = 4.8	Supine vs. 68.15 + 17, 55 PP.
Cammarota, et al (2022)	Italy	<i>Quasi-Experiment</i>	20 Respondents	10 Respondents prone to positioning	10 Respondents' supine position	Adult patients diagnosed with Corona Virus19 and admitted to the intensive care unit (ICU) for hypoxaemia and underwent NIV	Prone position is given for 1 hour then in the supine position, repeated for 48 hours	Respiratory Rate Intervention After Mean = 26 SD = 2,3 Control After Mean = 26 SD = 1.17 SPO2 Intervention After Mean = 97.75 SD = 0.82 Control After Mean = 95.7 SD = 0.82	Change to pronation worsened comfort score and increased diaphragm thickening.
Alhazani, et al (2022)	Canada, Kuwait, Saudi Arabia, and the USA	<i>RCT</i>	400 Respondents	205 Respondents prone to positioning	195 Respondents to position other than pronation	Patients aged 18+ with COVID-19 and an oxygen requirement of at least 40%.	The target duration of the prone position is 8-10 hours/day with breaks.	Oxygenation was a responder characteristic in the prone position group and control group.	
Qian, et al (2022)	United States	<i>Quasi-Experimental</i>	501 Respondents	258 Respondents received PP	243 Respondents received the usual care	Adult patients with acute hypoxaemic respiratory failure without mechanical ventilation receive NIV.	Patient instructed to perform PP as often and consistently as possible.	On day 3, the aOR was 1.22 (95% CrI: 0.88-1.70; P=.12), and on day 4, it was 1.39 (0.99-1.94; P=.03).	

Sartini, et al (2020)	Italy	<i>Quasi-Experimental</i>	15 Respondents	15 Respondents	No control group	Adult patients with acute hypoxaemic respiratory failure without mechanical ventilation receive NIV.	Duration of prone position 60 minutes for 14 days.	All patients' respiratory rates decreased during and after pronation (P 0.001), and their SpO2 and PaO2:FIO2 ratios improved.
Elharar, et al (2020)	France	<i>Quasi-Experimental</i>	24 Respondents	4 (17%) did not tolerate PP for more than one hour, 5 (21%), 1 to 3 hours, and 15 (63%) tolerated more than 3hours.	There is no control group	Adult patients with Corona Virus 19 non-intubated oxygen supplementation.	Target-PP is 3 hours but adjusted according to the respondent's tolerance level.	Patients who sustained PP for 3 hours or more had a mean PaO2 of 73.6 before and 94.9 during PP, similar to before and after resupination.
Thompson, et al (2022)	USA Union	<i>Quasi-Experimental</i>	25 Respondents	13 Respondents	12 Respondents	Adults with CORONA VIRUS 19 have acute hypoxaemia and spontaneous breathing.	PP was performed by respondents as long as tolerated up to 24 hours	SpO2 increased significantly after one hour of PP, with a range of 1%-34% (median SE, 7%; 95% CI, 4.6%-9.4%).
Taboada, et al (2020)	Spain	<i>Quasi-Experimental</i>	29 Respondents	29 Respondents	No control group	Non-ICU adult patients with Corona Virus 19	Patients were told to perform prone positions for at least thirty minutes three times per day, or as tolerated by the patient.	PP significantly increased blood oxygen (SpO2, PaO2, and PaO2/FiO2) in 23 (79%) individuals and 18 (62%) overall, and increased PaO2/FiO2 (242-107; P = 0.0072).
Tu, et al (2020)	China	<i>Quasi-Experimental</i>	9 Respondents	9 Respondents	No control group	Adult patients diagnosed with Corona Virus 19 with severe hypoxaemia and using HNCF	PP is done 2 times a day for 2 hours or according to the ability of respondents	PP combined with HFNC can improve oxygenation and potentially avoid mechanical ventilation, with mean blood oxygen saturation increasing from 90%2% to 96%3% and carbon dioxide partial pressure decreasing from 477 to 395 mmHg.

The effect of prone position on oxygenation status



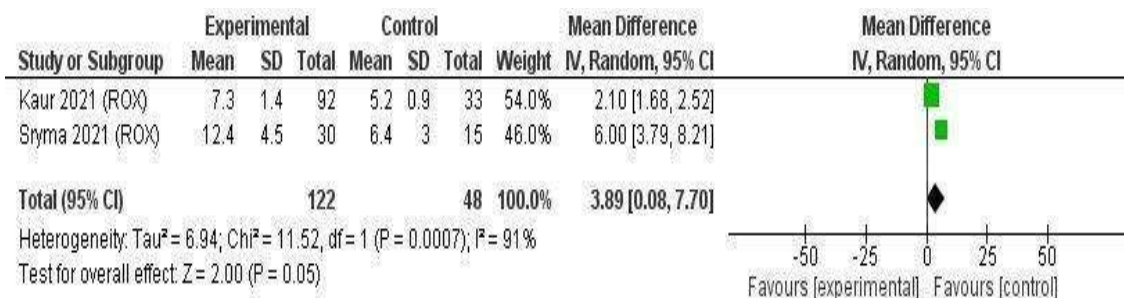
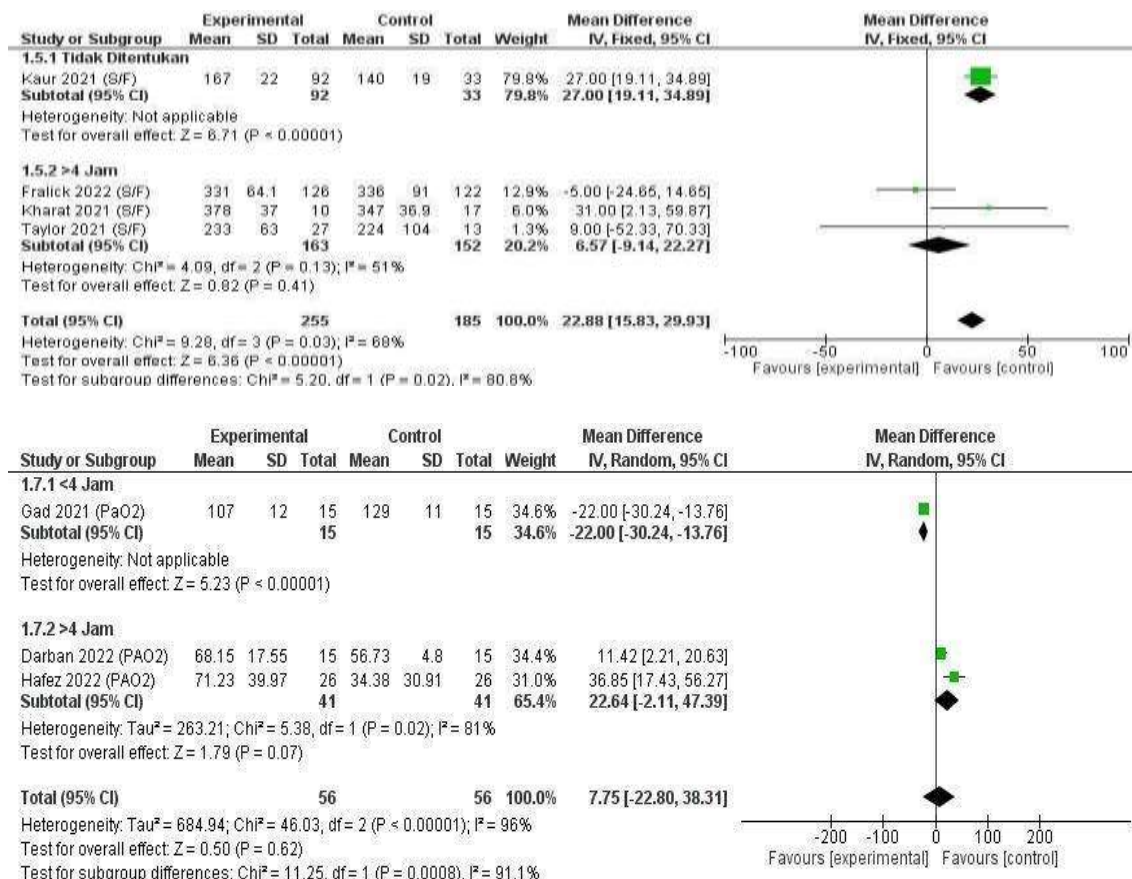


Figure 2. Forest plot for the effect of prone position

PP is predicted to have a P-Value of 0.05 or less on changes in the ROX Index, PaO₂/FiO₂ Ratio, SPO₂, and SaO₂/FiO₂ Ratio. Additionally, the heterogeneity value in the PaO₂ and ROX Index parameters,

specifically I², was high, meaning that the model employed in the meta-analysis was significantly different (Figure 2).

Difference effect of Prone based on Positioning Duration



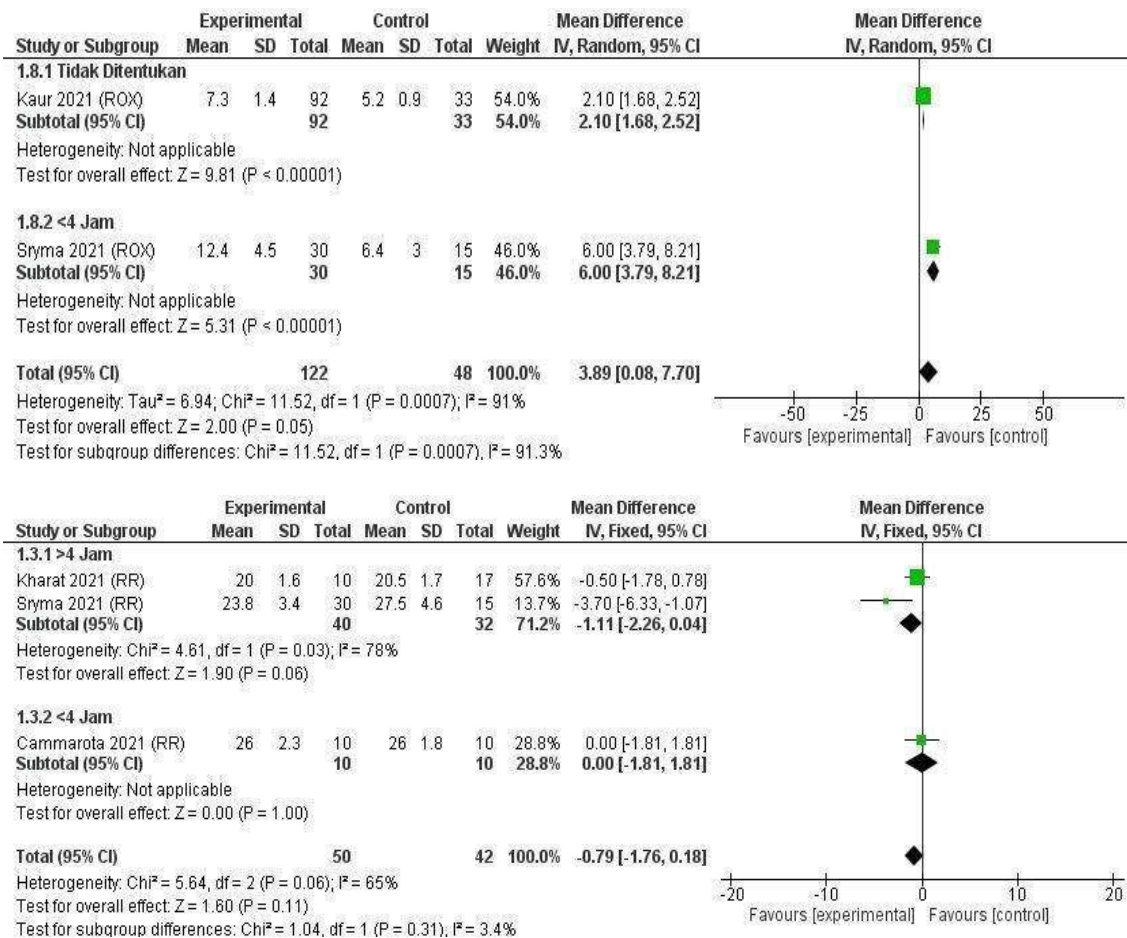


Figure 3. Subgroup results based on PP duration

The sub-group analysis of the effectiveness of PP on the oxygenation status of Corona Virus 19 patients based on the duration of PP patients revealed that in the 4-hour duration group there were significant changes in the oxygenation status values of the ROX index and PaO₂ with p-value 0.05, and in the >4-hour duration group, the oxygenation values that experienced significant changes were in the PaO₂ / FiO₂ Ratio, and the PaO₂. Then, it was established that neither the S/F ratio nor the ROX Index changed in the group that remained prone for a longer period of time (Figure 3).

DISCUSSION

This study looked at the effectiveness of PP on oxygenation as measured by various oxygenation parameters. According to the findings of the

meta-analysis, PP was found to influence changes in the values of the ROX Index, PaO₂ / FiO₂ Ratio, SPO₂, and SaO₂ / FiO₂ Ratio when looking at various oxygenation parameters. Several studies have suggested that implementing PP in Corona Virus 19 patients. Ehrmann et al. discovered that PP can result in a more homogeneous distribution of pleural pressure across the lung region based on observations during invasive mechanical ventilation. Additionally, during PP, there is a decrease in respiratory frequency, which indicates a decrease in respiratory drive and may result in a decrease in transpulmonary pressure changes. However, further research into these potential mechanisms is needed. According to Tu et al research, 's the PP mechanism that affects the oxygenation of Corona Virus 19 patients is a physiological effect called "lung recruitment," which can improve ventilation-perfusion matching.

However, based on the findings, the effect was only temporary, and the respiratory rate and oxygenation parameters frequently returned to their original state after resupination. Other benefits of PP include reducing the need for intubation, improving treatment success, and lowering the incidence of pressure sores in patients^{10,18–21}.

PP is also considered to be safe. Ehrmann et al¹⁸ found that the mortality and duration of invasive mechanical ventilation were comparable across groups, indicating that there were no danger signals from PP. Jayakumar et al. also found no significant differences in cumulative fluid balance, length of stay, respiratory escalation, use of other drugs, or death between groups, indicating that PP is safe.¹⁰ PP improves gas exchange by lowering transpulmonary pressure (difference between airway opening pressure and pleural pressure)^{9,22}. The weight of the intrathoracic viscera and abdomen decreases in the Prone position, relieving the limited diaphragm. Furthermore, because the dorsal part of the lung, which is rich in gravity-dependent blood flow, is placed in a non-dependent position, it improves aeration of poorly ventilated alveolar units. Other advantages include more uniform aeration distribution, increased ventilation-perfusion, increased secretion clearance, lung protection, and decreased mortality.

Higher transpulmonary pressure in the ventral part of the lungs causes hyperinflation, while lower transpulmonary pressure in the dorsal part of the lung causes atelectasis, where prone reduces the difference between dorsal and ventral transpulmonary, thereby causing a decrease in ventral alveolar hyperinflation and dorsal alveolar collapse²⁶. The study that stated the effectiveness of PP on oxygenation status used 4 hours, while the research of Hafez et al. compared 16 hours to 24 hours. Extending the duration of pronation sessions was found to be associated with a significant increase in PaO₂ and PaO₂/FiO₂. This is consistent with a study conducted on 103 non-Crona ARDS patients by Jochmans et al., who conducted an extension of PP sessions to evaluate the time required to obtain maximum physiological effects and

to look for parameters related to patient survival in PP. The results of the study recommended an extension of PP sessions for at least up to 24 hours, and even more if the Ratio of PaO₂/FiO₂ at 24 the clock remains below²⁷ Another study. Some research revealed that short duration is associated with increased adherence to the pronation programme and minimising patient discomfort^{7,19,28,29}.

CONCLUSION

PP on the oxygenation status of Corona Virus 19 patients has a significant influence on the ROX Index, PaO₂/FiO₂ Ratio, SPO₂, and SaO₂/FiO₂ Ratio values. Significant changes in the <4-hour duration group, namely in the oxygenation status values of the ROX index and PaO₂, in the >4-hour duration group at the PaO₂ / FiO₂ Ratio, SpO₂, and SaO₂ / FiO₂ Ratio values. Then in the group with the duration of PP, no change was determined to occur in the S / F ratio and ROX Index values.

REFERENCE

1. WHO. Clinical Management of Corona Virus 19: Living Guidance. 2021.
2. Wu Z, McGoogan JM. Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID1-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention. JAMA - J Am Med Assoc. 2020;323(13):1239–42. <https://doi.org/10.1001/jama.2020.2648>
3. Kemenkes RI. Situasi Terkini Perkembangan Covid-19. 2021.
4. Li X, Geng M, Peng Y, Meng L, Lu S. Molecular immune pathogenesis and diagnosis of Covid-19. J Pharm Anal. 2020 Apr;10(2):102–8. <https://doi.org/10.1016/J.JPHA.2020.04.001>

- 020.03.001
5. Bamford AP, Bentley A, Dean J. ICS Guidance for PP of the Conscious COVID Patient 2020. Intensive Care Soc. 2020; <https://emcrit.org/wp-content/uploads/2020/04/2020-04-12-Guidance-for-conscious-proning.pdf>
 6. Pujiastuti D, Larasasih LIN, Ismandani RS, Tenggara RM, Purba TB. Efektifitas Posisi Pronasi Pada Pasien Covid-19 Dengan Gangguan Pernapasan Tanpa Intubasi Di Ruang Icu : Literatur Review. J Ilm Keperawatan (Scientific J Nursing). 2021;7(2):326–30. <https://doi.org/10.33023/jikep.v7i2.845>
 7. Sryma P, Mittal S, Mohan A, Madan K, Tiwari P, Bhatnagar S, et al. Effect of proning in patients with COVID-19 acute hypoxemic respiratory failure receiving noninvasive oxygen therapy. Indian Chest Soc. 2021; <https://doi.org/10.4103/lungindia.lungindia>
 8. Hafez AF, Gamal R, Abd El-Rahman A, Kamal F. Is prolonged period of prone position effective and safe in mechanically ventilated patients with SARS-CoV-2? A randomized clinical trial. Egypt J Anaesth. 2022;38(1):276–83. <https://doi.org/10.1080/11101849.2022.2077048>
 9. Darban M, Memarian M, Malek F, Bahrami M, Gohari A. Comparison of prone and supine status on oxygenation of patients with Covid-19 with acute hypoxemia treated using reservoir mask; a randomized clinical trial. Immunopathol Persa. 2022;75(x). <https://doi.org/10.34172/ipp.2022.27260>
 10. Jayakumar D, Ramachandran, DNB P, Rabindrarajan, DNB E, Vijayaraghavan, MD BKT, Ramakrishnan, AB N, Venkataraman, AB R. Standard Care Versus Awake Prone Position in Adult Nonintubated Patients With Acute Hypoxemic Respiratory Failure Secondary to Covid-19 Infection—A Multicenter Feasibility Randomized Controlled Trial. J Intensive Care Med. 2021;36(8):918–24. <https://doi.org/10.1177/08850666211014480>
 11. Qian ET, Gatto CL, Amusina O, Dear ML, Hiser W, Buie R, et al. Assessment of Awake PP in Hospitalized Adults with Covid-19: A Nonrandomized Controlled Trial. JAMA Intern Med. 2022;182(6):612–21. <https://doi.org/10.1001/jamainternmed.2022.1070>
 12. Chua EX, Mohd S, Syed I, Zahir M, Ng KT, Teoh WY, et al. Effect of prone versus supine position in Covid-19 patients : A systematic review and meta-analysis. J Clin Anesth. 2021;74(May):110406. <https://doi.org/10.1016/j.jclinane.2021.110406>
 13. Li J, Luo J, Pavlov I, Perez Y, Tan W, Roca O, et al. Articles Awake PP for non-intubated patients with Covid-19 related acute hypoxaemic respiratory failure : a systematic review and meta-analysis. 2022;2600(22):7–9. [https://doi.org/10.1016/S2213-2600\(22\)00043-1](https://doi.org/10.1016/S2213-2600(22)00043-1)
 14. Reddy MP, Subramaniam A, Afroz A, Billah B, Lim ZJ,

- Zubarev A, et al. PP of non-intubated Patients With Coronavirus Disease 2019—A Systematic Review and Meta-Analysis. 2021;1001–14. <https://doi.org/10.1097/CCM.0000000000005086>
15. Tan W, Xu D, Xu M, Wang Z, Dai B, Li L. The efficacy and tolerance of PP in non-intubation patients with acute hypoxemic respiratory failure and ARDS : a meta-analysis. 2021; <https://doi.org/10.1177/17534666211009407>
 16. Barone-adesi F, Beyls C, Boselli E, Dapergola A, Grillenzoni L, Ledochowski S, et al. PP in Patients With Covid-19 : Analysis of Multicenter Registry Data and Meta-analysis of Aggregate Data. 2022;370:361–70. <https://doi.org/10.21873/invivo.12711>
 17. Pb S, Mittal S, Madan K, Mohan A, Tiwari P, Hadda V, et al. Awake PP in non-intubated patients for the management of hypoxemia in COVID-19 : A systematic review and meta-analysis. 2021;91. <https://doi.org/10.4081/monaldi.2021.1623>
 18. Ehrmann S, Li J, Ibarra-Estrada M, Perez Y, Pavlov I, McNicholas B, et al. Awake PP for Covid-19 acute hypoxaemic respiratory failure: a randomised, controlled, multinational, open-label meta-trial. *Lancet Respir Med.* 2021;9(12):1387–95. [https://doi.org/10.1016/S2213-2600\(21\)00356-8](https://doi.org/10.1016/S2213-2600(21)00356-8)
 19. Tu G-W, Liao Y-X, Li Q-Y, Dong H, Yang L-Y, Zhang X-Y, et al. PP in the high-flow nasal cannula for Covid-19 patients with severe hypoxemia: a pilot study. *Ann Transl Med.* 2020;8(9):598–598. <https://doi.org/10.21037/atm-20-3005>
 20. Ibarra-Estrada M, Li J, Pavlov I, Perez Y, Roca O, Tavernier E, et al. Factors for success of awake PP in patients with Covid-19 induced acute hypoxemic respiratory failure: analysis of a randomized controlled trial. *Crit Care.* 2022;26(1):1–13. <https://doi.org/10.1186/s13054-022-03950-0>
 21. Rosén J, von Oelreich E, Fors D, Jonsson Fagerlund M, Taxbro K, Skorup P, et al. Awake PP in patients with hypoxemic respiratory failure due to Covid-19: the PROFLO multicenter randomized clinical trial. *Crit Care.* 2021;25(1):1–10. <https://doi.org/10.1186/s13054-021-03602-9>
 22. Thompson AE, Ranard BL, Wei Y, Jelic S. PP in Awake, Nonintubated Patients With Covid-19 Hypoxemic Respiratory Failure. *J Am Med Assoc.* 2020;180(11):1537–40. <https://doi.org/10.1056/nejmoa072771>
 23. Jagan N, Morrow LE, Walters RW, Klein LP, Wallen TJ, Chung J, et al. The POSITIONED Study: PP in Nonventilated Coronavirus Disease 2019 Patients—A Retrospective Analysis. *Crit Care Explor.* 2020;2(10):e0229. <https://doi.org/10.1097/cce.0000000000000229>
 24. Kharat A, Dupuis-Lozeron E, Cantero C, Marti C, Grosgrurin O, Lolachi S, et al. Self-proning in Covid-19 patients on low-flow oxygen therapy: a cluster

- randomised controlled trial. *ERJ Open Res.* 2021;7(1):00692–2020.
<https://doi.org/10.1183/23120541.00692-2020>
25. Cammarota G, Rossi E, Vitali L, Simonte R, Sannipoli T, Anniciello F, et al. Effect of awake prone position on diaphragmatic thickening fraction in patients assisted by noninvasive ventilation for hypoxemic acute respiratory failure related to novel coronavirus disease. *Crit Care.* 2021;25(1):1–10.
<https://doi.org/10.1186/s13054-021-03735-x>
26. Touchon F, Trigui Y, Prud'Homme E, Lefebvre L, Giraud A, Dols AM, et al. Awake PP for hypoxaemic respiratory failure: Past, Covid-19 and perspectives. *Eur Respir Rev.* 2021;30(160).
<https://doi.org/10.1183/16000617.0022-2021>
27. Jochmans S, Mazerand S, Chelly J, Pourcine F, Sy O, Thieulot-Rolin N, et al. Duration of prone position sessions: a prospective cohort study. *Ann Intensive Care.* 2020;10(1).
<https://doi.org/10.1186/s13613-020-00683-7>
28. Rossi S, Palumbo MM, Sverzellati N, Busana M, Malchiodi L, Bresciani P, et al. Mechanisms of oxygenation responses to proning and recruitment in Covid-19 pneumonia. *Intensive Care Med.* 2022;48(1):56–66.
<https://doi.org/10.1007/s00134-021-06562-4>
29. Sartini C, Treoldi M, Scarpellini P, Tettamanti A, Landoni G, Zangrillo A. Respiratory Parameters in Patients With Covid-19 After Using Noninvasive Ventilation in the Prone Position Outside the Intensive Care Unit. *J Am Med Assoc.* 2020;323(22):2338–40.
<https://doi.org/10.1056/nejmoa1214103>