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### **a. References from books**

- Contento, I. R. (2011). *Nutrition education* (2nd ed.). Sudbury, Massachusetts: Jones and Bartlett Publishers.
- Mahan, L. K., & Raymond, J. L. (2017). *Krause's food & the nutrition care process*. Canada: Elsevier Health Sciences.

### **b. Books or reports composed by organizations, associations, or government agencies**

Kementerian Kesehatan. (2013). *Hasil Riset Kesehatan Dasar 2013*. Jakarta: Badan Penelitian dan Pengembangan Kesehatan, Kementerian Kesehatan RI.

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Brown, J.E. (2011). *Nutrition through the life cycle* (4th Ed.). Janet Sugarman Isaacs, *Infant Nutrition* (pp. 223–225). Belmont, CA, USA: Wadsworth.

d. **Conference manuscript – online**

Bochner, S. (1996). Mentoring in higher education: Issues to be addressed in developing a mentoring program. Paper presented at the Australian Association for Research in Education Conference, Singapore. Retrieved from <http://www.aare.edu.au/96pap/bochs96018.txt>

e. **Manuscripts from a journal**

El-Gilany, A. H., & Elkhawaga, G. (2012). Socioeconomic determinants of eating pattern of adolescent students in Mansoura, Egypt. *The Pan African Medical Journal*, 13, 22. <https://doi.org/10.4314/pamj.v13i1>.

McDonald, C. M., McLean, J., Kroeun, H., Talukder, A., Lynd, L. D., & Green, T. J. (2015). Correlates of household food insecurity and low dietary diversity in rural Cambodia. *Asia Pacific Journal of Clinical Nutrition*, 24(4), 720–730. <https://doi.org/10.6133/apjcn.2015.24.4.14>

Diana, R., Sumarmi, S., Nindya, T. S., Rifqi, M. A., Widya, S., & Rhitmayanti, E. (2017). *Household Income and Unbalanced Diet Among Urban Adolescent Girls. Proceedings of the 4th Annual Meeting of the Indonesian Health Economics Association (INAHEA 2017)*.

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Hilgendorf, M. (2018). *Assessing malnutrition in liver disease patients being evaluated for transplant using the nutrition focused physical exam* (Unpublished master's thesis). University of Kentucky, Lexington, Kentucky.

Diana, R. (2014). *Pengaruh pemanfaatan pekarangan dan penyuluhan terhadap konsumsi sayur dan asupan gizi rumah tangga dan balita*. Institut Pertanian Bogor.

g. **Thesis/Dissertation – web version**

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h. **Web page (if referenced are a few pages on the same web page, use the homepage page)**

SStatistic Bureau of East Java. (2018). Number and Percentage of Poor, P1, P2 and Poverty Line By Regency / Municipality, in 2017. Retrieved November 22, 2018, from <https://jatim.bps.go.id/statictable/2018/01/15/733/jumlah-dan-persentase-penduduk-miskin-p1-p2-dan-garis-kemiskinan-menurut-kabupaten-kota-tahun-2017.html>



**Example of tables:**

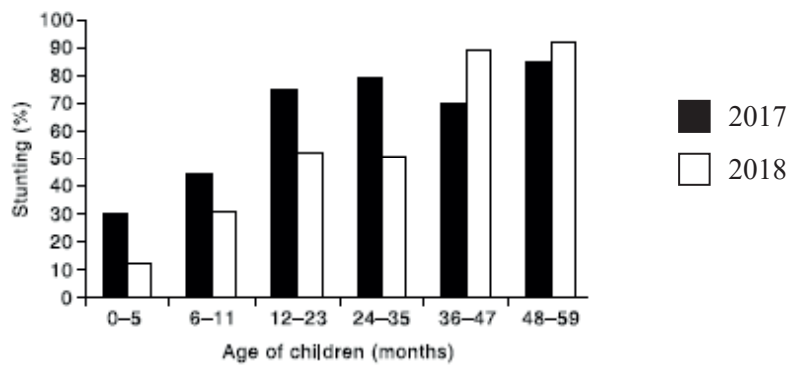
**Table 1.** Characteristics of Patients in Malnutrition and Non-Malnutrition Groups

Karakteristik	Malnutrition (n=70)		Non-Malnutrition (n=233)		Total (n=303)	X <sup>2</sup>	p value
	n	%	n	%			
<b>Sex</b>							
Male	38	54,3	117	52,5	155	0,070	0,790
Female	32	45,7	106	47,5	138		
<b>Age</b>							
<55 years old	48	68,6	151	67,7	199	0,890	0,180
≥55 years old	22	31,4	72	32,3	94		
<b>Education</b>							
Low	24	34,3	51	22,9	75	10,153	0,063
Middle	33	47,1	151	67,7	184		
High	13	18,6	21	9,4	33		

**Table 2.** Average of Nutrition Intake in Malnutrition and Non-Malnutrition Groups

Nutrition Intake	Malnutrition (Mean ± SD)	Non-Malnutrition (Mean ± SD)	t	p value
Calories	1328,1± 215,3	1482,9± 327,4	2,04	0,032
Protein	43,2±13,1	48,7±17,3	2,47	0,010

**Example of a figure:**



**Figure 1.** Changes in Stunting Prevalence (%) in Toddlers in Kalimantan

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## INTRODUCTION TO THE EDITOR

*Media Gizi Indonesia (MGI) is a scientific journal published regularly every 3 months that provides articles regarding the research and the development of nutrition knowledge including community nutrition, clinical nutrition, institutional nutrition, food service management, food technology, and current issues on food and nutrition. Media Gizi Indonesia tries to always present a variety of scientific articles in the scope of Nutrition and Health.*

*This volume provides both original research and literature review in the field of nutrition. The literature review are related to body images in adolescents, the function of chlorogenic acid in coffee and obesity, and vitamin D status in thalassemia patient. Meanwhile, original research varies from child nutrition, adolescent health, and elderly nutrition. To date, child and adolescent nutrition has become more attention because a good nutritional status in that period will manifest a better quality of life during adults and elderly period. For that, this current edition of MGI presents several best researches related to child and adolescent nutrition in relation to stunting, preschool children development, and dietary intervention. Besides presenting studies related to child and adolescent nutrition, the current edition of MGI also shows research in food product development for elderly and nutrition related elderly quality of life. More interestingly, this edition also publishes studies related to nutrition education during the covid pandemic in the hope that it can be useful for the wider community.*

*We do hope MGI scientific journals can leverage the development of a writing culture and communicative scientific studies as well as attract readers and writers to participate in MGI for future issues. Media Gizi Indonesia will maintain its role in providing current, relevant, and topical issues in food and nutrition. Hopefully, the works displayed by MGI can provide benefits and enrich the readers' knowledge.*

**Editorial Team**

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# THE ACCEPTANCE OF BAKED *GETUK* (CASSAVA CAKE) WITH RICE BRAN AND RED BEANS SUBSTITUTION AS HIGH FIBER SNACK FOR ELDERLY

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## ABSTRACT

Rice bran and red beans are one of food items that contain high dietary fiber and can be processed into traditional snacks such as baked *getuk* (cassava cake). Elderly needs enough fiber to support their metabolism. This study aims to analyze the effect of rice bran and red bean substitution of *getuk* toward its acceptance and dietary fiber contents. This study was an experimental study with a completely randomized design. There were four treatments of rice bran and red beans substitution (F0 = 0% rice bran, 0% red beans); (F1 = 10% rice bran, 13% red beans); (F2 = 13% rice bran, 10% red beans), (F3 = 17% rice bran, 7% red beans). This study further involved 30 untrained elderly and pre-elderly panelists (45–80 years). Acceptance was measured using a hedonic questionnaire on a scale of 1 to 6. Statistical analysis of acceptability differences was completed using Kruskal-Wallis and Mann-Whitney test with  $\alpha \leq 0.05$ . In results, there were significant differences between F1, F2, F3, and F0 on all characteristics (color, aroma, texture, taste) with  $p = 0.001$ , and the acceptance rating from highest to lowest was F3, F2, F1, respectively. The organoleptic test results further showed that the panelists mostly preferred the F3 formula (17% rice bran and 7% red beans). There was no significant difference in dietary fiber content between each formula, F1 contains 9.250 grams of dietary fiber (30.8% RDA), F2 contains 9.242 grams of dietary fiber (30.8% RDA), and F3 contains 9.235 grams of dietary fiber (30.7% RDA). This study proved that rice bran and red beans substitution to *getuk* improves its fiber content and also having good acceptability.

**Keywords:** acceptance, dietary fiber, elderly, red beans, rice bran

## INTRODUCTION

An elderly is someone who has reached the age of 60 years or above (Indonesia Ministry of Health, 2016), while a pre-elderly is someone whose age between 45–59 years old (Ramdhani, 2015). Based on the results of the BPS report in 2019, it was found that 51.08% of the elderly had health complaints, in which 26.20% of them experienced illnesses, while the rest were assumed to be healthy (Statistics Indonesia, 2018). The most common diseases affecting elderly aged 65–74 years based on their prevalence are hypertension (63.22%), stroke (45.30%), joint disease (18.63%), diabetes mellitus (6.03%), and heart disease (4.60%) (Indonesia Ministry of Health, 2018).

Hypertension is one of the leading health problems in Indonesia, with a national prevalence of 34.11% in 2018 in people aged 18 years or above (Indonesia Ministry of Health, 2018). This prevalence, moreover, was higher when compared to the majority in 2013, which was only 25.8 % and 31.7% in 2007 (Indonesia Ministry of Health,

2013). In East Java, the incidence of hypertension in 2018 was 22.71% in people aged 18 years or above (East Java Provincial Health Office, 2019). Basic Health Research in 2018 recorded that 69.53% of hypertension cases occurred to people aged 75 years old or above, 63.22% cases happened to those aged 65–74 years old, and 55.23% cases among 55–64 years old. These reports further indicated that the prevalence of hypertension depends on age increasement and mostly occurs in the elderly (Indonesia Ministry of Health, 2018).

Hypertension or high blood pressure is an increased systolic blood pressure over 140 mmHg and/or diastolic blood pressure over 90 mmHg on two occasions with five minutes interval with enough rest (Indonesia Ministry of Health, 2014). Persistent increase of blood pressure, at last, can cause damages to kidneys (kidney failure), heart (heart disease), and brain (stroke) if not detected early and receive adequate treatment (Indonesia Ministry of Health, 2014).

Adequate dietary fiber intake caused a modest reduction in diastolic blood pressure (Bazzano et al., 2013). Based on a prior cross-sectional study, it was revealed that total dietary fiber intake is associated with a lower risk of hypertension in American adults. The risk of hypertension tends to decrease gradually when the total fiber intake is increased to reach 0.35 g/kg/day. The selection of foods with high dietary fiber, thus, is suitable for preventing and controlling high blood pressure (Sun et al., 2018).

An adequate intake of dietary fiber is highly recommended to prevent high blood pressure. Based on several previous studies, dietary fiber has the potential to reduce high blood pressure. Rice bran and red beans are good sources of dietary fiber for controlling blood pressure. Both of them have a higher level of dietary fiber than cassava, which is the main component of *getuk* (cassava cake) to be substituted. Rice bran (100 g) contains 20 g of dietary fiber (USDA, 2019), while red beans (100 g) contain 26.3 g of dietary fiber. On the other hand, cassava (100 g) only contains 2.9 g of dietary fiber (Indonesia Ministry of Health, 2017). Besides that, bioactive compounds derived from rice bran have therapeutic potential against cellular oxidative stress (Saji et al., 2019). Red beans, moreover, have a high content of omega-3 fatty acids (David et al., 2019); omega-3 fatty acids significantly can reduce high blood pressure (Naini et al., 2015).

*Getuk* is one of the traditional Indonesian foods made from cassava (Lilly, 2015). Based on SNI 01-4299-1996, *getuk* is categorized as semi-wet food with a maximum water content of 40% (BSN, 1996). Because it is included in the category of semi-wet foods, *getuk* has a soft texture; thereby, it can be consumed easily by the elderly. Additionally, the ingredients for making baked *getuk* are relatively easy to obtain. Based on the background, hence, the authors aim to develop baked *getuk* formula that contains high dietary fiber from rice bran and red beans to help relieve high blood pressure.

## METHODS

This study was an experimental research with a completely randomized design. Four formulas

were further developed in this study involving rice bran and red beans substitution treatments (F0 = 0% rice bran, 0% red beans); (F1 = 10% rice bran, 13% red beans); (F2 = 13% rice bran, 10% red beans), (F3 = 17% rice bran, 7% red beans). The percentage of each formula was based on the addition and reduction of the rice bran and red beans composition, F1 has highest red beans composition and F3 has highest rice bran composition. The number of percentages was determined to find the substitution material with the highest acceptability. The untrained panelists for organoleptic test in this study were 30 untrained panelists of elderly (age 60 years and over) and pre-elderly (age 45–59 years) in Gadel, Tandes, Surabaya. Before tested on untrained panelists, each formula was tested by trained panelists to test its feasibility. Trained panelists in this study consisted of lectures and alumni of the nutrition study program, Faculty of Public Health, Universitas Airlangga. Trained panelists were also asked to describe the organoleptic characteristics of each formula. The dietary fiber content from developed formula was tested at the Laboratory of Biochemistry and Nutrition Analysis of Public Health, Universitas Airlangga, Surabaya.

The sample in this study was *getuk* with rice bran and red beans substitutions. The sample size served to the panelists was 12 to 13 g for each baked *getuk* formula. The sample for the organoleptic test was taken randomly by doing four repetitions of four different treatments. Each sample was given a random number code (987 = F0; 875 = F1; 112 = F2; 701 = F3) so that panelists could not estimate the proportion effect of rice bran and red beans on organoleptic test results. Laboratory test samples were taken randomly from 100 g *getuk*.

The assessment carried out in this study was acceptability test and dietary fiber content evaluation. The sensory evaluation of hedonic qualities (color, aroma, texture, and taste) was obtained from the appraisal of untrained panelists using a preference test questionnaire by seeing, smelling, touching, and tasting the food samples. At the same time, the evaluation for dietary fiber content was assessed based on the amount of dietary fiber content in each formula using analytical analysis.

The panelists assessed the sample presented with a favorite test questionnaire value including color, aroma, texture, and taste with 6 rating *Likert* scales: 1 for very much dislike, 2 for dislike moderately, 3 for dislike slightly, 4 for like slightly, 5 for like moderately, and 6 for like very much (Meilgaard, 1999). After the data was collected, the mean rank was performed to determine the hedonic rank. The results were then processed and analyzed to determine the formula with the highest acceptable value. Kruskal-Wallis test  $\alpha \leq 0.05$  was used to determine the differential effect of rice bran and red bean substitution on the acceptability of baked *getuk*. Mann-Whitney test  $\alpha \leq 0.05$ , meanwhile, was used to determine the acceptability differences in each formula. The baked *getuk* recipe, moreover, was tested for dietary fiber content in the laboratory using the residue weighing analysis method developed by The Association of Official Analytical Chemists (AOAC).

Ingredients used in making baked *getuk* with rice bran and red beans substitution included rice bran flour, red beans flour, sugar, coconut, margarine, and palm sugar. The reason for choosing the percentage of substitution ingredients in this formula was to find out which formula is more preferred, with more rice bran or more red beans formula. The formula is presented in Table 1.

Rice bran and red bean were the substitutes for cassava as a mixture in making baked *getuk*. The basis for the substitution of two ingredients was because both components have higher levels of dietary fiber than cassava.

**Table 1.** Baked *Getuk* Formula

Composition	Formula (%)			
	F0	F1	F2	F3
<b>Main Ingredient</b>				
Cassava	68	44	44	44
Sugar	13	13	13	13
Coconut	13	13	13	13
Margarine	3	3	3	3
Palm Sugar	3	3	3	3
<b>Substitution Ingredient</b>				
Rice bran flour	0	10	14	17
Red beans flour	0	14	10	7
<b>Total (%)</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

The process of making baked *getuk* consisted of two stages, namely preparation and processing. The preparation began with peeling and steaming cassava, roasting coconut, and weighing all the ingredients according to the proportions of each formula. The processing process, however, was carried out by mixing the ingredients according to the proportions of each recipe and grinding dough until smooth using a mincer. The dough was then weighed 12 g and formed in a cake shape before baked at 150° C for 15 minutes, and then cooled.

This study has been approved by the Health Research Ethics Commission, Faculty of Dentistry, Universitas Airlangga, Surabaya (Reg No. 136/HRECC.FDOM/ III/2020).

## RESULTS AND DISCUSSION

The Kruskal-Wallis test results of the organoleptic assessment affirmed that there were differences in color, aroma, texture, and taste significantly between formula F0, F1, F2, and F3 ( $p < 0.05$ ). The assessment results of the sensory level (color, aroma, texture, and taste) completed by 30 untrained panelists are shown in Table 2 and depicted in Figure 1.

**Table 2.** Value of Mean Rank and Kruskal-Wallis Test Results

Parameter	Mean Rank				<i>p-value</i>
	F0	F1	F2	F3	
Color	5.60	4.30	4.67	5.10	0.001*
Aroma	5.60	4.37	4.73	5.17	0.001*
Texture	5.67	4.33	4.76	5.30	0.001*
Taste	5.67	4.27	4.63	5.20	0.001*

\*) significantly different at  $\alpha < 0.05$

**Table 3.** Mann Whitney Test Results

<i>p-value</i>	Parameter			
	Color	Aroma	Texture	Taste
F0-F1	0.001*	0.001*	0.001*	0.001*
F0-F2	0.001*	0.001*	0.001*	0.001*
F0-F3	0.025*	0.028*	0.019*	0.019*
F1-F2	0.146	0.140	0.081	0.124
F1-F3	0.004*	0.003*	0.001*	0.001*
F2-F3	0.076	0.055	0.061	0.024*

\*) significantly different at  $\alpha < 0.05$

Table 2 displayed the distribution of the untrained panelists' ratings of color, aroma, texture, and taste for each baked getuk formula. For each parameter category, F3 was the more preferred formula than F1 and F2.

Based on the Mann-Whitney statistical test on organoleptic assessment, most of the color, aroma, texture, and taste of each formula compared had significant differences. The test results are further presented in Table 3.

Table 3 showed that the most of the formulas which compared in organoleptic characteristics (color, aroma, texture, and taste) had significant differences. This data was obtained from organoleptic characteristics value comparison between each formula.

### Color

Color is one of the indicators of the acceptability rating of the panelists' preference. According to the organoleptic characteristics' description of trained panelists, the control formula had a bright yellow appearance, while the modified formulas had a brown appearance. The modified formulas (F1, F2, and F3) tended to be brown due to the effect of rice bran and red bean substitution. Between all modified formulas, F3 with 17% rice bran and 7% red bean was the most preferred formula by the elderly because its color tended to be brighter than the colors of the other formulas.

Based on the results of the untrained panelists' assessment, there was a significant effect ( $p=0.001$ ) of rice bran and red bean flour substitution on the color of baked getuk. The modified baked getuk formula has a dark brown color which was the effect of red bean flour substitution. In other words, it can be argued that the more the red beans, the browner the color produced. Moreover, this was in line with research on the substitution of red bean flour in another food products; the more the red bean flour, the darker color of the food products (Verawati, 2015). The same theory, apparently, also applies to formulas that were substituted with rice bran; the more the rice bran used, the browner the food product will be. Prior research regarding this issue also affirmed that the more proportion of rice bran substitution was used, the browner the color will be (Fauziyah, 2011).

### Aroma

The aroma is an odor caused by chemical stimuli that are smelled by olfactory nerves in the nasal cavity (Fauziyah, 2011). This parameter is one of the crucial parameters in organoleptic assessment. The aroma of baked getuk expected to appear in this study was the fragrant aroma that comes from margarine to disguise the distinctive aroma of rice bran and red bean flour, which was rather unpleasant and tended to be less familiar to panelists' taste buds. To reduce the aroma of rice bran and red bean flour, roast and cook it with water first could be an option since those steps could remove the two's original aroma.

Based on the results of the assessment, it was shown that there was a significant effect ( $p=0.001$ ) of rice bran and red bean flour substitution on the aroma of baked getuk. The results further revealed that the F3 formula was quite favorable, where F3 contained quite a lot of rice bran with the proportion of 17% rice bran flour and 7% red bean flour. All the modified formulas were substituted with rice bran flour and red bean flour so that the margarine aroma was covered by the distinctive smell of the two ingredients despite the handling of both the material before processing. Rice bran has a musty aroma, but the formula produced does not smell musty because it has been anticipated by roasting the rice bran flour first with direct heat. Roasting process with direct heat can inactivate lipoxygenase enzyme so that it can reduce musty aroma (Tobing, 2010).

### Texture

Based on SNI 01-4299-1996, getuk is categorized as semi-wet food with a moisture content of 40% (BSN, 1996). Because it is included in the semi-wet food category, getuk has a soft texture. Based on assessment results, it can be further seen that the modified formula with the most preferred texture was F3, which contained highest percentage of rice bran flour (17%) and lowest percentage of red bean flour (7%).

Baked getuk went through the oven process tended to be drier. In this study, however, the *getuk* had a soft texture although it was also baked in the oven. This result, thus, was not in line with previous research which revealed that

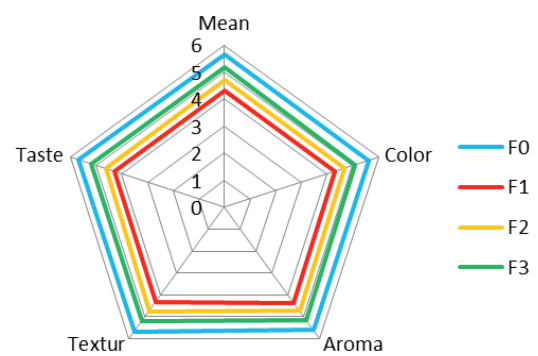
the texture of baked getuk would become hard because the water in the food is hydrolyzed during the oven process (Misnani, 2011). There are still many reasons behind the difference such as the differences in temperature setting and oven time. Low temperature setting and short oven time result in a soft texture of the getuk because the water in it is not completely hydrolyzed.

The results of the assessment disclosed that there was a significant effect ( $p=0.001$ ) of rice bran and red bean flour substitution on the texture of baked getuk. In other words, F0 tended to have a considerable difference to the respective textures of the modified formulas (F1, F2, and F3). Moreover, there was no significant difference between F1-F2 and F2-F3 texture comparison. Between F1-F3, on the contrary, there was a considerable difference, which was related to the proportion of rice bran and red beans substituted. F1, furthermore, had quite a lot of red bean flour content, while F3 has quite a lot of rice bran content. These results further implied that the formula containing higher red bean flour tends to have a different texture when compared to the formula that has higher rice bran content.

### Taste

Taste is an essential indicator in evaluating food products. The taste of baked getuk usually tends to be sweet because it is made using sugar (Oktavianawati, 2017). Although rice bran has a distinctive sweet taste of rice bran, it also has a slightly bitter aftertaste. Meanwhile, red beans have a unique savory flavor and a somewhat unpleasant and painful taste at the same time. The taste of rice bran flour tends to be slightly sweeter and less bitter than red beans flour. This taste, then, could affect the panelists' preferences.

The results of the assessment indicated that there was a significant effect of rice bran and red bean flour substitution on the taste of baked getuk ( $p=0.001$ ). Based on the organoleptic test of taste assessment, the taste of the modified formula most preferred by untrained panelists was the F3 formula, which contained quite a lot of rice bran with a proportion of 17% rice bran flour and 7% red bean flour. The results further implied that the formula with more rice bran flour substitution (F3) tended to be preferred to the recipe with added



Description of the scale:  
 1 = dislike very much  
 2 = dislike moderately  
 3 = dislike slightly  
 4 = like slightly  
 5 = like moderately  
 6 = like very much

**Picture 1.** Panelists Preferred Level Diagrams

red bean flour substitution (F1). This argument was indicated by the mean taste preference value of the F3 formula (5.20), which tended to be higher when compared to the F1 formula (4.27). These results, besides, were in line with previous research, which testified that products with more rice bran substitutions tend to have a more pungent distinctive taste of rice bran (Fauziyah, 2011).

Table 4 below shows the results of dietary fiber analysis per 100 g of baked getuk. Based on the results of the laboratory test showed that the best modification formula with good acceptance was F3, which had fulfilled the criteria for the claim of high dietary fiber food. Additionally, it contained a total dietary fiber of more than 6 g per 100 g of food weight: 9.235 g per 100 g of food weight. Furthermore, the control formula (F0) had met the claim criteria for the source of dietary fiber because it contained a total dietary fiber of more than 3 g per 100 g of food weight, which was 3.619 g per 100 g of food weight.

**Table 4.** Dietary Fiber Content Based on Laboratory Test Results

Dietary Fiber Content (g)	F0*	F1**	F2**	F3*
Soluble Fiber	0.300	1.143	1.142	1.141
Insoluble Fiber	3.319	8.107	8.100	8.094
Total Fiber	3.619	9.250	9.242	9.235

\* Laboratory Test

\*\* The approach was based on the results of laboratory test

Total dietary fiber intake is associated with a lower risk of hypertension. In other words, the risk of hypertension tends to decrease gradually as total fiber intake is increased. The selection of high dietary fiber (soluble or insoluble fiber) foods is useful for preventing and controlling hypertension (Sun et al., 2018). There has been a decrease in the need for several types of nutrients in the elderly and pre-elderly. Based on Recommended Dietary Allowances (RDA), the necessity of dietary fiber in the elderly and pre-elderly further ranges from 20 to 30 g, depending on gender and age group (Indonesia Ministry of Health, 2019). In this case, baked getuk formula can meet one-third to half of the dietary fiber needs of the elderly or pre-elderly in a day

## CONCLUSION

The substitution of rice bran and red bean flour affects the receptivity of baked getuk and dietary fiber contents. Moreover, there was a significant differences between F1, F2, F3, and F0 on all characteristics (color, aroma, texture, taste) with  $p = 0.001$ , and the acceptance rating was F3 (rank 1), F2 (rank 2), F1 (rank 3), respectively. The organoleptic test results further showed that the panelists mostly preferred formula with 17% rice bran and 7% red beans. There was no significant difference in dietary fiber content between each formula, F1 contains 9.250 grams of dietary fiber (30,8%), F2 contains 9.242 grams of dietary fiber (30,8%), and F3 contains 9.235 grams of dietary fiber (30,7%). The best formula composition, thus, was F3, which has highest acceptance rating value. It is also necessary to develop the organoleptic tests of this formula with a broader consumer panelist to improve the acceptability before being commercialized.

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# CORRELATION OF SNACKING FREQUENCY, HEMOGLOBIN LEVELS, PHYSICAL ACTIVITY AND POCKET MONEY WITH NUTRITIONAL STATUS IN FEMALE ADOLESCENTS

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## ABSTRACT

Nutritional problem that occurs in adolescents due to higher food intake and less physical activity leads to over-nutrition. Other nutritional problems occur among them is micronutrient deficiency including anemia, mostly in female adolescents. Higher consumption of energy-dense snacks, low physical activity and more pocket money have contributed to adolescent's body weight. This study aims to determine the correlation of frequency of snacking, hemoglobin levels, physical activity, and pocket money with the nutritional status of female adolescents. This cross-sectional study was carried out in 117 female adolescents in Karanganyar Regency, Central Java Province. Data of snacking frequency was collected using the Food Frequency Questionnaire (FFQ) and hemoglobin level were measured using a Hematology Analyzer. Physical activity data were collected using the IPAQ questionnaire (International Physical Activity Questionnaire) and were converted to Metabolic Equivalent Tasks (METs). Normally distributed data then analyzed using *Pearson test* and *Spearman test* for not normally distributed data to determine correlation between independent with dependent variables and followed by the multiple linear regression test if the p-value < 0.25. Most female adolescents had normal nutritional status, but 6.8% and 17.9% female adolescents were overweight and obesity, respectively. The frequency of snacking ( $r = 0.207$ ,  $p = 0.025$ ), physical activity ( $r = -0.201$ ,  $p = 0.030$ ), pocket money ( $r = 0.283$ ,  $p = 0.002$ ) and hemoglobin level ( $r = 0.150$ ,  $p = 0.107$ ) were not correlated with nutritional status. In conclusion, frequency of snacks, physical activity, and pocket money were significantly correlated with nutritional status in female adolescents but no correlation with hemoglobin level.

**Keywords:** snacking frequency, hemoglobin, physical activity, pocket money, nutritional status.

## INTRODUCTION

Adolescence is an important period for better generation which is primarily influenced by environmental factors (Bengtsson et al., 2009). Body composition, eating behavior such as eating pattern and habits, physical activity, and psychology significantly change during adolescent life (Alberga et al., 2012). Therefore, it is not surprising that nutritional problems arise in this age period (Deren et al., 2018). Malnutrition is a complex health problem that covers under and over-nutrition (WHO, 2014). Malnutrition can occur due to inadequate intake or excess energy. Malnutrition due to higher intake can lead to obesity and other comorbidities, while malnutrition due to insufficient intake can lead to stunting, wasting and deficiency of micronutrients (anemia) (Singh, 2020). Nutritional problems can

occur in all ages, but female adolescences are more vulnerable than male adolescences (Alberga et al., 2012; Branca et al., 2015). Globally, the prevalence of underweight in female adolescents has slightly increased from 32% in 2005 to 36% in 2015 (Berhe et al., 2019). In Indonesia, the prevalence of wasting has decreased at the age of 13–15 years (11.1% to 8.7%) and 9.4% to 8.1% (age of 16–18 years) (Indonesia Ministry of Health, 2018; Indonesia Ministry of Health, 2013) while the prevalence of wasting at the same age group in Central Java is 8.4% and 9.7%, respectively (Indonesia Ministry of Health, 2018). Despite this reduction, undernutrition is still a problem because of several factors such as low consumption of fruits and vegetables, increased anemia and low physical activity.



Many factors contribute to overweight and obesity such as higher consumption of energy-dense snacks and low physical activity (Al-hazzaa et al., 2014; Daly et al., 2017). Individually, some teenagers prefer snacks that look good with high calories or are energy dense and savory (De Cock et al., 2016; Hennegan et al., 2013). In addition, snacks are packaged foods that have less nutrients, are high in sodium, sugar and fat such as chiki, packaged biscuits and chips (Duffey et al., 2013; O'Connor et al., 2015).

Pocket money also affects over-nutrition because a teenager has many choices to buy snacks or fast food (Wijayanti et al., 2019; Punitha et al., 2014). Low physical activity also affects the nutritional status of adolescents because adolescents generally spend their free time doing light activities without expending a lot of energy, among others, watching movies, television, playing games and social media with gadgets (Cassidy et al., 2017; Chapman et al., 2014) thus leading to overweight and obesity (Wiklund, 2016).

Consumption of snacks that are more energy dense and high fat are often related to over nutrition (Duffey et al., 2013). Research by Bo et al. (2014) that a person who consumes 3 times or more snacks with high calories has higher BMI. Adolescents who consume snacks have 5 times greater effect on over-nutrition (Al Rahmad, 2019). This is also influenced by the allowance that is owned by the opportunity to buy food in large quantities, i.e., children with higher pocket money have a 2.18 to have a higher nutritional status (Wicaksana et al., 2019). This food intake must be balanced with adequate physical activity. Compared to sufficient physical activity, adolescents with light or insufficient physical activity has 3.3 times risk of over-nutrition (Wahyuningsih and Pratiwi 2019).

Apart from under and over-nutrition, anemia is also one of nutritional problem that often occurs in female adolescences and is generally caused by iron deficiency (Maakaron, 2019; WHO, 2011). One study reported that 60% young women in India with low hemoglobin levels have underweight (Siddharam et al., 2011). Meanwhile, in Indonesia, a research by Nisa et al. (2019) in female adolescents found a lower mean hemoglobin levels in the obese group (12,52 ± 1,34 g/dl) than in the normal nutritional status

group (12,62±1,48 g/ dl). The purpose of this study was to determine correlation of hemoglobin levels, frequency of snacking, pocket money and physical activity with nutritional status in female adolescents.

## METHODS

Female adolescents from 10th–11th grade of six high and vocational schools in Karanganyar Regency participated in this cross-sectional study. Sample size was calculated using the Slovin formula (1960) in Amirin (2011) and using the population in Karanganyar, Central Java namely

14.308 female adolescents then using purposive sampling method, we selected 117 female adolescents who met the inclusion criteria: aged 15-18 years old, were not menstruation during blood collection, and living in Karanganyar Regency in the last 6 months. Respondents agreed to take part in this study after signing the informed consent with their parents and the research protocol was approved by the Health Research Ethics Committee Faculty of Medicine, Universitas Sebelas Maret No.033 / UN27.06.6.1 / KEPK / EC/ 2020.

Data of snacking frequency were collected using the Food Frequency Questionnaire (FFQ) according to Sirajuddin et al. (2018) with a score of 50 (> 3 times / day), 25 (1 times / day), 15

(3-6 times / week), 10 (1-2 times / week), 5 (2 times / month), 0 (never) through direct interviews by asking >30 types of snacks packaged such as chiki, biscuits and several other packaged snacks commonly consumed by female adolescents during the past one month, and then the total score was calculated. Categorization was done using the normality test; often (>mean) and rarely (<mean). Blood hemoglobin levels were measured using the cyanmethemoglobin method with a Hematology analyzer at the Surakarta Regional Health Laboratory and the nearest Laboratory of Primary Health Centers from each district. Assessment of physical activity used the IPAQ short form to measure METs per minutes. Physical activity was then classified in to mild (<600 METs/week), moderate (600–1500 METs /week) and vigorous (>1500 METs/week) categories (IPAQ, 2002). Furthermore, nutritional status was determine

by calculating body mass index for age z-score (BAZ), which was obtained from weight and height data. Height was measured using a *microtoise* tool with an accuracy of 0.1 cm and body weight was measured using a digital scale with an accuracy of 0.1kg. The data then categorized as undernourished (underweight) (-3 SD to <-2 SD), normal (-2 SD to 1 SD), overweight (> 1 SD to 2 SD), and obesity (> 2 SD) (Indonesia Ministry of Health, 2020).

Statistical package for social science software (SPSS) version 21 was used to analyze all data collected from questionnaires, blood samples and anthropometric measurements. Numerical data were presented as mean  $\pm$  SD and categorical data were used as frequency and percentage.

For normally distributed data that is snacking frequency, Pearson test was used, while Spearman test was used for not normally distributed data including physical activity, pocket and hemoglobin levels. Then the multiple linear regression test if the p-value < 0.25 or 0.250. The statistical analysis was considered significance with the p-value <0.05.

## RESULTS AND DISCUSSION

Table 1 showed the general characteristics of respondents, which include age, parents' education, parents' income, pocket money and nutritional status. The majority of respondents were 15–16

**Table 1.** General Characteristics of female adolescents who participated in this study

Variable	Mean $\pm$ SD	n(%) (N = 117)
<b>Age (years)</b>		
15		47 (40.2)
16	15.89 $\pm$ 0.90	42(35.9)
17		21 (17.9)
18		7 (6)
<b>Father education</b>		
Elementary school		31 (25.5)
Junior high school	-	35 (29.9)
Senior School/vocational		45 (38.5)
College		6 (5.1)
<b>Mother education</b>		
Elementary school		38 (32.5)
Junior high school	-	36 (30.8)
Senior School/vocational		37 (31.6)
College		6 (5.1)
<b>Parent income (million IDR)</b>		
< MRW (1.989 million IDR)	2.22 $\pm$ 2.11	63 (53.8)
$\geq$ MRW (1.989 million IDR)		54 (46.2)
<b>Snacking frequency</b>		
Rarely (<mean)	76.19 $\pm$ 25.45	54 (46.2)
Often (>mean)		63 (53.8)
<b>Hb Levels (g/dl)</b>		
Anemic (< 12 g/dL)	13.10 $\pm$ 1.45	20 (17.1)
Non-Anemic ( $\geq$ 12 g/dL)		97 (82.9)
<b>Physical activity (METs)</b>		
Low (<600 METs)		34 (29.1)
Medium (600-2999 METs)	822.47 $\pm$ 307.45	80 (68.4)
High (>3000 METs)		3 (2.6)
<b>Pocket money</b>		
< 10,000 IDR	11897 $\pm$ 5728	26 (22.2)
$\geq$ 10,000 IDR		91 (77.8)
<b>BMI/age</b>		
Underweight (-3 SD to <-2 SD)		2 (1.7)
Normal (-2 SD to +1 SD)	-	86 (73.5)
Overweight (+1 SD to +2 SD)		21 (17.9)
Obese (>+2 SD)		8 (6.8)

years old with the average age of  $15.89 \pm 0.903$  years old. Most parents of respondents were completed their education at high school or less. Parents earned money below the minimum regional wage (MRW) were slightly higher than that of above the MRW. Although the average of parent income was lower than the Karanganyar MRW, 77.8% respondents had more than 10,000 IDR pocket money/day. From the BMI for age variable, there were 17.9% respondents with overweight and 6.8% respondents with obese.

This result is higher than the national prevalence of overweight (9.5%) and obesity, which is 4% (Indonesia Ministry of Health, 2018). Obesity can occur because energy intake is more than energy expenditure.

According to Huang et al. (2013) being overweight is caused by excess energy intake, inadequate physical activity, unhealthy eating patterns, or a combination of all three that results in excess energy.

This is in line with the frequency of snack consumption among adolescents that more than 50% of respondents often consume them. Respondents have physical activity that is less-moderate, while most respondents have hemoglobin levels that are classified as normal.

The classification of parents' income is based on the Regional Minimum Wage (RMW) in Karanganyar Regency (IDR 1.989.000). More than half of the respondent's parents' income is less than the RMW (53.8%). Parental income can

**Table 2.** Bivariate Analysis Frequency of Snacks, Hemoglobin Levels, Physical Activity, Pocket Money and Confounding Factors with Nutritional Status

Variable	r	p value
<b>Independent variable</b>		
Snacking frequency	0.207	0.025*
Hemoglobin Level	0.150	0.107
Physical Activity	-0.201	0.030
Pocket Money	0.283	0.002
<b>Confounding factors</b>		
Father Education	-0.036	0.703
Mother Education	0.22	0.811
Parent income	-0.017	0.859

\*Pearson test,  $p < 0.05$  significance

**Table 3.** Multivariate Analysis Frequency of Snacks, Hemoglobin Levels, Physical Activity, and Pocket Money with Nutritional Status

Variable	b*	t	sig	$\beta^{**}$
Snacks	0.10	-1.831	0.021	0.204
Hemoglobin Level	0.118	1.620	0.108	0.142
Physical Activity	-0.001	-2.513	0.013	-0.220
Pocket Money	4.351	2.359	0.020	0.207
R square= 0.145	F=4.757	$p$ (sig) = 0.000		

n observations = 117

b\* = Unstandardized coefficients

$\beta^{**}$  = standardized coefficients

refer to major changes in diet and availability of food for the family (Kant and Graubard 2013).

According to Mayen et al. (2014), reported that more fat consumption compared to fiber found in higher socioeconomic groups. This is because the level of prosperity and the existence of supermarkets also affects the ability to buy food and snacks (Popkin et al., 2012). A high economy or income allows for access to purchase and consumption of energy-dense food in large quantities (Mayen et al. 2014).

The results of the correlation test used Pearson analysis showing a positive correlation between the snacking frequency and nutritional status ( $r = 0.207$ ,  $p = 0.025$ ).

This research is in line with Larson et al. (2016), reported that there was a correlation between snack consumption with nutritional status. The consumption of these snacks such as *chiki*, potato chips, cassava chips, etc has a higher amount of energy than consumption of fruits and vegetables. In the United States, approximately 20-27% of kcal/day of total energy obtained from snacking and more than 27% of daily calories were from snacks (Duffey et al., 2013). The results of research by Borradaile et al. (2009) revealed that students buying food at supermarkets near schools can contribute an average of 356 additional calories and if this is done every day it will have an impact on weight gain.

Hemoglobin levels and nutritional status did not show a significant correlation ( $r = 0.150$ ,  $p = 0.107$ ) in line to the study of Parasdia et al. (2017). According to Ghrayeb et al. (2020), anemia can also cause malnutrition due to decreased appetite. Patients with iron deficiency anemia have low

iron stores and have high leptin levels so they have a feeling of fullness and have a low appetite. Previous studies have shown that low levels of ghrelin are found in someone with low Hb levels which causes decreased appetite (Akarsu et al., 2007).

Our study reveals an inverse correlation between physical activity and nutritional status ( $r = -0.201$ ,  $p = 0.030$ ), which means that the lower the physical activity, the higher the nutritional status will be. The results showed that most of the young women had moderate activity and almost half of them had light activity. According to Dapare et al. (2017) study in Ghana, there was a relationship between physical activity and nutritional status as well. Reduced physical activity can contribute to the prevalence of over-nutrition in female adolescents. The research of Grygiel-Gorniak et al. (2016) using the IPAQ questionnaire showed that adolescents with excessive food intake and high physical activity had normal nutritional status because physical activity can help burning the calories.

There was a positive correlation between pocket money and the nutritional status of female adolescents ( $r = 0.283$ ,  $p = 0.002$ ) and more than 50% the adolescents got  $\geq$  IDR 10,000. Similar to Hassan et al. (2016) study in Libya, there was a positive correlation between pocket money with nutritional status in children ( $r = 0.222$ ;  $p < 0.05$ ). The more frequent for buying food in large quantities with low fiber content can lead to higher BMI (Akbar et al., 2015). According to Li et al. (2017), students with higher amount of pocket money have the greater ability to buy food and snacks. Therefore, they have a chance to eat excessive food and becoming overweight or obesity.

Based on our findings, parents' education and their income had no significant correlation with nutritional status in female adolescents. Other study also states that there was no relationship the education of the father and mother with the nutritional status of children because education cannot be used as a benchmark that higher education means that knowledge in all fields is also good. Parents' interest in seeking information from various sources can be linked to good nutritional knowledge (Putri et al., 2017). Other research

have reported that mothers with higher education provide nutritional and healthy foods for optimum growth of their children, compared to mothers with lower education (Victora et al. 2008; Lopez et al. 2012; Vollmer et al., 2017); also emphasized that mother's education has a more effect on the children health and nutritional status because mothers play an important role for providing their daily food intake, especially for their children.

Then this insignificant, according to the study of Susanti et al. (2012) stated that parents' income is not slightly dependent on the influence of nutritional status in the sense that even though they have low income, children are always given food with adequate nutritional value even though the price is cheap. This is in line with research which states that most of the respondents earn

<MRW, but more than 50% of female adolescent have normal nutritional status. In contrast to our study, Suhartini and Ahmad (2018) reported that parent income has a correlation with nutritional status ( $p=0.037$ ) in adolescents. Study to Shariff et al. (2015) conducted in Malaysia explained that low socioeconomic status as indicated by low parent income could limit access to adequate diets thus could affect nutritional status.

From data of multiple linear regression test, significant correlations were observed from the independent variables and nutritional status except hemoglobin levels ( $p = 0.108$ ,  $b = 0.118$ ), because most female adolescents (82.9%) had normal hemoglobin levels. Study by Indartanti and Kartini (2014) also reports that there is no relationship between those two ( $p > 0.005$ ). This is because most female adolescents had normal nutritional status and hemoglobin levels. Anemia tends to be deficient in micronutrients (Fe) so that it does not affect nutritional status based on BMI/age because it has a low energy content, and if deficiency occurs it can last a long time (Rosmalina and Ernawati, 2010)

In addition, all variables contributed to 14.5% nutritional status of female adolescents. It clearly indicated that many factors importantly influence nutritional status in female adolescents such as macronutrient intake. The limitation of our study is that we did not calculate the number of nutritional snacks, daily food intake consumed, and records of female adolescent pocket money expenditures.

## CONCLUSION

Frequency of snacks, physical activity, and pocket money significantly correlate with nutritional status in female adolescents but no correlation for hemoglobin level. In order to prevent obesity in female adolescents, those factors should be socialized by determinants of nutrition policies related to health for female adolescent, counseling on adolescent nutritional status and healthy lifestyles to students.

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# THE ASSOCIATION OF FAMILY SUPPORT IN FULFILLING HEALTHY NUTRITIOUS FOODS, PROTEIN AND MICRONUTRIENT INTAKE WITH HEMOGLOBIN LEVELS AMONG ELDERLY

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## ABSTRACT

The elderly usually accompanied by many impairments due to decline in organ functioning which have a great impact on their daily intake and leads to anemia. Many elderly also have mobility impairment which make them become more dependent and need supports from their family. The aim of this study is to investigate the relationship of family support, the daily intake of protein, iron, vitamin C with hemoglobin levels in elderly. This observational analytic study with cross-sectional design was performed in 185 elderly aged 60-79 years determined using the OpenEpi program. Subjects collected by simple random sampling from chosen *Posyandu* in Klaten and Sragen districts. The data on daily intake and family support in fulfilling healthy nutritious foods were collected by using a 2x24-hour food recall form and a modified questionnaire from Hanim's study. Hemoglobin levels were measured from venous blood using *Cyanmethhemoglobin* method. The data were analyzed using the Pearson test and Multiple Linear Regression test. The prevalence of mild anemia was found in 10.27% women and 5.41% men. Family support ( $b=0.09$ , 95%CI:0.003-0.18), protein intake ( $b=0.41$ , 95%CI:0.25-0.57), iron intake ( $b=0.19$ , 95%CI:0.96-0.29), vitamin C intake ( $b=0.10$ , 95%CI:0.02-0.41) were significantly associated with hemoglobin levels ( $p<0.05$ ). To conclude, sufficient family support, adequate intake of protein, iron and vitamin C are associated to higher hemoglobin levels

**Keywords:** family support, macronutrient intake, micronutrient intake, hemoglobin level, Elderly.

## INTRODUCTION

The main characteristic of elderly is progressive loss of physiological integrity which turns to impaired function, thus, elderly considered as being vulnerable groups of the population (Lopez-Otin et al., 2013). Based on the National Social Economic Survey (2018), Yogyakarta, Central Java, East Java, North Sulawesi, and Bali provinces occupy five top ranks for the highest percentage of the elderly, i.e., 12.37%, 12.34%, 11.66%, 10.26%, and 9.68% respectively.

On digestive system, aging affects all function of GI system such as motility, enzyme and hormone secretion, digestion, absorption and metabolism (Dumic et al., 2018). Morphological changes such as mucosal, glandular, and muscular atrophies also commons among elderly. Those changes may lead to a reduction of gastrointestinal function and even pathological disorders such as low appetite, chewing difficulty, and swallowing disorder (Darmojo, 2014). In addition, it leads to another health problem related to nutrient intake

such as anemia. According to the study conducted by Bach et al. (2014) with total sample 19,758 elderly found the prevalence of anemia was pretty high as much 21,1% with 17,4% classified as mild, 60,3% as moderate, and 21,8% as severe. Nutritional deficiencies such as protein and iron were identified as the most possible causes of functional iron deficiency (Liu & Kaffes, 2012). Anemia in elderly could increase risk of death hazard ratio (HR) by 4.29, first cardiovascular-specific hospitalization (HR = 2.49) (Culleton et al., 2006), and dementia (HR = 1.64) (Hong et al., 2013).

In addition, limitless on nutrient intake could be possibly caused by mobility impairment. Many elderly have limitless mobility so they require supports from their spouse, children, and other family members in providing their daily physical and psychological needs include their nutrient intake (Indonesian Statistic Centre, 2017). A recent study has indicated that family support ( $p = 0.002$ ) and family character ( $p = 0.003$ ) were



significantly related with nutritional compliance among elderly (Nazari et al., 2016). Therefore, family support plays as an important role in maintaining their health and quality of life in order to remain active and productive (Hanim & Lestari, 2018a). Moreover, adequate nutrition is required for the elderly to keep their cellular turn over and inhibition of the ageing process (Fatmah, 2010).

From these viewpoints, authors aimed to investigate the association of the family support and daily consumption of protein, iron, and vitamin C with hemoglobin level in elderly.

## METHOD

This observational analytic study with cross-sectional design was conducted at two elderly integrated health services or called *Pos Pelayanan Terpadu (Posyandu)* in Kenaiban Village, Juwiring District, Klaten Regency, and Gemolong Village, Gemolong District, Sragen Regency. The Posyandu in these districts has completed services with a 5-table system in accordance with national standards, issued by the Indonesian Minister of Health no. 67 year 2015.

Subject of this study was elderly aged 60–79 years old. We chose those population age because previous study mentioned that people aged >79 years most likely to have a memory dysfunction which could be potential bias for a study (Pengpid et al., 2019). The sample size of this study was calculated using OpenEpi 3.01 program ([www.openepi.com](http://www.openepi.com)) for cross-sectional design (sample size portion) with population size of elderly aged 60–79 years old from two regencies, set up 25% anticipated % frequency (p), 5% confidence limits as +/- percent of 100 (d), and 1.0 design effect for complex sample surveys-DEFF for random sampling according to the sample size formula in OpenEpi. Total population in this study was 314,971 elderly >60 years in Klaten and Sragen district. Based on OpenEpi calculation, the minimum sample was 167 subjects with 10% adjusted for loss to follow up required. Random sampling was carried out when selecting the *posyandu* and 2 *posyandu* was selected (*Posyandu Lansia Ngudi Utomo* and *Posyandu Among Rogo*). From those two selected *Posyandu*, sample was chosen based on inclusion and exclusion criteria.

The inclusion of this study was elderly aged 60–79 years, did not experienced both chronic or acute disease for the past 3 months, visited *Posyandu* at least once a month during the past 3 months, did not have severe mobility impairment, and live with at least one member of family. While the elderly who had a history of blood transfusion within the last 4 weeks, who were on medical treatment or consume food supplements routinely in the last 1 month were excluded from this study. The research protocol was approved by the Health Research Ethics Committee, Faculty of Medicine, University of Sebelas Maret, Surakarta (Reg No. 006 / UN27.06 / KEPK / EC / 2020). Before conducting data collection, all selected subjects received detailed research information and agreed to the informed consent for those who participate in this study.

A total of 140 elderly women and 45 elderly men were interviewed for their daily food intake by using 24-hour food recall questionnaire. 2x24 food hours recall was collected by enumerator team on non-consecutive days including weekday and weekend to reduce the potential of memory bias during recall and confirmation to the subject's companion or family by comparing the answer of subjects and their companion. The daily food intake of subjects was then calculated by using NutriSurvey program for windows SEAMEO-TROPMED RCCN University of Indonesia copyright ©2007 then classified into adequate intake with cut-off point above 77% for micronutrient (Gibson, 2008) and above 90% for protein (Supriasa et al., 2016).

Family support in fulfilling healthy nutritious food data were collected using a modified questionnaire which already tested for its validation and reliability (Hanim & Lestari, 2018b). There are 17 questions in the family support in fulfilling healthy nutritious foods questionnaire. Questionnaire for family support in fulfilling healthy nutritious food is a closed ended/yes-no questions consist of aspect in subject's families financial assistance for living expenses (meals), assistance for accessed food (groceries), preparing food and cooking food, attention for providing main meals and snacks when the elderly are sick, evaluates the number, types and frequency of main meals including dishes and fruit in a day. Every

“yes” answer will be given score 1 and each “no” answer will be given score 0. Family support in fulfilling healthy nutritious food classified into “sufficient family support” if the total score was  $>9$ , and score  $\leq 9$  classified into “insufficient family support”.

Blood samples were drawn from their lower arms and then collected into blood tubes containing EDTA anticoagulant and sent to a directed clinical laboratory. At the clinical laboratory, the hemoglobin levels were directly measured by using a routine method for hematological analysis (*Cyanmethhemoglobin* method). In brief, 20  $\mu\text{L}$  venous bloods was reacted with 50 mL Drabkin’s reagents and then read spectrophotometrically at 540 nm light absorbance.

Lastly, categorical data, were presented as frequency and percentage whereas numeric data were presented as mean  $\pm$  standard deviation. Bivariate variable was analyzed by using Pearson association with  $p$ -value  $<0.25$  considered as significant. The variables were subsequently analyzed by using the multiple linear regression tests with  $p$ -value  $<0.05$ .

## RESULTS AND DISCUSSION

The main characteristics of 185 subjects were shown in Table 1. The mean age was  $67.54 \pm 5.33$  years old and 78.38% among them were women. Most subjects (82.16%) lived with their extended family which means the elderly not only live with their husband/ wife but also living together with their children, children in law, grandchild or other relatives who become their caregiver. Most of elderly had low formal education (83.25%). Majority of subjects (64.86%) received monthly income not only from their children/grandchildren but also from their own business and retired wage. However, their income remained lower than the minimum regional wage established by local governments ( $<$ IDR 1.7 million) and 88.11% of subjects spent their allowance on food expenditure for about IDR600,000 – 900,000 per month.

Based on the results presented in Table 2, the mean hemoglobin level was  $13.15 \pm 1.00$  g/dl and mild anemia was found in 10.27% women and 5.41% men. The prevalence of anemia in elderly was lower than the national prevalence. In

Indonesia, the proportion of anemia in the  $>45$ -year-old age group has been increasing during the last years (Kementrian Kesehatan RI, 2013a). For elder people aged  $>60$  years, the anemia prevalence in Indonesia is 46.3% (Kementrian Kesehatan RI, 2013b). Comparing to the data from The National Health and Morbidity Survey (NHMS) in 2015 carried out by Malaysian Ministry of Health, anemia prevalence in elderly aged  $\geq 60$  years old was 35.3% (Yusof et al., 2018). Difference results of this study with 2 previous study mentioned might be cause by the number of the sample. The national prevalence observed samples from all of province with more large numbers of samples size, while the samples of this study was chosen from only 2 *Poysandu* in 2 districts. In addition, in both national prevalence, there were no age limitation of samples, but in this study, the subject was limited to age 79 years. This study also excluded the elderlies who suffered both chronic or acute disease and mobility impairments. It could be said that this study only included healthy elderly.

Based on the results presented in Table 2, the results of the categorical data of food recall shown that majority of subject were having adequate protein, iron and vitamin C intake. The intake of protein and iron of subjects was obtained from chicken, chicken eggs, fish, milk, tofu, tempeh, *tempe gembus*, peanuts and soybeans. While vitamin C and other vitamin were obtained from vegetable and fruit consumption such as spinach, kale, moringa leaves, papaya leaves, cassava leaves, mustard greens, cabbage, eggplants, long beans, sprouts, chayote, young papaya, carrot, beans, pumpkin, mushroom, banana, papaya, orange, watermelon. Sources of protein and fruit are consumed 2-3 times a day, while vegetables are consumed 3 times a day. Subject’s food frequencies shown that majority subjects had consumed diverse food which are source of heme and non-heme iron, protein, and vitamin C.

Family support in fulfilling healthy nutritious foods of this study includes several aspects such as (1) financial assistance, (2) access to food (groceries, prepare, cooking meals), (3) motivation to eat and prepare food when sick, (4) attention to meal schedule, (5) attention to snacking schedule and (6) eating assistance/companion. Financial assistance refers to provision of material resources

especially healthy and nutritious food for the elderly by family members (Silva et al., 2014). The results of this study shown that 90.27% subjects got the financial assistance from their children, grandchildren, or other relatives. Aspects access to food (groceries, prepare, cooking meals) refers to how's family member provide meals start from groceries, preparation, and cooking a healthy and nutritious meals for the elderly. Many elderlies with mobility impairment might be difficult to go to grocery stores, prepare and cooking by their own. So, family support as their caregiver plays an important role to ensure the elderly have an adequate intake (Kim & Jin, 2018). In this study, majority of subjects (76.76%) did not go to grocery, prepare, and cooking by their own. Study of Kim & Jin (2018) in Korea among 2904 subjects age 65-84 years shown that the elderly who live alone have a lower health status and nutritional status than elderly living with their family ( $p < 0.05$ ). The elderly who live alone or did not supported by their family also experienced oral health disorder, dysphagia, more loose tooth which make their intake insufficient.

Aspect of motivation to eat and prepare food when sick refers to attention from family member as caregiver. This included provide assistance and material needs such as healthy foods, and medicine. Most of subjects (81.08%) in this study got more attention and affection when sick including fed

motivation and assistance. Study of Locher et al. (2005) among 50 elderlies with chronic or acute disease whose hospitalized in Geriatric Hospital of Alabama University shown that the elderly who companied, fed motivated and fed up by their family member consumed 114 Kcal more than the elderly who ate by their own ( $p = 0.009$ ).

Aspect of attention to meal and snacking schedule refers to how family member ensured that the elderly had their meals and snack on schedule and finish the food. In this study, most of family member of subjects (80.54%; 81.62%) did not clearly pay attention to meal and snacking schedule. Elderly who live alone tend to skip meals or snack or did not finished their food (Jamieson & Simpson, 2013). Study of Sidenvall et al. (2000) in Upsala University among 159 subjects aged >60 years shown that the elderly who live alone when their husband/ wives died or left by their children after got married made them lost their appetite and motivation to eat. Low appetite and motivation to eat can affects inadequate daily intake such as protein, iron, folate which then, leads to anemia (Zhang et al., 2018). Elderly with anemia have higher risk of mortality (Corona et al., 2017).

Aspect of eating assistance/ companion refers to family member habit to eating together with the elderly. In this study, half of subjects (56.21%) eat by their own without anyone companion. Study of Kimura et al. (2012) among elderly >65 years in Japan shown that elderly who eat alone have lower score of quality of life (QOL) than elderly who eat together with their family ( $58.5 \pm 22.7$  vs  $62.2 \pm 21.1$ ,  $p = 0.019$ ).

**Table 1.** Basic characteristics of subjects

Characteristics	n=185	%	Mean±SD
<b>Age (years)</b>			67.54±5.33
<b>Gender</b>			
Man	40	21.62	
Woman	145	78.38	
<b>Family Type</b>			
Nuclear family	33	17.84	
Extended family	152	82.16	
<b>Education</b>			
No education	79	42.71	
Elementary School	75	40.54	
Junior High School	17	9.19	
Senior High School	8	4.32	
College	6	3.24	
<b>Income Source</b>			
Children/ grandchildren	42	22.70	
Own business	10	5.41	
Retired salary	13	7.03	
Combination of three sources	120	64.86	
<b>Total Income</b>			
< IDR 1.7 million	126	68.11	
≥ IDR 1.7 million	59	31.89	
<b>Food Expenditure/month</b>			
IDR 600,000 – 900,000	163	88.11	
> IDR 900,000	22	11.89	

**Table 2.** Frequency Distribution of Hemoglobin Levels, Family Support, Protein and Micronutrient Intake

Characteristics	n=185	%	Mean±SD
<b>Hemoglobin level (g/dl)</b>			
Moderate anemia (8–10.9 g/dl)	1	0.54	
Mild Anemia			
Women (11–11.9 g/dl)	19	10.27	
Men (11–12.9 g/dl)	10	5.41	
Normal			
Women (≥12 g/dl)	125	67.57	
Men (≥13 g/dl)	30	16.22	
<b>Family support</b>			
Financial assistance			
Yes	167	90.27	
No	18	9.72	
Access to food (groceries, prepare, cooking meals)			13.15±1.00
Yes	142	76.76	
No	43	23.24	
Motivation to eat and prepare food when sick			
Yes	150	81.08	
No	35	18.91	
Attention to meal schedule			
Yes	36	19.45	
No	149	80.54	
Attention to snacking schedule			
Yes	34	18.37	
No	151	81.62	

Characteristics	n=185	%	Mean±SD
Eating assistance/companion			
Yes	81	43.78	
No	104	56.21	
<b>Nutrient Intake</b>			
Iron			
Adequate ( $\geq 77\%$ AKG)	88	47.6	
Inadequate ( $< 77\%$ AKG)	97	52.4	
Vitamin C			
Adequate ( $\geq 77\%$ AKG)	185	100.0	
Protein			
Adequate ( $\geq 90\%$ AKG)	152	82.2	
Inadequate ( $< 90\%$ AKG)	33	17.8	

This study also found elderly who eating alone have lower food diversity (score FDSK-11  $9.9 \pm 1.3$  vs  $10.2 \pm 1.3$ ;  $p = 0.002$ ) and lower BMI score. Based on Table 3, the average value of family support in fulfilling healthy nutritious foods is  $10.69 \pm 3.80$ . Based on numerical data, the average

subject's daily intake compared to Indonesian recommended dietary allowance for the elderly people were 97.7%, 97.5%, 78.5%, of subjects consumed adequate protein, vitamin C, and iron respectively.

**Table 3.** Association of Family Support, Protein Intake and Micronutrient Intake with Hemoglobin Levels

Variables	Mean ± SD	RDA	% RDA	r	p
Family Support (score)	10.69±3.80	-	-	0.64	<0.001
Protein intake (g/day)	56.56±2.67	58	97.7	0.78	<0.001
Vitamin C intake (mg/day)	73.28±1.85	75	97.5	0.78	<0.001
Iron intake (mg/day)	6.28±2.01	8	78.5	0.78	<0.001

\*RDA = Indonesia Recommended Dietary Allowance (AKG, 2019)

**Table 4.** Multiple Linear Regression Test of Sociodemographic, Family Support, Protein and Micronutrient with Hemoglobin Levels

Variables	Unstandardized Coefficients B	Standardized Coefficients Beta	95%CI	p
<b>Model 1</b>				
Family Support	0.093	0.124	-0.026-0.160	0.015
Protein Intake	0.321	0.329	0.195-0.448	<0.001
Iron intake	0.238	0.319	0.141-0.335	<0.001
Vitamin C Intake	0.10	0.19	0.001 - 0.16	0.048
<b>Model 2</b>				
Age	-0.151	-0.195	-0.246 – (-0.056)	0.002
Gender	-0.151	-0.166	- 0.299 – (- 0.003)	0.045
Residence Status	0.066	0.023	-0.55 – 0.187	0.285
Education	0.043	0.089	- 0.014 – 0.082	0.163
Family Support	0.093	0.124	0.003 – 0.183	0.044
Protein Intake	0.409	0.419	0.250-0.567	<0.001
Iron intake	0.193	0.049	0.96 – 0.289	<0.001
Vitamin C Intake	0.102	0.170	0.020 - 0.413	0.043

\*Adjusted R Square Model 1 = 0.541

Adjusted R Square Model 2 = 0.603

Table 3 revealed that family support, protein, and micronutrient intake (vitamin C and iron) were positively correlated with hemoglobin levels ( $p < 0.001$ ). The association was observed in daily intake of family support with  $r = 0.64$ , protein, vitamin C and iron with  $r = 0.78$ . Additionally, all variables had moderate association with hemoglobin levels.

Further analysis using multiple regression linear test was performed to evaluate association all variables together with hemoglobin levels. Based on Table 4 (Model 2), residence status and education did not associated with hemoglobin levels in the elderly aged 60-79 years old. Age ( $b = -0.151$ , 95%CI:  $-0.246 - (-0.056)$ ), gender ( $b = -0.151$ , 95%CI:  $-0.299 - (-0.003)$ ) significantly associated with better hemoglobin level with  $p < 0.05$ .

Based on Table 4, family support, protein and micronutrient intake were positively associated with hemoglobin levels among elderly aged 60-79 years old. Family support ( $b = 0.093$ , 95%CI:  $0.003 - 0.183$ ), protein intake ( $b = 0.409$ , 95%CI:  $0.250 - 0.567$ ), iron intake ( $b = 0.193$ , 95%CI:  $0.96 - 0.289$ ), vitamin C intake ( $b = 0.102$ , 95%CI:  $0.020 - 0.413$ ) significantly increased hemoglobin level with  $p < 0.05$ .

Furthermore, protein intake ( $B = 0.42$ ) was the strongest factors that associated hemoglobin levels. Altogether, four variables contributed to 54.1% hemoglobin levels in elderly while 45.9% hemoglobin levels were affected by other factors. In the 2nd model regression, basic characteristic of subject was analyzed and reveals an association of age ( $p = 0.002$ ) and gender ( $p = 0.045$ ) with hemoglobin levels, while residence status ( $p = 0.258$ ) and formal education were not associated with hemoglobin levels ( $p = 0.163$ ). Eight variables contributed to 60.3% hemoglobin levels in elderly while 39.7% hemoglobin levels were affected by other factors, which also means basic characteristic age, gender, education, and residence status were only contribute 6.2% to hemoglobin levels.

In elderly, many degenerative morphologic changes occurred, such as digestive changes and make easier to lose teeth. Atrophic changes also occur in the mucosa, glands and digestive muscles causing functional changes to pathological changes,

including chewing and swallowing disorders and appetite alteration (Darmojo, 2014). Impairment function of digestive organs and glands causes the need of food that easily digested (Sediaoetama, 2010). If the nutritional needs of the elderly cannot be fulfilled because of a decrease in the digestive tract function, especially in a long time, can cause iron deficiency anemia. Iron deficiency anemia is anemia that occurs due to lack of nutrients, namely calories, protein and iron (Clark, 2009).

Iron was minerals that are involved in erythropoiesis. Vitamin C is a factor that can enhance the absorption of heme and non-heme iron because it has the ability to reduce  $Fe^{3+}$  to  $Fe^{2+}$  through the intestinal brush border surface (Zhu et al., 2017). It is clearly indicated that our main findings support the existing theories, which iron and vitamin C consumption plays an important role in iron non-heme absorption in small intestine for hemoglobin production (Fuqua et al., 2012; Collins et al., 2012; Sharp, 2010).

The elderly in this study seem to consume more non-heme iron derived from tofu, *tempeh* and vegetables rather than livestock products because 88.11% among them spent IDR 20,000 – 30,000 per day to buy non-heme iron food. Furthermore, tofu, *tempeh*, and vegetables price in Central Java, Indonesia is cheaper than meat product price. In contrast to our results, 255 people who aged  $\geq 60$  years from 30 clusters village in Nainital District, Uttarakhand State, India showed that 42% and 72% among them had inadequate intake of vitamin C and iron intake respectively (Gupta et al., 2017).

A recent study carried out by Gupta et al. (2020) in the same district and state, India has also revealed moderate and severe anemia observed in 985 elderly who consumed significantly low daily consumption of iron ( $p < 0.001$ ), vitamin C, copper, and manganese ( $p < 0.01$ ) compared to the elderly with normal and mild anemia. The discrepancy of these results is probably caused by the population number, our study was only 185 compared to those study with 985 samples. Another reason is adequate vitamin C intake in our study is much higher than Gupta's study (100% vs. 28%) whereas adequate intake of iron is comparable (47.6% vs. 42.0 %).

The limited number of subjects and *Posyandu* chosen from 2 district in this study

might become a limitation. However, hemoglobin levels measurement using hematological analysis (Cyanmethemoglobin method) from venous in lower arm rather than simple kit Hb measurement from the blood of fingertip could be one of the study strength.

## CONCLUSION

In conclusion, low anemia prevalence was found in elderly aged 60–79 years old in Klaten and Sragen Regencies. Daily intake of iron, vitamin C, protein, and family support associated with hemoglobin levels. Families should be supports in terms of access to food, processing and preparation of food as well as monitoring the intake of healthy and nutritious food in the elderly to prevent anemia. Nutrition education for elderly families is also needed to increase knowledge of providing healthy guidelines, nutritiously balanced food, clean and healthy lifestyles that will support elderly's health. Related stakeholders also need to provide additional food program for improve nutrient intake of elderly.

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# FACTORS RELATED TO BODY IMAGE AND IT CORRELATION WITH NUTRITIONAL STATUS AMONG FEMALE ADOLESCENTS: A LITERATURE REVIEW

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## ABSTRACT

Adolescence is the transition period from children to adults. Adolescents, especially girls, are vulnerable to nutritional problem, one of the factors is due to the perception of body image. Body image can affect nutritional status if an individual has a negative body image, in which the perception that someone consciously or unconsciously cannot accept her body shape. It affects the behavior of adolescent girls related to nutrition to achieve their body goal in various ways that increase risk of becoming nutritional problems (under or over nutrition). The aims of this study is find out factors related to body image and it correlation with nutritional status in female adolescent using a literature review approach. This literature review research takes various sources of articles which published in the last 10 years (2010–2020) related to the research topics. Article were searched through the *PubMed - Medline* and *Google Scholar* databases using. Keywords "body image", "nutritional status", and "adolescent girl". Eighteen articles according to the topic and criteria were selected for review. Based on the results of the study, it was found that body image is related to the nutritional status of adolescent girls. This is related to the lack of nutritional knowledge of adolescent girls, which affects to an unhealthy and unbalanced diet. Besides, there is also a correlation of physical activity that is not balanced with food intake and the role of the environment such as family and friends which also affects knowledge, food intake, and body image of adolescent girls.

**Keywords:** Body Image, Literature Review, Adolescent Girls, Nutritional Status

## INTRODUCTION

Adolescence is a period when an individual has significant and important changes which are distincted by physical, cognitive, psychological, hormonal, and social in developing individual towards adulthood (Vieira et al., 2015). The World Health Organization (WHO) classify that adolescents as individual aged 10–19 years. In this period, puberty occurs then reaches sexual maturity (Permatasari et al., 2017).

Puberty that happens in adolescents, especially for adolescent girls, create significant physical and psychological changes. Physical changes involve the gain of weight and height, body proportions on the shoulders, arms, waist, and sexual changes including primary and secondary changes. (Pasaribu et al., 2015). Whereas the psychological changes that occur involve an identity crisis, an unstable spirit, emotional changes, tend to be childish, often sad/moody, and take more attention to the body shape. Physical changes in adolescents which followed by psychological changes cause

adolescents to be lack satisfaction with their body shape. Thus, during puberty, adolescent girls prone to have nutritional problems due to lifestyle changes to reach their body goal.

Based on the 2018 Indonesia basic health research data, 22 out of 100 adolescents aged 16–18 years are short, even 5 out of 100 adolescents are very short. Based on nutritional status (BMI / age), 14.5% are having over-nutrition status, while 8.1% had undernutrition status. (Kemenkes RI, 2019). Adolescent girls take a role in improving nutrition that focuses on the First 1000 Days of Life, although it is not directly stated. The nutritional status of adolescent girls has a crucial impact on health and safety during pregnancy and childbirth in the future. (Bapenas RI, 2012).

One of the puberty changes creates a change in the perception of body shape which is often referred to as body image. Body image is the perception, thoughts, and beliefs of an individual consciously about the shape of the body (Brown, 2011). There are two categories of body image,

namely positive and negative. A positive body image is when an individual is satisfied and acceptable with changes in her body shape (Jannah et al, 2019). Meanwhile, negative body image is when an individual can not accept her body shape (Bimantara et al, 2019).

Factors that lead to nutritional status changes can be caused by an individual having a negative body image such as irregular meal patterns and lack of intake of both macro and micronutrients, poor physical activity, exposure to misinformation from social media, lack of nutritional knowledge, and inappropriate peer influence (Normate et al, 2017).

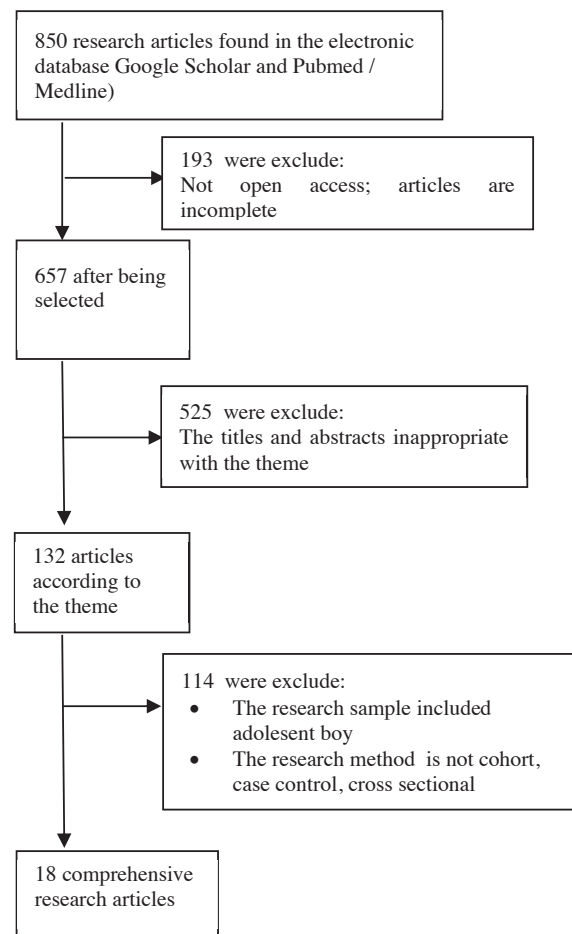
The meal pattern changes which happens because most adolescents, especially adolescent girls want to have an ideal body. According to them, the ideal body is classified as a thin and slender body, so efforts are needed to reduce weight (Mawaddah et al, 2019). Most of the methods which are done by the adolescent girl are not quite right, a strict diet without take attention to the nutritional needs (Widianti, 2012).

When negative body image continues to happen for a long time, it will increase the risk of malnutrition and eating disorders such as anorexia nervosa and bulimia nervosa, so it will create an impact on the nutritional and health status of adolescent girls. (Widianti, 2012). Thus, the researcher aims to examine the correlation of body image and nutritional status in adolescent girls through a literature review approach from various existing studies and articles.

## METHODS

This literature review is accomplished by searching for several articles that include observational studies, such as cohorts, case-control, and cross-sectional. The main article type chosen was observational research on body image with nutritional status in adolescents in the last 10 years (2010-2020). Articles were searched using electronic databases such Google Scholar, and PubMed / Medline.

The articles used were traced with the three keywords such as body image, adolescent, and nutritional status in accessible national and international journals. The inclusion criteria used



**Figure 1.** Flow diagram of research articles on the effect of body image on nutritional status in adolescent girls

to select the research articles were the results that showed the correlation, effect, or risk factors of body image on nutritional status, and research samples on adolescent girls. Research articles were excluded if the research method was literature review, systematic review, meta-analysis, the research sample was adolescent girl and boy, and the results of the research showed no correlation, effect, or risk factors of from body image on the nutritional status of adolescent girls. Figure 1 shows the process of research article selection.

## RESULTS AND DISCUSSION

There are some factors related with body image and its correlation with nutritional status. Seven studies show that body image can directly affect nutritional status (Table 1). Body image can not affect alone on nutritional status, together with food intake and physical activity factors affect

nutritional status in female adolescent (Table 2). Table 3. shows that knowledge, peers and body image have correlation with nutritional status in female adolescent.

### Body Image and Nutritional Status

Table. 1 results of literature review on body image and nutrition status association. The

**Table 1.** Results of Literature Review on Body Image and Nutrition Status Association

Research Title and Author	Research Methods	Result
Correlation of body image and nutritional status of female students at SMA Negeri 9 Surabaya (Bimantara, Adriani and Suminar, 2019)	Design: Observational, cross-sectional Subjects: 76 students of class XI and XII Data collection: BSQ-34 questionnaire and anthropometric measurements include weight and height Data analysis: spearman test	83% of respondents have adequate nutrition knowledge, 74% have a positive body image, and 71% have a normal nutritional status. Based on the Spearman correlation test, it was found that there was a significant correlation between body image and nutritional status ( $p < 0.001$ ; $r = 0.533$ )
Does Nnutritional Status Interfere with adolescents' body image perception? (Menconça, Karla L, <i>et al.</i> 2014)	Design : Dexpriptive cross-sectional Subjects : Female Adolescent (12 – 18 y.o) who are scholar Data Collection: antropometric, BI was evaluated by Application Scale which proposed by Childress, Brewerton, Hodges & Jarrel at 1993. Data Analysis : Pearson's Chi-square and Fisher's exact test	Underweight teenagers did not regard themselves thin (35%). Otherwise, 39.1% of the overweight individuals and 62.1% of the obese did not see themselves in their classification, other words, they satisfied what they are to be. Meanwhile, there were 29.8% normal BMI students who were dissatisfied and want to lose gain.
Perceptions of body size with the nutritional status of adolescent girls in Palangkaraya (Aprilianti, 2013).	Design: Observational, cross-sectional Subjects: 134 female students (3 SMA / SMK taken by proportional random sampling), 16-18 group age Collecting data: Using the Body Shape Questionnaire (BSQ) and antropometric measurements. Data analysis: Kappa analysis	59.7% of respondents were dissatisfied with body size. 29.8% felt overweight, and 51.4% had a normal BMI. Based on the analysis , the perception of body size affects the nutritional status of adolescents. Besides, eating behavior and economic conditions are also related to nutritional status.
Correlation of body mass index and body image for students of SMK Sentra Medika in 2018 (Batubara dan Batubara, 2019)	Design: Observational, cross-sectional Subjects: 56 students of class XII Collecting data: Using the Body Shape Questionnaire (BSQ), measuring weight and height Data analysis: chi-square test	There were 6.2% thin students (by BMI) who had negative body image. Then, 57.1% normal student (by BMI) who had negative body image. While, students who had overweight status by BMI, they satisfied with their body (10.5%). According to chi-square analysis, there were significant correlation between body image and nutritional status ( $p < 0.001$ )
Body image satisfaction in student from the sixth grade of public school in Caxias do Sul, southern Brazil (Finato <i>et al.</i> , 2013)	Design: Observational, cross-sectional Subjects: 1230 adolescent girl with a group aged 11-14 Data collecting: using the Body Shape Questionnaire (BSQ-34), measuring body weight, height, and waist circumference. Data analysis: chi-square test	There were 71.5% of adolescent girls who were dissatisfied with their body shape. There was a significant correlation between body image and nutritional status ( $PR = 3.84$ , 95% CL 2.72-5.41).
A Study on Consciousness of Adolescent Girls About Their Body Image (Dixit <i>et al.</i> , 2011)	Design: Observational, cross-sectional Subjects: 585 adolescent girls of age 10–19 years Data collecting: using predesigned questionnaire which were include some questions about perceived image; anthropometric measurement Data analysis: descriptive analysis and chi-square test	Among 73.4% satisfied girls, there were 32.8% underweight girl and 38.4% stunted girl. The difference between actual body weight and perceived body image was used to identifying the estimation about health. girls of high and medium BMI with thin and normal perceived body image were categorized into underestimation, and girls of low and median BMI with perceived body image of fatty were categorized into overestimation. This study found 32.8% of girls had overestimated their weight, while only 4.9% of girls had underestimated their weight
Perception of body image of adolescent and their parents in relation to the nutritional status and blood pressure (Vieira <i>et al.</i> , 2015)	Design: Observational cross-sectional Subjects: 914 adolescent girls with the age group of 10-19 and their parents Data collecting: questionnaires, weight, height, waist circumference and blood pressure Data analysis: Chi-square test and Spearman correlation test	Body image had a significant correlation with BMI ( $p < 0.001$ ), body weight ( $p < 0.001$ ), abdominal circumference ( $p < 0.001$ ), systolic blood pressure ( $p < 0.001$ ) and diastolic blood pressure ( $p = 0.013$ ). Then there was also a significant correlation of children's nutritional status and body image of their parents ( $p < 0.001$ ).

result of research have been accomplished by Aprilianti (2013) showed if an individual with a negative body image does not always have a poor nutritional status, on the other hand, an individual with a positive body image doubtful have a normal nutritional status. This occurs because nutritional status is not only influenced by perceptions but is also influenced by many factors including socio-economic conditions in the family, socio-culture, peers, media, family, and the environment. (Aprilianti, 2013).

Research of Aprilianti (2013) is also reinforced by research which states that nutritional status is not only influenced by body image but also influenced by nutritional intake and individual infectious diseases. (Cahyaningrum, 2013). Other studies suggest that a negative body image can increase when an individual thinks that their body shape is inappropriate with their desire. (Batubara and Batubara, 2019).

Study by Batubara and Batubara (2019) explained that female students, who had a normal BMI with negative body image, were due to a lack of self-confidence and felt that they were bigger than their peers who were thinner according to their own version. Therefore, they tend to go on a diet to lose weight. Meanwhile, female students, who had overweight and a positive body image, they had higher self-confidence. So, they tend not to care and will continue their unhealthy habit.

The appearance of a body image to nutritional status is triggered by the mass media presenting by public figures who have a perfect appraisal from the public. An individual who has an idol will admire all the behavior and habits of their idol. It can trigger to a negative body image. Negative body image also affects the nutritional status, because negative body image makes an individual less satisfied with their body shape. Subsequently, it can change their dietary behavior (Putri, Ani and Ariastuti, 2018).

Researched by Mendonça et al., (2014), body image could affects nutritional status. The results of it showed that dissatisfaction with body shape can affect lossing and gaining in body weight. The incidence of body image can be influenced by the media and the general public. The standard of community assessment is very influential on a person's body image. Person who has a normal

weight may still losing some weight because of standards in society, besides, it is different with the exact nutritional status standards.

While the research by Vieira et al., (2015) showed that there was a significant correlation between adolescent nutritional status with the body image of parents. Parents who have a negative body image will give an inappropriate diet to their children. Children who according to their parents are fat, but by BMI they are thin, will be forced to lose weight. Likewise, children who according to their parents are thin, but by BMI are fat, will be given food more than their requirement.

There is significant relationship between body image and nutritional status (Dixit et al., 2011). In that study showed body image in femal adolescents was caused by the surrounding environment. The body image in female adolescent in rural, urban and slum environment has different results. Most of satisfied girls was in slum area who had underweight and stunted of nutritional status. These environmental factors lead to different adolescent body images. Lack of understanding of body image is one of factors can make this differences. Thus, an inaccurate understanding will causing in nutritional status and eating disorders in female adolescents.

### **Food Intake, Physical Activity, and Body Image on Nutritional Status**

Articles in Table. 2 show several studies related to food intake, physical activity, and body image, all of which are related to nutritional status in adolescents. This happens because eating pattern and activities of adolescents will change follow the adolescent's desire to have slim and tall body shape. Research by Yusintha et al., (2018) showed that there was a correlation between eating behavior and nutritional status of adolescent girls. Adolescents can choose food without attention to nutrition. Besides, diet changes because adolescents make an effort to get an ideal body.

The changes in meal patterns are also supported by additional activities at school such as extracurricular activities both inside and outside school, that makes female students skip their meals. Students choose fast food to shorten the time and most of them often missed their breakfast. Skipping breakfast for students is considered one of the first

**Table 2.** Food intake, physical activity, and body image on nutritional status

Research Title and Author	Research Methods	Result
The correlation of eating behavior and body image with the nutritional status of adolescent girls with the age group of 15-18 (Yusintha and Adriyanto, 2018)	Design: Observational, cross-sectional Subjects: 93 female students aged 15-18 years Data collecting: BSQ-34, measurement of weight and height Data analysis: correlation test with Spearman test	There were 57% have good eating behavior, 80.6% have positive body image and 72% have normal nutritional status. The results of the Spearman correlation test showed that there was a correlation between eating behavior and the nutritional status of adolescent girls (result $p = 0.013$ $r = 0.256$ ). In addition, the Pearson correlation test results also showed correlation of the body image and nutritional status ( $p = 0.002$ ; $r = 0.315$ ).
Perception of the body image is related to the nutritional status of SMA N 1 Gianyar students (Putri, Ani, and Ariastuti, 2018)	Design: Observational, cross-sectional Subjects: 95 female students of class X, XI, and XII with the age group of 16-18 were selected by random sampling technique Data collecting: anthropometry, semiquantitative food frequency question (SQ-FFQ), Body Shape Questionnaire (BSQ-34). Data analysis: chi-square test	There were female adolescent who had less energy intake (6.3%), less protein intake (3.1%), less fat intake (3.1%) and less carbohydrates intake (3.1%) but have a negative body image. In addition, there is a significant relationship between perceptions of body image and nutritional status ( $p < 0.05$ ).
The correlation of the application of balanced nutrition guidelines and body image with nutritional status at SMK Nusantara 2 Kesehatan 2016 (Permatasari and Setiawati, 2017)	Design: Observational, cross-sectional Subjects: 121 female students aged 15-18 years Data collecting: interviews with the food recall questionnaire, PAL, and the Body Shape Questionnaire (BSQ-34) Data analysis: Chi-Square	Most of the respondents (70.2%) had normal nutritional status, adequate carbohydrate intake (90.1%), adequate fat intake (54.5%), adequate protein intake (67.8%), light physical activity (79%), the habit of do not have breakfast every day (52.9%) and negative body image (66.9%). Bivariate test result showed that there were correlation between <i>body image</i> ( $p < 0.05$ ; OR=3.333), protein intake ( $p < 0.05$ ; OR: 3.632), fat intake ( $p < 0.05$ ; OR=12.000) and physical activity ( $p < 0,05$ ; OR 6.146) with nutritional status in female students
Correlation of physical activity and body image with nutritional status of high school students SMA Yayasan Pupuk Kaltim Bontang (Prisilia, Rachmi, and Aminyoto, 2019)	Design: Observational, cross-sectional Subjects: 262 students of class X, XI, and XII with purposive sampling technique Data collecting: physical activity and body image perception with the help of a questionnaire, measurement of BMI (weight and height) Data analysis: the Kolmogrov-Smirnov test	There was a significant correlation of body image and nutritional status of students ( $p = 0.000$ ) ( $p < 0.05$ ) but there was no correlation of physical activity and nutritional status ( $p = 0.000$ ) ( $p > 0.05$ ).
Affect of body image and eating habits with nutritional status at SMAN 1 KAMPAR in 2017 (Hendarini, 2018)	Design: Observational, cross-sectional Subjects: 229 female students Data collecting: Body Shape Questionnaire (BSQ), questionnaire on eating habits and anthropometric measurements of body weight and height Data analysis: chi-square test	The results showed that most of the respondents had poor eating habits (53.3%) and negative body image (51.5%). Based on the results test statistically, there was a significant correlation of eating habits ( $p = 0.029$ ), body image ( $p = 0.039$ ), and the nutritional status of the students.
The correlation of body image and physical activity with the status of VII grade female students at SMPN 20 Surabaya (Nur, Mawarda and Amin, 2019)	Design: Observational, cross-sectional Subjects: 78 female students Data collecting: assistance (BSQ) and PAL and anthropometric measurements Data analysis: Spearman's Rank Correlation test	Respondents with normal nutritional status and positive body image were 25.6%. Respondents with nutritional status of 9% fat and 12.8% with obesity nutritional status accompanied by moderate negative body image. Based on the analysis, there was a significant correlation between body image and nutritional status but not with physical activity.

Research Title and Author	Research Methods	Result
The correlation of body image and eating behavior with the nutritional status of adolescent girls at SMA Theresia School Semarang (Widianti and Candra, 2012)	Design: Observational, cross-sectional Subjects: 72 students of class X, XI, and XII with the age group of 16-18 Data collecting: The Body Shape Questionnaire (BSQ-34) questionnaire was done by FGD, and anthropometric measurements were carried out including body weight and height. Data analysis: Kolmogorov Smirnov test and Pearson correlation test	40.3% of respondents were not satisfied with their body shape. Most of the 56.9% of subjects had not carried out good eating behavior. Based on bivariate analysis, there was a significant correlation of body image and nutritional status ( $r = 0.482$ $p = 0.001$ ) and eating behavior with nutritional status ( $r = 0.507$ $p = 0.001$ ).
The correlation of the body image, physical activity, and knowledge of balanced nutrition with the incidence of obesity in overweight girls in SMA Negeri 9 Semarang (Intantiyana, Widajanti, and Zen, 2018)	Design: Observational cross-sectional Subjects: 67 adolescent girls with a total sampling technique Data collecting: structured questionnaire interviews, recall, physical activity, measurement of body weight and height Data analysis: chi-square test	Based on the results of the chi-square test, there was a correlation between body image ( $p = 0.008$ ) and physical activity ( $p < 0.001$ ) with nutritional status. However, there was no correlation between balanced nutrition knowledge ( $p = 0.837$ ) and over nutritional status.

steps to lose weight, but this is not appropriate because it could reduce the concentration. Also, it could cause obesity because when the break time comes, students tend to binge eating or eat more than their normal habit (Widianti et al, 2012).

This is consistent with the research of Hendarini (2018) which showed that there is was correlation between eating habits and nutritional status. The results of the research indicated that most respondents with over nutritional status are consuming more macronutrients (carbohydrates, fats, and proteins) and also tended to have the habit of eating other foods outside of mealtime. Adolescents often consume high calories and fat snacks but low nutrients (Widianti et al, 2012). The negative perception of body image will encourage female adolescent to take various actions to achieve their goal body shape. However, these actions are harmful oftenly to health and affect their nutritional status, such as decrease food intake dramatically drastic reductions in food intake (Merinta, Veni and Djunaedi, 2012; Valter et al., 2014; Putri, Ani and Ariastuti, 2018).

Besides influenced by food intake, nutritional status is also influenced by physical activity. WHO (2010) recommended the physical activity for adolescents was physical activities with moderate level to severe with a minimum of 60 minutes/day. Based on recommendations by Indonesian Ministry of Health ((Kemenkes RI, 2018) in the Germas program that physical activity is carried out at least 30 minutes each day.

Physical activity for teenagers is not only beneficial for maintaining physical health or other body organs, but also mental health. Study by Prisilia, Rachmi and Aminyoto, (2019), explained that by doing physical activity, self-esteem in adolescents will increase. This self-esteem is important for psychological well-being, building a positive body image, increasing self-efficacy, and preventing the teenager from experiencing depression, anxiety, and high-risk behaviors such as consume/ abuse the drugs (example: weight loss drugs which are harmful to adolescent's health).

### Nutrition Knowledge, Peer Roles and Body Image on Nutritional Status

Table. 3 consists of articles related to nutritional knowledge, role of peers, body image, and its relation to nutritional status. Body image is triggered by several factors such as age, gender, nutrition knowledge, social media, and the environment (Denich et al., 2015).

Research by (Syati et al., 2019) showed that body image increase because of peer influence. Peers are used to making comments about their friends' physical appearance. It leads to the emergence of a body image, either negative or positive. However, peers are not the only factor that triggers body image, thus it affects nutritional behavior which leads to Parents have a crucial contribution as an environmental factor to define the adolescent nutritional status. Even adolescents are independent to pick their meal, parents still

**Table 3.** Knowledge, peers, and body image on nutritional status

Research Title and Author	Research Methods	Result
Correlation of peers and body image on nutritional status of women of childbearing age before marriage in MAN 1 Lampung Tengah, Kecamatan Terbanggi Besa, Kabupaten Lampung Tengah (Syati et al., 2019)	Design: Observational, cross-sectional Subjects: 115 adolescent girls Data collecting: Body Shape Questionnaire (BSQ-34) for body image variables peer influence scale for peer variables and anthropometric measurements. Data analysis: chi-square test and Fisher exact	There were 64.3% normal nutritional status, 22.6% over nutritional status, and 13.1% under nutritional status. In the body image variable, 73.9% were satisfied and 26.1% were dissatisfied. In the peer variable, it was found that 89.4% had no effect and 10.4% had the effect. Based on the bivariate analysis, the results showed that there was a correlation between body image and nutritional status ( $p = 0.001$ ) but there was no correlation with peers ( $p = 0.517$ ).
The correlation of nutritional knowledge, body image, and eating behavior with the nutritional status of students at SMAN 6 Jambi in 2015 (Irmayanti, 2015)	Design: Observational, cross-sectional Subjects: 72 students taking the proportional technique Data collecting: using a questionnaire and measuring nutritional status (weight and height) Data analysis: Chi-Square test	The results showed that 56.9% of students had good knowledge of nutrition, 54.2% had negative body image, 54.2% had good eating habits, and 51.4% had normal nutritional status. While the bivariate test results showed that there was a significant correlation of nutritional knowledge ( $p = 0.01$ ), body image ( $p = 0.03$ ), eating behavior ( $p = 0.00$ ) and nutritional status.
The correlation of self-esteem and body image in early adolescents who are obese (Nurvita, 2015)	Design: Observational, cross-sectional Subjects: 41 adolescent girls with the age group of 12-15 Data collecting: using a self-esteem questionnaire and a BSQ-34 questionnaire Data analysis: Spearman correlation test	The results showed that most of the respondents had fewer eating habits (53.3%) and negative body image (51.5%). Based on the chi-square test, there was a significant correlation between eating habits ( $p = 0.029$ ), body image ( $p = 0.039$ ), and the nutritional status of students.

take the role to provide the meal at home and create a childhood meal pattern. Research of Febriani (2019) showed that parents also contribute to the adolescent’s nutritional status, both over or under nutrition. The parent’s contribution that affects adolescent nutritional status provides the amount of allowance and food available at home. The allowance given will affect the consumption behavior of adolescent girls outside the home. Additionally, adolescents tend to spend their allowance for food thus it can increase their nutritional status to be over. Research by Nusa et al (2013) showed that most adolescents spend 1/3 of the allowance for fast food which has high fat and carbohydrates.

The adolescent girls’ knowledge regarding nutrition and health affects several things, such as nutritional behavior related to food consumption, physical activity, and perceptions of body shape. Research of Intantiyana et al, (2018) explains that the insufficient of adolescent nutritional knowledge is consistent with their inappropriate diet, they make meal restrictions without knowing their need. This changes the food choice and makes

inappropriate nutritional needs. Meanwhile, research by Florence (2017) indicates that a lack of nutrition knowledge is associated with abnormal nutritional status (under or over). This correlation happens because it is related to a uncorrect of choosing type and quantity of food (Sediaoetama, 2000).

Most of the nutritional problems (under and over nutrition) in adolescents emerge from negative body image, this is due to dissatisfaction with their body. According to research by Nurvita (2015) which showed that there was a significant correlation between self-esteem and body image in young adolescents who had obese nutritional status. The lower of self-esteem, the lower the body image. This happens because there are changes both physically and mentally in young adolescents, thus adolescents are quite difficult to accept these changes. Additionally, self-esteem is also influenced by pressure as a peer’s body image standard.

This literature review contains some limitations. That is, adolescents measured are only girl, not including boys thus it can’t be generalized.

This is because researchers want to focus on adolescent girls as part of the First 1000 Days of Life program whose nutritional status should be considered.

## CONCLUSION

Several factors affect the nutritional status of adolescent girls, one of which is body image. Body image is a self-perception of an individual body shape. Body image is related to nutritional status of adolescent girls, whether under or over nutrition. This is related to nutritional behavior which involves knowledge of nutrition and meal pattern of an adolescent girl. Furthermore, there is also a correlation of physical activity that is not balanced with food intake and environmental contribution, such as family and peers, which also affects nutritional behavior and body image.

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## EFFECT OF RED MULBERRY JUICE (*MORUS RUBRA*) ON THE INFLAMMATORY RESPONSE IN MALE WISTAR RATS DUE TO EXPOSURE TO CIGARETTE SMOKE

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### ABSTRACT

The increasing number of tobacco users will directly impact to an increase in the number of passive smokers. Various harmful substances that enter the respiratory tract can cause health problems. The airway will recognize these substances as pathogen and activate immune response accordingly. Inflammatory response becomes one of the effects of body compensation due to an increased pathogen. This effect is indicated by the elevation of C-Reactive Protein as one systemic inflammatory response parameters in the body. This study aimed to determine the efficacy of red mulberry juice to reduce levels of C-Reactive Protein in Wistar rats because exposure to cigarette smoke. This is an experimental study with a post-test control group design. Animals were divided into negative control group, positive control group, and 3 treatment groups with different red mulberry doses. The positive control group showed the highest increase in C-Reactive Protein levels compared with the red mulberry intake group ( $p < 0,001$ ). In conclusion, the administration of red mulberry juice can reduce inflammatory response in rats because of exposure to cigarette smoke.

**Keywords:** c-reactive protein, cigarette, inflammation, red mulberry

### INTRODUCTION

Tobacco cigarettes are the most common type of cigarette used worldwide (Gowing et al., 2015). Various studies have shown the dangers of using tobacco cigarettes both as active smokers and passive smokers (Suryadinata et al., 2017). Smoking has caused 6 million people dies each year and it is estimated will reach 8 million in 2030. Globally, the number of tobacco smokers has reached 1.1 billion people and almost 70% are residents of developing countries (Nasser et al, 2018). The prevalence of active smokers in developed countries has shown a significant decrease. Estimated in 2015, number of smokers in developed countries like America and Europe was around 15% of total population (West, 2017). In developing countries, the number of smokers increases every year, especially in the productive age (Hossain et al., 2017).

Smoke contains more than 4000 types various ingredients, including nicotine, ammonia, phenols, polycyclic aromatics, carbon monoxide, nitrogen oxides, and various metals (Kamceva et al., 2016). Two main phases that can be identified in cigarette smoke are tar phase and gas phase. Both phases

contain high free radicals such as superoxide ( $O_2^{\bullet-}$ ) and hydroxyl ( $\bullet OH$ ) (Suryadinata, 2018). Increased free radicals in body due to exposure to smoke cigarettes entering airways will cause oxidative stress and trigger lipid peroxidation. This will potentially cause cell damage and necrosis (Suryadinata et al., 2019). Normally, free radicals are mitochondrial metabolism and can be neutralized by enzymatic antioxidants in body (Suryadinata et al, 2019). In pathological conditions, excessive free radicals will directly stimulate inflammatory response through phagocytic process of macrophages (Arulselvan et al., 2016).

Inflammatory process is a form of body defence mechanism against pathogenic reactions from outside. Various pro-inflammatory cytokines are secreted into body microenvironment such as interleukin-1, interleukin-6, interleukin-8, and tumor necrosis factor-alpha (TNF- $\alpha$ ). Inflammatory mediator will induce liver to release C-Reactive Protein (CRP) into the blood (Phaniendra et al., 2015). Prevention of inflammatory process due to free radical increase in the body can be done with administration of antioxidants from the outside.

Various types of non-enzymatic antioxidants can be obtained from food especially flavonoids (Pratiwi et al., 2018).

Mulberry fruit is one type of fruit that high in antioxidants. Mulberries originated from genus *Morus* of Moraceae family, to date there are 24 species and 100 varieties (Zhang et al., 2018). Various studies have shown the provision of mulberry fruit has potential impact as antioxidant (Zhang and Shi, 2010). This study used red mulberry juice (*Morus rubra*) juice to reduce body inflammatory response due to exposure to tobacco smoke. Besides, red mulberries are also widely planted and consumed by Indonesian people so that at the same time can preserve local food. This study purpose is to analyze the efficacy of red mulberry juice to reduce levels of C-Reactive Protein in Wistar rats exposed to cigarette smoke.

## METHODS

This research was an experimental study with post-test control group design performed in 25 male Wistar rats (*Rattus norvegicus*) which were divided into 5 groups for 30 days. Inclusion criteria in this study were experimental animals aged 3-4 months with weight around 200 g. While the exclusion criteria are animals get sick or die during study. Maintenance and care of the animals during study are based on 3R principles (Replacement, Reduction, and Refinement). This research has been obtained Ethical Clearance Certificate from Institutional Ethical Committee, University of Surabaya (No:135/KE/VI/2020).

Red mulberries (*Morus rubra*) that have been obtained, sorted and cleaned in order to get fruit in good condition. Red mulberry juice that has been obtained then performed flavonoid levels measurement ( $\pm 38$  mg/g). Results of flavonoids levels that have been obtained then converted from daily needs of adults ( $\pm 190$  mg/kg) into daily dose intake of Wistar rats with 200g body weight ( $\pm 240$  mg/rats) using *Laurence and Bacharach* table. The amount of red mulberry juice given orally to the treatment group was 3.25 g, 6.5 g, and 13 g.

The results of CRP level measurement are based on agglutination process in blood through intracardiac puncture. Dilution process show the results of C-Reactive Protein measurement i.e., >

6 mg/L, 12 mg/L, 24 mg/L, 48 mg/L and 96 mg/L. Measurement results were classified as positive if C-Reactive protein levels obtained more than 6 mg/L, and negative if C-Reactive Protein level obtained were less than 6 mg/L.

This research was conducted for 30 days by dividing rats into 5 groups. The first was the negative control group, where animals did not received any treatment. In positive control group, animals received daily intake and exposure to 2 tobacco cigarettes smoke per day in smoking chamber. While last three groups were exposed to 2 tobacco cigarettes smoke per day, daily intake, and 3.25 g, 6.5 g, or 13 g red mulberry juice.

Results of study were ordinal data in the form of CRP levels in each group in mg/L units. CRP measurement method uses dilution to get a multiple of the result. CRP levels of >6 mg/L, 12 mg/L, 24 mg/L and 48 mg/L will be carried out for coding. Data analysis was performed using Kruskal Wallis analysis with SPSS version 22 to observe differences between groups.

## RESULTS AND DISCUSSIONS

Results of study were carried out by comparing C-Reactive Protein levels between groups. Table 1. shows results of C-Reactive Protein level measurement in blood between group. Group I, IV, and V had the same levels of C-Reactive Protein. The highest level of C-Reactive Protein obtained in Group II which is the Positive Control Group.

Kruskal Wallis test in Table 1 shows p-value of C-Reactive Protein levels between group was <0,001 (*p-value* <0.05), so it can be concluded that there are significant differences of C-Reactive Protein levels between groups.

Exposure to free radicals from tobacco smoke that enters respiratory tract causes body develop defence mechanisms to prevent the impact of cell damage due to oxidative stress (Indraswari et al., 2018). Antioxidant produced in body are enzymatic antioxidants (superoxide dismutase [SOD], glutathione peroxidase [GSH-Px], and catalase), while antioxidant from outside are non-enzymatic antioxidant derived from food intake such as flavonoids (Suryadinata et al., 2016). The balance between number of free radicals and

**Table 1.** Levels of C-Reactive Protein in research

Group	<i>C-Reactive Protein</i> levels (mg / L) in Wistar Rats					Kruskal Wallis Test
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	
<b>I</b>	The negative control group without exposure to cigarette smoke and intake of red mulberry juice					
<b>II</b>	The positive control group received exposure to smoke cigarettes and no intake of red mulberry juice					
<b>III</b>	Treatment group I was exposed to cigarette smoke and red mulberry juice intake of 3.25 g					<0.001
<b>IV</b>	Treatment group II received smoke exposure cigarettes and red mulberry juice intake of 6.5 g					
<b>V</b>	Treatment group III received smoke exposure cigarettes and red mulberry juice intake of 13 g					

antioxidants is needed for the stability of body normal metabolic process (Biswas et al., 2017).

Reactive Oxygen Species (ROS) are the most reactive and radical types that directly respond to inflammation in body. These radicals can be neutralized with superoxide dismutase (SOD) into hydrogen peroxidase (H<sub>2</sub>O<sub>2</sub>) then will be neutralized with glutathione peroxidase (GSH-Px) and catalase into water (H<sub>2</sub>O) and oxygen (O<sub>2</sub>) (Nimse and Pal, 2015).

However, an increase in excessive free radicals can result in cell damage or necrosis. This process will cause cells to become lysis and is called debris cells (Vénéreau et al., 2015). This will stimulate the movement of macrophages as one mechanism of body defence. Phagocytic process carried by macrophages will trigger secretion of pro-inflammatory cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) (Thomsen et al., 2016). Excessive release of proinflammatory cytokines will induce liver to secrete C-Reactive Protein (Sproston and Ashworth, 2018).

Inflammatory processes in the body have positive and negative effects. In acute and low condition, Inflammatory processes will function as a defence and healing process for cell tissue, while if the condition is chronic, then it will have impact on cell damage. Exposure to cigarette smoke that given regularly and continuously will create chronic inflammatory conditions that have a negative impact on health (Srivastava and Kumar, 2015). Therefore, the administration of antioxidants through food intake is expected to

be able to prevent the inflammatory process by decreasing free radicals.

Administration of red mulberry juice (*Morus rubra*) which rich in flavonoids shows its efficacy on decreasing levels of C-Reactive Protein in blood due to exposure to tobacco smoke. Therefore, the use of red mulberries as an additional intake of antioxidants from outside body can be considered as one way to prevent cell damage due to inflammatory process.

## CONCLUSION

Exposure to tobacco smoke can increase body inflammatory response through increased levels of C-Reactive Protein in the blood. Giving red mulberry juice can reduce the response of inflammation caused by exposure to tobacco smoke in rats.

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# DIETARY INTAKE AND SUN EXPOSURE RELATED TO VITAMIN D CONCENTRATION IN THALASSEMIA PATIENTS: A LITERATURE REVIEW

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## ABSTRACT

Vitamin D has an important role in calcium homeostasis and bone minerals during rapid growth periods. Several studies have shown that deficiency of vitamin D occurs in thalassemia patient. The study used literature review to determine relation of dietary intake and sun exposure with vitamin D concentration in thalassemia patients in 29 literatures. Those literatures were taken from books and articles published from 2010 to 2019 with the keywords “thalassemia”, “dietary intake”, “sun exposure” and “vitamin D” using database in *Pubmed*, *Google Scholar* and *Medline*. The results of 29 literatures showed that vitamin D deficiency is caused by reduced dietary intake and impaired vitamin D hydroxylation in the liver due to hemochromatosis resulting in high serum ferritin. Source of vitamin D comes from endogenous synthesis with sunlight exposure and little dietary source of vitamin D2 and vitamin D3. Another food intake can also affect serum vitamin D concentration, mainly fat and protein intake. Vitamin D is fat soluble vitamin, it can be stored in the fat for later metabolized in the liver. Protein is required to transport vitamin D to blood circulation, enzyme formation and vitamin D receptor (VDR). Thalassemia patients need to increase of macro and micronutrients requirement. Low Hb concentration causes fatigue, tired easily and decreased appetite. A lot of research on thalassemia children found that intake of energy and protein were lower than recommended and lack of sun exposure. These conditions will affect to vitamin D concentration. A comprehensive understanding in the relationship of dietary intake and sun exposure to vitamin D concentration in thalassemia patients is explained in this mini review. Maintaining normal vitamin D concentration through adequate dietary intake and sun exposure are very important to optimize growth in thalassemia patients

**Keywords:** dietary intake, sun exposure, thalassemia, vitamin D

## INTRODUCTION

Thalassemia is a hematological disorder caused by deletions or mutations in one or more globin genes that are inherited in an autosomal recessive manner and results in impaired  $\alpha$  or  $\beta$  globin chain synthesis resulting in ineffective hemolysis and erythropoiesis (Tharwat et al., 2019; Galanello & Origa 2010; Rachmilewitz & Giardina, 2011). It has been estimated that about 1.5% of the global population (80 to 90 million people) are carriers of beta thalassemia, with about 60,000 symptomatic individuals born annually, the great majority in the developing world (Galanello & Origa, 2010).

Vitamin D deficiency (VDD) in thalassemia major often occurs. Several countries in Asia report the occurrence of VDD in thalassemia major. A study in India in 2017 stated that only

13% had normal vitamin D concentration, 41% had deficiency, and 46% had vitamin D insufficiency (Gombar et al., 2018), while in Upper Egypt, deficiency and insufficiency of vitamin D reached 91% (Major et al., 2013). Vitamin D is formed through a complex metabolic process, derived from 7-dehydrocholesterol on the surface of human skin is changed into pre-vitamin D by ultraviolet B (UVB) irradiation and then converted into cholecalciferol (vitamin D3) with slow thermal isomerization. Dietary sources of vitamin D (ergocalciferol and cholecalciferol) are hydroxylated in the liver and kidneys, liver enzymes will add hydroxyl groups (OH) to cholecalciferol and ergocalciferol to produce 25 dihydroxyvitamin D3 (calcidiol). Calcidiol is synthesized in the kidneys and receives an additional hydroxyl group to 1,25-dihydroxyvitamin D3 (calcitriol), which is

hydroxylated by the kidneys (Wang et al., 2017). Both hydroxylation causes metabolism of vitamin D related to liver and kidney function (Iruzubieta et al., 2014; Kim, 2014). The number of vitamin D circulating in the body will decrease when hydroxylation is disrupted in the liver. (Gropper & Smith, 2012).

Several studies have shown that the majority of thalassemia children experience inadequate food intake. Lack of vitamin D intake is the most common problem found. In a US cohort study of thalassemia major children with good nutrition, 97% consumed inadequate vitamin D (Goldberg et al., 2018). In addition, energy and protein intake was also found to be lower than the recommended diet (Cortes-Penfield and Trautner 2017; Raimundo et al., 2011). Inadequate nutritional support will have an impact on not optimal growth and development and decreased immune function so that the quality of life of thalassemia children is low.

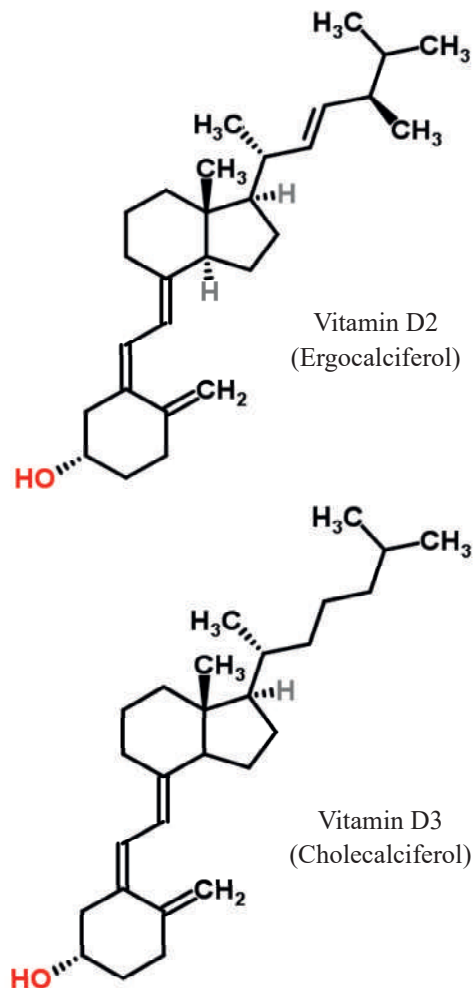
## METHODS

This literature review was obtained through collecting, evaluating and analyzing related books and articles published in the last 10 years with the keywords “thalassemia”, “dietary intake”, and “vitamin D” using database on *PubMed*, *google scholar* and *Medline* that aims to find the relationship between dietary intake and sun exposure with vitamin D concentration in thalassemia patients. The inclusion criteria were cross sectional, cohort, intervention and literature studies. We excluded animal studies. Ethical clearance was obtained from ethics committee of Health Research Dr. Hasan Sadikin Hospital Bandung, Indonesia number LB.02.01/X.6.5/312/2019.

## RESULTS AND DISCUSSIONS

### Vitamin D

Structurally, vitamin D is derived from a steroid which considered to be a seco-steroid because one of its broken four rings. Vitamin D contains three intact rings with a break between carbon 9 and 10 in the B ring. The two main types of vitamin D are vitamin D2 and vitamin



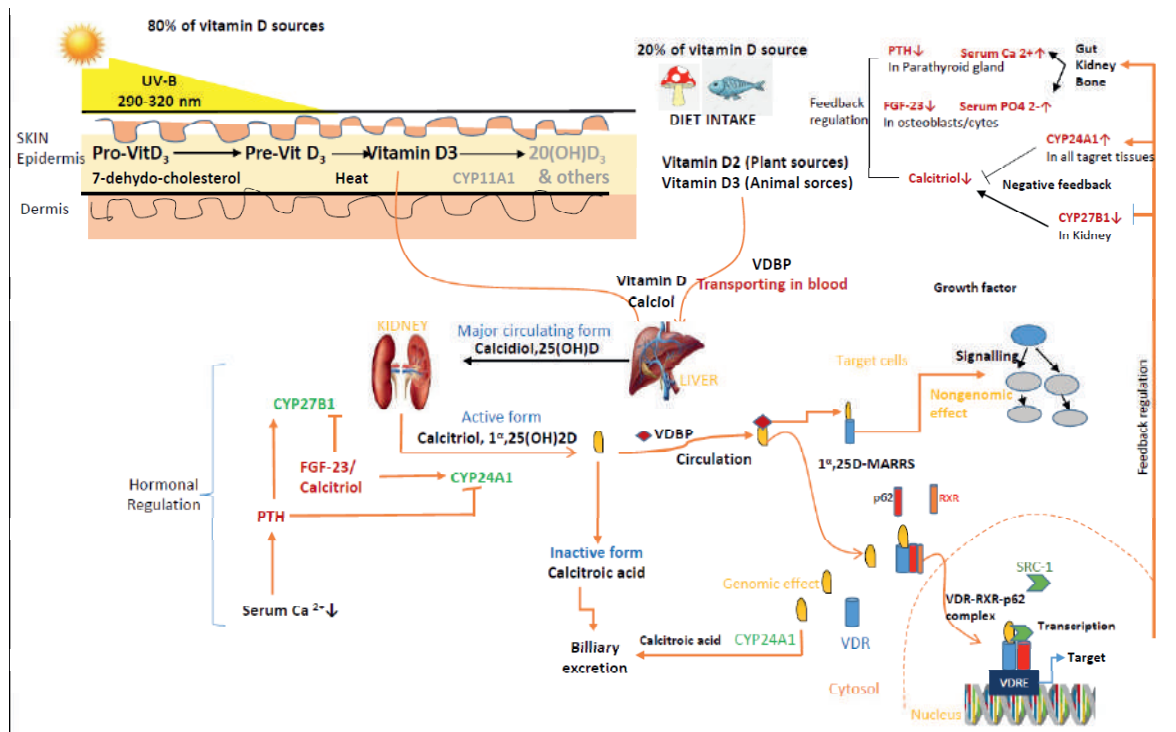
**Figure 1.** Chemical structure of vitamin D (Wacker & Holiack, 2013).

D3 with different structure. The only structural difference between vitamin D2 and D3 is their side chains. The side chain for vitamin D2 contains a double bond among C22, C23, and a C24 methyl group. Active metabolites are synthesized in the kidneys and liver and transported through the blood to target organs and tissues, such as intestinal epithelium and bone (Gropper & Smith 2012; Wacker & Holiack 2013). Chemical structure of vitamin can be seen at Figure 1.

### Absorption, Transportation and Storage

Figure 2 explains about absorption, transportation and storage of vitamin D. Vitamin D precursors are mainly obtained from 2 sources: endogenous synthesis and diet intake. In endogenous synthesis, cholecalciferol (vitamin D3) is synthesized from 7-dehydrocholesterol in the skin upon exposure to ultraviolet B. Vitamin





**Figure 2.** Vitamin D metabolism.

D, which is derived from large portions of food, is obtained in the form of vitamin D<sub>3</sub> (animal source) and/or as ergocalciferol (vitamin D<sub>2</sub>), the main precursor in plants. About 50% of vitamin D<sub>3</sub> from the diet is absorbed from a micelle, in association with fat and aid of bile salts by passive diffusion into the intestinal cell. The largest amount of vitamin D is absorbed in the distal small intestine although the rate of absorption is most rapid in the duodenum. (Mahan, 2012; Chareles, 2015; Wilhelms et al., 2016; Herrmann et al., 2017; Aw et al., 2016).

Protein which is responsible for carrying various types of vitamin D is vitamin D<sub>3</sub> binding protein (DBP). DBP has a high affinity and transporting 95-99% of the total 25(OH)D<sub>3</sub>, small portion is carried by albumin and lipoprotein through weak nonspecific bonds. (Mahan, 2012; Gropper & Smith 2012). Vitamin D, from food and skin is metabolized to 25(OH)D<sub>3</sub> in the liver by the enzyme 25-hydroxylase and will be available as a reserve in circulation during 2-3 weeks (Rolfes et al., 2014; Herrmann et al., 2017).

In the blood, vitamin D binds to DBP forming a complex of vitamin D-DBP. The second metabolic process in the kidneys, 25(OH)D<sub>3</sub> hydroxylates at C-1, forming an active

metabolite that is 1.25(OH)<sub>2</sub>D<sub>3</sub> (calcitriol), and also at C-24 forming an inactive metabolite that is 24.25- dihydroxyvitamin D (24-hydroxycalcidol). Calcitriol is easily released from DBP and quickly bound the cell nucleus receptor, vitamin D receptor (VDR). In the kidney, 1.25(OH)<sub>2</sub>D<sub>3</sub> stimulates tubular calcium reabsorption. In the small intestine, it stimulates calcium and phosphate absorption (Mahan, 2012; Rolfes et al., 2014; Gropper & Smith 2012; Wilhelms et al. 2016, Herrmann et al. 2017; Sarmah & Sharma 2014).

Production of extra renal tissue 1.25 (OH)<sub>2</sub>D<sub>3</sub> works as an autocrine or paracrine signaling molecule locally and it's no contribute to circulating 1.25(OH)<sub>2</sub>D<sub>3</sub> concentration (Herrmann et al., 2017).

In addition, VDR is found in almost all types of human cells, from brain to bone. Vitamin D directly or indirectly controls more than 3,000 genes related to calcium regulation and bone metabolism, modulation of innate immunity, cell growth and maturation, regulation of insulin and renin production, induction of apoptosis and inhibiting angiogenesis. Although many observational studies support a strong relationship vitamin D and effect of extra-skeletal, but there are not the exact proven low concentration of vitamin

D causes various diseases (Sarmah & Sharma, 2014).

Vitamin D homeostasis is controlled by the production of calcitriol. An increase of calcitriol causes a decrease in its own production directly or indirectly. Directly, calcitriol give negative feedback by 1-hydroxylase expression (Gropper, S. S., & Smith, 2012). Calcitriol also decreases parathyroid hormone synthesis which increasing the transcription of 1-hydroxylase. The effect of calcitriol on parathyroid hormone is an indirect mechanism. When concentration of calcitriol increase, the expression of phosphaturic factor, fibroblast growth factor-23 (FGF-23) will be increase too. FGF-23 suppresses expression of 1-hydroxylase indirectly suppressing production of calcitriol. In addition, calcium and phosphate from food also affect the activity of 1-hydroxylase, which is an increase in calcium and phosphate decreases the activity of 1-hydroxylase. Calcitriol also decreases the synthesis of PTH. (Mahan K. 2012, Rolfes, S. R., Pinna, K., & Whitney 2014, Gropper, S. S., & Smith 2012).

In thalassemia patients, severe hemolysis requires repeated transfusions to maintain normal Hb, and erythropoiesis causes increased iron absorption. The body loses 1-2 mg of iron per day, but blood transfusions contribute about 200 mg of iron. Patients who receive 25 units of blood per year, will accumulate 5 grams of iron per year if chelation therapy is not given. This excess iron is toxic to all body cells and can cause irreversible damage that carries a high risk of morbidity and mortality if left untreated.

Progressive iron overload in thalassemia major patients can deposit in the liver parenchyma, heart, and other organs. These iron deposits can interfere with the hydroxylation of vitamin D in the liver and kidneys. The buildup of bilirubin under the skin which causes a yellowish discoloration of the skin can interfere with vitamin D synthesis. Several studies have shown an association between increased ferritin and decreased levels of vitamin D.

Ferritin is a universal intracellular protein that stores iron and releases it in a controlled fashion. The clinical consequences of iron overload in thalassemia patients are varied and reflect the key sites of iron storage. In the liver, the formation

of collagen and portal fibrosis has been shown to occur after about two years of transfusion therapy. Thus, many studies show a significant increase in ferritin level in it. Patients affected by thalassemia major progressively develop iron overload, and a deficiency in liver hydroxylation of vitamin D (Gombar et al., 2018).

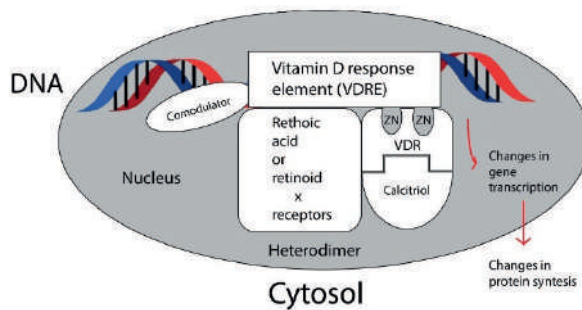
Several studies have reported a higher risk of vitamin D deficiency, decreased outdoor activities in thalassemic patients can also compromise cutaneous synthesis of vitamin D (Soliman, De Sanctis, & Yassin, 2013).

### Functions and Mechanisms of Vitamin D

Calcitriol has many functions and multiple mechanisms. The major mechanisms of calcitriol are genomics and non-genomics. In some cases, vitamin D works like a steroid hormone, acting through the activation of transduction signals that are bound to VDR cell membranes. Another case states that calcitriol functions to promote genomes by interacting with nuclear VDR to influence gene transcription. The binding calcitriol to VDR cell membranes in specialized tissues (such as intestine, parathyroid, bone, liver and pancreatic  $\beta$ -cells) triggers a sequences of occasions through intracellular signaling pathways (called signal transduction) to generate relatively rapid changes in several bodily processes.

Many actions initiated with this binding include increased intestinal calcium absorption or transcellular calcium flux called **transcaltachia** (*trans*=across, *cal*=calcium, and *tachia*=rapidly) and gate calcium channels opened with a resulting increase in calcium uptake into osteoblasts and skeletal muscle cells. This cellular event is mediated by phosphorylation/dephosphorylation of a number of enzymes by the second messenger such as MAP kinase, protein kinase C, cAMP, tyrosine kinase, phospholipase C, diacylglycerol, inositol phosphate, and arachidonic acid. Rapid response associated with membrane steroid binding proteins (MARRS) can also play a role, interacting with G-proteins or other signal transduction mediators (Gropper, S. S., & Smith, 2012).

Receptor of nuclear for vitamin D have been discovered in more than 30 organs, such as bones, intestine, kidney, lung, muscle, and skin. These receptors are part of the superfamily of receptors



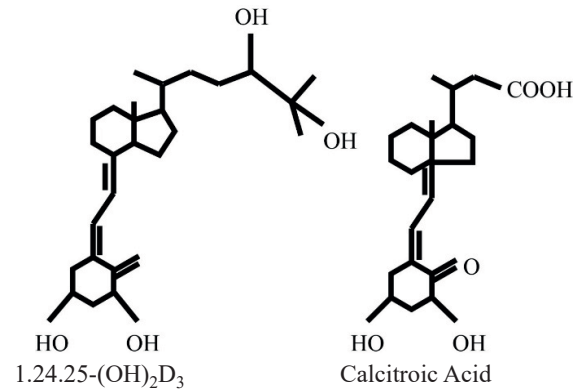
**Figure 3.** The role of vitamin D in gene expression

for retinoic acid, thyroid hormones and target tissue steroids. Calcitriol binds to nuclear VDR initiating conformational changes in the recently complex. Complex calcitriol-VDR is phosphorylated and then binds to retinoid X or retinoic acid receptors (RXR or RAR) to form heterodimeric complexes. The heterodimeric complex has zinc fingers interacting with certain vitamin D response elements (VDRE), discovered in the promoter region of specific target genes (Figure 3). When heterodimeric complexes are bound to VDRE, additional co-modulated proteins (coactivators or corepressors) interact with heterodimeric complexes to influence (increase or inhibit) the transcription of protein-encoded genes.

The function of proteins is largely unknown, but they can help connect receptors with enzymes, such as RNA polymerase II, or another component like transcription factors. The co-modulated proteins are SRC Family and NCoA-62. Proteins produced from the action of vitamin D in these genes are usually involved in calcium homeostasis, such as osteocalcin, 24 hydroxylase (CYP24), epithelial tracts of potent transient receptors of calcium type family member 6 (TRPV6), and calbindin (Gropper, S. S., & Smith, 2012).

### Metabolism and Excretion of Vitamin D

Calcitriol hydroxylation on carbon 24 produces metabolites 1,24,25-(OH)<sub>3</sub>D<sub>3</sub>, then oxidized to 1,25-(OH)224-oxoD<sub>3</sub>. Subsequent reactions, calcitroic acid is produced by side chain cleavage (Figure 4). After hydroxylation and oxidation, other vitamin D metabolites are also formed. These metabolites can be conjugated and



**Figure 4.** Some metabolites of vitamin D

excreted mainly in the bile. More than 70% of the vitamin D metabolites are excreted in the feces, with smaller amounts excreted in the urine.

### Measurement of Vitamin D

Recent guidelines suggest the use of serum 25(OH)D<sub>3</sub> concentration, which are measured by a reliable method for evaluating the status of vitamin D patients with have vitamin D deficiency risk. The best indicator of vitamin D status is serum 25(OH)D<sub>3</sub> concentration, because of 25(OH)D<sub>3</sub> concentration reflects the skin production and food source. Besides that, 25(OH)D<sub>3</sub> has a long half-life in circulation which is 3-4 weeks. 1,25(OH)<sub>2</sub>D<sub>3</sub> are not recommended for assessing vitamin D status because a half-life in the short circulation is 4-6 hours and its level in serum is very low, 1000 times lower than 25(OH)D<sub>3</sub> concentration.

When deficiency of vitamin D occurs, parathyroid hormone secretion will increase as a compensatory response which will stimulate the kidneys increasing 1,25(OH)<sub>2</sub>D<sub>3</sub> production so 25(OH)D<sub>3</sub> concentration decrease while concentration 1,25(OH)<sub>2</sub>D<sub>3</sub> is maintained at normal concentration and even increases (Wilhelms et al. 2016, Sarmah & Sharma 2014, Wolf, 2018).

Although recent guidelines recommend measurement of 25(OH)D<sub>3</sub> concentration to determinate vitamin D status there are exceptions where 25(OH)D<sub>3</sub> concentration measurement cannot be used in kidney disease where the kidney ability to produce 1,25(OH)<sub>2</sub>D<sub>3</sub> is low (Wilhelms et al., 2016).

## Range value

Expected 25(OH)D<sub>3</sub> concentration are still unclear. Various organizations such as the Vitamin D Council, Endocrine Society and the Food and Nutrition Board Testing Laboratories have determined the range values for vitamin D, but there is no consensus between these organizations.

At present, the range values determined by the Endocrine Society are the most widely used range values in medicine (Wolf, 2018), so most agree that VDD definition is if the 25(OH)D<sub>3</sub> level <20 ng/ mL (Sarmah & Sharma, 2014).

Determination of range values is still a problem today because several studies have found differences in concentration in various populations. Factors that cause differences in concentration between populations include melanin and obesity. Melanin provides protection against sunlight because it absorbs UVB photons. The dark skin people with more melanin pigment require longer sunlight exposure than light skin to produce the same vitamin D<sub>3</sub> amount. Therefore, 25(OH) D<sub>3</sub> concentration in people with dark skin are lower (Aw et al., 2016).

Obesity is also related to low 25(OH)D<sub>3</sub> concentration, caused that vitamin D is sequestered in fat tissue (Sarmah & Sharma, 2014).

## Vitamin D Requirement for Non-thalassemia and Thalassemia patients

The current vitamin D recommendations are criticized for being inadequate. The requirement for vitamin D recommended in 1997 is unknown, by suggesting an adequate intake of 5 µg or 200 IU per day for infants, children, adolescents, adults aged 19-50 years, including during pregnancy and breastfeeding (Mahan K. 2012, Rolfes, S. R., Pinna, K., & Whitney 2014, Gropper, S. S., & Smith 2012). More recent studies suggest at least

**Table 2.** Reference to Vitamin D intake

Age group	AI (µg/day)*	UL (µg/day)**
0–12 months	5 (200 IU)	25 (10000 IU)
1–50 years	5 (200 IU)	50 (2000 IU)
51–70 years	10 (400 IU)	50 (2000 IU)
> 70 years	15 (600 IU)	50 (2000 IU)
Pregnant and breastfeeding	5 (200 IU)	50 (2000 IU)

Sources: *Institute of Medicine, Food and Nutrition Board* (Mahan K. 2012, Rolfes, S. R., Pinna, K., & Whitney 2014, Gropper, S. S., & Smith 2012).

\*AI: Adequate Intake

\*\*UL: Tolerable upper intake level

**Table 3.** Recommended Dietary Allowances (RDA) of Vitamin D

Age group	RDA* (µg)	Age group	RDA* (µg)
0 – 11 months	10	Women:	
1 – 4 years	15	10 – 64 years	15
5 – 9 years	15	65 – 80+ years	20
		Men:	
10 – 64 years	15	Pregnant	+0
65 – 80+ years	20	Breastfeeding	+0

\*Recommended Dietary Allowances in 2019

12.5 µg (500 IU) per day, and > 25 µg (1000 IU) per day may be needed by some people without sun exposure to maintain adequate concentration of vitamin D (~> 80 nmol / L or 32 ng / mL). This amount is considered to be obtained from sun exposure for about 5 to 15 minutes at around 10.00 to 15.00 in spring, summer, and autumn (Gropper, S. S., & Smith, 2012).

The recommended nutritional adequacy concentration of vitamin D for various age groups and genders for Indonesia can be seen in Table 3.

Patients with thalassemia should have adequate vitamin D status to assure healthy bone accretion. Vitamin D status shall be assessed annually in all children and adults with thalassemia, can be seen in the following table.

**Table 1.** Level Vitamin D (Chareles S, 2015)

Level	Vitamin D Council	Endocrine Society	Food and Nutrition Board
Deficiency	0 – 30 ng/ml*	0 – 20 ng/ml	0 – 11 ng/ml
Insufficiency	31 – 39 ng/ml	21 – 29 ng/ml	2 – 20 ng/ml
Sufficiency	40 – 80 ng/ml	30 – 100 ng/ml	>20-150 ng/ml
Toxic	>150 ng/ml	>100 ng/ml	

\*Description: Convert IU units to traditional units using the formula: 25(OH)D nmol/l = 25(OH)D<sub>3</sub> ng/ml × 2.5.

**Table 4.** Recommendation for vitamin D assessment and therapy in patients with thalassemia (Soliman et al., 2013)

Assessment of vitamin D	Frequency/dose
For thalassemic patients with 25OH D3 level < 20 ng/ml	50 000 IU of vitamin D2 orally weekly for 8 weeks or 2000 IU of vitamin D3 orally daily for 8 weeks or a mega dose of 10.000 IU/kg (max 600.000 IU) orally or IM once.
For thalassemic patients with 25OHD3 level > 20 ng/ml maintenance therapy can be given especially in places with poor sun exposure	800-1000 IU of vitamin D2 orally daily or 50. 000 IU of vitamin D2 orally per month or a mega dose of vitamin D (10.000 IU/kg, maximum 600,000 IU) orally or IM every 6 months.

The other single randomized controlled trial demonstrated that supplementation with 400 to 1000 IU of vitamin D per day for a period of 16 weeks increased serum 25(OH)D concentration from 28.7 nmol/L to 48.8 nmol/L while Serum Ferritin concentrations remained unchanged. A preventive health program where participants used higher doses (at the follow-up, median doses were 7000 IU per day) which achieved serum 25(OH)D concentrations to increase, on average, from 87.2 nmol/L to 121.4 nmol/L (Munasinghe, Ekwaru, Mastroeni, & Mastroeni, 2019).

### Source of Vitamin D

Vitamin D is obtained by the body through body synthesis and dietary source. Residents of the tropics are at very low risk of developing deficiency of vitamin D. Infants and children are recommended to be in the sun for some time each day. Vitamin D deficiency is more likely to occur in countries that do not always get sunlight like 4 seasons countries (Gropper, S. S., & Smith, 2012).

The major source of vitamin D in non-tropic areas is from food. Animal food is the main source of cholecalciferol, namely: egg yolks, liver, butter, and fish liver oil. Cow’s milk and breast milk are not good sources of vitamin D. Vitamin D needs can be fulfilled through food fortification, especially milk, butter, food for babies with vitamin D2 (radiated ergosterol). Fish liver oil is often used as a vitamin D supplement for babies and children. Under normal circumstances vitamin D supplements are actually not needed. Vitamin D is relatively stable and is not damaged when heated or stored for a long time. The content of vitamin D in food can be seen in table 4.

### Sun Exposure and Vitamin D Concentration

Exposure of sunlight is the best source of vitamin D and there are no cases of vitamin D intoxication if excessive of sun exposure, because pre-vitamin D3 and vitamin D3 will absorb UVB

**Table 5.** Vitamin D content of various food ingredients (µg/100 gram) (Wacker & Holiack, 2013)

Sources	µg	Sources	µg
Milk	0,01–0,03	Fish liver oil	210
Breast Milk	0,04	Margarinee from	5,8–8,0
Milk Flour	0,21	Broom, pork, lamb	Less
Cream	0,1–0,28	Poultry	Less
Cheese	0,03–0,5	Liver	0,2–1,1
Yoghurt	less–0,04	Freshwater Fish	Less
Egg	1,75	Fat Fish	less–25
Egg yolk	4,94	Shrimp and scallops	Less
Butter	0,76	Fortified milk	200–250 IU (D2 and D3)
Livestock Salmon	200–250 IU	Cow’s Milk Formula	300
Canned Salmon	300-600	Cereal	40 (D2)
Canned Sardines	300	Cod liver oil	400–1000
Canned Mackerel	250	Shiitake Mushrooms	1000–1600 (D2)
Canned Tuna	230	Button Mushrooms	40 (D2)

1 IU vit D = 0.025 µg vit D3  
 1 µg vit D3 = 40 IU vit D

solar radiation and undergo transformation into several photoproducts biologically inactive so it will not Vitamin D intoxication occurs.

The intensity of UVB sunlight is low at 07.00 am, increasing in the following hours until 11.00; after 11.00 this intensity is relatively stable and high until 14.00 and then decreases, and at 16.00 reaches the same intensity as at 07.00.

Referring to Holick (2006) the required exposure time at an intensity of 1 MED/hour is  $1/4 \times 60$  minutes or equal to 15 minutes. If the exposure intensity is 2 MED/hour, the length of service will be shorter. This intensity was only reached at 11.00-13.00. Exposure to sunlight on the face and arms for 25 minutes at 09.00 or 11.00 to 13.00 for 15 minutes has increased the concentration of vitamin D by 2700 IU each time of exposure. We recommend that to prevent VDD with exposure to sunlight 15-30 minutes for 2-3 times/week or 2 hours/week (Nimitphong & Holick 2013; Gropper, S. S., & Smith 2012)

Variations in vitamin level are influenced by seasons, with higher concentrations in summer, and lower in winter. The sun-rich country of Indonesia throughout the year is at 6° N (North Latitude) - 11°08'S (South Latitude) and 95° East-14° East. Individuals living near the equator get sun exposure without sun protection have concentrations of 25(OH)D above 30 ng/mL. The use of chronic sunscreens can cause vitamin D deficiency. The use of sunscreens with SPF 8 decreases skin vitamin D production by 93% and will increase to 99% when using sunscreens with SPF 15 (Gropper, S. S. & Smith 2012).

Thalassemia children tend to be exposed to more sun than adults. This is due to the majority of children playing outdoors during the day compared to adults who work indoors. One study stated that thalassemia children with ferritin > 1.000 ng/dL, 30% exposed to sunlight 1-2 hours/week and 32% exposed to sunlight > 2 hours/week (Fadilah, Rahayuningsih, & Setiabudi, 2017).

### **Dietary Intake and Vitamin D Concentration**

Thalassemia patients are at risk of experiencing a lack of nutrient intake. Low Hb concentration cause fatigue, which causes decreased appetite and less food intake. In addition, eating habits that like to consume low-calorie foods, food intolerance

(such as lactose), avoiding certain foods, especially foods high in iron, and side effects of chelation drugs (nausea, cramps, and zinc loss) can reduce the intake of thalassemia patients.

Ineffective erythropoiesis and rapid red cell turnover in thalassemia causes an increase in energy expenditure and other nutrients to maintain normal erythropoiesis. Thalassemia patients have increased energy expenditure and protein turnover (Meksawan et al, 2011). Vitamin D plays role in controlling RQ through glucose utilization and is therefore very positively related to basal and bone metabolism (Ogata et al., 2018).

Low vitamin D intake is possible due to low intake of vitamin D rich foods such as milk and vitamin D fortified foods, limited availability of foods containing vitamin D and lack of public purchasing power for vitamin D rich food sources because these vitamin D food sources are relatively expensive. A study conducted in Indonesia showed that the subject's vitamin D intake did not affect serum vitamin D concentration.

There are little dietary sources of cholecalciferol. The richest sources are oily fish like fish liver oils, salmon, mackerel, and tuna. Egg also contains a relatively large amount. Vitamin D can also be obtained from foods fortified with vitamin D, including cereal products, bread products, milk, butter, cheese, margarine. Various multivitamins contain vitamin D3 plain (standard vitamin D) currently available on the market, as a nutritional supplement. In addition, there is now also available vitamin D3 which has been hydroxylated in the form of calcitriol and alfacalsidol. Calcitriol is an active vitamin D3 (already undergoing complete hydrosilation) that can work directly with the vitamin D receptors in the intestine so that it can increase calcium absorption in the intestine. Alfacalsidol is a synthetic active analogue of vitamin D which has been hydroxylated, which physiologically will take place in the kidneys only after the hydroxylation process in the liver.

Prevention of this deficiency at the age of 19-50 years is done by taking vitamin D supplements at least 600 IU/day so as to prevent bone disease and muscle function. However, vitamin D supplements 1500-2000 IU/day is recommended to increase serum vitamin D above 30 ng/mL (Aw et al., 2016).

Macronutrients are predicted affect serum vitamin D concentration. Dietary source of vitamin D are fat and protein sources. Most food sources of protein and fat come from animals, while carbohydrate sources of food contain very little vitamin D. Based on the research of Nicolas et al, protein-rich foods such as fish, fortified milk and meat are the main sources of natural cholecalciferol (vitamin D<sub>3</sub>) which can suppress the activity of *DHCR7*, a gene making enzyme that converts 7-dehydrocholesterol into cholesterol in human skin cells thereby affecting concentration of human vitamin D (Nicolas W. Cortes-Penfield, Barbara W. Trautner, 2017).

World Health Organization (WHO) recommends consuming fat as much as 15-30% of total calories. This amount meets the needs of essential fatty acids and helps the absorption of fat-soluble vitamins like vitamin D. Jungert et al's research in 2013 proved that fat intake is positively correlated with vitamin D intake and has an effect on vitamin D concentration (Jungert et al, 2014). Low or moderate fat intake makes vitamin D easier absorbed than high fat diet, no research can explain the reason. This is suspected that vitamin D becomes almost too soluble and forming clumps fat too large, making it difficult to pass through the intestinal lining. Vitamin D absorption is not influenced by the type of fatty acid (Raimundo et al., 2011). So, optimal nutrient intake is very important to prevent deficiency of vitamin D.

## CONCLUSION

Vitamin D concentration in patients with thalassemia are not only influenced by dietary vitamin D intake and sun exposure, but also energy, protein and fat intake. Thalassemia patients should meet the needs of nutrients, especially macronutrients and quite exposed to sunlight at least 2 hours per week at a time of high UVB intensity to prevent vitamin D deficiency.

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## RELATIONSHIP OF FORMER HISTORY OF DIARRHEA AND SANITATION WITH THE PREVALENCE OF STUNTING AMONG CHILDREN AGED 1–5 YEARS IN SIDOTOPO WETAN, SURABAYA

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### ABSTRACT

Stunting defines as an abnormal linear growth of children less than -2 standard deviations (SD) of the height measurements according to age. According to WHO (2013), the quality and quantity of nutrient intake and the presence of infectious diseases are directly associated with stunting, while hygiene and sanitation are indirectly associated with stunting. This study aimed to determine whether there is a relationship between disease history and sanitation with the incidence of stunting in children aged 1-5 years in the working area of Sidotopo Wetan Health Center (*Puskesmas*), Surabaya City. This cross-sectional study was used secondary data from the survey of Puskesmas Sidotopo Wetan children under five - supervising program 2020 which included 166 children aged  $\leq 5$  years. The dependent variable was stunting, and the independent variables are the history of diarrheal disease and sanitation facilities. The results found that 77 children under five were stunting (46.40%), history of frequent diarrhea was 19.26%, history of the last one month of having diarrhea was 20.47%, permanent healthy toilet ownership 89%, and qualified trash bin were 46.97%. The results of the chi-square statistical test on the research variables further showed a positive relationship with a history of frequent diarrhea ( $p = 0.023$ ) and diarrhea during the past month ( $p = <0.001$ ) with the incidence of stunting. There was also a negative relationship between the toilet ( $p = <0.001$ ) and trash bin ownership with the incidence of stunting ( $p = 0.023$ ). Thus, this study concludes that the history of diarrhea and environmental sanitation factors of toilet and trash bin ownership have a relationship with the incidence of stunting in children under five years old. The stunting prevention program shall more consider the awareness of the parents and their kids about nutrient intake, practice of hygiene and sanitation in the house.

**Keywords:** history of diarrhea, sanitation, stunting

### INTRODUCTION

Stunting is abnormal linear growth in children. A child categorized as stunted if the measurement results of height according to age are less than -2 standard deviation (SD) (WHO, 2010). The problem of stunting interprets the occurrence of chronic nutrition in the fetus, infants, and children under-five, as well as other indirect factors related to health issues (Pusdatin, 2016). Meanwhile, the direct cause of the incidence of stunting is lack of quantity of nutritional intake, as well as the presence of infectious diseases that occur over a long period of time or repeatedly, while the indirect causes include hygiene and sanitation (WHO, 2013).

The incidence of stunting is caused by food security at the household level, parenting, social, economic, and environmental conditions, including hygiene and sanitation. Meanwhile, the direct

cause of stunting is a lack of nutritional intake of quality or quantity so that children's needs are not fulfilled, as well as the presence of infectious diseases that occur over a long time or repeatedly (UNICEF, 2013).

Based on data from the Surabaya City Health Profile, the percentage of children under five with stunting in Surabaya in 2018 was 8.92%, of which was broken down into stunting of 2.04% and severe stunting of 6.88%. The Basic Health Research of the Republic of Indonesia (*Riskesdas*) in 2018 regarding infectious diseases affirmed that diarrhea was one of the infectious diseases and was the leading cause of under-five children mortality with 12.3% (Riskesdas, 2018).

The 2018 survey results in Indonesia showed that households with access to proper sanitation were 74.6%, which had been compared to the standard SDG's is only 7.47% qualifying

proper sanitation (BAPPENAS, 2020). Besides, according to the 2018 *Riskesdas* data, in East Java, the proportion of households that discharged wastewater directly into the sewer flow either from bathroom or laundry and kitchen waste reached 53.2% (Indonesia MoH, 2018).

According to the results of data analysis from the Indonesia Family Life Survey (IFLS), it was disclosed that an increase in sanitation factors is related to the risk of diarrhea infection in Indonesian children (Azhar, 2014; Patunru, 2015; Cronin, 2016). The results of other studies further showed that poor access to sanitation in types of unqualified toilets increases the risk of stunting by 1.3 times higher than those of babies under two years who use proper toilets (Adiyanti, 2014). These results thus confirmed that water and sanitation are the primary interventions to prevent stunting. Based on these findings, this study aims to determine the relationship between a history of diarrhea and sanitation facilities and the incidence of stunting in children aged 1-5 years.

## METHOD

This study applied the *cross-sectional* research design carried out in Sidotopo Wetan Health Center, Surabaya City. The population in this study was children under five years in the working area of Sidotopo Wetan Health Center with exclusion criteria are incomplete data, congenital disabilities, chronic disease, and had undergone a *Community Feeding Center (CFC) / Therapeutic Feeding Center (TFC)*. The sample of this study, however, was in the form of secondary data taken from the 2020 children under five monitoring database survey conducted by health center nutritionists. From a total of 651 data samples, 166 samples that met the assessment criteria for the study sample were obtained.

The independent variables in this study were a history of diarrhea and sanitation, including the ownership of healthy toilets and qualified trash bin, while the dependent variable was stunting. The stunting category, moreover, was based on the z-score, namely height for age (height/age) of less than -2 standard deviation (SD) (WHO, 2010). The measurement of body length for under-two-year children was carried out by utilizing an

infantometer length board and a microtoise to measure the children under five s' height, the tools used have an accuracy of 0.1 cm. The measurement was carried by the nutrition officer of Sidotopo Wetan Health Center Surabaya.

The data was collected using secondary data from the results of the 2020 children under five monitoring database survey conducted during January - February by health center nutritionists. Measurement of diarrheal data was obtained based on historical data from frequent infections and diseases experienced during the last one month, with the option: "fever, runny nose, cough, diarrhea, none, and other diseases" then classified into "diarrhea, other than diarrhea, and not sick". Data on toilet sanitation facilities, with options: "permanent healthy toilet, semi-permanent healthy toilet, public toilet, and open defecation". Data on waste bin facilities with the classification: "qualified, unqualified, and do not exist" (Surabaya City Health Office, 2020).

The statistical analysis with SPSS 20 software, furthermore, used the chi-square test for nominal data, while for ordinal and ratio data, logistic regression tests with a confidence level (CI) of 95% or  $\alpha = 0.05$  was employed. This study, moreover, has passed the ethical review from the ethics committee of the Faculty of Dentistry, Universitas Airlangga, with certificate number: 214/ HRECC.FODM / IV / 2020 also approval from Surabaya Health Office and Sidotopo Wetan Health Center Surabaya.

## RESULTS AND DISCUSSION

### Under-five Children Characteristics

Based on table 1, it can be seen that the sample of under-five children with stunting was 77 (46.4%) and 89 (53.6%) for normal children. Most of the respondents aged more than two years old and female, but for under-five children who experienced stunting were mostly male (23.49%). In a cohort study, furthermore, it was found that 6-24 months of age male infants had a twofold more significant risk of experiencing stunting compared to female infants (Medhin et al., 2010; Roscha et al., 2013). Male gross motor development is faster and less monotonous so that

it requires more energy, the energy reserves used for children's growth will decrease thus escalate stunting risk (Setyawati, 2018)

Under-five children who experienced stunting in this study were mostly in the group of children over two years old, as many as 76 under-five children (45.78%). This result is in line with the results of Maharani's research in 2018, which affirmed that 15 out of 25 children under five are stunted when they are five years old because it is a critical period of growth and they not receive breast milk as moved into the weaning phase; breast milk itself play roles as protection that supports the immune system so that they are at low risk. In addition, under-five children with 24 months of age have and have increased activity in their surroundings, develop and grow their children under five gross motor skills (Maharani, 2018). At this stage, some children under five experience several possibilities that result in a lack of intake and specific nutrients, decreased appetite, decreased sleep hours, and the risk of developing infectious diseases is high if the mother or nurse is lacking in hygiene and sanitation (Setyawati, 2018).

The number of families of under-five children in the entire sample of the stunting group was in small families, or the number of members was less than 4. In brief, there were 44 under-five children (26.50%) who came from small families and 45 under-five children from large families (27, 01%). Families with more than five children or more than eight family members can be at risk of stunting in children in their families (Fikadu, 2014; Kofuor, 2014). Additionally, under-five children who come from families with a large number of household members are 1.34 times more likely to experience stunting than children under five from families with sufficient household members (Oktarina dan Sudiarti, 2013). The number of family members does not guarantee the fulfillment of the nutritional status of each family member, the arrangement of food availability and distribution is even and balanced can reduce the risk of stunting (Fitri, 2010).

Most of the mothers had a status of housewives so that the mother had a direct role as caregivers for under-five children concerning the incidence of stunting ( $p = 0.001$ ), one possible

reason is education level mother that contribute to the stunting. Stay-at-home mothers will have a higher intensity in caring for their children under five. Therefore, they can control their feeding patterns and meet their intake needs so that optimal nutritional status can be achieved (Sari, 2017). For working mothers, nonetheless, a lot of time is consumed for work so that mothers do not have time to get information on children's growth (Nafi'ah, 2015).

Besides, most of the parents were still married or not single parents, namely 74 (44.57%) for parents of under-five children with stunting and 88 (53.01%) for parents of normal children.

### **History of Diarrhea**

Table 2 revealed that diseases other than diarrhea had a high frequency and were often suffered by both normal and stunting. Children under five with a normal nutritional status more often experienced diarrhea, as many as 24 children under five (14.45%), compared to the stunting children (4.81%). The same phenomenon also occurred in the history of the disease in the last month, confirming that children under five with normal nutritional status had diarrhea as many as 27 children under five s (16.26%). In contrast, only seven children under five (4.21%) were stunted. In stunting children under five, moreover, there were more diseases besides diarrhea, such as fever, cough, colds, or other conditions. In the interview results, several children under five had a history of other diseases such as inflammation and shortness of breath. This result can be further related to the symptoms of Acute Respiratory Infection (ARI) that many children experience when they are less than five years old and often affect their appetite. Thus, their intake and nutritional status are deficient. According to Mardiah's research in 2018, children under five not only experience one symptom complaint but three to five different complaints when experiencing ARI, and symptom grouping is based on complaints of ARI disease (Mardiah, 2018). According to the World Health Organization (WHO) in 2012, it was recorded that 78% of children under five experiencing ARI visited health services. Most parents, however, tended to ignore the symptoms; whereas, reciprocal interaction between infectious diseases

**Table 1.** Characteristics of Families and Children

Variable	Nutritional Status (HAZ)				p value
	Normal		Stunting		
	n	(%)	n	(%)	
<b>Parent Characteristics</b>					
<b>Father's Education</b>					
Graduated from high school	85	51.24	77	46.38	0.060
Didn't graduate from high school	4	2.40	0	0	
<b>Mother's Education</b>					
Graduated from high school	45	27.11	28	16.87	0.514
Didn't graduate from high school	44	26.51	49	29.51	
<b>Father's occupation</b>					
Work	89	53.61	76	45.78	0.281
Does not work	0	0	1	0.60	
<b>Mother's work</b>					
Work	23	13.65	13	7.83	0.162
Does not work	66	39.75	64	38.55	
<b>Family Income</b>					
High ( $\geq$ minimum wage)	5	3.02	11	6.62	0.059
Low ( $<$ minimum wage)	85	51.20	66	39.75	
<b>Number of Family Members</b>					
Small family ( $\leq 4$ persons)	44	26.50	77	46.38	$<0.001^*$
Extended family ( $>4$ persons)	45	27.01	0	0	
<b>Parents' Marital Status</b>					
Married	88	53.01	74	44.57	0.245
Ever been married	1	0.60	3	1.80	
<b>Under-five Children Caregivers</b>					
Mother	59	35.54	68	40.96	0.001*
Other than Mother	30	18.07	9	5.42	
<b>Under-five Children Characteristics</b>					
<b>Age (Month)</b>					
$<2$ Years	25	15.06	1	0.60	0,238
$>2$ Years	64	38.55	76	45.78	
<b>Gender</b>					
Male	35	21.08	39	23.49	0,748
Female	54	32.53	38	22.89	
<b>LBW</b>					
LBW	10	6.02	6	3.61	0,239
Non LBW	79	47.59	71	42.77	

\*Note: mean, average; SD, standard deviation; EIB, Early Initiation of Breastfeeding; LILA, the circumference of the upper arm; LIKA, head circumference; TB / U, height according to age; High school, high school. \* The *P*-value is significant if  $<0.05$ .

and nutritional status, malnutrition will increase the risk of infection and infection can lead to malnutrition. If this happens for a long time and is not balanced with good nutrition, it will increase the risk of stunting (Mardiah, 2018).

Based on the results of statistical tests, children under five who often experience diarrhea

are associated with the incidence of stunting, as indicated by the value of  $p = 0.023$ . Similarly, children who had diarrhea in the last month also have a relationship with the occurrence of stunting with the value of  $p = <0.001$ . These results, moreover, are in line with the UNICEF conceptual framework, namely infectious diseases as one

**Table 2.** Relationship between disease history and incidence of stunting

Variable	Nutritional status (HAZ)				p-value
	Normal		Stunting		
	n	(%)	n	(%)	
<b>Frequently Suffered Diseases</b>					
Diarrhea	24	14.45	8	4.81	0.023
Apart from diarrhea	62	37.34	67	40.36	
Healthy	3	1.8	2	1.2	
<b>Disease during the Past Month</b>					
Diarrhea	27	16.26	7	4.21	<0.001
Apart from diarrhea	47	28.31	62	37.34	
Healthy	15	9.03	7	4.21	

of the direct causes of nutritional problems. In 2018, Rosiyanti studied several risk factors for stunting in Indonesia, Malaysia, Thailand, Laos, Myanmar, and Cambodia, and found that infectious disease factors, namely the incidence of diarrhea, affect the prevalence of stunting (Rosiyanti, 2018). Furthermore, as many as 6 million children die every year, especially in developing countries such as Indonesia (Indonesia MoH, 2013; WHO, 2012).

Acute diarrhea infection in children under five is associated with viral or bacterial acute gastroenteritis. Viruses causing diarrhea that are commonly found in children include rotavirus, norovirus, astrovirus, and several types of adenovirus. Rotavirus further releases enterotoxins that destroy intestinal mucosal enterocytes resulting in reduced absorption area, imbalance of secretion and absorption, and increased antiviral

intestinal motility (Cooke, 2010). The result in diarrhea and dehydration (McCance et al., 2014). If this condition occurs for a long time and is not accompanied by adequate intake for the healing process, it will result in stunting (Indonesia MoH, 2018).

The occurrence of diarrhea in children under five is influenced by environmental sanitation and poor personal hygiene behavior, as well as insufficient knowledge (WHO, 2013). Transmission of diarrhea is generally through the fecal-oral method, such as through food or drink contaminated by enteropathogens, or direct hand contact with sufferers or items that have been contaminated with patient feces or indirectly through flies (Bambang and Nurtjahjo, 2011). The process of transmission, moreover, includes washing cooking utensils using unclean water, drinking water that is not boiled first, and so on (Indonesia MoH, 2010).

Research by Abeng in 2014 concluded that children with poor environmental sanitation conditions or do not meet the requirements have the potential to suffer diarrhea by nine times higher (Abeng, 2014).

**Table 3.** Relationship between Sanitation Facilities and Stunting

Variable	Nutritional status				p-value
	Normal		Stunting		
	n	(%)	n	(%)	
<b>Toilet Ownership</b>					
Permanent Healthy Toilet	78	46.98	70	42.17	0.001
Semi-Permanent Healthy Toilet	10	6.02	0		
Public Toilet	1	0.60	7	4.22	
<b>Trash can</b>					
Available, Qualified	33	19.88	45	27.11	0.006
Available, Unqualified	56	33.73	32	19.28	

### Sanitation Facilities

The results of the analysis identified that there was a relationship between toilet ownership and the incidence of stunting, indicated by  $p=0.001$ . In the sample group of children under five with stunting, 70 samples (42.16%) used permanent healthy toilets, and seven respondents (4.21%) still used public toilets. These findings further in line with the research carried out by Rohmah, explaining

**Table 4.** Relationship Between Diarrhea, Sanitation Facilities and Stunting

Variable	B	S.E	Sig	Exp (B)	CI 95%
<b>Frequently Suffered Diseases</b>					
Diarrhea					
Apart from diarrhea	0.483	0.93	0,029	1.621	0.262 10.027
Healthy					
<b>Disease during the Past Month</b>					
Diarrhea					
Apart from diarrhea	1.039	0.497	0.037	2.827	1.067 7.486
Healthy					
<b>Toilet Ownership</b>					
Permanent Healthy Toilet					
Semi-Permanent Healthy Toilet	-2.054	1.082	0.058	0.128	0.015 1.168
Public Toilet					
<b>Trash bin</b>					
Available, Qualified	-0.87	0.319	0.006	0.419	0.224 0.783
Available, Unqualified					

Note: B, koefisien beta; S.E, standar error; Sig, significant value; Exp (B), exponent value from B; CI, confident interval

that there is a significant relationship between the use of healthy toilets and the incidence of diarrhea (Rohmah, 2017). Research by Woldemicael in 2011 also revealed that toilet facilities increase the risk of stunting (Woldemicael, 2011). Improper fecal disposal behavior can increase the incidence of diarrhea because it can pollute the environment, mostly water, and soil around the place of residence (Rahman et al., 2016). Van der Hoek further stated that children who come from families that have clean water facilities have a lower prevalence of stunting than children who live with poor sanitation (Van der Hoek, 2014).

The use of water and soap in households is a contamination factor because children can ingest water that is contaminated with pathogens and is associated with the incidence of stunting (Corina, 2019). It is recorded that 34% of the diarrhea rate is higher in children whose households use open wells, which are used as sources of drinking water (Utami, 2015). Children under five who live with poor sanitation, thus, are more at risk of stunting because some stunted children under five have a place to live that does not meet the requirements for a healthy house, ventilation, lighting, and the availability of closed and watertight garbage dumps (Kusumawati, 2015). Those studies supported the results of the study, availability of qualified trash bin is associated with diarrhea ( $p=0.023$ ).

Sanitation also plays a role as a factor in the prevalence of stunting because poor sanitation will increase the risk of illness in children under five. Sanitation does not meet the requirements, such as not having the supply of clean water for washing hands and food, or cleaning eating utensils will cause germs and bacteria that cause diarrhea alive. Water supply, additionally, is closely related to health; water contamination can lead to repeated infections (Cumming and Cairncross, 2016; Cronin et al., 2015).

Garbage in the trash bin more than 3x24 hours (3 days) can invite vectors, especially flies. The vector flies that are in the house due to the pile of garbage that are not thrown away can carry bacteria so that it is possible to land on the food to be consumed, which causes infectious diseases, namely diarrhea (Herawati, 2020).

Based on the regression test, it was found a positive relationship between a history of diarrhea and the incidence of stunting. Children under five who often experience diarrhea will have a 1.6 times risk of experiencing stunting and in the past month experiencing diarrhea, the risk of experiencing stunting is 2.8 times. In addition, sanitation factors have a negative relationship with the incidence of stunting, which means that families of under-five children who have healthy toilets will reduce the risk of stunting by 0.1 times. The existence of trash

bins that meet the requirements will reduce the risk of children under five experiencing stunting by 0.4 times with a 95% CI value (0.224; 0.78).

## CONCLUSION AND RECOMMENDATIONS

There is no difference in the level of maternal education and maternal occupation between stunting and normal under-five children. Most of the mothers of the samples have completed their education up to high school. Most of the jobs of mothers are housewives, so mothers have a direct role in caring for children under five, which has a relationship with the incidence of stunting in under-five children. The number of family members divided into small and large families is also associated with the prevalence of stunting.

Most of the under-five families, however, are classified as small families and have a total income below the minimum wage. Based on the results of this study, therefore, it can be concluded that the variable history of diarrhea is significantly associated with the incidence of stunting in children under five. In addition, environmental sanitation factors where children live, namely ownership of toilet and trash bin, also have a significant relationship with the incidence of stunting. Hence, it is necessary to increase the intensity of socialization and education regarding the importance of maintaining environmental cleanliness. Implementing education by regularly cleaning sanitation facilities and using them properly, to avoid bacterial contamination that can cause infectious diseases. The stunting prevention program shall more consider the awareness of the parents and their kids about nutrient intake, practice of hygiene and sanitation in the house.

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## ASAM KLOOROGENAT PADA KOPI DAN OBESITAS: *A SYSTEMATIC REVIEW*

*Chlorogenic Acid in Coffee and Obesity: A Systematic Review*

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### ABSTRAK

Obesitas terjadi karena adanya penumpukan lemak yang berlebih akibat ketidakseimbangan asupan energi dengan pengeluaran energi. Mengonsumsi secangkir kopi dapat membantu mencegah obesitas melalui senyawa asam klorogenat yang ada pada kopi. Asam klorogenat adalah komponen bioaktif yang memiliki peran penting bagi tubuh. Asam klorogenat berperan untuk menurunkan berat badan sehingga mencegah terjadinya obesitas. Asam klorogenat memiliki efek untuk menghambat absorpsi glukosa di intestin yang pada akhirnya mencegah terbentuknya lemak di jaringan adiposa sehingga menurunkan risiko seseorang mengalami peningkatan berat badan. Kandungan asam klorogenat pada kopi juga berbeda tergantung pada varietas, jenis, durasi penyangraian, suhu dan ukuran biji kopinya. Berdasarkan beberapa penelitian, pemberian asam klorogenat baik dalam bentuk suplementasi maupun ekstrak kopi hijau telah menunjukkan hasil yang konsisten. Penelitian tersebut menjelaskan bahwa kandungan asam klorogenat pada kopi dapat menghambat akumulasi lemak dan membantu menurunkan berat badan. Tujuan *systematic review* ini adalah untuk mengetahui kandungan asam klorogenat pada kopi dan menganalisis pengaruh pemberian asam klorogenat terhadap penurunan berat badan. Studi literatur dilakukan dengan memilih penelitian sesuai kriteria inklusi yaitu penelitian dengan desain eksperimental pada manusia dan hewan coba selama 15 tahun terakhir serta kriteria eksklusi yaitu penelitian yang tidak menunjukkan hasil antropometri melalui beberapa jenis *electronic database*. Hasil telaah dari lima artikel menunjukkan bahwa asam klorogenat dapat menurunkan berat badan, persentase lemak tubuh dan kadar glukosa darah dengan durasi dan dosis asam klorogenat yang berbeda. Hal ini membuktikan bahwa asam klorogenat bermanfaat memperbaiki status gizi obesita.

**Kata kunci:** asam klorogenat, berat badan, obesitas, tinjauan sistematis

### ABSTRACT

*Obesity are defined as excessive fat accumulation caused of imbalance energy in and energy out. Consuming a cup of coffee can help prevent obesity through chlorogenic acid compound. Chlorogenic acid is one of biactive component that has an important role to our body. Chlorogenic acid has a potential role in body weight reduction and preventing obesity. Chlorogenic acid has an effect to inhibit the absorption of glucose in the intestine, block the conversion of glucose to fat in the adipose tissue and protect from weight gain. Chlorogenic acid that contain in coffee has a differences that depend on variety, type, roasting duration, temperature and coffee bean size. Based on several studies, giving chlorogenic acid as a form of supplementation or green coffee extract has demonstrated a consistent result. Those studies explain that chlorogenic acid in coffee can inhibit body fat accumulation and reducing body weight. The aim of this systematical review was to know the contain of chlorogenic acid in coffee and analyze the effect of giving chlorogenic acid to obesity. The experimental studies in human and animal subjects in the last 15 years as inclusion criteria and studies that is not represent the anthropometry result as exclusion criteria through electronic database were comprehensively reviewed. The result from five studies demonstrated that chlorogenic acid has an effect to reduce body weight, reduce body fat percentage, and reduce blood glucose concentration with the duration and chlorogenic acid dosage differently. Chlorogenic acid has many benefits in improving the obesity.*

**Keywords:** chlorogenic acid, body weight, obesity, review

## PENDAHULUAN

Status gizi adalah keadaan yang diakibatkan oleh keseimbangan antara asupan zat gizi dari makanan dengan kebutuhan zat gizi yang diperlukan untuk metabolisme tubuh. Gambaran status gizi seseorang dapat diketahui melalui indikator tertentu. Indikator yang dapat digunakan pada kelompok dewasa adalah Indeks Massa Tubuh (IMT) (Kemenkes, 2017). Status gizi seseorang tergantung dari asupan gizi dan kebutuhannya, jika antara asupan gizi melebihi kebutuhan tubuhnya maka akan menghasilkan status gizi obesitas.

Status gizi normal penting terutama untuk usia harapan hidup yang lebih panjang. Masalah kelebihan gizi pada usia dewasa merupakan masalah penting, karena selain mempunyai risiko penyakit - penyakit tertentu juga dapat mempengaruhi produktivitas kerja (Depkes, 2013). Berdasarkan hasil Riskesdas tahun 2007-2018, prevalensi penduduk dewasa >18 tahun dengan status gizi obesitas meningkat dari 10,5% pada tahun 2007 menjadi 14,8% pada tahun 2013 dan meningkat kembali menjadi 21,8% pada tahun 2018 (Riskesdas, 2018).

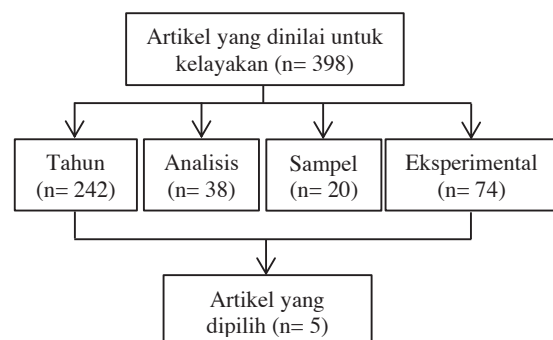
Masalah gizi obesitas yang terus meningkat pada kelompok dewasa ini menjadi penyebab munculnya berbagai alternatif dalam menurunkan berat badan salah satunya adalah mengonsumsi kopi (Icken *et al.*, 2016). Kopi adalah salah satu minuman yang banyak dikonsumsi di seluruh dunia, terdiri dari berbagai zat kimia yang bermanfaat bagi tubuh dibandingkan dengan jenis minuman lainnya (Tajik *et al.*, 2017). Kopi memiliki berbagai macam komponen bioaktif yang bermanfaat bagi tubuh seperti kafein, asam klorogenat, diterpen, kahweol dan lainnya (Gavrieli *et al.*, 2013).

Berbagai penelitian telah menyatakan terdapat hubungan terkait asam klorogenat pada kopi dengan obesitas karena kandungan asam klorogenat pada kopi dapat menurunkan berat badan sehingga dapat mencegah terjadinya obesitas. Systematic review ini bertujuan untuk mengetahui kandungan asam klorogenat pada kopi, mengetahui mekanisme asam klorogenat dalam menurunkan berat badan dan menganalisis pengaruh asam klorogenat pada kopi terhadap status gizi obesitas.

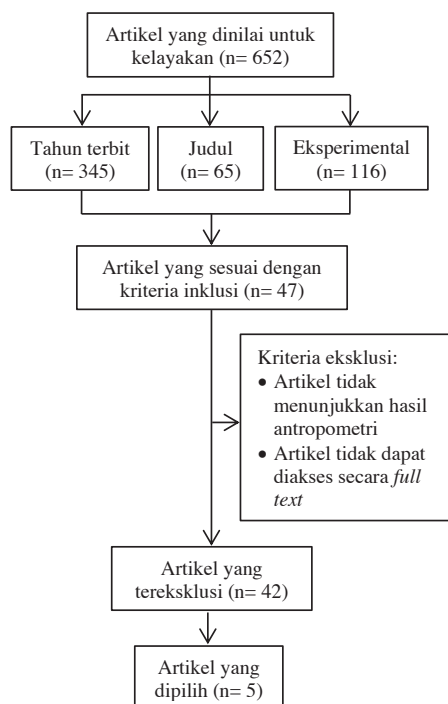
## METODE

Metode yang digunakan adalah metode *traditional systematic review*. Artikel yang digunakan adalah artikel jurnal internasional yang ditelusuri menggunakan *electronic database*, seperti *Medline*, *NCBI (National Center for Biotechnology Information)*, *Science Direct*, dan *Google Scholar*. Jenis artikel pertama yang dipilih adalah artikel penelitian eksperimental mengenai kandungan asam klorogenat pada kopi. Penelitian mengenai kandungan asam klorogenat pada kopi ditelusuri menggunakan kata kunci yaitu “*determination of chlorogenic acid in coffee*” dan “*the amount of chlorogenic acid in coffee*”. Dari kata kunci dan proses *critical appraisal*, didapatkan 5 artikel penelitian eksperimental selama 15 tahun terakhir mengenai penentuan kandungan asam klorogenat pada kopi menggunakan analisis *high performance liquid chromatography (HPLC)* dan menggunakan sampel berupa biji kopi hijau dengan berbagai macam kondisi seperti *green coffee beans*, *roasted coffee beans* dan *ground coffee*.

Jenis artikel kedua yang dipilih adalah artikel mengenai efek asam klorogenat pada kopi dengan status gizi obesitas. Artikel ditelusuri menggunakan kata kunci yaitu “*chlorogenic acid and obesity*”, “*chlorogenic acid and weight loss*” dan “*the effect of chlorogenic acid in obesity*”. Artikel yang dipilih merupakan artikel yang memenuhi kriteria inklusi antara lain kesesuaian judul dengan tujuan *systematic review*, artikel dengan desain penelitian eksperimental, dan artikel dengan tahun terbit selama 15 tahun terakhir. Kriteria eksklusi dari



**Gambar 1.** Diagram *consort* artikel penelitian kandungan asam klorogenat.



**Gambar 2.** Diagram *consort* artikel penelitian efek asam klorogenat pada status gizi obesitas.

*systematic review* ini adalah artikel yang tidak menunjukkan hasil pengukuran antropometri pada subjek dan artikel yang tidak dapat diakses secara *full text*. Dari kata kunci dan proses *critical appraisal*, didapatkan 5 artikel penelitian mengenai pengaruh asam klorogenat pada kopi terhadap status gizi obesitas dengan variabel antara lain kandungan asam klorogenat yang diberikan, lama pemberian intervensi, kadar glukosa darah, dan hasil pengukuran antropometri seperti nilai Indeks Massa Tubuh (IMT), lingkar pinggang dan persentase lemak tubuh.

## HASIL DAN PEMBAHASAN

### Kandungan Asam Klorogenat Pada Kopi

Asam klorogenat merupakan salah satu jenis komponen bioaktif yang ada pada kopi. Asam klorogenat adalah suatu senyawa yang termasuk kedalam komponen fenolik, mempunyai sifat yang larut dalam air dan terbentuk dari esterifikasi asam *quinic* dan asam *transcinnamic* tertentu seperti asam kafein, asam *ferulic*, dan asam *pcoumaric*. Asam klorogenat juga seringkali dikenal dengan

nama 5 - *caffeoylquinic acid* (Santana-Gálvez *et al.*, 2017). Kandungan asam klorogenat pada 200 ml gelas kopi sebesar 100 – 350 mg (De Rosso *et al.*, 2018). Kandungan asam klorogenat paling banyak ditemukan pada jenis kopi hijau. Jenis kopi hijau terutama jenis *robusta* paling banyak mengandung asam klorogenat yaitu sebesar 6.1–11.3 mg per gram (Farah, 2012). Perbedaan kandungan asam klorogenat tidak hanya didasarkan pada jenis saja, adanya beberapa faktor seperti pemanasan atau penyangraian biji kopi hijau atau disebut juga “*roasted coffee*” (Gloess *et al.*, 2014).

Proses penyangraian pada kopi merupakan kunci utama untuk mendapatkan kopi dengan kualitas tinggi. Hal ini disebabkan karena proses penyangraian pada kopi menentukan warna, aroma dan rasa dari biji kopi yang diproduksi (Pilipczuk *et al.*, 2015). Selama proses penyangraian, penguapan kandungan air pada biji kopi menyebabkan tekanan udara meningkat dan terjadi pemuaihan sel di dalam biji kopi. Dalam kondisi ini, terjadi kerusakan interseluler dan intraseluler matriks biji kopi dan membuat biji kopi menjadi keropos (Fadai *et al.*, 2018). Pada saat itu juga, warna pada biji kopi yang pada awalnya hijau menjadi lebih gelap karena pembentukan melanoidin melalui reaksi *Maillard* (Josiane Alessandra Vignoli *et al.*, 2014). Selain itu, salah satu efek dari penyangraian kopi adalah meningkatnya kepahitan kopi karena adanya pelepasan asam kafein dan pembentukan laktone yang bertanggung jawab untuk rasa dan aroma pada biji kopi (J. A. Vignoli *et al.*, 2011).

Proses penyangraian juga menyebabkan terjadinya perubahan fisik maupun kimia pada biji kopi tergantung dari durasi dan suhu yang digunakan (Cho *et al.*, 2014). Perubahan kandungan senyawa kimia pada biji kopi yang telah disangrai juga tergantung pada karakteristik biji kopi serta kondisi biji kopi pada saat penyangraian (Herawati *et al.*, 2019). Beberapa penelitian juga menyatakan bahwa dengan dilakukannya proses penyangraian pada biji kopi, asam klorogenat dapat terurai menjadi derivat fenol dan dapat menyebabkan nilai kandungannya menjadi berkurang (Liang dan Kitts, 2015). Analisis HPLC adalah analisis yang digunakan untuk memisahkan dan mengidentifikasi senyawa berdasarkan ukuran (Obayes, 2018).

Analisis HPLC paling sering digunakan untuk mengidentifikasi senyawa seperti asam

klorogenat, katekin, kafein dan berbagai macam senyawa fenolik lainnya (Vinson *et al.*, 2019). Berdasarkan hasil penelitian (de Carvalho, *et al.*, 2008) dengan metode eksperimental menggunakan analisis *square wave voltammetry* (SWV) dan *High Performance Liquid Chromatography* (HPLC) dan menggunakan 4 sampel kopi hijau yang dikemas dalam kemasan vakum dengan klasifikasi sampel A yaitu *roasted coffee (strong)*, sampel B yaitu *ground coffee (strong)*, sampel C yaitu *roasted green coffee* (tradisional) dan sampel D yaitu *ground green coffee* (tradisional). Sebanyak 3 gram dari masing-masing sampel dilarutkan ke dalam 50 ml air panas. Sampel kemudian dianalisis menggunakan SWV dan HPLC. Berdasarkan hasil analisis menggunakan SWV dan HPLC, kandungan asam klorogenat pada kopi hitam

*roasted* dan *ground* (sampel A dan B) lebih rendah daripada kandungan asam klorogenat pada kopi hijau (sampel A dan D).

Hasil penelitian mengenai penentuan kandungan asam klorogenat pada kopi oleh (Perrone *et al.*, 2012) menggunakan analisis HPLC juga memberikan hasil yang sama. Sampel berupa biji kopi dengan jenis robusta dan arabika disangrai pada suhu 170, 180, 190, dan 200°C selama 4, 5, 6, 7, 8, dan 9 menit. Hasil penelitian menyatakan bahwa kandungan asam klorogenat pada kopi akan menjadi lebih rendah apabila dilakukan proses penyangraian di suhu yang lebih tinggi dan durasi yang lebih lama karena asam klorogenat pada kopi akan menghilang secara perlahan.

Penelitian terkait kandungan asam klorogenat pada kopi juga dilakukan oleh (Vasilescu,

**Tabel 1.** Hasil Studi Kandungan Asam Klorogenat Pada Kopi

Peneliti	Metode	Analisis	Sampel	Hasil
de Carvalho, <i>et al</i> (2008)	Eksperimental	<i>Square Wave Voltammetry</i> (SWV) dan <i>High Performance Liquid Chromatography</i> (HPLC)	4 sampel kopi yaitu kopi hitam <i>roasted</i> dan <i>ground</i> serta kopi hijau <i>roasted</i> dan <i>ground</i> . Kemudian sampel masing – masing dibagi menjadi 3 gram dan disiapkan di dalam 50 ml air panas.	Analisis menggunakan SWV didapatkan hasil kandungan asam klorogenat pada sampel kopi hitam <i>roasted</i> = 444,8 mg/L dan <i>ground</i> = sebesar 545 mg/L. Sampel kopi hijau <i>roasted</i> = 522,7 mg/L dan <i>ground</i> = 746,5 mg/L. Analisis menggunakan HPLC didapatkan hasil kandungan asam klorogenat pada sampel kopi hitam <i>roasted</i> = 446,7 mg/L dan <i>ground</i> = 544,2 mg/L. Sampel kopi hijau <i>roasted</i> = 552,8 mg/L dan kopi hijau <i>ground</i> = 755 mg/L. Berdasarkan hasil analisis menggunakan SWV dan HPLC, kandungan asam klorogenat pada kopi hitam <i>roasted</i> dan <i>ground</i> lebih rendah daripada kandungan asam klorogenat pada kopi hijau. Kandungan asam klorogenat pada <i>ground green coffee</i> lebih tinggi daripada <i>roasted green coffee</i> .
Perrone, <i>et al</i> (2010)	Eksperimental	HPLC	2 sampel kopi hijau jenis robusta dan arabika yang kemudian masing – masing sampel sebanyak 30 gram disangrai pada 4 suhu yang berbeda yaitu 170°C, 180°C, 190°C dan 200°C dengan durasi penyangraian yang berbeda yaitu selama 4, 5, 6, 7, 8 dan 9 menit. Sebanyak 30 gram	Biji kopi hijau murni jenis robusta memiliki kandungan asam klorogenat lebih tinggi dari jenis arabika. Setiap 100 gr biji kopi robusta mengandung asam klorogenat sebanyak 10,16 gr dan biji kopi arabika sebanyak 8,28 gr. Kopi robusta dan arabika yang disangrai dengan suhu 170°C memiliki kandungan asam klorogenat lebih tinggi dari kopi yang disangrai pada suhu 200°C. Kopi robusta dan arabika yang disangrai selama 4 menit memiliki kandungan asam klorogenat lebih tinggi dari kopi yang disangrai selama 9 menit.

Peneliti	Metode	Analisis	Sampel	Hasil
Vasilescu, <i>et al</i> (2015)	Eksperimental	<i>Chronoamperometry</i> dan HPLC-PDA	2 sampel kopi hijau merk lokal (Grandia dan Jacobs) dan 2 sampel kopi hitam merk lokal (Carte Noir dan Davidoff) kemudian sebanyak 5 gram dari masing-masing sampel disiapkan di dalam 50 ml air panas atau etanol selama 30 menit.	Analisis menggunakan <i>chronoamperometry</i> didapatkan hasil kandungan asam klorogenat pada kopi hijau masing – masing 223,21 $\mu$ M dan 256,46 $\mu$ M, sedangkan kandungan asam klorogenat pada kopi hitam masing – masing 92,67 $\mu$ M dan 169,22 $\mu$ M. Analisis menggunakan HPLC didapatkan hasil kandungan asam klorogenat pada kopi hijau masing – masing 246,28 $\mu$ M dan 236,45 $\mu$ M, sedangkan kandungan asam klorogenat pada kopi hitam masing – masing sebesar 123,2 $\mu$ M dan 143,28 $\mu$ M. Berdasarkan hasil analisis menggunakan <i>chronoamperometry</i> dan HPLC-PDA, kandungan asam klorogenat pada kopi hijau sebagian besar lebih tinggi kandungan asam klorogenat pada kopi hitam.
Jeon, <i>et al</i> (2017)	Eksperimental	HPLC-DAD	Biji kopi hijau dari beberapa negara (Brazil, Colombia, Costa Rica, Indonesia dan Kenya) akan disiapkan untuk <i>coffee brew</i> dengan metode <i>filter drip</i> . Sampel kemudian disiapkan dengan langkah sebagai berikut: Biji kopi hijau disangrai menggunakan mesin dengan kondisi <i>medium</i> dan <i>medium-dark</i> . Biji kopi yang telah disangrai kemudian digiling menjadi 3 ukuran yaitu <i>coarse</i> , <i>medium</i> , dan <i>fine</i> . Kemudian sebanyak 10 gram sampel dimasukkan pada kertas saring diatas <i>coffee dripper</i> dan dilarutkan dalam 200 ml air mendidih.	Berdasarkan <i>roasting degree</i> , kandungan asam klorogenat menunjukkan hasil yang konsisten. Semua jenis kopi dari 5 negara untuk tingkat <i>medium roasting</i> memiliki kandungan asam klorogenat lebih tinggi daripada kopi yang disangrai tingkat <i>medium-dark</i> . Berdasarkan <i>ground size</i> , kandungan asam klorogenat juga menunjukkan hasil yang konsisten. Semua jenis kopi dari 5 negara menunjukkan bahwa kandungan asam klorogenat lebih tinggi apabila ukuran dari kopi yang digiling semakin kecil. Kopi yang digiling dengan ukuran <i>fine</i> ( $\leq 0,3$ mm) memiliki kandungan asam klorogenat lebih tinggi daripada kopi dengan ukuran <i>coarse</i> ( $\geq 1$ mm).
Choma, <i>et al</i> (2019)	Eksperimental	HPLC	5 sampel kopi arabika yaitu brazil <i>green</i> , salvador <i>green</i> , colombia <i>green</i> , papua <i>green</i> , dan papua <i>black</i> . Sampel diekstrak dengan metanol kemudian disaring menggunakan kertas penyaring. Analisis HPLC dilakukan selama 25 menit.	Analisis menggunakan HPLC didapatkan hasil kandungan asam klorogenat pada kopi brazil <i>green</i> sebesar 2,18 mg/mL, kopi salvador <i>green</i> sebesar 2,22 mg/mL, kopi colombia <i>green</i> sebesar 2,79 mg/mL, kopi papua <i>green</i> sebesar 3,1 mg/mL, dan kopi papua <i>black</i> sebesar 0,19 mg/mL. Berdasarkan hasil tersebut, kandungan asam klorogenat pada 4 jenis kopi hijau memiliki kandungan asam klorogenat lebih tinggi daripada jenis kopi hitam.

*et al.*, 2015) menggunakan 2 jenis kopi. Jenis kopi pertama menggunakan 2 sampel kopi hijau merek lokal yaitu Grandia dan Jacobs sedangkan

jenis kopi kedua menggunakan 2 sampel kopi hitam merk lokal yaitu *Carte Noir* dan *Davidoff*. Sebanyak 5 gram dari masing-masing sampel

dilarutkan ke dalam 50 ml air panas atau etanol. Pengukuran kandungan asam klorogenat pada kopi menggunakan analisis *chronoamperometry* dilakukan pada suhu  $24 \pm 0,5^\circ\text{C}$  pada pH 5. Sedangkan pengukuran kandungan asam klorogenat menggunakan analisis HPLC-PDA dilakukan pada suhu  $20^\circ\text{C}$  pada pH 3 dan dilakukan selama 30 menit. Hasil analisis *chronoamperometry* didapatkan hasil kandungan asam klorogenat pada kopi hijau *Grandia* sebesar  $223,21 \mu\text{M}$  dan Jacobs sebesar  $256,46 \mu\text{M}$ , sedangkan kandungan asam klorogenat pada kopi hitam *Carte Noir* sebesar  $92,67 \mu\text{M}$  dan *Davidoff* sebesar  $169,22 \mu\text{M}$ . Hasil ini menunjukkan bahwa kandungan asam klorogenat pada kopi hijau lebih tinggi daripada kopi hitam. Begitu pula analisis menggunakan HPLC, kandungan asam klorogenat pada kopi hijau *Grandia* sebesar  $246,28 \mu\text{M}$  dan Jacobs sebesar  $236,45 \mu\text{M}$ , sedangkan kandungan asam klorogenat pada kopi hitam *Carte Noir* sebesar  $123,2 \mu\text{M}$  dan *Davidoff* sebesar  $143,28 \mu\text{M}$ . Hasil ini juga menunjukkan bahwa kandungan asam klorogenat pada kopi hijau lebih tinggi daripada kopi hitam.

Penelitian lain juga dilakukan oleh (Jeon, *et al.*, 2017) dengan analisis HPLC-DAD untuk menentukan kandungan asam klorogenat pada kopi. Sampel yang digunakan adalah biji kopi hijau dari 5 negara yaitu Brazil, Colombia, Costa Rica, Indonesia dan Kenya. Tempat kultivasi setiap jenis kopi, karakteristik iklim dan lahan pertanian untuk biji kopi dari masing-masing negara tersebut tidak dicantumkan. Biji kopi hijau yang digunakan sebagai sampel penelitian akan disiapkan untuk proses *coffee brew* dengan metode *filter drip*. Sampel kemudian disiapkan dengan 2 proses. Proses pertama adalah biji kopi hijau disangrai dengan 2 hasil sangrai yaitu *medium* (biji kopi diangkat tepat setelah pecahan pertama) dan *medium-dark* (biji kopi diangkat tepat setelah pecahan kedua). Kemudian biji kopi yang telah disangrai memasuki proses kedua yaitu proses penggilingan menjadi 3 ukuran yaitu *coarse* ( $\geq 1 \text{ mm}$ ), *medium* ( $0,5-0,7 \text{ mm}$ ), dan *fine* ( $\leq 0,3 \text{ mm}$ ). Tahap selanjutnya, sebanyak 10 gram dari masing-masing sampel dimasukkan pada kertas saring diatas *coffee dripper* dan dilarutkan dalam 200 ml air mendidih selama 2,5-3 menit untuk hasil sangrai *medium* dan 3-4 menit untuk hasil sangrai

*medium dark*. Kandungan asam klorogenat pada biji kopi dibedakan berdasarkan *roasting degree* dan *ground size*. Berdasarkan *roasting degree*, tingkat *medium roasting* memiliki kandungan asam klorogenat lebih tinggi daripada kopi yang disangrai tingkat *medium-dark*. Hal ini disebabkan karena Sedangkan berdasarkan *ground size*, kandungan asam klorogenat lebih tinggi apabila ukuran dari kopi yang digiling semakin kecil. Kopi yang digiling dengan ukuran *fine* ( $\leq 0,3 \text{ mm}$ ) memiliki kandungan asam klorogenat lebih tinggi daripada kopi dengan ukuran *coarse* ( $\geq 1 \text{ mm}$ ).

Kandungan asam klorogenat pada kopi hijau murni lebih tinggi daripada kopi yang telah dilakukan penyangraian. Hal ini disebabkan karena kandungan asam klorogenat dapat bervariasi tergantung pada tingkat penyangraian yang dilakukan. Selama proses penyangraian, asam klorogenat mengalami kehilangan molekul air dan membentuk *lactones* dari asam *quinic* sehingga konsentrasi isomer 5-CQA, 4-CQA dan 3-CQA menurun menyebabkan kandungan asam klorogenat pada kopi tersebut juga menurun (Jeon, *et al.*, 2017). Kandungan asam klorogenat pada kopi juga dipengaruhi oleh ukuran kopi pada proses penggilingan. Ukuran kopi berperan penting pada proses *coffee brew* karena semakin kecil partikel maka semakin cepat kopi tersebut terekstrak jika dibandingkan dengan partikel yang lebih besar sehingga kandungan asam klorogenat pada kopi lebih tinggi pada kopi dengan ukuran partikel yang kecil (Uman, *et al.*, 2016).

Penelitian yang dilakukan oleh (Choma *et al.*, 2019) mengenai kandungan asam klorogenat pada kopi menggunakan sampel berupa kopi dengan jenis arabika yaitu *brazil green*, *salvador green*, *colombia green*, *papua green*, dan *papua black*. Sampel terdiri dari 4 jenis kopi hijau murni dan 1 jenis kopi hitam. Masing-masing sampel kemudian diekstrak menggunakan metanol dan selanjutnya disaring menggunakan kertas penyaring. Analisis HPLC untuk menentukan kandungan asam klorogenat pada kopi dilakukan selama 25 menit. Berdasarkan hasil analisis menggunakan HPLC didapatkan hasil kandungan asam klorogenat pada kopi *brazil green* sebesar  $2,18 \text{ mg/mL}$ , kopi *salvador green* sebesar  $2,22 \text{ mg/mL}$ , kopi *colombia green* sebesar  $2,79 \text{ mg/mL}$ , kopi *papua green* sebesar  $3,1 \text{ mg/mL}$ , dan kopi *papua black*

sebesar 0,19 mg/mL. Berdasarkan hasil analisis, kandungan asam klorogenat pada 4 jenis kopi hijau lebih tinggi daripada jenis kopi hitam. Hal ini disebabkan karena kopi hitam atau kopi yang telah melalui proses penyangraian mengalami penurunan kandungan asam klorogenat karena sifat dari asam klorogenat yang tidak stabil pada suhu panas yang menyebabkan asam klorogenat terurai menjadi derivat fenol dan secara signifikan mengalami penurunan kandungan asam klorogenat lebih dari 60% (Upadhyay & Mohan Rao, 2013).

### Efek Asam Klorogenat terhadap Status Gizi Obesitas

Hasil penelitian Shimoda, *et al.* (2006) dalam bentuk intervensi dengan pemberian diet *non-purified* yang ditambahkan kandungan asam klorogenat sebanyak 0,15% dan 0,3% pada tikus jantan menunjukkan adanya efek supresif pada peningkatan berat badan dan akumulasi lemak dengan persentase sebanyak 27% mempercepat proses metabolisme lemak di hepar. Adanya efek pemberian asam klorogenat dengan obesitas dalam penelitian (Watanabe, *et al.*, 2019) secara signifikan mampu menurunkan akumulasi lemak visceral ( $p < 0,001$ ), menurunkan berat badan ( $p = 0,0010$ ), menurunkan IMT ( $p = 0,006$ ), dan menurunkan lingkaran pinggang ( $p = 0,012$ ) setelah kelompok subjek diberikan *test drink* dengan kandungan asam klorogenat sebesar 369 mg per sajian selama 12 minggu. Sedangkan pada kelompok kontrol yang hanya diberikan asam klorogenat sebanyak 35 mg per sajian mengalami penurunan berat badan tidak signifikan.

Penelitian *in vivo* yang dilakukan oleh (A. Cho *et al.*, 2010) pada tikus jantan yang dibedakan menjadi 4 kelompok dengan diberikan intervensi selama 1 minggu berupa pemberian diet normal (11% kalori dari lemak), diet tinggi lemak (37% kalori dari lemak), diet tinggi lemak ditambahkan 0,02% *caffeic acid*, dan diet tinggi lemak ditambahkan 0,02% asam klorogenat. Pemberian intervensi ini menunjukkan hasil diet tinggi lemak yang ditambahkan asam klorogenat secara signifikan mengurangi berat badan dengan persentase sebesar 16% dibandingkan dengan diet tinggi lemak saja. Sedangkan diet tinggi lemak yang ditambahkan *caffeic acid* hanya mengurangi berat badan sebesar 8% saja. Asam klorogenat

yang ditambahkan pada diet mampu menghambat pertumbuhan sel adiposit sehingga berperan dalam penurunan kejadian obesitas.

Hasil penelitian lain didapatkan pada pemberian diet *ad libitum* yang dilakukan oleh (Ghadieh *et al.*, 2015). Tikus jantan berusia 3 bulan diberikan diet *regular diet* (RD) dengan persentase total kalori dari lemak 12%, karbohidrat 66% dan protein 22% serta *high-fat diet* (HF) dengan persentase total kalori dari lemak 45%, karbohidrat 35% dan protein 20% selama 7 minggu. Kemudian pada 3 minggu terakhir, untuk diet RD hanya diberikan air saja sedangkan diet HF diberikan suplementasi asam klorogenat sebesar 0,21 mg/hari. Selama 2 minggu setelah diet HF ditambahkan suplementasi asam klorogenat dapat mencegah peningkatan berat badan ( $p < 0,05$ ).

Asam klorogenat memiliki pengaruh terhadap kadar gula darah *postprandial* dan tingkat absorpsi glukosa di intestin dengan menghambat aktivitas *glucose-6-phosphatase* yang berperan terhadap homeostasis glukosa (Zuniga *et al.*, 2018). Hal ini kemudian diteliti oleh (Thom, *et al.*, 2007) pada 12 responden dengan kondisi sehat, tidak merokok, dan memiliki nilai IMT normal yaitu  $< 25 \text{ kg/m}^2$ . Intervensi kepada responden diberikan dengan pemberian 4 jenis perlakuan yang berbeda yaitu pemberian 25 gram sukrosa pada 400 ml air sebagai kelompok kontrol, pemberian 25 gram sukrosa dan 10 gram *coffee slender* (ekstrak kopi hijau) pada 400 ml air, 25 gram sukrosa dan 10 gram kopi instan pada 400 ml air, serta 25 gram sukrosa dan 10 gram kopi instan dekafeinasi pada 400 ml air yang diberikan selama 12 minggu. Kadar glukosa darah dilihat 2 jam setelah diberikan intervensi dengan diukur setiap 15, 30, 45, 60, 90 dan 120 menit. Dari 4 perlakuan di atas didapatkan hasil yaitu konsumsi ekstrak kopi hijau secara signifikan menurunkan kadar glukosa darah dibandingkan perlakuan lainnya ( $p < 0,05$ ).

Terdapat hubungan antara jumlah asupan gula dengan jumlah lemak yang ada pada jaringan adiposa (Aller *et al.*, 2011) Apabila total konsumsi gula berlebih dari jumlah yang dibutuhkan oleh tubuh maka akan terjadi proses glikogenesis pada hepar. Gula yang berlebih akan masuk ke adiposit dan disimpan sebagai lemak. Lemak tidak digunakan oleh tubuh sebagai energi sehingga akan menyebabkan penumpukan lemak di jaringan

**Tabel 2.** Hasil Studi Efek Asam Klorogenat Terhadap Status Gizi Obesitas

Peneliti	Metode	Populasi	Intervensi	Dosis	Hasil
Shimoda, <i>et al</i> (2006)	Eksperimental	Tikus jantan usia 6 minggu yang berada di ruangan dengan suhu 23°C ± 1°C dan diberi diet <i>non-purified</i> .	Pemberian diet <i>non-purified</i> yang mengandung ekstrak biji kopi hijau selama 14 hari. Asam klorogenat ditambahkan pada diet <i>non-purified</i> .	0,5% dan 1% ekstrak biji kopi hijau, 0,15% dan 0,3% asam klorogenat.	Konsumsi ekstrak biji kopi hijau memberikan efek supresi pada peningkatan berat badan dan akumulasi lemak visceral pada tikus. Sebanyak 27% asam klorogenat mempercepat proses metabolisme lemak di hepar.
Watanabe, <i>et al</i> (2019)	<i>Randomized, double-blind, controlled trial</i>	150 laki-laki dan perempuan di Hokkaido, Jepang dengan kriteria inklusi IMT ≥25 hingga <30 kg/m <sup>2</sup> , lemak visceral ≥80 cm <sup>2</sup> , dan berusia 20 hingga <65 tahun.	Pemberian <i>test drink</i> berupa denganditambahkan kandungan asam klorogenat. Diberikan 1x sehari sebanyak 180 ml selama 12 minggu.	369 mg untuk kelompok intervensi dan 35mg untuk kelompok kontrol.	Konsumsi kopi tinggi asam klorogenat secara signifikan mampu menurunkan lemak visceral (p= <0,001). Konsumsi kopi tinggi asam klorogenat secara signifikan mampu menurunkan berat badan, IMT, dan lingk pinggang (p= 0,0010, p= 0,006, dan p= 0,012).
Cho, <i>et al</i> (2010)	Eksperimental	23 tikus jantan usia 4 minggu yang berada di ruangan dengan suhu 22°C ± 2°C	Terbagi menjadi 4 kelompok dengan pemberian diet normal, diet tinggi lemak, diet tinggi lemak ditambah 0,02% <i>caffeic acid</i> , dan diet tinggi lemak ditambah 0,02% asam klorogenat. Intervensi diberikan selama 1 minggu.	0,02% <i>caffeic acid</i> dan 0,02% asam klorogenat.	Diet yang ditambahkan asam klorogenat secara signifikan mengurangi berat badan dibandingkan dengan diet tinggi lemak tanpa penambahan asam klorogenat dengan persentase sebesar 16%.
Ghadieh, <i>et al</i> (2015)	Eksperimental	Tikus jantan berusia 3 bulan dengan perlakuan <i>12 h dark/light cycle</i>	Pemberian diet secara <i>ad libitum</i> dengan <i>regular diet</i> (RD) serta <i>high-fat diet</i> (HF) selama 7 minggu. Pada 3 minggu terakhir diet RD diberikan air sedangkan diet HF diberikan suplementasi asam klorogenat.	0,21 mg asam klorogenat.	Tikus yang diberikan diet HF selama 4 minggu mengalami peningkatan berat badan dibandingkan dengan diet RD. Suplementasi asam klorogenat yang diberikan dapat mencegah peningkatan berat badan secara signifikan selama 2 minggu (p= <0,05).
Thom, E. (2007)	<i>Comparative, randomized, double-blind</i>	12 responden dengan kondisi sehat dan memiliki nilai IMT normal (<25 kg/m <sup>2</sup> )	Pemberian 4 jenis perlakuan selama 12 minggu.	400 ml air, 10 gram ekstrak kopi hijau, 10 gram kopi instan, dan 10 gram dekafeinasi.	Konsumsi ekstrak kopi hijau secara signifikan menurunkan kadar glukosa darah dibandingkan perlakuan lainnya (p=<0,05) Konsumsi ekstrak kopi hijau dapat menurunkan berat badan dibandingkan dengan kopi instan (p = <0,05) Konsumsi ekstrak kopi hijau sebanyak 80% dapat menurunkan persentase lemak tubuh.

adiposa tubuh. Asam klorogenat memiliki peran untuk menghambat absorpsi glukosa di intestin sehingga pada penelitian oleh Thom, *et al.* (2007) didapatkan hasil yaitu konsumsi ekstrak kopi hijau yang memiliki kadar asam klorogenat

yang tinggi dapat menurunkan berat badan dibandingkan dengan kopi instan (p=<0,05) dan konsumsi ekstrak kopi hijau sebanyak 80% dapat menurunkan persentase lemak tubuh sehingga menurunkan terjadinya obesitas.



*Systematic review* ini memiliki kekurangan karena penelitian terkait efek pemberian asam klorogenat pada kopi dengan obesitas masih terbatas sehingga hanya 5 artikel yang dapat dilakukan *review*.

## KESIMPULAN DAN SARAN

Berdasarkan penelitian yang telah diulas, kandungan asam klorogenat pada kopi tergantung pada varietas kopi, jenis kopi baik kopi hijau murni maupun yang telah disangrai, durasi penyangraian, suhu yang digunakan selama proses penyangraian dan ukuran kopi dari hasil proses penggilingan. Kandungan asam klorogenat pada kopi juga akan berbeda tergantung pada jenis analisis yang digunakan. Penelitian yang diulas di atas telah menunjukkan hasil yang konsisten. Kandungan asam klorogenat secara keseluruhan lebih tinggi pada kopi hijau murni dan kopi dengan ukuran partikel yang kecil.

Selain itu, baik penelitian pada hewan maupun manusia juga menunjukkan adanya peran asam klorogenat dalam bentuk suplementasi dan ekstrak kopi hijau dalam pencegahan status gizi obesitas. Melalui mekanisme menghambat pembentukan sel lemak dan menghambat absorpsi glukosa di intestin, asam klorogenat dapat membantu proses penurunan berat badan. Durasi pemberian intervensi dan dosis asam klorogenat yang berbeda pada setiap penelitian tidak secara signifikan mempengaruhi hasil penelitian yang ada. Selain itu, tidak ditemukan efek samping pemberian intervensi pada penelitian yang diulas.

Penelitian kedepan mengenai efek asam klorogenat dengan obesitas perlu dilakukan penelitian serupa pada kelompok manusia yang jumlahnya masih lebih sedikit dibandingkan dengan penelitian pada tikus maupun hewan coba lainnya. Selain itu, perlu mempertimbangkan kadar atau dosis asam klorogenat dan durasi pemberian intervensi dalam menilai pengaruh asam klorogenat terhadap status gizi obesitas.

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## PENGARUH DOSIS DAN LAMA PEMBERIAN EKSTRAKIDAUN ASAM JAWA (*TAMARINDUS INDICA LINN*) TERHADAP HOMA- $\beta$ PADA TIKUS MODEL DIABETES MELLITUS TIPE 2

*The effect of Tamarind Leaf (tamarindus indica linn) Extract on HOMA- $\beta$  in Rats with Type 2 Diabetes Mellitus Model*

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### ABSTRAK

Saat ini beban epidemiologis diabetes meningkat dengan gejala panjang yang mengancam jiwa dan efek dari obat antidiabetik. Kurangnya aktivitas insulin merupakan salah satu tanda dari diabetes mellitus. Mekanisme di dalam antidiabetes yaitu stimulasi sel  $\beta$ -Langerhans yang mengeluarkan insulin dan menghambat aktivitas enzim. Tujuan dari penelitian ini yaitu menganalisis pengaruh pemberian ekstrak daun asam jawa terhadap kadar homa- $\beta$  pada tikus model diabetes mellitus tipe 2. Studi ini menggunakan 30 ekor tikus wistar jantan berusia 8–12 minggu dengan berat badan 150–200 gram dan dipisahkan ke dalam 5 kelompok. Kelompok pertama yaitu kelompok KN (tikus DMT2 + standar diet), kelompok 2 yaitu KP (tikus DMT2 + Acarbose), kelompok 3 yaitu P1 (tikus DMT2 + ekstrak daun asam jawa 28 mg/200gr/hari), kelompok 4 yaitu P2 (tikus DMT2 + ekstrak daun asam jawa 56 mg/200gr/hari), dan kelompok 5 yaitu P3 (tikus DMT2 + ekstrak daun asam jawa 112 mg/200gr/hari). Metode pengukuran untuk Homa- $\beta$  yaitu menggunakan rumus yang telah terstandar dan menggunakan hasil pemeriksaan darah untuk glukosa darah puasa dan kadar insulin. Hasil dari penelitian antar variabel menggunakan *one-way* Anova yaitu terdapat perbedaan yang bermakna antara kadar homa- $\beta$  dengan pemberian ekstrak daun asam jawa pada tikus model diabetes mellitus tipe 2 ( $p < 0,05$ ). Pada ke-5 kelompok perlakuan terdapat perbedaan yang bermakna. Pada hari ke-7 terjadi peningkatan kadar homa- $\beta$  pada kelompok KP, P1, P2, dan P3 sedangkan pada kelompok KN mengalami penurunan pada kadar homa- $\beta$ . Kelompok P3 terlihat paling tinggi meningkatkan kadar homa- $\beta$  hari ke-14, akan tetapi pada hari ke-14 tidak terdapat perbedaan yang bermakna antara kelompok obat acarbose ( $99,57 \pm 6,41$ ) dan kelompok P3 ( $15,09 \pm 1,71$ ). Kesimpulannya pemberian ekstrak daun asam jawa dosis 28,56, dan 112 mg/kgBB/hari secara bermakna meningkatkan kadar HOMA- $\beta$  selama 7 dan 14 hari pada tikus model diabetes mellitus tipe 2.

**Kata kunci:** diabetes mellitus tipe 2, ekstrakidaun asamijawa, homa- $\beta$

### ABSTRACT

Nowadays the epidemiological burden of diabetes increases with long life-threatening symptoms and the effects of antidiabetic drugs. Lack of insulin activity is one of the signs of a drop in diabetes mellitus. The mechanisms in antidiabetic include stimulating  $\beta$ -Langerhans cells which secrete insulin and inhibit enzyme activity. The purpose of this study was to analyze the effect of giving tamarind leaf extract on levels of homa- $\beta$  in type 2 diabetes mellitus rats. This study used 30 male Wistar rats aged 8-12 weeks with a bodyweight of 150-200 grams and separated into 5 groups. The first group is KN group (DMT2 mice + standard diet), group 2 is KP (DMT2 + Acarbose mice), group 3 is P1 (DMT2 mice + tamarind leaf extract 28 mg / 200gr / day), group 4 is P2 (rat DMT2 + tamarind leaf extract 56 mg/ 200gr / day), and group 5 is P3 (DMT2 rat + tamarind leaf extract 112 mg / 200gr / day). The measurement method for Homa- $\beta$  is to use a standardized formula and use the results of blood tests for fasting blood glucose and insulin levels. The results of the inter-variable study using *one-way* Anova found a significant difference between the levels of homa- $\beta$  and the administration of tamarind leaves extract in rats with type 2 diabetes mellitus model ( $p < 0.05$ ). There were significant differences in the 5 treatment groups. On the 7th day, there was an increase in homa- $\beta$  levels in the KP, P1, P2, and P3 groups while in the KN group decreased in homa- $\beta$  levels. The P3 group was seen to have the highest increase in homa- $\beta$  levels in the 14th day, but on the 14th day there was no significant difference between the acarbose drug group ( $99.57 \pm 6.41$ ) and the P3 group ( $15.09 \pm 1, 71$ ). The conclusion was the administration of

*tamarind extract at a dose of 28.56, and 112 mg/kgBW/day significantly increased levels of HOMA- $\beta$  for 7 and 14 days in rats with type 2 diabetes mellitus.*

**Keywords:** Type 2 Diabetes Mellitus, Tamarind Leaf Extract, Homa- $\beta$

## PENDAHULUAN

Diabetes mellitus tipe 2 disebabkan oleh resistensi insulin dan disfungsi sel beta pankreas. Secara umum, diagnosis diabetes mellitus didasarkan oleh manifestasi umum seperti peningkatan glukosa dan patofisiologinya bervariasi tergantung oleh masing-masing individu (American Diabetes Association, 2011; Lemaitre et al, 2015; Ussher et al, 2010). Pada penderita diabetes mellitus tipe 2, sel beta pankreas masih bisa menyekresikan insulin akan tetapi insulin tersebut resisten dan glukosa tidak bisa masuk ke dalam sel lemak (Fumiaki et al., 2013).

Homeostasis Model of Assesment (HOMA) digunakan untuk menilai fungsi sel beta. Model HOMA pertama kali ditemukan pada tahun 1985. Pada penggunaannya, banyak model komputer telah tersedia untuk menghitung kerusakan sel  $\beta$  pankreas (Genova et al., 2014). Tes toleransi glukosa oral (TTGO) merupakan salah satu tes yang digunakan untuk menilai kerusakan sel  $\beta$  pankreas dan hanya dapat menjelaskan 27–64% perkiraan kerusakan sel beta pankreas.

Beberapa penelitian dengan studi *cross-sectional* telah menunjukkan bahwa kadar HOMA- $\beta$  yang rendah dapat dikaitkan dengan peningkatan prevalensi tingginya glukosa dan diabetes mellitus tipe 2 di Jepang serta Meksiko (Yu et al., 2014). Studi lainnya, menunjukkan peran HOMA- $\beta$  dalam memprediksi risiko diabetes mellitus tipe 2 di masa depan dalam populasi yang berbeda (Shuang et al., 2015; Park et al., 2013; Raquel et al., 2011; Babulreddy et al., 2013).

Salah satu mekanisme diabetes mellitus yang terjadi dalam aktivitas anti-diabetes yaitu menstimulasi sel  $\beta$  Langerhans yang menghasilkan insulin dan menghambat aktivitas enzim. Anti-diabetes yang dapat menstimulasi sel  $\beta$  pankreas dengan antioksidan salah satunya yaitu daun asam jawa. Daun asam jawa mengandung berbagai macam vitamin seperti thiamin, riboflavin, niasin, asam askorbat, dan  $\beta$ -karoten serta mengandung flavonoid, saponin. Kadar fenol total dalam daun

asam jawa yaitu 0,35–8,24% (Escalona et al., 2015; Haque et al., 2015; Takumi et al., 2015).

Alasan dilakukannya studi ini adalah untuk menilai perbaikan sel beta pankreas dengan penggunaan ekstrak daun asam jawa. Tujuan penelitian adalah untuk menganalisis pengaruh dosis dan lama pemberian ekstrak daun asam jawa terhadap kadar HOMA-  $\beta$  pada tikus model diabetes mellitus tipe 2.

## METODE

Komite etik Universitas Sebelas Maret telah menyetujui studi ini dengan nomor protokol 474/UNS27.06 / KEPK / EC / 2019. Hewan coba pada studi ini dipelihara di Pusat Studi Pangan dan Gizi Universitas Gadjah Mada Yogyakarta dan dilakukan pada bulan Desember – Januari 2019. Jenis penelitian ini merupakan penelitian *eksperimen laboratorik* dengan rancangan *Pre and Post Test Control Group Design*. Penelitian ini menggunakan 5 kelompok perlakuan dengan randomisasi sederhana. Populasi pada penelitian ini yaitu tikus *Albino Wistar* jantan dengan umur 8-12 minggu dengan berat 150–200 gram. Untuk menentukan jumlah sampel, peneliti menggunakan rumus *Federer* sehingga didapat jumlah sampel antar kelompok adalah 6. Total sampel dalam penelitian ini yaitu 30 ekor tikus.

Tikus di pelihara di ruangan khusus dan ditempatkan di kandang polypropylene yang higienis yang didalamnya diisi oleh 6 tikus dalam satu kandang besar. Tikus disimpan di ruangan dengan suhu 27–29°C, kelembaban 70–90%, 12 jam siklus lampu terang dan gelap (lampu dihidupkan pukul 07.00 WIB). Daun asam jawa diperoleh dari petani setempat di Karanganyar, Indonesia. Daun asam jawa yang masih hijau dibersihkan, dicuci dengan air mengalir, kemudian penyortiran basah dilakukan untuk menghilangkan batang utama, dikeringkan selama 3 hari sambil memisahkan tangkai daun ibu. Proses pengeringan dilakukan menggunakan oven dengan suhu 40°C, tujuannya adalah untuk meningkatkan mutu

penyimpanan, mencegah perubahan mikrobiologi dan kimia selama 1 hari (24 jam).

Maserasi adalah metode ekstraksi padat-cair bertahap yang dilakukan dengan membiarkan padatan tenggelam dalam pelarut. Serbuk yang dihasilkan kemudian dimaserasi dengan perbandingan daun asam jawa : pelarut etanol 96% yaitu 1:10. Untuk langkah maserasi, serbuk direndam selama 2 hari (48 jam), kemudian disaring untuk memisahkan pulp dan filtrat, setelah itu filtrat dimasukkan ke dalam *rotary evaporator* dengan kecepatan 100 rpm dan suhu 600°C. Hasil akhirnya adalah ekstrak kental daun asam. Ekstrak kental daun asam dimasukkan ke dalam wadah yang berbahan kaca, tertutup, dan ditaruh pada suhu kamar untuk menjaga kesegaran dan menghindari kerusakan nutrisi.

Pembuatan tikus diabetes mellitus tipe 2 dilakukan dengan induksi nicotinamide (NA) injeksi 110mg / kgBB secara intraperitoneal dan disuntikkan ke dalam rongga perut tanpa mempengaruhi organ, dibiarkan selama 15 menit setelah itu streptozotocin (STZ) dengan dosis 45 mg/kgBB disuntikkan. Di rongga perut, STZ dan NA akan segera diserap karena di rongga perut terdapat banyak pembuluh darah sehingga kondisi hiperglikemia akan cepat tercapai. Pakan yang digunakan dalam pemeliharaan tikus adalah AD 2. Kandungan dari AD II yaitu Energi 315–335 kalori, Karbohidrat 53–57%, Air Max 12%, Protein Kasar Min 15%, Lemak Kasar 3–7%, Serat Kasar Max 6%, Abu Max 7%, Kalsium 0,9–1,1 %, Phosphor 0,6–0,9%. Pakan diberikan sebanyak 10% bobot badan. Air minum diberikan secara adlibitum dan pergantian air minum setiap hari pada pagi hari.

Tiga puluh tikus dikelompokkan menjadi 5 kelompok perlakuan. Kelompok 1 adalah KN (STZ + diet standar (AD 2) + Aquades), kelompok 2 adalah KP (STZ + diet standar + Acarbose), kelompok 3 adalah P1 (STZ + diet standar + dosis ekstrak asam jawa 28 mg/ 200gr/hari), kelompok 4 adalah P2 (STZ + diet standar + ekstrak dosis daun asam jawa 56 mg / 200gr/hari), kelompok 5 adalah P3 (STZ + diet standar + dosis ekstrak asam jawa 112 mg/ 200gr /hari). Dasar dari penentuan dosis tersebut mengikuti penelitian pendahuluan dengan penggunaan ekstrak daun asam jawa pada mencit dan dosis yang paling berpengaruh adalah 56 mg/KgBB/hari sehingga pada penelitian ini

dijadikan nilai tengah. Pada penelitian ini variabel perancu telah diminimalisir dari kriteria inklusi dan eksklusi.

Ekstrak daun asam diberikan sekali sehari melalui tabung nasogastrik (NGT) pada waktu pagi hari. Tikus kemudian diamati untuk Homa-β sebelum (hari 0) dan setelah intervensi (hari 7 dan 14). Perhitungan Homa-β menggunakan rumus yaitu:

$$HOMA - \beta = \frac{360 \times \text{Kadar Insulin } (\mu\text{U/ml})}{GDP \text{ (mg/dl)} - 63}$$

Semua data dianalisis menggunakan SPSS, Versi 16, Chicago, IL, USA. Uji normalitas data dilakukan dengan menggunakan uji Shapiro-Wilk. Data terdistribusi normal jika nilai  $p > 0,05$ . Kemudian data homogenitas diuji dengan nilai  $p > 0,05$  yang berarti bahwa data tersebut memiliki varian yang homogen. Perbedaan efek dari lima kelompok perlakuan dianalisis menggunakan uji statistik parametrik *One Way Anova* untuk data terdistribusi normal dan homogen, diikuti oleh uji Post Hoc dengan *Tukey High Significant Difference (HSD)*, tetapi jika data terdistribusi normal dan tidak homogen dilanjutkan dengan tes Games Howell untuk mengetahui ada atau tidaknya perbedaan efek antara pasangan kelompok perlakuan.

Adapun data yang terdistribusi tidak normal, digunakan uji statistik non parametrik *Kruskal Wallis*. Pada penelitian ini, nilai kadar homa-β dianalisis dan data terdistribusi normal ( $p > 0,05$ ) serta homogenitas. Kemudian data dianalisis menggunakan *one-way Anova* didapat ada hubungan yang bermakna dan dilakukan uji lanjutan yaitu *Post Hoc* dengan *Tukey High Significant Difference (HSD)*.

## HASIL DAN PEMBAHASAN

Pemeriksaan kadar homa-β dilakukan sebanyak 3 kali yaitu H0, H7, dan H14.

Berdasarkan Tabel 1, terlihat bahwa rata-rata kelompok perlakuan dosis dan lama pemberian pada kadar homa-β mempunyai perbedaan yang bermakna ( $p < 0,05$ ). Untuk melihat secara lebih lanjut mengenai dosis dan lama pemberian ekstrak

**Tabel 1.** Pengaruh Dosis dan Lama Waktu Pemberian Ekstrak Daun Asam Jawa pada Homa-β Tikus

Dosis (%)	Lama Waktu			p
	0	7	14	
KN	21,35±0,16	20,97±0,03	20,39±0,25	<0,005
KP	22,14±0,48	41,53±0,95	99,57±6,41	<0,005
P1	22,62±0,95	36,87±1,48	55,41±1,89	<0,005
P2	22,33±0,31	41,37±0,85	80,67±3,69	<0,005
P3	22,70±0,72	48,13±2,48	105,09±1,71	<0,005

Keterangan: KN= Tikus DMT2; KP= Tikus DMT2 + acarbose 1,8 mg/200gr/hari; P1= Tikus DMT2 + ekstrak daun asam jawa 28 mg/200gr/hari; P2= Tikus DMT2 + ekstrak daun asam jawa 56 mg/200gr/hari; P3= Tikus DMT2 + ekstrak daun asam jawa 112 mg/200gr/hari.

daun asam jawa terhadap kadar homa-β dapat terlihat pada Tabel 2.

Berdasarkan Tabel 2, diketahui bahwa rerata kadar Homa-β di hari ke-0 berkisar antara 21 hingga 22. Dari kelompok perlakuan KP, P1, P2, dan P3 terdapat perbedaan yang bermakna ( $p < 0,05$ ). Setelah perlakuan selama 7 hari, terjadi peningkatan kadar homa-β pada kelompok KP, P1, P2, dan P3. Sedangkan pada kelompok KN terjadi penurunan pada kadar homa-β. Tidak ada perbedaan yang bermakna pada kelompok obat acarbose dengan P2 pada hari ke-7. Pada hari ke-14, dosis 112 mg/200gr/hari yaitu kelompok P3 terlihat paling tinggi meningkatkan kadar homa-β hari ke-14, akan tetapi pada hari ke-14 tidak terdapat perbedaan yang bermakna antara

**Tabel 2.** Pengaruh Dosis dan Lama Waktu Pemberian Ekstrak Daun Asam Jawa Terhadap Homa-β Tikus pada 7 dan 14 Hari

Dosis	Δ (%) 7 hari	P	Δ (%) 14 hari	P
KN : KP	-20,56*	<0,005	-79,17*	<0,005
KN : P1	-15,90*	<0,005	-35,01*	<0,005
KN : P2	-20,40*	<0,005	-60,27*	<0,005
KN : P3	-27,16*	<0,005	-84,69*	<0,005
KP : P1	4,66*	0,001	44,15*	<0,005
KP : P2	0,15	0,998	18,90*	0,002
KP : P3	-6,60*	0,004	-5,52	0,355
P1 : P2	-4,50*	0,001	-25,25*	<0,005
P1 : P3	-11,26*	<0,005	-49,67*	<0,005
P2 : P3	-6,75*	0,004	-24,42*	<0,005

Keterangan : KN= Tikus DMT2; KP= Tikus DMT2 + acarbose 1,8 mg/200gr/hari; P1= Tikus DMT2 + ekstrak daun asam jawa 28 mg/200gr/hari; P2= Tikus DMT2 + ekstrak daun asam jawa 56 mg/200gr/hari; P3= Tikus DMT2 + ekstrak daun asam jawa 112 mg/200gr/hari.

kelompok obat acarbose dan kelompok P3. Pada tabel 2 terlihat bahwa selisih peningkatan yang paling baik adalah P3 yaitu -25,43 di hari ke-7 dan -82,38 di hari ke-14.

Pada Tabel 1 menunjukkan bahwa pada kelompok KN mengalami penurunan pada homa-β, dan terlihat bahwa pada P3 memiliki peningkatan kadar homa-β dan hampir sama dengan kerja obat acarbose atau kelompok KP. Pada Tabel 1 diketahui bahwa lama pemberian dan dosis meningkatkan kadar homa-β pada kelompok KP, P1, P2, dan P3. Setelah hari ke-7 perlakuan, rerata kadar homa-β yang paling tinggi menunjukkan peningkatan adalah kelompok P3 (48,13±2,48). P2 dengan KP memiliki peningkatan kadar homa-β yang hampir sama. Pada hari ke-14, P3 masih menunjukkan peningkatan kadar homa-β yang paling besar yaitu 105,09±1,71 Hasil interaksi dua faktor antara dosis dan lama waktu memiliki perbedaan yang bermakna ( $p < 0,005$ ).

Hasil penelitian menunjukkan bahwa terjadi penurunan kadar homa-β pada KN (kontrol negatif) dan semakin lama perlakuan, peningkatan kadar homa-β semakin kuat. Peningkatan kadar homa-β dimungkinkan akibat adanya hiperglikemia. Hiperglikemia kronik pada DMT2 mengakibatkan sel β pankreas keracunan glukosa dan mengalami apoptosis. Homa-β merupakan indikator yang mengukur tingkat kekuatan sel beta pankreas untuk memproduksi insulin.

Semakin besarnya nilai kadar homa-β makan kekuatan sel beta akan semakin baik (Ghaffari et al, 2016; Havulinna et al, 2016; Forouhi et al, 2014). Pemberian ekstrak daun asam jawa dan acarbose selama 7 dan 14 hari mengakibatkan peningkatan kadar homa-β. Semakin lama pemberian ekstrak daun asam jawa, semakin meningkat kadar homa-β pada tikus DMT2.

Secara statistik, tidak ada perbedaan yang bermakna antara kelompok acarbose dengan kelompok P1, P2, dan P3 namun terlihat pada Tabel 2 bahwa selisih kadar homa-β yang paling tinggi ada pada kelompok P3 yaitu dosis 112 mg/200gr/hari. Pada tikus yang diinduksi STZ-Na terjadi hiperglikemia sehingga menyebabkan *Reactive Oxygen Species* (ROS) meningkat. Terbentuknya ROS akan menyebabkan depolarisasi membran sel beta dan peningkatan  $Ca^{2+}$ , sehingga sitosol akan mengaktifasi berbagai enzim yang

menyebabkan peroksidasi lipid, fragmentasi DNA, dan fragmentasi protein. Akibatnya sel beta pankreas menjadi nekrosis, sehingga fungsinya untuk sintesis dan sekresi insulin menurun. Perbaikan sel beta pankreas terjadi karena adanya antioksidan di dalam ekstrak daun asam jawa.

Adanya peningkatan antioksidan di dalam pankreas akan meningkatkan fungsi sel beta pankreas sehingga menghasilkan insulin dan menghambat aktivitas enzim. Pada penelitian yang dilakukan oleh Olfiana *et al.* (2017), menyatakan bahwa ekstrak daun asam jawa sebanyak 40 mg/KgBB berpengaruh terhadap penurunan kadar gula darah pada mencit. Pada penelitian tersebut meskipun sudah menurunkan kadar gula darah akan tetapi tidak melihat perbaikan kondisi sel beta pankreas maka dari itu penelitian ini melihat perbaikan sel beta pancreas dan belum ada penelitian yang membahas kaitannya daun asam jawa dengan sel beta pancreas.

## KESIMPULAN DAN SARAN

Pemberian ekstrak daun asam jawa dosis 28,56, dan 112 mg/kgBB/hari secara bermakna meningkatkan kadar HOMA- $\beta$  selama 7 dan 14 hari pada tikus model diabetes mellitus tipe 2. Perlu diadakannya studi lebih lanjut mengenai pengaruh pemberian ekstrak daun asam jawa dengan subjek penderita DMT2 dengan kriteria inklusi, kelompok umur, serta berbasis gender.

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## PENINGKATAN PENGETAHUAN DAN *SELF-EFFICACY* UPAYA PENCEGAHAN COVID-19 MELALUI EDUKASI GIZI KONVENSIONAL

*Increased Knowledge and Self-Efficacy of COVID-19 Prevention through Conventional Nutrition Education*

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### ABSTRAK

Pandemi COVID-19 membawa dampak pada berbagai sektor terutama kesehatan. Upaya pencegahan infeksi COVID-19 dapat dilakukan dengan menerapkan protokol kesehatan dan asupan gizi seimbang. Masih banyak ditemukan misinformasi terkait pencegahan COVID-19 yang berisiko meningkatkan kasus positif. Penelitian ini bertujuan untuk mengetahui efektivitas edukasi gizi konvensional terhadap pengetahuan dan *self-efficacy* upaya pencegahan COVID-19. Responden penelitian ini adalah 23 orang dewasa berusia 19-65 tahun dan diambil secara total sampling. Data pengetahuan gizi dikumpulkan dengan kuesioner berisi sepuluh pertanyaan sedangkan *self-efficacy* dinilai menggunakan kuesioner terstruktur. Edukasi konvensional diberikan berupa ceramah peran gizi seimbang, meluruskan hoax terkait makanan pencegah/mengobati COVID-19, serta upaya pencegahan COVID-19 lainnya selama 90 menit untuk semua materi. Data sebelum dan setelah edukasi dianalisis menggunakan uji t berpasangan menggunakan SPSS 23 version. Hasil penelitian menunjukkan bahwa edukasi gizi secara signifikan dapat meningkatkan pengetahuan gizi (rerata skor sebelum dan sesudah = 69.6 + 10.2 dan 85.7 + 10.4;  $p < 0.001$ ), *self-efficacy* untuk menjalankan pola gizi seimbang (rerata skor sebelum dan sesudah = 68.2 + 13.0 dan 75.5 + 17.5;  $p = 0.014$ ), dan *self-efficacy* penerapan protokol kesehatan (rerata skor sebelum dan sesudah = 82.3 + 7.8 dan 87.0 + 6.8;  $p = 0,002$ ). Penelitian ini dapat dijadikan *benchmark* pentingnya perluasan cakupan edukasi gizi konvensional kepada masyarakat luas.

**Kata kunci:** COVID-19, edukasi gizi, gizi seimbang, pengetahuan gizi, *self-efficacy*

### ABSTRACT

*The COVID-19 pandemic has impact on various sectors, especially in the health sector. Efforts to prevent COVID-19 can be done through the application of health protocols and balanced nutrition intake. There were a lot of misinformations related to COVID-19 prevention that might be a risk of increasing positive rate cases. The aim of this study was to determine the effectiveness of conventional nutrition education on knowledge and self-efficacy of COVID-19 prevention efforts. Study subjects of this study were 23 adults aged 19-65 years and taken by total sampling method. Nutritional knowledge data were collected using a questionnaire containing ten questions, while self-efficacy was assessed by creating a structured questionnaire on a scale of 0-100. Conventional education was given in the form of lectures related to the role of balanced nutrition, hoaxes related to food to prevent or treat COVID-19, and other COVID-19 prevention efforts for 90 minutes. Before and after education data were analyzed using paired t-test with SPSS version 23. This study results showed that nutrition education significantly improves nutritional knowledge (mean score before and after = 69.6 + 10.2 and 85.7 + 10.4;  $p < 0.001$ ), self-efficacy to apply a balanced nutrition pattern (mean scores before and after = 68.2 + 13.0 and 75.5 + 17.5;  $p = 0.014$ ), and the self-efficacy of implementing the health protocol (mean score before and after = 82.3 + 7.8 and 87.0 + 6.8;  $p = 0.002$ ). This research can be*

*used as a benchmark for the importance of expanding the coverage of conventional nutrition education to the wider community.*

**Keywords:** COVID-19, nutrition education, balanced nutrition, nutritional knowledge, self-efficacy

## PENDAHULUAN

Pandemi COVID-19 telah berlangsung selama lebih dari satu tahun dan perkembangan kasus di Indonesia mengalami fluktuasi dengan beberapa kali kenaikan yang signifikan. Hingga bulan Mei 2021, kasus terkonfirmasi positif COVID-19 di Indonesia sebanyak 1,691,658 jiwa dengan penambahan kasus harian sebanyak 5,285 dan kasus aktif sebanyak 98,217 (Satgas COVID-19, 2021). *World Health Organization* (WHO) (2020) menjelaskan bahwa selain 3M (Memakai Masker, Menjaga Jarak, dan Mencuci Tangan) alat untuk memerangi COVID-19 adalah ventilasi yang baik dan informasi yang akurat. Bahkan sampai saat ini dimana pandemi semakin parah, upaya ini ditambahkan dengan Membatasi Mobilitas dan Menjauhi Kerumunan sehingga menjadi 5M (Kemenkes, 2020). Saat ini, beredar banyak *hoax* di masyarakat terkait COVID-19 yang dapat menyebabkan informasi yang tidak tepat, menyebabkan praktek pencegahan yang keliru dan dapat berisiko meningkatkan kasus positif. Dilansir dari laman covid19.go.id (2021), setidaknya ada 756 berita *hoax* berkaitan dengan covid-19 yang beredar di masyarakat.

Penelitian di Arab Saudi tentang pengetahuan dan kepercayaan terhadap pencegahan penularan COVID-19 dan penggunaan produk herbal untuk pengobatan COVID-19 menunjukkan hasil bahwa mayoritas memiliki pengetahuan sedang dalam hal penularan COVID-19 dan tindakan pencegahannya. Selain itu, sebagian besar masyarakat juga melaporkan bahwa penggunaan produk herbal atau suplemen makanan telah digunakan untuk melindungi diri dari penyakit (Alyami, et al., 2020). Studi ini mengimplikasikan bahwa penggunaan herbal maupun suplemen yang efikasinya belum dapat ditentukan dan belum dapat menjamin keselamatan pasien, maka pencegahan yang tepat lebih dibutuhkan yaitu berupa penambahan pengetahuan tentang penularan dan tindakan pencegahan. Studi di China menunjukkan hasil pengetahuan masyarakat

sangat baik (90%) dan dalam studi tersebut juga ditekankan bahwa skor pengetahuan terkait COVID-19 secara signifikan berhubungan dengan kemungkinan rendahnya sikap negatif dan praktik baik pencegahan terhadap COVID-19 (Zhong, et al., 2020).

Desa Ketapanrame merupakan salah satu wilayah di Kecamatan Trawas, Kabupaten Mojokerto, Provinsi Jawa Timur yang menjadi salah satu potensi wisata paling banyak (5 titik) sehingga desa Ketapanrame menjadi wilayah yang memiliki risiko yang lebih tinggi dibandingkan desa lainnya dalam peluang penyebaran infeksi COVID-19. Data terakhir menunjukkan adanya peningkatan kasus aktif sebanyak 1,961 dari bulan Desember 2020 sebesar 1,480 kasus pada bulan Mei 2021. Selain itu, wilayah ini juga memiliki prevalensi obesitas (17.70%) yang lebih tinggi dari Jawa timur (16%) dimana kondisi obesitas dapat meningkatkan risiko keparahan infeksi COVID-19 akibat terjadinya imunodefisiensi di dalam tubuh. Oleh karena itu, perlu edukasi masyarakat terkait *hoax* covid-19 dan asupan gizi seimbang. Edukasi gizi yang didasarkan pada *social cognitive theory*, khususnya untuk meningkatkan *self-efficacy* masyarakat supaya bisa menerapkan asupan gizi seimbang dan menjadi agen untuk membantu meluruskan informasi *hoax* yang berkaitan dengan Covid-19. *Self-efficacy* merupakan suatu hal yang merujuk pada kepercayaan diri seseorang bahwa ia mampu melakukan perilaku tertentu (Bandura, 1994). Peningkatan *self-efficacy* didapatkan dapat meningkat melalui dukungan peningkatan *mastery experience*, *verbal motivation*, dan *vicarious experience* (Schunk, 2010). Peningkatan *mastery experience* dilakukan dengan praktek edukasi konvensional. *Verbal motivation* akan dilakukan melalui metode penyuluhan dan *vicarious experience* akan ditularkan pada tetangga dan masyarakat sekitarnya. Penelitian ini bertujuan untuk mengetahui efektivitas edukasi gizi konvensional dalam peningkatan pengetahuan dan *self-efficacy* upaya pencegahan Covid-19.

## METODE

Penelitian ini merupakan penelitian Quasi Eksperimen dengan desain *one group pre-test and post-test design*. Penelitian ini dilaksanakan di Desa Ketapanrame, Kecamatan Trawas, Kabupaten Mojokerto - Jawa Timur. Pemilihan lokasi penelitian dipilih secara *purposive sampling* berdasarkan data yang menunjukkan bahwa Kabupaten Mojokerto termasuk salah satu wilayah zona merah penyebaran COVID-19 di Jawa Timur. Populasi dalam penelitian ini adalah kelompok usia dewasa (19-65 tahun). Sampel dipilih dengan teknik *total sampling* sebanyak 23 orang. Intervensi yang dilakukan merupakan edukasi gizi konvensional dengan metode ceramah dan tanya jawab. Isi dari ceramah yang diberikan adalah informasi tentang peran gizi seimbang, *hoax* terkait makanan pencegah/mengobati COVID-19, dan *self-efficacy* upaya pencegahan COVID-19 selama 90 menit. Kegiatan selama 90 menit hanya berupa ceramah dan tanya jawab. Pengumpulan data dilakukan dengan kuesioner *self-administered* dengan asistensi dari enumerator sebanyak 2 (dua) mahasiswa. Kuesioner pengetahuan tentang peran gizi dalam pencegahan COVID-19 berisi sepuluh pertanyaan pilihan ganda. Hasil kuesioner pengetahuan gizi kemudian diklasifikasikan menjadi 3 (tiga), yaitu status pengetahuan kurang (skor <60), pengetahuan sedang (skor 0-80) dan pengetahuan baik (skor >80) (Khomsan, 2004). Sedangkan kuesioner *self-efficacy* dikembangkan secara mandiri oleh peneliti yang terdiri dari 2 set-kuesioner; yaitu kuesioner *self-efficacy* untuk mengonsumsi gizi seimbang selama masa pandemi COVID-19 dan *self-efficacy* untuk mematuhi protokol kesehatan guna melakukan pencegahan COVID-19. Kedua kuesioner yang menjadi instrumen penelitian dikembangkan sendiri oleh peneliti dengan dasar materi pendidikan gizi yang diberikan pada kelompok sasaran. Kuesioner diisi sebanyak dua kali yaitu sebelum dan sesudah diberikan intervensi pendidikan gizi melalui metode ceramah. Penelitian telah mendapatkan laik etik dari Komite Etik Penelitian Kesehatan Fakultas Kesehatan Masyarakat Universitas Airlangga No. 20/EA/KEPK/2021 Data yang terkumpul kemudian di analisis secara deskriptif dan inferensial. Analisis inferensial untuk melihat dampak edukasi gizi konvensional menggunakan

uji t-berpasangan (*Paired T-Test*). Hasil uji statistic dinyatakan berbeda signifikan jika memiliki *p value* <0.05. Data kategori akan ditampilkan dalam frekuensi dan presentase, sedangkan data numerik akan ditampilkan dalam bentuk *mean + SD*. *Software* analisis statistik yang digunakan dalam penelitian ini adalah SPSS 23 *version*.

## HASIL DAN PEMBAHASAN

Desa Ketapanrame berlokasi di Kecamatan Trawas, Kabupaten Mojokerto. Desa Ketapanrame memiliki tiga dusun di wilayahnya yakni dusun Ketapanrame, dusun Sukorame, dan dusun Slepri, diantara ketiga dusun tersebut yang memiliki luas wilayah paling lebar yakni dusun Ketapanrame, sedangkan pusat pemerintahannya terdapat di dusun Ketapanrame, dilihat dari lokasi area pusat balai desanya. Kondisi keadaan tanah yang dikelola oleh desa digunakan sebagai salah satu manifestasi desa serta lahan mata pencaharian warga desa Ketapanrame diantara terdapat wisata taman Ghanjaran, air terjun Dlundung, wisata taman kelinci, wisata sumber Gempong, pertanian dan peternakan (Perangkat Desa Ketapanrame, 2020).

Berdasarkan karakteristiknya, mayoritas responden adalah laki-laki (82,6%) dan bekerja di BUMDes atau Badan Usaha Milik Desa (60,8%). Sisanya, responden bekerja di perusahaan swasta, wiraswasta dan petani. Rata-rata usia responden yaitu 37,2 + 12,7 tahun dengan usia termuda 19 tahun dan usia tertua 63 tahun. Secara umum, beberapa hal terkait sosial ekonomi, pengalaman, pendidikan, lingkungan, paparan media dapat

**Tabel 1.** Karakteristik Responden Penelitian

Karakteristik	n (%)
<b>Jenis Kelamin</b>	
Laki-laki	19 (82,6)
Perempuan	4 (17,4)
<b>Pekerjaan</b>	
BUMDes / Karyawan desa	14 (60,8)
Swasta	5 (21,7)
Wiraswasta	1 (4,3)
Petani	1 (4,3)
Belum bekerja	2 (8,69)
	<b>Mean ± SD</b>
<b>Usia (tahun)</b>	37,2 ± 12,7

**Tabel 2.** Pengetahuan Gizi Responden Sebelum dan Sesudah Edukasi Gizi

Pengetahuan Gizi	Sebelum		Sesudah	
	n	%	n	%
Kurang	8	34,8	2	8,7
Cukup	13	56,5	5	21,7
Baik	2	8,7	16	69,6
Jumlah	23	100	23	100

memengaruhi tingkat pengetahuan seseorang (Anjani & Kartini, 2013).

Dari 23 responden yang hadir pada saat edukasi gizi, seluruhnya mengikuti kegiatan edukasi hingga selesai, sehingga *response rate* penelitian ini sebesar 100%. Pada awal sesi sebelum diberikan pendidikan gizi tentang gizi di masa pandemi, mayoritas responden masih memiliki pengetahuan yang cukup (56,5%) dan kurang (34,8%). Hanya 8,7% yang memiliki pengetahuan gizi baik (Tabel 2). Pengetahuan gizi pada penelitian ini di nilai menggunakan kuesioner berisi 10-pertanyaan tentang pola konsumsi gizi seimbang untuk meningkatkan imunitas di masa pandemi, *hoax* makanan pencegah COVID-19, dan makanan yang dapat menurunkan imunitas. Tingkat pengetahuan merupakan salah satu faktor yang secara tidak langsung dapat memengaruhi status gizi dewasa, termasuk obesitas dengan terlebih dahulu memengaruhi perilaku pemilihan makanan. Pada kelompok usia dewasa, pemilihan makanan sehari-hari juga dipengaruhi oleh pengetahuan gizi (Royyani, 2010). Pengetahuan gizi yang baik dapat meningkatkan kemungkinan sikap dan perilaku yang sesuai dengan prinsip gizi seimbang karena pengetahuan yang baik dapat membuat seseorang memahami manfaat dari gizi seimbang yang dikonsumsi (Kristianti, 2009). Setelah dilakukan edukasi, mayoritas responden memiliki pengetahuan gizi yang baik (69,6%) dan hanya 8,7% yang masih kurang pengetahuan gizinya (Tabel 2).

Hasil telaah lanjut terkait pengetahuan gizi menunjukkan bahwa pertanyaan nomor 1, 2, 4, dan 9 mengalami kenaikan yang cukup signifikan, sedangkan pada pertanyaan nomor 3, 7, dan 8 banyak dijawab benar oleh responden sejak *pre-test*. Evaluasi ini dapat digunakan sebagai informasi untuk mengetahui informasi apa saja yang perlu di elaborasi lebih lanjut ke kelompok

asaran. Pertanyaan nomor 1, 2, 4 menunjukkan sekitar 80% responden memiliki pengetahuan bahwa bawang putih, minyak kayu putih, dan konsumsi telur rebus dapat mencegah dan menyembuhkan COVID-19. Padahal, ketiga hal tersebut merupakan *hoax* atau informasi yang salah karena belum ada satupun penelitian yang menunjukkan efek bawang putih dan minyak kayu putih terhadap COVID-19. Pengetahuan yang salah dapat memengaruhi sikap dan perilaku yang tidak tepat dan berisiko membahayakan. Kemudian, pertanyaan nomor 3 terkait sumber protein dapat mencegah COVID-19 dengan memperbaiki sistem imun tubuh. Konsumsi protein tidak hanya dari telur. Telur merupakan sumber protein yang baik, namun tidak harus dikonsumsi setiap hari karena kuning telur juga mengandung kolesterol yang cukup tinggi sekitar 483 mg/100 gram (Saidin, 2000). Protein tersusun atas asam-asam amino yang dapat berperan sebagai imunomodulator diantaranya glutamin, arginin, dan lisin (Shetty, 2010; Maggs, et al. 2000). Pertanyaan lain yang sudah diketahui dengan benar yaitu konsumsi gula berlebih dapat menurunkan imunitas. Konsumsi gula harus dibatasi maksimal 4 sdm/hari atau setara dengan 54 gram/hari (Kemenkes, 2019).

Tabel 2 menunjukkan hasil mean jawaban pada masing-masing item pertanyaan *self-efficacy*. Menerapkan gizi seimbang merupakan salah satu upaya pencegahan COVID-19 yang perlu diterapkan karena asupan harian mempengaruhi status gizi dan status gizi yang tidak optimal dapat menurunkan kekebalan tubuh (Herzog & Rundles. 2015; Heredia, et al. 2012). *Self-efficacy* merupakan salah satu mediator perubahan perilaku yang didefinisikan sebagai persepsi individu terhadap kemampuannya dalam melakukan suatu hal tertentu (Gallagher, 2012). Dalam hal ini, *self-efficacy* atau keyakinan untuk menerapkan gizi seimbang dan perilaku yang sesuai dengan protokol kesehatan dapat mendukung terbentuknya perilaku pencegahan COVID-19 yang baik.

Hasil analisis dalam penelitian ini menunjukkan bahwa *self-efficacy* responden untuk menerapkan gizi seimbang sebelum edukasi paling rendah ketika sakit, malas memasak, dan saat harga lauk pauk seperti ayam, daging, ikan naik. Namun, setelah edukasi gizi, *self-efficacy* meningkat walau kondisi sakit dan harga lauk naik. Hasil

positif didapat mengingat lauk pauk merupakan sumber protein penting dalam komposisi diet harian, terutama berkaitan mempertahankan sistem imun tubuh ketika masa pandemi. Selain itu, ketika kondisi sakit, konsumsi gizi seimbang juga diperlukan untuk membantu mempercepat proses pemilihan (Wischmeyer, 2017). Secara umum, *self-efficacy* responden untuk menerapkan pola konsumsi gizi seimbang meningkat setelah diberi edukasi konvensional dengan peningkatan tertinggi terjadi pada konsumsi buah walaupun harga buah naik. Informasi pentingnya konsumsi buah diberikan pada saat sesi edukasi dimana buah mengandung banyak vitamin dan mineral yang juga berperan dalam memperkuat sistem imun dan memelihara kesehatan tubuh.

Dalam hal penerapan protokol kesehatan, mayoritas responden juga sudah memiliki *self-efficacy* yang baik dengan skor rata-rata >75 pada saat sebelum edukasi, kecuali poin tetap di rumah saat tempat wisata dibuka. Setelah pemberian edukasi gizi, seluruh poin *self-efficacy* mengalami peningkatan (Tabel 3). Responden

menjadi lebih yakin untuk tetap di rumah walau tempat wisata dibuka kembali karena tempat wisata dapat menjadi pusat penularan COVID-19 terutama jika terjadi kerumunan. Keyakinan untuk memakai masker, mencuci tangan, menggunakan *hand sanitizer* pada kelompok masyarakat di Desa Ketapanrame sudah cukup baik.

Tabel 4 menunjukkan analisis pengaruh dari edukasi gizi konvensional terhadap pengetahuan dan *self-efficacy* konsumsi gizi seimbang dan mematuhi protokol kesehatan. Hasil analisis menunjukkan bahwa edukasi gizi secara signifikan meningkatkan skor pengetahuan dan *self-efficacy*. Hal ini menjadi justifikasi bahwa edukasi gizi serupa dapat diduplikasi di wilayah lain di Indonesia karena dapat membawa dampak positif tidak hanya pada segi pengetahuan namun juga ditambah *self-efficacy*. Hal ini sejalan dengan penelitian sebelumnya seperti di Papua Barat, edukasi gizi dilakukan secara daring dapat meningkatkan pemahaman tenaga kesehatan hingga 30% (Briannita, 2020). Edukasi gizi lainnya yang dilakukan pada masa pandemi COVID-

**Tabel 3.** Rata-rata Skor *Self-Efficacy* Penerapan Gizi Seimbang dan Protokol Kesehatan dalam Pencegahan COVID-19 sebelum dan sesudah edukasi (Skala 0 – 100)

Pernyataan	Rata-rata nilai ( <i>mean</i> ± <i>SD</i> )		<i>P</i> *
	Pre-intervensi	Post-intervensi	
<b><i>Self-Efficacy</i> Penerapan Gizi Seimbang: Saya tetap mengonsumsi gizi seimbang ...</b>			
Saat pendapatan menurun/ uang belanja berkurang	70,0 ± 13,8	75,0 ± 17,2	0,000
Saat awal bulan	78,9 ± 17,2	78,5 ± 13,6	0,000
Saat akhir bulan	70,7 ± 16,9	71,1 ± 18,7	0,036
Saat harga buah naik	68,7 ± 20,1	96,9 ± 123,5	0,462
Saat harga lauk pauk naik	62,6 ± 19,1	73,5 ± 11,9	0,004
Saat harga sayur naik	67,8 ± 16,5	74,3 ± 16,2	0,000
Saat malas memasak	61,3 ± 20,3	67,6 ± 17,4	0,003
Saat sakit	60,7 ± 26,4	68,3 ± 21,7	0,000
Saat waktu terbatas (buru-buru)	68,0 ± 15,6	66,7 ± 17,2	0,000
10.Saat wabah corona sudah selesai	73,0 ± 28,5	83,3 ± 15,3	0,000
<b><i>Self-Efficacy</i> Penerapan Protokol Kesehatan</b>			
Tetap menggunakan masker saat keluar rumah	92,9 ± 11,5	95,9 ± 6,2	0,882
Tetap menggunakan masker saat harga masker meningkat	88,3 ± 19,7	91,5 ± 9,2	0,989
Tetap mencuci tangan sesering mungkin saat di luar rumah	88,7 ± 10,9	93, ± 7,8	0,473
Tetap mencuci tangan sesering mungkin setelah memegang sesuatu	88,0 ± 7,8	87,8 ± 10,4	0,021
Tetap menjaga jarak minimal 1M saat di luar rumah/keramaian	81,7 ± 12,3	83,0 ± 17,2	0,323
Tetap menggunakan <i>hand sanitizer</i> saat harganya meningkat	79,1 ± 12,0	84,1 ± 10,1	0,102
Tetap menggunakan <i>hand sanitizer</i> setelah memegang sesuatu	78,9 ± 15,0	84,1 ± 14,8	0,007
Tetap di rumah saat tempat wisata dibuka	61,1 ± 24,1	76,3 ± 18,9	0,064

\*Signifikan pada  $p < 0,05$

**Tabel 4.** Pengaruh Edukasi Gizi Terhadap Pengetahuan Gizi dan *Self-Efficacy*

Variabel	N	Mean ± SD		p*
		Sebelum	Sesudah	
Pengetahuan Gizi	23	69,6 ± 10,2	85,7 ± 10,4	0,000
<i>Self-efficacy</i> konsumsi gizi seimbang	23	68,2 ± 13,0	75,5 ± 17,5	0,014
<i>Self-efficacy</i> protokol kesehatan	23	82,3 ± 7,8	87,0 ± 6,8	0,002

\*Signifikan pada  $p < 0,05$

19 untuk kader posyandu menunjukkan adanya peningkatan pengetahuan dan sikap setelah diberi edukasi pencegahan stunting di masa pandemi (Permatasari, et al. 2020).

Salah satu kelebihan dari penelitian ini selain unsur kebaruan yaitu penilaian indikator *self-efficacy* yang dapat mendukung pengetahuan seseorang dalam mempraktekkan pola gizi seimbang dan protokol kesehatan dalam pencegahan COVID-19. Akan tetapi, penelitian dapat dikembangkan dengan menambah lebih banyak sampel dan menambah *hands-on-activity* yang melibatkan peserta dalam pendidikan gizi.

## KESIMPULAN

Pendidikan gizi konvensional dengan metode ceramah secara signifikan dapat meningkatkan pengetahuan terkait upaya pencegahan COVID-19, *self-efficacy* untuk melakukan asupan gizi seimbang dan melakukan protokol kesehatan selama masa pandemi COVID-19. Kegiatan ini dapat diimplementasikan pada daerah lain supaya semakin banyak masyarakat yang terpapar dengan informasi positif, terhindar oleh informasi *hoax*, dan bekerjasama menurunkan angka kejadian COVID-19 di Indonesia.

## PERSANTUNAN

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## KORELASI TINGKAT ASUPAN LEMAK DAN AKTIVITAS FISIK DENGAN KUALITAS HIDUP LANJUT USIA

*Correlation between Fat Intake and Physical Activity with Quality of Life in Elderly*

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### ABSTRAK

Kualitas hidup lansia ditentukan dari fisik, emosional, intelektual, sosial, vokasional, dan spiritual. Pentingnya menjaga kualitas hidup dengan selalu menerapkan perilaku hidup sehat, makan-makanan aman dan bergizi seimbang disertai aktivitas fisik, sehingga meminimalkan risiko terjadinya penyakit degeneratif. Penyakit tidak menular seperti hipertensi dan diabetes mellitus sering terjadi pada lansia. Salah satu penyebabnya adalah terlalu sering makan makanan tinggi lemak, ditambah kurangnya aktivitas fisik, sehingga dapat menyebabkan menurunnya kualitas hidup lansia. Penelitian ini bertujuan untuk menganalisis korelasi tingkat asupan lemak dan aktivitas fisik dengan kualitas hidup lanjut usia. Metode yang digunakan adalah rancangan *cross sectional* dengan responden sebanyak 200 lansia. Data asupan lemak didapatkan dengan metode wawancara menggunakan kuesioner *food recall 2×24 hour*, sedangkan aktivitas fisik dan Kualitas Hidup menggunakan kuesioner *Index Social Disengagement* dan WHOQOL-BREF. Data dianalisis menggunakan uji *Spearman* ( $\alpha=0,05$ ). Penelitian ini menunjukkan bahwa sebagian besar responden memiliki kualitas hidup yang baik tingkat asupan lemak defisit tingkat berat dan aktivitas pada tingkat sedang. Hasil analisis statistik menunjukkan tingkat asupan lemak dengan kualitas hidup lansia memiliki hubungan positif tidak signifikan ( $p>0,05$ ), dengan besar keeratan hubungan 0,086 atau sangat lemah, sedangkan aktifitas fisik ada hubungan positif signifikan dengan kualitas hidup lansia ( $p<0,05$ ), dengan besar keeratan hubungan 0,216 atau lemah. Disimpulkan bahwa meskipun sudah berusia lanjut penting untuk tetap melakukan aktivitas fisik untuk menjaga kebugaran tubuh.

**Kata kunci:** aktivitas fisik, asupan lemak, kualitas hidup, lansia

### ABSTRACT

*The quality of life of the elderly is determined by physical, emotional, intellectual, social, vocational, and spiritual. The importance of maintaining quality of life is always implemented by healthy living behaviors, eating safe and nutritious food balanced with physical activity to minimize the risk of degenerative diseases. Non-communicable diseases such as hypertension and diabetes mellitus often occur in the elderly. This is caused by so often eating high-fat foods, and lack of physical activity, which can decrease the quality of life in elderly. This study aims to analyze correlation between the level of fat intake and physical activity with quality of life of elderly. Method used was a cross sectional design with 200 respondents. Data on fat intake was obtained by interview using 2x24 hour food recall questionnaire, while physical activity and Quality of Life used the Social Disengagement Index and WHOQOL-BREF questionnaires. Data were analyzed using Spearman test ( $\alpha = 0.05$ ). This study shows that majority of respondents have a good quality of life at a moderate level of fat deficit intake and moderate activity. Results of statistical analysis, level of fat intake with quality of elderly life has a non-significant positive correlation ( $p > 0.05$ ) with value of correlation is 0.086 or very weak, whereas physical activity has a significant positive correlation with quality of elderly life ( $p < 0.05$ ) with value of correlation is 0.216 or weak. This study concluded that it is important to keep doing physical activities to maintain physical fitness in elderly life.*

**Keywords:** *elderly, fat intake, physical Activity, quality of life*

## PENDAHULUAN

Kesehatan merupakan aspek yang tidak lepas dari kehidupan manusia khususnya lansia (Arifin, *et al.*, 2019). Lanjut usia merupakan proses dari tumbuh kembang yang dialami setiap individu, yang ditandai dengan penurunan kemampuan tubuh dalam beradaptasi dengan lingkungan (Mansjoer, 2011). Usia lanjut saat ini diperkirakan meningkat mencapai 652 juta jiwa dan kemungkinan akan meningkat sebesar 2 kali lipat di tahun 2050, serta 79% populasi lanjut usia berada di negara berkembang seperti Indonesia (WHO, 2017). Jawa Tengah merupakan provinsi ke dua yang memiliki populasi lansia tertinggi di Indonesia (Kemenkes RI, 2017). Proyeksi penduduk diatas 60 tahun di Jawa Tengah tahun 2025 akan memasuki *aging population*, dimana penduduk usia 65 tahun ke atas mencapai 10% atau lebih, dengan rasio ketergantungan sebesar 47,78% untuk setiap 100 penduduk usia produktif menanggung 48 orang penduduk usia tidak produktif (BPS Jawa Tengah, 2018).

Lansia selalu dikaitkan dengan berbagai masalah kesehatan, karena adanya penurunan fungsi dari sistem tubuh, sehingga rentan terhadap penyakit termasuk penyakit tidak menular termasuk depresi akibat dari stress dalam menghadapi kehidupan (Saputri dan Indrawati, 2011). Prevalensi penyakit tidak menular pada usia lansia  $\geq 60$  tahun di Indonesia, seperti hipertensi pada perempuan (36,85%) lebih tinggi dibandingkan pada laki-laki (31,34%) dan diabetes mellitus pada perempuan (12,7%) juga lebih tinggi dibandingkan laki-laki (9,0%) (Kemenkes RI, 2018). Hal ini disebabkan karena kurangnya aktivitas fisik, status gizi obesitas, merokok, suka minum-minuman beralkohol, manajemen stress yang buruk dan pola makan khususnya makan makanan tinggi lemak (Arifin, *et al.*, 2016; Kartika, *et al.*, 2016).

Aktivitas fisik untuk lanjut usia merupakan suatu bentuk kebugaran, dimana seseorang melakukan aktivitas cukup dan teratur memiliki tingkat kebugaran lebih tinggi dibandingkan dengan orang yang tidak teratur, sehingga akan meningkatkan kualitas kesehatan fisik, serta mengurangi risiko mortalitas pada lansia (Lara, 2016; Dewi, 2018; Taylor, 2014). Kualitas aktivitas fisik yang baik erat kaitannya dengan kapasitas

fungsional dan kualitas hidup secara menyeluruh (Vagetti, *et al.*, 2014)

Kualitas hidup dapat dikatakan gabungan dari berbagai aspek, baik fisik, emosional, intelektual, sosial, vokasional, dan spiritual. Penurunan kualitas hidup akibat adanya penyakit kronis membuat lansia tidak mampu untuk hidup mandiri dan berinteraksi sosial sehingga dalam beraktivitas sehari-hari membutuhkan bantuan dari orang lain (Yenny dan Hermawan, 2006; Cao, 2018). Peningkatan kualitas hidup dilakukan dengan menerapkan perilaku hidup sehat makan-makanan yang aman dan bergizi sesuai dengan kebutuhan, melakukan aktivitas fisik dan memeriksakan diri ke pusat kesehatan terdekat (Li, *et al.*, 2018; Deluga, *et al.*, 2018). Kesehatan lanjut usia sangat berperan besar terhadap kualitas hidup dan meningkatkan angka harapan hidup lanjut usia (Hanim dan Lestari, 2018). Dengan demikian, penelitian ini bertujuan untuk menganalisis korelasi tingkat asupan lemak dan aktivitas fisik dengan kualitas hidup pada lanjut usia.

## METODE

Penelitian ini merupakan penelitian observasional analitik dengan rancangan *cross sectional*. Populasi pada penelitian ini merupakan lansia berusia  $\geq 60$  tahun yang berada di wilayah kerja Puskesmas di Kabupaten Klaten ( $N = 195.074$ ), dengan besar sampel sebanyak 200 orang yang diambil dengan teknik *Purposive Random Sampling*.

Pemilihan sampel dilakukan berdasarkan kriteria inklusi yaitu lansia yang berusia  $\geq 60$  tahun, dapat berkomunikasi dengan baik, tinggal bersama keluarga, baik yang berstatus menikah maupun janda/duda. Kriteria eksklusi yang dimaksud adalah lansia yang menetap di panti atau lembaga perawatan lansia, pindah rumah mengikuti anak, dan sakit pada saat penelitian berlangsung sehingga tidak mampu menjawab pertanyaan peneliti dan melakukan pengukuran antropometri. Pengukuran antropometri pada dengan menggunakan alat mikrotoa (GEA) dan timbangan injak digital (GEA) serta responden dalam keadaan berdiri, sehingga lansia dengan kondisi tubuh bungkuk tidak diikuti dalam penelitian.

Pengambilan data dilakukan dengan wawancara dan mengisi kuesioner oleh peneliti dan dibantu oleh 8 orang enumerator (mahasiswa UNS Prodi S2 ilmu gizi) yang sudah dilatih di posyandu lansia. Data Asupan lemak didapatkan dengan *2×24 hour food recall* dengan pengambilan 2 hari berturut-turut diolah menggunakan perangkat lunak Nutrisurvey 2007. Aktivitas fisik dengan kuesioner *Index Social*.

*Disengagement* (Bassuk, et al.,1999) yang didalamnya terdapat berbagai kegiatan yang mungkin dilakukan oleh lansia dan kualitas hidup dengan *WHO Quality of Life - BREF* (WHOQOL-BREF) (WHO, 2004) berisi 4 domain meliputi kesehatan fisik, psikologikal, hubungan sosial dan lingkungan yang terbagi dalam 26 pertanyaan. Aktivitas fisik dan kualitas hidup diolah dengan perangkat Ms. Excel 2010. Kriteria variabel penelitian yang diteliti disajikan pada tabel 1.

Data yang telah dikumpulkan dianalisis dengan uji *Pearson Product Moment* jika data berdistribusi normal ( $p\ value > 0,05$ ). Namun jika data tidak normal menggunakan uji *Rank Spearman* pada program SPSS versi 16 sehingga signifikansi bernilai jika nilai  $p < 0,05$ .

Penelitian dilaksanakan setelah dinyatakan layak etik oleh Komisi Etik Fakultas Kedokteran Universitas Sebelas Maret dengan No. 027/UN27.06.6.1/KEPK/EC/2020.

## HASIL DAN PEMBAHASAN

Tabel 2 menunjukkan bahwa sebaran responden lansia laki-laki sama dengan perempuan

**Tabel 1.** Kriteria Variabel Penelitian

Variabel	Kriteria	Klasifikasi
Tingkat asupan lemak (%)	<70	Defisit tingkat berat
	70–79	Defisit tingkat sedang
	80–89	Defisit tingkat Ringan
	90–119	Normal
	≥ 120	Lebih
Aktivitas fisik (METs-menit/minggu)	< 600	Ringan
	600–3000	Sedang
	≥ 3000	Berat
Kualitas hidup	≥ 60	Baik
	< 60	Buruk

**Tabel 2.** Karakteristik Subjek

Variabel	n	%
<b>Jenis Kelamin</b>		
Laki-laki	100	50,0
Perempuan	100	50,0
<b>Usia (tahun)</b>		
60–65	61	30,5
65–70	61	30,5
> 70	78	39,0
<b>Asupan Lemak</b>		
Lebih	12	6,0
Normal	20	10,0
Defisit ringan	21	10,5
Defisit sedang	18	9,0
Defisit berat	129	64,5
<b>Aktivitas Fisik</b>		
Ringan	34	17,0
Sedang	128	64,0
Berat	38	19,0
<b>Kualitas Hidup</b>		
Baik	101	50,5
Tidak baik	99	49,5

50%. Usia lansia yang ikut dalam penelitian rata-rata lebih dari 70 tahun (39,0%) dengan usia minimal 60 tahun dan maksimal 100 tahun. Asupan lemak lebih banyak defisit berat atau kurang dari kecukupan sehari (64,5%) dan kebanyakan responden lansia melakukan aktivitas fisik dengan kategori sedang (64,0%), seperti berjalan kaki, berkebun, bersih-bersih rumah, dan memasak. Kualitas hidup lansia secara keseluruhan termasuk dalam kategori baik (50,5%).

Pada Tabel 3 dapat diketahui bahwa sebagian besar lansia yang memiliki kualitas hidup kategori baik, diimbangi dengan aktivitas fisik sedang, meskipun asupan lemak termasuk dalam kategori defisit tingkat berat. Hasil analisis *rank spearman* menunjukkan bahwa antara tingkat asupan lemak dengan kualitas hidup lansia tidak memiliki hubungan signifikan ( $p = 0,225$ ;  $r = 0,086$ ). Angka koefisien korelasi menunjukkan nilai positif, berarti kedua variabel tersebut searah, namun cenderung lemah karena menjauhi angka satu. Sedangkan aktivitas fisik dengan kualitas hidup, terdapat hubungan yang signifikan ( $p = 0,002$ ;  $r = 0,216$ ) dan Angka koefisien korelasi menunjukkan hubungan positif yang searah namun cenderung lemah. Responden yang melakukan aktivitas

sedang lebih banyak memiliki kualitas hidup yang baik dibandingkan dengan tingkat aktivitas yang lain, sehingga aktivitas fisik memang penting dilakukan dalam rangka meningkatkan kualitas hidup, terutama pada lansia.

Mayoritas responden memiliki asupan lemak termasuk pada kategori defisit tingkat berat. Salah satu faktor penyebabnya adalah pemahaman responden penelitian bahwa pada usia mereka, konsumsi atau asupan lemak harus dibatasi. Hal ini sesuai dengan anjuran kemenkes bahwa konsumsi lemak tidak lebih dari 25% atau 50 g untuk laki-laki dan 40g untuk perempuan dari kebutuhan energi/hari (Kemenkes RI, 2014).

Hasil wawancara menyebutkan bahwa sumber lemak yang sering dikonsumsi terbagi menjadi dua yaitu nabati dan hewani. Sumber lemak nabati tahu, tempe dan dari hewani adalah telur, jarang makan daging baik ayam maupun sapi. Hasil recall menunjukkan gambaran bahwa sumber lemak sebagian besar responden hanya berasal dari minyak makanan yang digoreng dan di tumis saja, hanya sebagian kecil responden yang mengonsumsi sumber lemak lain.

Hasil *recall* juga menunjukkan porsi makan yang sedikit dikarenakan penurunan nafsu makan dan jam makan yang tidak teratur sehingga frekuensi makan tidak sampai 3x sehari, maksimal 2x, bahkan ada yang 1x makan dalam sehari. Penurunan nafsu makan sering terjadi pada usia lanjut, dikarenakan pada usia

ini terjadi penurunan fungsi organ, lingkungan sosial yang kurang mendukung, depresi, sering cemas dan merasa sedih, sehingga asupan perlu diperhatikan untuk mencegah malnutrisi (Arifin, et al., 2019; Munawirah, et al., 2017; Amran et al., 2012).

Tubuh tetap memerlukan zat gizi baik makro dan mikro untuk proses di dalam tubuh menjadi energi dalam aktivitas sehari-hari. Asupan lemak yang tinggi akan berisiko meningkatkan timbulnya penyakit degeneratif seperti hipertensi, dan meningkatkan kejadian seseorang menjadi obesitas. Pentingnya seseorang untuk mengatur pola hidup bersih dan sehat dengan makan makanan seimbang sesuai kebutuhan, paling tidak memenuhi kecukupan sehari energi 1600 kkal, protein 60g, lemak 45g, dan karbohidrat 250g serta melakukan aktivitas fisik (PMK RI No 28, 2019; Ambartana, et al., 2015).

Lansia yang tidak melakukan aktivitas fisik lebih berisiko terjadi penyakit degeneratif khususnya dan memungkinkan menjadi salah satu penyebab meningkatnya kematian di dunia (WHO, 2010). Aktivitas fisik yang sesuai untuk lansia adalah dengan memperhatikan FITT (Frequency, Intensity, Time, Type), antara lain bertani, mengasuh cucu, mengasuh anak, menyapu, mencuci, membersihkan kamar, jalan kaki, bersepeda, berenang (Baga, et al., 2010).

Secara fisiologis, lanjut usia yang menjalani aktivitas fisik memiliki tingkat kebugaran yang tinggi. Hal ini didukung oleh penelitian yang dilakukan Azmi et al., (2018) menunjukkan bahwa lansia yang melakukan aktivitas memiliki kualitas hidup baik 54,1%, hal ini dikarenakan lansia masih memiliki energi yang cukup untuk melakukan aktivitas sehari-hari dan memberikan kebugaran. Disamping itu dengan banyaknya aktivitas atau interaksi sosial, dapat menurunkan kecemasan, mempertahankan keterampilan berkomunikasi serta meningkatkan kesehatan mental dan kualitas hidup yang baik (Andesty, et al., 2015).

Aktivitas fisik yang tinggi dapat diartikan bahwa orang tersebut memiliki waktu yang lebih sedikit untuk duduk atau berdiam diri, sehingga risiko disabilitas dan kejadian obesitas sentral rendah, selain itu juga mengurangi risiko timbulnya penyakit jantung koroner, diabetes mellitus dan stroke (Ambartana, et al., 2015); McKee, 2014;

**Tabel 3.** Hubungan Asupan Lemak dan Aktivitas Fisik dengan Kualitas Hidup Lanjut Usia

Variabel	Kualitas Hidup		P value*	r**
	Baik	Tidak baik		
<b>Asupan lemak</b>				
Lebih	6	6	0,225	0,086
Normal	13	7		
Defisit ringan	11	10		
Defisit sedang	10	8		
Defisit berat	60	69		
<b>Aktivitas Fisik</b>				
Ringan	9	25	0,002	0,216
Sedang	68	60		
Berat	24	14		

\*p value Spearman, \*\*correlation coefficient

WHO, 2015). Sejalan dengan penelitian Dewi (2018), aktivitas yang dilakukan dengan intensitas tinggi, besar kemungkinan dapat berpengaruh terhadap kualitas hidup, namun berdasarkan kelompok jenis kelamin, tidak menunjukkan hubungan yang signifikan.

Kualitas hidup dipengaruhi oleh kondisi yang ada pada individu, dari fisik, mental, kemandirian sampai dengan hubungan dengan sekitar (sosial), sehingga menimbulkan rasa nyaman yang merupakan hasil dari keseimbangan dari aspek fisiologis maupun psikologis dalam aktivitas sehari-hari (Ratmini dan Arifin, 2011).

Baik ataupun buruk kualitas hidup lansia ditentukan dari lansia itu sendiri. Banyak faktor yang mempengaruhi mulai dari asupan makanan gizi seimbang sampai dengan depresi sehingga dukungan keluarga ataupun lingkungan tempat tinggal merupakan salah satu intervensi yang baik untuk mencapai kualitas hidup yang baik (Fitriana dan Khairani, 2018; Sutinah, *et al.*, 2017).

Kegiatan intervensi dalam upaya meningkatkan kualitas hidup lansia yang dilakukan Kiik, *et al.*, (2018) menerapkan latihan keseimbangan seperti yoga atau senam yang dilakukan pada lansia dengan durasi 30 menit selama 8 minggu memberikan perbedaan signifikan antara kelompok kontrol dengan perlakuan. Penerapan *Self Help Group Therapy* yang dibentuk oleh dan untuk kepentingan lansia dengan tujuan memaksimalkan peran lansia menunjukkan keberhasilan yang signifikan antara sebelum dan sesudah terapi selama 3 bulan (Sudiantara, *et al.*, 2015). Selain itu penerapan *reminiscence therapy* pada lansia di PSTW Bondowoso menunjukkan pengaruh signifikan terhadap penurunan tingkat depresi pada lansia (Vitaliati, 2018).

Keterbatasan dalam penelitian ini adalah peneliti tidak meneliti kandungan lemak secara klinis (cek darah), asupan gula dan riwayat obat-obatan yang dikonsumsi oleh responden, sehingga tidak dapat mengetahui hubungan antar variabel.

## KESIMPULAN DAN SARAN

Kesimpulan penelitian ini adalah tingkat asupan lemak dengan kualitas hidup lansia tidak memiliki hubungan yang signifikan, salah satu penyebabnya adalah penurunan nafsu

makan disertai pola makan yang tidak teratur. Sedangkan aktivitas fisik dengan kualitas hidup lansia memiliki hubungan yang signifikan. Dengan demikian semakin bertambahnya usia, diharapkan tetap melakukan aktivitas fisik baik intensitas sedang maupun berat atau disesuaikan dengan kemampuan tubuh, sehingga mendapatkan kebugaran yang optimal untuk meningkatkan kualitas hidup.

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## PENGARUH ASUPAN SAYUR KANGKUNG (*IPOMEA REPTANS POIR.*) DAN OLAHRAGA RENANG TERHADAP INTENSITAS KECEMASAN PADA REMAJA LAKI-LAKI

*The Effect of Kangkong Vegetables (Ipomea reptans Poir.) and Swimming on Anxiety Intensity  
in Adolescent Male*

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### ABSTRAK

Tingkat stres yang tinggi pada remaja dapat menyebabkan gangguan kesehatan mental seperti kecemasan. Sayur kangkung memiliki keunggulan zat gizi dalam mengatasi kecemasan, dalam 250 g sayur kangkung mengandung karbohidrat (9,7 g), vitamin B1 (0,17 mg), vitamin C (42,5 mg), kalsium (167,5 mg), zink (1 mg), Fe (5,7 mg), kalium (625,2 mg), natrium (162,5 mg), flavonoid, alkaloid dan steroid untuk metabolisme dan peningkatan hormon di otak seperti BDNF, GABA, serotonin, dopamin dan norepinefrin yang menurunkan kecemasan. Olahraga renang memiliki keunggulan sebagai upaya rekreasi dalam mengatasi kecemasan, juga membuat badan tetap bugar dan rileks untuk metabolisme dan peningkatan hormon di otak seperti BDNF, GABA, serotonin, dopamin dan norepinefrin yang menurunkan kecemasan. Tujuan penelitian menganalisis pengaruh asupan sayur kangkung dan olahraga renang terhadap intensitas kecemasan pada remaja. Penelitian menggunakan desain studi *quasi experiment pre-post test control grup design*, melibatkan 61 siswa laki-laki, diambil dari 3 Sekolah Menengah Atas dan dibagi menjadi 3 kelompok: kelompok kontrol dengan pemberian olahraga renang sebanyak 2 kali / pekan selama 2 pekan (kedalaman kolam 120 cm dan durasi renang selama 60 menit / latihan) (P0) (n=22), kelompok pemberian sayur kangkung sebanyak 250 gram / hari selama 14 hari (dibagi menjadi 2 porsi) (P1) (n=19) dan kelompok pemberian kombinasi sayur kangkung dan olahraga renang (P2) (n=20). Hasil penelitian menggunakan uji ANOVA, penurunan intensitas kecemasan pada seluruh kelompok tidak jauh berbeda dengan nilai ( $p=0,593$ ). Kesimpulan penelitian adalah pemberian sayur kangkung, olahraga renang dapat menurunkan intensitas kecemasan pada remaja laki-laki.

**Kata kunci:** intensitas kecemasan, sayur kangkung, olahraga renang

### ABSTRACT

High stress levels in adolescents can cause mental health disorders such as anxiety. Kangkong vegetables has nutrients superior in reducing anxiety, in 250 grams of kangkong vegetables contains carbohydrates (9,7 g), vitamin B1 (0,17 mg), vitamin C (42,5 mg), calcium (167,5 mg), zinc (1 mg), iron (5,7 mg), potassium (625,2 mg), sodium (162,5 mg), flavonoids, alkaloids and steroids for metabolism and increased hormone in the brain such as BDNF, GABA, serotonin, dopamine and norepinephrine which reduce anxiety. Swimming has superior as a recreational effort in reducing anxiety, also keeps the body fit and relaxed for metabolism and increased hormones in the brain such as BDNF, GABA, serotonin, dopamine and norepinephrine which reduce anxiety. The purpose of this study was to analyze the effect of kangkong vegetables and swimming in the intensity of anxiety in adolescent. The study uses a quasi-experimental study design pre-post test control group design, involving 61 male students, taken from 3 senior high schools and grouped into 3: control group by giving swimming 2 times / week for 2 weeks (pool depth 120 cm and swimming duration for 60 minutes / exercise) (P0) (n=22), group by giving 250 grams of kangkong vegetables / day for 14 days (divided into 2) (P1) (n=19) and group by giving combination of kangkong vegetables and swimming (P2) (n=20). The results of the study used the ANOVA, the decrease in anxiety intensity in all groups not much different from the value ( $p=0.593$ ). The conclusion this study is the giving of kangkong vegetables, swimming can reduce the intensity of anxiety in adolescent male.

**Keywords:** anxiety intensity, kangkong vegetables, swimming



## PENDAHULUAN

Ansietas atau kecemasan adalah masalah kesehatan mental yang banyak ditemui di masyarakat (Anggraini, 2014). Masalah kesehatan mental menjadi penyebab ke 3 (tiga) dari beban penyakit di seluruh dunia dan diprediksi menjadi beban penyakit utama pada tahun 2030 yang sangat berdampak terhadap kesehatan, kesejahteraan dan kehidupan (World Health Organization, 2008, Ferrari, et al., 2013, Whiteford, et al., 2013). Di Eropa dan Amerika Utara, masalah kecemasan dan depresi mencapai 10 – 20% kasus (Le, et al., 2012).

Di Indonesia, masalah mental emosional tahun 2018 yaitu 9,8%, pada laki-laki lebih rendah yaitu 7,6%, sedangkan pada perempuan lebih tinggi yaitu 12,1% (Kementerian Kesehatan, 2018a), namun bukan berarti kelompok laki-laki tidak berisiko, pada studi yang lain menyatakan bahwa laki-laki lebih banyak mengalami kecemasan dan depresi ringan hingga berat dikarenakan ketika mengalami masalah cenderung lebih tertutup dan berperilaku anti sosial (Riastiningsih dan Sidarta, 2018). Penggunaan remaja laki-laki adalah sebagai pembanding atas studi lain yang menggunakan remaja perempuan yang mengidap kecemasan yang diberi terapi buah pisang dan latihan fisik (Putra, 2018).

Jika masalah kesehatan mental emosional pada remaja tidak diatasi, remaja akan mudah mengalami kesulitan dalam kehidupan sosial, hilangnya kemauan bersekolah, mengalami kendala dalam belajar, nilai akademik menurun, kenakalan atau penyimpangan remaja dan kecanduan obat-obatan (Thapar, et al., 2012). Kecemasan juga dapat mendorong seseorang untuk menggunakan obat sedatif atau mengonsumsi narkotika, psikotropika dan zat adiktif untuk mengatasi kecemasannya tersebut (Rahangga, et al., 2018).

Kandungan zat gizi pada sayur kangkung seperti karbohidrat, vitamin B dan C, kalsium, zink, Fe, kalium, natrium, flavonoid, alkaloid dan steroid berdampak fisiologis terhadap metabolisme hormon-hormon di otak yang mengatur kecemasan, diantaranya meningkatkan *brain-derived neurotrophic factor* (BDNF), *gamma-aminobutyric acid* (GABA), serotonin, dopamin dan norepinefrin sehingga berpotensi menurunkan kecemasan (Scapagnini, et al., 2012, Młyniec, et

al., 2014, Setiawan, et al., 2012). Pada sayuran lainnya seperti sayur kubis kandungan gizinya hanya dapat memberikan efek hipnotis untuk meningkatkan durasi tidur, sedangkan pada sayur brokoli kandungan gizinya seperti *kaempferol* hanya berfungsi sebagai antioksidan, antiinflamasi, antimikroba dan antidiabetik (Hosseini, et al., 2018, Khalaj, et al., 2013, Calderon-Montano, et al., 2011).

Olahraga renang dapat memberikan dampak yang baik terhadap metabolisme beberapa hormon di otak diantaranya meningkatkan BDNF, GABA, serotonin, dopamin maupun norepinefrin sehingga berpotensi menurunkan kecemasan (Jiang, et al., 2014, Knöchel, et al., 2012, Lautenschlager, et al., 2012). Pada olahraga lainnya seperti olahraga yoga hanya dapat mengatur sumbu *hipothalamus pituitari adrenal* (HPA), sistem saraf simpatis dan meningkatkan aktivitas parasimpatis sehingga menurunkan tekanan darah, stres dan kecemasan, sedangkan pada olahraga pilates hanya dapat membentuk postur tubuh, memperlancar peredaran darah, sistem pernapasan dan sistem limfa, serta mengurangi nyeri haid (Yulinda, et al., 2017, Aryani, et al., 2018, Destyaningrum, et al., 2017).

Tujuan dari penelitian ini adalah untuk menguji pengaruh asupan sayur kangkung dan olahraga renang sebagai terapi non farmakologis dalam mengatasi masalah kecemasan pada remaja laki-laki.

## METODE

Penelitian *quasi experiment* ini menggunakan rancangan *pre-post test control grup design*. Tempat dilaksanakannya penelitian di Surakarta, melibatkan 3 Sekolah Menengah Atas (SMA). Pemilihan sekolah menggunakan *random sampling* terhadap seluruh SMA Negeri dan SMA Swasta yang mewakili 3 Kecamatan dengan data kasus masalah mental terbanyak di Surakarta, lalu dipilih 2 SMA Negeri dan 1 SMA Swasta dengan cara diundi. Data kelompok masalah mental di seluruh Puskesmas yang berada di Surakarta tahun 2017 yaitu 1.846 kasus (Dinas Kesehatan Kota Surakarta, 2018).

Sampel diperoleh menggunakan *purposive sampling* di 3 SMA. Sampel penelitian melibatkan

61 siswa laki-laki berusia 15 – 17 tahun, dibagi menjadi 3 kelompok: kelompok kontrol dengan pemberian olahraga renang yang dikontrol asupan makannya dengan formulir *food recall* 24 jam (P0) (n=22), kelompok dengan pemberian sayur kangkung (P1) (n=19) dan kelompok dengan pemberian kombinasi sayur kangkung dan olahraga renang (P2) (n=20).

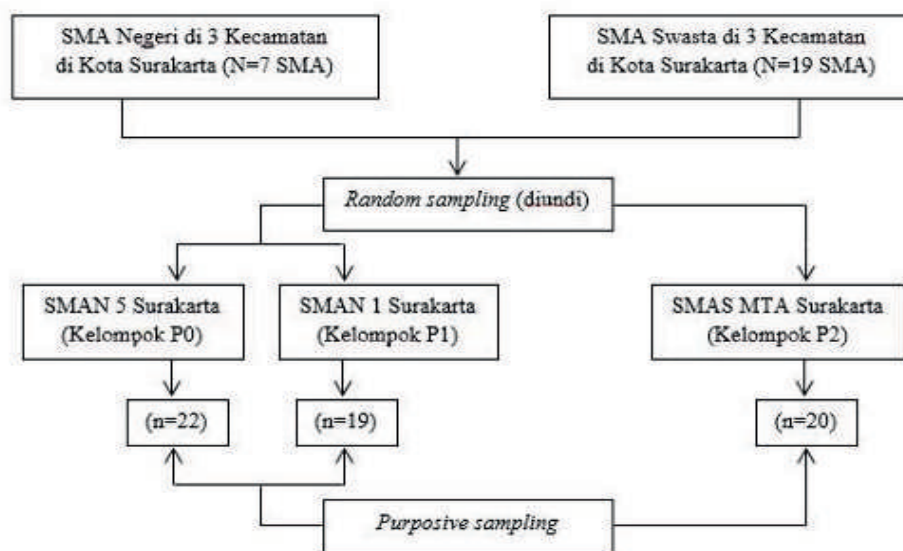
Penentuan sampel di masing-masing kelompok adalah dengan memerhatikan data jumlah berat ringannya intensitas kecemasan remaja yang dilibatkan di masing-masing sekolah yang diperoleh dari pengukuran awal (*pretest*) menggunakan kuesioner *Taylor Minnesota Anxiety Scale* (T-MAS). Pada SMA Negeri 5 Surakarta dalam kategori kecemasan ringan sehingga dipilih sebagai kelompok kontrol P0. Pada SMA Negeri 1 Surakarta dominan kategori kecemasan ringan dan terdapat subjek dengan kategori kecemasan sedang sehingga dipilih sebagai kelompok intervensi P1. Pada SMA Swasta MTA Surakarta dominan kategori kecemasan ringan dan terdapat subjek dengan kategori kecemasan sedang dan berat sehingga dipilih sebagai kelompok intervensi P2. Diagram *consort* penelitian ditunjukkan pada Gambar 1.

Variabel dan instrumen penelitian yaitu 1) Intensitas kecemasan adalah derajat intensitas kesehatan mental yang diukur menggunakan kuesioner T-MAS. Derajat intensitas kecemasan berdasarkan tinggi atau rendahnya total skor yang didapatkan, makin tinggi total skornya maka makin tinggi tingkat kecemasannya (Hidayah, 2010); 2) Asupan sayur kangkung adalah pemberian sayur kangkung darat (*Ipomea reptans* Poir.) yang diolah dalam berbagai variasi menu yang berbeda setiap harinya, seperti: kangkung tumis, kangkung bumbu brambang asem dan kangkung bumbu pecel, dengan suhu 100°C selama 5 – 10 menit, dengan berat matang 125 gram / porsi yang diberikan 250 gram / hari selama 14 hari (dibagi menjadi 2 porsi) (Lumbantobing, *et al.*, 2018, Arsyad, 2014, Kementerian Kesehatan, 2017). Subjek yang dilibatkan adalah mereka yang tidak memiliki masalah atau alergi terhadap sayur kangkung. Konsumsi sayur kangkung dipantau langsung sampai habis oleh peneliti dan dibantu oleh enumerator untuk memastikan habis tidaknya sayur kangkung yang diberikan setiap harinya.

Pemberian sayur kangkung dilakukan di sekolah yang diberikan sebanyak 2 porsi setiap hari pada pagi (jam 09.00 WIB) dan siang (jam 11.00 WIB) menyesuaikan jam istirahat pada masing-masing sekolah. Pada pemberian sayur kangkung di hari Sabtu dan Minggu tetap dilakukan di sekolah dan subjek tetap datang di sekolah atas instruksi dan daftar hadir khusus yang dibuat oleh guru sekolah yang mendampingi peneliti di masing-masing sekolah. Konsumsi sayur kangkung oleh subjek bersamaan dengan nasi putih yang dikontrol sebanyak 50 g per porsinya. Pemberian nasi putih bertujuan sebagai tambahan pendamping sayur kangkung agar lazim dikonsumsi dan membangkitkan selera makan subjek untuk menghabiskan pemberian sayur kangkung.; 3) Olahraga renang adalah olahraga di media kolam renang sebanyak 2 kali / pekan selama 2 pekan dengan kedalaman kolam 120 cm, dengan durasi renang selama 60 menit / latihan (pemanasan, latihan renang dan pendinginan dengan formasi waktu 10-40-10 menit) dan dipimpin oleh instruktur. Gaya renang menggunakan gaya bebas dan frekuensi renang dengan nomor renang 4x100 meter gaya bebas (Susanto, 2010, Sismadiyanto dan Susanto, 2008, Subagyo, 2017). Subjek yang dilibatkan adalah mereka yang bisa berenang karena telah mendapat pelatihan sebelum terapi oleh guru olahraga dan instruktur renang yang membantu pada penelitian ini.

Pengambilan data terdiri dari beberapa tahap,

1) Tahap pertama, Pengurusan kelaikan etik dengan nomor etik: 003/UN27.06/KEPK/EC/2020 dari Komisi Etik Penelitian Kesehatan Universitas Sebelas Maret; Pengurusan izin penelitian; Koordinasi dengan pihak sekolah dan pengelola kolam renang; Pengarahan pada petugas lapangan (enumerator) tentang prosedur pengumpulan data dan penggunaan instrumen penelitian; Rekrutmen subjek penelitian berdasarkan kriteria inklusi: usia remaja 15 – 17 tahun, tinggal dengan orang tua, skor intensitas kecemasan  $\geq 21$  (T-MAS), tidak memiliki penyakit asma dan jantung, tidak mengonsumsi sayuran lain selain sayur kangkung yang diberikan, tidak mengonsumsi suplemen asam lemak omega-3, tidak merokok dan alkohol, serta status gizi normal; Mempersiapkan bahan penelitian. 2) Tahap kedua, Penjelasan tentang proses penelitian kepada subjek; Pemberian



**Gambar 1.** Alur Pemilihan Tempat dan Subjek Penelitian

kuesioner kepada subjek sebelum perlakuan; Pemisahan subjek menjadi 3 kelompok; Pemberian kuesioner kepada subjek setelah intervensi. 3) Tahap ketiga, Pengujian data dengan uji statistik; dan Penyusunan laporan penelitian.

Pengujian data: 1) Uji univariat; dan 2) Uji bivariat. Pada data yang normal (*Shapiro-Wilk*/n <50) diuji dengan *ANOVA* untuk data perbandingan perubahan intensitas kecemasan ( $p \geq 0,05$ ), sedangkan untuk data yang tidak normal (*Shapiro-Wilk*/n <50) diuji dengan *Wilcoxon* untuk data pre-posttest intensitas kecemasan, uji *Mann-Whitney U* untuk data perbandingan umur dan pendapatan ayah remaja dan uji *Kruskal-Wallis Test* untuk data perbedaan karakteristik umum remaja, data perbandingan *pretest*, dan data perbandingan *posttest* ( $p \leq 0,05$ ).

## HASIL DAN PEMBAHASAN

### Karakteristik Umum Remaja Laki-laki

Data karakteristik umum remaja laki-laki tergambar di bawah ini (Tabel 1). Berdasarkan Tabel 2 diketahui bahwa hasil uji *Kruskal-Wallis Test*: Pada rata-rata umur dan pendapatan ayah remaja pada kelompok P0, P1 dan P2 signifikan secara statistik yaitu ( $p=0,001$ ) dan ( $p=0,049$ ), yang berarti rata-rata umur dan pendapatan ayah remaja pada masing-masing kelompok terdapat

**Tabel 1.** Karakteristik Umum Remaja Laki-laki pada Kelompok P0, P1, dan P2

Karakteristik	Kelompok			Total	
	P0 (n=22)	P1 (n=19)	P2 (n=20)	(n=61)	%
<b>Umur</b>					
15 tahun	2	3	11	16	26,2
16 tahun	13	11	8	32	52,5
17 tahun	7	5	1	13	21,3
<b>Pendidikan Orang Tua</b>					
<b>Ayah</b>					
SD	0	0	1	1	1,6
SMP	0	0	0	0	0
SMA	10	9	5	24	39,4
PT	12	10	14	36	59,0
<b>Ibu</b>					
SD	1	0	1	2	3,3
SMP	1	0	1	2	3,3
SMA	10	5	9	24	39,4
PT	10	14	9	33	54,0
<b>Pendapatan Orang Tua</b>					
<b>Ayah</b>					
Rp.0	0	0	0	0	0
≤Rp.1.800.000	8	4	1	13	21,3
>Rp.1.800.000	14	15	19	48	78,7
<b>Ibu</b>					
Rp.0	3	1	3	7	11,5
≤Rp.1.800.000	9	10	6	25	40,9
>Rp.1.800.000	10	8	11	29	47,6

Keterangan: Upah Minimum Kota (UMK) Kota Surakarta = Rp.1.800.000.

**Tabel 2.** Perbedaan Karakteristik Umum Remaja Laki-laki pada Kelompok P0, P1 dan P2

Kelompok	n	Mean ± SD				
		Umur ± SD	Pendidikan Ayah ± SD	Pendidikan Ibu ± SD	Pendapatan Ayah ± SD	Pendapatan Ibu ± SD
P0	22	16,22 ± 0,61	3,54 ± 0,50	3,31 ± 0,77	2,63 ± 0,49	2,31 ± 0,71
P1	19	16,10 ± 0,65	3,52 ± 0,51	3,73 ± 0,45	2,78 ± 0,41	2,36 ± 0,59
P2	20	15,50 ± 0,60	3,60 ± 0,75	3,30 ± 0,80	2,95 ± 0,22	2,40 ± 0,75
<i>p value</i>		0,001 <sup>a</sup>	0,583 <sup>a</sup>	0,093 <sup>a</sup>	0,049 <sup>a</sup>	0,883 <sup>a</sup>

**Keterangan:** kontrol dengan intervensi olahraga renang (P0); intervensi dengan sayur kangkung (P1); dan intervensi dengan kombinasi sayur kangkung dan olahraga renang (P2); <sup>a</sup>Uji *Kruskal-Wallis Test*

**Tabel 3.** Perbandingan Perbedaan Umur dan Pendapatan Ayah Remaja Laki-laki pada Kelompok P0, P1, dan P2

Kelompok	Karakteristik Umum Remaja			
	Median Umur	<i>p value</i>	Median Pendapatan Ayah	<i>p value</i>
P0 : P1	16,00 : 16,00	0,552 <sup>a</sup>	3,00 : 3,00	0,289 <sup>a</sup>
P0 : P2	16,00 : 15,00	0,001 <sup>a</sup>	3,00 : 3,00	0,015 <sup>a</sup>
P1 : P2	16,00 : 15,00	0,012 <sup>a</sup>	3,00 : 3,00	0,396 <sup>a</sup>

**Keterangan:** kontrol dengan intervensi olahraga renang (P0); intervensi dengan sayur kangkung (P1); dan intervensi dengan kombinasi sayur kangkung dan olahraga renang (P2); <sup>a</sup> Uji *Mann-Whitney U*

**Tabel 4.** Kepatuhan Konsumsi Sayur Kangkung dan Olahraga Renang Remaja Laki-laki pada Kelompok P0, P1, dan P2

Kelompok	Kepatuhan Remaja Laki-laki							
	Konsumsi Sayur Kangkung		T		Olahraga Renang		T	
	Patuh	Tidak Patuh	n	%	Patuh	Tidak Patuh	n	%
P0 (n=22)	22	-	22	100	22	-	22	100
P1 (n=19)	19	-	19	100	19	-	19	100
P2 (n=20)	20	-	20	100	20	-	20	100

**Keterangan:** T = Total

perbedaan. Berdasarkan Tabel 3 diketahui bahwa hasil uji *Mann-Whitney U*: Pada perbandingan perbedaan umur remaja pada kelompok P0:P2 dan P1:P2 signifikan secara statistik yaitu ( $p=0,001$ ) dan ( $p=0,012$ ), yang berarti perbedaan umur remaja pada kelompok P0:P2 dan P1:P2 terdapat perbedaan; Pada perbandingan perbedaan pendapatan ayah remaja pada kelompok P0:P2 signifikan secara statistik yaitu ( $p=0,015$ ), yang

berarti perbedaan pendapatan ayah remaja pada kelompok P0:P2 terdapat perbedaan.

#### Perubahan Intensitas Kecemasan Remaja Laki-laki

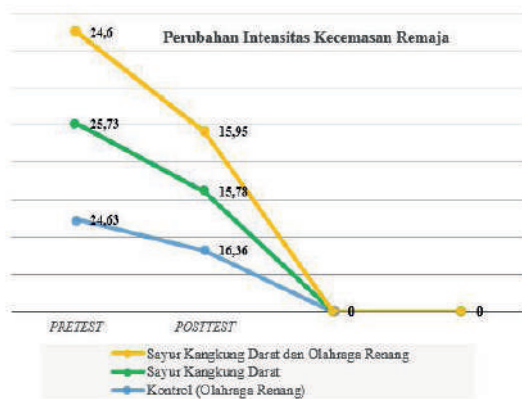
Data perubahan intensitas kecemasan remaja laki-laki tergambar di bawah ini (Tabel 5).

Berdasarkan Tabel 5 diketahui bahwa uji *Wilcoxon*: Pada skor *pre-post test* intensitas

**Tabel 5.** Perubahan Rata-rata Intensitas Kecemasan Remaja Laki-laki pada Kelompok P1, P1, dan P2

Kelompok	n	Mean ± SD			<i>p value</i>
		<i>Pretest</i> ± SD	<i>Posttest</i> ± SD	$\Delta$ ± SD	
P0	22	24,63 ± 4,06	16,36 ± 4,61	-8,27 ± 4,95	0,001 <sup>a</sup>
P1	19	25,73 ± 5,50	15,78 ± 6,69	-9,94 ± 6,16	0,001 <sup>a</sup>
P2	20	24,60 ± 2,92	15,95 ± 4,77	-8,65 ± 5,06	0,001 <sup>a</sup>
<i>p value</i>		0,751 <sup>b</sup>	0,887 <sup>b</sup>	0,593 <sup>c</sup>	

**Keterangan:** kontrol dengan intervensi olahraga renang (P0); intervensi dengan sayur kangkung (P1); dan intervensi dengan kombinasi sayur kangkung dan olahraga renang (P2); <sup>a</sup> Uji *Wilcoxon*; <sup>b</sup> Uji *Kruskal-Wallis Test*; <sup>c</sup> Uji *ANOVA*



Cambar 2. Grafik Perubahan Intensitas Kecemasan Remaja

**Gambar 2.** Grafik Perubahan Intensitas Kecemasan Remaja

kecemasan remaja laki-laki pada kelompok P0 signifikan secara statistik yaitu ( $p=0,001$ ), yang berarti terjadi penurunan skor intensitas kecemasan remaja laki-laki pada kelompok P0; Pada skor *pre-post test* intensitas kecemasan remaja laki-laki pada kelompok P1 signifikan secara statistik yaitu ( $p=0,001$ ), yang berarti terjadi penurunan skor intensitas kecemasan remaja laki-laki pada kelompok P1; Pada skor *pre-post test* intensitas kecemasan remaja laki-laki pada kelompok P2 signifikan secara statistik yaitu ( $p=0,001$ ), yang berarti terjadi penurunan skor intensitas kecemasan remaja laki-laki pada kelompok P2. Uji *ANOVA* pada rata-rata perubahan skor intensitas kecemasan remaja laki-laki pada kelompok P0, P1 dan P2 tidak signifikan secara statistik ( $p=0,593$ ) yang berarti rata-rata perubahan skor intensitas kecemasan pada masing-masing kelompok tidak jauh berbeda.

Sayur kangkung memiliki kandungan karbohidrat sebanyak 9,7 g per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan karbohidrat dalam kangkung dapat mendorong hormon *insulin* untuk meningkatkan sintesis *triptofan* dan *serotonin* sehingga terjadi perbaikan *mood* (Sudirman, 2011, Jones, *et al.*, 2012). Sayur kangkung juga memiliki kandungan vitamin B1 sebanyak 0,17 mg per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan vitamin B dalam kangkung dapat berperan mensintesis *serotonin*, *monoamina* dan *katekolamin* sehingga mendorong perubahan psikologis untuk perbaikan suasana hati (Stough, *et al.*, 2011). Sayur kangkung

memiliki kandungan vitamin C sebanyak 42,5 mg per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan vitamin C dalam kangkung dapat berperan mencegah kerusakan membran sel atau *deoxyribo nucleic acid* (DNA) di sistem saraf pusat (SSP), meningkatkan *serotonin* dan *dopamin* sehingga menginduksi ketenangan (Kodydková, *et al.*, 2009, Scapagnini, *et al.*, 2012).

Sayur kangkung juga memiliki kandungan kalsium sebanyak 167,5 mg per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan kalsium dalam kangkung dapat berperan mensintesis *serotonin* dan *dopamin* untuk mengatur kesehatan mental (Davison dan Kaplan, 2011). Sayur kangkung memiliki kandungan zink sebanyak 1,0 mg per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan zink dalam kangkung dapat berperan pada fungsi otak sebagai pengendali perilaku dan memperbaiki suasana hati lewat sinyal glutamat dan glukokortikoid saat stres (Takeda, *et al.*, 2007, Takeda dan Tamano, 2010). Sayur kangkung memiliki kandungan Fe sebanyak 5,7 mg per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan Fe dalam kangkung dapat meningkatkan kadar BDNF, serotonin dan norepinefrin, untuk mengatasi rasa gelisah (Texel, *et al.*, 2012).

Sayur kangkung memiliki kandungan kalium dan natrium sebanyak 625,2 mg dan 162,5 mg per 250 gramnya (Kementerian Kesehatan, 2018b). Kandungan kalium dan natrium dalam kangkung dapat berfungsi sebagai senyawa pembentuk garam (kalium) *bromida* yang menekan sistem saraf pusat (SSP) sehingga menimbulkan efek sedasi (Setiawan, *et al.*, 2012, Anggara, 2009, Astuti dan Fitriyanti, 2018). Kangkung juga mengandung flavonoid, alkaloid dan steroid yang dapat berfungsi mendorong pelepasan reseptor GABA dan *ligand-ion gated channel* (LGIC) yang menghasilkan efek sedatif untuk menurunkan ketegangan (Sabri, 2011, Sudirman, 2011, Hidayati, 2013, Anggara, 2009, Sutio, 2012).

Terapi berenang memiliki manfaat psikologis, diantaranya tidak hanya memberikan manfaat kesehatan dan ketenangan tetapi juga sebagai sarana rekreasi dan hiburan yang membuat seseorang menjadi tidak jenuh, merasa rileks dan badan tetap fit (Chaiton, 2002, Susanto, 2008). Aktivitas renang dan media kolam renang

dapat menjadi sarana untuk menjaga kesehatan melalui terapi air (*hydrotherapy*) dan juga untuk mengobati masalah kejiwaan (Susanto, 2010). Olahraga renang dengan cara yang benar dan tepat dapat menurunkan peningkatan hormon *kortisol* akibat stres sehingga menimbulkan rasa “kegembiraan,” membuat ingin tidur (*sopartifk*) dan menghilangkan stres serta menimbulkan relaksasi (Amirta, 2007, Ningrum, 2012). Studi terbaru memberikan bukti baru bahwa selama 14 hari latihan renang dapat memberikan efek penarikan *methamphetamine* (METH) spontan, menurunkan tingkat kecemasan, *obsessive-compulsive disorder* (OCD) dan menurunkan perilaku depresi (Damghani, *et al.*, 2016).

Kelebihan dari penelitian ini adalah yang pertama melakukan kombinasi penggunaan sayur kangkung darat dan olahraga renang sebagai intervensi dalam mengatasi masalah kecemasan dan seluruh perlakuan intervensi dikontrol sangat ketat. Kekurangan dari penelitian ini adalah keakuratan informasi yang diberikan oleh subjek terkait konsumsi sayuran dan aktivitas fisik lainnya yang dikonsumsi dan dilakukan oleh subjek selama penelitian berlangsung, karena hal tersebut bergantung pada daya ingat dan kejujuran yang diberikan oleh subjek, serta hal tersebut berpotensi menjadi faktor *confounding* dalam penelitian ini.

## KESIMPULAN DAN SARAN

Berdasarkan hasil penelitian di atas memberikan bukti bahwa asupan sayur kangkung dan olahraga renang memiliki pengaruh dan potensi yang sama baiknya sebagai terapi non farmakologis dan bisa menjadi pilihan alternatif yang murah, tanpa efek samping dan sebagai tindakan preventif maupun kuratif dalam mengatasi atau menurunkan intensitas kecemasan. Perlu dilakukannya kontrol yang sangat ketat terhadap keakuratan informasi yang diberikan oleh subjek terkait konsumsi sayuran dan aktivitas fisik lainnya yang dikonsumsi dan dilakukan oleh subjek selama penelitian berlangsung untuk mengurangi risiko faktor *confounding*.

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## UJI EFEKTIFITAS SINBIOTIK KEFIR TEPUNG PISANG BATU TERHADAP KADAR GLUKOSA DARAH DAN KADAR PROFIL LIPID TIKUS MODEL SINDROM METABOLIK

*Effectiveness Test of banana (Musa balbisiana) Flour Kefir Synbiotic on Blood Glucose Level and Lipid Profile Level in Metabolic Syndrome Rats Model*

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### ABSTRAK

Sindrom metabolik merupakan kelainan metabolik yang ditandai dengan hiperglikemia, hipertriglisieridemia, dan dislipidemia yang dapat diperbaiki melalui sinbiotik. Penelitian ini bertujuan untuk menganalisis pengaruh sinbiotik kefir tepung pisang batu terhadap kadar glukosa darah dan kadar profil lipid tikus model Sindrom Metabolik. Penelitian ini termasuk penelitian *true experimental* dengan *pre-post test with control group design* terhadap 24 ekor tikus *Sprague Dawley* jantan yang dibagi menjadi 4 kelompok secara acak. Kelompok kontrol negatif (K-) hanya diberi pakan standar, kelompok kontrol positif (K+) diberi pakan standar dengan *High Fat Fructose Diet* (HFFD), dan kelompok perlakuan I (PI) serta kelompok perlakuan II (PII) diberi pakan standar dengan HFFD dan sinbiotik kefir tepung pisang batu sebanyak 1,8ml/200g BB tikus/hari (PI) dan 3,6ml/200g BB tikus/hari (PII) selama tiga minggu. Pengukuran kadar glukosa darah menggunakan metode *glucose oxidase-peroxidase aminoantipyrine*, metode *cholesterol oxidase-peroxidase aminoantipyrine* untuk kadar kolesterol, dan metode *glycerol 3 phosphate oxidase phenol amino phenazone* untuk kadar triglisierida. Hasil uji *Analysis of Varians* menunjukkan perbedaan rerata yang signifikan ( $p=0,000$ ) antarkelompok yang dilanjutkan dengan uji *Post Hoc Bonferroni* atau uji *Post Hoc Games-Howel* yang menunjukkan perbedaan rerata pada kelompok PI dan PII. Pemberian sinbiotik kefir tepung pisang batu terbukti dapat menurunkan kadar glukosa darah dan memperbaiki kadar profil lipid.

**Kata kunci:** glukosa darah, profil lipid, sinbiotik kefir tepung pisang batu, sindrom metabolik

### ABSTRACT

*Metabolic Syndrome is a metabolic disorder characterized by hyperglycemia, hypertriglyceridemia, and dyslipidemia which can be repaired through synbiotics. This study is to analyzed the effects of banana (Musa balbisiana) flour kefir synbiotic on blood glucose level and lipid profile level of Metabolic Syndrome rats. This is true experimental study with pre-posttest with control group design of 24 male Sprague Dawley rats which were divided into 4 groups randomly. Negative control group (K-) given standard food only, positive control group (K +) given standard food with High Fat Fructose Diet (HFFD), intervention group I (PI) and intervention group II (PII) were given standard food with HFFD and banana (Musa balbisiana) flour kefir synbiotic 1,8 ml/200 g weight/day (PI) and 3,6 ml/200 g weight/day (PII) for three weeks. Blood glucose level was analyzed using glucose oxidase-peroxidase amino antipyrine method, cholesterol level was analyzed using cholesterol oxidase-peroxidase amino antipyrine, and triglyceride level was analyze using glycerol 3 phosphate oxidase phenol amino phenazone method. Result of Analysis of Varian test shows significant differences in mean between group ( $p=0,000$ ) followed by PostHoc Bonferroni test or Post Hoc Games-Howel test which showed a mean difference in the PI and PII groups. Banana (Musa balbisiana) flour kefir synbiotic can reduce blood glucose level and improve lipid profile level.*

**Keywords:** blood glucose, lipid profile, banana (Musa balbisiana) flour kefir synbiotic, metabolic syndrome

## PENDAHULUAN

Sindrom metabolik merupakan kondisi kelainan metabolik khusus yaitu obesitas sentral, resistensi insulin, hiperglikemia, dislipidemia, dan hipertensi (Srikanthan *et al.*, 2016). Seseorang dikatakan mengalami Sindrom Metabolik jika memiliki 3 dari 5 kondisi tersebut (Nolan *et al.*, 2017). Menurut *International Diabetes Federation* (IDF) sebesar 20% penduduk dunia mengalami Sindrom Metabolik (Rahmawati dkk., 2017). Prevalensi sindrom metabolik di Indonesia sebesar 13,13% (Rini, 2015) dimana 28,4% merupakan penduduk di Kota Jakarta (Oktavia dkk., 2017). Sindrom Metabolik biasanya diawali dengan resistensi insulin yang memicu produksi insulin berlebih atau hiperinsulinemia (Punthakee *et al.*, 2018). Produksi insulin akan melemahkan sel  $\beta$  pankreas hingga mengalami kerusakan yang memicu terjadinya peningkatan kadar glukosa darah atau hiperglikemia (Gandhi, 2017). Hiperinsulinemia juga menyebabkan peningkatan trigliserida (TG) dan peningkatan *Low Density Lipoprotein* (LDL) serta penurunan *High Density Lipoprotein* (HDL) (Soleha dan Azzaky, 2016).

Tata laksana sindrom metabolik dengan memanfaatkan pangan fungsional seperti sinbiotik diperlukan untuk memperbaiki kondisi tersebut (Ferrarese *et al.*, 2018). Sinbiotik sebagai kombinasi sinergis antara probiotik dan prebiotik bermanfaat untuk kesehatan tubuh (Rahmawati dkk., 2017). Produk probiotik salah satunya adalah kefir (Nurliyani dan Sunarti, 2017). Kefir susu kambing merupakan produk dengan penambahan probiotik berupa bakteri dan khamir (Martharini dan Indratiningsih, 2017). Bakteri probiotik berfungsi dalam menurunkan kadar glukosa darah dan memperbaiki kadar profil lipid secara signifikan (Aktimur *et al.*, 2017). Pertumbuhan probiotik dipengaruhi oleh keberadaan dari prebiotik (Moroti *et al.*, 2012).

Pisang memiliki kandungan prebiotik yang mudah ditemui di Indonesia (Hardisari dan Nur, 2016). Pisang batu (*Musa balbisiana*) merupakan jenis pisang dengan pemanfaatan yang kurang optimal (Musita, 2014). Pisang batu sebagai jenis pisang *plantain* lebih baik untuk dijadikan tepung dibandingkan jenis *banana* (Putri *et al.*, 2015). Pisang batu memiliki kandungan prebiotik

*fructooligosakarida* (FOS) sebesar 427,03 mg/ml (Musita, 2012).

Kefir tepung pisang batu merupakan sinbiotik. Penelitian pendukung menjelaskan bahwa prebiotik akan difermentasi mikroflora usus menghasilkan *Short Chain Fatty Acid* (SCFA) (Verbeke *et al.*, 2015) yang berperan dalam metabolisme glukosa dan resistensi insulin pada hiperglikemia (Markowiak dan Katarzyna, 2017). Selain itu, SCFA berperan dalam mengendalikan ekspresi enzim sintesis asam lemak (Ostadrahimi *et al.*, 2015). Oleh karena itu, peneliti tertarik untuk menganalisis pengaruh sinbiotik kefir pisang batu terhadap kadar glukosa darah dan kadar profil lipid tikus model Sindrom Metabolik yang belum pernah dilakukan sebelumnya.

## METODE

Penelitian ini termasuk penelitian *true experimental* dengan *pre-post test with control group design*. Rancangan penelitian ini menggunakan hewan coba yang dibagi secara acak menjadi empat kelompok, yaitu kelompok kontrol negatif (K-), kelompok kontrol positif (K+), kelompok perlakuan I (PI), dan kelompok perlakuan II (PII). Kelompok K- adalah tikus kondisi sehat, sedangkan kelompok K+ adalah tikus kondisi Sindrom Metabolik. Kelompok PI dan PII adalah tikus kondisi Sindrom Metabolik yang diberikan sinbiotik kefir tepung pisang batu dengan perbedaan dosis. Penentuan dosis menggunakan konversi dosis pada manusia dengan berat 70 kg sebanyak 100ml (Rahmawati dkk., 2017) dan 200 ml (Moroti *et al.*, 2012) sehingga didapatkan dosis pada tikus dengan berat 200g sebanyak 1,8 ml/200 g BB tikus/hari (PI) dan 3,6 ml/200 g BB tikus/hari (PII). (Gambar 1).

Populasi penelitian ini adalah tikus jenis *Sprague Dawley* (subjek) dengan penentuan besar sampel menurut *World Health Organization* (WHO) yaitu sebanyak lima ekor (WHO, 2001) dan penambahan *drop out* 20%, sehingga didapatkan jumlah sampel sebanyak 24 ekor. Subjek diikutsertakan dalam penelitian jika subjek bergerak secara aktif, berjenis kelamin jantan dengan berat badan 150–200 g dan berusia 8–12 minggu, sedangkan subjek tidak diikutsertakan dalam penelitian jika subjek mengalami diare

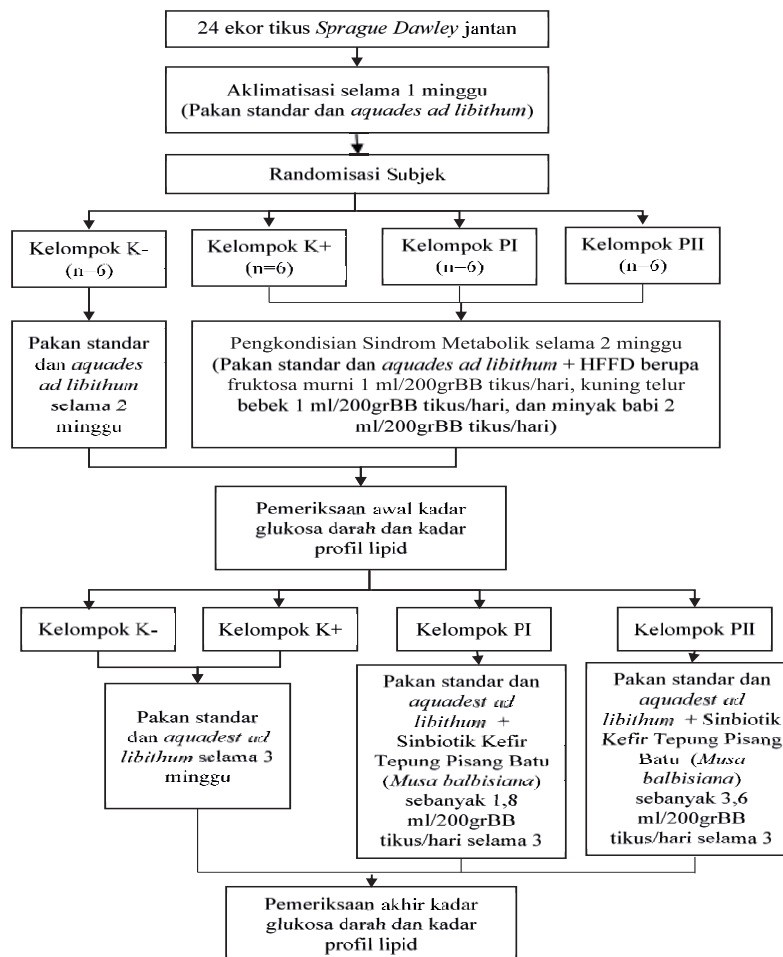
dengan penurunan berat badan lebih dari 10% atau mati selama penelitian.

Pembuatan sinbiotik kefir tepung pisang batu dilakukan di Laboratorium Fakultas Teknologi Pertanian Universitas Gadjah Mada dan pengujian pre-klinis dilakukan di Laboratorium Pusat Studi Pangan dan Gizi Universitas Gadjah Mada pada Maret sampai dengan Juli 2019.

Sinbiotik kefir tepung pisang batu dibuat melalui beberapa tahap, yaitu 1) penimbangan bahan baku berupa tepung pisang batu 40 g, susu skim kambing 62,5 g, *starter* kefir (*Lactobacillus lactis*, *L. cremoris*, *L. diacetylactis*, dan *L. acidophilus* serta khamir *Saccharomyces cerevisiae*) 2,5 g, dan air mineral 500 ml menggunakan timbangan digital, 2) pasteurisasi susu skim kambing selama 15 menit pada suhu 80°C, 3) pencampuran tepung pisang batu dengan susu skim kambing, 4) pendinginan hingga suhu 25°C, 5) penambahan *starter* kefir, 6) inokulasi

dalam inkubator selama 24 jam pada suhu 37°C hingga pH mencapai 4,6,7) penyaringan starter kefir, dan 8) penyimpanan dalam lemari pendingin pada suhu 4°C. (Setyawardani dkk., 2017 dan Azara *et al.*, 2018)

Sebelum dilakukan percobaan, tikus diaklimatisasi selama 1 minggu untuk adaptasi di tempat pemeliharaan sebelum dilakukan percobaan dan dipelihara dalam kandang berpencahayaan cukup, suhu ruang 25°C, dan dikandangkan secara individual. Pakan standar dan *aquadest* diberikan setiap hari secara *ad libitum*. Pakan standar mengandung protein minimal 15%, lemak 3–7%, air maksimal 12%, abu maksimal 7%, serat maksimal 6%, fosfor 0,6–0,9%, kalsium 0,9–1,1%, *coccidiostat* (+), dan antibiotika (+). Pengondisian Sindrom Metabolik dilakukan setiap hari (Oktavia dkk. 2017) dengan pemberian pakan standar dan *aquadest ad libitum* dengan tambahan HFFD (*High Fat Fructose Diet*) secara oral. HFFD berupa



Gambar 1. Prosedur Penelitian.

minyak babi 2ml/200g BB tikus/hari, kuning telur bebek 1ml/200g BB tikus/hari, dan fruktosa murni 1ml/200g BB tikus/hari (Rahmawati *et al.*, 2017). Pemberian HFFD tidak memengaruhi asupan pakan standar yang dikonsumsi tikus. Subjek dinyatakan Sindrom Metabolik ketika terjadi peningkatan Glukosa Darah Puasa (GDP) dan TG serta penurunan HDL (Wahyuni dan Ahmad, 2015). Sinbiotik kefir tepung pisang batu diberikan selama 3 minggu untuk kelompok PI (1,8 ml/200g BB tikus/hari) dan PII (3,6 ml/200g BB tikus/hari) setelah mengondisikan sindrom metabolik. Intervensi produk diberikan satu kali daam sehari pada pagi hari (Mohamed *et al.*, 2017) secara oral.

Pemeriksaan sampel darah subjek dilakukan dengan pengambilan darah sebanyak 2 ml melalui *plexus retroorbitalis* untuk analisis kadar glukosa darah dan kadar profil lipid. Sampel darah di sentrifugasi selama 10 menit dengan kecepatan 4000 rpm untuk mendapatkan serum darah subjek. Serum darah dibaca menggunakan metode *glucose oxidase - peroxidase aminoantipyrine* (GOD-PAP) untuk glukosa darah, metode *cholesterol oxidase - peroxidase aminoantipyrine* (CHOD-PAP) untuk kolesterol darah, dan metode *glycerol 3 phosphate oxidase phenol amino phenazone* (GPO-PAP) untuk kadar TG menggunakan fotometer pada panjang gelombang 546 nm selama 60 menit (Diasys Diagnostic System, 2012). Pengukuran berat badan dilakukan setiap hari menggunakan timbangan dan pengukuran panjang badan dilakukan satu kali pada awal penelitian menggunakan jangka sorong.

Analisis univariat digunakan untuk melihat rerata, median, dan Standar Deviasi (SD). Analisis bivariat dimulai dengan uji normalitas menggunakan uji *Saphiro Wilk* ( $n \leq 50$ ). Selain itu, dilakukan uji *Homogeneity of Variances* yang dilanjutkan dengan uji parametrik *Analysis of Varians* (Anova) untuk mengetahui perbedaan rerata GDP dan profil lipid antarkelompok. Selanjutnya, uji *Post Hoc Bonferroni* atau uji *Post Hoc Games-Howell* digunakan untuk mengetahui letak perbedaan rerata GDP dan profil lipid.

Penelitian ini telah memperoleh *ethical clearance* dari Komisi Etik Penelitian Kesehatan Universitas Pembangunan Nasional “Veteran” Jakarta Nomor B/2078/VII/2019/KEPK.

## HASIL DAN PEMBAHASAN

Asupan fruktosa menyebabkan peningkatan metabolisme fruktosa yang akan mendorong peningkatan sintesis asam lemak (Gopper dan Smith, 2013). Asam lemak kemudian dimobilisasi dari jaringan lemak menuju hati dan berikatan dengan gliserol membentuk TG (Cahyani, 2017). Asupan lemak membentuk timbunan lemak berlebih di jaringan adiposa. Asupan lemak jenuh dan kolesterol yang tinggi akan dicerna dalam usus halus yang akan menghasilkan TG, fosfolipid, dan kolesterol yang selanjutnya akan diubah menjadi kilomikron. Kilomikron *remnant* yang mengandung kolesterol tidak teresterifikasi disalurkan ke hati lalu diekskresikan dalam bentuk *Very Low Density Lipoprotein* (VLDL) selanjutnya terhidrolisis menjadi *Intermediate Density Lipoprotein* (IDL) dengan bantuan lipoprotein lipase. IDL akan mengalami hidrolisis kembali menjadi *Free Fatty Acid* (FFA) dan gliserol sehingga berubah menjadi LDL yang mengandung ikatan tak jenuh yang rentan terhadap radikal bebas serta dapat membentuk plak dalam peredaran darah (Gooper dan Smith, 2013).

Terjadi perubahan perbedaan rerata hasil berat badan yang signifikan pada awal aklimatisasi dan sebelum intervensi serta sebelum dan setelah intervensi (Tabel 1). Hasil uji Anova menunjukkan terdapat perbedaan rerata berat badan yang signifikan ( $p \leq 0,05$ ) antar kelompok. Perubahan berat badan pada kelompok PI dengan penambahan 24,4 g dan kelompok PII dengan penambahan 21 g lebih rendah dibandingkan kelompok K+ dengan penambahan 36,7 g. Pemberian dosis sinbiotik tepung pisang batu yang lebih tinggi pada kelompok PII memiliki penambahan berat badan yang lebih sedikit dibandingkan pada kelompok PI. Hasil penelitian ini sejalan dengan penelitian Cerdo *et al.*, (2019) bahwa pemberian sinbiotik dapat mempengaruhi perubahan berat badan pada obesitas sentral dengan kondisi Sindrom Metabolik.

Tabel 2 menunjukkan rerata hasil GDP sebelum dan setelah intervensi serta perubahan rerata hasil GDP sebelum dan setelah intervensi.

Hasil uji Anova menunjukkan terdapat perbedaan yang signifikan ( $p=0,000$ ) antarkelompok pada rerata GDP sebelum, setelah, dan perubahannya.

**Tabel 1.** Perubahan Berat Badan Tikus

Kelompok	N	Rerata ± SD			p <sup>1</sup>	p <sup>2</sup>
		Awal (g)	Sebelum (g)	Sesudah (g)		
K-	6	164,2 ± 2,3 <sup>a</sup>	179,2 ± 3,4 <sup>a</sup>	197,5 ± 3,9 <sup>a</sup>	0,000	0,000
K+	6	170,3 ± 3,9 <sup>b</sup>	199,8 ± 3,2 <sup>b</sup>	236,5 ± 2,5 <sup>b</sup>	0,000	0,000
PI	6	170,0 ± 4,4 <sup>b</sup>	200,3 ± 3,1 <sup>b</sup>	224,7 ± 3,9 <sup>c</sup>	0,000	0,000
PII	6	171,2 ± 3,7 <sup>b</sup>	202,0 ± 2,4 <sup>b</sup>	223,0 ± 2,6 <sup>c</sup>	0,000	0,000
p <sup>3</sup>		0,013	0,000	0,000		

<sup>1</sup>Hasil signifikansi uji *Paired Sample T Test* awal aklimatisasi dan sebelum intervensi

<sup>2</sup>Hasil signifikansi uji *Paired Sample T Test* sebelum dan setelah intervensi

<sup>3</sup>Hasil signifikansi uji Anova

<sup>a,b,c</sup>Nilai dengan notasi yang berbeda pada kolom yang sama menunjukkan perbedaan rerata yang signifikan pada uji lanjut

**Tabel 2.** Rerata Kadar Glukosa Darah (mg/dl) Sebelum dan Setelah Intervensi

Variabel	N	Sebelum	Sesudah	Δ Perubahan	
		Rerata ± SD	Rerata ± SD	Rerata ± SD	%
K-	6	71,02 ± 1,80 <sup>a</sup>	72,85 ± 1,75 <sup>a</sup>	1,83 ± 1,05 <sup>a</sup>	2,57%
K+	6	132,29 ± 1,43 <sup>b</sup>	133,45 ± 1,43 <sup>b</sup>	1,16 ± 0,24 <sup>a</sup>	0,88%
PI	6	130,44 ± 1,99 <sup>b</sup>	102,06 ± 2,15 <sup>c</sup>	-28,38 ± 3,58 <sup>b</sup>	-21,76%
PII	6	131,45 ± 2,38 <sup>b</sup>	83,80 ± 3,72 <sup>d</sup>	-47,64 ± 4,30 <sup>c</sup>	-36,25%
p <sup>1</sup>		0,000	0,000	0,000	

<sup>1</sup>Signifikansi hasil uji Anova

<sup>a,b,c,d</sup>Notasi berbeda menunjukkan adanya perbedaan rerata yang signifikan pada uji *Post Hoc Bonferroni* atau uji *Post Hoc Games-Howell*

Rerata GDP sebelum intervensi menunjukkan adanya perbedaan yang signifikan antara kelompok K- dengan kelompok K+, PI dan PII, sedangkan rerata GDP setelah intervensi menunjukkan adanya perbedaan yang signifikan pada setiap kelompok. Kelompok K- dan K+ tanpa pemberian sinbiotik kefir tepung pisang batu mengalami peningkatan GDP sebesar 2,57% dan 0,88%, sedangkan kelompok PI dan PII mengalami penurunan GDP sebesar 21,76% dan 36,25% setelah pemberian sinbiotik kefir tepung pisang batu selama tiga minggu.

Tabel 3 menunjukkan adanya perbedaan yang signifikan ( $p \leq 0,05$ ) antar kelompok pada rerata kadar profil lipid sebelum, setelah dan perubahannya. Rerata kadar profil lipid sebelum intervensi menunjukkan adanya perbedaan yang signifikan antara kelompok K- dengan kelompok K+, PI dan PII, sedangkan rerata kadar profil lipid setelah intervensi menunjukkan adanya perbedaan yang signifikan pada setiap kelompok. Kadar kolesterol total, TG, dan HDL pada kelompok K- dan K+ mengalami peningkatan, sedangkan pada kelompok PI dan PII mengalami penurunan.

Sebaliknya kadar HDL pada kelompok K- dan K+ mengalami penurunan, sedangkan pada

kelompok PI dan PII mengalami peningkatan. Selain itu, pada perubahan rerata kadar profil lipid menunjukkan adanya perbedaan yang signifikan antara kelompok PI dengan kelompok PII.

Pada kelompok K- dan K+ menunjukkan peningkatan kadar glukosa darah, kolesterol total, TG, dan LDL serta penurunan HDL setelah intervensi. Peningkatan kadar glukosa darah, kolesterol total, TG, dan LDL pada kelompok K- dapat disebabkan karena penambahan usia yang menyebabkan penurunan fungsi pankreas hingga mengalami hiperglikemia (Setiyorini dan Ning, 2017). Penelitian juga menunjukkan bahwa penuaan meningkatkan pelepasan FFA dari adiposit ke hati (Liu dan Li, 2015) yang akan berikatan dengan gliserol membentuk TG (Cahyani, 2017). Selain itu, pertambahan usia subjek juga menyebabkan penurunan metabolisme lemak akibat penurunan reseptor LDL sehingga terjadi pembentukan LDL (Auley dan Mooney, 2015). Penurunan HDL subjek terjadi karena mekanisme *Reverse Cholesterol Transport* (RCT) yang semakin menurun seiring dengan pertambahan usia subjek.

Pada kelompok K+, peningkatan kadar glukosa darah, kolesterol total, TG, dan LDL

**Tabel 3.** Rerata Kadar Profil Lipid (mg/dl) Sebelum dan Setelah Intervensi

Variabel	N	Sebelum	Sesudah	Δ Perubahan	
		Rerata ± SD	Rerata ± SD	Rerata ± SD	%
<b>Kolesterol Total</b>					
K-	6	86,96 ± 2,42 <sup>a</sup>	88,57 ± 2,05 <sup>a</sup>	1,61 ± 0,47 <sup>a</sup>	1,85%
K+	6	219,56 ± 4,13 <sup>b</sup>	221,63 ± 4,42 <sup>b</sup>	2,07 ± 1,17 <sup>a</sup>	0,94%
PI	6	217,72 ± 7,37 <sup>b</sup>	130,72 ± 6,52 <sup>c</sup>	-87,01 ± 10,94 <sup>b</sup>	-39,96%
PII	6	219,10 ± 7,87 <sup>b</sup>	106,06 ± 1,54 <sup>d</sup>	-113,04 ± 7,43 <sup>c</sup>	-51,59%
p <sup>1</sup>		0,000	0,000	0,000	
<b>Trigliserida</b>					
K-	6	67,60 ± 3,92 <sup>a</sup>	69,54 ± 4,06 <sup>a</sup>	1,93 ± 0,85 <sup>a</sup>	2,86%
K+	6	154,08 ± 2,66 <sup>b</sup>	156,80 ± 2,98 <sup>b</sup>	2,72 ± 0,70 <sup>a</sup>	1,77%
PI	6	154,35 ± 3,02 <sup>b</sup>	104,74 ± 4,58 <sup>c</sup>	-49,61 ± 4,88 <sup>b</sup>	-32,14%
PII	6	155,82 ± 2,92 <sup>b</sup>	94,01 ± 3,02 <sup>d</sup>	-61,82 ± 5,20 <sup>c</sup>	-39,67%
p <sup>1</sup>		0,000	0,000	0,000	
<b>HDL</b>					
K-	6	78,66 ± 2,22 <sup>a</sup>	76,23 ± 2,36 <sup>a</sup>	-2,44 ± 0,65 <sup>a</sup>	-3,10%
K+	6	25,84 ± 1,79 <sup>b</sup>	23,77 ± 2,26 <sup>b</sup>	-2,06 ± 0,96 <sup>a</sup>	-7,98%
PI	6	24,25 ± 1,13 <sup>b</sup>	50,00 ± 2,55 <sup>c</sup>	25,55 ± 1,81 <sup>b</sup>	104,48%
PII	6	25,03 ± 2,12 <sup>b</sup>	68,26 ± 2,73 <sup>d</sup>	43,23 ± 3,87 <sup>c</sup>	172,72%
p <sup>1</sup>		0,000	0,000	0,000	
<b>LDL</b>					
K-	6	23,71 ± 2,21 <sup>a</sup>	26,41 ± 2,29 <sup>a</sup>	2,71 ± 1,05 <sup>a</sup>	11,42%
K+	6	75,21 ± 2,01 <sup>b</sup>	77,62 ± 1,98 <sup>b</sup>	2,41 ± 1,26 <sup>a</sup>	3,21%
PI	6	74,61 ± 2,53 <sup>b</sup>	41,29 ± 3,27 <sup>c</sup>	-33,32 ± 2,22 <sup>b</sup>	-44,66%
PII	6	78,22 ± 1,56 <sup>c</sup>	33,68 ± 1,89 <sup>d</sup>	-44,54 ± 2,12 <sup>c</sup>	-56,94%
p <sup>1</sup>		0,000	0,000	0,000	

Signifikansi hasil uji Anova

<sup>a,b,c,d</sup>Notasi berbeda menunjukkan adanya perbedaan rerata yang signifikan pada uji *Post Hoc Bonferroni* atau uji *Post Hoc Games-Howell*

serta penurunan HDL kemungkinan disebabkan oleh pemberian HFFD selama 2 minggu tanpa pemberian sinbiotik kefir tepung pisang batu sehingga tidak terjadi penurunan kadar glukosa darah dan perbaikan profil lipid. Pengondisian Sindrom Metabolik menyebabkan terganggunya metabolisme lemak pada subjek (Crescenzo *et al.*, 2014). Gangguan metabolisme lemak atau dislipidemia dapat menyebabkan konsentrasi kolesterol dan TG plasma mengalami peningkatan secara persisten (Zhang *et al.*, 2017).

Kombinasi probiotik dan prebiotik berperan dalam metabolisme glukosa dan sensitivitas insulin pada hiperglikemia (Markowiak dan Katarzyna, 2017). Prebiotik akan difermentasi oleh Bakteri Asam Laktat (BAL) untuk menghasilkan SCFA (Verbeke *et al.*, 2015) yang berperan dalam meningkatkan ekspresi dari glucose transporter 4 (GLUT-4) (Yan dan Kolapo, 2015). Peningkatan

ekspresi GLUT-4 akan meningkatkan sensitivitas insulin dan peningkatan glukosa darah ke dalam membran sel sehingga terjadi penurunan kadar glukosa darah (Rahmawati *et al.*, 2017). Penurunan kadar glukosa darah juga dapat menyebabkan perbaikan produksi insulin sehingga dapat memperbaiki kondisi obesitas sentral (Gandhi, 2017).

Peningkatan jumlah SCFA dipengaruhi oleh jumlah BAL yang meningkat (Wahyuni dan Ahmad, 2015). Perbedaan penurunan kadar glukosa darah sebanyak 28,38 ± 3,59 mg/dl (22%) pada PI dan 47,64 ± 4,30 mg/dl (36%) pada PII terjadi karena pemberian dosis sinbiotik kefir tepung pisang batu yang lebih banyak pada kelompok PII. Perbedaan dosis memengaruhi peningkatan jumlah BAL dalam saluran pencernaan sehingga terjadi penurunan kadar glukosa darah yang lebih besar pada kelompok PII.

Hasil penelitian ini juga menunjukkan bahwa rerata kolesterol total dan TG pada kelompok PI dan PII mengalami penurunan secara signifikan ( $p=0,000$ ) setelah intervensi. Kelompok PI dan PII mengalami penurunan rerata kolesterol total masing-masing sebesar 39,96% dan 51,59%, serta penurunan rerata TG masing-masing sebesar 32,14% dan 39,67%. Kelompok PII yang diberikan sinbiotik kefir tepung pisang batu sebanyak 3,6 ml/200g BB tikus/hari atau setara dengan 200 ml/kgBB/hari untuk dosis manusia (Moroti et al., 2012) mengalami penurunan kolesterol total dan TG yang lebih besar dibandingkan kelompok PI yang diberikan 1,8 ml/200g BB tikus/hari. Penelitian ini didukung oleh penelitian yang memberikan sinbiotik berupa kefir susu kambing dengan penambahan porang glukomanan sebagai prebiotik menunjukkan dapat menurunkan kolesterol total dan TG pada tikus Sprague Dawley yang diberi HFFD (Nurliyani et al., 2018).

Penurunan kolesterol total dan TG terjadi pada kelompok yang diberikan sinbiotik kefir tepung pisang batu, yaitu kelompok PI dan PII. Prebiotik dapat bertindak sebagai substrat untuk pertumbuhan dan aktivitas bakteri, sehingga penambahan prebiotik efektif dalam meningkatkan populasi bakteri dalam usus (Gopper dan Smith, 2013). Prebiotik juga dapat mengganggu uptake kolesterol dari makanan dan mengurangi reabsorpsi asam empedu karena dapat meningkatkan viskositas usus (McLoughlin et al., 2017). Probiotik dapat mengurangi penyerapan kolesterol dalam usus dengan mengikat dan memasukkan kolesterol ke dalam membran selnya. Selain itu, probiotik juga dapat mengurangi sirkulasi enterohepatik dari asam empedu (Cho dan Kim, 2015) sehingga meningkatkan penggunaan kolesterol dalam tubuh (Gopper dan Smith, 2013).

Prebiotik juga akan difermentasi oleh bakteri dalam usus sehingga menghasilkan SCFA (McLoughlin et al., 2017). SCFA tersebut dapat menghambat sintesis kolesterol hati dan redistribusi kolesterol dari plasma ke hati (Cho dan Kim, 2015). SCFA dapat meningkatkan rasio molar propionat terhadap asetat (Ferrarese et al., 2018). Asam propionat yang dihasilkan bakteri dapat menghambat pengambilan asetat dan menekan sintesis asam lemak dalam hati (Weitkumat et al., 2017). Penurunan sintesis asam lemak di hati dapat

menurunkan sintesis TG di dalam tubuh karena biosintesis TG didorong oleh adanya asam lemak (Gopper dan Smith, 2013).

Penelitian pendahuluan tentang formulasi kefir susu kambing dengan penambahan 4% tepung pisang batu, menunjukkan kadar air 85,47%, kadar protein 4,44%, kadar karbohidrat 8,56%, kadar lemak 0,24%, kadar serat kasar 1,09%, dan total BAL  $2,0 \times 10^7$  CFU mL<sup>-1</sup>. Pemberian sinbiotik kefir tepung pisang batu diharapkan dapat memperbaiki fraksi lipid dengan menurunkan LDL dan meningkatkan HDL melalui mekanisme sinbiotik. Sinbiotik memiliki peran memperbaiki fraksi lipid terutama pada LDL dan HDL (Aktimur et al., 2017). Setelah intervensi, terjadi perbedaan yang bermakna pada LDL kelompok perlakuan ( $p=0,000$ ). Hal ini ditunjukkan dengan penurunan LDL pada kelompok PI sebesar 44,66% dan kelompok PII sebesar 56,94%. Perbedaan yang bermakna juga terjadi pada HDL kelompok perlakuan ( $p=0,000$ ). HDL mengalami peningkatan pada kelompok PI sebesar 104,50% dan kelompok PII sebesar 172,71%.

Penurunan LDL oleh BAL dilakukan melalui mekanisme asimilasi kolesterol, dekonjugasi *bile salt*, degradasi kolesterol, dan adanya produksi SCFA. Asimilasi kolesterol merupakan mekanisme secara langsung dalam menurunkan LDL, proses asimilasi kolesterol diduga terjadi melalui pengikatan LDL oleh BAL yang terkandung dalam sinbiotik, LDL tersebut diikat oleh BAL yang menempel pada usus halus sehingga terjadi penurunan jumlah kolesterol bebas atau FFA yang dimana akan diubah melalui metabolisme kolesterol menjadi LDL (Kavitha et al., 2016).

Berdasarkan penelitian oleh Abhari et al. (2015) menyebutkan bahwa pemberian kombinasi dari 5% prebiotik dan 109 bakteri *B. coagulans* menghasilkan perbaikan fraksi lipid pada tikus hiperkolesterol. Kombinasi probiotik dan prebiotik tersebut mampu menurunkan LDL pada tikus hiperkolesterol yang diintervensi selama 21 hari (Aktimur et al., 2017). Penelitian tersebut sejalan dengan penelitian oleh Nurliyani et al. (2018) bahwa pemberian sinbiotik berupa kombinasi probiotik dari kefir susu kambing dan prebiotik dari glukomanan mampu menurunkan LDL pada tikus jenis *Sprague Dawley* yang dikondisikan mengalami Sindrom Metabolik.

## KESIMPULAN DAN SARAN

Pemberian sinbiotik kefir tepung pisang batu dengan dosis 1,8 ml/200g BB tikus/hari (PI) dan 3,6 ml/200gBB tikus/hari (PII) dapat menurunkan kadar glukosa darah dan memperbaiki kadar profil lipid secara signifikan pada kelompok perlakuan. Dosis sinbiotik kefir tepung pisang batu yang paling efektif sebesar 3,6 ml/ 200 g BB tikus/hari. Saran untuk penelitian selanjutnya perlu dilakukan pengukuran jumlah BAL dalam saluran pencernaan hewan coba sehingga dapat membuktikan penurunan glukosa darah terjadi karena peningkatan produksi SCFA.

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## HUBUNGAN ANTARA STATUS GIZI TB/U DENGAN KEMAMPUAN KOGNITIF, FISIK, DAN SOSIO-EMOSIONAL ANAK USIA PRA-SEKOLAH

*Association of Height-For-Age Nutritional Status with Cognitive, Physical, and Socio-Emotional Ability of Pre-School Children*

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### ABSTRAK

Masa pra-sekolah adalah salah satu masa yang paling penting bagi pertumbuhan dan perkembangan anak. Apabila terjadi gangguan pertumbuhan dan perkembangan pada masa ini, maka akan berdampak pada saat anak beranjak dewasa. Salah satu faktor yang berhubungan dengan perkembangan anak adalah status gizi TB/U. Tujuan dari penelitian ini adalah untuk menganalisis hubungan antara status gizi TB/U dengan kemampuan kognitif, fisik, dan sosio-emosional anak usia pra-sekolah. Penelitian ini adalah penelitian observasional analitik dengan desain penelitian *cross-sectional*. Sampel untuk penelitian ini sebesar 35 anak usia pra-sekolah yang dipilih secara acak menggunakan teknik *simple random sampling*. Sampel merupakan siswa TK Hang Tuah 22, Kecamatan Candi, Kabupaten Sidoarjo dengan responden yaitu ibu siswa. Instrumen pengumpulan data meliputi kuesioner tentang karakteristik subjek dan responden, *Denver Developmental Screening Test II* (DDST/Denver II), dan *microtoise*. Analisis data menggunakan uji *spearman rho*. Hasil penelitian menunjukkan bahwa ada hubungan antara status gizi TB/U dengan kemampuan kognitif ( $p=0,007$ , RR 0,445). Akan tetapi, tidak terdapat hubungan antara status gizi TB/U dengan kemampuan fisik dan sosio-emosional. Kesimpulan dari penelitian ini adalah status gizi TB/U memiliki hubungan yang signifikan dengan kemampuan kognitif anak pra-sekolah. Maka, orang tua sebaiknya memperhatikan status gizi TB/U anak dengan cara pengukuran antropometri secara berkala sehingga apabila ada masalah yang ditemukan, akan segera dapat ditangani dengan benar dan tidak berdampak pada tumbuh kembang anak.

**Kata kunci:** fisik, kognitif, sosio-emosional, stunting

### ABSTRACT

*Pre-school period is one of the most important times for children's growth and development. If there is a growth and development disturbance at this time, it will impact when the child is growing up. One of the factors which related with growth of pre-school children is nutritional status of height for age. The purpose of the study was to analyzed the relationship between the nutritional status of height for age with the cognitive, physical, and socio-emotional abilities of pre-school age children. This research was an analytical observational study using a cross sectional design. Sample of this study was 35 pre-school children selected randomly using simple random sampling. Samples were student of TK Hang Tuah 22, Candi, Sidoarjo. Data collection instrument includes the questionnaire on the characteristics of the subject and the respondent, a Denver instrument Developmental Screening Test II (DDST/Denver II). Spearman Rho test was used to analyze the data. The results showed that there was a relationship between height for age nutritional status with cognitive abilities. However, there was no relationship between the nutritional status of height for age with physical and socio-emotional ability. The conclusion of the study is nutritional status of height for age has a significant association with cognitive abilities in pre-school children. Thus, parents need to monitor the nutritional status height for age of their children by measure the anthropometric result periodically and fulfill the nutritional needs of protein, calcium, vitamin D, zinc, and others. Therefore, if there is any problem founded, it can be handled properly and will not affect the growth and development of the children.*

**Keywords:** cognitive, physical, socio-emotional, stunting

## PENDAHULUAN

Masa anak pra-sekolah merupakan salah satu masa yang paling penting dalam proses pertumbuhan dan perkembangan anak. Pemenuhan kebutuhan gizi ketika usia prasekolah berhubungan dengan status gizi anak ketika beranjak dewasa. Akan tetapi, masih ada anak Indonesia yang tidak mendapatkan pemenuhan gizi yang optimal. Berdasarkan data Profil Kesehatan Indonesia, prevalensi balita usia 0-59 bulan yang memiliki status gizi TB/U kategori pendek dan sangat pendek pada tahun 2016 yaitu 27,54% yaitu dengan z-skor TB/U dibawah -2 dan -3. Pada tahun 2017 meningkat menjadi 29,6%. Jika dibandingkan dengan data provinsi, persentase status gizi dengan indeks TB/U di Provinsi Jawa Timur 2016, pada tahun 2017, terjadi peningkatan persentase balita sangat pendek dan pendek menjadi 32,81% (Kemenkes, 2018).

Menurut WHO (2017), anak yang mengalami kekurangan gizi akan lebih pendek dibandingkan dengan anak seumurnya. Menurut Walker *et al* (2011), didapatkan data bahwa terdapat hubungan yang signifikan antara status gizi TB/U dengan kemampuan kognitif atau bahasa pada anak usia di bawah 5 tahun.

Pertumbuhan dan perkembangan anak adalah suatu hal yang pasti dialami secara alami oleh semua makhluk hidup. Perubahan ini terjadi dalam 3 tahapan yaitu antara lain perkembangan fisik, kognitif, dan sosio-emosional. Ketiga hal ini terjadi dengan waktu dan besaran yang berbeda-beda tiap individu (Ruffin, 2009)

Kemampuan kognitif merupakan cara seorang individu untuk berpikir, berbahasa, memecahkan masalah, dan menambah pengetahuan atau wawasan (Ruffin, 2009). Proses pembelajaran untuk perkembangan kognitif berdasarkan 4 faktor utama yaitu maturasi, pengalaman nyata, interaksi sosial, dan progresi secara umum menuju keseimbangan (*equilibrium*) (Piaget, 1954).

Kemampuan motorik adalah perubahan kemampuan anak untuk mengatur pergerakan badannya, dari gerakan spontan atau reflex menjadi gerakan motorik yang bersifat kompleks (Adolph *et al*, 2003). Ada dua kategori kemampuan ini yaitu motorik halus dan kasar. Ketika anak mengalami perkembangan dalam kemampuan motoriknya,

mereka akan menggunakan kemampuan panca indranya untuk menentukan gerakan atau respon yang akan mereka lakukan (Adolph and Joh, 2007).

Perkembangan kemampuan sosio-emosional pada anak meliputi pengalaman, ekspresi, dan manajemen anak terhadap emosi yang dirasakan serta kemampuan untuk membentuk hubungan yang baik dengan orang sekitarnya (Cohen *et al.*, 2005). Anak-anak yang tumbuh dengan kemampuan sosio-emosional yang baik, akan memiliki kesempatan untuk tumbuh dengan kualitas kesehatan yang lebih baik, memiliki gaji yang lebih besar, kesulitan ekonomi yang lebih sedikit, dan kemungkinan untuk terkena kasus kriminal yang lebih sedikit juga (Moffit *et al.*, 2011).

TK Hang Tuah 22 dipilih sebagai tempat pelaksanaan penelitian karena lokasi sekolah yang ada di Kecamatan Candi dengan angka kejadian stunting yang cukup tinggi (19%) di Kabupaten Sidoarjo. Menurut data PSG Nasional (2017), prevalensi balita di Kabupaten Sidoarjo yang memiliki status gizi kategori sangat pendek dan pendek adalah 19% dengan angka nasional 26,7%.

Berdasarkan permasalahan yang masih ada dalam hal perkembangan anak usia pra-sekolah dan prevalensi stunting yang masih cukup tinggi, maka diperlukan adanya penelitian mengenai hubungan antara status gizi TB/U dengan kemampuan kognitif, fisik, dan sosio-emosional anak usia pra-sekolah. Rumusan masalah yang dibuat yaitu apakah ada hubungan antara status gizi TB/U dengan kemampuan kognitif, fisik, dan sosio-emosional pada anak usia pra-sekolah.

Tujuan penelitian ini adalah untuk menganalisis hubungan antara status gizi TB/U dengan kemampuan kognitif, fisik, dan sosio-emosional anak usia pra-sekolah.

## METODE

Penelitian ini termasuk jenis penelitian observasional analitik dengan desain *cross-sectional*. Data yang digunakan berasal dari hasil wawancara, pengukuran antropometri dan data hasil indeks kemampuan kognitif, fisik, dan sosio-emosional pada anak yang didapatkan

dari kerjasama dengan psikolog anak. Penelitian dilakukan di TK Hang Tuah 22, Kecamatan Candi, Kabupaten Sidoarjo. Besar sampel minimal dihitung menggunakan rumus Lameshow (1997) yaitu 35 anak. Pemilihan sampel memakai teknik *simple random sampling* dengan kesempatan yang sama bagi semua anggota populasi. *Random sampling* menggunakan pemilihan nomer data secara acak menggunakan *randomizer* setelah data diseleksi melalui kriteria inklusi. Kriteria inklusi yang digunakan adalah anak pra-sekolah dengan usia 3-6 tahun serta tidak memiliki kelainan fisik dan mental.

Instrumen pengumpulan data yang digunakan guna memperoleh informasi yang relevan dalam penelitian antara lain kuesioner untuk mengetahui data diri subjek dan responden. Untuk pengukuran tinggi badan menggunakan *microtoise* merek GEA dengan ketelitian 0,1 cm dan dilakukan pengulangan pembacaan sebanyak 2 kali yang dilakukan oleh mahasiswa gizi yang sudah terlatih dalam melakukan pengukuran. Pengelompokan status gizi berdasarkan TB/U menggunakan klasifikasi menurut WHO yaitu sangat pendek jika z-score <-3 SD, pendek jika z-score -3 SD

- <-2SD, normal jika z-score -2SD – 2 SD, dan tinggi jika z-score >2SD. Untuk pengukuran indeks kemampuan kognitif, fisik dan sosio-emosional anak menggunakan instrumen *Denver Development Screening Test (DDST/Denver II)* (Frankenburg, 1967) yang dilakukan oleh psikolog anak dan ketika proses pengukuran, anak didampingi oleh guru. Pengelompokan hasil pengukuran tersebut menggunakan kategori terhambat apabila ada dua atau lebih dalam status waspada dan/atau lebih dari satu dalam status terhambat, normal apabila tidak ada perkembangan yang tertunda dan maksimal 1 dalam status waspada, dan tidak ada kesempatan apabila anak tidak mau melakukan tugas yang diberikan.

Jenis analisa data yang digunakan yaitu analisis deskriptif yaitu menyajikan data dalam bentuk tabel distribusi frekuensi dan analisis statistik yaitu dilakukan uji korelasi *Spearman Rho*, dilakukan untuk menganalisis hubungan antar variabel.

Penelitian ini telah dikaji oleh Komite Etik Penelitian Kesehatan Fakultas Keperawatan

Universitas Airlangga dan lolos kaji etik dengan nomor etik yaitu No. 1497-KEPK tahun 2019.

## HASIL DAN PEMBAHASAN

### Karakteristik Subjek

Subjek di TK Hang Tuah 22, Kecamatan Candi, Sidoarjo terdiri atas laki-laki (57,1%) dan perempuan (42,9%). Usia subjek penelitian dibatasi antara usia 3–6 tahun dengan mayoritas subjek berusia 5 tahun (57,1%) dengan rata-rata usia 68,46±6,9 bulan dengan nilai minimum 47 bulan dan maksimum 79 bulan. Sebagian besar subjek tidak memiliki riwayat penyakit infeksi (60%), sementara sisanya memiliki riwayat penyakit yaitu diare (11,4%), demam berdarah (8,6%), cacangan (8,6%), dan cacar air (11,4%).

### Status Gizi TB/U

Distribusi status gizi TB/U subjek di TK Hang Tuah 22 bervariasi dengan jumlah anak terbanyak dengan status gizi normal (68,6%). Akan tetapi, masih ada subjek yang masuk dalam kategori *stunting* yaitu pendek (14,3%) dan sangat pendek (5,7%).

**Tabel 1.** Distribusi Frekuensi Karakteristik Subjek di TK Hang Tuah 22, Kecamatan Candi, Sidoarjo Tahun 2019

Karakteristik Subjek	n	%
<b>Usia</b>		
3 tahun	1	2,9
4 tahun	1	2,9
5 tahun	20	57,1
6 tahun	13	37,1
<b>Jenis Kelamin</b>		
Laki-laki	20	57,1
Perempuan	15	42,9
<b>Kelas</b>		
TK A	20	57,1
TK B	15	42,9
<b>Riwayat Penyakit Infeksi (6 bulan terakhir)</b>		
Diare	4	11,4
Pneumonia	0	0
Demam Berdarah	3	8,6
Cacangan	3	8,6
Cacar Air	4	11,4
Tidak Ada Riwayat	21	60

**Tabel 2.** Distribusi Status Gizi TB/U Subjek di TK Hang Tuah 22, Kecamatan Candi, Sidoarjo Tahun 2019

Status gizi TB/U	n	%
Sangat pendek	2	5,7
Pendek	5	14,3
Normal	24	68,6
Tinggi	4	11,4

### Kemampuan Kognitif, Fisik, dan Sosio-Emosional Subjek

Mayoritas subjek masuk dalam kategori normal yaitu kemampuan kognitif (80%), kemampuan fisik (94,3%), dan kemampuan sosio-emosional (74,2%). Berdasarkan hasil, masih ada subjek yang memiliki kemampuan kognitif (17,1%), fisik (2,9%), dan sosio-emosional (22,9%) yang terhambat. Subjek paling banyak

**Tabel 3.** Distribusi Kemampuan Kognitif, Fisik, Sosio-Emosional Subjek Pada Anak Usia Prasekolah di TK Hang Tuah 22, Tahun 2019

Kemampuan	Terhambat		Normal		Tidak Ada Kesempatan	
	n	%	n	%	n	%
Kognitif	6	17,1	28	80	1	2,9
Fisik	1	2,8	33	94,3	1	2,9
Sosio-Emosional	8	22,9	26	74,2	1	2,9

mengalami kesulitan untuk menyelesaikan tugas mendefinisikan kata untuk penilaian kemampuan kognitif. Ketika subjek di minta untuk mendefinisikan kata-kata tertentu, mereka cenderung tidak bisa.

Akan tetapi apabila kata tersebut ditunjukkan terlebih dahulu, mereka dapat menyelesaikan tugas tersebut. Untuk penilaian kemampuan fisik, tugas yang paling sedikit diselesaikan dengan benar oleh subjek adalah menyusun balok secara vertikal.

Ketika diminta menyusun secara vertikal, beberapa dari mereka menyusunnya secara horizontal walaupun sudah diberitahu sebelumnya. Untuk kemampuan sosio-emosional, tugas yang paling sedikit diselesaikan oleh subjek adalah memakai seragam sendiri dan menyiapkan atau mengambil makanan sendiri. Pada penilaian kemampuan sosio-emosional, pengisian instrumen didasarkan pada wawancara dengan responden dan wali kelas. Penyebab anak tidak mampu menyelesaikan tugas tersebut adalah orang tua tidak membiasakan anak untuk melakukan tugas tersebut sendiri sehingga anak tidak pernah terbiasa.

### Hubungan Antara Status Gizi TB/U dengan Kemampuan Anak

Sebagian besar anak dengan status gizi TB/U normal memiliki kemampuan kognitif (68,6%),

**Tabel 4.** Hubungan Status Gizi TB/U dengan Kemampuan Kognitif Subjek di TK Hang Tuah 11 Tahun 2019

Status Gizi TB/U	Kemampuan Anak						<i>P</i> value	RR
	Terhambat		Normal		Tidak Ada Kesempatan			
	n	%	n	%	n	%		
<b>Kemampuan Kognitif</b>								
Sangat Pendek	2	5,7	0	0	0	0	0,007	0,445
Pendek	4	11,4	0	0	1	2,9		
Normal	0	0	24	68,6	0	0		
Tinggi	0	0	4	11,4	0	0		
<b>Kemampuan Fisik</b>								
Sangat Pendek	1	2,9	1	2,9	0	0	0,773	0,050
Pendek	0	0	4	11,4	1	2,9		
Normal	0	0	24	68,6	0	0		
Tinggi	0	0	4	11,4	0	0		
<b>Kemampuan Sosio-Emosional</b>								
Sangat Pendek	1	2,9	1	2,9	0	0	0,731	0,060
Pendek	1	2,9	3	8,6	1	2,9		
Normal	4	11,4	20	57,1	0	0		
Tinggi	1	2,9	3	8,6	0	0		

fisik (68,6%), dan sosio-emosional (57,1%) yang normal (Tabel 4).

Sedangkan untuk subjek dengan status gizi TB/U sangat pendek dan pendek atau stunting memiliki tingkat kemampuan kognitif, fisik, dan sosio-emosional yang bervariasi.

Berdasarkan uji korelasi *Spearman Rho*, ada hubungan yang signifikan antara status gizi TB/U dengan kemampuan kognitif ( $p=0,007$ ,  $p<0,05$ ). Nilai RR untuk hubungan antara kedua variabel tersebut sebesar 0,445 yang menunjukkan bahwa kekuatan korelasi antar 2 variabel ini bersifat cukup kuat. Akan tetapi, tidak di temukan adanya hubungan yang signifikan antara status gizi TB/U dengan kemampuan fisik ( $p=0,773$ ,  $p>0,05$ ) dan kemampuan sosio-emosional ( $p=0,731$ ,  $p>0,05$ ).

Salah satu faktor yang sangat penting dalam proses pertumbuhan dan perkembangan anak adalah gizi. Kondisi kurang gizi dapat digambarkan dalam berbagai manifestasi yaitu salah satunya gangguan pertumbuhan yaitu menggunakan indikator status gizi tinggi badan menurut usia (Solihin *et al.*, 2013). Kondisi rendahnya tinggi badan menurut usia disebut dengan keadaan *stunting* yaitu dengan kategori pendek dan sangat pendek (Kemenkes, 2016).

Berdasarkan hasil penelitian, terdapat hubungan yang signifikan antara status gizi TB/U dengan kemampuan kognitif pada anak usia pra-sekolah. Akan tetapi, tidak ada hubungan yang signifikan antara status gizi TB/U dengan kemampuan fisik dan sosio-emosional anak. Anak dengan kondisi *stunting* akan mengalami perubahan dalam struktur serta kematangan sel otak termasuk sel saraf yang dapat memengaruhi perkembangan kemampuan anak (Hanum and Khomsan, 2012). Selain itu, akan mengganggu fungsi otak pada bagian *dorsolateral prefrontal cortex*, *right parietal*, dan *bilateral temporal cortex* yang berhubungan dengan perkembangan kemampuan kognitif anak (Levitsky and Strupp, 1995). Hal ini menyebabkan adanya implikasi berupa penurunan kecerdasan anak akibat kondisi *stunting* (Solihin dkk, 2013).

Hambatan dalam proses perkembangan motorik anak dapat disebabkan oleh keadaan *stunting*. Hal ini dibuktikan dengan hasil penelitian Solihin *et al.* (2013), yaitu terdapat hubungan yang

signifikan antara status gizi TB/U balita dengan kemampuan motorik kasar dan halus.

Mekanisme gangguan kemampuan fisik anak yang meliputi dua hal yaitu motorik kasar dan motorik halus disertai dengan keadaan *stunting* adalah adanya gangguan kemampuan mekanik dari otot *triceps surae* yang menyebabkan adanya keterlambatan kematangan fungsi otot dan berdampak pada terhambatnya kemampuan motorik anak dengan kondisi *stunting* (Paiva *et al.*, 2012). Akan tetapi, hasil uji hubungan yang menunjukkan tidak adanya hubungan yang signifikan disebabkan oleh adanya kemungkinan faktor lainnya yaitu seperti usia subjek yang rata-rata di atas 5 tahun dan faktor-faktor lainnya. Intervensi untuk memperbaiki pertumbuhan dan perkembangan anak terkait status gizi TB/U yang sangat mungkin adalah ketika sebelum usia 5 tahun (Branca and Ferrari, 2002), sehingga hal ini memungkinkan untuk mempengaruhi hasil uji hubungan karena apabila intervensi diberikan ketika setelah usia 5 tahun, maka tidak akan berdampak signifikan pada kemampuan fisik anak. Selain itu, hasil penelitian ini juga di dukung oleh penelitian lainnya yang menunjukkan bahwa tidak ada hubungan yang signifikan antara status gizi TB/U dengan kemampuan fisik anak usia pra-sekolah (Miller *et al.*, 2015).

Hubungan antara kondisi *stunting* dengan perkembangan kemampuan sosio-emosional anak masih belum jelas. Beberapa penelitian menunjukkan bahwa ada perbedaan yang signifikan mengenai kemampuan dan kondisi sosio-emosional anak dengan kondisi *stunting* dibandingkan dengan anak dengan tinggi normal (Kranzler *et al.*, 2000; Steinhausen *et al.*, 2000). Beberapa penelitian lainnya menyatakan tidak adanya hubungan antara status gizi TB/U dengan kemampuan sosio-emosional anak yang signifikan (Miller *et al.*, 2015; Chang *et al.*, 2002). Hal ini mungkin disebabkan oleh beberapa faktor lain yang saling berhubungan dalam proses perkembangan sosio-emosional anak seperti lingkungan dan kualitas pengasuhan orang tua terhadap anak (Chang *et al.*, 2002).

Untuk mencegah kondisi *stunting*, dapat dilakukan dengan cara pemenuhan kecukupan zat gizi anak yaitu pemenuhan zat gizi makro maupun zat gizi mikro yang berhubungan dengan

pertumbuhan tulang anak. Zat gizi mikro yang dapat diberikan antara lain kalsium, vitamin D, seng, zat besi, dan vitamin A yang berhubungan dengan keadaan stunting (Van Stuijvenberg, 2015).

Kelebihan dari penelitian ini adalah sejauh pengetahuan penulis, belum ada penelitian yang secara lengkap membahas tentang hubungan antara status gizi TB/U dengan kemampuan kognitif, fisik, dan sosio-emosional sekaligus di Indonesia. Akan tetapi, kelemahan untuk penelitian ini adalah ukuran subjek penelitian yang kecil sehingga tidak dapat digeneralisir pada seluruh populasi anak usia pra-sekolah maupun digunakan untuk acuan penelitian dengan skala yang lebih luas.

## KESIMPULAN DAN SARAN

Terdapat hubungan antara status gizi TB/U dengan kemampuan kognitif anak usia pra-sekolah. Namun, tidak terdapat hubungan antara status gizi TB/U dengan kemampuan fisik dan sosio-emosional anak.

Orang tua atau wali subjek sebaiknya selalu memperhatikan status gizi TB/U anak dengan cara pemeriksaan antropometri secara berkala sehingga ketika ada gangguan status gizi, dapat segera diintervensi agar memiliki kemampuan kognitif, fisik, dan sosio-emosional yang optimal. Selain itu, perlu adanya intervensi dari Puskesmas setempat berupa pendampingan atau monitoring dan evaluasi secara berkala untuk menindaklanjuti adanya kejadian *stunting* di TK Hang Tuah 22, Sidoarjo.

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