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Association Between Adolescents Perceived for Behaviour In Accessing Mental Health Services

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Abstract

The government of Indonesia provides programs to make it easier for adolescents to access mental health services. Adolescents are very vulnerable to mental and emotional health disorders, but there is low coverage of mental health services in primary health care. This study uses the theory of health belief models to examine how adolescents perceive having access to mental health services. This study used a cross-sectional design for 55 unmarried adolescents (15-24 years old) in Yogyakarta with a total sampling technique. Most adolescents (83.6%) perceive many barriers to accessing mental health services, so their self-efficacy becomes low (53.7%). Nevertheless, they have cues to act reasonably well (58.2%). Adolescents who perceive barriers (p-value = 0.007) and cues to action (p-value = 0.031) have a significant relationship with the behaviour of accessing mental health services. Meanwhile, perceived susceptibility (p-value = 0.909), perceived severity (p-value = 0.420), perceived benefits (p-value = 0.980), and self-efficacy (p-value = 1,000) did not have a significant relationship. The findings demonstrated that adolescents have sound cues to action in accessing mental health services, but low self-efficacy is thought to be the barrier.

Introduction

Mental health is the most crucial aspect of achieving complete health. Physical and mental wellness are equally vital. According to the World Health Organization (WHO), health is an excellent physical, psychological, and social condition, not only the absence of disease or weakness (WHO, 2013) The suicide rate in Indonesia is 11.4% per 100,000 people, possibly due to a lack of psychological support and proper health care (Kementerian Kesehatan Republik Indonesia, 2018). The number of people aged 15 and up who suffer from mental and emotional illnesses was 19 million. Meanwhile, up to 12 million people suffer from depression (Purwaningsih & Nurmala, 2021), and as many as 7 out of 1000 families have family members who have schizophrenia ((Kementerian Kesehatan Republik Indonesia, 2018). Mental and emotional illnesses affect 14% to 20% of adolescents, and 50% of all cases identified with mental-emotional illnesses began before age 14, and three-quarters began before age 24 (Saam & Guidance, 2017). Adolescent health concerns physical changes, psychological problems, emotions, and intellect that can lead to conflict within adolescents; impact health is quite an issue today. Nowadays, we frequently hear about the prevalence of adolescent brawls, promiscuity, and even stress leading to suicide due to uncontrolled adolescent psychology and emotion. If we can identify the source of the problem, we can prevent it from recurring with proper treatment. The problem of Internet gaming disorder must be a concern of government and cross-sectoral to prevent the

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development of this problem in Indonesia as a protective way for adolescents. Internet gaming disorder is one of mental disorder (Arnani, 2021). Adolescents with online game addiction could increase mental health disorders by 1.57 times more than adolescents without online game addiction (adjusted odd ratio = 1.57 (1.28–1.94); $p \leq 0.001$. with internet game disorder, 21.7% had moderately severe/severe depression, and 11.4% had severe anxiety (Alhamoud *et al*., 2022; Purwaningsih & Nurmala, 2021). Thus, the significance value of $p = 0.000$ between cyberbullying and mental health. It can be interpreted that there is a relationship between cyberbullying victimization and mental health in adolescents (Ningrum & Amna, 2020).

Similarly, the Special Region of Yogyakarta has a 10% prevalence of mental and emotional illnesses. Mental and emotional illnesses affect one out of every 1,000 people over 15. One person suffers from emotional and mental illnesses (Health Office of Special Region of Yogyakarta, 2018). DIY is currently the second province with the highest number of cases of severe mental problems after Bali (Safitri, 2016). Adolescent mental health cases are increasing, as are mental health services (MHS). Counselling is included in MHS for adolescents, and Primary health care (PHC) provides it. MHS, on the other hand, have not been fully utilized. MHS is not being implemented in every PHC. Another reason is the number of health workers and the knowledge of adolescents, who are still less concerned about mental health, making it harder to recognize and treat mental health cases correctly (Orji *et al*., 2012)

Individual behaviour in seeking treatment in health services is relatively low. Individuals still have a vulnerable perception of the behaviour of accessing health services (Az Zachra, 2019). Adolescents prefer to access online mental health information rather than coming to MHS. They perceived themselves to have relatively high digital health literacy, rating themselves at a mean score of 3.7 (SD = 0.5) out of 5, indicating a strong sense of self-efficacy. However, if they felt anxious or relieved after finding online health information, they rarely discussed findings with health professionals, even though they were open to discussing and helping them find information online correctly (Taba *et al*., 2022).

According to the findings of a preliminary survey among adolescents in Yogyakarta, there were around five people with mental problems. The municipal government's strategy for dealing with this problem is to hold MHS socialization. Youth representatives attended The function only (Annisa & Nurmala, 2018). Meanwhile, early detection results on 64 teens revealed that 15.6%, or up to ten teenagers, experienced severe depression, 10.9%, or seven teenagers, experienced anxiety, and 6.3%, or four teenagers, experienced anxiousness (Ningrum & Amna, 2020). Adolescents in Yogyakarta are under much pressure; although psychological services are available at the PHC, they are underutilized. Furthermore, the Youth Information and Counseling Center is an excellent place for adolescents to talk about everything youth-related, including adolescent mental health. This study is critical to conduct with teenagers in Warungboto because it can provide an overview of teenagers' perceptions regarding access to mental health so that solutions and alternative solutions can be created to solve the problem of access to mental health services for teenagers, which is still low. It is hoped that this research can provide input for service providers to provide adolescent mental health services according to the needs of adolescents in the area.

Most adolescents regard mental illness as a severe issue. They believe religious rites can alleviate mental illnesses (Onoruoiza *et al.*, 2015). A study into the behaviour of adolescents seeking MHS is required. This study describes adolescent perceptions toward MHS access. Adolescents' perceptions of the seriousness and susceptibility to mental health illnesses are used to make the assessment. The study was then repeated to assess teenagers' perceptions of the benefits and barriers to obtaining MHS. Furthermore, the study examined teenagers' self-efficacy and cues to action in accessing MHS. It evaluated adolescents previously examined for early diagnosis of mental health problems in earlier trials. This is advantageous in this study because adolescents' mental health status is more intimately related to their perceptions of MHS.

Methods

This is a quantitative study with a cross-sectional approach. Participants are 55 unmarried adolescents aged 15 to 24 and youth organisation members in Warungboto, Yogyakarta. The respondent's inclusion criterion is to be willing to engage in this study by thoroughly completing the questionnaire, having lived in Yogyakarta for at least the last six months, and being fluent in Indonesian. Participation did not highlight the history of access to teenage mental health treatments. For two months (August - September 2020), they completed online surveys using a total sampling technique to acquire primary data. The link to the questionnaire was sent to respondents, who were then taken to a page with details about the study and their position as participants. They then forwarded participants to the previous consent form. If so, it went on to complete the questionnaire. The research team presented a reward in the form of digital currency to the participants as a token of appreciation.

The research team designed the questionnaire, information sheets, informed consent, and online survey. Data were collected using a self-administrated questionnaire in eight sections as follows: Part (A) had sociodemographic characteristics (age, sex, education level, and regular activities); Part (B) involved the behaviour of access to MHS; Part (C) comprised perceived susceptibility related to mental health disorder among adolescents; Part (D) identified perceived severity of adolescents related to mental health disorder; Part (E) explored perceived of benefit to access adolescents MHS; Part (F) mentioned perceived barriers to access MHS; Part (G) was clarified cues to action among adolescents, and part (H) confirmed the self-efficacy of adolescents to access MHS in their city. The questionnaire tested its validity and reliability. It was carried out on thirty adolescents at Jogokariyan Village, Yogyakarta, who were in different locations but had similar characteristics to the participants. Each question item in the questionnaire was tested using product moment for validity and Croncbach's alpha for reliability. If the value of $p>0.3$, then it is declared valid and if the value of $p>0.6$ is declared reliable. The fourteen questions about adolescent behaviour in using MHS were all deemed valid. There is only one question on the perceived hurdles to getting MHS that is invalid from the twelve questions about the perception of teenage susceptibility to mental disorders. Up to three items are invalid on perceived rewards, perceived seriousness, and cues to act. Tfwo questions on the self-efficacy variable, however, are invalid. The question is removed from the study and not used if the question item is invalid. When all of the variables were shown to be reliable by statistical testing, the same was valid for reliability.

Data were coded and entered into SPSS v22.0 for data analysis. We used the chi-square test for standard data and the Spearman rank test for abnormal data. Chi-square tests were employed to investigate the bivariate relationship between outcome variable behaviour of accessing MHS towards independent variables, specifically perceived susceptibility, perceived severity, perceived benefits, cues to action, and self-efficacy. The variable of perceived barriers was tested with Spearman rank. The Research Ethics Committee of Universitas Ahmad Dahlan approved this protocol, 012008035, on September 4, 2020. Research explanations and consent from participants have been carried out before the study. This was an anonymous survey, and participation was voluntary. All the data of participants were strictly kept confidential.

Results and Discussion

This study uses the theory of health belief models (HBM) to examine how adolescents perceive having access to MHS. Depression and anxiety disorders are adolescents' most common mental health disorders, with estimated prevalence rates of 5% and 8%, respectively (Lawrence *et al*., 2015; Polanczyk *et al*., 2015; Sadler *et al*., 2018). However, hardly two-thirds of adolescents with anxiety or depression seek and receive professional care. Only a tiny percentage of young people receive MHS (Lawrence *et al*., 2015; Sadler *et al*., 2018). As a result, this study focuses on examining teenage behaviour in accessing MHS. Adolescents' judgments of susceptibility and severity in coping with mental health illnesses are referred to as assessment and adolescents'

perceptions of the benefits and barriers of MHS access (Syamlan *et al*., 2022). This study will also evaluate self-efficacy and cues to action.

Of 55 participants, most belonged to late teens (17-24 years). The age category is divided into early adolescents (15-16 years) and late adolescents (17-24 years) based on the Minister of Health regulation number 25 of 2014. Only 17% of the participants were female, and 49.1% were students at elementary to junior high school (Table 1). However, 40% said they had worked. According to their confession, half of the participants have one to more than two communities they join in their leisure time. They recognize that participation in the community can be stress-coping when facing a problem. The median score of the behaviour variable was 4 (SD=2.679), and the mean score was 4.4. Half of the participants have poor behaviour in accessing health services. They do not attend adolescent MHS. Mental health issues have never been obtained from schools. In addition, they also prefer to discuss with friends and look for online information sources rather than coming to health services or discussing with parents.

Some adolescents have an excellent perceived susceptibility to mental health disorders (Table 1). They consider that accessing MHS routine is one way to avoid mental health

Table 1. Sociodemographic and HBM Variables Summary of Participants (N=55)

Characteristics	Overall (%)	Mean ±SD	Median ±SD	p	CI	r
Age (years)		-	-	-	-	-
15-16	12,7					
17-24	87,3					
Sex		-	-	-	-	-
Male	69,1					
Female	30,9					
Education level		-	-	-	-	-
Less than high school	49,1					
High school/ university	50,9					
Employment status		-	-	-	-	-
Unemployed	60					
Employed	40					
Behaviour in accessing MHS		4.44	4±2.679	-	-	-
Good	58,2					
Poor	41,8					
Perceived susceptibility		31.64±3.884	32.00	0,909	0,884 (0,473- 1,650)	-
Good	50,9					
Poor	49,1					
Perceived severity		34.84	34±4.017	0,420	1,409 (0,757- 2,621)	-
Severity	56,4					
No severity	43,6					
Perceived benefits		36.20	36±4.089	0,980	1,100 (0,590- 2,050)	-
Good	54,5					
Poor	45,5					
Perceived barriers		43.53	46±7.489	0,001		-0,450
Many barriers	83,6					
No barriers	16,4					
Cues to action		32.89±3.253	33.00	0,031	2,164 (1,137- 4,119)	-
Good	58,2					
Poor	41,8					
Self Efficacy		27.31	27.31±2.993	1,000	0,978 (0,524- 1,825)	-
Good	47,3					
Poor	53,7					

N number of participants

Source: Primary Data, 2020.

problems. In contrast, the disorder will worsen if they do not get professional help immediately. Participants who perceived susceptibility to poor behaviour as much as 11 (39.3%) is smaller than good behaviour as many as 17 (60.7%) (Table 2). Similar results were also shown in the variable perceived severity of mental health disorders and perceived benefits in accessing adolescent MHS. Some participants feel that mental health disorders are a severe problem, but not for others. They also think mental health disorders can interfere with daily activities and social relationships with others. Adolescents perceive that the benefit of accessing MHS is that they can perform early detection or screening related to their mental health status. This can add value to them, mainly supported by high self-efficacy. However, the results of this study reported that participants' self-efficacy did not have a significant relationship with behaviour in accessing MHS (p-value=1.000). Of participants with low self-efficacy and poor behaviour, as many as 12 people are smaller than participants with low self-efficacy but behave as well as 17 people.

On the other hand, these results can be masked by high cues to act so that adolescents can behave well (p-value=0.031). Fourteen participants did not have cues to action with poor behaviour compared to the participants who did not have good behaviour and sound cues to action, many as nine people (Table 2). They often seek mental health information online and attend health services on their initiative. Meanwhile, adolescents feel they have many barriers to accessing health services (Table 1). The median score was 46 (SD=7.489), and the mean score was 43.53. Adolescents feel that mental health is not an important issue. Spearman's rank test shows a correlation r value of -0.450 with moderate relationship strength. However, the p-value indicates a significant relationship between perceived barriers and behaviour in accessing MHS (Table 1). In addition, they are afraid of being stigmatized and lazy, and they claim to be busy and do not have time to come to professional services. Adolescents more often share experiences with friends to find solutions to their problems.

Table 2. The Results of Correlation Among Study Variables

Variable	Category	Behaviour in Accessing MHS			
		Poor		Good	
		n	%	n	%
Perceived susceptibility	Poor	12	52.2	15	46.9
	Good	11	47.8	17	53.1
Perceived severity	Poor	12	52.2	12	37.5
	Good	11	47.8	20	62.5
Perceived benefits	Poor	11	47.8	14	43.8
	Good	12	52.2	18	56.3
Self-efficacy	Poor	12	52.2	17	53.1
	Good	11	47.8	15	46.9
Cues to action	Poor	14	60.9	9	28.1
	Good	9	39.1	23	71.9

Source: Primary Data, 2020.

According to the chi-square test, only one variable corresponds with teenage behaviour in accessing MHS. Cues to action are experiences, events, physical symptoms, or the surroundings that motivate people to act. Individual interpretations of action cues are believed to drive people to engage in healthy behaviours. It will be easier to take action if the individual already has confidence. The signal to act is Health motivation, which refers to the disparity between persons regarding health quality and readiness to be motivated to maintain health. Individuals driven to maintain their health are prompted to engage in health-related behaviours (Conner, M., & Norman, 2017). A similar study found that acting is closely associated with follow-up medication behaviour in depressed cases. Cues to action that initiate disease-relief measures. Cues to action include a recent visit to a doctor (e.g., a primary care doctor) and the level of nonclinical emotional health assistance. Primary care practitioners were cited as a vital cue to action (Lilly *et al*., 2020; Nobiling & Maykrantz, 2017).

Furthermore, this study found a link between perceived barriers to behaviour and teenage MHS access. The Spearman's rank test demonstrated this association. One HBM theory component that harms individuals who are barriers to healthy behaviour is perceived barriers. The HBM theory's goal in dealing with health problems is individuals' perceived barriers to change. Individuals will assess the difficulties encountered. Individuals who are perceived to be impediments are evaluated by modifying their conduct. The obstacles

determine individual conduct people exist (Buglar, M.E., White, K.M., Robinson, 2010). The correlation coefficient value of 0.450 suggests the variables have a strong association. However, the link is skewed, meaning adolescents who see numerous barriers to MHS will act out (Doll *et al*., 2022). Adolescents are unclear whether they want professional assistance with their problems. A preference to rely on oneself is a crucial obstacle preventing adolescents from seeking professional help. According to some parents, adolescents may have inherited this coping method after witnessing their parents. Older teenagers and adolescents who have never sought professional help appear to be particularly anxious about dealing with their difficulties on their own and feel 'too proud' to seek professional assistance (Radez, Reardon, Creswell, Orchard, *et al*., 2021). A person's perceived benefit is the benefit they feel when they make a preventive effort. People who believe they are vulnerable to disease will respond with the anticipated benefits.

Adolescents do not yet believe in the serious consequences of mental health illnesses; thus, they do not need services. Depression and other mental illnesses, according to one respondent, were not as severe as mental disorders. Adolescents can handle difficulties by themselves without the assistance of MHS (Widati & Siddiq, 2022). According to the findings of the meta-analysis, teenagers face barriers due to a lack of understanding about mental health and access to MHS (Putri *et al*., 2021; Radez, Reardon, Creswell, Lawrence, *et al*., 2021; Shi *et al*., 2020). Furthermore, teenagers' lack of understanding of mental health causes them to have a negative perspective of their vulnerability and the significance of being affected by mental health illnesses. The findings show that teenagers who believe they are not at risk for mental health illnesses have limited access to these services. The same is true for adolescents who believe that mental health illnesses do not have significant consequences.

One of the most essential perceptions for adolescents to embrace healthy activities is their perceived susceptibility. Adolescents with poor susceptibility may dispute that they are at risk of acquiring mental illnesses. As a result, these teenagers can participate in non-access to MHS behaviours. As a result, teenagers are less likely to want to attend MHS (Efendi *et al*., 2022). Adolescents with a strong perception of vulnerability are more likely to be influenced by health problems and seek MHS to help them lower their risk of mental health disorders (Brandye D. Nobiling & Maykrantz, 2017). Adolescents' lack of awareness and perception of the gravity of mental diseases is a primary reason they do not seek MHS. In such a situation, adolescents should have positive perspectives on the benefits of receiving MHS to help them act better when dealing with mental health illnesses. Perceived benefit is a person's estimation of the utility or value of a behaviour change that will lessen the person's chance of getting a disease (Setiyaningsih *et al*., 2016).

A similar study found a link between the prevalence of depression and the perceived health advantages of getting mental health information (Akhther & Sopory, 2022). Several studies have also found that compared to visiting PHC, adolescents frequently use the internet and social media to seek mental health information (Arnani, 2021). Accessing mental health services through primary health care has several advantages, including accountability for the content of the information and an accessible site to examine the experiences of people with similar health concerns. It can then minimize shame when seeking information directly from friends, interlocutors, or experts and empower by understanding the disease and learning about self-care. Perceived benefits might aid decision-making when embracing new technology or services. Perceived health advantages are people's assessments of the benefits of using social media to communicate about their health (Akhther & Sopory, 2022; Lee, 2009; Li *et al*., 2018).

According to the findings of this study, respondents did not perceive any benefits from their behaviour in accessing MHS. Adolescents prefer to relieve or prevent stress by playing with friends, practising physical activities, watching movies, and engaging in positive behaviours rather than using MHS, indicating that respondents' self-efficacy in carrying out good behaviour in accessing MHS remains low.

It was established that there is no substantial association between teenage self-efficacy and MHS access behaviour. Furthermore, as many as fifteen kids show self-efficacy and good behaviour when accessing MHS. This figure exceeds the twelve responders who lack self-efficacy and misbehave. Of course, different internal and environmental factors influence self-efficacy.

Internal and external causes can hamper adolescents' behaviour in accessing health care. Internal issues frequently lack understanding of mental health and adolescent views. The perception of adolescents seeking professional help in dealing with mental health concerns is highlighted. Meanwhile, external factors primarily identified by research focus on ambient attitudes, unfavourable stigmatization of teenagers who seek MHS, and the restricted availability of mental health practitioners (Putri *et al*., 2021; Radez, Reardon, Creswell, Lawrence, *et al*., 2021). In a prior study, self-efficacy and problem-solving were direct and indirect determinants of mental health. Furthermore, emotional self-efficacy is vital to adolescent well-being (Andretta & McKay, 2020; Parto, 2011). In a prior study, self-efficacy and problem-solving were direct and indirect determinants of mental health. Furthermore, emotional self-efficacy is an essential factor in adolescent well-being.

The study's shortcomings were that it did not differentiate between teenagers with mental health conditions; therefore, the results are more general. As a result, the findings of this study cannot tell whether teenagers' bad conduct in accessing MHS is due to the teenager not being diagnosed with a mental health issue. Furthermore, the number of participants and the breadth of this study are still modest. Another disadvantage is that no healthcare providers or professionals were triangulated in this study. Furthermore, the researchers did not thoroughly examine MHS's program. It is intended that further researchers would improve this research so that it may be utilized as a database to evaluate teen mental health support programs.

Conclusion

This study focuses on adolescent mental health service-seeking behaviour. The significant finding is that adolescents have poor self-efficacy but high action cues. Adolescents believe the barriers to coming to MHS are too high, but they do not rule out accessing them if they require the assistance of professional health providers**.**

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Visualizing The Knowledge Structure of Geriatric Rehabilitation: A Bibliometric Analysis

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Abstract

This study undertakes a comprehensive bibliometric analysis to visualize the knowledge landscape of geriatric rehabilitation. Utilizing the Web of Science and Scopus databases from 1947 to 2023, a meticulous bibliometric analysis was executed. The research was facilitated through ScientoPy and VOSviewer tools, enabling meticulous scrutiny and insightful visualization of the research network. A total of 5120 papers were identified through the search strategy. The outcomes reveal the United States as the foremost contributor to geriatric rehabilitation research, with the Archives of Physical Medicine and Rehabilitation emerging as a highly active journal. Among the most significant author's keywords, "rehabilitation", "aged" and "hip fracture" are prominent, underscoring pivotal domains for targeted interventions within geriatric care. Furthermore, this analysis highlights noteworthy keywords such as "sarcopenia," "physical activity," and "virtual reality," offering essential insights into core themes within geriatric rehabilitation. Consequently, this study presents a valuable resource for scholars and researchers alike. It serves as a foundational tool for identifying prevalent research trends, addressing existing gaps, and embarking on new explorations in the dynamic realm of geriatric rehabilitation. The findings provide a holistic understanding of the knowledge landscape, paving the way for informed decision-making, innovative research endeavors, and the enhancement of geriatric rehabilitation practices.

Introduction

Geriatric rehabilitation has gained significant global recognition due to the growing need to address the unique healthcare requirements of the aging population (Ayoubi-Mahani *et al*., 2023). Rehabilitation of geriatric patients has a positive effect on outcomes for functioning, relative risk for nursing home admission, and relative risk for mortality (Tijsen *et al*., 2019). The mounting frequency of age-related maladies such as musculoskeletal disorders, neurological disorders, and chronic diseases among the elderly population is the stimulus behind the requirement for geriatric rehabilitation (Becker & Achterberg, 2022). In addition, research suggest that 54,1% of the elderly are at risk of developing cardiovascular disease (Magnussen *et al*., 2023). Frequent challenges encountered by people with dementia and their caregivers in using HCBS include limited awareness of dementia and lack of information about available services (Bieber *et al*., 2019). Geriatric rehabilitation is defined as multidimensional approach of diagnostic and therapeutic interventions (Lubbe *et al*., 2023). Geriatric Rehabilitation (GR) is defined as 'a multidimensional approach of diagnostic and therapeutic interventions, the purpose of which is to optimize functional capacity, promote activity and preserve functional reserve and social participation in older people with disabling impairments (van Balen *et al*., 2019). The core objective of geriatric rehabilitation is to maximize functional autonomy, augment quality of life, and heighten general welfare for the aged population (Goldman & Schafer,

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2011; Grund *et al*., 2020). GR can be offered as a home-based service or as an inpatient care trajectory within hospitals, rehabilitation hospitals, skilled nursing facilities or nursing homes with rehabilitation units (Grund *et al*., 2020). This because people who enter old age will be threatened by health problems (Feng *et al*,. 2022). Patients in GR are mostly of old age (i.e. 75 years and older), are often frail and have several comorbidities, including cognitive dysfunctions and communication problems. However, they want to achieve self-dependence after a medical event (Pel-Littel *et al*., 2021). In terms of patterns, there is a growing emphasis on community-based and home-based geriatric rehabilitation programs globally (Wang *et al*., 2021). These programs aim to promote aging in place and enable older adults to maintain independence within their own homes and communities (Achterberg *et al*., 2019). Geriatricians are exclusively in charge of the treatment in post-acute geriatric rehabilitation units (Rapp *et al*., 2022). Home-based rehabilitation facilitates bespoke interventions that are carefully tailored to the unique needs of individuals. In contrast, community-based programs offer a route to social support and engagement. These patterns align with the shift towards person-centered care, enabling older adults to receive rehabilitation services in familiar environments (Jeste *et al*., 2020).

Globally, there has been a discernible shift towards a multidisciplinary approach in geriatric rehabilitation concerning trends (Verstraeten *et al.,* 2024). The approach towards geriatric rehabilitation has undergone a global shift with an increasing trend towards a multidisciplinary approach (Loveland *et al.,* 2022). The amalgamation of numerous disciplines guarantees a holistic approach to meeting the intricate needs of the elderly population and enhancing their overall outcomes (Rudnicka *et al.,* 2020). There is a paucity of data concering structured multicomponent exercise programs of geriatric patients on are habilittaion ward and the content of the geriatric rehabilitation processes are different across countries (Xin *et al*., 2022). Of significant importance in geriatric rehabilitation is physiotherapy, which offers a distinctive perspective and a broad range of scopes to improve the health and functional outcomes of older adults (Wilson *et al*., 2022). Physiotherapy plays a significant role in geriatric rehabilitation as a part of a multidisciplinary approach involving cooperation among health professionals to offer comprehensive care to elderly individuals (Jacobs *et al*., 2024). They employ evidence-based techniques and interventions to improve mobility, strength, balance, endurance, and overall physical function (Mh *et al*., 2018). The domain of physiotherapy in geriatric rehabilitation transcends the confines of clical settings (van Dijk *et al*., 2021). Physiotherapists can participate in community outreach programs, educational initiatives, and research endeavors to propel the field's knowledge and foster healthy aging (Liu-Ambrose & Li, 2022). By incorporating technological advancements and telerehabilitation, physiotherapy services can extend to seniors residing in remote areas, expanding access to care and amplifying desirable outcomes (Khan *et al*., 2022). As the aging population continues to grow, the role of physiotherapy in geriatric rehabilitation will remain vital in maximizing functional independence, improving quality of life, and promoting healthy aging globally (Martini *et al.,* 2023).

However, geriatric rehabilitation also faces several challenges on a global scale (Kraaijkamp *et al*., 2021). One major challenge is the shortage of trained healthcare professionals specializing in geriatric rehabilitation (Abdullah & Azizan, 2024). The aging population is growing rapidly, leading to an increased demand for geriatric rehabilitation services (Fulmer *et al*., 2021). It is crucial to address this workforce shortage by promoting geriatric rehabilitation education and training programs to meet the rising needs of older adults (Puts *et al*., 2020). Additionally, issues related to access to care, resource allocation, and reimbursement policies pose challenges in delivering comprehensive geriatric rehabilitation services across different regions (Lynch *et al*., 2017). Research on the developmnet of geriatric care is currently developing rapidly, but research collaboration between countries/regions and institutuons is still very limited (Wang *et al.,* 2019). This paper aims to map and graphically analyze comprehensive physiotherapy for geriatric

rehabilitation from a bibliometric standpoint. Bibiometric analysis as a quantitative statistical tool for academic literature analysis (Zyoud & Al-Jabi, 2020). This bibliometric study also identifies the publication patterns and intellectual framework of this field. The research questions (RQs) that are addressed include the following:

RQ1: How has the publication growth in the field of geriatric rehabilitation evolved, and are there any notable trends or spikes in research output?

RQ 2: Which countries have been at the forefront of research in geriatric rehabilitation, and how have their contributions evolved over the years?

RQ 3: Which journals have been central to disseminating research in geriatric rehabilitation, and how does their influence manifest in terms of citations and impact factors?

RQ 4: What are the prevalent author keywords used in publications related to geriatric rehabilitation, and how have their frequencies changed over time?

The remainder of the paper is organized as follows: The first section will emphasize a review of the literature on the perspective of geriatric rehabilitation, followed by the methodologies employed in this investigation. The analysis and findings are presented next, followed by the final section, which will discuss and conclude the paper.

Method

Bibliometricanalysis is a pioneering and meticulous technique for investigating and analyzing scientific evidence. It assists in exploring the subtleties of a discipline's evolutionary history while also illuminating the newly discovered area of study (Kokol *et al*., 2020; Azizan, 2024). Secundo, Del Vecchio, and Mele (2021) argue that bibliometric assessment is a scientific way to analyze published reading materials, such as books, journals, and other publications, using appropriate statistical tools (Secundo *et al*., 2021). Its specialized analytical tool, "Citation Analysis", is a component of the bibliometric method based on citation graph creation, effectively referring to a network or graph representation of document citations. It is widely used in libraries and information science (Pan *et al.*, 2018).

On May 31, 2023, data for publications in this study were taken straight from the Web of Science (WoS) and Scopus databases. This dataset comes from the Web of Science (WoS) and Scopus databases and involves research papers on geriatric rehabilitation. Referring to Table 1, initially, 9,219 papers were collected. But after excluding papers with certain document types (21.10% of the total), the dataset was refined to 7,270 papers for analysis. From these databases, 44.70% (3,252 papers) came from WoS, and 55.30% (4,018 papers) came from Scopus. Duplicates were a concern, and 2,150 duplicates (29.60%) were identified. Among them, 27 duplicates (0.80% of WoS papers) were removed from WoS, and 2,123 duplicates (52.80% of Scopus papers) were removed from Scopus. Additionally, 1,387 documents had duplicate content but different "cited by" counts. After duplicates were handled, there were 5,120 unique papers. After duplicate removal, the distribution was 63.00% (3,225 papers) from WoS and 37.00% (1,895 papers) from Scopus.

Table 1. Pre-Process Data

Info	Number	Percentage
Loaded papers	9219	
Omitted papers by document type	1949	21.10%
Total papers after omitted papers removed	7270	
Loaded papers from WoS	3252	44.70%
Loaded papers from Scopus	4018	55.30%
Duplicated removal results:		
Duplicated papers found	2150	29.60%
Removed duplicated papers from WoS	27	0.80%
Removed duplicated papers from Scopus	2123	52.80%
Duplicated documents with different citations by	1387	64.50%
Total papers after rem. dupl.	5120	
Papers from WoS	3225	63.00%
Papers from Scopus	1895	37.00%

Source: Data from ScientoPy

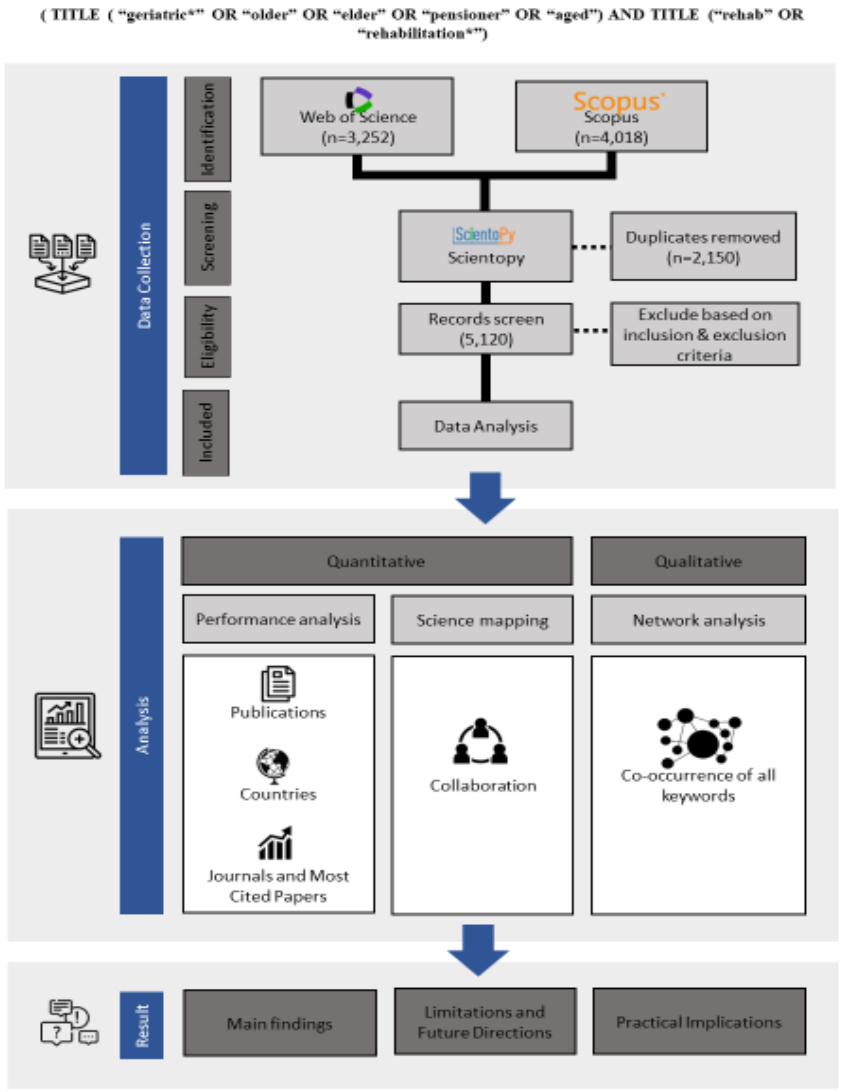

Figure 1. Diagram of the Search Process Adapted from the Previous Study (Azizan *et*

In short, this dataset combines efforts from the WoS and Scopus databases to gather geriatric rehabilitation research papers. After addressing duplicates and exclusions, the dataset consists of 5,120 distinct papers. This dataset can support detailed analyses to uncover the structure of knowledge in geriatric rehabilitation. See Table 1. For the analysis procedure, two key tools, ScientoPy and VOSviewer, were employed to delve into the dataset's contents and map out the knowledge structure of geriatric rehabilitation based on a previous study (Azizan *et al.*, 2024). The study framework is exhibited in Fig. 1.

Result and Discussion

The publication growth trends in geriatric rehabilitation in Fig. 2 show that, as documented in the Web of Science (WoS) database, they provide valuable insight into the evolution of research in this field from 1947 to 2023. The early years, spanning the late 1940s to the mid-1950s, showcased a gradual but steady rise in publications. This initial uptick might signify the nascent exploration of rehabilitation strategies tailored for the elderly population. As the 1960s unfold, there's been a more pronounced increase in publications, suggesting a growing recognition of the importance of geriatric rehabilitation. This upward trend persists through the 1970s and 1980s, perhaps

indicating the escalating attention given to elderly care and rehabilitation methods within the medical and research communities. During the 1990s, a significant escalation in the growth of publications was observed, whereby the quantity of published materials nearly doubled in comparison to the prior decade. This surge aligns with the demographic shifts towards aging populations and the heightened emphasis on addressing healthcare concerns specific to the elderly. The path of development maintains a high degree of consistency throughout the early two-thousand and ten-year period, albeit at a slightly moderated pace relative to the preceding decade of the nineteen-nineties. However, a discernible shift emerged around 2013, marked by a decline in growth rates. While the exact reasons for this decline could be multifaceted, they may reflect a maturation of the field, a potential saturation of specific research angles, or changing research priorities.

The Scopus database offers parallel insights into the growth of geriatric rehabilitation research from 1947 to 2023. The earlier years, spanning from the late 1940s to the 1960s, demonstrate a gradual but steady upward trajectory in publications. This aligns with the exploration and development of strategies catering to the rehabilitative needs of the elderly. The late 1960s through the mid-1990s saw a pronounced increase in publications, possibly mirroring the growing recognition of geriatric rehabilitation's significance within medical and research circles. The period of the late 1990s and early 2000s saw noteworthy growth, which was marked by a considerable surge in published works. This surge could reflect a heightened awareness of the aging population's healthcare needs and a corresponding surge in research efforts in geriatric rehabilitation.Similar to WoS data, Scopus data also shows a moderation in growth rates during the 2010s, potentially indicating a shift in research focus or the field reaching a certain level of saturation.

Fig. 3 offers a comprehensive panorama encompassing the top ten countries that significantly contribute to the landscape of geriatric rehabilitation research. This assemblage serves to illuminate the global distribution of scholarly endeavors while underscoring the intrinsic importance of addressing the healthcare exigencies of the elderly population on a global scale. Foremost, the United States (USA) takes precedence by securing the vanguard position with an impressive corpus of 879 research papers. This preeminence accentuates the nation's substantive involvement as a propellant in the domain of geriatric rehabilitation research. This pervasive presence is emblematic of the United States' unwavering commitment to scientific inquiry, technological progress, and pioneering healthcare resolutions tailored to the complex requirements of the aging demographic.

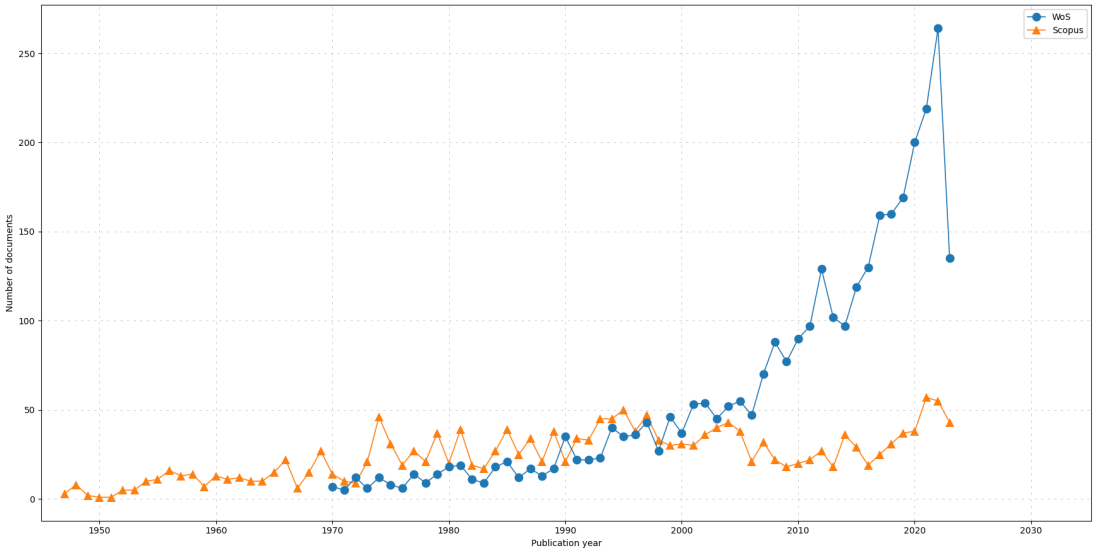

Figure 2. Total Yearly Publications from WoS and Scopus Database (1947-2023)

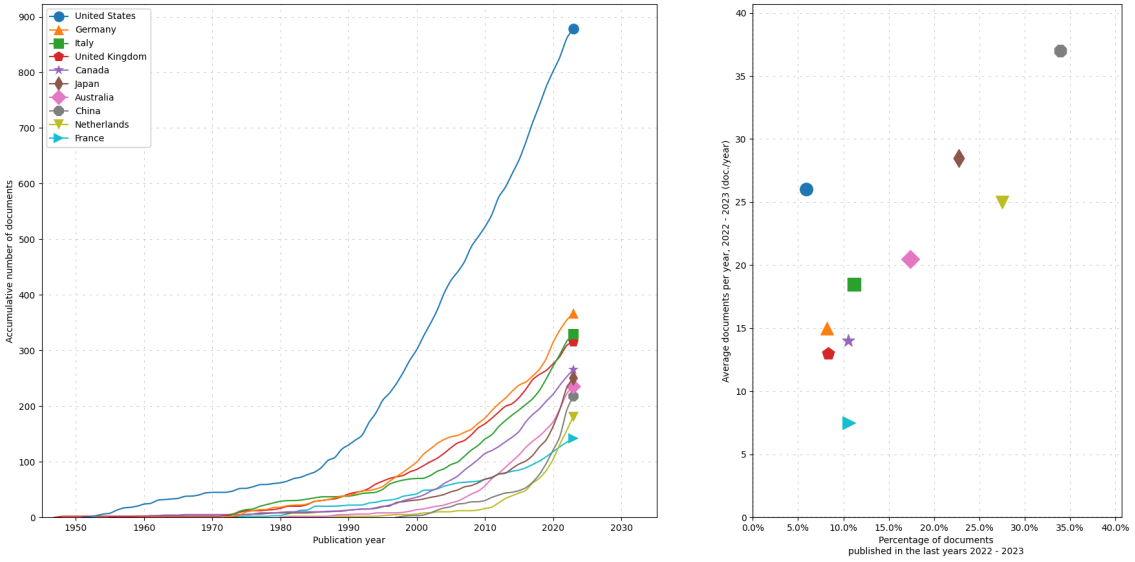

Figure 3. Top 10 Contributing Countries in Geriatric Rehabilitation Research (1947-2023)

Secondly, Germany's proximate position emerges with 367 research papers, consolidating its pivotal role as a significant participant in the landscape of geriatric rehabilitation research. Germany's substantial contribution serves as a compelling testament to its unswerving dedication to fostering healthcare innovations aimed at ameliorating the quality of life for its aging populace. Similarly, Italy's scholarly output, amounting to 330 research papers, elucidates its palpable engagement in geriatric rehabilitation research pursuits. This notable involvement underscores Italy's earnest investment in healthcare advancements, particularly in the context of confronting the distinctive healthcare requisites of the elderly population through pioneering rehabilitation methodologies. In contrast, the United Kingdom (UK), ranking fourth with 315 research papers, robustly exemplifies its earnest commitment to geriatric rehabilitation research. This substantive commitment is consonant with the UK's established renown for healthcare excellence, amplifying efforts to elevate healthcare standards for the aging demographic.

Continuing along this trajectory, Canada's contribution of 266 research papers underscores its meritorious role in advancing geriatric rehabilitation research. This representation serves to underscore Canada's dedicated exploration of innovative healthcare strategies and interventions tailored to enhancing the overall well-being and quality of life for its elderly population. Shifting focus to Japan, its research output comprising 251 research papers positions it prominently within geriatric rehabilitation research. Japan's prolific scholarly output is indicative of its characteristic technological prowess and proactive disposition in addressing the healthcare imperatives of its aging populace. Similarly, Australia's participation is evidenced through 236 research papers, providing a clear depiction of its active involvement in geriatric rehabilitation research pursuits. Australia's contributions resonate with its commitment to fostering health, well-being, and optimal aging through meticulous rehabilitation paradigms. Meanwhile, China's corpus of 218 research papers underscores its burgeoning influence within the domain of geriatric rehabilitation research. This burgeoning contribution accentuates China's recognition of the pivotal role research assumes in the advancement of bespoke healthcare solutions tailored to meet the needs of a burgeoning aging population.

In contrast, the Netherlands' substantial contribution of 182 research papers is emblematic of its noteworthy imprint in geriatric rehabilitation research. The nation's resolute participation underscores its concerted endeavors in pioneering high-caliber healthcare interventions addressing the needs of its elderly citizens. Lastly, France's scholarly offering, totaling 142 research papers, underscores its

pivotal role within the landscape of geriatric rehabilitation research. This engagement harmoniously aligns with France's distinguished commitment to healthcare innovation, substantiating its pursuit of augmented well-being for its aging population.

Table 2 presents the list of top journals related to geriatric rehabilitation publications and highlights influential sources contributing significantly to the field. These journals are pivotal in disseminating research findings and advancing knowledge in geriatric rehabilitation. The Archives of Physical Medicine and Rehabilitation leads the list with 124 publications. Despite a slight negative growth rate of -1.5%, its h-index of 35 underscores its strong citation impact. Published by W.B. Saunders Ltd., this journal holds a robust position in physical medicine and rehabilitation.

The Journal of the American Geriatrics Society follows closely with 112 publications. Its steady annual publication rate, coupled with an h-index of 31, reflects its influence on geriatric rehabilitation. Wiley-Blackwell Publishing Ltd. serves as its platform for sharing insights on geriatrics and aging. Topics in Geriatric Rehabilitation offers 93 publications and demonstrates a growth rate of 0.5%. With an h-index of 9, it holds a niche influence within geriatric rehabilitation. The journal's discussions are channeled through Lippincott Williams and Wilkins Ltd. Disability and Rehabilitation presents 75 publications with a growth rate of 0.5%. Its wide coverage, encompassing geriatric rehabilitation, contributes to an h-index of 21. Informa Healthcare serves as the journal's publisher, focusing on research that enhances the lives of individuals with disabilities.

The Giornale Di Gerontologia provides 66 publications, primarily in the Italian context. Its modest growth rate and h-index make it valuable in the Italian gerontological landscape. PaciniEditores.r.l. facilitates its contributions to Italian-language literature. ZeitschriftfürGerontologie Und Geriatrie showcases 65 publications and caters to the German-speaking sphere. Its h-index of 10 denotes its significance in German gerontology. Published by D. Steinkopff-Verlag, it fosters German research exchange. Geriatrics contributes 51 publications addressing geriatric care and rehabilitation. With a slight negative growth rate and an h-index of 4, it informs healthcare professionals. Advanstar Communications Inc. is its platform for dissemination.Aging Clinical and Experimental Research features 50 publications focusing on aging and clinical practice. Its steady publication rate, coupled with an h-index of 15, advances knowledge. Springer Verlag serves as its conduit.

BMC Geriatrics offers 50 publications despite a -2.5% growth rate. Its h-index of 16 signifies open-access contributions. BioMed Central Ltd. promotes accessibility and collaboration. The Journal of the American Medical Directors Association concludes the list with 50 publications. Its h-index of 17 indicates its role in geriatric healthcare discourse. Published by Elsevier Inc., it addresses clinical, administrative, and policy aspects. In essence, these top journals collectively contribute to geriatric rehabilitation's growth and dissemination. Their diverse growth rates, focus areas, and citation impacts enrich the field's discourse, fostering collaboration and knowledge advancement in elderly care and well-being.

We also ran the keyword co-occurrence analysis in VOSViewer to build the network map (Fig. 4). We picked fractional counting with at least twenty (20) occurrences of terms in publications. 51 keywords met the criteria of 5770 keywords. Therefore, we decided to create a network map that only shows keywords related to each other. The co-occurrence patterns of the author's keywords reveal the prevalence of several terms, indicating their substantial presence and interconnectedness within the body of research. "Rehabilitation" (Occurrences: 1056) has emerged as the foremost co-occurring term, boasting a significant count of 1056 occurrences. This prevalence underscores the research's central concentration on the multifaceted process of restoring and augmenting functional capacities, enhancing quality of life, and promoting overall well-being among elderly individuals. Next, "Aged" (Occurrences: 613) prominently appears with 613 occurrences, signifying a foundational emphasis on the elderly population as the

Table2. The Most Productive Journals with the Most Cited Articles are Basedon the ScientoPySoftware.

No	Journal	TP	AGR	ADY	PDLY	h-Index	Publisher	Most Cited Article
1	Archives of Physical Medicine and Rehabilitation	124	-1.5	1	1.6	35	W.B. Saunders Ltd	*Cognitive status at admission: Does it affect the rehabilitation outcome of elderly patients with hip fractures?(Heruti et al., 1999)*
2	Journal of the American Geriatrics Society	112	-1	2.5	4.5	31	Wiley-Blackwell Publishing Ltd	*Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls (Hauer et al., 2001)*
3	Topics in Geriatric Rehabilitation	93	0.5	1	2.2	9	Lippincott Williams and Wilkins Ltd.	*Evaluation of a vision rehabilitation program for older adults with visual impairment (Pankow et al., 2004)*
4	Disability and Rehabilitation	75	0.5	6	16	21	Informa Healthcare	*Communication and psychosocial consequences of sensory loss in older adults: overview and rehabilitation directions (Heine & Browning, 2002)*
5	Giornale Di Gerontologia	66	0	0	0	2	Pacini Editores.r.l.	*Clinical severity and comorbidity: Their impact on geriatric rehabilitation (Colombo et al., 2003)*
6	Zeitschrift Fur Gerontologie Und Geriatrie	65	-0.5	1.5	4.6	10	D. Steinkopff-Verlag	*Combined whole body vibration and balance training using Vibrosphere (R) Improvement of trunk stability, muscle tone, and postural control in stroke patients during early geriatric rehabilitation (Merkert et al., 2011)*
7	Geriatrics	51	-0.5	0.5	2	4	Advanstar Communi cations Inc.	*What Influence Does Age Have on the Rehabilitation Of Amputees (Kerstein et al., 1975)*
8	Aging Clinical and Experimental Research	50	0	5.5	22	15	Springer Verlag	*Effect of nutritional status on clinical outcome in a population of geriatric rehabilitation patients (Donini et al., 2004)*
9	BMC Geriatrics	50	-2.5	4.5	18	16	BioMed Central Ltd.	*Effectiveness and feasibility of early physical rehabilitation programs for geriatric hospitalized patients: a systematic review (Kosse et al., 2013)*
10	Journal of the American Medical Directors Association	50	-2	2.5	10	17	Elsevier Inc.	*Delirium Superimposed on Dementia Strongly Predicts Worse Outcomes in Older Rehabilitation Inpatients (Morandi et al., 2014)*

Notes: TP= Total Publication; AGR= Average Growth Rate; ADY=Average Publication per Year; PDLY=Publications in the Last Year.

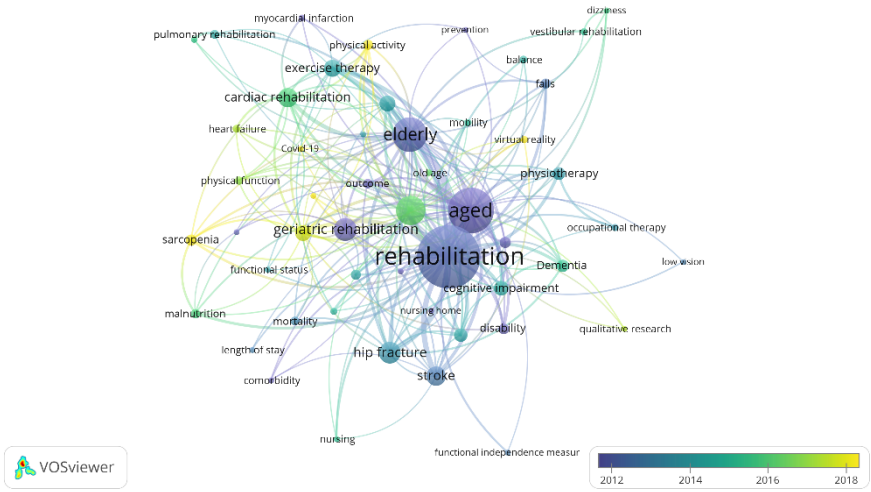

Figure 4.OverlayVisualization Map of Co-Occurrence of All Keywords from the VOSviewer.

principal focus of interest. This prevalence highlights the research's steadfast commitment to addressing the distinctive healthcare requisites of older adults comprehensively.

"Hip Fracture" (Occurrences: 176) in 176 instances signifies a notable concentration on this specific health concern within the geriatric demographic. This prevalence sheds light on research endeavors dedicated to comprehending, averting, and managing hip fractures among the elderly, with potential implications for rehabilitation strategies. "Stroke" (Occurrences: 147) has emerged significantly with 147 occurrences, indicating substantial exploration of its effects on the elderly population. This underscores the focus on rehabilitation interventions to facilitate recovery and enhance post-stroke quality of life among the elderly. In addition, "Cardiac Rehabilitation" (Occurrences: 145) with 145 occurrences underscores pronounced attention to cardiovascular health and related rehabilitation approaches within the geriatric context. The prevalence of this keyword accentuates the integration of comprehensive methodologies to enhance heart health and overall well-being among the elderly.

"Exercise Therapy" (Occurrences: 117) was noted with 117 occurrences, denoting a robust consideration of physical activity interventions as pivotal components of geriatric rehabilitation. This emphasis aligns with the acknowledgment of exercise's crucial role in maintaining functional capabilities and holistic well-being in the elderly population. The prevalence of "frailty" in 109 instances underscores the significant interest in exploring the concept's impact on the elderly population. Research within this domain is likely focused on identifying effective strategies to address and manage frailty, thereby contributing to comprehensive and tailored rehabilitation approaches.Collectively, these terms offer a comprehensive portrayal of the research landscape centered on geriatric rehabilitation. The co-occurrence of these keywords highlights the adoption of a multidisciplinary approach, encompassing aspects of physical health, medical conditions, intervention strategies, and the multifaceted challenges and opportunities that accompany the aging process.

Conclusion

In conclusion, this bibliometric analysis has provided a comprehensive overview of the knowledge structure and research trends in geriatric rehabilitation, shedding light on growth patterns, top contributing countries/institutions/journals, prevalent author keywords, clusters, and themes. The findings reveal priority areas for future research endeavors and practical implications for enhancing rehabilitation practices, fostering collaborations, tailoring healthcare solutions to elderly needs, and ultimately improving outcomes and quality of life. As the aging

population expands globally, the insights from this analysis serve as an evidence-based foundation for advancing geriatric rehabilitation through translational research and strategies that enable older adults to age with optimal well-being and independence.

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Effectiveness of Short Message Service Reminder and Counseling of Immunization for Age 18-24 Months

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Abstract

Indonesia now ranks fourth in the world in terms of the largest number of unimmunized children. SMS (Short Message Service) reminders and counseling have been shown to increase outreach, but no research has combined these two interventions. This study aimed to determine the effectiveness of SMS Reminder and Counseling on the knowledge, attitude, and willingness of mothers under five and to find out the factors that influence this willingness. This study used the one-group method, pretest, and posttest design. The samples were 186 children under five (18-24 months) who felt incomplete and mothers who had children under five (control and intervention groups). The Chi-Square test shows significant results during the post-test ($p < 0.05$). The Mc-Nemar test shows the influence of counseling and SMS Reminders on increasing knowledge, attitudes, and willingness ($p = 0{,}000$). The logistic regression test shows the factors that affect the advanced immunization of under two years child, that was sufficient knowledge ($\rho = 0{,}000$; OR = 13,384; CI = 5,986-29,926). SMS Reminders and counseling affect parents' knowledge, attitudes, and willingness. Factors affecting parental willingness to continue immunization are adequate knowledge. Collaboration between officials and health agencies, the community, and cellular operators is needed to implement the training of health workers.

Introduction

Indonesia now ranks fourth in the world in terms of the largest number of unimmunized children (World Health Organization, 2020). The WHO Expanded Programme on Immunization was launched in Indonesia in 1977, and the country currently has a comprehensive multiyear plan for immunization, covering 2015–2019. Basic immunization for children is indicated as part of the minimum standard health services for districts and provinces, as specified in the 2016 Ministry of Health Decree No. 43. Furthermore, the complete basic immunization for children is included in the Healthy Indonesia Programme with Family Approach (Program Indonesia Sehat Dengan Pendekatan Keluarga/PIS-DPK), a recent program to promote health through primary health centers (World Health Organization, 2017). Some of the most effective vaccines are composed of attenuated microbes, which are treated to abolish pathogenicity while retaining their infectivity and antigenicity (Abbas & Lichtman, 2020).

Data from Indonesia in 2018, 66% of districts attained >80% coverage with the third dose of the pentavalent vaccine, while only 17% of districts attained >90% coverage with the second dose of measles-containing vaccine (MCV2). Only 11 (32%) of 34 provinces had more than 95% fully immunized children (World Health Organization, 2020). Most

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locations fell below the 2020 GVAP (Global Vaccine Action Plan) target of achieving at least 90% coverage across vaccines in 2019, signaling the need to further expand the program reach of unvaccinated or under-vaccinated children. In 2019, 75% of zero-dose children lived in 14 countries one of them being Indonesia (Galles *et al*., 2021).

Indonesia, the complete basic immunization indicator had the lowest national average coverage (59.2%). The highest national average coverage was reported for the two indicators that capture a single vaccine dose (BCG at 87.6% and measles at 82.1%), followed by polio (77.0%) and DPT-HB (75.6%) (World Health Organization, 2017). Based on research Chu H in 2022 showed data in 2017, only 5 out of 34 provinces had full immunization rates above 80%, while 11 provinces had full immunization rates below 60% one of them East Java (Chu & Rammohan, 2022). Several outbreaks of diphtheria have occurred in the East Java Province of Indonesia there were 97 diphtheria cases approved by the Diphtheria Expert Committee in 2019. The reports came from 36 of 38 districts. One patient died, denoting a case fatality rate of 1%. The majority were 19 years of age or less, with incomplete immunization (Husada *et al.*, 2020). Cases of diphtheria in 170 regencies or cities in 30 provinces in Indonesia with a CFR of 4.6% in 2017 and 48% of cases of diphtheria came from East Java. Kediri is one of the regencies that was affected by the outbreak in January 2018 and found 19% of toxigenic positive cases from 21 cases of diphtheria until May 2018 (Sari & Shofiya, 2020). Pneumonia disease is the second leading cause of death in children under five after diarrhea. The study with Wati, N *et al* in 2021 concluded the significant relation between immunization status. DPT immunization is one of the effective immunizations to reduce factors that increase mortality from pneumonia (Wati *et al.*, 2021). Immunization status and maternal knowledge are variable factors that influence the occurrence of measles in Indonesia. Parents, especially mothers, need to increase their knowledge of measles and support government programs called measles-rubella immunization to avoid infection with measles (Ramadhani *et al.*, 2023).

This study's tendency is that the low education level is one of the risk factors for the incompleteness of immunization coverage (Hu, 2015; Abebe *et al*., 2019; Choi *et al*., 2017). The other research findings indicate that there is a wide range of inequality in immunization throughout the Indonesia region due to socioeconomic and demographic factors that complete immunization status was significantly associated with the mother's education (Siramaneerat & Agushybana, 2021).

Program innovation using mobile phone short message service is a widely applicable appointment reminder intervention to improve healthcare. The majority of mothers have the intention to use text message reminders for child vaccination. Mother's age and education use were associated with the intention of mothers to use text messages for vaccination. Considering these predictors and user preferences before developing and testing text message reminder systems is recommended (Akinrinade *et al*., 2018; Mekonnen *et al.*, 2021; Yeung *et al*., 2018).

Many previous studies have examined one type of intervention to increase parental awareness of immunization and significantly better routine immunization performance (Choi *et al*., 2017; Hu, Li, and Chen, 2018; Eze & Adeleye, 2015). After achieving large gains in childhood vaccine coverage worldwide, in much of the world this progress was stalled or reversed from 2010 to 2019. These findings underscore the importance of revisiting routine immunization strategies and programmatic approaches, recentring service delivery around equity and underserved populations. Strengthening vaccine data and monitoring systems is crucial to these pursuits, now and through to 2030, to ensure that all children have access to, and can benefit from, lifesaving vaccines (Galles *et al.*, 2021) Therefore, this study was conducted to determine the combined effects of the two interventions (SMS Reminder and counseling) on immunization awareness from mothers in the working area of Mrican Health Center in Mojoroto District, Kediri City. Researching using more than one intervention can help increase parental awareness of immunization, which is one of the Public Health Center programs.

Methods

The types of research used in this study are One group Pretest and Postest Design. The study was conducted in the working area of Mrican Health Center in Mojoroto District, Kediri City in 2020. The sample of this study was under two years child and under two years child mothers whose incomplete immunization status was in the working area of the Mrican Health Center and fulfilled the inclusion and exclusion criteria. Inclusion criteria in the form of under two years child and mothers who are willing to participate in the whole series of research, and mothers with under two years child who have mobile phones and can read. While the exclusion criterion is the mothers with under two years child who are not willing to participate in this research activity, in this study, there were 212 under two years child born in January - September 2018 with details of 26 under two years children that had complete immunization and 186 under two years child with incomplete immunization. The incomplete follow-up immunization referred to in this study is the two-year-old child who has not received DPT-Hb-Hib and measles immunization, measles immunization, or only DPT-Hb-Hib immunization. This study used Total Sampling, which samples the number of under two years people born in January - September 2018. The Children born in the working area of Mrican Health Center covering the villages of Mrican, Gayam, Ngampel, and Dermo, whose immunization status is still incomplete. The population used is the incomplete under two years child status of immunizations born in January-September 2018 is as many as 186 under two years child so that the number of samples of this study is equal to the number. Subsequently, a sample of under two years child born in that month (March 2020) was used because in the month of data collection, even under two years children aged 18-24 months added time opportunity to catch up. The number of samples needed in this study was 186 samples consisting of 2 groups: 93 control groups in which the group was not given counseling and intervention SMS Reminders and the intervention group amounted to 93 samples where in this group the intervention was given in the form of counseling and SMS Reminder. The instruments used in this study were questionnaires, 2019 preschool toddler cohort data, counseling materials in the form of power points, videos, and leaflets regarding the definitions, types, schedules, importance, and KIPI of advanced immunization for children, tabs, and laptops used as a tool for displaying power points and videos. The questionnaire was filled out following the sample data, including identity, age, occupation, and last education. The questionnaire uses thirty-five questions divided into the first fifteen questions about knowledge, the next thirteen questions about attitude, and the last seven questions about willingness. The independent variables assessed by the questionnaire included knowledge variables divided into adequate (values greater than 7.5) and inadequate (values less than 7.5), attitude variables divided into positive (values greater than 48) and negative (values less than 48), and willingness variables which divided into agree (value greater than 24.5) and disagree (value less than 24.5).

The flow of data collection first determines the age of under two years (18-24 months). Initially search for under two years child data which in March 2020 aged 18-24 months then look for under two years child born in January - September 2018 from 2019 cohort book sources. Completeness of immunization data seen using the 2019 and 2020 cohort books. After that, names and home addresses are recorded. Samples that have determined then visited one by one or found during the Integrated Family Planning Health Service activities to be informed whether parents are willing to be respondents, then samples that agree do a pretest, and continue counseling about the definition, type, schedule, importance and KIPI advanced immunization of under two years child by researchers to under two years child mothers (Jaca *et al*., 2018).

Counseling is done individually and face to face. One researcher gave counseling to one respondent using power points and videos that were displayed through electronic media (laptops, tabs) and given leaflets about immunizations. After counseling, the researcher explained to participants have mobile phones and are willing to receive messages the intervention SMS Reminder that will be carried

out by researchers (Akinrinade *et al*., 2018 Jaca *et al*., 2018; Oladepo *et al.*, 2019). Researchers explain the definition of SMS Reminder, its objectives, and methods. After the respondent understands, then the researcher asks for an active mobile number or the number of the closest person at home who often uses a cell phone and is asked to be willing to text

After that, the SMS Reminder is carried out once a day before the schedule for the immunization of the under two-year-old child is carried out. The SMS was sent to mothers with under two years child with the following format by phone in the local language: "Assalamualaikum mom, we are doctors from the Mrican Health Center, we want to remind you, that tomorrow is the time for measles continued immunization for your child, please take your child to the Mrican Health Center tomorrow. Do not forget to bring a pink book or an immunization card. Thanks. Wassalamualaikum" (Eze & Adeleye, 2015; Choi *et al*., 2017; Omoniyi & Williams, 2020). The next day the mothers of the under two years child who came further to immunize their children at the Mrican Health Center then did a post-test. The remaining visits were made to homes to fill out post-tests of advanced immunization counseling and SMS Reminder.

The author has previously passed an ethical review with the health research ethics committee with No.007/26/V/EC/KEPK/Lemb. Candle/2020. The data obtained will be analyzed using the SPSS 23 program. Univariate analysis is used to look at the frequency distribution and percentage of each research variable. Bivariate analysis to see differences in the variables of knowledge, attitudes, and willingness. Bivariate analysis was performed chi-square to determine differences in the pretest of the control group against the pretest of the intervention group, and the post-test of the control group against the post-test of the intervention group. The Mc Nemar test was conducted to determine the effect of counseling and SMS Reminder on knowledge, attitude, and willingness.

Results and Discussion

Based on Table 1, the number of mothers with under two years child aged 18 to 29 is 37 people a year, while more than 30 years old are 49 people. Mothers with under two years child who have a high level of education are 162 people, and those who have low education are 24 people. The work of mothers with under two years child is divided into two, namely working and not working, where 60 people work and the remaining 126 people do not work. The characteristics of respondents at the most are 18-29 years old (73.7%), this is in line with research by Mugada *et al* (2017) India found more respondents aged 21-25 years as many as 190 people (50.39%) (Mugada *et al*., 2017). In the study of Noh J., *et al* (2018) in Sindh City, Pakistan obtained more respondents aged 25-34 were 652 people (52.6%) (Noh *et al*., 2018). For the education level of respondents, most are in tertiary education (≥ high school) (87.1%), this is following research of Choi A. *et al* (2017) at the Korea Cancer Center Hospital found that more mothers had higher education or higher of 466 people (72.9%) and also in line with research Mugada *et al* (2017) in India found more mothers who have higher education levels of 142 people (37.66%) (Choi *et al*., 2017; Mugada *et al*., 2017).

Table 1. Sociodemographic Characteristics of Respondents

	n	%
Age:		
18-29 years	37	73,7%
≥ 30 years	49	26,3%
Education Level:		
High (≥ High School)	162	87,1%
Low (< High School)	24	12,9%
Occupation:		
Working	60	32,3%
Not Working	126	67,7%

(Source: Results Data, 2020)

However, this is different from the research of Noh J., *et al* (2018) where most mothers have no education in Sindh City, Pakistan is 420 people (44.5%) (Noh *et al*., 2018). Most respondents in this study were parents who did not work, as many as 126 people or 67.7%, this is following research conducted by Mugada *et al* (2017) regarding parental reasons for the incompleteness of the immunization status of their children in India, which was obtained more unemployed mothers were 340 people or 90.18% while mothers who

worked were 37 people or 9.18% (Mugada *et al*., 2017). According to Choi A. *et al* (2017), the Korea Cancer Center Hospital found 395 (61.8%) unemployed mothers and 244 (38.2%) working mothers (Choi *et al*., 2017).

To find the relationship between giving treatment with SMS reminders and counseling on knowledge, attitudes, and willingness of mothers with under two years child in advanced immunization of under two years child assessed in the pretest and post-test. A comparative category test was conducted by Mc Nemar in the two control and intervention groups. Based on Table 2, it was found that in the intervention group, the number of mothers with under two years child who had adequate knowledge at the pretest and post-test 25 people and 68 people who initially had inadequate knowledge at the pretest became adequate at the post-test after giving SMS reminder and counseling. Mothers with under two years child in the control group who had adequate knowledge at the time of the pretest and post-test were 23 people. In contrast, those who initially had inadequate knowledge at the pretest then still had inadequate knowledge at the post-test as many as 70 people and none became adequate at the post-test. This shows there is an influence between the treatment of knowledge mothers with the advanced immunization of the intervention group (p= 0,000). There is an influence between the treatments on advanced immunization knowledge of the control group (p= 0,000).

This is also consistent with the research of Navin *et al*. (2019), which states that counseling can increase respondents' knowledge about immunization, especially in areas with low levels of health knowledge (Navin *et al*., 2019). The method of counseling in this study is face-to-face or one researcher educating one respondent, and this is in line with previous research that education face to face can increase respondents' knowledge about immunization in children, especially in areas that experience immunization-related obstacles, moreover, mobile immunization strategy improved the immunization access and utilization in the health facilities (Shikuku *et al*., 2019). Parental knowledge is essential in increasing child immunization coverage (Mugada *et al*., 2017; Noh *et al*., 2018). Moreover, the ease of access to immunization in various health service facilities should also be prioritized. From the results of this research and discussion, it is recommended that the government increase the number of health facilities, especially in areas that have low immunization coverage (Siramaneerat & Agushybana, 2021).

Moreover, an attitude factor was found in the intervention group, the mothers with under two years child who had a positive attitude at the pretest and post-test as many as 19 people. In contrast, samples that have a negative attitude when pretest and became positive at the time of the post-test number 72 people, and 2 others remain in the negative attitude category. Mothers under two years child in the control group who had a positive attitude at the pretest and remained good when the post-test were 19 people, but there were no mothers with under two years child who had a negative attitude at the pretest and became positive when the post-test. At the same time, the sample that still had 74 negative people was pretest and post-test. This shows there is an influence between treatment to the attitude of the mothers in the intervention group (p= 0.000). There is no influence on the attitude of the mothers with under two years child to the continued immunization of the under two years child in the control group (p= 1,000[a]). In terms of the willingness variable, explained that mothers with under two years child in the intervention group who still agreed with continued immunization when the pretest and post-test were 25 people, while those who changed from the category of disagreeing willingness to agree were 59 people.

Based on the results of this research, counseling and SMS reminder interventions are effective against parental attitudes about the importance of immunization with a significance value of 0.000 (p <0.05). The results of these significant values are likely to occur because the interventions given have conveyed how attitudes towards the importance of immunization properly so as not to become a category of children with incomplete immunizations. Hu's (2015) study shows that counseling interventions in health promotion can improve knowledge, attitudes, and practices towards

Table 2. Analysis of Knowledge, Attitude, and Willingness of Mothers with Under Two Years Child's Advanced Immunization

Knowledge Pretest		Post-test		p-value
		Adequate	Inadequate	
Intervention	Adequate	25	0	.000
	Inadequate	68	0	
Control	Adequate	23	0	.000
	Inadequate	0	70	
Attitude Pretest		Positive	Negative	p-value
Intervention	Positive	19	0	.000
	Negative	72	2	
Control	Positive	19	0	1.000[a]
	Negative	0	74	
Willingness Pretest		Agree	Disagree	p-value
Intervention	Agree	25	0	.000
	Disagree	59	9	
Control	Agree	33	0	.500[a]
	Disagree	2	58	

(Source: Results Data, 2020)

vaccination among caregivers and suggests this strategy should be focused on caregivers with low education levels or with misinformation or bad perception about immunization and must be integrated into the immunization program (Hu, 2015). In addition, well-informed mothers will increase immunization coverage and are very cost-effective (Powell-Jackson *et al*., 2018). In contrast to other studies, a value obtained of p=0.592 where the SMS Reminder intervention did not affect parental attitudes about immunization even though the percentage of parents who had a positive attitude was higher than the negative attitude. This is explained in the disposition of the study, which means that the study was welcomed by parents but must be careful because even though the positive attitude towards the mother is strong if it is not balanced with good knowledge, it will not increase the coverage of immunization in children (Oladepo *et al*., 2019)

In this study, counseling, and interventions were SMS reminders effective against parents' willingness to immunize their children with a significance value of 0,000 (p <0.05). This is likely due to the reminder system that serves to remind parents to immunize their children because many parents claim to forget their child's immunization schedule often so it can be prevented by giving an SMS reminder the day before the immunization schedule. This is consistent with previous research, which says that text message reminders on mobile phones have the potential to increase child vaccination coverage (Mekonnen *et al.*, 2019; Mekonnen *et al.*, 2019). Most parents welcomed this SMS

Table 3. Comparison of Control Group and Intervention Pre-test - Posttest Knowledge, Attitude, and Willingness of Mothers with under two years of child Advanced Immunization.

		Control	Intervention	p-value (Chi-Square)
Knowledge Pretest	Adequate	23	25	0,738
	Inadequate	70	68	
Knowledge Posttest	Adequate	23	93	0,000
	Inadequate	70	0	
Attitude Pretest	Positive	19	19	1,000
	Negative	74	74	
Attitude Posttest	Positive	0	61	0,000
	Negative	93	32	
Willingness Pretest	Agree	33	33	1,000
	Disagree	60	60	
Willingness Posttest	Agree	12	51	0,000
	Disagree	81	42	

(Source: Results Data, 2020)

Reminder intervention because it was quite helpful in reminding their child's immunization schedule so that it was not missed (Oladepo *et al.*, 2019; Omoniyi & Williams, 2019; Mekonnen *et al.*, 2021). In another study, it was mentioned that effective immunization education interventions increase parental willingness, so child immunization coverage also (Jaca *et al.*, 2018; Mora & Trapero-Bertran, 2018). Immunization counseling in the form of video performances can increase parent willingness because the method is considered exciting and easier to understand (Hu *et al.*, 2018).

Mothers with under two years child in the control group were initially unwilling at the pretest, and when the post-test were 2 people and those who still disagreed were 58 people so it can be concluded that there is an influence between the treatment given to mothers with under two years child's willingness in the continued immunization of the under two years child in the intervention group (p= 0,000). There was no influence on the willingness of the mothers with under two years child in the continue immunization of the under two years child in the control group (p= 0.500[a]).

Based on Table 3, showing knowledge during the pretest in the control group was found that 23 respondents had adequate knowledge, and 70 respondents had inadequate knowledge. In contrast, in the intervention group, it was found that 25 respondents had inadequate knowledge, and 68 respondents had inadequate knowledge. Test Chi-Square results showed insignificant results because it has a p-value of 0.738 (p> 0.05). The results of the comparison of the attitude at the pretest in the control group found that 19 respondents had positive attitudes, and 74 respondents had traits negative. In comparison, in the intervention group, 19 respondents had positive traits, and 74 respondents had negative traits. Test Chi-Square results showed insignificant results because they had a p-value of 1,000 (p> 0.05). The results of the comparison of the willingness pretest in the control group found 33 respondents who agreed and 60 respondents who did not agree. In comparison, in the intervention group, 33 respondents agreed, and 60 respondents did not, the test Chi-Square results showed insignificant results because it had a p-value of 1,000 (p> 0.05).

Based on table 3 shows the current knowledge post-test on the control group found 23 respondents who had adequate knowledge and 70 respondents who had inadequate knowledge. In contrast, in the intervention group, 93 respondents had adequate knowledge, and no respondents had inadequate knowledge, test results Chi-Square shows significant results because it has a p-value of 0,000 (p <0.05). The comparison results of attitudes post-test in the control group did not show respondents had a positive attitude, and 93 respondents had a negative trait. In contrast, in the intervention group, it was found that 61 respondents had a positive trait, and 32 respondents had a negative trait. Chi-Square test results showed significant results because it had a p-value of 0,000 (p <0.05).

The comparison of the pretest knowledge of attitude, and willingness before being given treatment to the control group and the intervention group have insignificant results, it shows that the knowledge, attitudes, and willingness of the respondent before being treated either control or intervention are not much different. The results of the comparison of post-test knowledge, attitudes, and willingness after being treated in the control group and the intervention group showed significant results. This shows that knowledge, attitudes, and willingness after being treated in both controls and interventions have differences, which means the treatment given by researchers in the form of SMS Reminder and Counseling can affect the knowledge, attitudes, and willingness of respondents. This is consistent with the journal stating that according to Hu (2015), research shows that one-hour educational counseling given to parents in clinics that provide vaccinations is an effective and practical strategy to increase the level of knowledge about vaccination (Hu, 2015). Likewise, it is in line with research that explains that educational interventions can improve parent knowledge scores and their willingness to vaccinate their children (Otsuka-Ono *et al.*, 2019). In the study of Choi A. *et al* (2017), evaluating the effect of educational interventions on parental opinions about infection and immunization, the results of

the study indicate that counseling interventions improve parental attitudes toward vaccination (Choi *et al*., 2017). Other studies also show that parents who are good at vaccinating their babies four times (AOR=4.308, 95% CI: (2.609–7.111) are more likely to be knowledgeable than their peers. This may be related to an increase in the mother's educational status which increases people's health-seeking behavior. Parents have a positive influence on the absorption of infant immunization (Gebre *et al*., 2021).

In other research extrinsic factor related to incident pneumonia is education. The recommendation can be low incident to improve MCH (Maternal and Child Health) management, such as complete basic immunization, and routine vitamin A administration (Jannah *et al.*, 2021). In another study, it was explained that the text message reminder could help mothers who had attended immunization to complete their child's immunization to completion (Oladepo *et al.*, 2019; Yeung *et al*., 2018). The success of SMS reminder intervention will be 100% successful if every household has a functional cellular telephone, and the language in the text message uses the local language (Omoniyi & Williams, 2019). Other studies have shown that information is simply given to remind mothers that their children should be immunized, using low-cost interventions such as SMS reminders (Powell-Jackson *et al*., 2018). SMS reminders are useful for mothers who forget their vaccination appointment date (Abebe *et al*., 2019).

Based on Table 3, prior knowledge is the most influential variable in increasing mother's willingness to carry out further immunizations on their children. It was revealed that parental knowledge could increase willingness to complete child immunization (GebreEyesus *et al*., 2021; Akinrinade *et al*., 2018). This also provides information on the benefits of immunization as well as a form of health promotion in general (Omoniyi & Williams, 2020).

Table 4. Analysis of Factors Affecting Willingness Bivariate Mothers with Under Two Years Child Advanced Immunization

			Willingness		p-value
			Agree	Dis agree	
Knowledge	Pretest	Adequate	37	11	0,006
		Inadequate	29	109	
Attitude	Pretest	Positive	15	23	0,002
		Positive	51	97	
Age		18-29	37	78	0,653
		≥30	29	42	
Education Level		High	38	64	0,079
		Low	28	56	
Occu pation		Working	27	58	0,000
		Not Working	39	62	

(Source: Primary Data Processed, 2020)

Analysis of factors that influence mothers' wishes based on p-value p<0.25, namely attitude, level of education, and employment. However, the age factor did not influence the mother's desire to continue immunizing toddlers (p>0.25) so it could not be continued with the regression test.

Based on table 5 shows that adequate parental knowledge simultaneously influences the willingness of mothers to advance immunization for children. These results that knowledge and attitude before treatment, parental education level, and parental occupation have a significant p-value(p<0.05),

Table 5. Logistic Regression Factors Affecting Mother's Willingness in Under Two Years Child Advanced Immunization

Variables	B	Wald	Sig.	OR	95% C.I.for EXP(B)	
					Lower	Upper
LAST EDUCATION						
Low (< HS)	-,236	,417	,518	,790	,387	1.615
OCCUPATION						
Not Working	.478	1.676	,195	1.613	,782	3.324
ATTITUDE						
Positive	,086	,037	,848	1,089	,455	2.609
KNOWLEDGE						
Adequate	2.594	39.924	,000	13.384	5.986	29.926
Constant	-1.519	17.993	,000	.219		

(Source: Primary Data Processed, 2020)

which shows that there is a relationship with the level of willingness to carry out advanced immunizations. This is the following research by Kara *et al* (2018), which explains that the knowledge, attitudes, work, and education of parents influence the scope of child immunization (Kara *et al.*, 2018). In line with other studies that explain that the level of parental education and parental worker an important role in increasing the coverage of child immunization (Singh *et al.*, 2019). Another study also said the level of a mother's education affects health behavior (health-seeking behavior). It is also believed that the higher the mother's level of education, the higher the number of fully immunized children (Mugada *et al.*, 2017). Education also influences visits by child's age study from Mora 2018 found that less educated parents visit their general practitioner more often for immunizations when their child is under six years of age (Mora & Trapero-Bertran, 2018). Other studies show the results that knowledge increases with education level. This finding is similar to research on maternal knowledge, perceptions, and child immunization practices in Enugu, Nigeria, which found that up to 90% of mothers in the study had at least secondary school education, which influenced their knowledge (Akinrinade *et al.*, 2018). Based on Table 6, it was found that the age factor has a p-value that is not significant, so it shows that there is no relationship between the mother's willingness to continue immunization. In line with Mekonnen's 2021 study, the majority of mothers have the intention to use text message reminders for child vaccination. Mother's age, education, duration of mobile phone use, perceived usefulness, and perceived ease of use were associated with the intention of mothers to use text messages for vaccination (Mekonnen *et al.*, 2021).

This study found that parents of under two years child refused to be sampled because according to the local regional midwife, the parents refused their children to be immunized on the grounds of side effects of immunization and religion. It was also explained in the study of Navin *et al* in 2019 that there were strong differences in the vaccination behavior of parents who refused the vaccine for different reasons indicating that the reasons for rejection were different according to the different motivations of parents (Navin *et al.*, 2019). Thus, different interventions might be effective for different groups of rejections. For example, some vaccine-driven vaccine rejection can be overcome if religious leaders communicate with their congregations about the moral imperatives of vaccination, or if vaccines produce materials removed from vaccines originating from aborted fetal tissue. Another study stated the reasons given by more than half of parents not to vaccinate their children were lack of awareness of the importance of vaccination, and some significant respondents responded to fear of side effects of immunization and sick children as reasons (Abebe *et al.*, 2019; Chang & Lee, 2019).

Conclusions

The results of the research that have been done show that SMS reminders and counseling affect the knowledge, attitudes, and willingness of mothers to increase the coverage of under two years child continued immunization in the working area of Mrican Health Center in Kediri. As well as the factors that influence the mother's willingness to increase the coverage of under-two-year-old child immunizations are adequate knowledge.

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Food Calory Intake and Physical Activity in Obesity Risk among College Students in Surabaya City

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Abstract

Productive age is at the peak of its activities, physical activities carried out tend to be heavier than other ages and one of the characteristics of developed countries is a country that has a high level of health, intelligence, and work productivity, which is influenced by nutritional intake and diet. Diet and excess tend to be owned by obesity. Obesity is also included in the condition of malnutrition. The research aimed to know the effect of diet and physical activity on the risk of obesity in students at a university in Surabaya. The method used in this study is case-control with 152 obese and non-obese adult respondents at a university in Surabaya using a 24-hour recall questionnaire, IPAQ for physical activity, and measurement of BMI (body mass index). The results of the study on average food calorie intake in obese adult respondents were higher than non-obese. The most consumed type of food obesity group (60 people) is chicken meat (mean: 348.55 kcal), while the most consumed food non-obese group (60 people) is white rice (mean: 753.71 kcal). The biggest calorie consumed in obese groups (34 people) is pizza (1,925.48 kcal), while those that are most consumed by non-obese groups are white rice. The results of statistical analysis using the chi-square test showed that there were significant differences in food intake between obese adult groups and non-obese adult groups (p=0.000). The results of the analysis of physical activity obtained in the obese group showed that most

Introduction

The highest level of physical activity is usually at productive age which is in optimal condition both physically and biologically. Physical activity also tends to be heavier than other ages (Szychowska and Drygas, 2021). Busy activities often trigger stress and irregular eating patterns can also cause health instability to diseases that are often experienced by people, the emergence of stress can change the normal functions of the body and in the long run this condition will cause hormonal changes. that occurs in the body unconsciously. If intake is not maintained properly, it can cause disease to decrease productivity (Yaribeygi *et al*., 2017). Productive age is very important. A significant reduction in productive age can cause losses to the state so the state needs migratory workers from other countries to stabilize productivity (Prokopenko, 2021).

High productivity will be greatly influenced by a balanced nutritional state. This is closely related to one's diet because the quality and quantity of food/beverage consumption will affect one's level of health. Good and balanced nutritional intake makes the body weight normal (healthy), the body's resistance to disease is high, work productivity increases and it has a lower risk of chronic disease and premature death (Kim, 2021).

Overeating patterns tend to be owned by someone who is overweight or obese (based on BMI/body mass index calculations). This causes the person to be more sensitive than someone with a normal BMI to external hunger cues that arise from the taste and smell of food

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(Reents and Pedersen, 2021). In addition, they also tend to eat when they feel like not just when they feel hungry. Some of the causes of obesity are excessive food intake but lack of activity (Belfort-DeAguiar and Seo, 2018), genetic factors (through hormonal and neural mechanisms) (Mahmoud *et al*., 2022), dietary changes with age (Villani, 2022), and behavior (Olateju *et al*., 2021). Therefore, obesity should be avoided as early as possible because obesity harms the quality of health, health costs, and productivity in society. A person's nutrition at an earlier age (children and adolescents) will reflect nutrition at a later adult age so nutritional status needs to be considered from an early age (Purnell, 2018).

Obesity is also included as a condition of malnutrition because malnutrition is defined as having too little nutritional intake (undernourishment) or too much to cause obesity (Kobylińska *et al*., 2022; Lorensia *et al*., 2022). Conditions such as students or students tend to have limitations in choosing healthy food other than ready-to-eat food outside the home. The impact of the double burden of malnutrition is not only felt by the people themselves but also the wider economic burden, where losses due to stunting and malnutrition are estimated to be equivalent to 2-3% of Indonesia's GDP (Sogari *et al*., 2018).

Significant weight changes are also associated with an imbalance between the energy content of food intake and the energy expended when a person is doing physical activity (Lorensia *et al*., 2021; Suryadianta *et al*., 2020). Maintaining food intake is one of the precautions that must be carried out because it is important to maintain the balance of calories in the body. Calories consumed must also be compared with calories burned into energy through physical activity. The higher a person's physical activity, the more calories they burn (Aditama *et al*., 2022; Kim, 2021). The imbalance of calories is the cause of obesity because this can be seen from the law of thermodynamics or called the law of conservation which states the balance of calories, namely 'calories in the body must be equal to calories out'. Therefore, if you gain weight, it can be caused by eating too much and not doing enough physical activity (Camacho and Ruppel, 2017).

Measuring the level of obesity can be done using a method that is more often used to measure the level of obesity in adults, namely BMI, compared to standard criteria (Gutin, 2018; Khanna *et al*., 2022). BMI is calculated from body weight (kg) divided by the square of height (meters square). Measurement of Body Mass Index which is a method used to determine a person's nutritional status (Gutin, 2018; Khanna *et al*., 2022), then to see the food intake obtained each day will be obtained by using the 24-hour Multiple Food Recall method which has better reliability for measuring food intake or consumption because this method will record all types of food intake consumed for 1x 24 hours for 3 days so food consumption can be pictured (Bailey, 2021). This research was focused on productive age with student status because the level of education and one's employment status as a student (Gamage *et al*., 2021), can affect diet. The purpose of this study was the effect of diet and physical activity on the risk of obesity in students at a university in Surabaya.

Method

This study used a case-control research design with a retrospective approach. The research was conducted from March 2018 to May 2018. The ethical test for this research was number 034/KE/I/2018 from the University of Surabaya. The independent variables in this study were: obese and non-obese adult patients. The dependent variable in this study was food calorie intake for 24 hours. Sources of calories from food are produced from fat (1 gram = 9 calories) (largest), carbohydrates and protein (each 1 gram = 4 calories). The number of carbohydrates, proteins and fats consumed in a day expressed in grams and the amount of food intake translated into energy is calculated based on the results of a 3×24-hour food recall from a 24-hour food recall interview processed using the Nutrisurvey program. The classification level of calorie intake includes deficit (<70% DRA); not enough (70-80% DRA); enough (80-100% DRA); good (100-110% DRA); and more (>110% DRA) (DRA=Deficit Reduction Act) (Peraturan Menteri Kesehatan RI, 2019; Kim, 2021). Obesity is an imbalance due to the consumption of calories that is greater than the

burning of energy in the body, many factors cause obesity, for example, genetic and lifestyle factors. People were said to be obese if they had a BMI >25.0 kg/m^2 (Camacho and Ruppel, 2017).

The population in this study were students at a private campus in the city of Surabaya, East Java. The sample used in this study was active students who met the inclusion and exclusion criteria. This study used a purposive sampling technique. The research criteria included: (1) Filling in informed consent; (2) Do not have certain diseases such as renal and hepatic disorders; (3) Not experiencing digestive problems (eg toothache, etc.); (4) Not following a diet/fasting; (5) Not currently pregnant/breastfeeding. The national prevalence of obese adults was 15.4%. The prevalence of obese adults in the city of Surabaya in 2013 was 27.3% (Ministry of Health and Health, 2018). To calculate the sample size in this study, the Lemeshow formula was used, namely: n = (Zα2.P.Q)/(d2). The P value used was 27.3% obtained from RISKESDAS in East Java province in 2013 regarding the prevalence of obese adults with a value of Zα=1.96 due to α=0.05 with a value of d=10%. n=76.24 people~76 people. Then the minimum sample size (n) for each group in this study was 76 adults.

The measuring instrument used in the study was a 24-hour recall questionnaire given for 3 days (1 weekend day and 2 weekdays), namely by recording the type and amount of food consumed in the past 24-hour period through direct interviews. Then the food/beverage intake data is included in the nutrition survey program to obtain the total amount of energy and protein per day. And for measuring weight and height, digital weight scales and a microtoise stature meter were used for height. The data collection technique in this study used a quantitative structured interview method. In preparing the questions the researcher will use an interview guide for measuring food consumption, namely the 24-hour recall method. The 24-hour recall method was carried out three times, and days representing workdays and holidays were chosen. If the measurement is only done once (1 x 24 hours), the data obtained is not representative enough to describe a person's eating habits. So, it should be done repeatedly on non-consecutive days (Freedman *et al*., 2017).

Questionnaires that have been given to the respondents were then analyzed. Analysis of nutritional intake data was carried out using the average of each 24-hour recall calculation from three meetings. Calorie calculations use the nutritional survey application which will describe the level of food consumption in the form of calories, then will be assessed by looking at the calorie intake requirements recommended by the Deficit Reduction Act (DRA). Then it will classify the level of calorie intake based on the minimum size value divided into five, which has been determined, from these results will describe the level of food calorie intake.

Physical activity in adults can be measured using the International Physical Activity Questionnaire (IPAQ) (Cleland *et al*., 2018). Measurements of weight and height were carried out using a digital weight scale and a Microtoise stature meter, respectively. The original IPAQ was available in English. The validation process was carried out by translating the questionnaire into Indonesian and then giving it to three professional judges in the field of community pharmacy. The validity was enforced in the analysis step based on the opinion of professional judges in the field of community pharmacy. The IPAQ instrument used has been validated and previously used in Indonesia by Lorensia *et al*. (2021) and Lorensia *et al*. (2022). This can be measured by asking seven questions related to daily activities. The data scale obtained from the measurement of physical activity was an ordinal data scale, where the results obtained from the patient questionnaire were categorized into low, medium, and high physical activity. The variables in this study are ordinal and nominal scales, so this analysis was carried out using the Chi-square test. If the probability value was ≤0.05, then it is significant, in other words, the variable number of food calorie adequacy levels and physical activity levels can be associated with obese and non-obese adult respondents.

Result and Discussion

This research was conducted from March to July 2018 located at the University of Surabaya, Kalirungkut, East Surabaya, where 152 adult student respondents were obtained. The respondents were grouped into two groups, namely the obese group of 76 respondents and the non-obese group of 76 respondents. Respondents in this study were grouped based on obesity or non-obesity. Of the 152 respondents, the most common age was 23 years. The highest BMI in the obese group was 26.09 while in the non-obese group, it was 19.00. It was known that there was a significant difference in the distribution of age and BMI factors between the two groups (Table 1).

The average types of food consumed by obese respondents are rice, chicken, wheat bread and crackers. The drinks most often drunk by the respondents were milk and tea (Table 2). While the data from Table 3, the average types of food consumed by non-obese respondents are rice, tempeh, chicken meat, eggs and chilli sauce with the number of respondents being 60.53, 66, 45 and 49 respondents respectively. As for the beverage most often drunk by respondents was tea with a total of 67 respondents. The average 24-hour calorie recall in both groups was highest in the third measurement (holidays) the caloric value in the obese group was greater (average=3.001,35kcal) than that of the non-obese (average=2.352,62kcal). The results obtained on the chi-square test for ordinal data scales, namely the value of p0.000 with a P-value<0.05, there was a significant difference in the intake of food calories in the obese adult group and the adult group non-obese (Table 4).

The method of collecting calorie intake data in this study used the 24-hour food recall method. A person's nutritional intake can be influenced by knowledge about nutrition (Bailey, 2021), and certain habits or restrictions in choosing food. and economic status (Sogari *et al.*. 2018). A low level of knowledge regarding nutritional intake can increase the risk of a lack of balanced nutrition and a low level of health (Afina and Retnaningsih. 2018). While the habit of choosing food. such as dietary

Table 1. Characteristics of Respondents

Characteristics		Group				Difference Test
		Obese (n: 76)		Non-Obesity (n: 76)		
		Frequency	Percentage (%)	Frequency	Percentage (%)	P value
Age (years)	Late adolescence (17-25)	55	72.36	72	94.73	0.00
	Early adulthood (26-35)	21	27.63	4	5.26	
BMI (kg/m2)	Underweight (< 18.5)			11	14.47	0.00
	Normal (18.5-<24.9)			59	77.63	
	Overweight-obese (25.0-<27)	70	100			

The P-value <0.05 means there is a difference between the obese and non-obese groups
Source: Primary Data, 2018

Table 2. Calorie Type Profile of Respondents from the Obese Group

Food consumed	Number of respondents	Means (kcal)	Standard Deviation	CI 95%	Minimum (kcal)	Maximum (kcal)
White rice	56	762.37	177.03	118.93	520.1	975.1
Tempeh	46	184.77	24.84	16.69	164.8	247.2
Chicken meat	60	348.55	48.80	32.78	306.68	412.97
Shrimp crisp	55	77.93	17.13	15.84	64.2	96.25
Pizza	34	1925.48	385.22	296.11	1656.8	2563.8
Know	43	47.78	7.2729	4.88	38.5	56.23
Potato	21	210.37	141.00	117.87	128.71	542.21
Wheat bread	55	452.38	85.61	106.30	374.5	543.25
Indomie	55	621.19	147.03	154.29	439.45	739.45
Meatball	47	189.5	61.67	153.19	135.3	256.6
Chilli sauce	53	50.5	12.08	15.00	38.7	67.3
Vegetable soup	34	170.02	35.43	56.39	118.2	198.16
Milk	41	264.66	19.10	12.83	239.71	294.17
Tea	56	24.70	7.00	4.70	22.10	45.07

Source: Primary Data, 2018

Table 3. Calorie Type Profile of Respondents from the non-obese group

Food consumed	Number of respondents	Means (kcal)	Standard Deviation	CI 95%	Minimum (kcal)	Maximum (kcal)
White rice	60	753.71	212.53	54.90	432	990
Egg	45	250.60	28.32	8.50	214	294.17
Tempeh	53	76.06	15.91	4.38	52	96.25
Chicken meat	66	180.49	20.70	5.08	164.8	247.2
Shrimp crisp	34	35.62	5.54	1.61	31	38.5
Tofu	38	48.66	9.31	3.06	40	69
Catfish	25	180	27.46	11.33	134	198
Soup	37	80.22	4.92	1.64	64	96.3
Indomie	41	657.54	147.03	46.40	439.45	739.45
Chicken stew	28	171.66	19.13	5.96	164	192
Meatball	34	465.5	13.85	4.83	432	787
Sauteed kale	27	45.85	5.43	2.14	25	65
Chilli sauce	49	29.2	5.67	1.98	22	34
Tea	67	48.66	12.39	3.17	40	69

Source: Primary Data, 2018

Table 4. Test for Differences in Caloric Intake Levels between the Two Groups

Calorie Intake Level Classification*	Group				Chi-Square test	
	Obese (n: 76)		Non-Obesity (n: 76)			
	Frequency	Percentage (%)	Frequency	Percentage (%)	P value	Conclusion
Deficit	0	0	1	1.31%	0.000	Significantly different
Not enough	0	0	9	11.84%		
Enough	7	9.21%	54	71.05%		
Good	29	38.15%	12	15.78%		
More	40	52.63%	0	0		

*) Calorie Intake Level based on Table 1

Source: Primary Data, 2018

restrictions. excessive preference for certain foods. cause a poor variety of food so that the body does not get nutrition from other sources. In addition, alcohol use due to excessive alcohol consumption can contribute to nutritional deficiencies (Barve *et al.*. 2017). In this study, nutritional intake was found between obese adult respondents and non-obese adult respondents by looking at food nutrition intake. And the lack of food nutrition intake is possible because of the factors mentioned above but the above were not examined in this study.

Nutrients function to maintain and repair body tissues. meet energy requirements for metabolic processes. and growth at an early age. The nutritional condition of a person's food intake is called nutritional status which is categorized into four, i.e.: bad, not enough, good, and more. Nutritional status will not only affect one's body health but also work productivity. growth and development of the brain in childhood (Woldehanna *et al.*, 2017). Nutritional conditions are largely determined by a person's eating habits. namely, the quality and quantity of food consumed by a person and when nutritional needs are optimally met, good nutritional levels can be achieved. The nutrients needed by the body consist of six kinds namely. carbohydrate. proteins. fat. vitamin. minerals and water (Morris *et al.*, 2023). A person's diet is influenced by economic factors (Bloom *et al.*, 2017), socio-cultural (Buksh *et al.*, 2022), education and environment (Gubbels, 2020), and age (Bloom *et al.*, 2017).

From the results of the study, it was found that 3 types of food were most often consumed, namely: white rice. chicken eggs, and tempe. White rice, based on the food pyramid, is at the bottom. This means that it includes the type of food that can be consumed every day. namely grains. White rice has lower fiber than rice cooked from mixed (whole grain) rice. Adult men need about 2,200 calories which can be increased to 2,800 calories according to daily activities and work. The heavier the physical activity, the higher the calorie requirement (Capurso, 2021).

Egg consumption is not a risk factor for

Table 5. Test for Differences in Caloric Intake Levels between the Two Groups

Physical activity level	Group				Chi-Square test	
	Obese (n: 76)		Non-Obesity (n: 76)			
	Frequency	Percentage (%)	Frequency	Percentage (%)	P value	Conclusion
Low physical activity	47	61.84%	32	42.11%	0.047	Significantly different
Moderate physical activity	23	30.26%	42	55.26%		
High physical activity	2	2.63%	2	2.63%		

Source: Primary Data, 2018

CVD in healthy people. However. people at high risk of developing CVD such as diabetic or hypertensive patients should be careful with dietary cholesterol intake. especially eggs. Also. some people seem to be more sensitive to dietary cholesterol as their blood cholesterol levels are highly correlated with food intake. On the other hand. studies on egg components impacting CVD risk suggest that some egg components have a potential protective effect against CVD. while others may have adverse effects (Kuang *et al*., 2018). Consumption of tempeh which is a food rich in protein is beneficial for the health of the digestive tract (intestines). reduce the risk of heart and blood vessel disease. prevent cancer. and maintain bone health. Long-term consumption of tempeh does not show any side effects so it is relatively safe at the level seen in Central Java (Astuti *et al*., 2000).

The results of the analysis of physical activity obtained in the obese group showed that most of them had low physical activity (61.84%). Meanwhile, in the non-obese group, most of them had moderate physical activity (55.26%) (Table 5). Based on the results of the analysis with the Chi-Square Test, with P value of 0.047 was obtained (p value <0.05) so that it could be concluded that there was a significant difference in physical activity between the non-obese and obese respondent groups. This was supported by previous research evidence in which the results showed that there were significant differences in physical activity in the normal group compared to the obese group, where the obese group had a longer sitting time compared to the overweight group, and obesity had a relationship with low physical activity and physical function (Suliga *et al*., 2018).

Several factors affect physical activity for overweight or obese adolescents, the following were some of these factors: age, diet, disease, and measurement of physical activity. The physical activity of adolescents to adulthood increases until it reaches a maximum at the age of 25-30 years, then there will be a decrease in the functional capacity of the whole body, approximately 0.8-1% per year, but if you are diligent in exercising this decrease can be reduced by up to half (Sluijs *et al*., 2021). Food is one of the factors that affect activity, because if the amount of food and the portion of food is more, the body will feel tired easily, and does not want to do activities such as exercise or carry out other activities. The content of fatty foods also influences the body to carry out daily activities or exercise, it is better if the food consumed is considered for its nutritional content so that the body does not experience excess energy but cannot expel it optimally (Azzolino *et al*., 2020). Affects the capacity of the heart and lungs, body posture, obesity, haemoglobin/ blood cells and muscle fibers. If there are abnormalities in the body as above it will affect the activities to be carried out. Like a shortage of red blood cells, the person is not allowed to do strenuous exercise. Obesity also makes it difficult to do physical activity (Joyner and Casey, 2015). Physical activity is usually assessed using subjective self-reported measures such as diaries, physical activity, recall surveys, and questionnaires; these methods have been used in studies and epidemiological surveys conducted until now (Sattler *et al*., 2020).

Conclusion

Based on the results of research that has been done by looking at food calorie intake and physical activity in obese and non-obese adults, it can be concluded that in the different tests, the average food intake in obese adult respondents is higher than that of non-obese adult respondents. Most of the adult respondents in the obese group had a higher adequacy than the non-obese adult respondents. There is a

significant difference between food intake in obese and non-obese adults. Therefore. High-calorie intake is at risk of causing obesity. The average level of physical activity in non-obese is higher than in the obese group. By increasing physical activity and reducing food calorie intake, the risk of obesity in adulthood can be reduced.

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Digital Healthcare: Is A Trend Or Necessity?

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Abstract

In the era of digital advancement, the government is actively endorsing different digital health apps. This trend is particularly noticeable in Indonesia, where consumer-focused eHealth services have gained extensive approval. The acceptance of these services has risen significantly over time, propelling Indonesia to a global ranking of third place in using health apps. This research intends to determine whether the inclination towards digital healthcare is genuinely embraced as a necessity, or if it's just a passing trend. The study involves conducting a nationwide quantitative investigation across Indonesia among 418 users of mobile health apps, based on the UTAUT 2 theory which was modified according to research needs by adding variable FOMO. Data collection through online surveys and uses structural equation modeling (SEM-PLS), to assess the connections between these factors. They reveal that digital healthcare is not only embraced but also perceived as a necessity. While necessity-driven motivation remains dominant, the study also uncovers hedonic factors playing a role. This combination of necessity and trend-related aspects underscores the potential market for digital healthcare. The outcomes of this research bring promising news for developers of digital healthcare solutions. It reveals that there is a genuine demand and need for digital healthcare services.

Introduction

The rapid shift towards digitalization in healthcare, spurred by the Covid-19 pandemic, is causing significant changes in various aspects of the field. Progress in the health industry might not be straightforward and could encounter obstacles along the way. Medical professionals have a crucial part to play in embracing the digital transformation in healthcare, all the while upholding ethical principles in their practice. Physicians need to actively steer the path of digital health evolution, ensuring that upcoming health technologies serve as tools to enhance the capabilities of doctors and healthcare providers, ultimately leading to improved patient care. These technologies must remain subservient to medical experts, rather than gaining control and distancing them from the patients they serve (Butcher & Hussain, 2022; Zhu *et al*., 2023).

The research delves into the concept of digital transformation within the domain of consumer-oriented digital health services. These services, catering to the general public, are commonly referred to as consumer informatics. Electronic health services, often termed digital health services, serve the purpose of disseminating health-related information to the public. In the contemporary landscape, mobile health applications have gained prominence, being downloadable on mobile devices, and categorized as M-health applications. These applications play a pivotal role in facilitating online access to healthcare services, as highlighted by (Zulkarnain & Dkk, 2021).

As per a report by KataData.id in October 2020, supported by Statista data, Indonesia stands at the third position globally in terms of health application usage. The leading countries in this regard are China and India. Notably, approximately 65% of respondents in

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these two nations acknowledged using health applications within the past year, according to Statista's Global Consumer Survey. Following closely, Indonesia recorded a health application usage rate of 57%.

The rise of health-based programs (health apps) in Indonesia can be seen in the presence of various digital health service programs, namely: Halodoc, Klikdokter, Alodokter, Good Doctor, Good Doctor, Linksehat, Lekassehat, and others, as applications that claim to be ready as digital healthcare. Collaborative efforts from the government and non-government organizations to build a more comprehensive health network and information system will enable better infiltration of digital health coverage, especially to realize a smart healthcare model (Jeffree *et al*., 2020). So far, previous studies have tended to raise the acceptance/ rejection factors for mobile application-based digital healthcare as well as the advantages and disadvantages of digital healthcare.

The exploration of digital transformation within the healthcare sector, including its requirements and trends, often employs systematic review methodologies. This research highlights that digital transformation is not only an aspirational concept but a fundamental necessity (Kruszyńska-Fischbach & Sysko-Romańczuk, 2022). Additionally, the contemporary trends in technology are shaped by users' lifestyle choices and the advantages offered by these technological advancements (Budi *et al*., 2021). This presents an intriguing research topic: whether the acceptance of Digital Healthcare stems from its necessity or is merely a fleeting trend from the user's standpoint. Such an inquiry could yield valuable insights to guide the comprehensive development of digital health services.

The primary aim of this study is to examine the way individuals perceive digital healthcare services delivered via applications. This investigation will center around varying user needs and will be tackled using an adapted and enhanced iteration of the Unified Theory of Acceptance and Use of Technology (UTAUT). Through this approach, the study intends to uncover whether users adopt Digital Healthcare due to necessity or if it's merely a temporary fad, by analyzing their attitudes and behaviors towards it.

UTAUT proposes four core variables, Effort Expectancy (EE), Performance Expectancy (PE), Social Influence (SI), and Facilitating Condition (FC), that directly influence user acceptance and usage behavior (Venkatesh *et al*., 2003). The current research employs an extended version of UTAUT, known as UTAUT 2. This version incorporates additional variables such as Hedonic Motivation (HM) while excluding Price Value (PV) and Habit due to their incompatibility with the research scenario. These modifications are made to align the model with the study's objectives and ensure its applicability (Marikyan & Papagiannidis, 2021; Sudburya *et al*., 2013; Venkatesh *et al*., 2012). UTAUT-2, a well-established model, holds high predictive validity and offers a solid foundation for examining user acceptance behavior in the context of mobile technology across diverse research domains (Zhu *et al*., 2023).

In this research, the UTAUT 2 model was adapted and modified to include an additional reflective variable, FOMO (Fear Of Missing Out), to better understand the reasons behind individuals' acceptance of a technology, specifically a mobile health application based on digital healthcare. FOMO holds significant importance in today's digital era (Elhai *et al*., 2021). FOMO is rooted in the innate human desire to be part of a community, which greatly influences human behavior. The concept of fearing missing out is widely recognized and has even been utilized in commercial advertising for marketing purposes. FOMO, a relatively new term, has been embraced in consumer psychology, particularly in the realm of social media advertising (Dinçer *et al*., 2022; Yazkan *et al*., 2022). Consequently, the extended UTAUT model employed in this study includes 7 independent variables (PE, EE, SI, FC, HM, FOMO, BI) and 1 dependent variable (UB).

Methods

This research was conducted using a quantitative approach to find out whether the digital healthcare phenomenon can be accepted by users as a need or just a trend. The goals encompass recognizing crucial elements, validating assumptions, and establishing

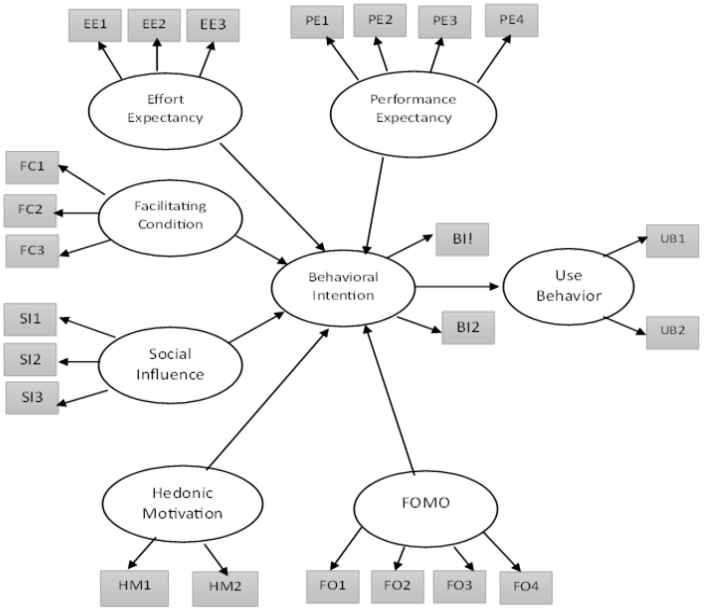

Figure 1. Research Concept Framework

noteworthy drivers. The outcomes aim to provide advice to digital healthcare providers to improve consistent utilization and draw in prospective users effectively. To gather data, an online questionnaire was distributed via platforms like WhatsApp, Telegram, Instagram, and Facebook between May 17, 2023, and June 5, 2023. The questionnaire, grounded in the UTAUT 2 model and pertinent prior research indicators, comprises 24 quantitative questions. An additional open-ended question supplements this to provide qualitative insights. The survey is split into two parts. The initial section collects fundamental details such as age, gender, educational background, and location. Additionally, there is an open-ended question aimed at understanding the reasons for utilizing the app. The second segment comprises the main inquiries, organized around factors illustrated in Figure 1 (derived from UTAUT 2). Each question provides a range of response options, ranging from "strongly disagree" to "strongly agree," which correspond to scores ranging from 1 to 5.

In this research, the focus is on individuals utilizing mobile healthcare applications in Indonesia. The study employs a statistical method by analyzing data from Play Store reviews. The data pertains to comparable telemedicine applications that enjoy widespread use in Indonesia. Specifically, Alodokter has 430,000 users, Halodoc has 406,000 users, and Klikdokter has 11,000 users. Consequently, the total population under consideration is 847,000 users. The determination of the sample size adheres to the Slovin formula. This formula

Table 1.Relationship between Variables

Code	Hypothesis
H1	The greater the Performance Expectancy, the greater the interest in using digital healthcare applications
H2	The greater the Effort Expectancy, the greater the interest in using digital healthcare applications
H3	The higher the Social Influence, the greater the interest in using digital healthcare applications
H4	The better the Facilitating condition, the greater the interest in using digital healthcare applications
H5	The higher the Hedonic Motivation, the greater the interest in using digital healthcare applications
H6	The higher the FOMO, the greater the interest in using digital healthcare applications
H7	The greater the behavioral intention, the higher the frequency of behavior to use digital healthcare applications

Table 2. Variable Operational Definitions

Variable	Code	Indicator
Performance Expectancy	PE1	Useful
	PE2	Helpful/helpful
	PE3	Saving time
	PE4	Effective
Effort Expectancy	EE1	Easy to use
	EE2	Easy to understand
	EE3	Easy to learn
Social Influence	SI1	someone's influence
	SI2	Community influence
	SI3	Influencer/advertising influence
Facilitating Conditions	FC1	Device
	FC2	Knowledge
	FC3	Guidelines/tutorials
	FC4	Technology anxiety
Hedonic motivation	HM1	Interesting using new things (novelty enjoyment)
	HM2	It's fun to use new things (usage enjoyment)
FOMO (Fear Of Missing Out)	FO1	Experience / one step ahead
	FO2	Phenomenon
	FO3	Social group
	FO4	Always be the first
Behavioral Intention	BI1	use continuously
	BI2	Recommend
Use Behavior	UB1	Used for various health needs
	UB2	Intensity of use

is instrumental in ascertaining an appropriate sample size from a known population. Hence, the study included a sample size of 400 respondents.

Results and Discussion

The research collected information from 418 individuals throughout Indonesia, as indicated in Table 3. The breakdown indicated that 74.9% of the participants were women, whereas 25.1% were men. This indicates a higher female user presence in mobile health applications. In terms of age, the largest user groups were aged 31-40 years and above 40 years, accounting for 32.8% and 28.5% of users respectively. Users aged 20-30 years made up 20.3%, and the remaining age categories had a combined total of 5.9%. These findings suggest that young adults are the primary users of health applications, highlighting their engagement with technology during their productive years.

Regarding education, the majority had completed undergraduate degrees (45.9%), followed by diplomas (32.5%), and high school (11.7%). The remaining 9.9% represented other educational levels. This points to a relatively high level of education among health application users. Geographically, the respondents were predominantly from Bali Province (53.3%), with smaller percentages from East Java (7.6%), West Java (6.9%), Central Java (5.3%), Central Kalimantan (4.8%), DKI Jakarta and NTT Provinces (3.8% each), NTB Province (2.9%), and 11.6% from 22 other provinces in Indonesia. Among the 418 respondents, 199 were identified as active users of mobile health applications.

The evaluation of the measurement model, including factors like the reliability of individual items, internal consistency reliability, average variance extracted, and discriminant validity, as presented in Table 3, indicates the strong foundation of the research model chosen by the researchers. All indicators exceeded the specified minimum criteria, with outer loading values and composite reliability scores surpassing 0.7. Furthermore,

all variables utilized in the research displayed AVE values greater than the recommended 0.5 threshold. As a result, the study can confidently progress to the subsequent phase of analysis, which involves examining the structural model. Path analysis or the examination of path coefficients is employed to explore the impact of relationships between variables and assess the validity of model hypotheses. If the influence among pathways is statistically significant, it supports the path hypothesis, and conversely, if not significant, it challenges it. Detailed path coefficients and significance levels for each variable are presented in Table 4.

Variables that positively and significantly affect the intention to use (BI) are PE, FC, and HM. Variables that positively impact usage intention (BI) are SI and FOMO. However, the variable EE shows no significant effect. Notably, the path coefficient for EE is negative, indicating that it negatively influences the intention to use. The other variables have positive facilitating effects, although not all of them exhibit statistically significant effects. The BI variable further exhibits a positive impact on usage behavior (UB). Consequently, hypotheses H1, H3, H5, and H7 are supported, while hypotheses H2, H4, and H6 are not substantiated.

All Cronbach's Alpha > 0.7 means that all variables meet internal reliability consistency. All Composite reliability > 0.7 means that all variables meet internal reliability consistency. All AVE > 0.5 means that all valid variables converge (Hair et al., 2021). Convergent validity pertains to the accuracy of a variable when its outer loading exceeds 0.7, as mentioned by Cheung et al. (2023). All reliable indicators are observable. The primary indicator for the PE variable, which signifies time-saving in consulting a doctor or purchasing medicine, is PE3 with a substantial loading of 0.835. Similarly, the dominant EE variable, associated with ease of comprehending features, is best captured by EE3 with a loading of 0.847. The most prominent SI variable, involving the use of health applications due to recommendations from the community, finds its representation in SI2 with a high loading of 0.935. When it comes to FC, denoting sufficient knowledge for health app usage, FC2 stands out with a loading of 0.839. HM, centered around the fascination with health apps, is most clearly explained by HM1 with a loading of 0.923. Similarly, the dominant element of the Fear of Missing Out (FOMO), associated with the desire to stay up-to-date with online health trends, is most accurately symbolized as FOMO2, displaying a loading of 0.905. The main factor related to Behavioral Intention (BI), indicating the propensity to consistently utilize digital health applications for addressing health issues, is effectively captured by BI1, exhibiting a loading of 0.923. Lastly, the prominent factor of User Behavior (UB), signifying the frequent usage of digital health applications for health-related

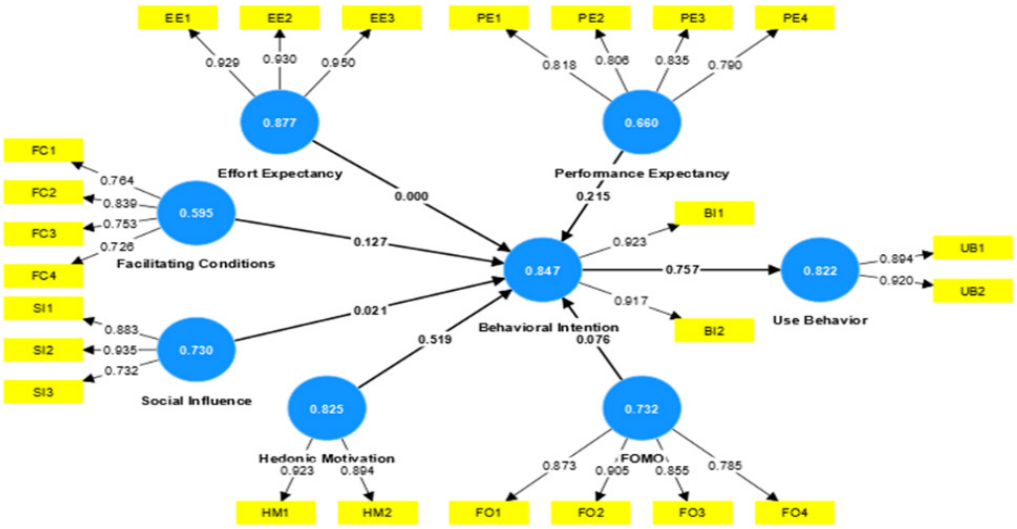

Figure 2. Graphic Output Algorithm

Table 3. Reliability and Validity and The Outer Model

Variable	Code	Standard factor loading	Cronbach's Alpha	CR	AVE
PE	PE1	0.818			
	PE2	0.806	0.830	0837	0.660
	PE3	0.835			
	PE4	0.790			
EE	EE1	0.929			
	EE2	0.930	0.930	0931	0.877
	EE3	0.950			
SI	SI1	0.883			
	SI2	0.935	0.816	0.918	0.730
	SI3	0.732			
FC	FC1	0.764			
	FC2	0839	0.774	0.777	0.595
	FC3	0.753			
	FC4	0.726			
HM	HM1	0.923	0.790	0.803	0.825
	HM2	0.894			
FOMO	FO1	0.873			
	FO2	0.905	0.878	0897	0.732
	FO3	0.855			
	FO4	0.785			
BI	BI1	0.923	0.819	0.820	0.847
	BI2	0917			
UB	UB1	0.894	0.785	0.795	0.822
	UB2	0.920			

Note: PE = Performance Expectancy; EE = Effort Expectancy; SI = Social Influence; FC = Facilitating Conditions; HM = Hedonic Motivation; FOMO = Fear Of Missing Out; BI = Behavioral Intention; UB = Use Behavior; CR = Composite Reliability; AVE = Average Variance Extracted

solutions, is appropriately represented by UB2, with a loading of 0.920.

Analysis of the direct effect of variable X (PE, EE, FC, SI, HM, FOMO) on variable Y1 (BI) and analysis of the direct effect of variable Y1 (BI) on variable Y2 (UB) can be seen in Table 4. One-sided testing is said significant effect if t > 1.65 or P < 0.05 (Chin, 2014). The objective of this research is to comprehend the fundamental elements influencing the utilization of mobile health apps, investigating whether digital healthcare represents a necessity or simply a transient fad. Through the utilization of structural equation modeling, six factors have been identified as potential influencers of user intention (BI): PE, EE, SI, FC, HM, and FOMO. Among the three variables that gauge perceived necessity (PE, EE, and FC), only two, PE and FC, demonstrate significant impact. Similarly, among the three variables reflecting the perception of trends (SI, HM, and FOMO), only HM holds statistical significance. The subsequent explanation delves into these findings in greater detail.

Performance Expectancy (PE) significantly and positively influences users' intention to use mobile health applications. This means that when users have higher expectations regarding the performance of the system, they are more inclined to be interested in using these apps for their health needs (Ammenwerth, 2019). This finding suggests that mobile health apps can enhance the effectiveness and efficiency of medical care. The main indicator of PE, specifically related to time-saving during medical consultations and prescription needs, aligns with previous research (Hannemann & Götz, 2021; Philippi *et al.*, 2021). This is consistent with studies that have shown that integrating online and offline services can reduce offline waiting times, breaking the constraints of time and location. This trend of adopting digital health technology has become more pronounced during the Covid-19 pandemic, as it ensures access to health services for a broader range

of individuals. Other similar research also found that analysis of mobile health insurance user perceptions showed optimal quality of information and quality of service (Rachmawati *et al*., 2021). This research further supports the idea that a stronger sense of perceived efficiency (PE) is linked to a higher likelihood of wanting to use mobile health apps. The numerical data emphasizes that users' desire to use these apps is impacted by how they view the medical services' efficiency and effectiveness, highlighting the growing importance of digital healthcare. This conclusion is backed by qualitative information, where participants point out the ease of online medical consultations, the usefulness and simplicity of these apps, and the flexibility to use them at any moment and location. As a result, Hypothesis 1 (H1) is accepted.

On the other hand, Effort Expectancy (EE) does not significantly affect users' behavioral intention (BI) to use mobile health applications. In other words, when users anticipate lower effort in using the system, it doesn't necessarily lead to a higher intention to use these applications for health-related purposes. This finding suggests that mobile health apps might not be very user-friendly or easy to learn. This aligns with prior research that emphasizes how factors related to effort can hinder the adoption and continued use of e-health innovations (Iyanna *et al*., 2022). Therefore, service providers in the digital health sector should prioritize improving the user experience to simplify the app usage process (Dash & Sahoo, 2022). The study suggests that the necessity to use mobile health apps might stem from their alignment with the Ministry of Health's guidelines during the pandemic rather than from their ease of use (Murhum *et al*., 2022). This finding contradicts the theory that higher EE leads to greater BI. Quantitative information indicates that the reduced desire to utilize mobile applications is impacted by the perceived inconvenience associated with using these apps. This suggests that digital healthcare might not be seen as a necessary or trendy option. Qualitative data further supports this by revealing respondents' struggles with understanding how to use these apps. In summary, the study underscores the importance of users' performance expectations in driving their intention to use mobile health applications, while the level of effort expectancy doesn't seem to have the same impact. This has implications for improving the user experience and highlighting the necessity of digital healthcare, especially during challenging times like the Covid-19 pandemic. H2=rejected.

The impact of Social Influence (SI) on behavioral intention (BI) toward using mobile health applications is positive, although not statistically significant. This suggests that higher levels of social influence correspond to increased interest in these apps. The results imply that factors like social groups, communities, and advertisements influence the intention to use these apps. Notably, the influence of the community (SI2) has a positive effect, indicating that social groups positively affect nearby users, even though the effect is not significant. These results are consistent with earlier studies that suggest the growth of digital healthcare doesn't erode confidence in conventional medical methods (Kukoryte, 2022). Positive and negative effects of SI on attitudes towards digital services are also present. The positive aspect is seen when friends and family recommend digital treatment (Hardebro & Edblad, 2021; Philippi *et al*., 2021). The community and environment play a role in convincing users to adopt mobile health services (Zhu *et al*., 2023). However, a contrary study shows SI harms BI, especially when digital health consulting lacks advertising and has limited users (Dash & Sahoo, 2022). The COVID-19 pandemic has also made mobile health apps essential regardless of social impact (Murhum *et al*., 2022). This challenges the theory that higher SI leads to greater BI. On the whole, quantitative data suggests that the influence of others, communities, and advertisements doesn't significantly affect the intention to use these apps, implying that digital healthcare is neither a necessity nor a trend. This is supported by qualitative information demonstrating favorable reactions due to community impact, online media visibility, and marketing efforts on search engines and social platforms. H3 has been rejected.

Regarding Facilitating Conditions (FC), they significantly and positively affect BI. This implies that better conditions for using

mobile health apps lead to greater interest in their use. These results show that apps with adequate knowledge, guidance, device support, and network assistance support boost usage intention. FC encompasses internal and external factors (Zhu *et al*., 2023). External factors include network conditions, device support, and app usage instructions. Internal factors involve individual knowledge and technology anxiety. Good FC, specifically having sufficient knowledge for using health apps (FC2), aligns with past research where the ability to use affects the acceptance of digital health services (Ammenwerth, 2019; Gupta, 2022). Leveraging technology infrastructure for a seamless digital healthcare experience is essential for user acceptance (Kang *et al*., 2022). Learning about new digital health technology enhances convenience and the importance of FC in sustainable usage behavior is emphasized (Bai & Guo, 2022). These findings confirm the theory that better FC leads to greater BI. Quantitative data supports this, indicating that good system facilitation conditions influence the intention to use mobile apps, underscoring digital healthcare's necessity. Qualitative data further reinforces this, with respondents citing factors like application usability, easy access, and speed as reasons for positive responses. H4=accepted.

Hedonic Motivation (HM) plays a significant and positive role in shaping the intention to use mobile health applications. This suggests that a stronger desire for pleasure and enjoyment from using technology leads to a greater interest in utilizing mobile health apps. This aligns with previous research indicating that people's interest and acceptance of new technology hinge on the enjoyment they derive from using it, rather than the fear of not being able to use it effectively (Nikolopoulou *et al*., 2021; Sudburya *et al*., 2013). This finding underscores the idea that higher levels of hedonic motivation are associated with greater behavioral intention. From a quantitative standpoint, the inclination to use mobile applications is influenced by the enjoyment and pleasure derived from utilizing technology, reflecting the growing trend of digital healthcare. Qualitative data, gathered through open-ended questions, also supports this conclusion, as respondents express positivity towards mobile health apps due to their appealing and user-friendly features (H5=accepted).

On the other hand, the Fear of Missing Out (FOMO) positively affects behavioral intention (BI), although not to a statistically significant degree. This implies that a heightened fear of missing out on interesting experiences contributes to a greater interest in mobile health applications. This finding is consistent with previous studies that highlight humans' inherent desire to be part of communities and their concerns about missing out on information and opportunities, which often govern their behavior (Dinçer *et al*., 2022; Oztemel, 2019; Yu *et al*., 2020). It's noteworthy that changes in behavior attributed to technology, such as the tendency to observe others' actions and seek information due to the availability of new digital tools, are noteworthy (Li *et al*., 2020; Tomczyk, 2021; Yazkan *et al*., 2022). However, contrary to the initial hypothesis, the quantitative data suggests that the fear of missing out, along with anxiety over missing interesting events, does not significantly drive the intention to use mobile applications in the context of digital healthcare. The qualitative responses from the questionnaire also indicate that respondents are positively inclined towards mobile health applications due to reasons such as staying updated on online doctor services and trying out new applications (H6=rejected).

The positive and significant impact of behavioral intention (BI) on the actual usage behavior (UB) of mobile health applications is evident. This means that when users have a strong desire to use MHAs, they tend to use them more frequently. This connection suggests that how often someone uses a health app is related to their intention to use it. Notably, the most significant factor contributing to this connection is a specific aspect of BI, referred to as BI1. This aspect represents a consistent interest in using digital health apps to manage health concerns. This finding is consistent with previous research, emphasizing that BI is a crucial factor in predicting continuous use of digital health services, especially in the context of increased digital engagement during the Covid-19 pandemic (Bai & Guo, 2022; Dash & Sahoo, 2022; Murhum *et al*., 2022; Zhu *et al*.,

Tabel 4. Hypothesis Test

	Oh sample	Means	SD	T statistics	P-value
BI→UB	0.757	0.759	0.034	22,514	0.000*
PE→BI	0.215	0.211	0.094	2,289	0.012
EE→BI	0.000	-0.009	0.063	0.003	0.499
FC→BI	0.127	0.135	0.073	1,731	0.042
SI→BI	0.021	0.022	0.070	0.297	0.383
HM→BI	0.519	0.522	0.072	7.159	0.000*
FOMO→BI	0.076	0.081	0.077	0.984	0.163

Note: *significant at p<0.05; SD = standard of deviation

2023). This underscores the idea that higher BI leads to more frequent usage. The analysis of quantitative data further supports the idea that how often people use health apps is strongly influenced by their intention to use them, highlighting the growing importance of these apps in healthcare. This conclusion is also backed by qualitative data from open-ended survey responses, where participants express their excitement about health apps due to their interest in understanding the app's features and benefits. They also acknowledge the significance of health and technological advancements, which contribute to the convenience of using these apps. Thus, hypothesis H7 is validated.

Conclusion

The outcomes of this research bring promising news for developers of digital healthcare solutions. It reveals that there is a genuine demand and need for digital healthcare services, highlighting a market potential focused on efficiency and effectiveness in terms of time and cost. While the primary driver is the necessity of digital healthcare, there are also hedonic factors that contribute, indicating a blend of essential needs and trend-related factors. Even though the main motivation is the necessity, developers should consider both aspects to gain wider acceptance. Enhancing usability features and creating an appealing interface are key to this effort. Addressing user feedback suggests improving ease of use, enhancing the user interface, and increasing advertising efforts, as community influence was found to have a limited effect.

The study's findings lend theoretical support to shaping improved mobile health applications, particularly for societies that view digital healthcare as indispensable. The evolution of digital healthcare services offers avenues for future advancements. On the flip side, digital service providers need to refine their networks to foster wider adoption of digital health information systems, positioning them not just as trends but as essentials.

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Medical Students' Vulnerability to Anxiety: Its Frequency and Associated Factors

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Abstract

Medical students are vulnerable populations at risk of mental health problems, particularly anxiety. Specifically, during COVID-19, the prevalence of anxiety among medical students increased rapidly and several factors affected its causes. This study aimed to find out the frequency of anxiety among medical students by using the TMAS questionnaire and factors that significantly contribute to anxiety levels. This cross-sectional study used simple random sampling of undergraduate medical students. The correlation between TMAS scores and several variables was analyzed with the Spearman and Kruskall-Wallis correlation test and also multiple linear regressions. Among 275 respondents, the average age is 18.81 (SD 1.18), dominated by females (62.2%), in their first year (84.4%), non-scholarship (96.7%), lived in boarding houses (57.8%), and academic problem as the dominant cause of anxiety (46.5%). Later, 40.7% were anxious, then age and the year of study were found to be negatively correlated to their anxiety. A survey regarding the preferred form of anxiety therapy by medical students showed that 27.4% of respondents chose relaxation. These results are expected to help the development of future anxiety therapy based on the specific needs of medical students.

Introduction

Medical students are prone to run into mental health problems. Anxiety among medical students has become emerging rapidly during the pandemic of COVID-19. The prevalence of anxiety among medical students was higher than in general populations with a rate of 33.8% among medical students compared to a mere 3% in the general population (Quek *et al*., 2019). That result was similar to research by (Mao *et al*., 2019) which showed the average prevalence of anxiety among medical students in China was 27.22%. Based on the study of anxiety among medical students in Peru, most of them had moderate anxiety (29.8%) and severe anxiety (28%) (Alves *et al*., 2021).

The American Psychological Association defines anxiety as the manifestations of emotions that are characterized by feeling tense, anxious thoughts, and changes in physical conditions such as changes in blood pressure (APA, 2023). Anxiety can be considered as the normal reaction of the body when facing pressure and stressful life events. Nevertheless, if left untreated, anxiety can have consequences in becoming mental health problems. These consequences can give rise to reduced productivity (Hendriks *et al*, 2016). As a result, medical students will experience decreased academic performance, and delay in completing their studies, until they are unable to finish their studies. Later, if they were a doctor, they would have less empathy, care, and interest in treating their patients (Quek *et al*.,

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Several factors affected medical students to be prone to anxiety such as year of study, gender, history of mental health disorders, history of childhood violence, loss of parents, undergoing exams, being burdened by exams, dissatisfaction with exam scores, history of chronic illness, conflict with parents, lack of social supports, and economic disadvantage stemming from low-income backgrounds (Robles-Mariños, 2022; Alves *et al*., 2021; Arisyna, *et al*., 2020). Previous research revealed that anxiety among medical students mostly occurred in their first, second, and fifth year of study (Robles-Mariños, 2022; Arisyna *et al*., 2020). Factors affected significantly medical students were age, gender, year of study, place of residence, supportive environment, type of financing, parents' income stability, and causes of stress (Bandelow & Michaelis, 2015; Yusoff *et al*., 2013; Quek *et al*., 2019; Rahmayani *et al*., 2019; Cao *et al*., 2020).

As medical students are a vulnerable population at risk of having anxiety, anxiety among medical students can be detected and must be treated early. Regarding those issues, this study was carried out as a preliminary study to find out the frequency of anxiety among medical students by using the TMAS questionnaire and factors that significantly contribute to the manifestation of anxiety. We also surveyed to find out what kinds of psychiatric interventions were intended by medical students.

Method

This research was conducted as a cross-sectional design in May – December 2021 through an online survey. The sampling technique was carried out by simple random sampling. The subject of this study was undergraduate medical students from the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada. The population of this study was determined based on the results of the Indonesian Basic Health Survey (Riskesdas) 2018. Based on Riskesdas 2018, the prevalence of Mental Emotional Disorders at the age of ≥15 years in Indonesia was 9.8%. The minimum sample was calculated with a Z score of 1.96 (confidence interval 95%), a margin of error of 0.05, and an estimated proportion of 0.098 was 136. The online survey was filled by 275 students who were studying in their first until the fourth year (batch 2016-2019).

Taylor Manifest Anxiety Scale (TMAS) questionnaire was used as the instrument of this research. TMAS is a self-report questionnaire that consists of 50 questions that require either a "yes" or "no" with a cut-off point >21. TMAS is part of the Minnesota Multiphasic Personality Inventory (MMPI) that has been translated to the Indonesian version with the validity assessment of the instrument indicating sensitivity of 90%, specificity of 95%, positive predictive value (PPV) of 94.7%, and negative predictive value (NPV) of 90.4%. The reliability of the instrument was tested using Kuder-Richardson Formula 20 (KR 20) with the result of r = 0.86 (Wicaksono, 1992). Based on the literature review, factors associated with the level of anxiety symptoms among medical students such as age, gender, year of study (first until fourth year), type of financing (scholarship or non-scholarship), place of residence (living with parents, residing in boarding houses, or inhabiting dormitories/ religious-based dormitories (pesantren), and the specific types of issues that may precipitate anxiety (whether academic, non-academic, or both). We also surveyed to find out the psychiatric interventions that medical students with anxiety would prefer to receive.

Quantitative data such as respondents' demographic and TMAS score category would be analyzed as quantitative descriptive. The correlation between TMAS scores and several variables was analyzed with the correlation test. Numeric variables such as the correlation of TMAS scores with age and year of study were analyzed with Spearman's correlation test. Categorical variables such as the correlation of TMAS scores with gender, place of residence, and the specific types of issues that may precipitate anxiety were analyzed with Kruskall-Wallis' correlation test. Variables that demonstrated a significant correlation (p-value <0.05 were then analyzed using multiple linear regression tests to see the direction of the relationship between these variables and the TMAS score. Descriptive analyses were conducted on data obtained from the survey

regarding the psychiatric interventions that respondents wanted to receive. This research has received ethical approval from the UGM FK-KMK Ethics Committee. The ethical approval letter was issued on September 21 2021 with No: KE/FK/1051/EC/2021. The study participants provided online consent and the study was conducted according to the ethical principles of human studies as enshrined in the Declaration of Helsinki.

RESULT AND DISCUSSION

Respondents' demographic characteristics and TMAS survey results were analyzed descriptively and presented in Tables 1 and 2. Based on Table 1, the average age of the respondents is 18.81 years old (SD 1.18). Most of them were female (62.2%), studying in their first year of school (84.4%), studied with non-scholarship financing support (96.7%), living in boarding houses (57.8%), and academic problems were their dominant problem causing anxiety (46.5%).

Table 2. Anxiety Frequency

TMAS Categories	N	%
Not Anxious	163	59.3
Anxious	112	40.7

Table 1. Respondents' Demographic

Variables		Mean (SD)	
Age		18.81 (1.19)	
Characteristics		N	%
Gender	Female	171	62.2
	Male	104	37.8
Year of Study	First year	232	84.4
	Second year	14	5.1
	Third year	4	1.5
	Fourth year	25	9.1
Types of Financing	Scholarship	9	3.3
	Non-scholarship	266	96.7
Place of Residence	Living with parents	81	29.5
	Residing in boarding houses	159	57.8
	Inhabiting dormitories/ religious-based dormitories (pesantren)	35	12.7
Causes of Anxiety	Academic	128	46.5
	Non-academic	41	14.9
	Both	106	38.5

Table 3. Correlation of Variables with TMAS Scores

Variables (Spearman's correlation test)		Correlation Coefficient	p-value
Age		-0.210	0.000
Year of Study		-0.503	0.000
Variables (Kruskall-wallis' correlation test)		Mean Rank	p-value
Type of Financing	Scholarship	102.22	0.170
	Non-scholarship	139.21	
Causes of Anxiety	Academic	136.56	0.312
	Non-academic	123.44	
	Both	145.37	
Place of Residence	Living with parents	135.28	0.425
	Residing in boarding houses	142.50	
	Inhabiting dormitories/ religious-based dormitories (pesantren)	123.87	
Gender	Male	138.67	0.913
	Female	137.59	

Based on Table 2, the frequency of anxiety among the respondents was 40.7% with a mean TMAS score of 19.67. Based on Table 3, age and year of study are the variables that have significant correlations ($p<0.05$) with the TMAS score.

Table 4. Direction of The Relationship between Significant Variables with the TMAS Score

Variables	Unstandardized B Coefficients	p-value
Age	-2.127	0.000
Year of Study	-4.337	0.000

Based on the results of multiple linear regressions, the R Square value was 0.276. This result means age and year of study affected 27.6% of the total TMAS score meanwhile the remaining 72.4% were affected by other variables. Based on Table 4, Unstandardized B Coefficients of the age and year of study had negative values. It means the correlations of those variables are inversely proportional (negative correlations) with the TMAS Scores. We also surveyed to find out the psychiatric interventions that were preferred by medical students who experienced anxiety. The survey results were analyzed descriptively and presented on the pie chart below (Graphic 1).

Based on Figure 1, most of the respondents wanted to get relaxation practice as their psychiatric intervention (27.4%). This study found out the frequency of anxiety among respondents was 40.7%. This amount of frequency is closely related to the prior study that found the prevalence of anxiety among medical students globally was 33.8% (Quek *et al.*, 2019) and the average anxiety among medical students in Tiongkok was 27.22% (Mao *et al.*, 2019). These findings reinforce the prior statement that medical students are at risk of having anxiety. Factors associated with causing high prevalence of anxiety among medical students were lack of time to study, high demand of academic load, and more frequent and difficult examinations than other non-medical majors (Quek *et al.*, 2019; Ma *et al.*, 2021). The COVID-19 pandemic during the study played a role in triggering anxiety among medical students. The threat and fear of being infected by the SARS-COV-2 virus and shifting learning methods to be online made it difficult for medical students to concentrate and comprehend the subject. Additionally, the implementation of social distancing protocols has further contributed to a reduction in interpersonal communication (Cao *et al.*, 2020; Sadiq *et al.*, 2019; Xiao *et al.*, 2020). Furthermore, a study conducted in Pakistan has revealed that medical students hailing from universities that employ a quantitative assessment system, such as GPA, are more prone to experience heightened levels of anxiety. This assessment system is also utilized by the university where the study was conducted (Ali *et al.*, 2015).

Based on the bivariate test, this study revealed that age has a negative correlation with TMAS scores, indicating that individuals tend to have lower TMAS scores as they get older. This finding is consistent with previous studies

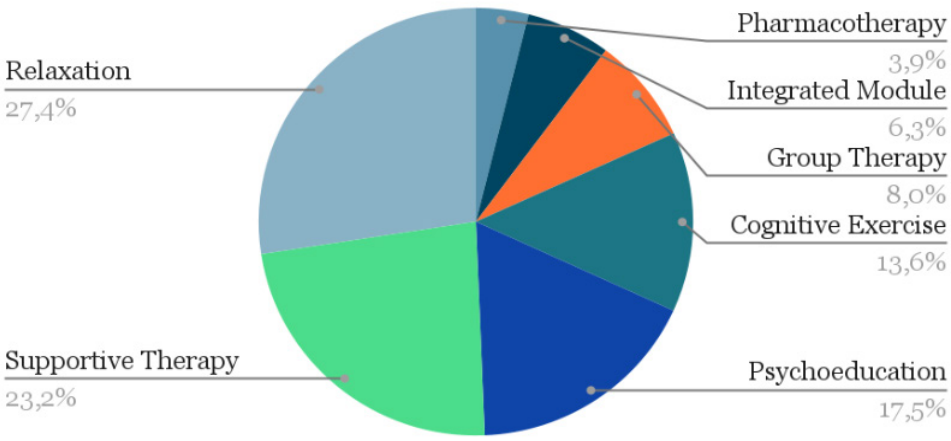

Figure 1. Graph of the Choice of Therapy Methods Preferred by the Respondents

that suggest young people are more susceptible to experiencing anxiety. The average age of the respondents in this study is 18.81 (SD ± 1.19), categorized into the adolescent age group. The adolescent age group is an important period that is marked by emotional changes related to stress management (Rahmayani *et al*., 2019). Older individuals or those who have reached maturity have superior emotional regulation as they have low reactivity to stress and adaptive coping mechanisms (Losada-Baltar, 2021). Previous studies stated that age is related to personality maturity in dealing with stress and their coping mechanism to adapt to anxious conditions (Zouharová *et al*., 2019). An epidemiological study conducted in Germany showed that anxiety disorders are most prevalent among individuals aged 18 to 34 years, with a decline observed as age increases. The lowest prevalence of anxiety disorders was recorded among individuals aged 65 to 79 years (Bandelow & Michaelis, 2015).

The present study has identified that, in addition to age, the college year also exhibits a significant association with TMAS scores. As evidenced by the negative correlation, it is anticipated that a medical student's TMAS score will be higher in the earlier years of study and lower in the subsequent years. It is suitable with previous studies that revealed the ability of individual emotional management affected by their education level. Specifically, the higher the education level, the greater the capacity for rational thinking and assimilating new information. Furthermore, better analytical skills enable individuals to effectively address novel challenges (Bölükbaş *et al*., 2010). Several studies conducted in Malaysia, Indonesia, and Hong Kong have demonstrated that anxiety disorders are more prevalent among medical students in the first and second semesters or the first year of education, compared to the second and third years. However, the prevalence of anxiety disorders increases again in the fourth year. This phenomenon can be attributed to the transition from adolescence to adulthood in their first year of medical school, as well as the shift in educational institutions from high school to university, where social environmental conditions and academic systems differ significantly (Yusoff *et al*., 2013; Chandratika & Purnawati, 2014; Rahmayani *et al*., 2019).

A meta-analysis study, with a specific focus on the global medical student population, discovered that anxiety is more prevalent among female medical students (38.0%, 95% CI: 27.6-49.5%) compared to their male counterparts (27.6%, 95% CI: 19.3-37.8%). However, similar to the result of this current study, the mean difference observed between the genders in this study was also statistically insignificant (Quek *et al*., 2019). Another study, specifically observing anxiety among medical students in the early phase of clinical rotation, revealed that there are insignificant correlations between genders and anxiety levels, but female students exhibited more concern for those around them (Shah *et al*., 2013). Previous studies revealed that gender significantly affected the anxiety level. Female medical students are 2.3 - 11.8 times more susceptible to stress than male medical students due to various psychosocial and biological differences (Ruzhenkova *et al*., 2018; Farhane-Medina *et al*., 2022). It explains that female sexual hormones will reduce the sympathoadrenal and HPA axis response leading to a decrease in cortisol's negative feedback to the brain, resulting in an increased vulnerability to stress (Manuaba *et al*., 2023; Rincón-Cortés *et al*., 2019). Psychologically, females have a higher sensitivity to stress or threats (Burani & Nelson, 2020). An experimental study conducted in animals demonstrated that adult men's testosterone has the potential to have an anxiolytic effect (Domonkos *et al*., 2018).

This study revealed that there is an insignificant correlation between TMAS Score and place of medical students' residence. This result is different from the prior study that revealed place of residence as one of the stress factors associated with anxiety. A lot of medical students are coming from different cities and separating from their parents to study for the first time in their lives. Meanwhile, living with parents and the presence of parents during childhood and adolescence will affect the maturity of individual mental conditions, particularly their ability to manage stress (Rahmayani *et al*., 2019; Cao *et al*., 2020). Another study revealed that an individual who

is in a foreign environment that necessitates a social adaptation process, particularly new sociocultural and habits will be more prone to experience anxiety than an individual who is in a familiar environment. The presence of an unsupportive environment can inhibit the development of an adaptable personality, leading to feelings of boredom, loneliness, stress, and anxiety (Lin *et al*., 2015; Çaksen, 2021; Shao *et al*., 2020; Mehmood *et al*., 2021).

Regarding the type of financing, this study revealed that there is an insignificant correlation between the source of financing and medical students' TMAS scores. The type of financing is typically related to socio-economic ability. As mentioned in a previous study, parents' income stability specifically during COVID-19 was related to psychological pressure and is one of the important factors in anxiety conditions among medical students (Cao *et al*., 2020). Individuals with low socio-economic status and financial difficulties are prone to experience anxiety (Ridley *et al*., 2020). Research conducted in Canada showed that most of the medical students had higher socio-economic status than other populations (Manstead, 2018). Another research conducted in Arab showed that most medical students were supported by high-income parents (Shukri, 2019). People with high socio-economic status had a tendency not to seek or receive scholarships (Dragun, 2020). Nevertheless, in the present study, it remains indeterminate whether the students who were granted scholarships were from underprivileged cohorts, and conversely.

This study revealed that stress among medical students was dominated by academic stress (46.5%) and followed by stress caused by academic and non-academic (38.5%). This result is in line with a previous study by Rahmayani *et al*. (2019) that showed most medical students experienced a high level of academic stress (51.5%) that was measured by the Medical Student Stressor Questionnaire. Stress and anxiety often occur in their first 3 years of study. Academic stress that is associated with anxiety includes being in the period of lectures and examinations, heavy academic load, numerous lecture materials that must be prepared, and lack of sleep (<6 hours a day). The heavy academic workload, which serves as a source of stress and anxiety, encompasses numerous factors, including the extensive volume of material to be mastered, an intensified study load leading up to examinations, a densely packed schedule, engagement in cadaver-related laboratory work or lecture-based learning, pressures exerted by instructors and family, and competition among students. This academic burden is further compounded by internal factors within individual students, such as a deficiency in time management skills, an inability to establish priorities, and disillusionment regarding their chosen profession. Collectively, these factors culminate in a scarcity of time for self-evaluation, a decline in academic performance, and a failure to attain anticipated grades. Consequently, this can lead to feelings of life dissatisfaction, despair, and contemplation of self-harm (Ruzhenkova *et al*., 2018; Yusoff *et al*., 2014).

Currently, various therapeutic methods are available for anxiety, including pharmacotherapy, supportive therapy, group therapy, psychoeducation, cognitive therapy, relaxation techniques, and others. However, previous studies have indicated that the management of mental health issues among medical students and healthcare professionals has not been optimal due to their busy schedules, time limitations, and the presence of intrapersonal, interpersonal, and structural stigmas that limit their access to mental health services (Knaak *et al*., 2017). Therefore, we surveyed to determine the preferred form of anxiety therapy among medical students. In this study, it was found that 27.4% of respondents chose relaxation therapy. Relaxation techniques are known to assist in managing anxiety by activating a "bottom-up" emotional regulation mechanism, involving the reactivation of the amygdala as an emotional region. Additionally, relaxation techniques are capable of inducing alpha brainwave states, which stimulate the release of endorphins. The release of endorphins can induce feelings of comfort and tranquility (Ibrahim *et al*., 2013). Nevertheless, further research with more in-depth methods is needed to explore and develop therapies that are suitable for the needs, preferences, and characteristics of medical students, to enhance their coverage and effectiveness.

Conclusion

From this study, it can be concluded that the frequency of anxiety among medical students is relatively high, and several factors significantly correlated with this anxiety level including age and the year of their current academic enrollment. Despite some limitations in this research, such as the restricted geographical scope to a single university, a predominance of first-year students among the respondents, the self-report form of the questionnaire, and the absence of in-depth qualitative data exploration, the findings of this study are expected to be valuable for future research, particularly in the purpose of addressing and developing anxiety therapies for medical students.

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Influential Factors on Maternal Self-Efficacy in Exclusive Breastfeeding Among Tengger Tribe Toddlers

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Abstract

Exclusive breastfeeding is the action in which the infant only receives breast milk without any additional food or drink including water. In 2022, coverage of exclusive breastfeeding in Indonesia and East Java respectively is 72.04%. However, the coverage of exclusive breastfeeding in the Tengger Tribe is still low, only 38%. This study aims to determine what factors that influenced exclusive breastfeeding self-efficacy practices in toddlers in the Tengger Tribe. This research is an analytic observational study with a cross-sectional study design targeting mothers with children aged 6-24 months in Wonokitri Village, Tosari District, Pasuruan Regency. The research was conducted in April-August 2022. Data analysis used univariate and bivariate analysis using the chi-square test. Most of the respondents were aged 20-34 years (78.9%), mothers had a good level of knowledge (70.2%), fathers and mothers had low levels of education (71.9%), worked as farmers (86%; 61.4%), income <UMK (78.9%), children aged 13-24 months (68.4%), male (56.1%), 1st child (38.6%), no cultural influences during childbirth, breastfeeding, and toddlers (93%, 56.1%, 52.6%) and good family support (68.4%). Most mothers have sufficient self-efficacy (52.6%). From the bivariate results, there was no relationship between internal and external factors and the mother's self-efficacy in exclusive breastfeeding except for the order of the children (p = 0.004). Order of children was the factor associated with the mother's self-efficacy in exclusive breastfeeding to toddlers in the Tengger Tribe. However, it's vital to carry out a more in-depth investigation of the internal and external factors that have already been researched in this study.

Introduction

One of the public health problems that can be the main cause of death in children under five in Indonesia is the incidence of malnutrition and the high prevalence of stunting. Data from RISKESDAS 2018 showed that the prevalence rate of stunting under five in Indonesia was 30.8% (Indonesian Health of Ministry, 2019). The problem of malnutrition and stunting can be influenced by two direct factors, namely inadequate food consumption (dietary factors) and infectious diseases.

Based on the World Health Organization (WHO), exclusive breastfeeding is the action in which the infant receives only breast milk without any additional food or drink, not even water (Elyas *et al.,* 2017). Exclusive breastfeeding has many benefits for children such as forming healthier children's eating behavior, reduced length of hospital stays, favorable weight increase, lower body mass index, lower adiposity, lower total cholesterol values, better cognitive and behavioral development, as well as stability of metabolic levels in children with metabolic disorders (Couto *et al.,* 2020). Data in 2022 showed that the coverage of exclusive

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breastfeeding in Indonesia in 2022 has reached 72.04% (Indonesian Central Bureau of Statistic, 2022). In 2022, the coverage of exclusive breastfeeding in East Java Province will increase to 69.72% compared to 2021 which was only 69.61% (Indonesian Central Bureau of Statistic, 2022). Even though the percentage of exclusive breastfeeding coverage is quite high both nationally and in East Java, there are still some inappropriate breastfeeding practices that can be one of the factors causing malnutrition problems in children (Zhao, *et al*., 2016). Besides that, the data also shows that mothers are still low in giving breast milk who do not fulfill balanced nutrition (Bappenas, 2010).

Wonokitri Village, Tosari District, Pasuruan Regency is one of the traditional villages where the majority of the Tengger people live. Some various cultures and customs are very thick in the daily life of the people. Based on research by Muniroh *et al.* (2019) the use of formula milk is quite a lot, the average age of 0 months has been given formula milk. This is because mothers find it more practical to provide food for their babies. After all, the majority of mothers also help their husbands work in the fields. Apart from the lack of knowledge, socio-cultural factors also greatly influence this. Research by Muniroh *et al.* (2019) showed that there is a culture that causes low coverage of exclusive breastfeeding in the Tengger people, namely formula feeding from newborns (25%) and giving young coconut water to newborns (100%). Apart from that, there is also a culture of throwing away colostrum (28%) because they regard it as dirty breast milk. A study conducted in Indonesia in 2021 shows that toddlers who get exclusive breastfeeding have a 20% lower risk of experiencing stunting compared to toddlers who don't get exclusive breastfeeding (Hadi *et al*., 2021).

The practice of exclusive breastfeeding can be influenced by internal and external factors (Balogun *et al.*, 2015). Internal factors include education, employment, income, knowledge, attitudes, actions, type of family, child health status, and psychological and physical mother. External factors include cultural factors, the role of health workers, and families that are not optimal. Culture and tradition, family eating habits including self-efficacy encourage mothers to breastfeed (Hendriyani *et al*., 2020). The higher the family's functioning in supporting the mother, the higher the mother's self-efficacy in parenting (Vance *et al.,* 2020). Self-efficacy is needed to do something according to one's abilities because it influences individuals to make wishes (Linge *et al.*, 2021). Low self-efficacy in the mother can lead to poor parenting, decreased quality of feeding to children, and cause malnutrition in children (Swanson *et al*., 2011). Based on this explanation, researchers are interested in examining internal and external factors related to the level of self-efficacy of mothers in giving exclusive breastfeeding to children aged 6-24 months in Tengger.

Method

This research is an analytic observational study with a cross-sectional study design. A cross-sectional design study was used to see what factors were related to the self-efficacy of mothers in the Tengger community in exclusive breastfeeding for toddlers aged 6-24 months. The research location is in Wonokitri Village, Tosari District, Pasuruan Regency, which is where most of the Tengger Tribe live. The research was conducted in April-August 2022. Respondents in this study were mothers who had children aged 6-24 months in Wonokitri Village, Tosari District, Pasuruan Regency who were willing to participate in the study and met the criteria. The criteria are: 1) Mothers have children aged 6-24 months who have been given MP-ASI; 2) Mother can read and write; 3) Mother is willing to be a research respondent with informed consent.

Independent research variables include internal factors including education, employment, income, knowledge, attitudes, actions, type of family, child health status, and mother's physique; and also, external factors including cultural factors and family support. Meanwhile, the dependent variable in this study was the mother's self-efficacy in exclusive breastfeeding for children aged 6-24 months. Data collection was carried out through interviews using a structured questionnaire on mothers who have children aged 6-24 months in the Tengger Tribe community.

The questionnaire contains data on internal and external factors, as well as a self-efficacy questionnaire. Data on mothers under five were obtained from posyandu cadres in Wonokitri Village, Tosari District, Pasuruan Regency.

In this study, data were analyzed using 2 methods, namely univariate analysis and bivariate analysis. Univariate analysis was used to determine the distribution of frequencies and percentages of each variable in tabular form. Bivariate analysis was used to analyze the two variables and find out whether there is a relationship between the independent variable and the dependent variable (mother's self-efficacy). This research has received ethical approval from the Health Research Ethics Commission of the Faculty of Public Health, Airlangga University with the ethical certificate number: 93/EA/KEPK/2022.

Result and Discussion

According to the World Health Organization (WHO), exclusive breastfeeding is a situation where the mother only gives breastmilk to her child up to 6 months of age without giving or adding other foods and drinks including vitamins and minerals except water (Elyas *et al*., 2017). Exclusive breastfeeding can provide many advantages and benefits for children in infancy and also in the next phase of life, including reducing the risk of children experiencing gastrointestinal infections, reducing the risk of menstrual periods that are not smooth, preventing malnutrition in children, reducing the risk of various diseases such as asthma, obesity, type 1 diabetes, lower respiratory tract disease, and many more (World Health Organization (WHO), 2011) (Centers of Disease Control and Prevention (CDC), 2023). The success of exclusive breastfeeding is determined by various things, one of which is the mother's level of self-efficacy. Self-efficacy is a belief in a person that they can do something or overcome a situation and that they will succeed in doing it. A study conducted in 2018 in Bandung showed that there was a relationship between the level of a mother's self-efficacy and the success rate of exclusive breastfeeding (Gonzales, 2020). A low level of self-efficacy in the mother can result in poor parenting and decreased quality of feeding to children which can then have an impact on decreasing the nutritional status of the child. In this study, most mothers had a sufficient level of self-efficacy in exclusive breastfeeding (52.6%). There were only 27 respondents (47.4%) who had a good level of self-efficacy (Table 1.)

Table 1. Mother's Self-Efficacy Level in the Success of Exclusive Breastfeeding

Variable	n (%)
Mother's Self-Efficacy Level in the Success of Exclusive Breastfeeding	
Good	27 (47.4)
Enough	30 (52.6)

In this study, some various factors and characteristics can influence a mother's self-efficacy such as the mother's age, religion, father's and mother's occupation, father's and mother's highest level of education, family income level, age of toddlers, order of children in the family, mother's level of knowledge, and external factors. Most of the respondents (mothers) were aged between 20-34 years (48.9%) and had a good level of knowledge regarding exclusive breastfeeding (70.2%). Besides that, some of the respondents in this study were Hindus (98.2%), had a low level of education for both fathers and mothers (71.9%), fathers who worked as farmers (86%), and mothers who worked as farmers (61.4%). The majority of respondents in this study had an income level below the district minimum wage (UMK) (78.9%). In addition, 56.1% of the children in this study were male, 68.4% were aged between 13-24 months, and were the first children (38.6%). In terms of external factors, this study shows that most of the socio-cultural practices during childbirth (93.0%), breastfeeding (43.9%), and toddlers (47.4%) have no cultural influence in them. This study also showed that more than half of the respondents stated that they had good family support in exclusive breastfeeding (68.4%). To find out more clearly, the distribution of the characteristics of the respondents can be seen in Table 2.

Based on the relationship test using chi-square, it was found that there was no relationship between the mother's age, mother's level of knowledge, religion, father's education

Table 2. Characteristics of Respondents

Variables	n (%)
INTERNAL FACTORS	
Mother's age	
<20 yrs	10 (17.5)
20-34 yrs	45 (78.9)
>=35 yrs	2 (3.5)
Religions	
Hindu	56 (98.2)
Islam	1 (1.8)
Father's Education Level	
Low	41 (71.9)
High	16 (28.1)
Mother's Education Level	
Low	41 (71.9)
High	16 (28.1)
Father's Occupation	
Government Employee	1 (1.8)
Entrepreneur	5 (8.8)
Farmer	49 (86.0)
Businessman	1 (1.8)
Others	1 (1.8)
Mother's Occupation	
Not Working/Housewives	15 (26.3)
Government Employee	1 (1.8)
Entrepreneur	4 (7.0)
Farmer	35 (61.4)
Businessman	1 (1.8)
Others	1 (1.8)
Family Income	
<District Minimum Wage	45 (78.9)
>District Minimum Wage	12 (21.1)
Mother's Knowledge Level	
Good	40 (70.2)
Enough	17 (29.8)
Gender of Toddlers	
Girls	25 (43.9)
Boys	32 (56.1)
Age of Toddlers	
6-12 months	18 (31.6)
13-24 months	39 (68.4)
Order of Toddlers in Family	
1st Child	22 (38.6)
2nd Child	16 (28.1)
3rd Child	19 (33.3)
EXTERNAL FACTORS	
Socio-Cultural Practices During Childbirth	
There are Cultural Influences	4 (7.0)
No Cultural Influence	53 (93.0)
Socio-Cultural Practice of Breastfeeding	
There are Cultural Influences	32 (56.1)
No Cultural Influence	25 (43.9)
Toddler Socio-Cultural Practices	
There are Cultural Influences	30 (52.6)
No Cultural Influence	27 (47.4)
Family Support for Exclusive Breastfeeding	
Good	39 (68.4)
Enough	18 (31.6)
Deficient	0 (0.0)

level, and mother's education level and mother's self-efficacy in exclusive breastfeeding (p = 1,000; p = 0.576; p = 1.000; p = 0.776; p = 0.556). A mother's age is one of the important factors that can determine the parenting style that will be given to her child, behavior related to health, feeding patterns, and so on (Lopes, *et al*., 2018; Tung, *et al*., 2014). In this study, there was no significant relationship between maternal age and self-efficacy in exclusive breastfeeding (p = 1,000). There is no relationship between the two variables, which can be caused by the fact that most mothers in this study are aged in the range of 20-34 years, which is a productive age both physically and psychologically, so this age is a good age for pregnant women, giving birth and breastfeeding mothers (Londero *et al*., 2019). At a productive age, mothers will be more mature in making decisions and acting. This age is the age of a mother who is healthy and ready to breastfeed with an excellent mental condition and ready to face problems when breastfeeding.

In addition, this study also found that there was no relationship between the respondent's religion and the mother's level of self-efficacy in exclusive breastfeeding (p = 1,000). This research is in line with a study that showed that religion was not significantly related to breastfeeding practices in mothers (Rashid *et al.,* 2018). Religion in the Tengger Tribe, both Hindu and Islamic, both teach related to the importance of breastfeeding for children so that this is likely to be a factor, there is no relationship between the two variables in this study. The father and mother's occupations were not significantly related to the mother's self-efficacy in exclusive breastfeeding (p = 0.356; p = 0.197). Likewise, the level of family income, number of family members, gender, and age of children also did not have a significant relationship (p = 0.340; p = 0.169; p = 0.183; p = 1.000). However, the order of children in this study showed a significant relationship with the mother's self-efficacy in exclusive breastfeeding (p = 0.004).

Education determines a person to more easily receive information and make a decision. The level of education of parents, both fathers and mothers, will affect their ability to receive health information, especially about exclusive

breastfeeding, and make a decision (Banu & Khanom, 2012). In this study, the educational level of the father and mother also did not have a significant relationship with the level of the mother's self-efficacy in exclusive breastfeeding (p = 0.776; p = 0.556). This can be due to the easy access to receive information about exclusive breastfeeding through local midwives or doctors and can also be through word of mouth which makes it easier for a father to receive information about the importance of exclusive breastfeeding. In addition, in Wonokitri Village, most breastfeeding mothers also routinely come to the midwife and the midwife provides information about the importance of exclusive breastfeeding for children, which can also be a factor in the absence of a relationship between the two variables. This research is in line with one research that stated that there was no significant relationship between a mother's education and breastfeeding self-efficacy in exclusive breastfeeding (Awaliyah, 2019). In this study, there was no significant relationship between the type of father's occupation and the mother's level of self-efficacy in exclusive breastfeeding (p = 0.356). This can be because almost all fathers in the Tengger Tribe work mainly as farmers so they can provide emotional support or motivation to breastfeeding mothers and can also meet their material needs by providing nutritious food for breastfeeding mothers to consume and being able to come and control the midwife or local doctor.

In this study, the majority of mothers worked as farmers and the results showed that there was no significant relationship between the type of work of the mother and the level of self-efficacy in exclusive breastfeeding (p = 0.197). Mothers who work outside the home have limited space and opportunities to breastfeed their babies, while mothers who don't work and live at home have more time to breastfeed their babies. Research in Iran found that working mothers can have high breastfeeding self-efficacy (Maleki-Saghooni *et al.,* 2017). This is because working mothers will feel worried about breastfeeding when they return to work, so mothers will be encouraged to seek help and increase their knowledge to maintain their confidence in breastfeeding. However, other research on working mothers with breastfeeding self-efficacy states that mothers who do not work tend to have higher breastfeeding self-efficacy than mothers who work outside the home (Ahmed *et al.*, 2020). The results of this study are not in line with a study that states that there is a relationship between mother's work and breastfeeding self-efficacy (Ngo *et al.*, 2019). Besides that, family income is an important factor that can affect a person's health condition because the level of income will determine the ability of a family to provide healthy and balanced nutritious food (French *et al.*, 2019). The higher the income level of a family, the better the family's ability to provide nutrient-rich food. Conversely, the lower the economic level of a family, the lower the level of family consumption of foods rich in nutrients (Darmon & Drewnowski, 2015). In this study, no significant relationship was found between the level of family income and the level of self-efficacy of mothers in exclusive breastfeeding (p = 0.340). This research is in line with research conducted in Brazil which used the BSES-SF questionnaire that there was no relationship between family income level and mother's breastfeeding self-efficacy (Ddodt *et al.*, 2012).

Knowledge is one of the factors that influence a person's behavior. A study shows that the higher the mother's knowledge, the higher the self-efficacy that the mother will have. Conversely, mothers with low knowledge tend to have low self-efficacy when compared to those with high knowledge (Titaley *et al.*, 2021). This is in line with this study which shows that the majority of mothers have good knowledge about exclusive breastfeeding. Mothers with good nutritional knowledge had high self-efficacy, but almost half were in the moderate category, while mothers with sufficient nutritional knowledge had the majority of moderate self-efficacy, but almost half were also in the high category. However, this study also shows that there is no significant relationship between the level of mothers' knowledge and self-efficacy in exclusive breastfeeding. There is no relationship between mothers' knowledge and breastfeeding self-efficacy in this study because the majority of mothers have good knowledge about exclusive breastfeeding. The results of this study are not in line with research

that stated there is a relationship between a mother's knowledge and self-efficacy in breastfeeding (Titaley *et al*., 2021).

In this study, the results showed that the sex of the child was not significantly related to the level of the mother's self-efficacy in exclusive breastfeeding (p = 0.576). There is no relationship between the two variables because in this study most of the children were boys. A study shows that boys consume more breast milk, that is, they consume an average of 76 ml (2.6 fl oz) more than girls (Kent *et al*., 2006). The results of this study are in line with research conducted in Iran which shows that exclusive breastfeeding self-efficacy does not have a significant relationship with the sex of the child (Mirghafourvand *et al*., 2018).

Besides that, in this study, the results showed that the age of the child was not significantly related to the mother's self-efficacy in exclusive breastfeeding (p = 1,000). There was no relationship between the two variables, which could be because most of the children in this study were aged 13-24 months, which at that age was already in the weaning period, so they were no longer given breast milk. The results of this study are in line with research in 2018 which showed that the age of the child is not related to the mother's self-efficacy in exclusive breastfeeding (Mirghafourvand *et al*., 2018). However, in this study, it was found that the order of children had a significant relationship with the mother's self-efficacy in exclusive breastfeeding (p = 0.004). There is a relationship between the two variables because, in this study, the level of the mother's self-efficacy in the good category tends to increase along with the increase in the number/order of children born in the family, especially when the second child is born. The results of this study are inconsistent with a study showing that the number of children/order of children is significantly related to the self-efficacy of mothers in exclusive breastfeeding (Topuz *et al*., 2021).

Table 3. Bivariate Analysis of Respondent Characteristics with Mother's Self-Efficacy in Exclusive Breastfeeding

Variables	Level of Mother's Self-Efficacy in the Success of Exclusive Breastfeeding		p-value
	Good n (%)	Enough n (%)	
INTERNAL FACTORS			
Mother's age			
<20 yrs	5 (8.8)	5 (8.8)	1.000
20-34 yrs	21 (36.8)	24 (42.1)	
>=35 yrs	1 (1.8)	1 (1.8)	
Religions			
Hindu	27 (47.4)	29 (50.9)	1.000
Islam	0 (0)	1 (1.8)	
Father's Education Level			
Low	20 (35.1)	21 (36.8)	0.776
High	7 (12.3)	9 (15.8)	
Mother's Education Level			
Low	18 (31.6)	23 (40.4)	0.556
High	9 (15.8)	7 (12.3)	
Father's Occupation			
Government Employee	0	1 (1.8)	0.356
Entrepreneur	1 (1.8)	4 (7.0)	
Farmer	24 (42.1)	25 (43.9)	
Businessman	1 (1.8)	0 (0.0)	
Others	1 (1.8)	0 (0.0)	
Mother's Occupation			
Not Working/Housewives	8 (14.0)	7 (12.3)	0.197
Government Employee	0 (0.0)	1 (3.3)	
Entrepreneur	0	4 (7.0)	

Farmer	17 (29.8)	18 (31.6)	
Businessman	1 (1.8)	0 (0.0)	
Others	1 (1.8)	0 (0.0)	
Family Income			
<District Minimum Wage	23 (40.4)	22 (38.6)	0.340
>District Minimum Wage	4 (7.0)	8 (14.0)	
Mother's Knowledge Level			
Good	20 (35.1)	20 (35.1)	0.576
Enough	7 (12.3)	10 (17.5)	
Gender of Toddlers			
Girls	9 (15.8)	16 (28.1)	0.183
Boys	18 (31.6)	14 (24.6)	
Age of Toddlers			
6-12 months	9 (15.8)	9 (15.8)	1.000
13-24 months	18 (31.6)	21 (36.8)	
Order of Toddlers in Family			
1st Child	7 (16.7)	15 (35.7)	0.004*
2nd Child	12 (28.6)	4 (9.5)	
3rd Child	0 (0.0)	4 (9.5)	
EXTERNAL FACTORS			
Socio-Cultural Practices During Childbirth			
There are Cultural Influences	1 (1.8)	3 (5.3)	0.613
No Cultural Influence	26 (45.6)	27 (47.4)	
Socio-Cultural Practice of Breastfeeding			
There are Cultural Influences	18 (31.6)	14 (24.6)	0.129
No Cultural Influence	9 (15.8)	16 (28.1)	
Toddler Socio-Cultural Practices			
There are Cultural Influences	13 (22.8)	17 (29.8)	0.600
No Cultural Influence	14 (24.6)	13 (22.8)	
Family Support for Exclusive Breastfeeding			
Good	19 (33.3)	20 (35.1)	0.784
Enough	8 (14.0)	10 (17.5)	
Deficient	0 (0.0)	0 (0.0)	

*) Significant at p-value <0.05

In addition, looking at external factors, the results showed that there was no significant relationship between socio-cultural practices during labor and the mother's self-efficacy in exclusive breastfeeding (p = 0.613). There is no relationship between sociocultural nutrition during childbirth and breastfeeding self-efficacy because the variation in data on the socio-cultural variable of nutrition during childbirth differs only slightly between the two categories used. Likewise, socio-cultural practices when breastfeeding and when toddlers were also not significantly related to mothers' self-efficacy in exclusive breastfeeding (p = 0.129; p = 0.600). There is no relationship between these variables which can be caused by several other factors that might affect a person's self-efficacy. One of the factors that influence self-efficacy is culture through values, beliefs, and self-regulatory processes which serve as a source of self-efficacy assessment and also as a consequence of self-efficacy beliefs (Burke, 2009).

In addition, family support for exclusive breastfeeding also did not have a significant relationship with the mother's self-efficacy in exclusive breastfeeding (p = 0.784). The results of this study are not in line with research conducted in Iran which shows that social support from the family and those around them is highly related to the self-efficacy of mothers in exclusive breastfeeding (Mirghafourvand *et al.,* 2018). Postpartum breastfeeding is the most sensitive period in a mother's life both physically and emotionally, so breastfeeding during this

period can be difficult for a mother. Some mothers can feel anxiety and psychological discomfort after the birth of a child. This condition is often found in mothers because of the transition to parenthood (Rados *et al*., 2018). As for the external factors in this study, there was no significant relationship between the variables of socio-cultural practices during childbirth, socio-cultural practices during breastfeeding, socio-cultural practices during toddlers, and family support for exclusive breastfeeding (p = 0.613; p = 0.129; p = 0.600; p = 0.784). To find out more clearly related to the results of the bivariate analysis in this study can be seen in Table 3.

During this breastfeeding period, it is necessary to have support that is perceived by the mother from the family, that comfort, attention, and help are always available when the mother needs it. This support can be provided in the form of emotional support, instrumental support, informational support, and assessment support (Bengough *et al*., 2022). The support provided by the family can increase the mother's self-efficacy to provide exclusive breastfeeding. Mothers who get verbal persuasion from the family tend to be able to continue breastfeeding their babies even though they experience obstacles. Apart from motivation from the family, mothers with good family support also receive practical assistance from the family so they can continue to breastfeed their babies (Li *et al*., 2022).

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Conclusions

In this study, it was found that the factors associated with mother's self-efficacy in exclusive breastfeeding to toddlers in the Tengger Tribe were the order of children/ number of children in the family. With the results of this study, it is hoped that in the future it can become a reference for health and private institutions to create a program related to increasing the coverage of exclusive breastfeeding in the Tengger Tribe. In addition, it is vital to carry out a further and more in-depth investigation on internal and external factors that have already been researched in this study regarding to self-efficacy of exclusive breastfeeding practice on toddlers in the Tengger Tribe.

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Effectiveness of Ricinus communis as Natural Larvicide for Aedes aegypti Mosquito Larvae in Medan City

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Abstract

Abstract. Dengue Hemorrhagic Fever, a disease caused by Aedes aegypti, can be prevented by reducing larval density using natural larvicides. This research aimed to investigate the natural larvicide effectiveness in reducing the Aedes aegypti larvae density in Medan City in 2023. This quasi-experimental research conducted a pre-test and post-test on the Container Index (CI). The population in this study was 1,057 houses in Ladang Bambu Village, the sample being 150 houses. The treatments were control and Ricinus communis-seed powder at 40 mg, 80 mg, 100 mg, and 120 mg/l doses in ovitraps, placed next to the water reservoir. Consider specifying the unit of measurement for the container index. The container index was calculated before (day 0) and after treatment (day 7). Data were analyzed using paired T-test, one-way ANOVA, and LSD. The results were that the modified ovitrap with the seed of Ricinus communis was effective in reducing the Aedes aegypti mosquito larvae density. The analysis showed a significant difference in the mean CI between the control and the modified ovitrap, the most effective dose in reducing CI being 100 mg/l of water. The community can use the 100 mg/l seed of Ricinus communis in ovitraps as an eco-friendly vector control.

Introduction

Dengue fever is a viral infection that spreads from mosquitoes to humans and ranks among the top ten global health threats. Dengue fever incidence has increased dramatically worldwide in recent decades, with cases reported to the World Health Organization (WHO) increased from 505,430 cases in 2000 to 5.2 million in 2019. Dengue fever is an endemic disease in more than 100 countries in Africa, the Americas, the East Mediterranean, Southeast Asia, and West Pacific Regions. The Americas, Southeast Asia, and the Western Pacific are the worst affected regions, with Asia representing approximately 70% of the global disease burden (World Health Organization, 2023). Bhatt *et al.* (2013) estimate that 390 million dengue infections occur every year with 96 million of them having clinical manifestations with varying levels of disease severity. Untreated dengue can trigger extraordinary events, severe dengue, and even death.

The number of dengue fever cases in Indonesia has been increasing every year. There were 73,518 cases of dengue fever with 705 deaths and 143,266 cases of dengue fever with 1,237 deaths respectively in 2021 and 2022. In 2023, dengue cases increased from 1,259 cases in the 5th week to 57,884 cases in the 33rd week (Minister of Health Republic of Indonesia, 2023). DHF cases in North Sumatra Province in 2019 amounted to 7,584 cases of illness and 37 cases of death. This number has increased compared to 2018, which recorded 5,786 cases with 28 deaths (Minister of Health Republic of Indonesia, 2020).

The target or indicator for dengue hemorrhagic fever set in the 2020-2024 Ministry

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of Health the Republic of Indonesia Strategic Plan is that 90% of districts/cities have a dengue incidence rate (IR) ≤49/100,000 population in 2024 which will be achieved in stages. This target is expected to be achieved through activities such as: (1) increasing innovation (integrated and biological vector control); (2) strengthening case management; (3) increasing advocacy and communication; (4) strengthening the public health laboratory system to strengthen surveillance; (5) strengthening reporting and real-time surveillance; (6) building an early warning system; and (7) increasing regional capacity (Minister of Health Republic of Indonesia, 2020).

Vector control is crucial for the prevention and control of dengue fever. The use of insecticides in vector control plays a crucial role in the dengue control program, especially to break the chain of transmission. It is essential to follow WHO recommendations and national guidelines for the safe use of insecticides to prevent the development of vector resistance, as chemical insecticides can cause such resistance. According to the research conducted by Goindin *et al*. (2017), the larvae of *Ae. aegypti* exhibited high resistance levels to temephos (from 8.9 to 33.1-fold) according to the resistance ratios (RR50) computed. This pattern of resistance to insecticides requires serious attention and the implementation of national guidelines for the use of insecticides needs to be closely monitored. Thus, biological vector control is one of the strategies outlined in the 2020-2024 Strategic Plan of the Ministry of Health Republic of Indonesia.

Long-term application of insecticides to the same targets puts unprecedented pressure on the population of *Aedes aegypti*, causing it to develop more quickly and become resistant. The development of a safer and more specialized biological insecticide is one approach to solving this issue. A biological insecticide is defined as an insecticide derived from plants and contains chemicals (bioactive) that are poisonous to insects but biodegradable, meaning they do not harm the environment and are generally harmless to humans (Wahyuni *et al*., 2019). One of the natural larvice is *Ricinus communis* (castor seed). Castor plants are toxic to nematodes, insects, and fungi because they contain the bioactive ricin. Ricin is an enzyme protein that can inhibit protein synthesis causing cell death (Sowa-Rogozińska *et al*., 2019). Ricin is a highly toxic ribosome-inactivating lectin found in castor seeds (Sousa *et al*., 2017). In the research conducted by Sogan *et al*. (2018), *Ricinus communis* leaf and seed extracts showed significant mortality of *Aedes aegypti.* The research of Wamaket *et al*. (2018) carried out can conclude that the ethanol extract of *Ricinus communis* seed and leaves was effective as a larvicide against *Aedes aegypti* mosquito larvae. As a more efficient larvicide against mosquitoes, *Ricinus communis* seed extract exhibits higher larvicidal activity than leaf extract (Sogan *et al*., 2018).

Therefore, the seed of *Ricinus communis* to be studied in the form of powder was put into a small container (ovitrap) and placed near a water reservoir. In line with this, mosquito egg traps (ovitrap) are an effective way to control *Aedes aegypti* mosquito larvae. Ovitrap was effective in reducing the density of *Aedes sp*. mosquitoes and can control dengue fever in a simple and environmentally friendly. Ovitrap has been modified to maximize its function in reducing larval density. Modifications Rekattidiri ovitrap has undergone significant in comparison to the larval density index (HI p-value: 0.025, CI p-value: 0.052, BI value of p: 0.04). Additionally, there are variations in the mean number of larvae trapped in Rekattidiri ovitrap and standard ovitrap (p-value: 0.001) (Saepudin *et al*., 2017). Modifying the shape and adding natural ingredients is one way to improve the function of the ovitrap. Ovitrap modified with natural ingredients can attract and inhibit the growth of larvae. According to the research results of Cahyati *et al*. (2017), hay infusion and papaya leaf juice can be natural attractants when using modified ovitrap.

The latest national data in 2022 showed that Medan City with 2,262 cases was among the 5 cities with the highest number of dengue fever cases in Indonesia (Minister of Health Republic of Indonesia, 2023). The study conducted by Purba *et al*. (2022) showed that Medan Tuntungan District is one of the areas with a high vulnerability to dengue fever analyzed spatially. Ladang Bambu Urban Village in Medan Tuntungan District is a risk

area for dengue fever transmission. The pre-survey showed that 62% of the 135 houses examined were positive for mosquito larvae in Ladang Bambu Urban Village. This research aimed to investigate the effectiveness of *Ricinus communis* (castor seed) in an ovitrap to reduce the density of *Aedes aegypti* larvae in Medan City.

Method

This type of research was quasi-experimental research with a nonequivalent control group design where pre-test and post-test are carried out on the container index for ovitrap without treatment and ovitrap modification with *Ricinus communis* seed powder. This research was conducted in the residential area of Ladang Bambu Urban Village, Medan Tuntungan District in September 2023. The population in this study was 1,057 houses, with a sample size of 150 households chosen using purposive sampling. In this study, observation sheets and questionnaires were used to collect data. The treatments in this study were controlled and *Ricinus communis* seed powder at doses of 40 mg, 80 mg, 100 mg, and 120 mg/l water was put into ovitraps placed next to the water reservoir. Two containers were examined for each house, one inside and one outside, and observed for 7 days. These treatments had been in 6 different houses at the same time. Container Index (CI) was obtained from 5 differently inspected houses at each repetition, resulting in as many as 30 CI data. CI was calculated as the number of containers with any larvae or pupae, divided by the total number of inspected containers, multiplied by 100. The data was observed on day 0 (before treatment) and day 7 (after treatment).

The independent variable in this study was the modification of the ovitrap with *Ricinus communis* seed powder and the dependent variable was the density of *Aedes sp* mosquitoes, which was measured by the CI. The tools and materials used in this research included 1.3 litre as many as 300 buckets, small plastic, stirrers, *Ricinus communis* seed powder, and water. The data analysis technique uses the paired t-test, one-way ANOVA, and the LSD multiple comparison test. Previously, the data assumptions were carried out using the Shapiro-Wilk test and homogeneity test. Ethical approval was received from The Ethics Committee, Universitas Sumatera Utara with registration number 937/KEPK/USU/2023.

Result And Discussion

The results showed that the average CI after treatment decreased, of which the highest decrease occurred at a dose of 100 mg/l water, which amounted to 33.33%. The lowest decrease occurred at a dose of 0 mg/l water, with no CI change (0%) (Table 1). Based on the results of the normality test using the Shapiro-Wilk test, it was found that the average CI after treatment with ovitrap placement with a dose of 0 mg/l of water (control), 40 mg/l of water, 80 mg/l of water, 100 mg/l of water, and 120 mg/l of water is normally distributed with p values respectively 0.078; 0.091; 0.110; 0.212; 0.101 (p-value $\geq$ 0.05). The test was continued with the paired T-test (Table 2) which showed that each dose (40 mg, 80 mg, 100 mg, and 120 mg/l of water) was effective in reducing the average CI after treatment (p-value < 0.05).

The overall density of *Aedes aegypti* mosquito larvae (CI) after the ovitrap modification treatment decreased compared to the container index before treatment. The decrease in the average container index after ovitrap treatment occurred because the ovitrap attracted mosquitoes to lay eggs inside it so they no longer lay eggs in the water reservoir at home. The ovitrap used in this study was dark-colored and made of plastic. This is based on the bionomics of the *Aedes aegypti* mosquito, which prefers dark colors for egg-laying (Windyaraini *et al*., 2020). Furthermore, mosquitoes tend to lay their eggs in plastic containers and do not tend to dislike soil (Cahyati & Siyam, 2019). The statement relevance of Aedes mosquitoes inhabiting plastic materials has also been reinforced by a study conducted in Zanzibar City, Tanzania, where both larvae and pupae *Aedes aegypti* preferred plastic containers, followed by metal containers, ceramic or cement containers, rubber (tires), and natural habitats. Similar findings were found in Dar es Salaam, Tanzania, indicating that *Aedes aegypti* is the primary dengue vector and breeds primarily in medium-sized plastic containers (Mboera *et al*., 2016).

Ovitrap in this study was modified by adding *Ricinus communis* as a natural larvicide which is lethal to larvae. Following the other research results it was stated that *Ricinus communis* seed extracts showed significant mortality of *Aedes aegypti* (Sogan *et al*., 2018; Wamaket *et al*., 2018). This causes the number of containers that are positive for larvae to decrease so that the CI also decreases. According to the findings of Wamaket *et al*. (2018), which affirms that Among the five concentrations that were investigated, the highest dosage (100 ppm) exhibited the highest effectiveness against third-instar larvae, leading to an 85.33% mortality rate. This is additionally substantiated by the study carried out by Sogan *et al*. (2018), at concentrations of 32 ppm and 64 ppm, the seed extract resulted in 100% mortality for *An. culicifacies* and *Ae. aegypti*, respectively.

Ricinus communis is one such plant that has the potential to be utilized in vector control programs, attributed to its castor oil and ricinine (Sogan *et al*., 2018). Ricin is a toxin that is naturally contained in *Ricinus communis* seed. Ricin can be created from leftover material from the processing of *Ricinus communis* seed. It can be made in the form of powder, mist, or pellets, or it can also be dissolved in water or weak acid (Centers for Disease Control and Prevention, 2018). Furthermore, numerous bioactive phytochemical elements of *Ricinus communis* have been identified in methanol extract, including alkaloids, flavonoids, tannins, terpenoids, and others. The research conducted by Alugah and Ibraheem (2014) revealed the presence of flavonoids and tannins in the methanol extract of *Ricinus communis* seeds. The phytochemical contents found in the methanol extract of *Ricinus communis* seeds are also elucidated in other studies, encompassing alkaloids, steroids, triterpenoids, tannins, flavonoids, saponins, coumarins, and emodins (More & Pandhure, 2015; Rahman *et al*., 2022). The phytochemical content exhibits larvicidal properties against *Aedes aegypti* larvae by impeding the transition of eggs into larvae and enhancing the rate of larval mortality (Panche *et al*., 2016; Shymanovich *et al*., 2015).

Table 1. Container Index Before and After Treatment

Doses (mg/l)	Repetition	Container Index (%)		Diff
		D-0	D-7	
0	1	60.00	60.00	0.00
	2	60.00	60.00	0.00
	3	80.00	80.00	0.00
	4	50.00	50.00	0.00
	5	60.00	60.00	0.00
	6	50.00	50.00	0.00
Average		60.00	60.00	0.00
40	1	50.00	30.00	20.00
	2	50.00	40.00	10.00
	3	50.00	30.00	20.00
	4	50.00	40.00	10.00
	5	50.00	40.00	10.00
	6	50.00	20.00	30.00
Average		50.00	33.33	16.67
80	1	40.00	40.00	0.00
	2	50.00	20.00	30.00
	3	40.00	20.00	20.00
	4	50.00	50.00	0.00
	5	50.00	30.00	20.00
	6	50.00	20.00	30.00
Average		46.67	30.00	16.67
100	1	40.00	10.00	30.00
	2	40.00	50.00	10.00
	3	50.00	20.00	30.00
	4	50.00	10.00	40.00
	5	50.00	0.00	50.00
	6	40.00	10.00	30.00
Average		45.00	11.67	33.33
120	1	30.00	20.00	10.00
	2	40.00	30.00	10.00
	3	50.00	10.00	40.00
	4	40.00	20.00	20.00
	5	40.00	20.00	20.00
	6	30.00	20.00	10.00
Average		38.33	20.00	18.33

Table 2. Mean Difference of Container Index Before and After Treatment

Doses (mg/l)	Mean CI Pre-test (%)	Mean CI Post-test (%)	Mean Diff	t	p
0	60.00	60.00	0.00	-	-
40	50.00	33.33	16.67	5.00	0.004
80	46.67	30.00	16.67	2.99	0.031
100	45.00	11.67	33.33	7.91	0.001
120	38.33	20.00	18.33	3.84	0.012

Table 3. Data Homogeneity

		Statistics	df1	df2	p
Container Index Post-Test	Based on Mean	1.047	4	25	0.403
	Based on Median	0.873	4	25	0.494
	Based on the Median and with adjusted df	0.873	4	19.6	0.498
	Based on trimmed mean	1.065	4	25	0.394

Table 4. Influence of Ricinus communis Seed Dosage on Container Index

Sources of Variation	Sum of Squares	Df	Mean Square	F	p
Between groups	8053.333	4	2013.333	22.707	0.0001
Within groups	2216.667	25	88.667		
Total	10270.000	29			

Table 3 of the homogeneity test above shows that the average CI after treatment is homogeneous with a p-value of 0.403 (p-value < 0.05) and can proceed with the ANOVA test. The results of the one-way ANOVA test in Table 4 showed that the difference in the average CI for the various doses of *Ricinus communis* seed powder used had a p-value of 0.0001 (p-value < 0.0001), meaning that there was a significant difference in the average CI between the doses. This shows that there was an influence of *Ricinus communis* seed dosage on CI. This is in line with research conducted by Wamaket *et al.* (2018) in Thailand which showed that among the five doses examined, the highest dosage (100 ppm) was the most effective against third-instar larvae, with a mortality rate of 85.33%.

Table 5. Effective Ricinus communis Seed Dosage in Reducing Container Index

Observation Group		Mean Diff	p
Doses (I)	Doses(I)	|I – J|	
0 mg/l	40 mg/l	26.67	0.0001
	80 mg/l	30.00	0.0001
	100 mg/l	48.33	0.0001
	120 mg/l	40.00	0.0001
40 mg/l	80 mg/l	3.33	0.545
	100 mg/l	21.67	0.001
	120 mg/l	13.33	0.022
80 mg/l	100 mg/l	18.33	0.002
	120 mg/l	10.00	0.078
100 mg/l	120 mg/l	-8.33	0.138

Based on the results of the multiple comparison test (Table 5), there is a difference in the average CI after treatment between the control ovitrap and ovitrap at various doses with a p-value of 0.0001 (p-value <0.05), which means that dosing *Ricinus communis* seed is effective in reducing CI. Then, based on the results of the average difference in CI, a dose of 100 mg/l water is the most effective dose in reducing CI. The results showed that seed powder of *Ricinus communis* in an ovitrap with a dose of 100 mg/l was more effective than a dose of 120 mg/l water in reducing CI. It happens because, at a dose of 120 mg/l water, the water in the ovitrap becomes more turbid. *Aedes aegypti* likes clear water reservoirs and has a low level of turbidity. Research by Dalpadado *et al.* (2022) showed that *Aedes sp.* tends to like water with low turbidity and TDS.

The density of *Aedes sp.* mosquito larvae in an area must be controlled and handled appropriately by breaking the chain of transmission and controlling the dengue vector population. The incidence of DHF was substantially correlated with *Aedes aegypti* larvae presence in a water container (Panggabean *et al.*, 2019; Surendran *et al.*, 2021; Yuanita *et al.*, 2019). Mosquito Nest Eradication (PSN) is a government program that can be carried out to control mosquito populations, including by using larvicides. Research by Retnaningrum *et al.* (2019) showed that 85.5% of respondents did not use temephos powder, potentially increasing the risk of dengue vector mosquitoes exploding. However, temephos resistance has been discovered in several locations (Goindin *et al.*, 2017; Haziqah-Rashid *et al.*, 2019; Ikawati *et al.*, 2017). This pattern of resistance to insecticides requires serious attention hence it is necessary to modify the use of natural ingredients as insecticides that do not cause resistance and are biodegradable (environmentally friendly).

The use of appropriate technology to prevent dengue that can be applied in the community is the manufacture of ovitrap hence the use of modified ovitrap with natural larvicide rather than chemical. The use of modified ovitrap with *Ricinus communis* seed larvicide at a dose of 100 mg/l can be used as an environmentally friendly vector control activity because chemical larvicide can trigger mosquito resistance. In line with this study, natural ingredients from ethanolic preparation of *C. papaya* leaf possess larvicidal action against *Aedes spp.* (Ilham *et al*., 2019). The seed of *Ricinus communis* also were determined to be non-harmful to non-target organisms, such as Guppy fish (*P. reticulata*), as it did not show any discernible impact on *P. reticulata* even after 24 or 48 hours of exposure at their LC50 and LC90 values against fourth-instar larvae of *Ae. aegypti* (Sogan *et al*., 2018).

Integrated vector control can be carried out in conjunction with other vector control measures. The current methods for Aedes larval source reduction employed in dengue (DENV) control efforts in the Jaffna Peninsula face significant challenges, including issues with littering practices, non-compliance with established dengue control guidelines, vertical transmission of DENV in vector mosquitoes, and the development of larvae in brackish water, open surface drains, and domestic wells used for potable water supply (Surendran *et al*., 2021). As a result, the use of natural larvicides should be complemented by promoting community involvement in dengue prevention activities, such as emptying water containers four times a month and regularly monitoring for the presence of larvae in water containers (Sarumpaet *et al*., 2017; Windiyaningsih & Nurhastuti, 2018). The community's role in vector control is of utmost importance, as the health of households and proper sanitation presence of facilities in the community are closely related to the container index (Sukesi *et al*., 2023).

Conclusion

Ricinus communis seed powder in an ovitrap effectively reduced the density of *Aedes aegypti* mosquito larvae at an optimal concentration of 100 mg/l. The modified ovitrap employed in this study represents an advancement in effective technology involving the modification of a small dark-colored plastic container filled with *Ricinus communis* seed larvicide. This method principle combines the creation of a breeding site for *Aedes aegypti* egg deposition with the prevention of egg and larvae development, ultimately leading to mortality. This innovative approach serves as an environmentally friendly method for mosquito vector control.

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IMS-Dengue Survey (Integrated management strategy for dengue) as a Diagnosis of Village Readiness in Realizing Integrated Dengue Prevention and Control

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Abstract

In 2022, Semarang City experienced a 4-fold increase in dengue cases with IR: 51.7/100,000 residents, CFR: 3.8%. The purpose of the study was to determine the readiness of village-based dengue control based on IMS-dengue criteria in realizing integrated dengue prevention and control. The study was conducted in Bandarharjo Village, a high-risk community on the outskirts of Semarang City, consisting of 30 cadres and 83 people who had stayed for at least 6 months. Samples were taken using a purposive sampling technique. Analytical survey research, data collection with questionnaires, and observation checklists. The results of an integrated dengue control survey in households show that the use of mosquito repellent is still high (94.0%) and the use of larvicide to prevent mosquitoes in water reservoirs that are difficult to clean is preferred. Good practices in the use of mosquito nets during early morning sleep 42.2%, rearing larval predatory fish 61.4%, and the use of mosquito repellent plants (39.8%) are still quite minimal. Factors related to dengue control practices are perceptions of the seriousness of dengue disease in the community.

Introduction

Prevention and control of dengue fever have been carried out since the beginning of the emergence of dengue disease and extraordinary events (outbreaks), but the prevention and control of this disease have caused a lot of resistance to the Aedes aegypti mosquito vector as in previous studies (Harapan *et al*., 2019; Arfan, Rizky and Hernawan, 2022; Siyam, Sukendra and Santik, 2022), (Hamid *et al*., 2018), and the increase in dengue disease both at the national level and Semarang City is still occurring (Siyam *et al*., 2021). Data from the Indonesian Ministry of Health shows that dengue fever in Indonesia is spread across 472 regencies/cities in 34 provinces. until the 49th week of 2020 as many as 95,893, while the number of deaths due to dengue fever until the 49th week was 661. Data from the Semarang City Health Office shows that dengue cases in Semarang City in 2022 reached 857 cases, an increase of 3 times compared to previous years. The fatality rate of dengue disease is 3.5%, meaning that 30 people died of dengue fever in 2022. DHF is a disease for which there is no cure, and also its high incidence of transmission is caused by the decline of the dengue virus from mother to egg (transovaria) (Saepudin *et al*., 2022; Wanti, Isnawati and Respati, 2022).

The three puskesmas work areas that have the highest dengue cases are Puskesmas Tembalang, Bandarharjo, and Banyumanik. One of the villages in Puskesmas Bandarharjo that is endemic to dengue fever is Bandarharjo Village, which is a suburb of Semarang City that is at high risk of dengue transmission. Based on the results of the 2022 Epeniti survey, it is reported that the Larvae Free Rate (ABJ) is still below 95%, an area that has a lot of untreated puddles, many abandoned buildings or buildings that are neglected, and has a high density of mosquitoes. The results of interviews

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with Lurah and the head of FKK Bandarharjo reported that 5 priority RWs need assistance in dengue control, currently due to the increasing dengue cases, namely RW 5, 6, 8, 3, and 2.

There have been many efforts made by the government to overcome the possible adverse effects of environmentally unfriendly and harmful control of the ecosystem (Hassan *et al*., 2021). The DHF prevention and control program that has been carried out is COMBI (communication for behavioral impact), but this program has been less actively implemented, while the 1 house 1 jumantik program that is currently running also experiences many obstacles (Sukesi *et al.,* 2018). In addition, the latest program being developed in various regions in Indonesia is a dengue vector control program using natural enemies from Aedes ae. i.e. using Wolbachia bacteria (Anders *et al*., 2020a). These bacteria can spay eggs produced by Aedes ae mosquitoes. to reduce the number of Aedes ae. mosquito populations in the community (Anders *et al*., 2020b). Prevention of DHF with Wolbachia bacteria has not fully received a positive response from the community (Buchori *et al*., 2022). In Semarang City itself, the controls carried out are improving waste management, Community-Based Total Sanitation (STBM), and intensifying 3M plus. Where prevention and control require many supporting aspects to make the program run in an integrated and sustainable manner.

From these problems, researchers have the idea to predict village readiness in dengue control in Bandarharjo Village based on IMS-dengue as a basis for integrated dengue prevention and control. The principle of dengue control must be carried out in an integrated manner, meaning that dengue control must pay attention to all aspects that affect the incidence of dengue disease so that dengue control can be sustainable. Integrated control includes aspects of Dengue Severity, Dengue outbreak opportunity, biological-social environment, household prevention, and control behavior, Larvae Surveillance System by Health cadres, the role of stakeholders, climate, and regional vulnerability. In addition, integrated prevention and control must also prioritize the sustainability of ecosystems and the environment (Nguyen-Viet *et al*., 2015). Integrated control also combines eco-bio and social aspects of strategies to achieve low risk of dengue (Sommerfeld & Kroeger, 2012; Kittayapong *et al*., 2012).

To avoid outbreaks and worse health and environmental problems, identification of areas at risk of dengue is important. Areas that are prone to dengue fever can be a priority location for comprehensive prevention and control of dengue hemorrhagic fever that looks at various risk criteria that may be prioritized for prevention. So, predictions of village readiness need to be made. DHF prevention and control must involve the community or community because community readiness is the key to the success of dengue control. People are people who have lived and understand the environment they live in and understand the culture or habits of residents carried out every day. It is the community that must be able to actively participate in realizing the prevention and control of the disease they need (Waleckx *et al*., 2015). The amount of community readiness in dengue control must be immediately identified to immediately get appropriate treatment as well. The risk of vulnerability to dengue severity, the opportunity for outbreaks, the risk of environmental hazards, climate, and regional vulnerability are basic aspects, while community behavior, the role of stakeholders, health workers, and cadres in dengue control become capital in the sustainability of integrated prevention and control programs (Arunachalam *et al*., 2012; Sulistyawati *et al*., 2019). So, the purpose of this study is to identify integrated prevention of dengue fever, its knowledge, solutions to dengue fever, and the understanding of the community and cadres on dengue mosquito larvae surveillance.

Methods

The study was conducted in the Suburban area of Semarang City, Bandarharjo Village, with a focus on RW 5, 6, 8, 3, and 2 which are areas with the highest cases and have the lowest ABJ. The inclusion criteria are high-risk dengue communities on the outskirts of Semarang City / who live in the Bandarharjo Village area of Semarang City (at least 6 months). The criteria for cadres are cadres who are responsible for dengue control in the RW where the research has stayed for at least 6 months and can read

and write. Household samples were calculated using the slovin formula, and 99 samples were obtained, because the completeness of the data was only obtained in 83 household samples. The cadre sample is determined by purposive sampling, i.e. 6 cadres each representing each RW with a total number of 30 cadres.

The research design is survey research, with a quantitative descriptive approach. Research Data generated: data on the implementation of dengue prevention and control in households in an integrated manner, data on integrated dengue prevention knowledge by cadres and heads of families, data on understanding of dengue solutions for heads of families, data on understanding of dengue solutions for health cadres, data on understanding of the larvae index surveillance system on heads of families, data on understanding of the larvae index surveillance system on health cadres.

The research instruments were a questionnaire (questionnaire modified from Nontapet *et al*. Study, 2022 (Nontapet *et al*., 2022) and checklist of observations by respondents. Data collection techniques by filling out questionnaires are filled directly by respondents. The results of the research data are presented by univariable analysis for respondent characteristics (demographic picture of respondents), research data are described in percentage distribution and presented in the form of tables and narratives. The research has received a Letter of Ethics from the Health Research Ethics Commission of Universitas Negeri Semarang no. 306/KEPK/EC/2023 dated July 13, 2023.

Results and Discussion

The research was conducted on July 14-September 2023 in Bandarharjo Village, Semarang City. The research involved PKK mothers as health cadres, village health forums (FKK), and village stakeholders. The following are the results of an integrated control action survey on DHF.

Table 1. Characteristics of Health Cadres (n: 30)

Cadre Characteristics	% (n)
Education	
Basic	10.0 (3)
Middle	83.3 (25)
High	6.7 (2)
Age	
31-40 th	6.7 (2)
41-50 years	43.3 (13)
51-60 th	43.3 (13)
>61 th	6.7 (2)
Work	
Employee	13.3 (4)
Merchant	3.3 (1)
Housewives	83.3 (25)

Source: Primary Data, 2023

Table 2. Integrated Control Action on Dengue Fever by Health Cadres (n: 30)

No.	Environmental and Behavioral Control Actions	Yield (%)
1	Provide closed trash cans and keep them clean	100
2	Managing waste and used items	53.3
3	Emptying/draining the bathtub/container that can be a breeding place for mosquitoes at least once a week in your own home	96.7
4	Monitor the mosquito larvae in public places and unoccupied houses/buildings	63.3
5	Installing wire gauze on the ventilation of the house	53.3
6	Keeping fish to eat mosquito larvae in ponds that are difficult to clean (Shafique et al., 2019)	56.7
7	Not hanging clothes	53.3
8	Wearing mosquito nets when sleeping in the early afternoon	36.7
9	Use lotion / burnt medicine/mosquito repellent only when necessary	63.3
10	1 family member participates in monitoring the presence of mosquito larvae once a week in their own homes and residents' homes	53.3
11	Planting mosquito-repellent plants	53.3
12	All people must do PSN 3M Plus regularly and simultaneously	100
13	Check your health immediately if you find symptoms such as DHF	100
14	Report to cadres or kelurahan if they find residents or families who have symptoms of DHF	93.3
15	Actively participate in environmental service work	100

Source: Primary Data, 2023

Table 1 shows the characteristics of respondents from health cadres. The Health Cadres who participated in filling out the questionnaire were 30 people. Health cadres in Bandarharjo Village are mostly secondary educated (junior high, high school, and equivalent) (83.3%). Most were aged 41-60 years (86.6%). Twenty-five people (83.3%) were housewives.

Table 3 shows that the percentage of households with only primary education is 26.1% (30). Sixteen respondents (19.3%) lived in rented houses. The average number of people living per household was five (4.49). Most households have piped water inside the house (92.8%). However, 20.5% (n = 17) reported daily or weekly disruptions to piped water supply. People consider DHF to be a serious problem (83.1%), and this means that there are still some people who think DHF is not a health problem that is feared by the community. The assumption of dengue people is not a serious problem during the COVID-19 pandemic (66.3%).

Integrated control actions against DHF by Health cadres are shown in Table 2. The practice of using mosquito nets (36.7), installing wire gauze on house ventilation (53.3%), and the use of mosquito repellent plants is still low (53.3%). The use of mosquito repellent plants is still small because of the limited availability of space. Mosquito nets are less desirable based on residents' information due to the hot weather.

Table 3. Socio-Demographic Information from Survey Respondents (n=83)

Socio-Demographics	% Household (n)
Head of household < 26 years old	8.4% (7)
Living in a contract house	19.3% (16)
The head of the household has only basic education	36.1% (30)
The head of household has secondary education	63.9% (53)
Work as Laborer	31.3% (26)
Work as a private employee/entrepreneur	37.3% (31)
Another job	28.9% (24)
Income below minimum wage before the Pandemic	63.9% (53)
Income below minimum wage during the Pandemic	83.1% (69)
Water and Garbage Access	
Households do not use water pipe sources	7.2% (6)
The plumbing does not work well	20.5% (17)
Garbage pick up 1-3 times a week	47.0% (34)
No garbage collection	12.0% (10)
Housing Condition	
House ventilation uses window/door	48.2% (40)
House ventilation uses a fan	51.8% (43)
Wall material from wood/bamboo	6.0% (5)
Road access rocky/ soil	19.3% (16)
Knowledge and perception	
There were family members/neighbors infected with DHF / Chikungunya 6 months ago	9.6% (8)
Knowledge that dengue is transmitted by mosquitoes	100% (83)
Consider dengue to be a serious problem in the community	83.1% (69)
Consider dengue to be a serious problem in the community in the COVID-19 Pandemic era	66.3% (55)
Implementation of DHF Prevention different before and during the COVID-19 pandemic	32.5% (27)
Expenditure mosquito control different before and during the COVID-19 pandemic	24.1% (20)

Source: Primary Data, 2021

Table 4. Integrated Control Action on Dengue Fever by Family (n = 83)

Community-integrated control action	%households
Draining the bathtub once every 1 week	96.4% (80)
Closing existing water reservoirs	94.0% (78)
Manage waste	88.0% (73)
Managing/burying used tires/bottles in the environment around the house so that they are not flooded with water	74.7% (62)
Change the water in the flower vase/bird drinking water regularly at least once every 1 week	85.5% (71)
Keeping fish on a pond that is difficult to clean	61.4% (51)
Not hanging clothes	84.3% (70)
Wearing mosquito nets when sleeping in the early afternoon	42.2% (35)
Using larvicide/Abate to kill larvae in water reservoirs	77.1% (64)
Using lotion/burn/mosquito repellent spray to repel mosquitoes	94.0% (78)
Check the presence of mosquito larvae once a week in your own home/people's homes	98.8% (82)
Keeping mosquito-repellent plants	39.8% (33)

Source: Primary Data, 2023

The results of an integrated dengue control survey in households are shown in Table 4. The use of mosquito repellent, both repellent, mosquito coil, and spray is still high (94.0%). In addition, a high use of larvicide to prevent mosquitoes in water reservoirs that are difficult to clean. Good practices in the use of mosquito nets during sleep early in the afternoon (42.2%), maintenance of larval predatory fish (61.4%), and use of mosquito repellent plants are still quite minimal (39.8%).

Table 5. Understanding of Integrated Control

Comprehension Criteria	Yield % (n)
Cadre	
Understanding Integrated Control	60.0 (18)
Understanding of DHF solutions	56.7 (17)
Understanding of larvae monitoring surveillance systems	70.0 (21)
Household	
Understanding Integrated Control	46.7 (14)
Understanding of DHF solutions	43.3 (13)
Understanding of larvae monitoring surveillance systems	66.7 (20)

Source: Primary Data, 2023

Table 6. Factors affecting Community Integrated Control Practices (n=83)

Variable	Category	DHF Control Practices		P-value
		Good	Less	
Perception of DHF Seriousness	Serious	42	14	0.000*
	Not Serious	2	25	
Information Barriers	Not being an obstacle	24	27	0.251
	Become an obstacle	20	12	
Education Level	High School or More	26	27	0.465
	Basic Education/equivalent	18	12	
Home Ownership	Own	39	28	0.096
	Hire/Contract	5	11	

Source: Primary Data, 2023

Table 5, understanding larval monitoring surveillance systems in cadres has the highest value (70%) compared to understanding dengue solutions and integrated control. The understanding of the head of the household with the highest value is also in the larval monitoring surveillance system (66.7%), while the understanding of integrated control and dengue solutions is still limited, this is related to Table 6, where the variable of Community Perception related to the seriousness of DHF is a factor related to the Integrated Control Practice of the Community in dengue control.

The determinants that influence the prevention and control of dengue fever are very diverse. Health Cadres spearhead the community's movement to carry out mosquito nest eradication activities (Siyam *et al.,* 2022). Health cadres as key communities in carrying out their duties are influenced by many factors, starting from factors related to internal/individual, factors of facilities and infrastructure, factors of cost availability, and support of stakeholders, communities, and health workers. In addition, social capital is a determining factor in the sustainability of the implementation of the duties of health cadres (Tapia-Conyer *et al.,* 2012; Asri & Festi, 2017; Siyam *et al.,* 2022). Internal factors of Health cadres can be knowledge factors (Harapan *et al*., 2018; Kumaran *et al*., 2018; Sulistyawati *et al*., 2019; Msellemu *et al*., 2020; Rahman *et al*., 2021), perception (Zaki *et al*., 2017), motivation (Shafie *et al*., 2023), from cadres. Several studies reveal that education affects cadre performance (Mitchell-Foster *et al*., 2015; Nontapet *et al*., 2022). Good stakeholder support will improve the morale and performance of cadres (Nontapet *et al*., 2022).

Prevention and control of dengue disease that has high effectiveness must use the concept of integrated vector control (Tapia-Conyer *et al.,* 2012), for in the implementation of assessment or identification of risk predictions for dengue events must also include factors that affect the incidence of dengue disease as a whole and integrated so that aspects of dengue control carried out by all elements of society, Stakeholders, health workers, and the government can be right on target and as needed. For this reason, it is important to predict village dengue risk based on IMS-dengue to realize integrated dengue prevention and control. To create a community that is ready to be prepared for the prevention and control of dengue fever (Arunachalam *et al*., 2012; Kittayapong *et al*., 2012; Sommerfeld & Kroeger, 2012; Nguyen-Viet *et al*., 2015; Waleckx *et al*., 2015; Musesengwa *et al.,* 2017).

Integrated dengue control is an interrelated control between all elements that affect the incidence of disease including the host agent and its environment. Not only focusing on the ecosystem as a place where humans live in their environment. The integrated concept here is that disease control is inseparable between humans and the biological, physical, chemical, social, economic, and cultural environment (Rida *et al*., 2023; Siyam *et al*., 2023). It is integrated here that disease control must be carried out by all levels of society without exception by combining various evidence-based control techniques and prioritizing environmental safety (Kittayapong *et al*., 2012; Mitchell-Foster *et al*., 2015), (Mungall-Baldwin, 2022). The support of health cadres/volunteers in dengue surveillance will increase the success of integrated dengue control (Nontapet *et al*., 2022).

Integrated control can be carried out by the community to improve the effectiveness of disease prevention and control activities (Tapia-Conyer *et al.,* 2012). Disease control that is still fragmented will hinder the success of dengue control. The principle of environment-based disease control is very dependent on the integration of various control techniques, both mechanical control such as environmental management, biological control, chemical control, and technological engineering which has recently begun to be implemented (Sommerfeld & Kroeger, 2012; Buchori *et al*., 2022). However, how sophisticated and advanced the control carried out must not forget the importance of maintaining good practices in environmental sanitation control which is a breeding ground for mosquitoes. In essence, control must focus on the community as a subject that must be involved to protect the environment to avoid diseases that may occur (Selvarajoo *et al*., 2020).

Healthy living practices that prioritize

environmental sanitation management and good dengue prevention behavior by the community must always be fostered and improved (Wilson *et al*., 2020). This practice is commonly done by the community, namely draining the bathtub, managing garbage, and not hanging clothes. Meanwhile, the use of biology in dengue control still must be improved, such as the use of larva-eating fish, mosquito-repellent plants, and vegetable larvicide. Other good practices that are still low are the use of mosquito nets while sleeping and the installation of wire gauze to prevent mosquitoes from entering the house. People prefer to use practical methods, namely chemical prevention, such as the use of lotions, mosquito coils, and sprays to avoid mosquito bites. Chemical prevention has been proven to cause resistance to vectors, health problems, and environmental hazards (Bowman *et al.,* 2016).

Understandings related to DHF solutions, the seriousness or danger of DHF, larval monitoring surveillance systems, and related to integrated control are important to be improved at all levels of society, both in the community, cadres, stakeholders, and health workers, as well as related parties (Nontapet *et al*., 2022; Nontapet, Maneerattanasak, *et al*., 2022). It is intended to obtain optimal results from prevention and control activities and realize integrated control in the community. So that the incidence of dengue fever can be suppressed, and a safe environment can be realized.

Conclusions

The results of an integrated dengue control survey in households show that the use of mosquito repellent, both repellent, burn and spray is still high (94.0%). In addition, a high use of larvicide to prevent mosquitoes in water reservoirs that are difficult to clean. Good practices in the use of mosquito nets during sleep early in the afternoon (42.2%), maintenance of larval predatory fish (61.4%), and use of mosquito repellent plants are still quite minimal (39.8%). Understanding the surveillance system of larval monitoring in cadres has the highest value (70%) compared to understanding dengue solutions and integrated control. The understanding of the head of the household with the highest score is also in the larval monitoring surveillance system (66.7%), while the understanding of integrated control and dengue solutions is still limited. Factors related to dengue control practices are perceptions of the seriousness of dengue disease in the community. The implementation of integrated control by the community is still quite lacking because it prioritizes chemical control. The research recommends increasing the understanding of cadres and the community related to integrated control and solutions to dengue handling so that dengue control can be carried out completely.

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Honey, Crocus-Sativus-Linnaeus, and Clitoria-Ternatea Improve the Elderly's Quality of Life and Sleep Quality in Yogyakarta

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Abstract

Older adults have sleep disorders that lead to decreased quality of life and risk of chronic disease complications. Older adults need to improve their sleep quality to gain a better quality of life. They aimed to investigate the effectiveness of Crocus-sativus-Linnaeus and Clitoria-Ternatea in enhancing the quality of life and sleep of older adults. The quasi-experiment with a control group design was used. The 40 elder adults with hypertension, without dementia, severe cardiovascular disease, and hypersensitivity to compounds; were recruited. The tools were PSQI and WHO-QL. Analysis used t-test and Wilcoxon test. Crocus-sativus-Linnaeus and Clitoria-Ternatea were insignificant in improving sleep quality p = 0.264 (p<0.05) and physical domain in quality-of-life p = 0.075. It significantly improved the quality of life in the psychological, social relationships, and the environment, with p = 0.007, p = 0.003, and p = 0.041. For Future research increasing the number of samples is needed.

Introduction

Sleep disorders are a collection of symptoms in the form of disturbances in the amount, quality, or sleep in individuals. The older adults often experience sleep disorders. This is because older adults experience a decrease in physical and psychological conditions, such as arthritis, decreased hearing and vision, decreased memory, reduced muscle mass, stress, and other infectious diseases (Warseno & Sukmawati, 2019). It will have an impact on older people's sleep time. He will experience a longer time to sleep and a shorter time to fall asleep soundly (Luo *et al*., 2013). Whereas according to WHO the number of older adults is expected to continue to increase from 12% to 22% between 2015 and 2050. In 2050 the older adult will reach 2 billion and 80% of the older adult will be in low- and middle-income countries. In Indonesia, the number of older people in 2022 is around 31(WHO, 2023).

One of the efforts to improve the quality of life and empowerment of older adults is to enhance the sleep quality of older adults. The older adult needs 6.5 - 7 hours of sleep per day. The impact of lack of sleep experienced is fatigue, excessive daytime sleepiness, metabolic disorders, endocrine disorders, and disruption of the immune system. In addition, sleep apnea is also found in this age group. Sleep apnea is a recurrent episode of reduced or no airflow during sleep. This condition is a result of airway obstruction, such as snoring, or due to the influence of drugs and narcotics (Rodriguez *et al*., 2015; Yang *et al*., 2012).

One of the physical conditions that can affect sleep quality in older adults is hypertension. As many as 94.9% of older adults with hypertension have poor sleep quality (Warseno & Sukmawati, 2019). The lower a person's sleep duration, the risk of hypertension increases. This is because sleep quality affects individual systolic and diastolic

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pressure (Gulia & Kumar, 2018). The increase in blood pressure is accompanied by vascular dysfunction and inflammatory activity. This is also related to changes in sympathetic nerves and an increased release of catecholamines. Furthermore, cardiac output is insignificant at night (Liu *et al*., 2016).

Method

This study was a Quasi-Experiment study using a pre-test and post-test control group design to analyze Honey, Crocus-sativus-Linnaeus, and Clitoria-Ternatea, called Sahdu Tea in patients with hypertension. The study population was the older adults who attended Posyandu. The number of samples was 40 people with a composition of 22 intervention groups and 18 placebo groups. The intervention group was the older adult who got a tea bag of Crocus-sativus-Linnaeus and Clitoria-Ternatea with honey. However, the placebo was for the older adult who got Wedhang Uwuh, a traditional Javanese drink. Inclusion criteria are: 1) At least 55 years old (pre-older adult); 2) Hypertension medical diagnosis; 3) Independent ADLs; 4) Good verbal communication. Exclusion criteria are: 1) Moderate to severe dementia; 2) Severe cardiovascular disease; 3) Allergy to the components. The questionnaires used were The Pittsburgh Sleep Quality Index (PSQI) and WHO-QL(Bangun *et al*., 2020). Furthermore, there was a physical assessment to determine the blood pressure and health history of the older adult. Data collection was done by giving a teabag containing Crocus-sativus-Linnaeus and Clitoria-Ternatea, then the elderlies were asked to drink before bed. The research assistant gave 3 doses at once for 3 days (1 dose/day). Furthermore, therapy continued for up to 3 weeks. At the end of the 3rd week, a post-test was conducted as the final evaluation of the therapy. Put in a tea bag dried bay flowers (300 mg) and saffron (14 mg). Then, soak dried bay flowers and saffron in 800 C hot water for 15 minutes in 200 mL mineral water. Finally, add 20 ml of honey (assuming the patient's weight is 60 kg) (The density of honey is 1.36 g/ml; so, the volume of honey = mass of honey (30 g): density of honey). The research protocols were approved by The Research Ethics Committee on Faculty of Health Universitas Jenderal Achmad Yani Yogyakarta with the approval number SKep/148/KEP/V/2023.

Result and Discussion

Based on the data, most have primary education, namely elementary and junior high school by 60%, and 90% of respondents are not actively working. Respondents also did not understand that they had hypertension. This can be seen from the data that 50% of respondents admitted that they did not know that they had the disease and did not carry out routine controls. In addition, most (65%) respondents also did not apply 30 minutes of exercise as an effort to implement a healthy lifestyle.

Table 1. Frequency Distribution of Respondents

Variables	Mean ± SD	n (N=40)	%
Age	65.65 ± 8.91		
Gender			
1. Male		20	50
2. Female		20	50
Education			
1. Elementary School		16	40
2. Junior High School		8	20
3. Senior High School		13	32.5
4. Diploma/ College		3	7.5
Jobs			
1. Housewife		31	77.5
2. Labor		1	2.5
3. Private		2	5
4. Retired		5	12.5
5. Self-employed		1	2.5
Duration of Hypertension		23	57.5
Diagnosis		1	2.5
1. Don't know		12	30
2. 0 - 1 year		4	10
3. 2 - 5 years			
4. >5 years			
Doctors' Visit			
1. Monthly routine		22	55
2. Not Routine		18	45
Length of Doctors' Visit			
1. Don't know		23	57.5
2. 0 - 1 year		3	7.5
3. 2 - 5 years		10	25
4. >5 years		4	10
Exercise 30 minutes per day		26	65
1. Yes		14	35
2. No			
Has Comorbidities			
1. Yes		13	32.5
2. No		27	67.5

Primary Data Source 2023

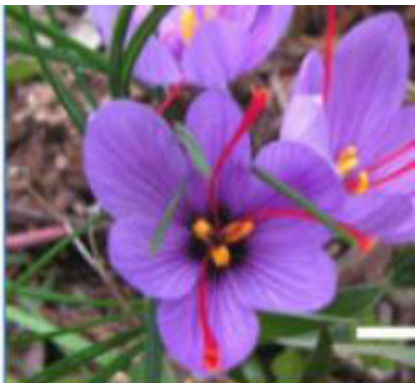
Tabel 2. The Effect of Plasebo (Wedang Uwuh) and Tea "Honey; Crocus sativus Linnaeus; and Clitoria Ternatea"

Group	Variables	Mean ± SD	df	Sign. (p<0.05)
Control	Pre Sleep Quality	6.11 ± 2.95	17	0.264
	The post Sleep Quality	5.44 ± 2.62		
	Physical Domain Pre	69.22 ± 15.44		0.202
	The post Physical Domain	71.39 ± 13.76		
	Psychological Domain Pre	60.44 ± 10.29		0.225
	The post-Psychological Domain	58.33 ± 13.11		
	Social Relationship Pre-Domain	62.11 ± 17.34		0.201
	The post-Social Relations Domain	59.00 ± 20.16		
	Environment Pre Domain	65.00 ± 11.26		0.317
	The post-Environmental Domain	63.61 ± 12.94		
Intervention	Pre Sleep Quality	6.41 ± 3.38	21	0.075
	The post Sleep Quality	5.05 ± 2.82		
	Physical Domain Pre	66.95 ± 11.88		0.76
	The post Physical Domain	72.27 ± 12.94		
	Psychological Domain Pre	50.32 ± 11.37		0.007
	The post-Psychological Domain	59.00 ± 20.16		
	Social Relationship Pre-Domain	49.41 ± 11.85		0.003
	The post-Social Relations Domain	65.86 ± 15.36		
	Environment Pre Domain	61.27 ± 10.37		0.041
	The post-Environmental Domain	69.73 ± 11.23		

Primary Data Source 2023

Based on the data, it is known that in the control group, the traditional drink from Java, called *wedhang uwuh*, both for psychological well-being and sleep quality, there is no difference between before and after giving *wedhang uwuh* for three weeks (p> 0.05). The number of samples in the control group was 18 respondents. These results differ from the intervention group, tested using 22 older adult people. Based on the table, only the psychological well-being of the physical domain does not affect the tea p = 0.76 (p> 0.05).

Saffron is the dehydrated stigma of the flower of Crocus sativus Linnaeus, which is native to Iran (Maggi *et al*., 2020). Saffron has components of hydrophilic carbohydrates, amino acids, proteins, minerals, mucilage, starch, gums, vitamins (riboflavin and thiamine), pigments (crocin, alpha and beta-carotene, mangicrocin, xanthone-carotenoid glycosidic conjugate, anthocyanin, lycopene, flavonoids, and zeaxanthin), alkaloids, saponins, saffranal (aromatic essence terpene) and picrocrocin (bitter flavor). Based on several studies, it is known that saffron has benefits for laxatives, antidepressants, decongestants, diaphoretics, dysminor, skin, liver, and kidney disorders. In addition, it helps penetration in ascites, wounds, headaches, bronchitis, pharyngitis, nausea, vomiting, asthma, eye disorders, and memory impairment, reduces pain during childbirth, and strengthens the heart (Shahi *et al*., 2016).



Picture 1. Saffron (Crocus-sativus-Linnaeus)

Clitoria ternatea L. is a plant from tropical Asia, but other sources say this plant comes from central South America. Telang flowers have a butterfly-like shape that is purplish blue, known as Butterfly pea. Chemical compounds contained in Clitoria

ternatea flowers from various studies are 21 items, including flavonoids, anthocyanins, flavonol glycosides, kaempferol glycosides, quercetin glycosides, myricetin glycosides, tannins, flobatanins, carbohydrates, saponins, glycosides, triterpenoids, phenols, flavonoids, proteins, alkaloids, steroids, anthraquinones, palmitic acid, stearic, oleic lonoleic, and linoleic (Oguis *et al*., 2019).

White, J W (1978) describes honey as a natural substance produced by honeybees (Apis mellifera) from flower nectar that is sweet, thick, and flavorful (Ashagrie, 2021). Di In honey, there is a carbohydrate content of 80-85% (Alreshidi *et al*., 2021), It consists of fructose (41%), glucose (34%), and sucrose (1%-2%) (Cummings & Stephen, 2007). Other contents are amino acids and proteins. Protein is obtained from nectar and pollen. However, the amino acid and protein content in honey is still relatively small at 0.3 % - 0.7 % (Alreshidi *et al*., 2021; Ashagrie, 2021). The amino acid, proline, in honey assesses the authenticity of the honey, a value below 180 mg/kg indicates that the honey has been added with sugar (Ashagrie, 2021). In addition, phenols, pigments, and vitamins are around 0.2% (Bogdanov *et al*., 2008; Miguel *et al*., 2017). In addition, minerals such as potassium, calcium, chlorine, copper, iron, magnesium, phosphorus, potassium, sodium, and zinc. Research shows that each has levels as in Table 3 (Ashagrie, 2021).

Based on the study's results, the control group obtained p = 0.264 and the intervention group p = 0.075 (p> 0.05). It means that both groups do not affect improving the quality of sleep of older adults with hypertension. Some things that affect sleep quality are gender, pain, environmental stimuli, daily physical activity, and menopausal problems (Aliabadi *et al*., 2017). More than 50% of elderlies have moderate pain levels (Nugraha & Aprillia, 2020). Women tend to have problems with sleep compared to men, Thichumpa *et al*. (2018) also confirmed that the quality of older adult sleep is influenced by education and psychological disorders, such as depression and poor communication with family members (Thichumpa *et al*., 2018). Based on the PSQI questionnaire, some older adult people complain of pain in the knees and back. Pain in the knees experienced by the older adult increases the intensity of pain in the physical function of the older adult even with light activities (Alburquerque-García *et al*., 2015). It is in line with the research results that pain can reduce sleep quality in older adults (Alburquerque-García *et al*., 2015; Morelhão *et al*., 2022; Nugraha & Aprillia, 2020).

Based on the results, it is known that Honey, Crocus Sativus Linnaeus, and Clitoria Ternatea Tea, called Sahdu Tea, is not practical in improving the quality of life of the physical dimension, p = 0.76 (p> 0.05). Based on the WHO-QL questionnaire, the physical domain is found in Q3, Q4, Q10, Q16, Q17, and Q18, namely about physical pain during daily activities; how often you need medical therapy; having enough energy for activities; sleep satisfaction; daily activity ability satisfaction; and work satisfaction. Based on the questionnaire, the average value of Q3 is 2.39, Q4 = 1.94, Q10 = 4, Q16 = 3.83, Q17 = 4.06, and Q18 = 4.06, it can be seen that the lowest value is Q4. However, the fewer Q4 statements, the better the score. In contrast to Q3 which examines older adult pain. The

Table 3. The Composition of Honey

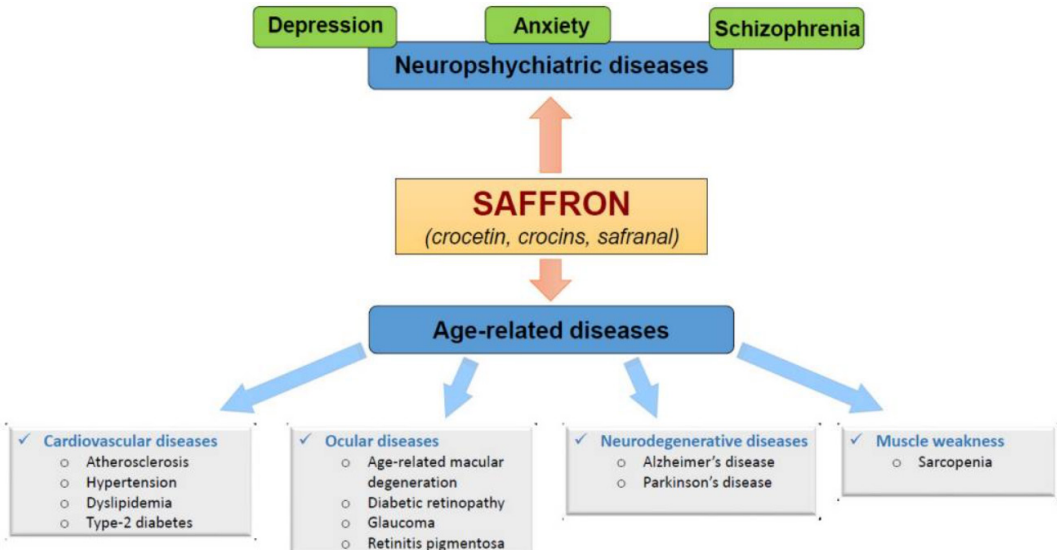
Minerals	Unit	Average amount/100 grams of honey	Daily Recommendations
Calcium	mg	4 - 30	1000
Chlorine	mg	2 - 20	
Copper	mg	0.01 - 0.1	2
Iron	mg	1 - 3.4	18
Magnesium	mg	0.7 - 13	400
Phosphorus	mg	2 - 60	1000
Potassium	mg	10 - 470	-
Sodium	mg	0.6 - 40	-
Zink	mg	0.2 - 0.5	15

average older adult person answers Q3, a little and in moderate amounts. Research states that older adults often feel persistent pain which is strongly related to the disease, the older adult's disability, social isolation, and the cost of care, as well as fatigue in the healthcare system (Domenichiello & Ramsden, 2019). However, the results of other studies differ, the anti-nociceptive and anti-inflammatory content of saffron can reduce pain. The dose used in the study was 30 mg/kg and given by injection, which was observed for 14 days (Safakhah *et al*., 2016). Other studies also mention that saffron has a positive impact on pain reduction. Oral administration of saffron as an analgesic is 2000 mg/ kg (Ait Tastift *et al*., 2022). In this study, saffron used was 15 mg/ person by brewing and taken once a day. Differences in results can be due to several factors including the type or quality of saffron used, the dose of saffron, and the method of administration of saffron. The quality of saffron depends on the color, taste, and aroma contained in crocin, picrocrocin, and safranal (Ait Tastift *et al*., 2022).

However, based on the table data, it can be seen that sahdu tea has a positive impact on improving quality of life in the psychological domain, $p = 0.007$ ($p < 0.05$). This study is in line with several studies that saffron has a positive impact on neuropsychological problems, prevention of age-related diseases, as an antidepressant, and a decrease in depressive symptoms (El Midaoui *et al*., 2022; Maggi *et al*., 2020; Shafiee *et al*., 2018). Saffron contains crocin which is a good anti-inflammatory. Crocins are not recommended to be given orally. This is because crocin will be converted to crocetin in the small intestine, but the amount of crocetin in the blood is meager. The crocetin is distributed to various tissues because the interaction weakens when it binds to albumin. Crocetin will pass through the blood vessels of the brain and reach the central nervous system through passive transcellular diffusion, making it effective in neurodegenerative disorders. If the amount of crocin is excessive, it will be excreted through feces (El Midaoui *et al*., 2022).

Safranal and crocin are antidepressants that activate serotonergic, noradrenergic, and dopamine systems. Saffron with 50 mg can significantly reduce Beck Depression and anxiety compared to the control group (El Midaoui *et al*., 2022; Yaribeygi *et al*., 2019). In addition, safranal also has a positive effect, like diazepam, in reducing anxiety. This is possible due to the interaction of benzodiazepines with GABA receptor A. In addition, saffron also has a positive impact on reducing symptoms of social isolation and improving memory (El Midaoui *et al*., 2022; Pitsikas, 2016).

In this study, not only saffron was administered, but also blue pea (Clitorea ternatea) or butterfly pea flower, which has antioxidants that are good for the body. Antioxidants regulate oxidation stress in the body's biological system. The antioxidant



Picture 2. The Advantages of Saffron (Crocus-sativus-Linnaeus) in Neuropsychiatric Disease

content contained in blue telang flowers can reduce malondialdehyde (MDA), such as flavonoids and anthocyanins (Putri *et al*., 2023). Clitorea ternatea increases norepinephrine in the synapse. This study used 50 mg of fresh Clitorea ternatea flowers, dried, and produced 35 mg of dried flowers. Then extraction was carried out using the Soxhlet extraction method. The extracted flowers contained flavonoids - kaempferol and apigenin, and triterpenoids - α, β-amyrin which are antianxiety. This is because the extraction from Clitorea ternatea is likely to bind to benzodiazepine receptors as an agonist that increases the level of ascorbic acid in the brain, inhibits butyric acid transmission, and inhibits monoamine oxidase. So it can be concluded that triterpenoids or flavonoids are responsible for antianxiety activity (Mittal *et al*., 2021). Here is the algorithm of the saffron effect in psychology (El Midaoui *et al*., 2022)

Based on the study's results, the social and environmental relationship domains on older adult well-being are also significantly different with $p = 0.003$ and $p = 0.041$ ($p < 0.05$). Based on research psychological improvements in the older adult have a positive impact on the socialization of the older adult in their environment (Ruiz-Comellas *et al*., 2021). Social relationships make physical and emotional connections with other people and communities. Good social relationships can reduce negative experiences, and avoid conflict, and the community and environment can make the older adult more able to think positively and have great forgiveness (Rook & Charles, 2017).

Conclusion

Crocus sativus Linnaeus and Clitoria Ternatea have a practical effect on improving the quality of life of older adults in the psychological, social relations, and environmental domains. We suggest that future research can increase the number of samples and modify the method of administration and the amount of Crocus sativus Linnaeus and Clitoria Ternatea content.

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Stunting on Children Aged 6 – 23 Months in East Nusa Tenggara Province

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Abstract

Stunting is the impaired growth and development that children experience from chronic malnutrition, repeated infection, poor maternal health, and inadequate psychosocial stimulation. The focus of this study is determinants of stunting of 6 – 23 months children in East Nusa Tenggara Province using data from the Study of Indonesian Nutritional Status in 2021. This research is a quantitative study that uses a cross-sectional design. The results showed that the proportion of stunting in 6-23 months in NTT province was 32.8%. The results of the bivariate analysis showed that variables significantly associated with stunting included child age (OR: 1.723 CI 95% 1.215-2.445), gender (OR: 1.777 CI 95% 1.305-2.419), LBW (OR: 2.106 CI 95% 1.206-3.423), SBL (OR: 1.768 CI 95% 1.133-2.759), history of infectious disease (OR: 1.548 CI 95% 1.141-2.099), maternal education (OR: 1.555 CI 95% 1.136-2.127), and toilet sanitation (OR: 1.881 CI 95% 1.384-2.555). The results of multivariate analysis showed that the most dominant factor of stunting was a history of infectious diseases (p-value 0.003; OR: 2.244). Children who have a history of infectious diseases are at risk of stunting by 2.2 times higher than children who do not have a history of infectious diseases after being controlled by child age, gender, LBW, SBL, and toilet sanitation.

Introduction

Stunting remains a significant health issue in Indonesia, which still exceeds the WHO standard of <20% (WHO, 2019). Indonesia ranked second in the prevalence of stunting in Southeast Asia in 2020 at 26.92% (UNICEF, 2020). The impact of stunting on children includes short-term and long-term impacts, including increased morbidity and mortality, stunted child development, impaired learning, and working capacity, increased risk of infectious and non-communicable diseases, increased fat accumulation, especially in the abdomen, low-fat oxidation, low energy expenditure, insulin resistance, and increased risk of diabetes, hypertension, and dyslipidemia (Akseer *et al*., 2022; Soliman *et al*., 2021).

Stunting can be caused by various factors, which are classified as caused during pregnancy and after birth. Mothers who have a chronic energy deficiency, anemic mothers, insufficient weight increase during pregnancy, stunted mothers, mothers exposed to nicotine and cigarette smoke, and risky pregnancy age are all factors that contribute during pregnancy (Santosa *et al*.,2022; Syahril *et al*., 2020). Stunting after birth can result from direct and indirect factors. The direct causes of stunting are insufficient nutritional intake and infectious diseases, meanwhile, indirect factors include non-exclusive breastfeeding, low maternal knowledge, insufficient complementary foods, taboos or unhealthy traditions, an unhealthy environment, sanitation and water supply, food insecurity, an inability to receive complete immunization according to age, health services, and parenting as household (Vonaesch *et al*., 2017; Yani *et al*., 2023).

The region in Indonesia that has the highest prevalence of stunting is East Nusa Tenggara (NTT) Province, which reached 37.8% based on SSGI 2021 (Kemenkes RI,

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2021). Although it shows a decrease compared to data based on Basic Health Research (Riskesdas), which reached 42.6% in 2019 NTT Province remains the largest contributor to stunting every year (Kemenkes RI, 2018). According to this number, one in three children in NTT Province is stunted (BPS Nusa Tenggara Timur, 2022). The purpose of this study was to determine the probable factors of stunting and the dominant factors associated with the incidence of stunting in children aged 6–23 months in East Nusa Tenggara Province based on data from the Indonesian Nutrition Status Study in 2021.

Method

This research is a quantitative study with a cross-sectional study design using secondary data from the Indonesian Nutrition Status Study in 2021. A cross-sectional study is a type of observational study design that looks at data from the population at one point in time (Wang & Cheng, 2020). A total of 759 data samples were collected from all children aged 6–23 months recorded in the Census Block in NTT Province. After applying the inclusion and exclusion criteria, there were 490 samples in the multivariate analysis. The dependent variable studied was the incidence of stunting in children aged 6–23 months in NTT Province. The independent variables studied included child characteristics (age, sex, birth weight, birth length, early breastfeeding initiation, exclusive breastfeeding status, minimum dietary diversity (MDD), history of infectious diseases); family characteristics (maternal age at childbirth, father's education, mother's education, father's occupation, mother's occupation, number of family members, and family food insecurity; health facility utilization characteristics (basic immunization, vitamin A supplementation); and environmental characteristics (residence, drinking water source, and toilet sanitation). The analysis included univariate, bivariate, and multivariate analyses using multiple logistic regressions of determinant models.

Result and Discussion

This study examines the factors associated with stunting in children aged 6–23 months in NTT Province, which has the highest incidence of stunting at 37.8% according to SSGI 2021 (Kemenkes RI, 2021). Despite this proportion being lower than the 42.6% reported by Riskesdas (2018), NTT Province continues to be a significant contributor to stunting in Indonesia. A public health issue is considered chronic if the prevalence of stunting exceeds 20% (WHO, 2019). Figure 1 presents the percentage of stunted children aged 6–23 months in NTT Province in 2021.

According to the results of the study, the prevalence of stunting in children aged 6 to 23 months in NTT Province is 32.8%, indicating a very high prevalence category of public health issues (30%) (WHO, 2019). Furthermore, 190 children (25.0%) were classified as moderately stunted (-3 SD to -2 SD), while 59 children (7.8%) were classified as severely stunted (-3 SD). Table 1 shows the distribution of child features, mother and household characteristics, access to health services, and environmental factors.

The research results evinced that child age, gender, LBW, SBL, history of infectious diseases, mother's education level, vitamin A supplementation, and toilet sanitation all had a significant relationship with the prevalence of

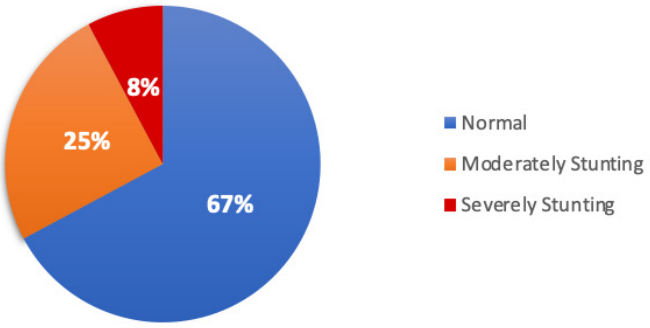

Figure 1. Proportion of Stunting among Children 6–23 Months in NTT Province in 2021

Table 1. Distribution of Children, Maternal and Family Characteristics, Access to Health Services, and Environmental Characteristics

No	Variables	Frequency (n)	Percentage (%)
	Children Characteristics		
1	Child age		
	12 – 23 months	533	70.2
	6 – 11 months	226	29.8
	Total	759	
2	Sex of Child		
	Boy	391	51.5
	Girl	368	48.5
	Total	759	100.0
3	Low Birth Weight (LBW)		
	LBW (<2500 gram)	75	11.2
	Normal (≥ 2500 gram)	594	88.8
	Total	669	100.0
4	Short Birth Length (SBL)		
	SBL (<48 cm)	104	20.1
	Normal (≥48 cm)	414	79.9
	Total	518	100.0
5	Early Initiation of Breastfeeding (EIB)		
	No	366	50.1
	Yes	365	49.9
	Total	731	100.0
6	Exclusive Breastfeeding		
	No	289	38.4
	Yes	463	61.6
	Total	752	100.0
7	Minimum Dietary Diversity (MDD)		
	Not achieved (score <5)	548	72.2
	Achieved (score ≥5)	211	27.8
	Total	759	100.0
	Breast milk	478	63.0
	Grains, roots, and tubers	717	94.5
	Legumes and nuts	107	14.1
	Dairy products	213	28.1
	Flesh foods	295	38.9
	Egg	245	32.3
	Vitamin A-rich fruits and vegetables	255	33.6
	Other fruits and vegetables	536	70.6
8	Children with a History of Infectious Diseases		
	Yes	344	45.3
	No	415	54.7
	Total	759	100.0
	1 history of disease	243	32.0
	2 history of diseases	75	9.9
	3 or more history of diseases	26	3.4
	Acute respiratory infection	304	40.1
	Diarrhea	91	12.0
	Pneumonia	37	4.9
	Tuberculosis (TBC)	5	0.7
	Measles	37	4.9
	Helminthiasis	13	1.7
	Maternal and Household Characteristic		
1	Maternal age at childbirth		
	<20 or >35 y	184	25.2
	20–35 y	547	74.8
	Total	731	100.0
2	Father's education level		
	Low (≤ Junior High School)	533	70.2
	High (> Junior High School)	226	29.8
	Total	759	100.0
	No Education	52	6.9
	Incomplete Primary School	92	12.1
	Completed Primary School	294	38.7

No	Variables	Frequency (n)	Percentage (%)
	Completed Junior High School	95	12.5
	Completed High School	162	21.3
	Completed DI/D2/D3	18	2.4
	Completed D4/College	46	6.1
3	Mother's education level		
	Low (≤ Junior High School)	382	51.9
	High (> Junior High School)	354	48.1
	Total	736	100.0
	No Education	26	3.5
	Some Primary	58	7.9
	Completed Primary	188	25.5
	Completed Junior High School	110	14.9
	Completed High School	230	31.3
	Completed DI/D2/D3	51	6.9
	Completed D4/College	73	9.9
4	Father's Employment Status		
	Not working	41	5.4
	Working	718	94.6
	Total	759	100.0
	Government Employee	37	4.9
	Corporate Employee	51	6.7
	Entrepreneur	92	12.1
	Farmer/farm laborer	431	56.8
	Fisherman	34	4.5
	Labourer	50	6.6
	Other	23	3.0
5	Mother's Employment Status		
	Not working	345	46.9
	Working	391	53.1
	Total	736	100.0
	Student	5	0.7
	Government Employee	36	4.9
	Corporate Employee	71	9.6
	Entrepreneur	26	3.5
	Farmer/farm laborer	172	23.4
	Other	81	11.0
6	Family size		
	>4 individuals	482	63.5
	≤4 individuals	277	36.5
	Total	759	
7	Food Insecurity		
	Insecurity	544	71.9
	Security	213	28.1
	Total	757	
	Food insecurity that is classified as low (score 1–4)	351	46.4
	Food insecurity that is classified as moderate (score 5–6)	130	17.2
	Food insecurity that is classified as severe (score 7–8)	63	8.3
	Access to Health Service Characteristics		
1	Basic Immunization Status		
	Incomplete	225	29.6
	Complete	534	70.4
	Total	759	100.0
	Incomplete (6–8 months)	53	46.9
	Complete (6–8 months)	60	53.1
	Incomplete (9–23 months)	172	26.6
	Complete (9–23 months)	474	73.4
2	Vitamin A Supplementation		
	Incomplete	319	42.0
	Complete	440	58.0
	Total	759	
	Environmental Characteristics		
1	Residence		
	Rural	606	79.8
	Urban	153	20.2

No	Variables	Frequency (n)	Percentage (%)
	Total	759	
2	Drinking water sources		
	Insufficient	111	14.6
	Sufficient	648	85.4
	Total	759	100.0
3	Toilet Sanitation		
	Insufficient	335	44.1
	Sufficient	424	55.9
	Total	759	100.0

stunting. In this study, there was no statistically significant relationship between early initiation of breastfeeding, exclusive breastfeeding status, MDD, maternal age at childbirth, father's education level, father's employment status, mother's employment status, number of family members, food insecurity, basic immunization status, place of residence, and drinking water source. Table 2 presents the results of the bivariate analysis of the association between the independent variables and the incidence of stunting.

Children aged 12 - 23 months have a 1.72 times greater chance of stunting than children aged 6 - 11 months. This finding is similar to a study on children in Indonesia, which found that children aged 12 to 23 months are 1.89 times more likely to be stunted than children aged 6 to 11 months (Titaley *et al*., 2019). Children's body length rises by 50% during the first year of life, or around 25 cm, compared to birth, whereas development slows significantly in the second year, increasing by just 10-12 cm (Caballero *et al*., 2003). In addition, children should receive complementary feeding after 6 months of age, but the incidence of early and delayed complementary feeding still occurs, leading to malnutrition and other health problems. Stunting is significantly associated with Infant and Young Child Feeding (IYCF) practices as late and early introduction of complementary foods (Tessema *et al*., 2013).

Boys have a 1.78 times greater chance of stunting than girls. This result follows other studies that boys have a 1.31 times higher chance of being stunted compared to girls (Thurstans

Table 2. The Association Among Independent Variables and Stunting

Independent Variables	Stunting Status				Total		OR (95% CI)	P-value
	Stunting		Normal					
	n	%	n	%	N	%		
Child age								
12 – 23 months	193	36.2	340	63.8	533	100	1.723	0.003*
6 – 11 months	56	24.8	170	75.2	226	100	(1.215 – 2.445)	
Sex of baby								
Boy	152	38.9	239	61.1	391	100	1.777	<0.001*
Girl	97	26.4	271	73.6	368	100	(1.305 – 2.419)	
Low Birth Weight (LBW)								
LBW (<2500 gram)	36	48.0	39	52.0	75	100	2.106	0.003*
Normal (≥ 2500 gram)	181	30.5	413	69.5	594	100	(1.296 – 3.423)	
Short Birth Length (SBL)								
SBL (<48 cm)	43	41.3	61	58.7	104	100	1.768	0.016*
Normal (≥48 cm)	118	28.5	296	71.5	414	100	(1.133 – 2.759)	
Early Initiation of Breastfeeding (EIB)								
No	116	31.7	250	68.3	366	100	-	0.618
Yes	123	33.7	242	66.3	365	100	(0.670 – 1.244)	
Exclusive Breastfeeding								
No	100	34.6	189	65.4	289	100	-	0.393
Yes	145	31.3	318	68.7	463	100	(0.849 – 1.585)	
Minimum Dietary Diversity (MDD)								
Not achieved (score <5)	189	34.5	359	65.5	548	100	- (0.936 – 1.875)	0.132
Achieved (score ≥5)	60	28.4	151	71.6	211	100		
Children with a History of Infectious Diseases								
Yes	131	38.1	213	61.9	344	100	1.548	0.006*
No	118	28.4	297	71.6	415	100	(1.141 – 2.099)	

Independent Variables	Stunting Status				Total		OR (95% CI)	P-value
	Stunting		Normal					
	n	%	n	%	N	%		
Maternal age at childbirth								
<20 or >35 y.o	68	37.0	116	63.0	184	100	-	0.116
20–35 y.o	166	30.3	381	69.7	547	100	(0.849 – 1.910)	
Father's education level								
Low	186	34.9	347	65.1	533	100	-	0.072
High	63	27.9	163	72.1	226	100	(0.986 – 1.950)	
Mother's education level								
Low	140	36.6	242	63.4	382	100	1.555	0.007*
High	96	27.1	258	72.9	354	100	(1.136 – 2.127)	
Father's Employment Status								
Not working	11	26.8	30	73.2	41	100	-	0.505
Working	238	33.1	480	66.9	718	100	(0.364 – 1.501)	
Mother's Employment Status								
Not working	114	33.0	231	67.0	345	100	-	0.649
Working	122	31.2	269	68.8	391	100	(0,798 – 1.484)	
Family size								
>4 individuals	163	33.8	319	66.2	482	100	-	0.482
≤4 individuals	86	31.0	191	69.0	277	100	(0.827 – 1.558)	
Food Insecurity								
Insecurity	184	33.8	360	66.2	544	100	-	0.363
Security	64	30.0	149	70.0	213	100	(0.845 – 1.676)	
Basic Immunization Status								
Incomplete	68	30.2	157	69.8	225	100	-	0.368
Complete	181	33.9	353	66.1	534	100	(0.603 – 1.182)	
Vitamin A Supplementation								
Incomplete	120	37.6	199	62.4	319	100	1.454	0.020*
Complete	129	29.3	311	70.7	400	100	(1.071 – 1.974)	
Residence								
Rural	205	33.8	401	66.2	606	100	-	0.273
Urban	44	28.8	109	71.2	153	100	(0.859 – 1.868)	
Drinking water sources								
Insufficient	38	34.2	73	65.8	111	100	-	0.812
Sufficient	211	32.6	437	67.4	648	100	(0.705 – 1.649)	
Toilet Sanitation								
Insufficient	136	40.6	199	59.4	335	100	1.881	<0.001*
Sufficient	113	26.7	311	73.3	424	100	(1.384 – 2.555)	

*Significant (p<0.05)

et al., 2020). In addition, research conducted on children in Indonesia shows that boys are 1.33 times more at risk of stunting than girls (Titaley *et al*., 2019). Boys are more at risk of stunting, this according to research conducted in Bangladesh can be caused by the factor that boys more often skip meals, so that food intake becomes inadequate due to boys playing more than girls (Islam *et al*., 2018). Boys are known to be more vulnerable than girls from the beginning of conception. Male fetuses during pregnancy grow faster, have smaller placentas for their size, and have relatively lower levels of adipose tissue, making them more likely to face greater nutritional disruption during periods of rapid cell division compared to slower-growing female fetuses (Eriksson *et al*., 2010; Guihard-Costa *et al*., 2002; Thurstans *et al*., 2020). This results in boys having less nutrient reserve capacity and thus being more vulnerable to malnutrition (Aiken & Ozanne, 2013; Sandman *et al*., 2013).

LBW children have a 2.1 times greater chance of stunting than children who are not LBW. These results are in line with research conducted in Rwanda that children who have a history of LBW are at risk of stunting 2.12 times more than children who do not have a history of LBW (Nshimyiryo *et al*., 2019). In addition, research conducted in Ethiopia shows that the probability of stunting is 3.2 times higher in children who have a history of LBW than children who do not have a history of LBW (Gonete *et al*., 2021). Children under two years old in Indonesia who have a history of birth weight <2500 grams are at a 2.55 times

higher risk of stunting compared to children whose birth weight is ≥2500 grams (Titaley *et al*., 2019). This may be due to children with a history of LBW being at higher risk of remaining malnourished during the early childhood years, even after controlling for child biological factors, child health, maternal factors, household environment, health service utilization, and community characteristics (Aryastami *et al*., 2017; Ntenda, 2019).

SBL children have a 1.77 times greater chance of stunting than children who are not SBL. This is in line with research conducted in Bogor showing that children aged 0 - 23 months who have a history of SBL are 1.6 times more at risk of stunting than children who are not SBL (Utami et al., 2018). Children who have a history of SBL <48 cm, have a 2.02 times risk of stunting compared to children whose birth length is ≥48 cm (Hastuti et al., 2020). SBL indicates poor nutritional status during pregnancy (Utami et al., 2018). Chronic nutritional deficiencies including maternal macronutrients and micronutrients during pregnancy can cause the mother after childbirth to have less protein and energy reserves and cannot provide adequate breast milk for the baby, thus impacting child growth (Kusharisupeni, 2006).

Children with a low level of maternal education are 1.55 times more likely to have stunted children than children with a high level of maternal education. This is following research conducted on children under two years of age in Indonesia that mothers whose highest level of education is junior high school have a 1.430 times chance of having stunted children compared to mothers with tertiary education (Laksono et al., 2022). In addition, mothers with low educational status are 3 times more likely to have stunted children compared to mothers with secondary and higher education (Yefri et al., 2022). Low education level is a risk factor for having stunted children because parental education affects better employment opportunities with higher income which is associated with the risk of stunting in parents with low income (Torlesse et al., 2016). Higher family income reflects the increased ability of households to buy good quality food, be able to access adequate health facilities, have proper sanitation facilities, and have a source of safe drinking water (Titaley et al., 2019).

Children who received incomplete vitamin A supplementation had a 1.45 times greater chance of being stunted than children who received incomplete vitamin A supplementation. This result is consistent with research conducted on toddlers in Bengkulu province that children who do not get vitamin A supplements have a 2.4 times greater risk of stunting compared to children who get vitamin A supplements (Simanjuntak et al., 2018). Vitamin A plays a role in the maintenance of mucous membranes and immune function (Hodge & Taylor, 2023). Vitamin A deficiency can cause diseases such as diarrhea, respiratory problems, and a decreased immune system (Ssentongo et al., 2020).

Households with inadequate sanitation are 1.89 times more likely to have stunted children than households with proper sanitation. This is following research conducted in Aceh province that households with improper sanitation have a 2.98 times higher risk of having stunted children compared to households with proper sanitation (Wicaksono et al., 2021). Poor sanitation and an unhealthy environment can lead to infectious and inflammatory diseases that have an impact on the incidence of stunting (Millward, 2017). Children with a history of illness have a 1.55 times greater chance of stunting than children without a history of illness. These results are in line with research conducted in Bangka Belitung that children suffering from infectious diseases have a 2.27 times chance of stunting compared to those who did not (Julianti & Elni, 2020). Research in Zimbabwe states that infectious diseases that occur repeatedly are associated with the incidence of stunting in children (Beal et al., 2018; Mutasa et al., 2022).

Table 3 shows the results of the multivariate analysis. Determinants of stunting incidence in this study based on multivariate analysis were child age, gender, history of infectious disease, and toilet sanitation, while birth weight and birth length were control variables. The most dominant variable associated with stunting was a history of infectious disease. Children who have a history of infectious disease have a risk of stunting 2.2 times higher than children who do not have a history of infectious disease after

controlling for the variables of child age, gender, birth weight, birth length, and toilet sanitation. Infectious diseases cause a decrease in appetite, and inadequate fulfillment of nutritional needs, in addition to diseases that occur chronically and repeatedly cause gastrointestinal disorders such as environmental enteric dysfunction (EED) which has an impact on changes in intestinal morphology, decreased absorption of nutrients, and impaired barrier function against pathogens (Crane et al., 2015). EED causes inflammation that inhibits bone growth and directly affects height (Budge et al., 2019; Millward, 2017).

Table 3. Final Multivariate Modeling

Variables	P-value	OR	95% CI
Child age	0.004	2.025	1.251-3.277
Sex of baby	0.005	1.982	1.223-3.211
Birth weight	0.096	1.947	0.882-4.296
Birth length	0.058	1.925	0.972-3.813
History of infectious diseases	0.003	2.244	1.299-3.875
Toilet sanitation	0.016	1.748	1.104-2.768

In addition, air pollution can impair linear growth through repeated infections with respiratory illnesses and fevers and is associated with an increased risk of stunting in children (Dewey & Mayers, 2011). This can be caused by immune activity, namely increased metabolic demand, anorexia and decreased food intake, increased catabolism, and altered metabolism of essential nutrients, such as retinol and iron that are diverted as part of the body's defense mechanisms (Dewey & Mayers, 2011; Sederquist et al., 2014). This combination can lead to nutritional imbalances, resulting in impaired growth. In addition, an indirect cause of impaired growth is household income allocated not to food and nutrition, but to health care costs related to infections, leading to inadequate diets for children and impaired linear growth (Sinharoy et al., 2020).

Infectious diseases in children, especially those that are recurrent and/or severe, can interfere with the absorption and digestion of macronutrients and micronutrients which can further increase the catabolism of nutrient reserves, alter the activity of intestinal enzymes, and damage the intestinal lining (Gabain *et al*., 2023). Infectious diseases were causally linked to stunting by directly reducing insulin-like growth factor (IGF-1) levels in a study of children in Zimbabwe (Jones *et al*., 2015). The Global Enteric Multicenter Study (GEMS) showed significantly lower length-for-age (HAZ) z-scores in children after infection (Kotloff *et al*., 2013). Cohort studies have shown that infection during the first 2 years of life has an impact on linear height (Korpe & Petri, 2012).

Conclusion

The incidence of stunting in children aged 6 - 23 months in NTT Province, namely 247 children (32.8%) were stunted, while 506 children (67.2%) had normal nutritional status. Moderately stunted children were 25.0%, while severely stunted were 7.8%. Determinants of stunting in children aged 6 - 23 months in East Nusa Tenggara Province include child age, sex, birth weight, birth length, history of infectious disease, mother's education level, vitamin A supplementation, and toilet sanitation. The most dominant variable associated with stunting was a history of infectious disease. Children who have a history of infectious disease have a risk of stunting 2.2 times higher than children who do not have a history of infectious disease after controlling for the variables of child age, gender, birth weight, birth length, and toilet sanitation. The most dominant variable associated with stunting was a history of infectious disease.

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Rheumatoid Factor, C-Reactive Protein, Erythrocyte Sedimentation Rate Responses on Brisk Walking in Rheumatoid Arthritis Women

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Abstract

Modified Physical Exercise Program (MPEP) is necessary for people with rheumatoid arthritis (RA). This study aims to investigate the effects of MPEP on the Rheumatoid Factor (RF), C-Reactive Protein (CRP), and Erythrocyte Sedimentation Rate (ESR); to evaluate the correlation between CRP-ESR. This is a quasi-experimental study. Ten RA women who were recommended by the Dukuhseti PHC have participated. The procedure is ethically approved. The venous blood samples were used to measure the dependent variables. Eight-teen sessions of MPEP were done. A two-tailed paired t-test to elucidate the differences in pre-post data; the bivariate Pearson correlation test for CRP-ESR. The RF increased significantly (pre: 19,40±2,46 and post: 22,40±2,41). CRP increased (pre: 0,30±0,07 and post: 0,37±0,06; p< 0,05). The change in ESR is not significant. There is a strong-positive, significant correlation (r: 0,831) between CRP-ESR. We concluded that MPEP is not able to lower the RA parameters, and there is a positive feedback correlation between CRP-ESR.

Introduction

Each population has a different Rheumatoid Arthritis (RA) prevalence and incidence rate. Women are 2-3 times as likely as men to have RA. In many communities, the prevalence of RA ranges from 0.5 to 1%, which is essentially constant (Safiri *et al*., 2019). Although in Indonesia the precise prevalence of RA is unknown, it is currently predicted that at least 1.3 million Indonesians have the disease (Hidayat *et al*., 2021a). Based on Indonesian Basic Health Research data (Riskesdas), around 7.30% of the population had RA in 2018, declining from 24.7% in 2013, and 6.78% of Central Java residents had RA. As a part of non-communicable disease, several variables such as age, gender, education level, marital status, family history, source of health information, knowledge, and attitude play a role in the prevalence among the community (Prihanti *et al*., 2022).

Nearly 36% of patients reported worsening health, and they were twice as likely to have activity restrictions. Additionally, compared to people without arthritis, patients have a 30% higher likelihood of needing help with personal care (Padjen *et al*., 2020). Rheumatoid factor (RF), which is found in 70–80% of RA patients and is utilized as an RA diagnostic marker, is typically identified in serological tests to determine the presence of RA. To successfully manage the condition and stop further joint deterioration and impairment, early detection, and rapid therapy with disease-modifying anti-rheumatic drugs (DMARDs) are crucial (Padjen *et al*., 2020). To reduce the

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risk of adverse medication reactions, screening tests must be completed before beginning treatment with conventional synthetic DMARD (csDMARD). C-Reactive Protein (CRP) and erythrocyte sedimentation rate (ESR) are two commonly utilized inflammatory indicators that can be applied to gauge the severity of the condition and the efficacy of treatment.

The primary goal of RA treatment is to control the progression of the illness, particularly to achieve remission, which is characterized by the absence of symptoms and the presence of severe inflammatory signs. Education, medical therapy, and rehabilitation/exercise programs are the three primary aspects of RA treatment (Hidayat *et al*., 2021b). For better treatment outcomes, patients and clinicians must work together to increase adherence to the recommended treatment plan of action. Education significantly improved attitudes, pain, and disability in patients throughout a six-month study with 100 RA patients (Senara *et al*., 2019). The key to controlling the spread of disease is early detection and treatment. Successful treatment during the first six months after starting treatment of the disease can predict how the patient will respond to therapy over the following five years.

Maintaining joint flexibility and muscular strength requires regular exercise and therapy. Other advantages include lowering risk factors for heart disease and bone loss, improving bone density, delaying the development of radiological alterations in small joints, limiting depression, enhancing sleep, lowering the feeling of pain, and improving quality of life. Walking, cycling, and swimming are the suggested forms of exercise. "Start low, go slow" is a good way to begin a workout. It is advised to exercise for 30 minutes each day. The use of orthotics or splints is advised by both the American Pain Society and the American College of Rheumatology, along with aerobic and physical activity that involves flexibility and physical endurance (Verhoeven *et al*., 2016).

Exercise has a strong and beneficial effect on cognitive performance in RA patients. Furthermore, physical exercise is both safe and beneficial in the treatment of chronic inflammatory joint disease, and it is advised as an essential component of these patients' overall care (Azeez *et al*., 2020). In older individuals with stable RA, ten weeks of a high-intensity interval walking program has been linked to reduced disease activity, increased cardiovascular fitness, and enhanced innate immunological functioning, indicating a lower infection risk and inflammatory potential (Bartlett *et al*., 2018). When establishing a PA intervention for patients with RA, it is critical to remember that education from a trained instructor must support program implementation, and it will give favorable effects to effective medicine. This is a recommended strategy to enhance physical activity in people with RA. Determined from the explanation above, the current study aims to investigate the promising effects of a physical exercise program (brisk walking) on biochemical parameters such as Rheumatoid Factor, C-Reactive Protein, and Erythrocyte Sedimentation Rate in women with RA, and to evaluate the correlation between CRP and ESR in individuals with RA.

Method

This is a quasi-experimental study with a group cross-sectional design. The independent variable in this study is the brisk walking program as an exercise therapy, and the dependent variables are RA parameters including Rheumatoid Factor (IU/mL), C-Reactive Protein (mg/dL), and Erythrocyte Sedimentation Rate (mm/h). The target population in this study is all mature women aged 46-64 years in the Alasdowo village with RA and recognized by the Dukuhseti Primary Healthcare Center (PHC), Pati Regency in Central Java. Based on the data, there were found 25 prospective candidates for the subjects in this study. However, only 10 candidates were recommended by the Dukuhseti Primary Healthcare Center.

The Research Procedures have been agreed upon by the institutional health research ethics committee Universitas Negeri Semarang (Number: 323/KEPK/EC/2022). There are five stages (Figure 1) in this study as follows: 1) Preparation stage which includes research permit, focus group discussion with the staff of the Dukuhseti Primary Healthcare Center, subjects agreement (inform consent), and explanation of the research procedure, 2) Pre-

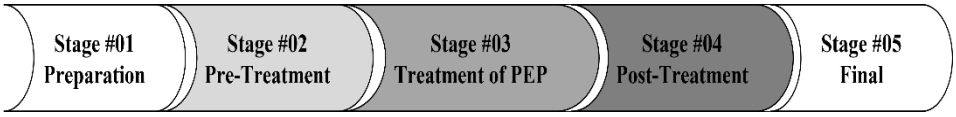

Figure 1. Stages of the current study

treatment stage is a data collection activity (venous blood sampling, 2 days before the first session of brisk walking as MPEP is given to subjects) as the baseline data for RF, CRP, and ESR, 3) Treatment stage is by giving a brisk walking treatment for a total of 18 sessions, about one and a half months, 4) Post-treatment stage is a data collection activity (venous blood sampling, 2 days after the last session of brisk walking exercise given to subjects) as the main data to evaluate the effectiveness of brisk walking program as the exercise treatment, and 5) Final stage including data tabulation, data analysis, data presentation, data interpretation, and writing a report to be published.

The total sessions of the brisk walking program are done 18 times. Subjects performed brisk walking three times a week (every two days) with light intensity (65% of their maximal heart rate). Most RA patients are active at the intensity of very light to light. Exercise at these intensities may reduce disability and disease activity in RA patients and seems to be linked with favorable cardiovascular indicators (Khoja *et al*., 2016). To determine the maximum heart rate, the formula of 220 minus the subjects' age was used. Meanwhile, determine the targeted heart rate for the exercise zone by determining the percentage multiplied by the maximum heart rate. The progressive overload principle was applied in this exercise program by improving the total duration, especially the duration of the main exercise every two weeks of the program. Hence, warming up was given to increase the heart rate, blood flow, and flexibility, and to prevent any risk of injury. On the other hand, cooling down was given as a stress relief, body restoration, regulating the heart rate, reducing the accumulation of blood lactate, and preventing any risk of injury. To check the details about the brisk walking program please see Table 1. Brisk walking was done outside in the public sports facility of Alasdowo Village, Dukuhseti District, Pati Regency, Central Java, Indonesia.

Venous blood drawing was conducted two times at the pre-treatment stage (two days before the first brisk walking program) and the post-treatment stage (two days after the last brisk walking program). Further, the venous blood sample was used to measure the rheumatoid factor (IU/mL), c-reactive protein (mg/dL), and erythrocyte sedimentation rate (mm/h). The procedure for measuring RF, CRP, and ESR refers to the standard operational measurements from the health laboratory of Dukuhseti Primary Healthcare.

The normality and homogeneity tests were carried out as a prerequisite. To determine the effects of brisk walking on changes in rheumatoid parameters such as RF, CRP, and ESR, a paired t-test with two-tailed was used to evaluate the differences in means on endpoints, and the bivariate Pearson correlation test was carried out to estimate the correlation between CRP and ESR. The statistical level of $p< 0,05$ was

Table 1. The Physical Exercise Program (Brisk Walking)

Week (s)	Exercise Structure	Duration (minutes)	Targeted Heart Rate (bpm)	Maximum Heart Rate (bpm)
01st-02nd	Warming up	3'	N.S.	156-174
	Main Exercise	20'	102-113	156-174
	Cooling down	3'	N.S.	156-174
03rd-04th	Warming up	3'	N.S.	156-174
	Main Exercise	25'	102-113	156-174
	Cooling down	3'	N.S.	156-174
05th-06th	Warming up	3'	N.S.	156-174
	Main Exercise	30'	102-113	156-174
	Cooling down	3'	N.S.	156-174

used. Data is presented as the standard error of the mean (SEM). Meanwhile, the presentation in ratio and percentage shows the response of each subject. All data analyses were carried out using IBM SPSS Statistics 26.

Results and Discussion

A total of 25 females with RA were identified in Alasdowo Village, Dukuhseti District, Pati Regency. However, there are only 10 eligible females (aged 46-64 years) who were recommended by the Dukuhseti Primary Healthcare Center. Physical Exercise Program (Brisk Walking) on RA Parameters. The RF (IU/mL) in women with RA increased significantly by Δ 3,00 post-treatment (brisk walking) 22,40±2,41 compared to pre-treatment data 19,40±2,46 as p< 0,05 (Figure 2. A), and the details of individual data are in Figure 2. B showed that 8/10 (80%) of subjects experienced an increase in the RF. The same response also occurred in CRP (mg/dL), it is increased significantly by Δ 0,07 post-treatment 0,37±0,06 compared to pre-treatment 0,30±0,07 (Figure 2. C), and to see the details of everyone's response is in figure 2. D, there are 9/10 (90%) subjects who experienced increased CRP. However, there is no significant change in ESR (mm/h) pre-treatment 31,70±14,43 compared to post-treatment 39,00±11,86 as p> 0,05 (Table 2), and see the detail of individual data in Table 3. There are 6/10 (60%) subjects who showed increased ESR value.

Table 2. Effect of Brisk Walking on ESR (Mean Data)

Variable (s)	Mean±SD	N	Sig. (2-tailed)
ESR Pre-Brisk Walking	31,70±14,43	10	N.S.
ESR Post-Brisk Walking	39,00±11,86	10	
N.S. No Significant as P > 0,05			

Table 3. Effect of Brisk Walking on ESR (Individual Data)

Subject (s)	ESR Pre-Brisk Walking	ESR Post-Brisk Walking
1	35,00	35,00
2	10,00	15,00
3	33,00	33,00
4	18,00	38,00
5	34,00	34,00
6	12,00	42,00
7	48,00	58,00
8	37,00	47,00
9	54,00	52,00
10	36,00	36,00

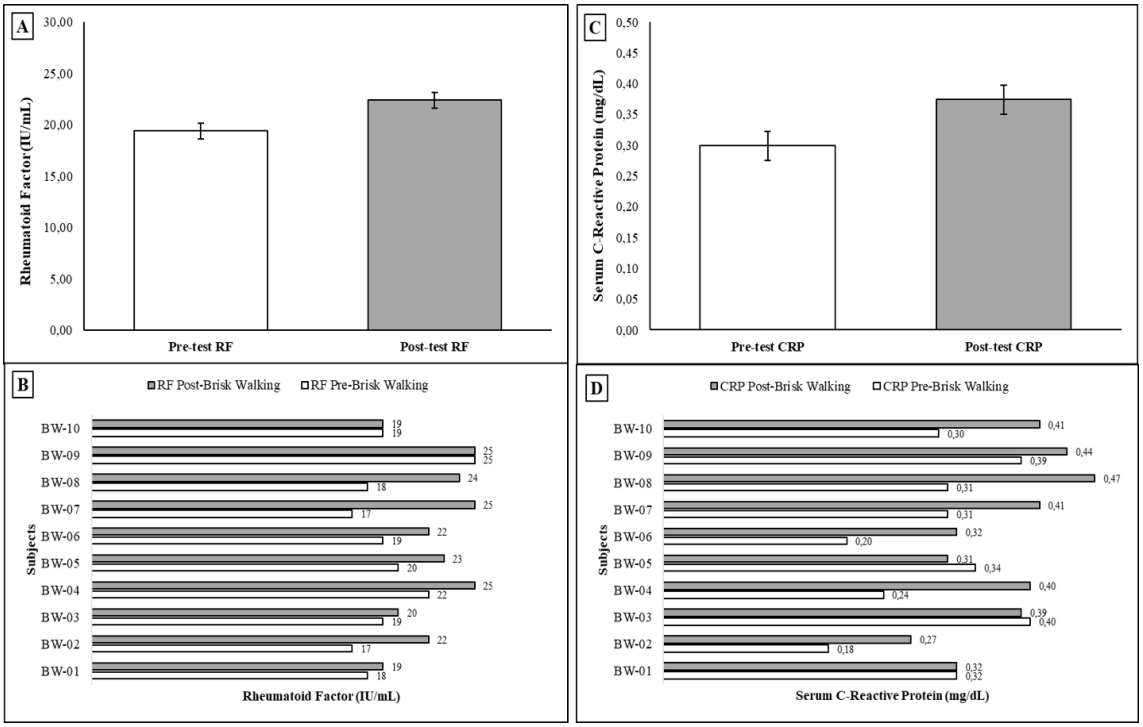

Figure 2. A: Effect of Brisk Walking on RF (Mean Data), B: Effect of Brisk Walking on RF (Individual Data), C: Effect of Brisk Walking on CRP (Mean Data), D: Effect of Brisk Walking on CRP (Individual Data)

Data in Table 4 showed that there is a strong, significant, and positive linear correlation between C-Reactive Protein and Erythrocyte Sedimentation Rate as P < 0,05 and r 0,831. Previous studies also showed that there is a positive linear correlation between these two variables. It is regardless of the age, sex, or duration of RA (Kotulska *et al*., 2015; Lapić *et al*., 2020).

Table 4. The Correlation between CRP and ESR

		CRP	ESR
CRP	Pearson Correlation	1	0,831**
	Sig. (1-tailed)		0,001
	N	10	10
ESR	Pearson Correlation	0,831**	1
	Sig. (1-tailed)	0,001	
	N	10	10

**. Correlation is significant at the 0,01 level (1-tailed)

In this study, we found that a brisk walking program could increase significantly in RF and CRP, but not for ESR. A positive rheumatoid factor (IU/mL), high C-reactive protein (mg/dL), and/or erythrocyte sedimentation rate (mm/h) tests all support RA diagnosis. Most patients with RA have abnormal RF, CRP, and ESR ≥28 (mm/h). This study also confirmed that there is a strong, significant, and positive linear correlation between CRP and ESR. According to a study done by Kotulska, there is a significant correlation between ESR and CRP, and there is no difference in either male or female individuals, or those older than 40 years old (Kotulska *et al*., 2015). The most often used laboratory tests to identify the acute phase response (the bodies quickly strive to reinstate homeostasis post tissue damage, infection, growth of neoplastic, or immunological disruption) and hence diagnosing and observing inflammatory diseases are the ESR and CRP (Bray *et al*., 2016). Furthermore, ESR and CRP have comparable symptomatic accuracy in assessing inflammation, particularly in orthopedic diseases (Lapić *et al*., 2020). ESR's inflammatory response is sluggish and insensitive to mild inflammation. The first spike happens within one to two days of start and is followed by a gradual decline when the inflammation resolves (Markanday, 2015).

The ESR is a simple and popular hematological test that can determine and track the increment of inflammatory activity within the body due to one or more illnesses such as autoimmune disease, infections, or malignancies. It is carried out alongside other tests to detect the existence of elevated inflammatory activity. In RA, the ESR value independently could be used to determine significant increases in symptoms in rheumatic disease, and the elevated rate of ESR in RA patients becomes a signal to have a higher risk (twice) of heart failure compared to individuals without RA (Hashemi *et al*., 2015).

An increase of CRP in the blood concentration has been well acknowledged as a marker of systemic inflammation in RA. Unfortunately, the high level of CRP in RA populations seems to play a primary role in bone destruction, and disease progression such as increased atherogenic consequences, and it is also linked with the danger for other degenerative diseases such as metabolic syndrome, diabetes, cardiovascular disease, pulmonary diseases, and mental disorder such as depression. CRP was found higher in obese patients with positive rheumatic disease compared to patients with low BMI values, and CRP levels in RA were affected by different socio-economic factors (Dessie *et al*., 2021). These factors perhaps become the reason which is related to affordable healthy food both the quantity and the quality of afforded food. Furthermore, the case of high CRP levels found that it is independently related to adiposity in women with RA. CRP and ESR rates are affected by age and sex as non-inflammatory variables in early RA, but BMI seems to become more applicable for the disease's later stages (Siemons *et al*., 2014).

RF is an immune-system protein that can abuse robust tissue in your body. RF degree in the circulatory system is commonly linked with autoimmune disorders such as rheumatic diseases, bacterial infections, lung disease, and other diseases such as aging, malignancy, and periodontal disease. Without immunogenic stimulations, RF is not frequently detected in the blood. They are thought to be a typical response to a range of antigenic stimuli, like bacterial toxins like lipopolysaccharides or

viruses like Epstein-Barr virus (EBV). They produce immunological complexes, which are then phagocytosed by inflammatory cells. The germinal center produces low-affinity, transitory, and polyclonal antibodies. In this regard, their role may be termed protective. The RF in RA, on the other hand, is thought to be produced from germline gene rearrangements and somatic hypermutations. They are monoclonal, show affinity maturation (the formation of antibodies with enhanced avidity to antigens during the process of an immune response), and cause more severe illness at higher titers (Ingegnoli *et al*., 2013).

In the etiology of RA, physical exercise can be a preservative factor. However, the positive benefits and the better improvement in health status can only be seen by the chronic effects of regular physical activity. In general, aerobic exercise is good and safe for RA patients, and it has a certain relieving impact on the condition, such as functional ability improvement, pain alleviation, and increased aerobic capacity (Ye *et al*., 2022). Moreover, people with RA who completed the SARAH exercise program >2 years after randomization, exhibited better hand function compared to baseline data. The opposite was true for the control group. However, the outcomes were no longer statistically different across the groups, which means that the PEP SARAH influence had waned with time. This decrease in hand function relative to earlier follow-up periods correlated with a decrease in self-reported hand exercise performance (Williamson *et al*., 2017).

The acute effect of PEP seems unfavorable. There are no significant differences in the pain sensation, CRP and ESR rate (clinical inflammatory markers), and interleukin 6 and tumor necrosis factor-alpha (inflammatory cytokines) between RA patients and healthy individuals (Balchin *et al*., 2022; Di Giuseppe *et al*., 2015). Moreover, both in patients with RA and healthy subjects, a single session of PEP can effectively lower the serum brain-derived neurotrophic factor levels (it plays a crucial role in the survival of neurons and growth, acts as a neurotransmitter modulator, and participates in neuronal plasticity, which is essential for learning and memory) (Bağlan Yentur *et al*., 2023).

The physical exercise program is a part of three pillars of RA treatment, and to maximize the benefits of a physical exercise program for RA patients, it is necessary to differentiate exercise methods according to the symptoms of RA, and individual needs (Hu *et al*., 2021; Marni & Husna, 2023). Maintenance of a physical exercise program over a lengthy period is difficult for people with developed RA. An excellent quality of life has a positive impact on physical exercise maintenance, but disease-related and unhealthy lifestyle characteristics have a negative impact. Physical exercise programs are multidimensional treatments with several characteristics and behaviors. Hence, any exercise is better than no exercise. When supporting physical exercise maintenance, health providers should include the patient's perspective, preferably through integrated lifestyle treatments (Bremander *et al*., 2020).

Conclusion

The increment of rheumatoid factor, c-reactive protein, and erythrocyte sedimentation rate after eighteen sessions of the brisk walking program with light intensity leads to a conclusion that brisk walking is not able to lower the RA parameters in women with RA. Additionally, there is a strong, significant, and positive linear correlation between c-reactive protein and erythrocyte sedimentation rate. This recent study only focuses on biochemical parameters. However, future studies would be much better the consideration to do assessments of food intake, physical activity, functional movements, drug consumption, socio-economic factors, different sexes, the age categories, as well as qualitative data, and perhaps with different promising exercise programs.

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Factors Causing Decreasing Quality of Vaccines: A Systematic Review

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Abstract

Objectives. Vaccines were essential to prevent the spread of disease. The contents would be practical if the storage, distribution, handling, and delivery to the target were carried out correctly and following procedures. Methods. Using guidelines from the PROSPERO platform using the PRISMA flow diagram to select articles. The search keywords are observational studies, experiments, qualitative studies, and grey literature. Studies addressing factors affecting vaccine quality, published between 2009 and 2022 in English, were included. Results. Of the 13 included studies, several factors were identified, all explained due to inaccurate vaccine storage temperature settings. From several studies, it is recommended to carry out consistent SOPs, supervision, training for staff involved in vaccines, innovation of vaccine distribution tools, and policies from local government stakeholders.

Introduction

Vaccines are a very effective health strategy to help prevent disease and extend life expectancy (Pandolfi *et al.*, 2018). Vaccination in European and American countries can prevent outbreaks of diseases such as measles. In addition to the vaccination implementation, its content is crucial because it will affect its effectiveness (Satcher *et al.*, 2022). The success of a vaccine is also determined by the correct selection of the vaccine type, carrier or vector, adjuvant, excipient, dosage form, route of administration, logistics of vaccine production, storage, distribution, and mass vaccination (Wang J, *et al,* 2020). Disease prevention using vaccines has been shown to reduce mortality cost-effectively and increase life expectancy. According to WHO, it can prevent 2 to 3 million deaths annually and is projected to increase by 6 million if vaccinated according to the recommended vaccine schedule. A form of concrete evidence is the Covid 19 Vaccine (Kumraj *et al.,* 2022). The COVID-19 pandemic globally has not ended and is still significantly impacting people worldwide, especially among people in Indonesia. Overcome these vaccination programs are crucial to ending the COVID-19 pandemic as they can reduce morbidity and mortality, achieve herd immunity in communities and build herd immunity against the COVID-19 virus (Tambunan *et al.*, 2022).

Some vaccines are part of a wholly or partially purified protein. Acellular pertussis vaccine has replaced whole cell pertussis vaccine. These licensed acellular vaccines consist of one to five proteins from the pertussis bacillus (Plotkin S., 2014). Stability is an important variable that needs to be considered in any product (Cheng *et al.*, 2023). The stability of biological products, such as vaccines, will be a more significant challenge when compared with other pharmacological molecules. The protein's physical activity, which is the main constituent of the vaccine, originates from the covalent bond structure and the folded conformation of both the secondary and tertiary structures (Kardani, 2021). Vaccines

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not carried out according to standard operating procedures (SOP) will increase morbidity and mortality from preventable diseases (Pandolfi *et al*., 2018). In the manufacture of vaccines, the membrane protein of a disease virus is involved. For example, the S. aureus vaccine contains five antigens containing bacterial toxin molecules, membrane proteins, and proteins that are closely related to the metabolism of bacterial growth and provide enhanced protection by inhibiting or blocking key pathogens(Zeng *et al.,* 2020). In the vaccine protein structure, a conformation causes partial or even complete denaturation of biological activity, which will cause the protein of the vaccine to lose its action, so this needs to be handled carefully (Mohammed *et al*., 2021).

Multiple factors cause the decrease in protein in the vaccine. Related to the vulnerability of the molecules in vaccines, costs, and low-temperature stability must be maintained so that when a vaccine is produced, problems related to *the cold chain* are critical to pay attention to (Gebretnsae *et al*., 2022). The cold chain stores and transports vaccines in their potential state (within the acceptable temperature range) from the producer to the target (Bogale *et al.,* 2019). The cold chain system is vital in maintaining vaccine quality during distribution. This is assumed to pose the most significant risk, especially in tropical countries where the electricity supply is unstable, and facilities for its maintenance need to be better developed (Bogale *et al.,* 2019). Vaccines lose their function and content can also be caused by exposure to heat and sunlight, so a strategy is needed to avoid exposure to heat (Gebretnsae *et al*., 2022).

In building immunity, each vaccine with different ingredients has different handling. The innate immune system must be activated and recognize antigens as foreign substances to establish an antigen-specific immune response. However, inactivated viruses and recombinant protein antigens are often poorly immunogenic and require adjuvants to enhance their immunogenicity. Viral and bacterial vector-based vaccines do not require adjuvants (Wang *et al.,* 2020). Based on the description above, researchers want to examine several things related to what factors cause vaccines to lose or lack the protein content in them, which in this case is called vaccine quality.

Methods

We preferred Reporting Item Systematic Review and Meta-Analysis Guidelines (PRISMA) Guidelines. The search strategy aims to retrieve studies that discuss the factors that cause protein in vaccines to decrease. We also reviewed *the gray literature* and the bibliography of relevant and included studies to minimize the risk of missing eligible studies. The keywords used are "storage area" AND vaccine AND protein OR "vaccine raw materials" AND "cold chain management".

Researchers included observational and experimental studies using RCT, quasi-experimental, *case-control, cohort*, and *cross-sectional study designs*, qualitative studies, and articles published from 2009-2022. In addition, the researchers (DL and MF) conducted a critical appraisal of the reports analyzed using the JBI essential appraisal guidelines. Five researchers (N, HR, DL, MF, and WS) independently reviewed three databases: PubMed, ScienceDirect, and Google Scholar. The search strategy is described in Figure 1. The search was conducted between April 2022 to June 2022. The feasibility of the article is assessed from the process of evaluating the abstract and the title of each article for inclusion and exclusion. The inclusion criteria are articles that use English, discussing the protein content in vaccines, while the exclusion criteria are articles before 2000. After extraction, identical pieces are removed and extracted into Microsoft Excel. Two researchers (N and HR) applied the eligibility criteria, and the results were validated by a third researcher (WS) to consolidate the final study selection. This difference was resolved by conducting discussions between the three researchers.

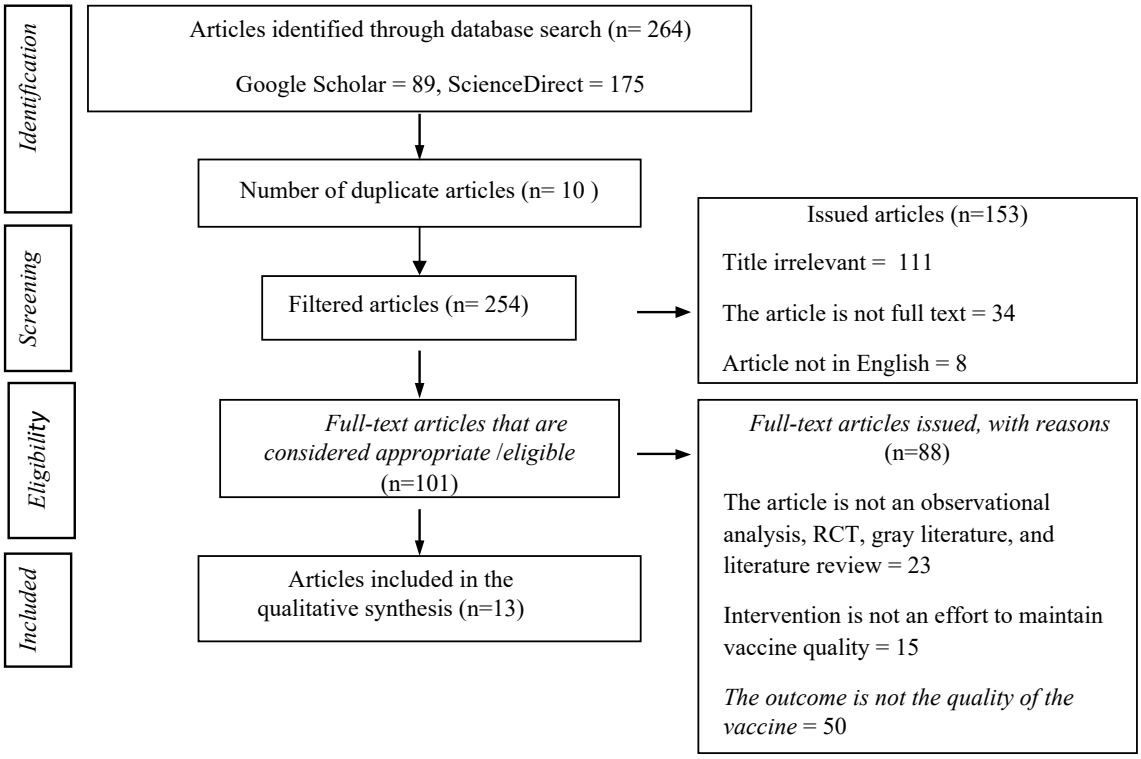
Results and Discussion

In April 2022, researchers found 264 articles using *the keywords* they sought. Among the articles that have been obtained, researchers choose relevant articles. Many factors cause the quality of vaccines to decline. This is very important to study because it affects the quality of vaccines that will be given to prevent certain

diseases. The search for the initial identification of articles was 264, with ten duplicates, so they were excluded, and 254 articles went to the next stage. There were 111 irrelevant titles, 34 non-full text articles, and eight non-English articles, so 153 were issued. Ninety-eight full-text articles were screened, but 88 were excluded for reasons, not observational analysis, 23 experimental articles were included, 15 were not the intended intervention, and 50 were not outcomes to maintain vaccine quality. So, the remaining thirteen articles were analyzed (Fig. 1).

The articles found for analysis came from high-income countries (HICs) such as the United States of America and Australia and low- or middle-income countries (LMIC) such as Ethiopia, Vietnam, Ghana, Africa, and India, with the year of article publication being between 2009-2021. Shows that the findings in this article are still relevant and in a good year of publication. The implementation of research conducted by David (2016) in Nigeria is a cross-sectional study regarding the bonding of protein content and how to stabilize it related to this content, in contrast to Manoja (2020), who conducted research in 213 health facilities in vaccine rooms at the level of three states in India. Meanwhile, another study by Bogale (2019) made an observational study that recommended an urgent need to improve cold chain management knowledge and practices through enhanced monitoring. Other articles conducted a cross-sectional study and quasi-experiment to observe the causes of decreased vaccine quality.

The study results cover high-income countries (HICs) (United States of America and Australia) and low- or middle-income countries (LMIC) (Ethiopia, Vietnam, Ghana, Africa, and India). Various vaccines are examined in this article, such as measles, polio, influenza, and hepatitis B vaccines which are included in the VFC. The same problem is found in the distribution of vaccines, both in high and low-income countries. The existence of temperature regulation in the distribution of vaccines makes this one of the most influential factors in reducing the quality of the vaccine. In addition, the knowledge of vaccine workers and the lack of training for officers is also a factor that influences vaccine quality.



Source: Prepared by authors based on the PRISMA flow diagram.
Figure 1. Prisma Flow Diagram Systematic Review

Table 1. Summary of Research on the Factors that Affect the Decline in Vaccine Quality

Title/Author Name (Year)	Country	Types of Vaccines and Proteins	Method	Research result	Outcomes
Factors affecting vaccine handling and storage practices among immunization service providers in Ibadan, Oyo State, Nigeria., David et al. 2016, Dairo & Osizimete, 2016 (Mojtabavi et al., 2019)	Nigeria	Vaccines in LGA's	Cross-sectional	73% knew vaccine handling and storage guidelines, and 68.4% had read such guidelines. Only 15.3% of the study said they had read the guidelines one month before. Approximately 65.0% had received immunization administration training. Reported mishandling included storing the injection with the vaccine (13.7%) and maintaining the temperature of the vaccine with an ice block (7.6%). Approximately 43.0% had good knowledge of immunization management, but 66.1% had good immunization management practices.	Regular training is recommended to enhance vaccine handling and storage practices.
Evaluation of Cold Chain Management Performance for Temperature-Sensitive Pharmaceuticals at Public Health Facilities Supplied by the Jimma Pharmaceuticals Supply Agency Hub, Southwest Ethiopia: Pharmaceuticals Logistic Management Perspective Using a Multicentered, Mixed-Method Approach, Diriba, Feyisa et al., 2021 (Chen & Kristensen, 2009)	Ethiopia	All types of vaccines and temperature-sensitive medicines	Cross-sectional	According to the survey, the average inventory rate of major cold chain products was 72.1±14.8%, and the average non-stock rate was 26.2±8.6%. The mean length of stay across all public health facilities visited was 23 ± 21 days. We found 263 (43.06 ± 15.3%) of the inventory records from public health facilities to be correct, with a rejection rate of 9.2 ± 7.8% across all health facilities visited. Thirty public health facilities (63.8 ± 36.2%) had acceptable storage conditions.	Facility management by providing proper training and supervision of cold chain pharmaceutical staff

Title/Author Name (Year)	Country	Types of Vaccines and Proteins	Method	Research result	Outcomes
Temperature integrity and exposure of vaccines to suboptimal temperatures in cold chain devices at different levels in three states of India, Manoja Kumar et al., 2020 (Das et al., 2020)	India	All types of vaccines	Cross-sectional	Vaccine stability and efficacy are generally temperature-dependent. The effects of exposure to vaccines at elevated temperatures are usually cumulative, altering protein structure and chemical stability and potentially rendering vaccines ineffective.	Vaccine stabilization method
Assessment of Factors Affecting Vaccine Cold Chain Management Practice in Bahir Dar City Health Institutions, Mulatu et al. (Mulatu et al., 2020; Sykes, 2018)	Ethiopia	All types of vaccines	Cross-sectional	The fitted model showed that well-informed respondents were 2.6 times more likely to practice good cold chain management than uninformed respondents. HCWs with 2+ years of professional experience are 95% 5.2 (1.4-19.14) and 95% 1.97 (0.77-5.03) in cold chain management, nearly five times more likely than their peers to perform well. It was very reasonable.	Ongoing efforts to maintain a safe and effective cold chain Required for both education and training to improve the knowledge of medical professionals and improve both infrastructure capacity and suitable equipment
Cold chain temperature monitoring in Vietnam, Robertson, 2010 (Hanson et al., 2017)	Vietnam	HPV vaccine	Observational study	There is a documented risk of exposure to ambient temperatures, seasonal and geographical effects during storage and transportation, and temperatures below recommended storage temperatures.	Recommendations for temperature regulation, transport, and storage of the HPV vaccine.
Vaccine instability in the cold chain: Mechanisms, analysis and formulation strategies, Kumru, 2014 (Kumru et al., 2014)	United States of America	Vaccination against measles, polio, influenza, and hepatitis B	Observational study	Vaccine instability is due to a lack of stabilization in the vaccine cold chain.	Modifying and innovating vaccine development, production, and distribution capabilities.
Effective Vaccine Management: The Case of a Rural District in Ghana, Osei, 2019 (Osei et al., 2019)	Ghana	All types of vaccines	Qualitative study	Vaccine management and supply are inadequate and need improvement. Health workers need training in distributing and procuring vaccines to bridge the knowledge gap regarding vaccine storage and distribution.	EVM assessment recommendations are carried out for vaccine distribution.

Title/Author Name (Year)	Country	Types of Vaccines and Proteins	Method	Research result	Outcomes
Calling for the next WHO Global Health Initiative: The use of disruptive innovation to meet the healthcare needs of displaced populations, Staruch, 2018 (Staruch et al., 2018)	United States of America	All types of vaccines	Observational study	There is a need for proprietary formulations for biologics and vaccines due to stability in the risk of an unstable environment.	Vaccine stabilization innovation
Factors that affect vaccine availability in public health facilities in Nairobi City County: a cross-sectional study, Kanja et al., 2021 (Kanja et al., 2021; Tan et al., 2014)	Africa	Vaccines for Children (VFC)	Cross-sectional	Most facilities had shortages of vaccines and deliveries during the survey and in the last 12 months. The most affected vaccines were tetanus (88%), measles-rubella (81%), and oral polio (79%). Inventory shortages were caused by rationing (82%), inventory levels (93%), transport shortages (55%), and forecast shortages (50%). The majority of facilities (91%) used public transportation, and only 1% used reliable government commercial vehicles for vaccine delivery and other logistics.	Cross-sectoral collaboration of all stakeholders in support of vaccination to harmonize roles between national and local governments and improve vaccine availability in public health settings.
Practice nurses best protect the cold vaccine chain in general practice, Carr (2009)	Australia	All types of vaccines	Quasi experiment	A key finding of this study was the positive impact of general practice nurses on achieving the integrity of the vaccine cold chain as defined by WHO. His 98% (98%) of general practices employing GPs maintained the integrity of the vaccine cold chain, whereas in general practices not employing GPs, he was only 42% (95% CI: 10, 58) obtained similar results.	The primary outcome criteria were adherence to acceptable cold-chain management practices for vaccines according to the National Health and Medical Research Council guidelines and keeping vaccines refrigerated within the World Health Organization (WHO) recommended range of 2 °C to 8 °C to maintain the temperature.

Title/Author Name (Year)	Country	Types of Vaccines and Proteins	Method	Research result	Outcomes
Evaluation of cold chain and logistics management practice in Durg district of Chhattisgarh: pointer from Central India, Sinha et al. (Sinha et al., 2017)	India	Vaccines for Children (VFC)	Cross-sectional	Correct placement of ice packs in the freezer was only observed with one CCP. T-series vaccine vials were placed correctly in the ILR at 85 µP. When it came to knowledge about freeze-sensitive vaccines and shake tests, 74% of cold chain workers had correct knowledge compared to 53% of them. Also, cold chain and logistics management components did not meet the requirements of the study area.	We recommend continued training and the supportive monitoring of cold chain handlers to take into account the surprising findings of this study. Regular on-site monitoring by local physicians/vaccinators responsible for proper cold chain practices will help ensure the quality of immunization services in the study area.
Assessment of factors affecting cold vaccine chain management practice in public health institutions in the east Gojam zone of Amhara region, Bogale et al. (Bogale et al., 2019)	Ethiopia	All types of vaccines	Cross-sectional	Thirty-five (58.3%) had adequate cold chain management of vaccines, and the remaining 25 (41.7%) had inadequate practices. Logistic regression showed that knowledge gaps and occupations were significantly associated with P< cold vaccine chain management practices $p < 0.05$.	Recommendations for there is an urgent need to improve knowledge and practice on cold chain management through improved supervision.
Knowledge of vaccine handlers and status of cold chain and vaccine management in primary health care facilities of Tigray region, Northern Ethiopia: Institutional based cross-sectional study, Gebretnsae et al. (2022)	Ethiopia	All types of vaccines	Cross-sectional	In this study, fifty Primary Health Care Facilities (PHCFs) were included with a response rate of 94.4%. The overall level of good knowledge of vaccine handlers and good status of cold chain and vaccine management was 48% (95% CI; 30.7%-62%) and 46% (95%CI; 26.1%-61.3%) respectively. Receiving training on cold chain and vaccine management (AOR = 5.18; 95%CI: 1.48–18.18) was significantly associated with knowledge of vaccine handlers. Furthermore, receiving supportive supervision (AOR = 4.58; 95%CI: 1.04–20.17) and good knowledge of vaccine handlers (AOR = 10.97; 95%CI: 2.67–45.07) were significantly associated with cold chain and vaccine management.	The cold chain and vaccine management status was poor. Program-based supportive supervision is needed to improve cold chain and vaccine management.

Title/Author Name (Year)	Country	Types of Vaccines and Proteins	Method	Research result	Outcomes
Vaccine Cold Chain Management and Associated Factors in Public Health Facilities and District Health Offices of Wolaita Zone, Ethiopia, Erassa et al.(2022)	Ethiopia	All types of vaccines	Cross-sectional	The study indicates that 83 (61%) public health facilities had good cold chain management practices at 95% CI (52.2–68.4). Experience greater than 2 years (AOR=2.8, 95% CI=1.13–6.74), good knowledge on cold chain management (AOR=3.02, 95% CI=1.2–7.4), training on cold chain management (AOR=1.86, 95% CI=1.36–9.84), and supportive supervision on cold chain management (AOR=2.71, 95% CI=1.1–7.14) were statistically significantly associated with good cold chain management practice.	Strengthening the knowledge of healthcare workers and supportive supervision on cold chain management by giving training and monitoring their practice toward cold chain management may help to improve the cold chain management practice.
Assessment of cold chain equipment and their management in government health facilities in a District of Delhi: A cross-sectional descriptive study, Kumar et al. (2020)	India	All types of vaccines	Cross-sectional	Out of 56 electrical CCEs, 8.9% were nonfunctional, 48.2% were noncompliant with WHO standards, 5.4% were not chlorofluorocarbon free, 4.7% did not have a temperature monitoring device, and 18.8% did not have a stabilizer. Eighty-six percent of passive containers were compliant with the WHO standards. The storage capacity of electrical vaccine storage equipment was insufficient in 3.4%, passive container capacity in 65.5%, and ice pack preparation and storage capacity in 24.1% of HFs.	Many CCEs used in the ISC of assessed sites were noncompliant with the WHO standards. There was no PPM of CCEs and no guidelines for emergency event management.
The Analysis of Cold Chain Management of Basic Immunization Vaccine in Health Service Centers, 2018, Fauza et al. (2018)	Indonesia	All types of vaccines	Qualitative study.	The availability of human resources, funds, facilities infrastructure, and work procedures are sufficient, although there is still one untrained health service center staff, a lack of vaccine flasks in two health service centers, and a lack of voltage stabilizers in seven health service centers. Almost all health service centers have applied vaccine boxes 20C-80C in the vaccine transportation system. Based on the evaluation, only one health service center needs to improve, especially in temperature evaluation procedure by thermometer. The vaccine storage procedure has been applied by the health service center. However, the observation noticed three health service centers have problems with the time delay in the melting process	it is necessary to provide a thermometer in a vaccine flask that is brought from the puskesmas to the posyandu and improvement of daily and weekly refrigerator maintenance so that frost does not form > 0.50cm

Source: prepared author from studied retrieved

Protein consists of amino acids, and a high-pressure environment, low pH, and high temperature can cause unstable protein content (Wang *et al.,* 2020). Giving osmolytes gives the impression of stability in various existing proteins. However, apart from that, the change in protein is also influenced by pH, temperature, and pressure. The vaccine is a product that has a high sensitivity to temperature (Yakum *et al.,* 2015). Vaccine storage needs at different temperatures, oral polio vaccine (2-8 °C), DPT vaccine (< 0 °C), and HPV vaccine (-20 °C) are also different, and the vaccine protein will be damaged if the vaccine is exposed to heat at temperatures of more than 8 °C. In addition, other studies have shown that some drugs and vaccines will react to exposure to moisture, light, vibration, and shock (Yakum *et al.,* 2015). Air that is too cold or too hot, as well as the sun's intensity that continuously hits a product, will negatively impact the product's effectiveness.

Vaccine packaging will be the key to maintaining the quality of the vaccine itself. The protein contained will also be safe if distributed in the right conditions. Packaging using temperature or thermal controllers can monitor the temperature in a particular room. In its development, materials from PCM (Phase Change Materials) will provide the ideal or desired temperature and are relatively consistent (Das & Arora, 2020). Besides materials and distribution methods, vaccine shelf life also needs to be considered.

Another laboratory study, at Vexes Technologies, at the Harvard Life Lab in Boston, Massachusetts, used silkworms to help change the behavior of the molecules in vaccines. It can overcome degradation when the vaccine is at room temperature or higher. The interaction between the vaccine and this charge causes the molecules to stick together and denature the vaccine antigen, thereby changing its molecular structure. This access starts with a solid but flexible fiber that the silkworm makes from a protein solution that it secretes through the glands, and this can protect the vaccine molecules so that the contents in the vaccine cannot move and stick to each other (Yang *et al*., 2021; Sykes C., 2018).

Each vaccine has its characteristics, but the available vaccines generally survive at temperatures of 70 to 8 °C (WHO, 2021). Controlling temperature, light intensity, vibration, and cold storage is critical because this vaccine is a substance that contains a protein that changes its properties and properties quickly when stored at an inappropriate temperature (Hanson *et al*., 2017). Temperatures above average should be, pose a risk of ineffective vaccine administration. Therefore, it is also necessary to innovate tools for storing vaccines at cold temperatures using appropriate methods, such as cold storage (Bogale *et al*., 2019; Hatchett, 2017).

The selection of the proper cold storage is essential because of the nature of the vaccine, which is sensitive to changes in temperature. The vaccine will be stable by providing an effective cold chain, from manufacture, distribution, and storage, to administration (Kumru *et al*., 2014). Several things make vaccine storage refrigerators according to standards, such as the type of refrigerator that is suitable for cold storage of vaccines, the presence of a thermometer that can record the maximum and minimum temperature, in the vaccine cabinet, there is no food stored together with the vaccine (Yakum *et al*., 2015; Thielmann *et al*., 2019). Research shows that cold storage is generally reserved at room temperature between 20 and 25 degrees Celsius, with a humidity recommended by WHO of around 55% and a humidity level of about 45% to 75% (Kumru *et al*., 2014; CDC, 2021; Osei *et al*., 2019; WHO, 2020).

Many studies mention and highlight knowledge gaps in relevant health professionals in vaccines about the damage caused by vaccine freezing and improper temperature regulation, and it is vital to educate and train vaccine manufacturers and workers who manage cold chain temperature monitoring to improve temperature maintenance and chain management that facilitates targeted vaccine distribution (Hanson *et al*., 2017; Alonso-García *et al*., 2019). The process of storing, handling, preparing, and administering vaccines is complicated, and this requires efforts to simplify and improve overall education and training for staff involved in vaccines (Tan *et al*., 2014). That way, officers can have good knowledge about vaccine cold chain management and help

maintain vaccine quality to the target (Mulatu *et al*., 2020; Tan *et al*., 2014; Pambudi *et al*., 2022).

Cold chain management is very important for vaccine distribution, damage to vaccines, both the content and packaging, occurs because there is no good management in the cold chain management, good knowledge of cold chain management will help distribute vaccines properly to ensure good quality vaccine content (Fauza *et al*., 2019). In addition to temperature regulation, cold storage innovation, lack of staff knowledge, and lack of consistent standards, another critical thing that regulates all of this is the presence of government policies that also contribute. Several organizations such as Disease Control and Prevention (CDC), VFC Programs, Public Health Immunization Programs, the World Health Organization (WHO), and other health departments need to collaborate to recommend the best so that it becomes a guideline for the government to implement policies to comply with the best vaccine distribution implementation standards (Alvarez *et al*., 2022; Tan *et al*., 2014).

Effective maintenance of cold chain standards is also influenced by the knowledge and practice of the health worker or staff on duty. The results of the study revealed that only 38.3% of respondents had sufficient knowledge about vaccine cold chain management. Related potential factors were possibly responsible for this low level of cold chain management practices including inadequate knowledge or training, and inadequate support. So, in this case, the knowledge of officers regarding cold chain management is something that needs to be improved because it is important in maintaining vaccine quality (Bogale *et al*., 2019).

Conclusions

The protein content in vaccines varies depending on the function of the vaccine itself. Factors that reduce the quality of vaccines are humidity, temperature, the intensity of sunlight, vibration, and the pattern of vaccine distribution until it reaches consumers or patients. It is necessary to pay attention to the packaging and distribution methods to maintain the quality of the vaccine content and protein, as well as the knowledge of health workers regarding cold chain management so that all of them can create stable and quality vaccines.

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Relationship of Environmental Factors with Leptospirosis Incidence in Southeast Asia

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Abstract

Southeast Asia is a leptospirosis endemic with the highest estimated incidence of cases. This type of research is a systematic review using the PRISMA. These search results found 2.322 research articles and only thirteen articles that matched the research criteria. Two articles discussed the relationship between sewer conditions and the incidence of leptospirosis, one article discussed the relationship between the presence of trash bins and the incidence of leptospirosis, nine articles discussed the presence of rats and the incidence of leptospirosis, and one article discussed standing water and the incidence of leptospirosis. There is a relationship between the presence of trash bins, the presence of rats, and standing water and the incidence of leptospirosis in Indonesia, Thailand, and Malaysia and there is no relationship between sewer conditions in Thailand and Indonesia.

Introduction

Leptospirosis is a contagious disease that affects people all over the world. It develops from an acute bacterial infection brought on by bacteria of the genus Leptospira, which affects many organs and can have fatal side effects. Leptospirosis occurs across the world, although tropical and subtropical areas are where it is most prevalent. Leptospirosis is thought to cause 58.900 deaths and 1.03 million cases worldwide each year, which represents substantial morbidity and mortality rates. The regions of South Asia, Southeast Asia, Oceania, the Caribbean, the Andes, Latin America, and Eastern Sub-Saharan Africa have the highest estimated rates of leptospirosis morbidity and mortality.

A significant incidence of instances of leptospirosis is thought to exist in Southeast Asia. Leptospirosis is transmitted and distributed differently throughout Southeast Asia due to factors like floods, heavy rainfall, and high temperatures (Douchet *et al*., 2022). Leptospirosis is mostly transmitted by rodents like rats, though it can also spread to livestock like pigs, cows, horses, dogs, buffalo, sheep, and goats. The knowledge and attitudes of those who are less concerned about leptospirosis are to blame for the rise in leptospirosis cases. Many people are unaware of the causes, symptoms, and methods for treating and preventing leptospirosis.

Numerous studies have already examined the literature to determine how certain variables relate to the prevalence of leptospirosis. The environmental elements that affect the countries of Southeast Asia, where leptospirosis is prevalent and its prevalence rises during the rainy season, have not however received much attention. As a result, a thorough study of the literature is required to determine how environmental factors affect the prevalence of leptospirosis. The findings will assist decision-makers and enhance the control of leptospirosis in Southeast Asia. The study's overarching goal is a general understanding of the leptospirosis between environmental conditions and the prevalence of leptospirosis in Southeast Asia.

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Method

This type of research is a systematic review using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) method. The research was conducted by searching data in the form of online electronic-based research articles that have been published in national and international journals in several databases, namely BioMed Central, Google Scholar, ProQuest, PubMed, and Scopus. The research was conducted after obtaining ethical approval from the ethical committee number KE-FK-0496-EC-2023 by the Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University.

Based on established inclusion and exclusion criteria, an electronic research article found online served as the study's sample, inclusion standards: original study, the full text of the paper, observational research, the study was carried out in a Southeast Asia nation, use English and publish between January 2019 and March 2023, examines how leptospirosis occurs in Southeast Asia and how sewer conditions, the presence of trash bins, the presence of rats, and standing water are related. Exclusion standards: thesis with insufficient text, books, seminar and conference proceedings, and article, qualitative research.

Tracking a strategy, The Medical Subject Headings (MeSH) and Booleans (AND/OR) were used in the data search. Useful keywords or phrases comprise 1) "gutter" OR "gutter conditions" OR "sewer" OR "drain" OR "ditch" OR "gully" OR "canal" OR "brook" OR "runnel" OR "waste" OR "garbage" OR "trash" OR "rubbish" OR "trash can" OR "kitchen midden" OR "presence of mice" OR "rats" OR "mouse" OR "shrew" OR "puddle" OR "pool" OR "standing water". 2) "leptospirosis" OR "human leptospirosis", and 3) "southeast asia" OR "indonesia" OR "thailand" OR "malaysia" OR "timor leste" OR "brunei darussalam" OR "singapore" OR "philippines" OR "myanmar" OR "laos" OR "cambodia" OR "vietnam". The search is carried out by putting (1) AND (2) AND (3) together. Article Bias Rating, quality, and relevance ratings are used to avoid recalls, and conclusions based on unreliable data (Effect *et al*., 2020). A bias assessment was carried out using an Office of Health form Assessment and Translation Risk (OHAT) of Bias Tool from The National Institute of Environmental Health Science, National Toxicology Program (OHAT, 2015).

Result and Discussion

The process of searching for articles in this study was carried out according to the flow of PRISMA with a time limit of 2019-2023. The first stage is identification, carried out by a research article data search process in five databases using predefined keywords. The database used in searching for research article data is BioMed Central, Google Scholar, ProQuest, PubMed, and Scopus. Results of the identification stage resulted in 2.322 research articles that were detected. As many as 308 research articles were duplicated, so only 2.014 articles research that can be continued in the second stage, namely the search. The search stage was carried out with three exclusion processes, namely excluding research articles based on titles and abstract designs, and articles conducted in countries other than Southeast Asia (n= 1.901).

The next step is to exclude research articles that do not according to the inclusion criteria set by the searcher, namely research articles that have positive cases of leptospirosis in addition to humans that do not test the relationship between environmental factors and events leptospirosis, non-English articles, articles in the form of the final project is a thesis, as well as systematic review articles (n= 100). The final exclusion stage aims to obtain articles, and research that discusses sewer conditions, the existence of trash bins, the presence of rats, and standing water with the incidence of leptospirosis in Southeast Asia. The results of the articles obtained in the second stage were thirteen research articles, which then proceed to the results stage, namely articles research can be done through systematic review.

Based on the search for articles that have been done, there are 2.322 articles. However, only thirteen articles were analyzed, and most of them were research conducted in Indonesia, Malaysia, and Thailand. The thirteen articles are observational analytics with a cross-sectional study design and case-control.

According to the study's findings,

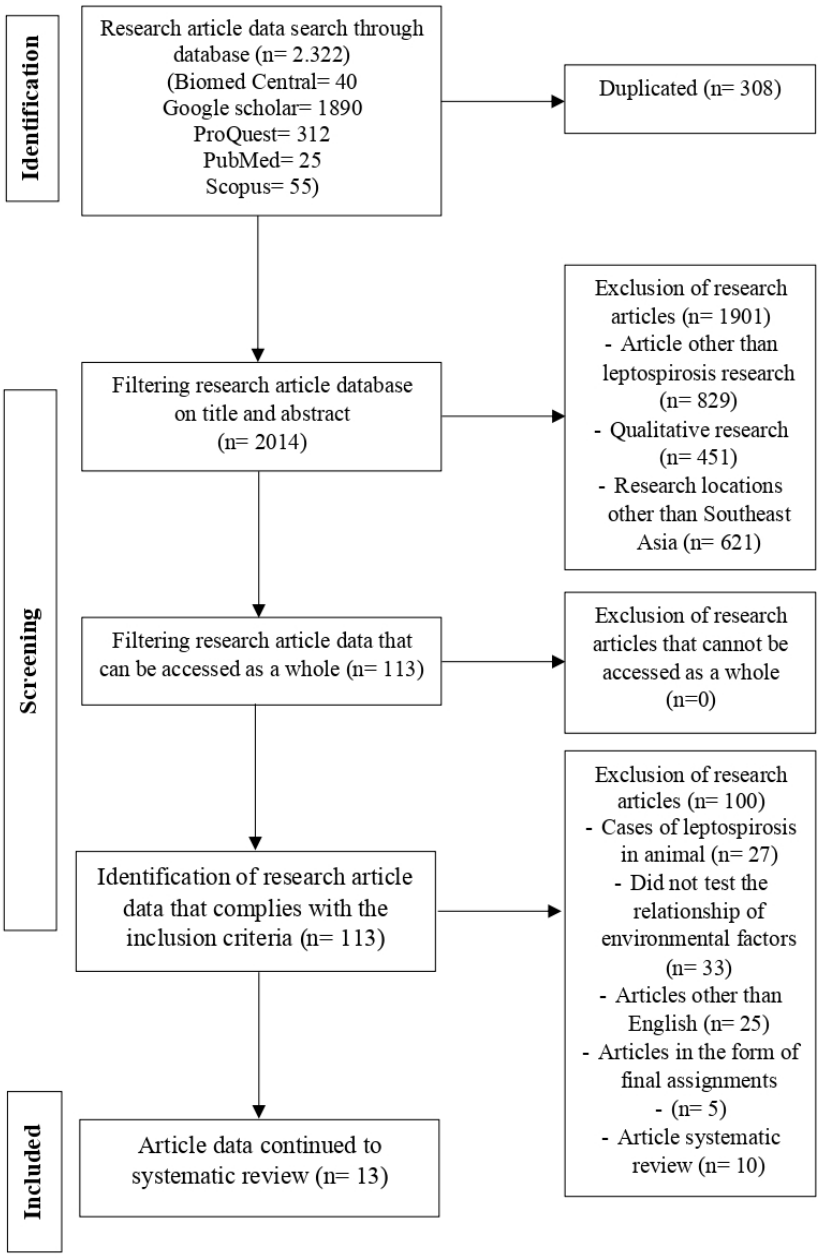

Figure 1. PRISMA Diagram

leptospirosis cases in Indonesia, Thailand, and Malaysia correlated with the presence of rats. The primary reservoir for leptospirosis transmission has been identified as rats. Because rats can access garbage cans through sewer linked to the sewage system, their presence has been recognized as a significant risk factor for developing leptospira antibodies in slums (Narkkul *et al.*, 2021). Rats carcasses, rat urine, rat droppings, and rats roaming around the house are indications that can spread the leptospira bacterium.

Rats gather in places with food, water, and shelter, which presents an opportunity for the spread of leptospira bacteria. Rats that were infected with the leptospira bacteria did not exhibit persistent symptoms and can spread the germs to the environment through urination. Rat urine, rat droppings, rat trails in the ground, garbage, ditches, standing water, and vegetation are all ways that rats can directly transmit the leptospira bacterium to people (Notobroto *et al.,* 2021). Rats can adapt to changes in humidity, temperature, light, and soul texture to survive.

Table 1. Summary of Research on Factors Associated with The Incidence of Leptospirosis

Study identity	Location	Method	Adjusted variables
Hinjoy et al. (2019)	Mahasarakham, Thailand	Case-control	Sewer conditions
Sulistyawati et al. (2020)	Gunungkidul, Indonesia	Case-control	Sewer conditions
Setyaningsih et al. (2022)	Boyolali, Indonesia	Case-control	The presence of trash bins
Notobroto et al. (2021)	Ponorogo, Indonesia	Case-control	The presence of rats
Harisa et al. (2022)	Semarang, Indonesia	Case-control	The presence of rats
Narkkul et al. (2021)	Hua, Thailand	Cross-sectional	The presence of rats
Goh et al. (2019)	Johore and Malaysia, Malaysia	Cross-sectional	The presence of rats
Mohd Hanapi et al. (2021)	Peninsular, Malaysia	Cross-sectional	The presence of rats
Suwannarong et al. (2022)	Nakhon Sawan, Thailand	Cross-sectional	The presence of rats
Dewi et al. (2020)	Klaten, Indonesia	Case-control	The presence of rats
Dung et al. (2022)	Thai Binh, Thailand	Case-control	The presence of rats
Toemjai (2023)	Si Sa Ket, Thailand	Case-control	The presence of rats
Pawitra & Diyannah (2021)	Ponorogo, Indonesia	Cross-sectional	Standing water

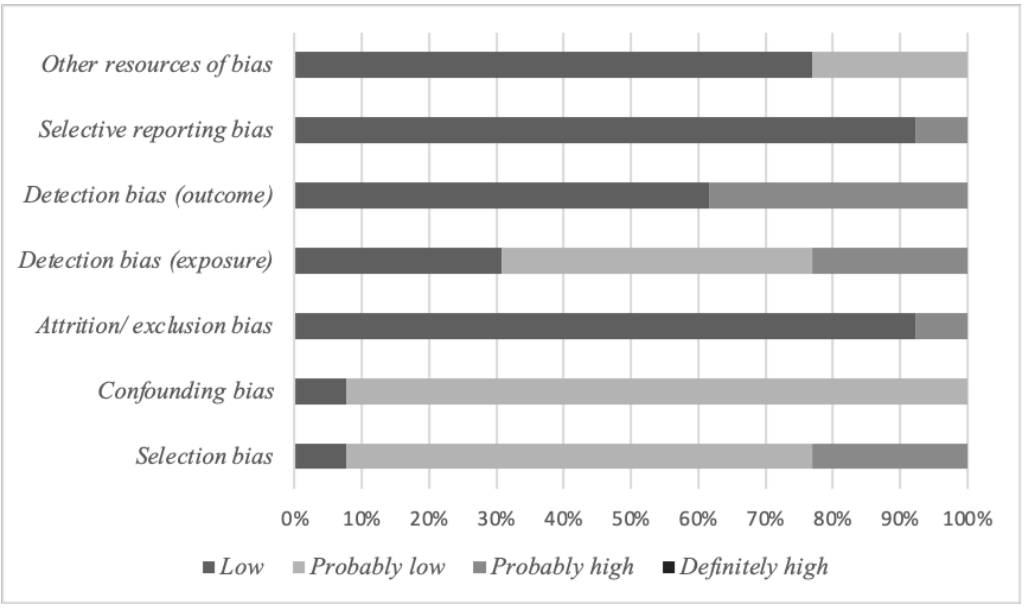

Figure 2. Risk of Bias and Publication Bias

In both tropical and temperate cities, Rattus rattus and Rattus norvegicus have been identified as transmission leptospirosis reservoirs. However, Rattus norvegicus, a species of rat, is the most common vector of leptospirosis. One of the most invasive species is the Rattus norvegicus, sometimes known as the Norwegian rat. Rattus norvegicus has adapted to occupy a variety of environments, making it a dominating species in Southeast Asia (Griffths *et al*., 2022). Rattus norvegicus is the species most frequently infected with leptospira bacteria because it is frequently discovered in sewer systems with damp habitats. Rattus norvegicus always requires water to drink because it cannot stand to be thirsty.

Rattus rattus is one of the most common domestic rats found in cities, open spaces, and residential areas. It is a rodent species that can adapt well to a variety of climates and environmental situations. Rattus rattus is an ideal reservoir for transferring numerous infectious diseases to humans because it may use trash as food and piles of trash as a refuge. In poorly maintained buildings with dry ecosystems, Rattus rattus is frequently discovered in cracks and ceilings (Innes *et al.,* 2018).

Leptospira bacteria can be transmitted from rats to humans through wounds on

their bodies and old age. These rats are more likely to be a source of the bacterium than rats without wounds. Leptospira bacteria are spread between rats by fighting, which results in rat bites on other rats and speeds up the spread of the bacteria between them. The majority of leptospirosis outbreaks happen during prolonged periods of severe rain and flooding, which has increased the number of cases of leptospirosis being reported. This is so that the environment is made more conducive to the spread of leptospira bacteria between rats and humans and helps wash away the rats that are transmitting the disease.

Leptospirosis can be spread through livestock, such as cattle or goats, and is brought on by direct contact with infected animal urine or by coming into contact with people after coming into contact with contaminated soil (Rees *et al*., 2021). In addition to rats, livestock and pets such dogs, pigs, horses, buffaloes, cats, insects, and sheep can also spread the leptospira bacteria. Maintaining a clean home environment is one way to stop the cycle of transmission and manage rats. Rats can be individually controlled by tearing out rat holes, vaccinating pets (dogs, cats, and ghost birds), maintaining a clean home, or setting up rat traps. To stop the spread of leptospirosis, it is crucial to actively monitor people, pets, and wild animals while implementing rodent control measures for community rodents and farm animals. To this end, it is crucial to work with a variety of partners and stakeholders from the agricultural, animal, and health sectors.

According to the study's findings, Indonesia's incidence of leptospirosis is correlated with the presence of trash bins. Open trash bins in the environment have the potential to turn into rat habitats. The incidence of leptospirosis with a rat reservoir will be impacted by the amount of trash in the home and surrounding area (Mamonto *et al*., 2020). As a result, it is recommended that residents cover trash bins in their residences and the neighborhood. Rats that flourish in the environment may not develop too if there is open rubbish nearby.

Rats adore places where there are trash bins, provided that the trash bins are both open and not watertight. Rats find it simpler to enter trash bins and search for food because of these circumstances. Unsafe garbage disposal locations are one of the factors contributing to the rise of leptospirosis cases. This is because trash bins are a particular favorite of the vector that carries the leptospira bacteria. Leptospira bacteria are spread by rats contaminating water from wet trash bins with their urine, which is then transferred to rats hunting for food (Ridzuan *et al.,* 2016). As a result, rats become sick and die as a result of the infection.

The presence of trash bins is an environmental component that may have an impact on disease vectors, particularly those that are related to the environment. Rats carry the leptospira bacteria, which causes leptospirosis. The community is urged to conduct leptospirosis management measures by maintaining good trash bin conditions. Rats will enter an open trash might that is not watertight.

According to the research findings, there was no correlation between the state of the gutters and the prevalence of leptospirosis in Thailand and Malaysia. The greater percentage of leptospira bacteria in standing water proves that rats frequently contaminate it. Leptospira bacteria can live in soil and water, and they do so better in standing water than in rainwater or underground water (Hinjoy *et al*., 2019; Sulistyawati *et al*., 2020). Standing water surrounding the house brought on by overflowing gutters and rainwater that does not seep in properly are environmental factors that have been linked to the prevalence of leptospirosis. gutters that comply with the regulations must not overflow when it rains, flow smoothly, be free of rubbish and rodents, and be less than two meters from the house. Ditches with non-current flows, rats crossing them, and overflowing after rain are indicators of poor sewer conditions.

Household wastewater is often disposed of in cement tubs that are buried in the ground and tightly closed in areas without sewage systems. In the meanwhile, those who own ditches use them to dispose of household wastewater, but they fall short of the standards for a decent ditch, turning it into a pathway or a rat colony. Leptospirosis incidence is unrelated to the quality of the ditch since not all rats that

cross across it are infected with the leptospira bacteria (Sofiyani *et al.*,2018).

According to the study's findings, Indonesia leptospirosis cases are correlated with the presence of standing water. One of the leptospirosis transmission mediums is standing water. Leptospira bacteria from rodents contaminate standing water, which infects people through scraped skin. Leptospirosis can be brought on by drinking water that has been tainted with the leptospira bacterium in both people and animals. The leptospira bacteria are spread through standing water. This is because standing water in and around the home can spread leptospira bacteria when people come into contact with it accidentally. Leptospira bacteria are spread to standing water by rats carrying the leptospira bacteria when they move through puddles or urinate in them.

Standing water that can become a place for leptospira bacteria to live is found in old water reservoirs that are not wasted, pools of water in rice fields, and standing water that does not flow into rivers. In agricultural areas, there is much-standing water, so agricultural areas are very suitable for the development of leptospira bacteria and rats. Patients with leptospirosis are typically infected by standing water, household waste-contaminated standing water, or rainwater (Manyullei *et al.*, 2020).

Conclusion

The results of a systematic analysis that looked into the relationship between sewer conditions, trash bins, rats, and standing water and the incidence of leptospirosis in Southeast Asia revealed the following: there is a relationship between the presence of trash bins and the incidence of leptospirosis in Indonesia. In Malaysia, Thailand, and Indonesia leptospirosis cases are correlated with the presence of rats. In Indonesia, there is a connection between the prevalence of leptospirosis and standing water. In Thailand and Indonesia, there is no correlation between sewer conditions and the prevalence of leptospirosis. Based on research findings, the following recommendations can be made: recommendations for the government, including the provision of closed trash bins in people's houses and the management of rat pests, to build collaboration with the cross-sector in efforts to prevent leptospirosis. Recommendations for raising community awareness of the prevalence of leptospirosis, including the fact that open trash cans, rats in the home, and standing water all contribute to the disease's occurrence. Recommendations for future researchers to expand on this study include including additional variables related to the prevalence of leptospirosis and performing a meta-analysis.

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Maternal Characteristics and Nutritional Status among First Trimester Pregnant Women in West Sumatera

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Abstract

Optimizing the health and nutritional status of mothers during pregnancy can reduce the risk of stunting, with prevalence among children under five, in which the undernutrition condition was still high. It was about 24.4%. The research objective is to determine the association between maternal characteristics with nutritional status in the first trimester. This cross-sectional study involved 52 pregnant women in the first trimester. This study was conducted in the working area of health centers in Padang City 2022 which had a high prevalence of undernutrition problems. Data analysis was carried out using univariate tests and bivariate tests using chi-square with 95% CI and a significance level of p-value < 0.05. The analysis results showed a significant relationship between BMI before pregnancy with nutritional status in the first trimester among pregnant women (p-value = 0.000). There is no relationship between education, occupation, age, and parity of the mother with nutritional status in the first trimester. Suggestions for pregnant women are to know their nutritional status, consume nutritious foods that are needed for fetal growth, and reduce the risk of low birth weight and stunting.

Introduction

Globally, the prevalence of Chronic Energy Deficiency (CED) among mothers is still high, especially in developing countries, such as Indonesia (Angraini, 2023). A national basic health survey in Indonesia on year 2018 identified that pregnant and not pregnant women's prevalence with CED was 17.3% and 14.5% respectively (Kemenkes RI, 2018). In addition, Indonesia's health data showed that mothers with undernutrition status during pregnancy are at increased risk of poor maternal and child health outcomes in later life. Based on data from the Indonesian toddler nutritional status survey in the year 2022, stunting prevalence among children under five which is one of the undernutrition conditions was still high, it was about 21.6% (Kemenkes RI, 2022).

Many factors contribute to the nutritional status of children, some of those factors are maternal nutritional status before and during pregnancy. Mothers who had normal pre-pregnancy Body Mass Index (BMI) means they had sufficient nutrients stored in their bodies to meet the infant's needs when mothers came into pregnancy. Then during pregnancy, mothers need increases according to meet the increased nutritional demands for the growth and development of the fetus and to take care of the mother's health (Jouanne *et al.*, 2021).

Previous studies in Ethiopia and China have shown that maternal inadequate gestational weight gain was positively related to increased risk of having a small baby, such as Low Birth Weight (LBW), small for gestational age, and risk of stunting (Li *et al.*, 2013; Woldeamanuel *et al.*, 2019). Also, a study in Malaysia found that a mother's BMI and gestational weight gain were determinants of LBW. Another study identified that mothers who had a pre-pregnancy BMI below 18.5 kg/m2 were associated with lower

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birth weight of infants (Bonakdar, 2019). As we know that mother's nutritional status in the first trimester of pregnancy is also a crucial factor that has an association with fetal growth. At this time many metabolic and physiological functions are changed which also impact gestational weight gain and maternal health. Therefore, the objective of the study was to assess the characteristics of pregnant women and pre-pregnancy body mass index concerning nutritional status in the first trimester of pregnancy in West Sumatera Province, Indonesia.

Method

The study was conducted by a cross-sectional study among 52 pregnant women in the first trimester of pregnancy which collected the data from health centers. The participant of the study was recruited from 3 (three) health centers that had a high prevalence of undernutrition problems in Padang City, Indonesia. The inclusion criteria of the study were mothers who were in healthy condition, had no serious medical condition, such as a history of diabetes mellitus and cardiovascular diseases, and were able to communicate.

Information regarding socio-demographic characteristics, obstetric history, dietary intake, and anthropometric data were assessed through direct interviews and a standardized questionnaire. Maternal pre-pregnancy Body Mass Index (BMI) was collected from a maternal health book and maternal BMI in the first trimester of pregnancy was collected through direct assessment, measuring weight and height. BMI was calculated by weight in kilograms divided by the square of height in meters (kg/m^2). Weighing is carried out 1 time per month and each time weighing is carried out 2 times. The type of scales used is the GEA brand digital scales with a capacity of 5-150 kg and an accuracy of 50 grams. Next, measure the mother's arm circumference using Lila's tape measure. It is expected that Lila's mother is not more or less than the normal limit for pregnant women (≥ 23.5 cm), if it is less, it means that the mother is said to be CED and is not included in the expected respondent criteria.

Characteristic of pregnant women, such as age was categorized into age at risk, if the mother was under 20 years and more than 35 years. Then, no risk of age if the mother has an age range of 20-35 years. The mother's education level was categorized into low education, if the mother had education under middle high school, and high education if the mother had education more than senior high school. Mother's occupation was categorized into not working or as a housewife and working groups. Frequency of pregnancy was categorized into two groups, have less than 2 of pregnancy (≤ 2) and more than 2 (>2) of pregnancy. Maternal pre-pregnancy BMI and nutritional status in the first trimester of pregnancy were categorized into 2 (two) groups, normal nutritional status, if the mother's BMI was 18.5-25.0 kg/m^2 and not normal nutritional status or malnourished, if the mother's BMI was <18.5 kg/m^2 and > 25.0 kg/m^2.

Univariate and bivariate analysis were used to present the result of the study. The chi-square test was used to determine the association of maternal characteristics and pre-pregnancy nutritional status with nutritional status in the first trimester of pregnancy. The significant association was examined through a *p-value* less than 0.05 with a 95% confidence interval. The Ethics Committee of the Andalas University of Medical Faculty approved the study protocol and written informed consent was obtained from all respondents who signed the agreement before collecting the data. This research permit was issued by the Padang City Health Office with the letter number 891/4379/DKK/2022 issued on May 31, 2022. A research permit was issued by the Faculty of Medicine Andalas University with the letter number 945/UN.16.2/KEP-FK/2022.

Results and Discussion

The results showed that the average age of pregnant women was 29 years with the youngest being 21 years old and the oldest being 45 years old. For the frequency of pregnancies, this average was the second pregnancy, with the lowest frequency being 0 (it is the first pregnancy) and the highest indicating that this was the fifth pregnancy. For the results of the upper arm circumference, the average value was 28.9 cm with the smallest value of 19 cm and the largest being more than 31 cm (39 cm).

The value of pre-pregnancy BMI was 25 kg/m^2 with the smallest value being 14 kg/m^2 and the highest being 38 kg/m$^{2.}$ The results can be seen in Table 1.

Table 1. Characteristics of Pregnant Women According To Average Age, Mid Upper Arm Circumference, and Pre-Pregnancy BMI (Body Mass Index)

Variable	Mean	+ SD	Min - Max
Age	29	+ 4.5	21 – 45
Frequency of Pregnancy	2.05	+ 1.2	0 – 5
Mid-upper arm circumference	28.9	+ 4.4	19 – 39
Pre-Pregnancy BMI	24.4	+ 5.5	14 – 38

(Primary data, 2023)

Table 2 below shows the results of the frequency distribution for each variable. This study showed that most of the respondents had high school education levels (45.5%), for the type of work, it showed that 70.5% of respondents did not work or as housewives. Based on the mothers' age category, most of the pregnant women were less than 35 years old (88.6%). There were two categories of frequency of pregnancy, most of the respondents had been pregnant less than 2 times (71.6%). According to the results of pre-pregnancy BMI, most of the respondents were overweight (39.8%).

Table 2. Frequency Distribution of Characteristics of Pregnant Women According to Mothers' Education Level, Mothers' Occupation, Mothers' Age Category, Frequency of Pregnancy, and Pre-Pregnancy BMI.

Category	Freq	Percent (%)
Mothers Education Level		
Completed Elementary School	3	3.4
Completed Middle School	5	5.7
Completed High School	40	45.5
Finished College	40	45.5
Mothers Occupation		
Housewife	62	70.5
Civil Servant/Private Employees	12	13.6
Self-Employed	4	4.5
Others	10	11.4
Mothers Age Category		
≤35 years	78	88.6
>35 years	10	11.4
Frequency of Pregnancy		
0-2	63	71.6
>2	25	28.4
Pre-Pregnancy BMI		
Underweight	8	9.1
Normal	45	51.1
Overweight	35	39.8

(Primary data, 2023)

The results of the present study showed four characteristics were predictors for the nutritional status of pregnant women, including the mother's education level, mother's

Table 3. The Correlation between the Characteristics of Pregnant Women, Pre-Pregnancy BMI, and Nutritional Status

Variable	Nutritional Status						P-value
	Normal		Malnourished		Total		
	n	%	n	%	n	%	
Mother Education Level							
High	48	60	32	40	80	100	1.000
Low	5	62.5	3	37.5	8	100	
Mother Occupation							
Work	27	43.5	35	56.5	62	100	0.264
No work	8	30.8	18	69.2	26	100	
Mother Age Category							
≤35 years	62	74.7	21	25.3	83	100	0.072
>35 years	2	40	2	40	5	100	
Frequency of Pregnancy							
Nulliparous	24	38.1	39	61.9	63	100	0.610
Primiparous	11	44	14	56	25	100	
Pre-Pregnancy BMI							
Normal	33	71.8	13	28.2	46	100	0.000
Malnourished	2	4.8	40	95.2	42	100	

(Primary data, 2023)

occupation, frequency of pregnancy, and BMI Pre-Pregnancy. Table 3 below shows the relationship of variables with nutritional status during pregnancy. The mother's education level was divided into two, high level (completed high school and college) and low education level (completed elementary and junior high school). The results showed that the majority of mothers with higher education were malnourished (40%) and pregnant women with low education levels had normal nutritional status (60%). The type of mother education, there were working mothers (civil servants/ private employees) and housewives. Both of type education, the proportion of nutritional status of housewives had the proportion of nutritional status (56.5%).

The category of mother's age showed that 50 percent of respondents were malnourished by both categories (≤35 years and > 35 years). For the frequency of pregnancy, the pregnant women who had been pregnant 0-2 times, most of the respondents were malnourished (61.9%) and the frequency of more than twice were 56% normal nutritional status. There was no significant association between the mother's education level, mother occupation, frequency of pregnancy with nutritional status during pregnancy (Table 3). Mother's education level affects the mother's knowledge and how to access information related to health and nutrition (Handayani *et al.,* 2017). Mothers with better levels of education tend to have better knowledge and ability to apply better knowledge than mothers with lower levels of education. A good level of education can also lead to better job opportunities, a better socio-economic situation, and good food choices in preparing for pregnancy and during pregnancy. This can have an impact on the health status and nutritional status of the mother during pregnancy (Philippou *et al.*, 2017; Sun *et al.*, 2020; Permatasari *et al.*, 2021).

A mother's occupation can affect her nutritional status. Working mothers have sufficient income to meet nutritional adequacy. For working mothers, the food consumed was not always prepared from home, usually bought food outside. For this reason, it was necessary to pay attention to the food to be consumed must be healthy and nutritious and meet the nutritional requirements of pregnant women. In mothers who do not work, the opportunity to eat food from home is greater. So that mothers could ensure that the food consumed was healthy and that cleanliness was maintained. Both working and non-working mothers must pay attention to food intake by consuming foods that follow balanced nutrition and appropriate portions.

The ideal age of the mother during pregnancy is in the range of 20-35 years. Mothers who are pregnant over the age of 35 years can be referred to as high-risk pregnant women. If the pregnant woman is too young, according to the literature, it states the unpreparedness of the reproductive organs and mental readiness as a prospective mother. If the pregnancy is too old, over the age of 35 years, there is a risk of pregnancy complications such as bleeding, anemia, Chronic Energy Deficiency (CED), and labor complications that have an impact on the child being born. The risk of genetic defects increases after the age of forty.

Pregnant women are a vulnerable group whose health and nutritional status must be considered to prepare for a healthy pregnancy and good pregnancy outcomes. Measurement of nutritional status through anthropometry before pregnancy is very important to determine the nutritional status of pregnant women and to prevent unexpected health problems during pregnancy (Mahanta, 2015; Li, 2013). The problem of malnutrition or (malnourished and overweight) pre-pregnancy and during pregnancy can increase the risk of pregnancy outcomes (Gondwe *et al.*, 2018; Yang *et al.,* 2021).

Of the pregnant women who were malnourished pre-pregnancy, there were 95.2% as malnourished pregnant women. The results of statistical tests showed that there was a significant relationship between nutritional status before pregnancy and during pregnancy (*p-value* = 0.000). Several studies state that assessment of nutritional status through anthropometric measurements such as maternal weight and height, and maternal upper arm circumference before pregnancy are important predictors of maternal weight gain during pregnancy. The nutritional status of pregnant women before and during pregnancy affects the condition of pregnancy and the weight of

the newborn (Xiao *et al.*, 2017; Bhowmik *et al.*, 2019). This is to prevent complications from pregnancy and children with LBW (Kuan *et al.*, 2017; Bonakdar *et al.*, 2019). Pre-pregnancy BMI is an important factor for assessing the conditions of a healthy pregnancy and as an assessment or risk assessment of pregnancy, especially related to weight gain which will have an impact on identification when women are at risk of having difficulty conceiving due to excessive or insufficient weight gain (Aji *et al.*, 2022; Ciptaningtyas *et al.,* 2022). For this reason, it is very important to monitor the nutritional status of the mother from before pregnancy until the end of pregnancy to ensure that the mother and fetus are in good health (Mahanta *et al.*, 2015; Kisworo *et al.*, 2021).

In this study, there was a significant association between BMI Pre-Pregnancy and nutritional status during pregnancy. Maternal and undernourished children account for more than one-third of all deaths among children. Moreover, it has been reported that proper nutrition before and during pregnancy is of high importance for health outcomes in the later life of both mothers and children. It is proposed that to promote the long-term health of both the mother and her child, following a healthy diet before and during pregnancy is crucial (Bonakdar *et al.*, 2019; Nugroho *et al.*, 2023). Both maternal anthropometry and weight gain during pregnancy are important determinants of birth weight (Soltani *et al.*, 2017; Jiménez, 2019; Meutia & Yulianti, 2019).

Inadequate prenatal weight gain was associated with an increased risk of intrauterine growth retardation, preterm delivery, low birth weight in infants, and increased perinatal mortality, whereas overweight, obesity, and excessive weight gain may also be at risk in mother and pregnancy outcomes. Maternal weight gain during pregnancy could affect the relationship between BMI before pregnancy and pregnancy outcome. Women with less pre-pregnancy BMI who experienced enough gestational weight gain potentially delivered babies with normal or near-normal weight. Good gestational weight gain might compensate for the adverse effects on fetal growth associated with low maternal BMI during early pregnancy.

Conclusion

Pre-pregnancy BMI is a factor in a healthy pregnancy and identifies when women are at risk of a difficult pregnancy due to excessive or insufficient weight gain. Underweight and overweight during the preconception period may directly affect maternal health development and adverse pregnancy outcomes such as preterm birth. Maternal weight gain during pregnancy can be an indicator to assess maternal nutritional status and predict pregnancy outcomes. Suggestions for pregnant women were to know their nutritional status, consume nutritious foods that were needed for fetal growth, and reduce the risk of low birth weight and the risk of other stunting triggers. A healthy pregnancy will determine the child's future by optimizing the first 1000-day period that begins from the time of the womb.

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Covid-19 After Effect: School-Age Visual Acuity Analysis with Secondary Data

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Abstract

Students' ability to see is crucial for learning and helps them achieve more. Normal visual acuity enables students to read the writing on the blackboard clearly, which improves their comprehension of the information the teacher is providing. With the online learning system, students spend more time using a computer or phone, which impairs their visual acuity, hinders their understanding of the material, and lowers their academic performance. The purpose of this study was to ascertain how online learning affected elementary school students' visual acuity. A Snellen chart and a questionnaire are used in this observational analytic research study with a cross-sectional design. 728 students from 7 elementary schools in Surabaya's Jeruk and Lakarsantri Districts made up the sample size. The results of the study showed that 184 of the 728 students who took part had deteriorated visual acuity during the observation period. These were divided into three categories: mild (166 cases), moderate (4 cases), and severe (14 cases). 79 pupils had recently seen a level increase in their eyesight, 27 had recently experienced a level increase in their vision, and 4 had experienced an additional level gain in their vision. There is a substantial difference in visual acuity between the pre-and post-online learning periods, according to the Wilcoxon signed-rank test results. The results of this study can support the responsible use of computers and mobile devices by parents, educators, and students.

Introduction

Despite the potential for COVID-19 infection control-related events to affect child well-being, comprehensive assessments of post-lockdown changes and persistent outcomes are lacking (Sum *et al*., 2022). On March 11, 2020, the World Health Organization (WHO) declared that the Corona Virus Disease (COVID-19) pandemic was underway. On Saturday, March 14, 2020, the Indonesian government issued a Presidential Decree of the Republic of Indonesia Number 12, 2020, concerning the Stipulation of Non-Natural Disasters of the Spread of COVID-19, designating Covid-19 as a national disaster. Since April 17th, 2020, the government has implemented extensive social restrictions (PSBB) to prevent the coronavirus from spreading to a wider population. The Government implemented Restricting Community Activities from January 11 to January 25, 2021. The government's implementation of abrupt and specific restrictions in response to Covid-19 could potentially result in an undesirable situation (Hermahayu, Faizah, & Candra, 2022). The government has implemented an online learning system starting on March 16th, 2020, where students can begin studying from their homes instead of attending school to prevent the coronavirus from spreading in schools. Students are required to use electronic devices, such as computers and mobile phones, in the online learning system. An online learning system takes one to three hours per day on average.

During the coronavirus disease 2019 (COVID-19) self-quarantine period, the transition to online courses has profoundly

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changed the learning modes of millions of school-aged children (Li *et al*., 2021). Students also receive school assignments that they complete on computers or mobile devices, in addition to online meetings using the programs Zoom, Meet, or Microsoft Teams. The process of working on school assignments involves using a web search engine to find information on a website, and then using a computer to analyze the data that is returned. Due to this condition, more eyes are exposed to computers and mobile devices. After prolonged exposure, radiation from a computer or laptop screen, according to Kumar (2020), may harm people. The radiations enter the body, and the cells and tissues of the human body absorb electromagnetic energy (Kumar *et al.,* 2020).

Students frequently use computers and mobile devices to play online games and are active users of social media websites to get rid of their boredom. Students use it to continue playing online games during downtime or school breaks. Games frequently involve a team of friends or other students playing on a computer or a mobile device. This may go on for hours, allowing students to indirectly spend more than three hours per day staring at computer or mobile phone screens. This increases the chance that students will experience decreased vision acuity, as noted by Santosa (2018) that school children who have a habit of playing online games for an extended period are susceptible to visual acuity impairment. Without taking breaks, playing online games for an extended period can lead to eye fatigue and decreased visual acuity (Santosa & Sundari, 2018).

It has been reported that myopia prevalence is high in Southeast Asia, and refractive errors if not corrected properly may lead to amblyopia. Therefore, a regular eye screening is important (Darusman, 2021). School closures during the COVID-19 pandemic increased the risk of myopia in Chinese children and adolescents due to the accumulation of poor eyesight habits, unhealthy lifestyles, and excessive screen time (Dong *et al*., 2022). Children's visual acuity is impacted by technological advancements that encourage school-aged kids to spend more time watching television, reading comic books or other reading material, and playing games on laptops or other frequently used devices. Consider implementing health education and discussions to improve the eye health of school-age children as early detection of decreased visual acuity is necessary for providing an overview of the condition of visual acuity in elementary school-age children (Birch *et al.,* 2021). Concerns have been raised about whether home confinement may have worsened the burden of myopia owing to substantially decreased time spent outdoors and increased screen time at home (Wang *et al*., 2021). Decreased time spent outdoors and increased sustained near work and digital screen time due to the lockdown and quarantine measurements could have visual repercussions for children (Alvarez-Peregrina *et al*., 2021). During this last year of the pandemic outbreak, the study habits of children have been modified, increasing the use of digital technology and online e-learning. Based on the foregoing, the goal of this study is to ascertain whether schoolchildren's visual acuity has been impacted by the pandemic's online learning environment.

Method

This study has a cross-sectional design and is an observational analysis. In this study, samples were collected from seven schools in Surabaya City's Jeruk and Lakarsantri subdistricts. The 728 students who make up the entire student body are in the Elementary School's grades 4, 5, and 6. Grades 4, 5, and 6 elementary school students were chosen as samples because this study tracked how students' visual understanding changed over the previous three years (the year 2019 to the year 2022). Students who had previously undergone an acuity check in March 2019 or before the online learning period and were observed once more in March 2022 or following the online learning period made up the sample in this study. To ascertain the following: 1. The number of additional new decreased vision in the right and left eye; 2. The severity of reduced vision in the right and left eye; and 3. Correlation of duration of computer/mobile phone use with the severity of decreased visual acuity. The secondary data from the visual acuity examination in March 2019 will be compared

with the primary data taken in March 2022.

Seven elementary schools were visited, and visual acuity physical exams were conducted on students using a Snellen chart and a questionnaire. Normal visual acuity is defined as 20/20 feet, or 6/6 meters, on the Snellen chart. This means that within 20 feet, or six meters, normal eyes can see the alphabet. An alphabet that is large enough to read can only be seen by a patient at a distance of 30 feet (9 meters) or 20 feet (6 meters) if the visual acuity results are 20/30 (Azzam & Ronquillo, 2023). The independent variable in this study is the number of hours spent using a computer or a mobile device. The primary data from the visual acuity examination in March 2022 or the value of visual acuity from the results of the visual acuity examination after the online learning period serve as the dependent variable. The visual acuity value obtained from the visual acuity test results obtained before the online learning period or secondary data obtained from the visual acuity test in March 2019 and March 2020 serves as the control variable. Based on the outcomes of the visual acuity test, univariate analysis data count respondent characteristics, frequency, distribution, and visual acuity values. Using the Wilcoxon signed rank test with continuity correction in a bivariate analysis, the relationship between the independent and dependent variables will be determined.

Results and Discussion

Table 1 lists the characteristics of this research sample. The total number of respondents is 728 students, with male students accounting for 377 of them (51.8%), the average age of respondents being nine (31.9%), the majority of respondents attending grade 4 elementary schools (286, or 39.3 percent), and the least number attending grade 5 elementary schools (206, or 28.3 percent), respectively. The majority of respondents, or 715 students, reported using mobile phones (98.2 percent).

Visual acuity may be impacted by prolonged computer/mobile phone use. Based on the findings of that study, it can be deduced that increasing the amount of time students spend using computers or mobile devices for online learning can increase the risk of their visual acuity deteriorating. The study observed an increase in students experiencing significant visual acuity deterioration when comparing test results from 2019 to 2020 and 2022. In 2021, due to the adoption of online learning at home as per Circular Letter No. 15 of 2020 from the Ministry of Education and Culture, there were no physical visual acuity assessments for pupils, so no data is available for that year. Visual acuity was classified by the WHO into four categories: normal, mild vision decrease, moderate vision decrease, and severe visual impairment. The study analyzed data for both left and right-eye visual acuity declines, starting with the right eye, comparing data from 2019-2020 (pre-online learning) and 2022 (post-online learning). Additional data points related to students experiencing new vision loss in their eyes were also examined.

Table 1. Respondents' Characteristics

Characteristics	n	%
Gender		
Male	377	51,8
Female	351	48,2
Age (years)		
9	232	31,9
10	183	25,1
11	225	30,9
12	88	12,1
Grade Elementary School		
4	286	39,3
5	206	28,3
6	236	32,4
Electronic Devices Used		
Computer	13	1,8
Mobile phone	715	98,2
Total	728	100

Source: Primary data, 2023

As shown in Table 3, some additional students have a new vision decrease, including up to 15 students (2.1%) at mild level severity 20/30, 23 students (3.2%) at mild level severity 20/40, 5 students (0.7%) at mild level severity 20/50, 11 students (1.5%) at mild level severity 20/70, and 14 students (1.9%) at severe level severity 20/200. According to severity level categories, the enhancement amount of students who develop new vision experience decreases as follows: As many as 54 additional

students (7.5%) had a recent mild level severity decrease in vision; however, no student had a recent moderate level severity decrease in vision. However, an additional 14 students (1.9 percent) of the total research population had a recent severe level severity vision decrease.

Table 2. Duration of Computer/Mobile Phone Usage Before and During Online Learning

Duration (hours)	Before online learning		During online learning	
	n	%	n	%
0-2	485	66,6	1	0,1
2,1-4	184	25,3	170	23,4
4,1-6	44	6	244	33,5
6,1-8	15	2,1	166	22,8
8,1-10	0	0	103	14,1
>10	0	0	44	6
Total	728	100.0	728	100
Total respondents' daily use (hours)	1.455,54		4.562,80	
Mean	1,9		6	
Minimum	0		1,5	
Maximum	8		18	

Source: Primary data, 2023

According to Table 4, some additional students have new vision loss. There are eight students (1.1%) at mild level severity 20/30, 24 students (3.3%) at mild level severity 20/40, seven students (1.0%) at mild level severity 20/50, five students (0.7%) at mild level severity 20/7, and fourteen students (1.9%) at severe level severity 20/200. According to severity level categories, the number of students who experience new vision decreases as follows: Up to 44 additional students (6.0%) had recent mild level severity vision declines; however, no students had recent moderate level severity declines in vision. However, there were additional students—up to 14 students, or 1.9% of the total research population—who had recent, severe vision decline.

Data analysis reveals a significant increase in students experiencing reduced visual acuity before and after online learning. This suggests that prolonged computer and mobile device use may contribute to declining vision. One contributing factor is the emission of radiation from screens, confirming Sayekti's theory that computer screens can transmit harmful

Table 3. Right Eyes Vision Decrease

Vision Decrease	Category	2019		2020		2022	
		n	%	n	%	n	%
Normal	Best corrected	663	91,1	634	87,1	544	74,7
20/30	Mild	32	4,4	53	7,3	89	12,2
20/40		13	1,8	15	2,1	40	5,5
20/50		11	1,5	13	1,8	20	2,7
20/70		4	0,5	5	0,7	17	2,3
20/100	Moderate	5	0,7	8	1,1	4	0,5
20/200	Severe	0	0	0	0	14	1,9
Total		728	100	728	100	728	100

Source: Primary data, 2020

Table 4. Left Eyes Vision Decrease

Vision Decrease	Category	2019		2020		2022	
		n	%	n	%	n	%
Normal	Best corrected	665	91,3	634	87,1	552	75,8
20/30	Mild	29	4	52	7,1	83	11,4
20/40		14	1,9	17	2,3	44	6
20/50		10	1,4	9	1,2	15	2,1
20/70		5	0,7	6	0,8	12	1,6
20/100	Moderate	5	0,7	10	1,4	8	1,1
20/200	Severe	0	0	0	0	14	1,9
Total		728	100	728	100	728	100

radiation to the eyes. Monitors emit various waves and radiation, including electromagnetic microwaves, shallow frequencies, X-rays, and ultraviolet rays, which can strain the eyes and affect their health due to screen brightness and sharpness. Continued exposure may lead to eye fatigue and potential harm (Sayekti *et al.,* 2016). Prolonged use of computer or mobile phone screens can cause eyestrain and potential visual acuity decline, leading to Computer Vision Syndrome (CVS). Santoso's study demonstrates a direct correlation between extended online gaming and visual acuity impairment. The percentage of students experiencing decreased visual acuity rises as they spend more time playing online games without breaks each day (Santosa & Sundari, 2018). Visual impairment levels were assessed through data coding. The vision decrease code categories are: Normal (code 0), 20/30 (code 1), 20/40 (code 2), 20/50 (code 3), 20/70 (code 4), 20/100 (code 5), and 20/200 (code 6). To calculate the increased severity of visual acuity decline, the difference in codes between pre-online learning (2019–2020) and during online learning (2020–2022) was analyzed for both right and left eyes.

Before the online learning period in 2019–2020, there was an increasing severity of right eye visual acuity decrease, as indicated by the number of respondents who reported experiencing this decline: 683 respondents (93.8%) had normal vision; 40 respondents (5.5%) had one level of vision impairment; and five respondents had two levels of impairment (7 percent of whole population samples). During the online learning period in 2020–2022, the increasing severity of right eye visual acuity decreased. It was discovered that the number of respondents who experienced right eye visual acuity decreased as follows: respondents with normal vision in the right eye were 560 respondents (76.9 percent); 130 respondents (17.9 percent); 34 respondents (4.7 percent); and four respondents (three levels of vision decreased) (0.5 percent of whole population sample).

The number of respondents with a new level of decreased vision was calculated using the difference between data on the rate of decline in right eye vision in 2019–2020 and data on the rate of decline in right eye vision in 2020–2022. There was an increase in the number of new respondents who increased to one level, totaling 90 respondents (12.4%); an increase in the number of new respondents who increased two levels, totaling 29 respondents (4.0%); an increase in the number of new respondents who increased three levels, totaling four respondents (0.5%); and there was no increase in the number of new respondents who increased three levels.

Table 5. Right and Left Eye Vision Decrease Level

Vision Decrease Level	Before Online Learning 2019-2020 (1)		During Online Learning 2020-2022 (2)		New Increase of Right Eye Vision Decrease (Compare 1 and 2)	
	n	%	n	%	n	%
Right Eye Vision Decrease Level						
0 (No increase)	683	93,8	560	76,9	-123	-16,9
1	40	5,5	130	17,9	90	12,4
2	5	0,7	34	4,7	29	4
3	0	0	4	0,5	4	0,5
4	0	0	0	0	0	0
Total	728	100	728	100	123	16,9
Left Eye Vision Decrease Level						
0 (No increase)	680	93,4	570	78,3	-110	-15,1
1	41	5,6	120	16,5	79	10,9
2	7	1	34	4,7	27	3,7
3	0	0	4	0,5	4	0,5
4	0	0	0	0	0	0
Total	728	100	728	100	110	15,1

Source: Primary data, 2020

Before online learning in 2019–2020, left-eye visual acuity changes were as follows: 93.4% had normal vision, 5.6% experienced a one-level decrease, and 1.0% had a two-level decrease. Specifically, for left-eye visual acuity: 78.3% had normal vision, 16.5% had a one-level decrease, 4.7% had a two-level decrease, and 0.5% had a three-level decrease. Comparing left-eye vision data between 2019–2020 and 2020–2022, there were: 10.9% with a one-level increase, 3.7% with a two-level increase, and 0.5% with a three-level increase. No new respondents experienced a three-level decrease. Extended computer and mobile device use can expose eyes to harmful radiation, leading to eye strain. Poor monitor contrast and viewing distance worsen the issue, influenced by factors like lighting, object shape, contrast, viewing duration, and distance. A Chinese study during COVID-19 found increased myopia among Wuhan students due to online learning, with genetics and habits playing a role. Another study in Argentina showed higher myopia progression rates during pandemic confinement (Hu *et al*., 2021; Picotti *et al.*, 2021). Myopia is rising among students globally, driven by increased visual demands. Homebound children during the COVID-19 pandemic experienced significant myopic shifts (Markova *et al.,* 2021). Egyptian schoolchildren also saw increased myopia rates due to pandemic-induced screen time (Sallam *et al.,* 2022). To combat this trend, a stricter visual regimen with regular breaks and at least 2 hours of outdoor time during daylight is recommended (Frolova & Bezditko, 2022). In a previous study, a connection was observed between a family history of myopia and visual acuity, whereas no correlation was found between visual acuity and factors such as knowledge, attitude, behavior, screen time, reading position, and reading distance. The primary factor contributing to myopia appears to be the elongated anteroposterior axis of the eye, which is inherited from parents to their offspring (Asiyanto *et al.,* 2020).

The Shapiro-Wilk Test for Normality was used before the correlation test, yielding W = 0.95477 and a p-value of 3.632e-14. Data is considered non-normally distributed if the p-value is below 0.05. A Wilcoxon signed-rank test with continuity correction was used for right-eye vision decrease data before and after online learning, resulting in V = 94 and p-value 2.2e-16, where p exists = 0.05. A significant difference in vision loss before and after online learning is indicated when the p-value is below 0.05. These results highlight the significant impact of online learning on vision, a crucial aspect of education and overall life, especially in school-age children, as it directly affects their learning capacity and cognitive development. During the COVID-19 pandemic, myopia increased in children, particularly among younger ones, due to higher screen time and less outdoor activity. Recommendations include more outdoor time and reduced digital device usage post-pandemic (Yang *et al*., 2022). Increased reliance on digital devices for remote learning led to visual problems like myopia progression, dry eye symptoms, visual fatigue, and accommodation issues in children (Masihuzzaman *et al.*, 2023). Implementing post-pandemic ophthalmological surveillance programs based on individual factors is crucial for better disease control (Pellegrini *et al.,* 2020). To maintain good eye health while studying online, the Indonesian Ministry of Health's P2PTM advises limiting computer or mobile device use to two hours, maintaining a 40-50 cm screen distance, reducing brightness, and taking 20-second breaks for every 20 minutes of screen time (Kemenkes RI, 2020). These practices relax eye muscles and promote eye health.

Conclusions

The study's findings demonstrated a statistically significant difference between the visual acuity scores of schoolchildren before and after the online learning period. The value of school students' visual acuity is impacted by online learning. To track the development of eye health, it is advised that the Public Health Center conduct screening health exams for schoolchildren regularly. It is advised that schools advise parents to closely monitor their children's use of computers and mobile devices at home and advise students to limit their use of these devices outside of class to preserve their visual acuity and raise their academic performance.

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Socioeconomic and Public Health Impacts of Waste Management in Piyungan Landfill, Bantul-Indonesia

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Abstract

Piyungan Landfill in Bantul, Indonesia, still uses an open dumping system, leaving environmental impacts. This research examined the effects of open dumping on the socioeconomic and health conditions of nearby populations. Surveys and interviews using questionnaires were employed with households as the analysis unit. From four sub-villages (Ngablak, Banyakan III, Sentulrejo, and Baruwan I), 128 respondents were sampled randomly. Statistical quantitative analysis was employed to analyze the research data. Descriptive statistics were selected to describe sample data. Data were then expressed as percentages and presented in pie charts. Results show that for people who salvaged recyclables, the landfill was their primary source of livelihood. More than half (62.5%) earned an average of IDR1,093,095 (approximately USD70) per month as waste pickers. However, open dumping lowered the environment's aesthetic value due to the unpleasant view and smell, and large populations of animals like rats, flies, cats, and mosquitoes attracted to waste piles. Nearly all respondents (90.6%) expressed their anxiety about these adverse effects, triggering social conflicts. It was claimed that property values and public health were, however, unaffected. Most respondents stated that the landfill did not lower the property values (96.9%) and did not cause health concerns (71.9%).

Introduction

Waste remains a major environmental issue worldwide. The global average rate of waste generation is about 0.74 kg/person/day but varies widely across countries, from 0.11 to 4.54 kg/person/day (Mor *et al.*, 2023). These streams of waste end in municipal solid waste landfills or final disposal sites in their respective regions and can cause environmental impact unless properly managed (Simsek *et al.*, 2014; Dregulo *et al.*, 2022). Indonesia's Law No. 18 of 2008 on Waste Management defines landfills as a place to safely process and return waste to the natural media for humans and the environment. Landfills and all activities entailed should not negatively affect the environment because, as described in the Law above, waste management aims to improve public health and environmental quality and turn waste into resources. However, with many landfills in Indonesia and other developing countries still practicing the open dumping system, numerous cases of environmental pollution, particularly groundwater contamination, have been reported due to the poor design (El-Mathana *et al.*, 2021).

Open dumping is not recommended for waste management because it merely accumulates waste in open fields without periodic compaction and burial. On the contrary, sanitary waste landfills are widely proposed because the designated areas are prepared and operated systematically by spreading, compacting, and covering or

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burying the waste daily—a technical definition laid in the Regulation of Indonesia Minister of Public Works No. 03/PRT/M/2013. Alao *et al.* (2023) stated that open dumping adversely affects the entire environmental components; it contributes 17% of global methane emissions, deteriorates soil and air quality, lowers property values, and adversely affects public health as it creates a breeding ground for disease-carrying vectors (e.g., rodents, flies, and mosquitoes) and produces leachate that contains toxic substances and pathogens.

The Piyungan Landfill in Bantul, Indonesia, has been operating since 1995 in a 12.5-ha area and still employs an open dumping system. It receives the waste streams from three regions: Bantul Regency, Sleman Regency, and Yogyakarta City. According to the Waste Management Center, Department of Environment and Forestry in Yogyakarta (2022), the city generated the most significant amount of waste fed to the landfill in 2019 and 2020, but in 2021 and 2022, Sleman was the largest waste contributor. In 2022, the landfill received 105,441 tonnes of waste from Sleman, 97,035 tonnes from Yogyakarta, and 67,677 tonnes from Bantul. More waste was transported from Sleman as customers of the garbage collection services grew in number, from 758 households in 2020 to 974 in 2022.

The landfill's capacity to accommodate more waste accumulation decreases over time, raising environmental problems. More people who reside in neighboring areas are feeling disadvantaged and concerned about the open dumping. Since 2019, these unfavorable circumstances have occasionally burst into social conflicts that repeatedly end with residents blocking the landfill's access roads. Therefore, this research was designed to investigate the socioeconomic and public health impacts of open dumping practices in the Piyungan Landfill. It is expected to provide input for evaluating and improving the waste management design to comply with Law No. 18 of 2008 on Waste Management in Indonesia and, ultimately, minimize threats to humans and the environment.

Methods

Piyungan Landfill is located in Ngablak Sub-village (Sitimulyo, Piyungan, Bantul Regency, Indonesia). The research location covered four sub-villages that were directly and indirectly affected by waste management activities in the landfill: Ngablak, Banyakan III, Sentulrejo, and Bawuran I. Administratively, these regions are part of Sitimulyo and Bawuran Villages (Figure 1.).

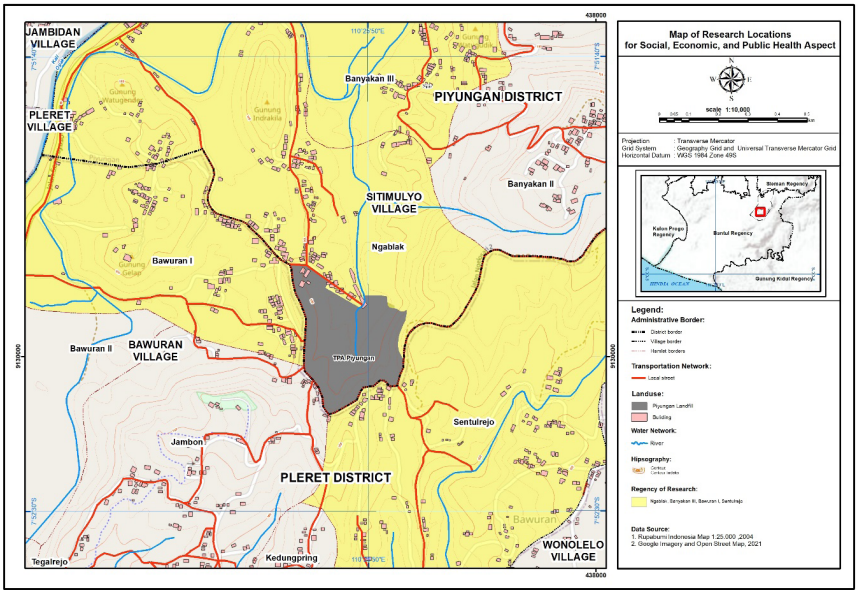

Figure 1. Map of the Research Location for Socioeconomic and Public Health Impact Analysis of Waste Management Activities (i.e., Open Dumping) in Piyungan Landfill, Bantul, Indonesia.

Surveys and interviews using questionnaires were conducted to obtain primary data, with households as the unit of analysis. From each sub-village, 32 samples of households were selected randomly and evenly distributed across neighborhood units (RTs); thus, the total sample size was 128. For the interviews, the respondents were the heads of households aged 17 years old and above that were directly or indirectly impacted by the open dumping. These interviews collected primary data on income, property prices, environmental aesthetics, public unrest, and public health.

Results and Discussion

Open dumping in Piyungan Landfill affects numerous components of the environment, including socioeconomic conditions and public health. Five parameters were gauged to assess these impacts: income, property prices, aesthetic values of the environment, public unrest, and public health. Piyungan Landfill has been the primary and secondary source of income for many people living in its surroundings. The survey results showed that of the 128 respondents, 80 (62.5%) reaped the benefits of it to earn money either as a main occupation (77 respondents) or as a side job (3 respondents). The latter respondents were engaged in waste management in the landfill to supplement their primary income from working as farmers or casual laborers. Most of the local population earned a living from salvaging, sorting, and selling reusable and recyclable waste or as garbage collectors. Based on data from the local waste pickers community "MARDIKO", there were 14 garbage collectors and 467 waste pickers in 2020. These many laborers indicated that the materials disposed of into the landfill were not residues but still held some economic value. The sorted reusables or recyclables were sold to garbage collectors. From this, waste pickers received, on average, IDR1,093,095 (approximately USD70) per month, which is still far below the 2023 provincial minimum wage in Yogyakarta, IDR1,981,782.39 (USD130) per month. Meanwhile, garbage truck drivers could earn up to IDR4,000,000 (USD260) monthly. From these figures, it can be inferred that the landfill offers economic benefits through primary and additional incomes for dependent households.

Waste picking can be seen as a new perspective on reducing the amount of waste accumulating in landfills because the collected salvageable materials are brought to garbage collectors, who then transport them and continue the waste processing outside landfills. Previous works confirmed that waste picking as an informal sector contributes to managing and decreasing waste both at the source (household) and on the regional scale, creating a new subdivision in the waste management system (e.g., Wilson *et al.*, 2006; Besiou *et al.*, 2012; Putra *et al.*, 2019; Chen *et al.*, 2021). This contribution can be substantially improved if informal sector recycling (ISR) is integrated into sustainable waste management, which relies upon several factors like "social acceptance, political will, mobilization of cooperatives, partnerships with private enterprises, management, and technical skills, as well as legal protection measures" (Ezeah *et al.*, 2013, p. 2509). Waste pickers play an essential part in economic growth, waste control, and conservation of resources and in providing secondary materials for the recycling industry (Asim *et al.*, 2012). Many examples have been discussed in the literature. In the Greater Accra Region, Ghana, waste pickers sort out recyclable materials from the waste stream, reducing total solid refuse, and earn USD 7–17 from the daily sale of plastics and metals collected from the city's commercial districts and landfills (Rockson *et al.*, 2013). This exceeds the minimum daily income of USD1 set by the Millennium Development Goals as a reference target for halving the share of economically disadvantaged people. Similarly, after working for 10 to 12 hours, a waste picker in Abuja, Nigeria, can collect 19.76 kg of salvageable materials daily and earn USD2.8–4.20 from their sale (Ogwueleka *et al.*, 2021). Despite the significant contribution to waste control, waste pickers are exposed to serious health threats. Regardless of the risk, many decide to continue working in this field due to a lack of awareness and economic necessity. The same case has been observed in 33.6% of waste pickers in Tehran, Iran (Ghaedrahmati *et al.*, 2023).

In addition to income, property prices can also be used as a parameter to measure the socioeconomic impact of a landfill. Previous

studies have investigated the relationship between solid waste facilities and property values. A study in Hangzhou, China, found an increase of 0.027% in price for every 1% addition to the property's distance from the waste sorting and reduction complex (WSRC) (Wen *et al.*, 2022). Likewise, property prices in Bellville and Coastal Park (Cape Town, South Africa) increased respectively by 2% and 12% per km of distance away from landfills (Nahman, 2011). In other words, the closer the house or land is to the waste facility, the lower the property value. However, the opposite was observed in the study area. Based on the survey, 85 respondents (66.4%) stated that the Piyungan Landfill did not affect the neighboring land values (Figure 2.). According to 124 respondents (96.9%), there had not been a decline in the said land price over the last five years; instead, 106 respondents thought it was rising.

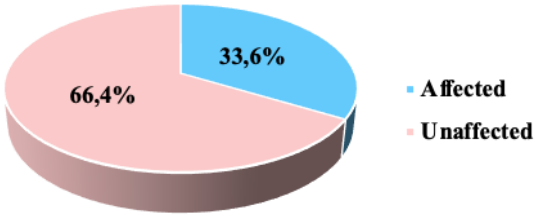

Figure 2. Public Perceptions of Property Values Around the Piyungan Landfill, Whether the Land Price is Affected or Unaffected by the Disamenities

The increase in land prices might be associated with a mountain landmark, Puncak Sosok, in Jambon Sub-village (Bawuran, Pleret Subdistrict, Bantul Regency). Bawuran is located next to the landfill, and the economic growth from managing a tourist attraction has sprawled to its surroundings, including high demand for land that inevitably raises the price. This phenomenon contradicts findings in other areas where the property values plummet due to proximity to landfill sites.

Environmental aesthetics is the broad term used to characterize the interaction between a person and their surroundings in terms of beauty (Jane Reece *et al.*, 2015). It was used to observe the environmental conditions of the Piyungan Landfill, including the unpleasant smell and sight of scattered waste, the appearance of disease-carrying animals, loud noise, and road damage. It is necessary to understand public perceptions of environmental aesthetics as it can be used to quickly determine the landfill's performance in managing waste. Properly implemented waste management is manifested in an aesthetic environment because it aims to diminish the adverse impact associated with waste generation and processing to promote environmental and human health (Schmidt *et al.*, 2023).

The survey found that 76 respondents (59.4%) complained about the smell from waste putrefaction and, as a result, they had to buy air fresheners, wear masks, close the house doors, apply eucalyptus oil just below the nose, and turn on fans. However, the others felt that the odor was normal and only bothered them occasionally (47 respondents, 36.7%), and some rarely smelled the stench (5 respondents, 3.9%). The average cost incurred to overcome the foul odor was IDR29,075 (USD2) a month. Concerning environmental aesthetics, smell can be an aspect of disamenities that affect property values around landfills (Li *et al.*, 2018).

Furthermore, while being transported, waste might fall off garbage trucks onto the access roads to the landfill. The survey revealed that 74 respondents (57.8%) had varying perceptions as to how much waste was scattered afterward (Figure 3.), from "very small" to "very large", while 54 others (42.2%) answered with "none". There were generally more people around the landfill complaining about aesthetic disruptions from the litter. To clean it, they collected, burned, threw it away to unused lands or the river, left the waste as it was, or reported it to the Piyungan Landfill office. Waste piles also attract large populations of animals that potentially spread diseases to neighboring settlements, such as flies, rats, cockroaches, cats, and mosquitoes. In large numbers, disease-carrying animals are indications of poor environmental hygiene and sanitation, particularly mosquitoes. The mosquito larval count index is positively related to house cleanliness and environmental sanitation (Sukesi *et al.*, 2023). Therefore, the poorer the environmental hygiene, the more disease-carrying animals appear. To deal with

this, the respondents sprayed insecticide and applied glue traps to catch rodents. For this trouble, they had to spend an additional amount of IDR25,430 (USD2) monthly.

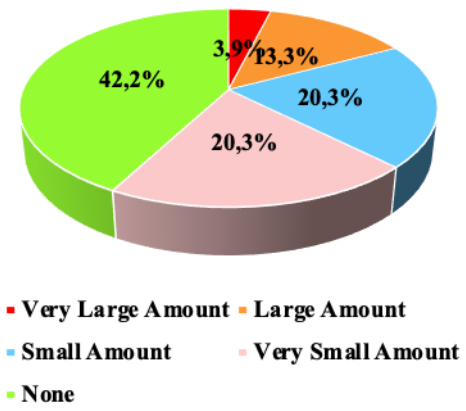

Figure 3. Public Perceptions of the Amount of Litter Scattered Around the Piyungan Landfill.

The respondents also expressed concerns about loud noises and damage to roads from the waste transport and unloading activities by garbage trucks. The survey identified different perceptions of the noise problem: 52 respondents (40.6%) were disturbed by the noise, while 74 others (57.8%) were not. These results depend on how close the respondent's house is to the landfill's access roads; noise from the garbage trucks entering and exiting the site would be louder to settlements nearby. In addition, 55 respondents (43%) explained that this traffic caused minor to severe damage to roads.

Social conflicts were the kind of public unrest specifically analyzed in this study as the social impact of open dumping. Social conflicts commonly occur concerning environmental injustice. Moreover, they are often an integral part of development processes (Owusu *et al.*, 2012). One of the issues that frequently sparked conflicts in neighboring sub-villages was the unmet demand for safe settlements. There were two opposing perceptions of land allocation in the area: whether the houses encroached on the land designated for open dumping or the landfill was developed in the middle of the residential zone.

The survey discovered that 116 respondents (90.6%) identified poorly designed waste management in the landfill as the cause of social conflicts (Figure 4.). These conflicts occurred repeatedly, according to 55 respondents (43%), and had been more frequent since the landfill overflew and began to affect neighboring settlements negatively. Many times, these events led to protests and residents blocking the access roads to the dump site. Oppositions by residents to the continued open dumping practices were becoming more common. A similar situation has been reported in Campania, Italy, where residents were against landfill development in their area, commonly called the NIMBY (not in my backyard) syndrome (Gallo, 2019). Table 1. summarizes the solutions people in the four sub-villages demanded to address these persistent problems.

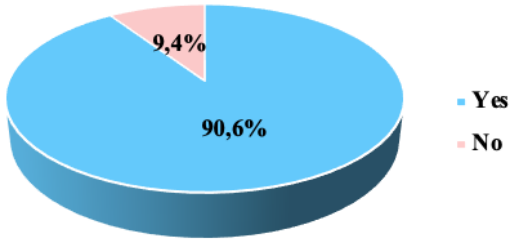

Figure 4. Public Perceptions of Social Conflicts, Whether or Not Open Dumping in the Piyungan Landfill is the Leading Cause

In addition to socioeconomic impact, open dumping is believed to harm public health. The survey inquired about the health condition of the residents in the last six months. Results show that 92 respondents (71.9%) did not experience any sickness related to activities in the landfill, while the remaining 36 (28.1%) had suffered some in the last six months (Figure 5.). The most common illnesses were headaches, colds, coughs, and nausea/vomiting. However, they could not be linked directly to the landfill. Respondents added that abnormally cold weather during the dry season in the last six months might have played a role. This corresponds to Norsa'adah *et al.* (2020), which ascertained the significant correlations between exposure to open dumps and throat problems/disorders, diabetes mellitus, and hypertension, but whether or not it was the cause of these diseases could not be determined. However, Vinti *et al.* (2021) reviewed nine studies publishing evidence that increased risks

Table 1. Causes and Expected Solutions of Social Conflicts Due to the Waste Management Activities in the Piyungan Landfill

Causes of Social Conflicts	Solutions Demanded by Affected Villages
Water pollution due to leachate generation in the Piyungan Landfill	a. Construction of a separate impermeable channel for leachate disposal b. Optimized leachate processing to be safely disposed of in the environment c. Construction of drilled wells and clean water facilities as substitutes for the contaminated wells
Air pollution due to the unpleasant smell from waste putrefaction	Improved waste processing technology at the landfill to control or eliminate odor
Road damage due to waste transport to the landfill	Restrictions on the number of garbage collection trucks
The landfill's capacity has long been exceeded (overflowing), creating more waste piles near the settlements	a. Expansion of the landfill area to the north b. Restrictions on landfill development near residential areas c. Establishing frequent communication with the residents about the landfill development
No compensation fund for losses suffered from poor waste management	Compensation for affected residents
Protests over the planned expansion of the landfill area	Landfill relocation
Disruptions to public health	Medical examination and public dissemination of information on potential health impacts of landfill operations by the authorized Health Office
Traffic jams due to long queues of garbage trucks entering the landfill	a. Operating hours for garbage trucks entering/exiting the landfill b. Truckloads should be covered with tarps to prevent waste from flying or falling off the trucks while waiting in line to enter the landfill

of adverse pregnancy outcomes, death from respiratory diseases, and mental health have been reported from households close to landfills. Living within 1 km of landfills is a health risk factor because the residential quality that does not meet physical requirements can lead to health problems (Farsida *et al.*, 2023). Therefore, proper waste management is needed to reduce the exposure of nearby settlements to medical disorders (Norsa'adah *et al.*, 2020). Moreover, it is necessary to provide health education for the public using an individual approach to prepare them for health emergencies (Handayani *et al.*, 2023).

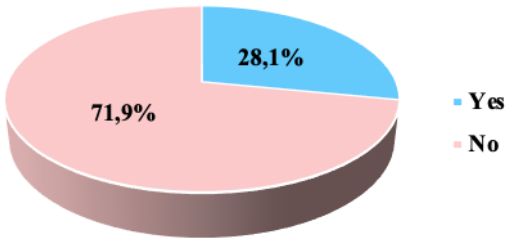

Figure 5. Public Perceptions of Health Problems Suffered in the Last Six Months

Based on the survey results, almost half of the respondents (46.1%) opposed the landfill operation in their area on account of its adverse socioeconomic and public health impacts on nearby settlements. Moreover, 75% felt disadvantaged by the landfill's presence in their area, and 89.1% agreed there should be compensation funds for the suffered losses and discomfort.

Conclution

Open dumping in the Piyungan Landfill affects the socioeconomic and health conditions of nearby populations. The impacts are substantial on income, environmental aesthetics, and public unrest, but no direct link has been identified between proximity to the landfill and property values and public health. Waste pickers and collectors can earn daily to monthly income from the landfill. The aesthetic value of adjacent neighborhoods is reduced due to litter on the landfill's access roads (waste falling off open truckloads), unpleasant odors, and increasing populations of rats,

flies, cats, and mosquitoes. Environmental pollution has been pointed out as the leading cause of social conflicts, often resulting in repeated blocking of access roads. On the contrary, the landfill does not directly affect property values and public health. There is no decline in property values; instead, a rise in land price has been linked to the new tourist attraction "Puncak Sosok", which is close to the landfill. While some cases of headaches, coughs, colds, and nausea/vomiting have been reported in the last six months, they cannot be directly linked to landfill operations due to the probable combined influence of weather conditions. Nevertheless, people living nearby also acknowledge that the landfill can cause various health problems, such as skin diseases, nausea, and dizziness. Therefore, considering the above socioeconomic and public health impacts, the government should immediately begin planning for and implementing a well-designed, environmentally friendly waste management system and technology to sustain its operation while complying with Law No. 18 of 2018 on Waste Management in Indonesia.

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Prevalence and Determinants of the Double Burden of Malnutrition at Household Level

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Abstract

The persistent problem of undernutrition and the emerging prevalence of overnutrition hints at a new term for the double burden of malnutrition among children globally. This study aims to provide a review of the published studies concerning the prevalence of double burden of malnutrition at the household level and the associated factors. Articles were identified from the electronic databases of PubMed, Nature, SAGE, Scopus, and SpringerLink, using the same search terms for all. A total of fourteen articles were eligible and sixteen sets of prevalence values were obtained. Most articles were published in 2018 – 2020. Fourteen articles used secondary data from the Demographic and Health Survey. Most articles studied under five children and mothers 15-49 years. Mother's nutritional status was identified using BMI, while for children height for age z-score was commonly used. The reported prevalence of double burden at the household level varied from 1.0 to 28.0% by country. Frequently assessed factors observed that older children and older mothers were likely to develop a household double burden of malnutrition. A negative association was found when households possessed access to mass media. Overall, the media should have been channels for health promotion. Intervention concerning the nutrition of mothers and children at the household level is required to be intensified through nutrition-specific and nutrition-sensitive programs.

Introduction

In 2020, WHO estimated that global malnutrition among under five years children affected 149 million with stunting, 45 million for wasting, and 38.9 million for overweight/obese. Stunting has plummeted steadily to 22%, while being overweight has slightly increased to 5.7%, and wasting remains at an alarming rate of 6.7%. Regionally, most malnourished children live in Asia and Africa, whereas 53% and 41% are stunted, 70% and 27% are wasted, and 48% and 27% are overweight, respectively (UNICEF, WHO & World Bank, 2021). This coexistence of overnutrition along with undernutrition is referred to as the double burden of malnutrition (DBM) (Blankenship *et al*., 2020a).

Undernutrition, especially among children, has been associated directly with a lack of dietary intake and infectious disease. Further, caring capacity, household food security, and access to health services are also distal factors of malnutrition (UNICEF, 2021). As for overnutrition, the imbalance of energy intake and energy expenditure are the main causes (Williams & Greene, 2018). As consequences of childhood malnutrition are health problems such as non-communicable diseases and infectious diseases, and non-health related consequences such as lower cognitive ability and rate of wages later in adulthood (Shaban *et al*., 2022).

WHO suggested that DBM may occur at community, household, and individual levels as a result of nutrition transition. Nutrition

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transition is described as the changes in diet, physical activity, and body composition as the result of urbanization and modernization (Popkin, 2004). In many developing countries the transition occurs at a great speed (Roemling & Qaim, 2012). The changes in dietary patterns can be highlighted by the shift of traditional food that is rich in grains, vegetables, and fruits, which are locally available to diet high in sugar, fat, salt, and processed food (Adair & Popkin, 2005; Popkin *et al*., 2017). As for the physical activity spectrum, there is a limited study that has been observing the global trends of physical activity changes among children. However, studies have associated insufficient physical activity with the increase in television viewing, changes in the mode of transportation, and the emergence of modern technologies (Alotaibi *et al*., 2020; García-Soidán *et al*., 2020; Wachira *et al*., 2022). Each transition leads to changes in body composition. A global map developed by Barry M. Popkin depicted the increased prevalence of overweight and obesity from the 1990s to the 2010s (Popkin & Ng, 2022).

Over the years, the problem of overnutrition has escalated globally (Rachmi *et al*., 2017), while the number of undernutrition cases remains a public health problem (Barkley *et al*., 2015; Beal *et al*., 2018). The emergence of the double burden of malnutrition has been investigated extensively among scholars, however, there is a limited review article published on this topic. The double burden of malnutrition at the household level occurred when undernutrition coexisted with overnutrition within a household, mainly involving children and mothers. This current systematic review aims to provide an overview of the prevalence and associated factors of the double burden of malnutrition at the household level from the published articles.

Method

Several inclusion criteria were employed to identify eligible articles: (1) articles published in the year 2016-2021; (2) full-text articles written in English; (3) derived from original analysis of primary survey or secondary data analysis, excluded reviews, meta-analysis, and qualitative study; (3) measured the outcome of DBM prevalence at the household level. Articles were searched using the electronic databases in Nature, PubMed, SAGE, Scopus, and SpringerLink. The following MeSH terms were used to search the literature using Boolean Logic 'Double burden of malnutrition' OR 'dual burden of malnutrition' OR 'obesity' OR overweight OR overnutrition OR 'undernutrition' AND 'children' AND 'prevalence' AND 'risk factors' OR 'determinants'. Furthermore, the identified articles were checked for duplicates using Mendeley and went through title and abstract review using the PICOS formula. Then, selected articles were critically appraised using the Centre for Evidence-Based Medicine (CEBM) for a cross-sectional study. This selection process is depicted in a flow diagram together with the number of articles in each step in Fig 1.

Data were extracted from the final eligible articles using extraction form for several information such as publication data: name of the journal, year of publication, volume and issue number, and page number. Methods information obtained such as country, type of data collection, study design, year of

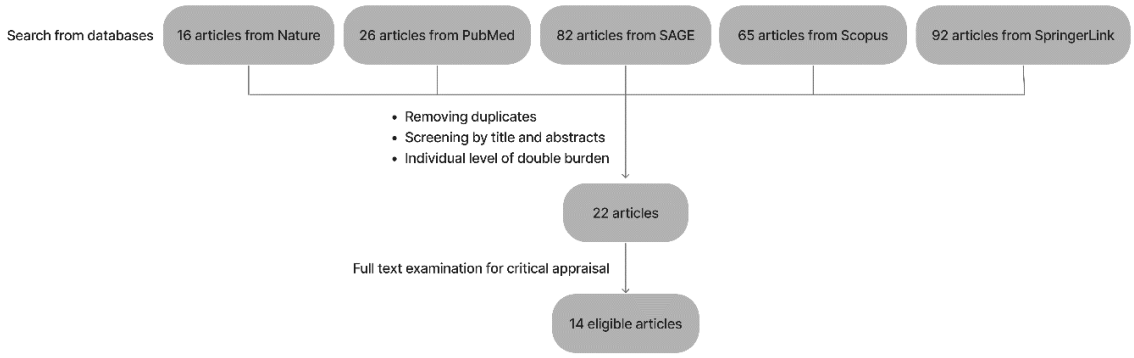

Figure 1. Diagram Process of Study Selection

data source, number of households analyzed, scope of data collection, sampling method, age range of the mother and children, nutritional indicators used to determine undernutrition and overnutrition among adults and children. Results information that was extracted: prevalence of households with double burden of malnutrition and the associated factors.

Several articles reported the prevalence of double burden with distinguished coexistence. All articles presented DBM with overnutrition from the maternal side, however, the children's undernutrition came in different forms, such as stunting, being underweight, wasting, and anemia. Some articles showed the prevalence values with 'any' children malnutrition, meaning all types of malnutrition were mixed and considered. For associated factors, we retrieved data only from statistically significant results.

Result and Discussion

Eventually, fourteen articles were identified as eligible for inclusion in the present review. Fig. 1 depicts a flow diagram of the selection process and the number of articles in each step. After removing duplicates, screening by titles and abstracts, and excluding the individual scope, twenty-two articles remained for the full-text examination. Reasons for exclusion during the full-text examination included: malnutrition prevalence not combined as DBM (four articles), different study design (two articles), and different scope (two studies, e.g. association between maternal stature and wasted newborn). Using the data extraction form, sixteen prevalence values were obtained from fourteen articles.

The characteristics of the included articles are shown in Table 1. Most of the articles are derived from the year 2018 – 2020. Of the fourteen articles, nine used secondary data from the Demographic and Health Survey. All articles analyzed the data using a cross-sectional design. In total, sixteen countries were identified in the extracted data, of which two were in Africa, eleven were in Asia, two were in America, and one from the Central Pacific Ocean. Several articles specified the settings within the country, such as the population at refugee camps in the Gaza Strip (El Kishawi *et al*., 2016) and urban areas (Mahmudiono *et al*., 2018). The year of data collection ranged from 2006 to 2017.

All of the articles focused on the DBM definition of pairs of undernourished children and overweight/obese mothers. The age ranges of the children and adults varied among articles; most of the articles included children aged under five years and only one article categorized 5 to 10-year-old individuals as children, while nine articles included adults aged 15-49 years. The most used indicator for the nutritional status of adults was BMI, with fourteen articles using a cut-off point > 25 kg/m^2 for overweight and > 30 kg/m^2 for obese adults, while two articles used BMI classification for the Asian population 23 – 27.4 kg/m2 for overweight and ≥ 27.5 kg/m2 for obese (Barba *et al*., 2004). Indicators for children's nutritional status differed between articles, most of the articles used height-for-age *z-score* (HAZ), however weight-for-age *z-score* (WAZ), weight-for-length *z-score* (WLZ), BMI-for-age *z-score* (BAZ) and anemia status were also used in several articles. The WHO Child Growth Standard was used to identify undernourishment among children (World Health Organization (WHO), 2006). The numbers of household samples varied between articles, with > 2356-fold (339 (Shinsugi *et al*., 2019) and 798,961(Biswas *et al*., 2021).

Table 2 provides the prevalence of double burden of malnutrition by countries in different years. The prevalence values were derived from children's undernutrition (stunting/wasting/underweight/anemia) paired with mothers overweight/obese. Overall prevalence values vary from 1.0 to 28.0%, ranging by the nutritional status indicators, countries, and years. Of the sixteen prevalence values, nine were national prevalence rates for the double burden of malnutrition. Among them, high prevalence values are from Pakistan, Indonesia, and the Republic of the Marshall Island. Geographically, Asian countries show a lower prevalence value than Africa and America. Only Nepal in 2019 and Brazil in 2006 had prevalence values less than 3%. Most countries had a prevalence of less than 10% (Republic of Benin, India, Sri Lanka, Myanmar, Pakistan 2019, and Bangladesh). However, Pakistan's 2017 data reported a higher

prevalence of 28%. A high prevalence of DBM is also reported in several countries, such as Indonesia (24.7%), the Republic of the Marshall Islands (25.2%) and Palestine (2.5-15.7%).

The prevalence distribution of DBM in the current systematic review is consistent with that of a systematic review in 2017 (Kosaka *et al*., 2018). It has also been found that low-income countries tended to have a lower prevalence of DBM than middle-income countries. Also, a low prevalence was more seen in Asian countries than in African countries by geographical area. In the current review, the prevalence of DBM varied from 1.0 to 28.0%. This wide range reflects differences in age ranges, nutritional indicators, and cut-off points used, as well as the involvement of different countries, years, and data sources (Kosaka & Umezaki, 2017). Age classification varied among the studies; for example, one study included 5-10 years old among children whereas the other studies included under 5 years old among children.

Among several factors frequently assessed in terms of association to double burden of malnutrition was access to mass media, family socioeconomic status, and age of children and mother. Mix finding was observed between maternal education and double burden of malnutrition Table 2 summarizes the association results. Most articles reported a negative association between possessing access to mass media and DBM, inversely, wealthier families were positively associated with DBM. Older mothers and older children were found to be positively associated with DBM.

Five articles reported a negative association between possessing access to mass media and a double burden of malnutrition. The studies explained that children who did not have access to mass media were more likely to suffer malnutrition (Brennan *et al*., 2004; Rahman, 2016). Most of the countries applied media as a platform for distributing nutrition information to tackle malnutrition to reduce the consumption of unhealthy food (oily and sugar-sweetened beverages). Therefore, it was considered that media access is one of the protective factors of the double burden of malnutrition. On the other hand, a study in Bangladesh found that women (Hossain *et al*., 2023) who did not have access to media were less likely to suffer from the double burden of malnutrition because media use can increase sedentary behavior and decreased physical activity although media campaign can improve nutritional knowledge (Fox *et al*., 2019; Matusitz & McCormick, 2012).

Seven articles show a positive association between higher socioeconomic status and a double burden of malnutrition. The wealthier family has a higher risk of having malnourished children. This is related to a global nutrition transition that included urbanization, lifestyle factors as well as limited nutrition education and behaviors. A study in Africa showed countries characterized by higher socioeconomic status (SES) tend to exhibit a greater degree of urbanization and a higher prevalence of obesity compared to countries with lower SES (Mbogori *et al*., 2020). Research conducted in Indonesia found that children from affluent families residing in urban areas are still susceptible to stunting. Additionally, the study identified seven factors associated with the risk of stunting among children from wealthy families: the age of the mother, marital status of the mother, level of maternal education, employment status of the mother, age of the children, gender of the children, and early initiation of breastfeeding (Latifah *et al*., 2023).

Seven articles observed a positive association between the age of the mother and the double burden of malnutrition. Advanced maternal age increases the likelihood of having malnourished children due to various reasons. As women grow older, their reproductive capabilities may diminish, resulting in reduced nutrient absorption and utilization that can adversely affect the nutritional well-being of their offspring. The research indicated that children born to mothers aged over 34 at the time of birth had a lower likelihood of experiencing childhood underweight in comparison to those born to mothers under the age of 34 (Seidu *et al*., 2023). Older mothers have a higher prevalence of underlying health issues or chronic diseases that can impact their nutritional status as well as the health of their children (Galang *et al*., 2021).

Table 1. Characteristics of Selected Studies (in Chronological Order of Publication)

Year of Publication	Country	Data	Analysis	Year of Data Source	Number of HH Sample	Adult		Children		Notes	Article ref.
						Age Range	Indicator	Age Range	Indicator		
2016	30 countries in Sub-Saharan Africa	S	CS	2006-2012	154,789 women, 114,552 children	15-49	BMI & anemia	12-59 months	HAZ	National representative survey (DHS)	(Jones et al., 2016)
2016	Palestine	P	CS	2012	357	18-50	BMI	2-5 years	WAZ	3 regions in the Gaza Strip (urban, rural, refugee camp), systematic sampling	(El Kishawi et al., 2016)
2017	Brazil	S	CS	2006	4299	15-49	BAZ, BMI	< 5 years	HAZ	National representative survey (DHS)	(Gubert et al., 2017)
2018	Bangladesh	S	CS	2014	5687	15-49	BMI	0-59 months	HAZ	National representative survey (DHS)	(Hauqe et al., 2019)
2018	Indonesia	P	CS	2015	685	Not available	BMI	0-59 months	HAZ	Surabaya (urban), systematic cluster sampling	(Mahmudiono et al., 2018)
2018	Bolivia	S	CS	2015	3946	15-49	BMI & anemia	0-59 months	HAZ, WAZ	2 regions in Bolivia (city and satellite city), stratified sampling	(Jones et al., 2018)
2019	Bangladesh	S	CS	2014	5951	15-49	BMI	< 5 years	HAZ, WLZ, WAZ	National representative survey (DHS)	(Das et al., 2019)
2019	Bangladesh, Nepal, Pakistan, Myanmar	S	CS	2012-2016	Varied	15-49	BMI	0-59 months	HAZ	National representative survey (DHS)	(Anik et al., 2019)
2019	Sri Lanka	P	CS	2017	339	20-59	BMI	5–10 years	BAZ	1 district of Gampaha (urban), stratified random sampling	(Shinsugi et al., 2019)
2019	Republic of Benin, West Africa	P	CS	2014	426	15-49	BMI	6-59 months	WAZ, HAZ	Solar Market Garden Project in Kalale district, random sampling	(Alaofè & Asaolu, 2019)
2020	8 countries	S	CS	2007-2016	798,961	15-49	BMI	< 5 years	HAZ, WAZ, WHZ	National representative survey (DHS)	(Biswas et al., 2021)

Year of Publication	Country	Data	Analysis	Year of Data Source	Number of HH Sample	Adult		Children		Notes	Article ref.
						Age Range	Indicator	Age Range	Indicator		
2020	Nepal	S	CS	2016	2261	15-49	BMI	< 5 years	HAZ, WHZ, WAZ, Anemia	National representative survey (DHS)	(Sunuwar et al., 2020)
2020	Republic of the Marshall Islands	S	CS	2017	464	Not available	BMI	0-59 months	HAZ, WAZ	National representative survey (DHS)	(Blankenship et al., 2020b)
2021	India	S	CS	2015-2016	168,784	15-35	BMI	0-59 months	HAZ, WHZ, WAZ, anemia	National Family Health Survey	(Kumar et al., 2021)

HH: Household; CS: cross-sectional; BAZ: BMI for age z-score; BMI: Body Mass Index; HAZ: height for age z-score; WAZ: weight for age z-score; WLZ: weight for length z-score; WHZ: weight for height z-score; P: primary data; S: secondary data

Table 2. Prevalence of Double Burden of Malnutrition at the Household Level and Its Association with Various Factors

Countries	Year of Data	Prevalence (%)	Associated Factors
Nepal	2006	5[e]	Rural residence (n), wealthier family (p), older mother (p), non-working mother (p), exposure to mass media (n), middle education attainment (p)
Pakistan	2017	24.0[a] 14.0[b] 15.0[c] 28.0[e]	Rural residence (n), wealthier family (p), older mother (p), non-working mother (p), exposure to mass media (n)
Brazil	2006	2.6[a]	Boy (p), HH severe food insecure (p), lower educational level head of HH (p)
SSA	2006-2012	3.3 – 9.2[a] 1.0-22[d]	Urban (p)
Bangladesh	2014	4.7[a] 1.7[b] 3.8[c]	No exposure to media (p), cesarean section delivery (p), having more than one kid in a household (p), mother's age at first birth being 21-25 years (p)
Nepal	2016	6.6[e]	Rural residence (n), wealthier family (p), older mother (p), non-working mother (p), exposure to mass media (n)
Bangladesh	2019	4.10[a]	Breastfeeding not given (p), older mother (p), wealthier family (p)
Nepal	2019	1.54[a]	Older mother (p), girl (n), access to media (n)
Pakistan	2019	3.93[a]	older children (p), wealthier family (p), girl (n), mother higher education (n)
Myanmar	2019	5.54[a]	Breastfeeding not given (p), older mother (p), older children (p)
Surabaya, Indonesia	2018	24.7[a]	HH food insecurity (p)
Republic of the Marshall Islands	2017	25.2[a]	Older children (p), older maternal age at birth (p), higher maternal education (p), lower maternal height (p), larger household size (p), open defecation (p)
Gaza Strip - Palestine	2012	2.5-15.7[c]	Childbirth order (p), lower paternal education (p), higher maternal nutrition knowledge (p), lower monthly income (n)
Sri Lanka	2017	2.1-5.3[b]	Mother lower education (p)
India	2015 to 2016	4.2[a] 2.0[b] 3.3[c] 7.8[d]	Older mother (p), mother lower education attainment (p), not exclusively breastfed (n), cesarean section delivery (p), older children (p), smaller birth size (p), wealthier family (p), rural (n)
Republic of Benin	2014	6.1[Δ]	Older children (p), wealthier families (p), educated mothers (n),

OBM: overweight/obese mother; aOBM/STC; bOBM/WSC; cOBM/UWC; dOBM/AC; eOBM/ANY; ΔOBM/STC-UWC

Four articles reported a positive association between mothers' higher education and the double burden of malnutrition. Two other articles showed a negative association between educated mothers and the double burden of malnutrition. A possible explanation for these findings is study proposed that the relationship between education and overweight/obesity is intricate and varies across different countries (Monteiro *et al*., 2001). The conflicting findings might be because having a higher level of education doesn't necessarily guarantee the adoption of healthy lifestyle behaviors. In cases where mothers have poor health and nutritional knowledge, they may be less attentive to their child's nutritional status or less responsive to health and nutrition concerns, such as food choices and barriers

like food cost, accessibility, and lack of cooking skills (Sunuwar *et al*., 2020). A study by Kumar *et al*. (2021) shows women with higher degrees of education typically have higher wealth status than women with lower levels of education. Mothers who had completed at least secondary education were found to be at a higher risk of facing a double burden of malnutrition (Sunuwar *et al*., 2020). Study shows women with primary/secondary education are more prone to overweight or obesity (Rai *et al*., 2019).

Five articles reported a positive association between the age of the children and the double burden of malnutrition. Older children were more likely to suffer from malnutrition. The explanation for this finding is as children get older, their malnutrition rates rise, which is related to their increased TBM (Kumar *et al*., 2021). Previous research has shown that children's growth faltering is more common later in life (Headey *et al*., 2019). It is conceivable to have greater rates of DBMHL among children 24-59 months when nursing has a limited impact on a child's dietary adequacy and is less commonly practiced by mothers because breastfeeding has a preventive effect on both stunting in children and overweight in mothers. Recent studies have investigated the fact that, in addition to Pakistan, other Asian nations are facing malnutrition among older children as a result of eschewing continued nursing traditions, and these investigations have corroborated this conclusion (Anik *et al.,* 2019). Another study observed the elevated risk of TBM among children at later ages is most likely caused by a higher prevalence of stunting, wasting, and underweight. The significant risk of TBM among children in the high age group is confirmed by the fact that in addition to undernutrition, anemia is also more common among children in the high age group than among children of lower age.

Two articles explored a positive association between household food insecurity and the double burden of malnutrition. Research conducted in Brazil shows a strong association between household food insecurity and the occurrence of the double burden of malnutrition. Even after considering factors related to DBM, severe HFI remains a significant factor associated with DBM (Gubert *et al*., 2017). Although previous studies have indicated a relationship between economic factors and the presence of DBM (Lee *et al*., 2017). Research in Indonesia also indicates a relationship between household food insecurity and DBM. In Indonesia, research also demonstrates a relationship between household food insecurity and the occurrence of double-burden malnutrition. This study reveals that HFI is a contributing factor to the development of DBM, even after considering other related factors. The results of this study provide new insights into the impact of food insecurity on nutritional balance in the Indonesian population (Mahmudiono *et al*., 2018; Septiani *et al*., 2021).

Household food insecurity can indeed contribute to the occurrence of double-burden malnutrition, which refers to the simultaneous presence of undernutrition and overnutrition within the same population, household, or individual. When a household experiences food insecurity, it means they have limited or uncertain access to sufficient and nutritious food. This can result in a lack of dietary diversity and poor food quality. In many cases, food-insecure households may rely on inexpensive but nutrient-poor foods that are high in energy. This can contribute to the development of overweight and obesity. Household food insecurity can also lead to undernutrition and deficiencies in micronutrients. Inadequate access to nutritious foods can result in an insufficient intake of essential nutrients, including proteins, vitamins, and minerals. This can hinder growth and development, leading to stunting, wasting, and deficiencies in important nutrients such as iron, vitamin A, and zinc (Gao *et al*., 2020).

Limitations in the present study are the heterogenicity in the sample size and the scale setting of the study, which prevented from performing meta-analysis. However, for such a new field in nutrition, reporting the published article qualitatively through a systematic literature review has been a cornerstone for impending research.

Conclusion

Overall, the prevalence of double burden of malnutrition at the household

level was < 30% with a lower prevalence in Asian countries. However, with the emerging cases of overnutrition, the increasing trend of double burden was projected in Asia. Among the factors that had been associated with the double burden of malnutrition was access to media. Media should have been channels for health promotion. Intervention concerning the nutrition of mothers and children at the household level is required to be intensified through nutrition-specific and nutrition-sensitive programs.

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