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Association between body image and skipping meals behavior among premarital women of reproductive age

Lisa Wardiyana[1], Yhona Paratmanitya[2*], Sintha Dewi Purnamasari[2], Amelia Faradina[3], Dang Khanh Ngan Ho[3]

[1]Student, Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata Yogyakarta, Jalan Brawijaya 99, Tamantirto Yogyakarta, Indonesia
[2]Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata Yogyakarta, Jalan Brawijaya 99, Tamantirto Yogyakarta, Indonesia
[3]School of Nutrition and Health Sciences, College of Nutrition, Taipei Medical University, Taipei 110, Taiwan

Corresponding author: yhona.nitya@almaata.ac.id

ABSTRAK

Latar Belakang: *Wanita usia subur (WUS) pranikah perlu memperhatikan kecukupan gizinya, karena sebagai calon ibu status gizi wanita usia subur prakonsepsi akan mempengaruhi tumbuh kembang janin, kesehatan bayi, keselamatan ibu dan bayi selama proses melahirkan. Namun pada masa pranikah ini, perhatian terhadap body image biasanya meningkat, dimana hal ini dapat mempengaruhi perilaku makan seseorang, salah satunya perilaku skipping meals. Perilaku skipping meals berdampak pada kualitas diet yang buruk yang pada akhirnya dapat mempengaruhi status gizinya.*
Tujuan: *Mengetahui adanya hubungan antara body image dengan perilaku skipping meals pada wanita usia subur pranikah di kabupaten Bantul.*
Metode: *Penelitian ini merupakan penelitan observasional dengan pendekatan cross-sectional. Penelitian dilakukan pada 132 WUS pranikah di kabupaten Bantul yang mendaftarkan pernikahannya di Kantor Urusan Agama (KUA). Pengukuran body image menggunakan Body Shape Questionnaire-34 (BSQ-34) dan perilaku skipping meals diidentifikasi menggunakan kuesioner. Data dianalisis dengan uji Mann-Whitney dikarenakan data tidak terdistribusi normal.*
Hasil: *Sejumlah 30.3% responden mempunyai body image negatif. Nilai median perilaku skipping meals responden adalah 2 kali/minggu. Responden yang mempunyai body image negatif lebih sering melakukan skipping meals yaitu 4 kali/minggu dibandingkan dengan responden yang mempunyai body image positif yaitu 2 kali/minggu. Hasil uji bivariat menunjukkan adanya hubungan yang signifikan antara body image dengan perilaku skipping meals p<0,001.*
Kesimpulan: *Terdapat hubungan yang signifikan antara body image dengan perilaku skipping meals. Disarankan bagi Kantor Urusan Agama (KUA) untuk memberikan materi*

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terkait body image dan pentingnya makan secara teratur guna mencegah masalah gizi pada masa kehamilan pada kegiatan bimbingan perkawinan.

KATA KUNCI*:* Wanita usia subur pranikah; *body image*; *skipping meals behavior*

ABSTRACT

Background: *Premarital women of reproductive age need to care about their nutritional adequacy, because as prospective mothers, the nutritional status of premarital women of reproductive age will affect the fetal growth and development, infant health, mother and baby safety during childbirth. But at this time, their concern of body image increases which can affect the eating behavior, one of which is skipping meals behavior. Skipping meals behavior has an impact on poor diet quality, in the long term, it can affect the nutritional status.*
Objectives: *The aim of this research was to describe the association between body image and skipping meals behavior among premarital women of reproductive age in Bantul district.*
Methods: *This study was an observational study with a cross-sectional design. This study was conducted on 132 premarital women of reproductive age in Bantul district who registered their marriage at the office of religious affairs. Body image measurement used Body Shape Questionnaire 34 (BSQ-34) and skipping meals behavior was measured by questionnaire. Data was analyzed with Mann-Whitney because data was not normally distributed.*
Results: *A 30.3% of respondents had a negative body image. The median value of a respondent's skipping meals behavior was 2 times/week. Respondents who had a negative body image more often do skipping meals 4 times/week compared to respondents who had a positive body image 2 times/week. The result of bivariate analysis showed a significant association between body image and skipping meals behavior p<0,001.*
Conclusions: *There was a significant association between body image and skipping meals behavior. It is recommended for the office of religious affairs to provide material related to body image and the importance of eating regularly to prevent nutritional problems during pregnancy in marriage guidance activities.*

KEYWORD*:* *Premarital women of reproductive age; body image; skipping meals behavior*

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INTRODUCTION

Premarital women of reproductive age need to prepare their nutritional adequacy, because as prospective mothers the nutritional status of premarital women will affect the fetal growth and development, infant health, mother and baby safety during childbirth (1). Premarital period is a period before pregnancy. Optimal nutritional status during the premarital period is the key to the birth of a normal and healthy infant (2). Maintaining optimal nutritional status during the premarital period is the right time to reduce risk of nutritional problems during pregnancy such as chronic energy deficiency (CED). A person is categorized as CED if the upper arm circumference is less than 23.5 cm (3). Based on Indonesian Basic Health Survey 2018, the proportion of non-pregnant women of reproductive age was 14.5% (4). In the Special Region of Yogyakarta, the prevalence of non-pregnant women of reproductive age was 19.8%. The

highest incidence of CED was in Bantul district, with the prevalence was 20.11% (5). Our previous study in Bantul district found that the prevalence of CED in women of reproductive age was 35,6% (6).

During the premarital period, the concern of body image can increase. Body image has a broad meaning that refers to the thoughts, feelings, and perception of individuals about their body shape (7). Interest in body image increases along with the increasing influence of social media in shaping people's views about need to look perfect at the time of wedding (1). An Australian study examining the prevalence of appearance and weight concerns in 879 brides-to-be found that almost 75% of the sample intended to exercise more and follow a diet plan, while more than 35% planned to reduce their fat or carbohydrate intake. The average sample wished to lose more than 8 kg on the wedding day (8). Body image is one of the factors that can affect a person's eating behavior. A study conducted in the United Arab Emirates on university students Zayed United Arab Emirates 24% of the sample showed the nature of irregular eating, 74.8% were not satisfied with their body image. Irregular eating attitudes had a positive correlation with body image dissatisfaction and negatively correlated with satisfaction of body image (9).

One of the bad eating behaviors is skipping meals behavior. Skipping meals behavior is the behavior of neglecting or reducing intake of one or more main meals (breakfast, lunch or dinner). In a systematic review, breakfast was the most frequently skipped meal 14-88% compared to 8-57% lunch and 4-57% dinner in young adults (10). In a study conducted in Poland on female college students, 11% of respondents skipped breakfast, 8.2% skipped lunch, and 12.6% skipped dinner, this skipping behavior was affected by perceptions of body mass (11). Frequent skipping meals has an impact on poor diet quality, insufficient intake of vitamins and minerals, and it is a risk factor for chronic diseases such as central obesity and insulin resistance (12). The aim of this research was to describe the association between body image and skipping meals behavior among premarital women of reproductive age in Bantul district.

MATERIALS AND METHODS

This study was an observational study with a cross-sectional design. This study was conducted at the Office of Religious Affairs of Bantul, Banguntapan, Kasihan, and Sewon subdistrict in Bantul district, Special Region of Yogyakarta in June – July 2022. The population of this study were all premarital women of reproductive age in Bantul district who registered their marriage at the office religious affairs. Based on the calculation of sample size, it was obtained that the minimum of samples that must be met were 130 subjects, but 132 subjects were obtained when the study was conducted. Sampling was done by quota sampling technique. The inclusion criteria were women 19-49 years old, will get married for the first time, registered their marriage at office religious affairs, not-pregnant, signed the informed consent form. The exclusion criteria was women who were on a certain diet due to illness. Ethical approval was granted by the Alma Ata University Ethics Committee with ethical approval number KE/AA/VI/10821/EC/2022.

Body image was measured using the Body Shape Questionnaire-34 (BSQ-34) which was adopted from Sitepu (2020) which has been tested for validity and reliability. The instrument showed very high internal consistency reliability, which was 0.966 ($\alpha>0.9$) with a sensitivity value of 99% and a specificity value of 98%, so the questionnaire was valid and could be used to measure body image (13). Then the results obtained were categorized into negative body image if the total score was 80 and positive if the total score was less than 80 (14). Skipping meals behavior was measured using a questionnaire. The questionnaire consists of two questions i.e. how many times did the respondent do skipping meals in the last week and what meal times were the most skipped. Skipping meals behavior was measured using a numerical scale of 0-7 times/week according to Bahl et al in 2012 (15). Statistical analysis used Mann-Whitney because the data obtained was not normally distributed.

The test used to determine the normality of the data was Kolmogorov Smirnov (16).

RESULTS AND DISCUSSIONS

Participants in this study were 132 women of reproductive age in Bantul district with an age range of 19-36 years old. The characteristics of subjects are shown in **Table 1**. The research participants amounted to 132 people with the largest number was from KUA Sewon (36.4%). Based on the research location, participants with the highest negative body image were from KUA Sewon (47.5%).

Participants with the highest skipping meals behavior were from KUA Sewon and Bantul 3 times/week.

Table 1. Characteristics of Subjects

Characteristics	Total (n = 132)	Body image		Skipping meals behavior	
		Negative (n = 40)	Positive (n = 92)	Median	IQR
Religious Affairs Office Location (KUA)					
Kasihan	43 (32.6%)	12 (30%)	31 (33.8%)	2	4
Bantul	16 (12.1%)	4 (10%)	12 (13%)	3	3
Sewon	48 (36.4%)	19 (47.5%)	29 (31.5%)	3	3
Banguntapan	25 (18.9%)	5 (12.5%)	20 (21.7%)	2	2
Age (years)					
<20	4 (3%)	1 (2.5%)	3 (3.3%)	2.5	3
20-35	127 (96.2%)	39 (97.5%)	88 (95.7%)	3	2
>35	1 (0.8%)	0 (0%)	1 (1%)	1	
Education Level					
Elementary school	1 (0.8%)	0 (0%)	1 (1.1%)	3	
Junior/senior high school	72 (54.5%)	24 (60%)	48 (52.2%)	2	3
College	59 (44.7%)	16 (40%)	43 (46.7%)	2	3
Occupation Status					
Not working	11 (8.3%)	4 (10%)	7 (7.6%)	1	3
Working	121 (91.7%)	36 (90%)	85 (92.4%)	2	3
Income/month					
< Rp. 1.916.848,-	66 (50%)	16 (40%)	50 (54.3%)	2	2
≥ Rp. 1.916.848,-	66 (50%)	24 (60%)	42 (45.7%)	3	3
Nutritional status					
Underweight	28 (21.2%)	1 (2.5%)	27 (29.4%)	2	2
Normal	68 (51.5%)	17 (42.5%)	51 (55.4%)	2	3
Overweight	36 (27.3%)	22 (55%)	14 (15.2%)	3	3

The majority of participants aged 20-35 years old (96.2%), the highest negative body image in the age group 20-35 years old 31% of participants, with meal skipped 3 times/week. 54.5% of participants had secondary education (junior/senior high school). Participants with the highest negative body image were participants with a junior/senior high school education (60%). Based on education level, the highest skipping meals behavior was in elementary school participants 3 times/week.

The majority of the participants had worked (91.7%), 90% of the participants who had a negative body image were participants who had worked. Based on the occupation status, the highest skipping meals behavior was in participants who have worked (2 times/week). 50% of the participants had income per month more than Rp. 1,916,848,- (≥ regional minimum wage), 60% of participants who had a negative body image were participants with income more than regional minimum wage, participants who did the highest skipping meals were 3 times/week. 51.5% of the participants had normal nutritional status.

Based on nutritional status, the highest negative body image was in the overweight group 55% of participants with skipping meals 3 times/week. Based on **Table 1**, it is known that most of the participants had a positive body image 69.7% (92 people), while only 30.3% (40 people) of the participants had a negative body image.

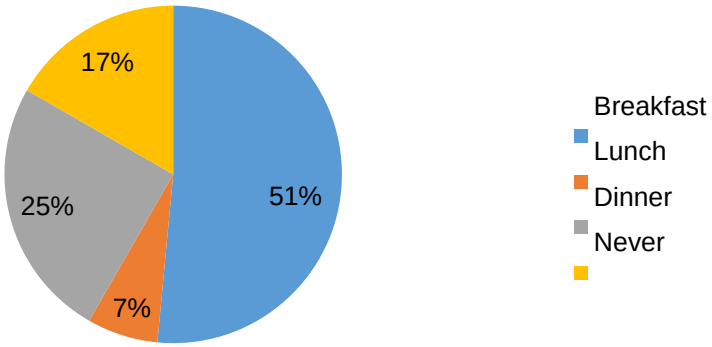

Figure 1. Distribution of skipped meal times

The lowest frequency of skipping meals behavior of participants was 0 times/week and the highest was 7 times/week. The median value of skipping meals behavior was 2 times/week with the most frequently skipped meal times was breakfast (51%).

Table 2. Association between body image and the frequency of skipping meals behavior

	Body image	N	Median of skipping meals behavior	p-value
Skipping meals behavior	Negative	40	4	< 0.001*
	Positive	92	2	

*) analyzed using Mann-whitney test

Based on **Table 2**, it is known that there was a significant association between body image and skipping meals behavior ($p < 0.01$). participants who had a negative body image tend to do skipping meals more often (4 times/week) than participants who had a positive body image only 2 times/week.

DISCUSSIONS

Based on the results of the study, it was found that the majority of participants were from KUA Sewon (36.4%). A total of 96.2% were aged 20-35 years. The highest frequency of skipping meals behavior was found in participants 20-35 years (3 times/week) while participants aged over 35 years only 1 time/week. This study is in line with research conducted by Lee and Yoon (2014) where skipping meals behavior was more often carried out at a younger age than at an older age (17). It is because someone at a young age concerns more attention to their body shape (body image). In this study, of all participants who have a negative body image, 97.5% of them are in the age range 20-35 years. Participants with a negative body image tend to be dissatisfied with their body shape, limiting their intake to become more ideal.

Based on the education level of the participants, it is known that the highest frequency of skipping meals behavior was in elementary school participants (3 times/week). In line with our findings, research conducted by Pendergast (2019) found that skipping meals was more common in people with lower education (12). Someone with higher education is likely to be more exposed to information about health, especially nutrition, than someone with low education. Participants with secondary education (junior/senior high school) had more positive body images (52.2%) than participants with higher education (46,7%). This is in line with research in Legon in 2014 which found that women who had lower education were more satisfied with their body image than those who had higher education (18).

Based on occupation status, it is known that the highest frequency of skipping meals behavior was found in participants who had worked (2 times/week). It related to participants who were already working tend to be busier, so they had less time to eat. This is in line with research conducted by Afolabi (2013) which stated that 48% of the sample who did skipping meals was due to lack of time (19). Based on the level of income, participants who had income of more than Rp. 1,916,848,- (≥ regional minimum wage) tend to do skipping meals more often than participants who had income < Rp. 1,916,848,- (< regional minimum wage). This current study is different from research conducted by Ukegbu (2015) which stated that skipping meals behavior was affected by money or lack of money, someone who had less money tended to skipping meals more often (20). The difference in the results of this study can be caused by socio-cultural differences, respondents in this study still live with their parents so that even though their income is less, they can still eat regularly because they are still borne by their parents. Not only that, it can be caused participants with higher incomes to be busier at work so they have less time to eat.

Based on nutritional status, skipping meals behavior was more often carried out by overweight participants (3 times/week) than underweight and normal participants (2 times/week). It is because someone with overweight and obese nutritional status tends to have a negative body image or feel dissatisfied with their body shape that is higher than someone with normal nutritional status (21). Most of the participants had a positive body image (69.7%), while only 30.3% had a negative body image. In line with our findings, the previous research in Yogyakarta city showed that the majority of women of reproductive age had a positive body image, and only 12.1% had a negative body image (1). A negative body image can affect a person's eating behavior. Irregular eating behavior has a positive correlation with negative body image, and negatively correlated with positive body image (9). One of the irregular eating behaviors is

skipping meals behavior. The results of this study show that the median value of skipping meals behavior was 2 times/week with the most frequently skipped meal times was at breakfast (51%). This is in line with the research conducted by Pendergast (2016), breakfast was the most frequently skipped meal time 14-88% compared to lunch 8-57%, and dinner 4-57% (10). In addition, this study is also in line with research conducted in Egypt by Eittah (2014), breakfast was the most frequently skipped meal time (72.7%) (22).

There was a significant association between body image and skipping meals behavior in women of reproductive age in Bantul district ($p < 0.001$). Subjects who had a negative body image do skipping meals more often (4 times/week) than subjects who had a positive body image 2 times/week. In line with our findings, the research in Poland found that skipping meals behavior was affected by perceptions of body mass (body image) (11). Body image dissatisfaction makes someone control their weight by skipping meals (23). Someone who has a negative body image tends to have a dissatisfied feeling with her body shape and weight, so she plans to diet to be ideal by limiting food intake, one of which is skipping meals behavior (24).

A study in Bantul showed that the majority of Women of reproductive age intake was still lacking (<80% of RDA) (25). It showed that without skipping meals the intake of women of reproductive age was still less than the recommended dietary allowance (RDA), especially if women of reproductive age do skipping meals their intake can be even less and in a long time it can affect their nutritional status. It needs special attention because as prospective mothers, the nutritional status of premarital reproductive age women can affect pregnancy. Maintaining optimal nutritional status during the premarital period is the right time to reduce the risk of nutritional problems during pregnancy such as chronic energy deficiency (CED). CED in pregnant women can cause various problems including anemia, maternal death during childbirth, fetal death, low birth weight (LBW) babies, premature birth, and infant death (26).

CONCLUSIONS AND RECOMMENDATIONS

There was a significant association between body image and skipping meals behavior in premarital women of reproductive age in Bantul district. Most (69.7%) premarital women of reproductive age in Bantul district had a positive body image. The median value of skipping meals behavior in premarital women of reproductive age was 2 times/week.

Premarital women of reproductive age who had a negative body image were more likely to do skipping meals 4 times/week than those who had a positive body image 2 times/week, with breakfast the most often skipped. The current study suggests for the office of religious affairs provides material related to body image and the importance of eating regularly to prevent nutritional problems during pregnancy in marriage guidance activities.

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Implementation of an e-pocket book to improve knowledge and perceive anemia in adolescents

Lisa Ratna Wijaya[1], Siti Budi Utami[1], Muhammad Primiaji Rialihanto[1,2], Tri Siswati[1,2]

[1]Department of Nutrition, Politeknik Kesehatan Kemenkes Yogyakarta, 55293. Indonesia
[2]Center of Excellence in Health Science and Research for Applied Technology Innovation in The Field of Public Health (PUI_Novakesmas), Politeknik Kesehatan Kemenkes Yogyakarta, Indonesia.

*Correspondence: tri.siswati@poltekkesjogja.ac.id

ABSTRAK

Latar Belakang: *Anemia remaja adalah masalah kesehatan masyarakat yang serius.*
Tujuan*: Penelitian ini bertujuan untuk mengetahui efektivitas edukasi dengan menggunakan e-pocket book berbasis Android dan poster.*
Metode: *Penelitian ini merupakan quasy eksperimental dengan desain pre-test post-test with desain control group design. Penelitian dilakukan di Kabupaten Magelang, Jawa Tengah, Indonesia, pada bulan Februari hingga April 2023. Kelompok perlakuan diberi edukasi gizi menggunakan e-pocket book, sedangkan kelompok kontrol diberi poster. Hasil yang diukur adalah pengetahuan dan persepsi sebelum intervensi, 3 hari setelah (post-test 1), dan 14 hari setelah intervensi (post-test 2). Subyek ditentukan dengan rumus Lemeshow, dengan kriteria inklusi bersedia menjadi responden, hadir saat penelitian dilakukan, memiliki data yang lengkap, dan khususnya kelompok perlakuan memiliki Android. Berdasarkan kriteria tersebut subyek sebanyak 49 remaja per kelompok. Analisis dilakukan dengan uji Mann-Whitney untuk sampel yang tidak berdistribusi normal dan independent t-test untuk sampel yang berdistribusi normal. Data diolah dengan SPSS.*
Hasil: *Skor pengetahuan dan persepsi kelompok intervensi pada awal, post-test 1, dan 2 lebih tinggi daripada kelompok kontrol. Ada perbedaan yang signifikan secara statistik skor pengetahuan antara post-test 1 dan 2 dan pretest. Namun, dalam hal persepsi, perbedaan signifikan hanya terdapat pada post-test 1.*
Kesimpulan*: Media e-pocket book dan poster meningkatkan pengetahuan dan persepsi tentang anemia. Namun, e-pocket book ternyata lebih efektif untuk meningkatkan pengetahuan remaja terhadap anemia dibandingkan poster. Edukasi baik menggunakan e-pooket book maupun poster memperbaiki persepsi remaja tentang anemia hanya dalam jangka pendek.*

KATA KUNCI*: anemia; e-pocket book; pengetahuan; persepsi; poster; remaja*

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ABSTRACT

Background: *The prevalence of anemia among adolescents is a serious public health problem.*
Objectives: *This study aims to determine the effectiveness of education using an e-pocket book based on an Android and poster.*
Methods: *A quasi-experimental study using a pre-test and post-test with a control group design. The study was conducted in Magelang Regency, Central Java, Indonesia, from February to April 2023. The treatment group focused on nutrition education using an e-pocket book, while the control group focused on posters. Outcomes measured were knowledge and perception before the intervention, 3 days after (follow-up 1), and 14 days after (follow-up 2) the intervention. Subjects were determined by the Lemeshow formula, with inclusion criteria being willingness to be respondents, present when the study was conducted, having complete data, and specifically the treatment group having android, which amounted to 49 persons per group. The analysis was conducted with the Mann-Whitney test for non-normally distributed samples and an independent T-test for normally distributed samples. We apply SPSS.*
Results: *Score knowledge and perception of the intervention group at baseline, follow-up 1, and 2 were higher than in the control group. There was a statistically significant difference in the knowledge scores between follow-ups 1 and 2 and the pretest. Education using both e-pooket books and posters improves adolescents' perceptions of anemia significantly only in post-test1.*
Conclusions: *Media e-pocket books and posters increase knowledge and perceptions about anemia. Education using both e-pooket books and posters improves adolescents' perceptions of anemia only in the short term.*

KEYWORD*:*, *adolescent; anemia; e-pocket book, knowledge; perceive; poster*

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INTRODUCTION

Anaemia is a condition characterized by an abnormally low number of red blood cells or haemoglobin concentration. Iron deficiency, often known as iron-deficiency anemia (ID), is one of the most common dietary deficiencies that affects children and adolescents around the world(1). Anemia is characterized by a lack of the oxygen-carrying hemoglobin. If blood cells become slightly reddened, the blood's ability to transport oxygen to body tissues will decrease, resulting in lethargy, weakness, dizziness, and shortness of breath. Because adolescent girls and women of childbearing age or 14-49 year old menstruate, they are highly susceptible to be anemia. WHO categories women of childbearing age with hemoglobin levels lower than 12 g/dL are anemic, with classified as 11-11,9 g/DL is mild anemia, 8-10.9 g/DL is moderate anemia, and <8 g/DL is severe anemia(2).

Iron-deficiency anemia was found to be the only non-fatal condition to rank in the top 10 global leading causes of disability-adjusted life years in the most recent report from the Global Burden of children and adolescents(3). WHO estimates that anemia affects 40% of children aged 6–59 months, 37% of pregnant women, and 30% of women aged 15–49 years across the globe(1). Surveys in Indonesia in 2013 and 2018 reported that the prevalence of female adolescent anemia

between 15 and 24 years old increased from 18,4%(4) to 32%(5). Based on a survey in Central Java in 2015, anemia in adolescents is a serious public health concern as many as 57,7%(6). Magelang regency was area the highest anemia prevalence among female adolescence. Local health office reported that between 754 of 2511 female adolescent were anemia (30,03%), while the highest of the anemia prevalence were Borobudur and Salam sub-district, that were 37,74% and 37,58% respectively(7).

Anemia throughout adolescence has the potential to produce a wide variety of functional effects throughout a person's life, some of which include decreased resistance to illness, diminished physical performance and neurodevelopment, and suboptimal schooling outcomes(8). Anemia in adolescent also may lead to possibly long-term effect particularly among women of childbearing age, lead to an increase in the rates of pregnancy problems, such as low birthweight, early births, and the mortality of newborns(9) as well as maternal mortality(10).

Multiple factors can lead to anemia, including nutrient deficiencies due to inadequate diets or inadequate absorption of nutrients, infections (such as malaria, parasitic infections, tuberculosis, and HIV), inflammation, chronic diseases, gynecological and obstetrical conditions, and inherited red blood cell disorders. Iron deficiency is the most common nutritional cause of anemia, but deficiencies in folate, vitamin B12, and vitamin A are also significant causes(1)(11)(12)(13)(14). Lack of proper knowledge, perceives, and practices surrounding optimal eating may also be a possible explanation for the high prevalence of anemia among adolescents. A number of studies have proven the link between knowledge, perceives, and behavior of adolescents with adequate food intake and optimal nutritional status. For instance, a cross-sectional study of 300 female secondary school students aged 13 to 16 years in Iran revealed that 23.3% of the students engaged in poor dietary practices and that 25.7% lacked knowledge about anemia, its manifestations, prevention, and treatment(15). In Ethiopia, a community-based cross-sectional study of 1,323 females aged 10 to 19 was conducted, and its resulted that less than half of the sample were aware of anemia, and less than one-third was aware of the connection between iron-rich food intake and anemia(16).

Anemia is a preventable health problem. Several previous studies have proven educational interventions to increase adolescent knowledge in order to prevent and tackle anemia. For example study in Jordanian adolescent showed that education intervention group have higher of total knowledge, perceive, and practice scores post-program and significantly increased from pre- to post-test than control group(15). Implementation of PRECEDE model in Iran also showed significantly improve knowledge of study population(17). Researchers used media to encourage students to better assimilate learning materials, educational media including social media aids load and disseminate them more effectively and efficiently(18). Android-based media has many advantages, such as being portable, simple, requiring little storage space, being interactive, containing engaging image and sound features, and complementing the lifestyle of adolescents in accordance with the most recent technological advances(19). This study aims to determine the effect of android-based e-pocket books on improving knowledge and perceive of anemia in adolescents.

MATERIALS AND METHODS

This was an experimental quasi-research study with a pre-test and post-test with a control group design. Intervention is education with Android-based e-pocket books, while control is education with posters. Research is carried out by providing education for 90 minutes, accompanied by WhatsApp group of each group to discuss using two way communication between researchers as experts and participants.

The study was conducted in Borobudur District, Magelang Regency, Central Java by considering the high problem of anemia in the region. The teenagers who participated were students of senior high school Muhammadiyah Borobudur as an intervention group and students of vocational secondary school Muhammadiyah Borobudur as a

control group. Subjects were determined by the Lemeshow formula(20) with reference to the difference in knowledge after the intervention(21), amounted to 49 students became participants in each group. The study was conducted from February to April 2023. The output measured was knowledge collected with a questionnaire of 15 questions with true score values of 1 and false 0, and perceive scores measured by a Likert scale with a range of 1 (strongly disagree) to 5 (strongly agree) with a total of 15 statements. Knowledge and perceives were measured at baseline, follow-up1 on 3 days after intervention and follow-up 2 on day 14 days after intervention.

Educational media, both e-pocket books and posters, are tested for usability using PSSUQ with a value of <2.82(22) so that this media is usable as an educational medium. While the questionnaire is tested for reliability and validity. Data were analyzed with Man Whitney and Independent T-test with SPSS. This research has approved by Institutional Review Board of the Poltekkes Kemenkes Yogyakarta No.e-KEPK/POLKESYO/0004/VII/2022 dated July 29, 2022.

RESULTS AND DISCUSSIONS

Sample tree

The subjects of this study were adolescent female aged 16-18 years with 49 students each group. The sample tree depicted in Figure 1.

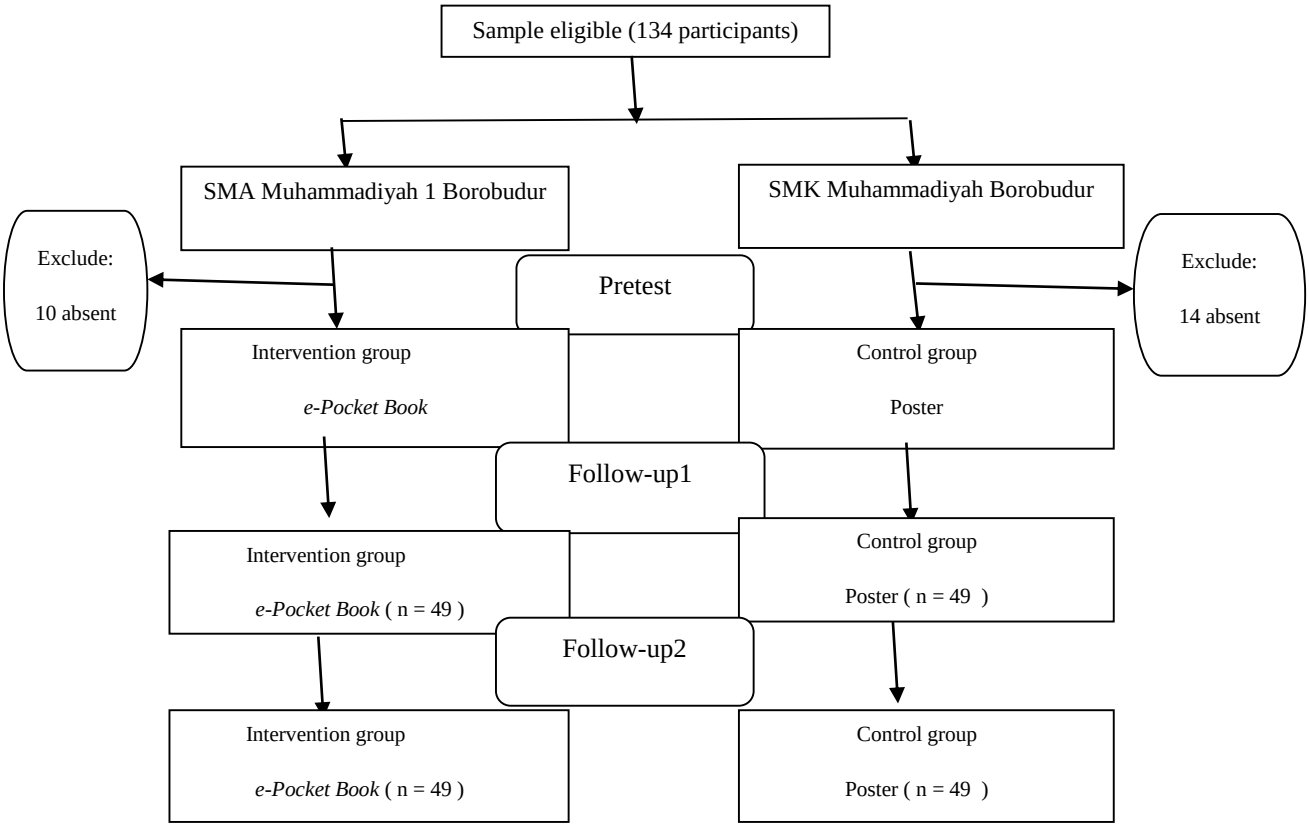

Figure 1. Sample tree and CONSORT diagram

Knowledge and perceive female adolescent regarding anemia

The intervention increased the knowledge and perceives regarding anemia of adolescent girls; the increase in knowledge and perceives was higher in the intervention group than in the control group. But unfortunately, the results of measuring knowledge and perceives in the follow-up period of both the treatment and control groups decreased. AS detail in Figures 2 and 3.

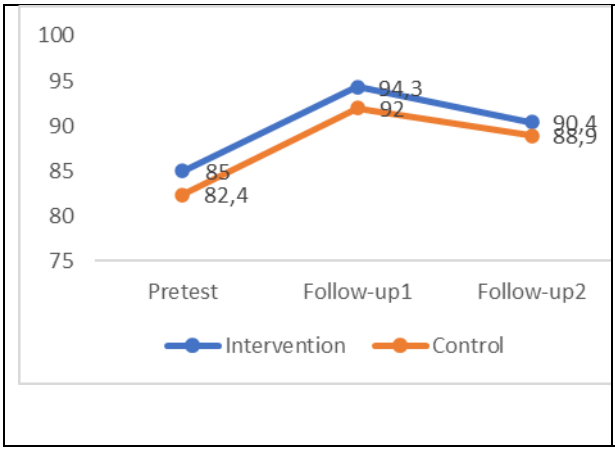

Figure 2. Adolescent knowledge before and after the intervention

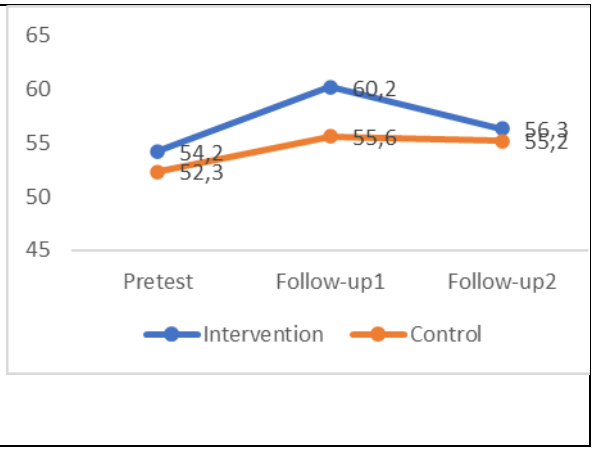

Figure 3. Adolescent attitute before and after the intervention

Association between time and research outcome among different intervention groups. Result showed that there are significant improvement regarding knowledge of anemia between adolescent on follow-up1 dan 2 both in intervention and control group. But the significant improvement regarding perceive of anemia between adolescent only showed on follow-up1 between control group. Among the treatment groups, only perceives of adolescent at follow-up 1 showed significant differences. As detailed in **Table 1**.

Table 1. Association between time and research outcome among different intervention groups.

Variable	Pretest	Follow-up1	Follow-up1	Follow-up1 vs pretest (p)	Follow-up1 vs pretest (p)
Knowledge					
Intervention[a]	82.4±11.9	92.0±9.1	88.9±11.8	9.6 (0.000)*	6.5 (0.006)*
Control[b]	85.0±10.1	94.3±8.6	90.4±10.7	9.3 (0.000)*	5.4 (0.044)*
p-value	0.263	0.122	0.569		
Perceive					
Intervention[c]	54.2±5.5	60.1±7.3	56.3±4.8	5.9 (0.000)*	2.1 (0.065)
Control[d]	52.3±3.4	55.6±4.9	55.2±5.8	3.3 (0.000)*	2.9 (0.070)
p-value	0.06	0.001*	0.317		

[a]Wilcoxon [b]Mann Whitney [c]Paired Sample T-test [d]Independent Sample T-Test
**: p<0.05*

Teenagers are a high age of curiosity. Providing education to adolescents is one of the efforts to overcome health problems, while fulfilling their rights to develop themselves through education including education in the health sector(23). There are several educational benefits provided at an early age, including their high interest in new information, adequate learning power and ability, adaptation to high science and technology, as well as the possibility of very broad implementation potential both for himself, a good influence on peers(24), influencing the environment and his family in the future(25). Education about anemia in adolescent girls, in particular, is expected to provide good knowledge(26) and perceive so that they can avoid anemia(27), have good learning outcomes, more productive and prevent long anemia during childbearing age, pregnancy, and get quality birth outcomes(26) (27). Thus, nation-building can be achieved through a healthy and accomplished generation(23).

In this research, android-based educational intervention is a form of technology utilization in the field of health, education with this method has proven successful in several previous studies (28–31) This finding showed that knowledge and perception increased at follow-up 1 between two group, but decreased at follow-up 2. This happens because naturally a person's memory on the information obtained will tend to decrease after day by day or weeks(32). In addition, the education provided only provides short information, which is 90 minutes long so that it does not touch the competence of adolescents to understand, analyze or apply the information that has been received.

When compared to the measured outcomes, knowledge at follow-up 1 and 2 is significantly different from perceive which is only significant at follow-up-1. This occurred in both treatment and control groups. The results of this study mean that to change one's perception, education may not be enough, but it must be accompanied by active involvement of adolescents so that behaviour change communication, as previous study to increase knowledge and practice of healty living movement (or Gerakan Masyarakat Hidup Sehat or Germas in bahasa) in adolescents(33).

Several previous studies have proven the effectivity of android app as educational intervention, for instance education of Ibu Sehati to prevent anemia in pregnancy (20), education for healty eating diet in DM patients(34), health education for vulnerable people(35), as well as education for maternal and children health(36). Additionally, the various advantages of android features, appealing images, and opportunities for direct interaction between experts and users tend to increase user sensory involvement(37). Thus, according to Edgar Dale the chances for retention of the information obtained are higher when compared to visual media such as posters(38). The knowledge and attitudes of adolescent girls increased in follow-up 1 but decreased in follow-up 2, besides that Android-based e-pocket books are more effective in increasing adolescent knowledge and attitudes about anemia than control groups.

CONCLUSIONS AND RECOMMENDATIONS

Media e-pocket book and poster increase knowledge and perceptions about anemia. However, e-pocket book media is more effective at improving adolescents perceptions of anemia than poster.

This program can be continued as an effort to prevent and overcome anemia of adolescent girls by combining with other methods that provide opportunities for more active involvement of adolescents so that they can maintain knowledge and perceive even changes in health behavior are expected.

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CONFLICT OF INTEREST

The authors declare have no conflict of interest

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Antioxidative properties of purple okra (*Abelmoschus esculentus l. moench*) pudding

Nadya Rizki Fadilah[1], Evy Damayanthi[1*], Zuraidah Nasution[1]

[1]Department of Community Nutrition, Faculty of Human Ecology, IPB University, 16680, Bogor, Indonesia

*Correspondence: edamayanthi@apps.ipb.ac.id

ABSTRAK

Latar Belakang: *Stres oksidatif merupakan gangguan keseimbangan pro-oksidan dan antioksidan dalam tubuh yang dapat mengarah pada perkembangan penyakit tidak menular. Pada kondisi stres oksidatif, antioksidan eksogen yang berasal dari asupan makanan sangat dibutuhkan untuk mempertahankan fungsi seluler. Okra ungu telah banyak diteliti karena senyawa antioksidannya yang melimpah, seperti flavonoid, yang lebih tinggi dibandingkan dengan okra hijau. Komponen bioaktif pada okra ungu dapat dimanfaatkan dalam bentuk pangan fungsional salah satunya puding karena okra menghasilkan mucilago yang dapat berperan sebagai gelling agent dalam memperbaiki tekstur makanan karena memiliki sifat hidrokoloid.*

Tujuan: *Penelitian ini bertujuan untuk mengembangkan puding okra ungu varietas zahira hasil biofortifikasi sebagai pangan fungsional dan menganalisis kandungan zat gizi, sifat antioksidatif, dan karakteristik mikrobiologinya.*

Metode: *Penelitian ini merupakan penelitian eksperimen laboratorium. Pembuatan puding okra ungu menggunakan metode blanching dan perebusan. Metode analisis terdiri dari AOAC, BPOM, dan SNI untuk uji proksimat, DPPH untuk uji aktivitas antioksidan, AlCl3 untuk uji kandungan total flavonoid, dan HPLC untuk uji kandungan kuersetin, serta metode cawan tuang untuk uji mikroba.*

Hasil: *: Puding okra ungu memiliki kadar air 92,86 g/100 g, kadar abu 0,4 g/100 g, lemak total <0,02 g/100 g, protein 0,91 g/100 g, karbohidrat 5,84 g/100 g, serta energi 26,98 kkal/100 g. Sifat antioksidatif yang teridentifikasi pada puding okra ungu adalah aktivitas antioksidan sebesar 53,66% inhibisi, total flavonoid 31,66±0,92 mg QE/g ekstrak, dan 1,01±0,04 mg/g ekstrak terduga turunan kuersetin. Karakteristik mikrobiologi puding okra ungu telah memenuhi standar BPOM untuk batas maksimal cemaran mikroba pada pangan olahan.*

Kesimpulan: *Puding okra ungu yang diformulasikan menujukkan potensi sebagai pangan fungsional dengan sifat antioksidatif.*

KATA KUNCI*: antioksidan; kuersetin; pangan fungsional; puding Okra ungu*

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ABSTRACT

Background: *Oxidative stress is a disturbance in the balance of pro-oxidants and antioxidants in the body that can lead to the development of NCDs. In the condition of oxidative stress, exogenous antioxidants coming from dietary intake are needed to maintain cellular function. Purple okra has been widely studied for its abundant antioxidant compounds, such as flavonoids, which were higher compared to green okra. The bioactive components in purple okra can be utilized in the form of functional food, one of which is pudding since it produced mucilage that can act as a gelling agent in improving food texture because it has hydrocolloid properties.*

Objectives: *This study aimed to develop biofortified zahira variety purple okra pudding as a functional food and analyze its nutrient content, antioxidative properties, and microbiological characteristics.*

Methods: *This study was a laboratory experimental study. The making of purple okra pudding used blanching and boiling method. The analysis methods consisted of AOAC, BPOM, and SNI for the proximate test, DPPH for the antioxidant activity test, AlCl3 for the total flavonoid content test, and HPLC for quercetin content, as well as pour plate method for microbial tests.*

Results: *Purple okra pudding has a water content of 92.86 g/100 g, ash of 0.4 g/100 g, total fat of <0.02 g/100 g, protein of 0.91 g/100 g, carbohydrate of 5.84 g/100 g, as well as energy of 26.98 kcal/100 g. Antioxidative properties identified in purple okra pudding were 53.66% inhibition of antioxidant activity, 31.66±0.92 mg QE/g extract of total flavonoid, and 1.01±0.04 mg/g extract of suspected quercetin derivative. Microbiological characteristics of purple okra pudding were in accordance with BPOM standards for maximum limits of processed food microbial contamination.*

Conclusions: *The formulated purple okra pudding showed its potential as a functional food with antioxidative properties.*

KEYWORD*:* *antioxidant; functional food; purple okra pudding; quercetin*

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INTRODUCTION

Oxidative stress is a disturbance in the balance of pro-oxidants and antioxidants in the body (1). Modern lifestyles associated with unhealthy eating patterns, lack of exercise, and exposure to combinations of chemicals from various sources are external factors that contribute to increased oxidative stress which leads to the development of Non-Communicable Diseases (NCDs) (2,3). Globally, the World Health Organization (WHO) states that NCDs were responsible for 41 million deaths out of 57 million (71%) deaths in 2016. In Indonesia, NCDs became the highest cause of death as well, reaching 73% of all causes of death in 2016 (4).

Nowadays oxidative stress is also the main target for the development of new prevention and therapeutic strategies for NCDs (5). Under normal conditions, the increased free radicals can be controlled by the body's various antioxidant defenses. However, in conditions of an imbalance in the production of free radicals and their absorbers, exogenous antioxidants are needed to maintain cellular function (6). Bioactive components obtained from dietary intake such as flavonoids contained in fruits and vegetables can protect the body from oxidative stress. Flavonoids can play a role in various biological activities, including antitumor, anti-inflammatory, antioxidant, and antimicrobial activity (7). One of

the vegetables that has been widely studied for its bioactive components is okra. Okra contains various antioxidant compounds including polyphenols, hyperosides, quercetin, coumarin, uridine, and phenylalanine (8).

Purple okra or red okra (Abelmoschus esculentus L. Moench) is a superior variety identified as having better anti-diabetic bioactive components compared to green okra (9,10). Purple okra extract has an antioxidant capacity and antioxidant activity of 417.54 mg AEAC/100 g and 316.86 ppm respectively which acts as a free radical scavenger (9). Most of the antioxidant activity of purple okra (70%) comes from quercetin as the main flavonoid with a content of 0.45 mg/g which is higher than that of green okra 0.27 mg/g (9,11).

The bioactive components in purple okra can be utilized in the form of functional food, one of which is pudding. Pudding is usually consumed as a dessert and is in great demand by the public because of its sweet taste and soft texture (12). Okra produces mucilage which also contains antioxidants, has α-glucosidase inhibitory activity, and can act as a gelling agent in improving food texture because of its hydrocolloid properties (13,14). Hence, this study aimed to develop purple okra pudding as a functional food and analyze its nutritional content, microbiological characteristics, and bioactive components.

MATERIALS AND METHODS

This study was a laboratory experimental study. The ingredients used in the production of purple okra pudding were biofortified zahira variety purple okra which was developed at the Leuwikopo Experimental Garden of Bogor Agricultural University by Prof. Muhammad Syukur from the Agronomy and Horticulture department, water, skimmed milk, red dragon fruit extract, lemon juice, agar powder, sorbitol, and vanilla essence. Optimization of the formulation and process of making purple okra pudding was determined by trial and error. The method used was boiling which began with blanching (at 97°C for 30 seconds) of purple okra which has previously been washed. Some of the blanched okra was extracted for its mucilage using water as the solvent (1:3) at room temperature for 12 hours (14). The other blanched okra was pureed using a blender until it was smooth. The okra mucilage and pureed okra finally be mixed with the other boiled ingredients.

Table 1. Purple Okra Pudding Composition

Ingredients	Composition (%)
Water	43.4
Pureed purple okra	21.7
Purple okra mucilage	13.0
Skim milk	13.0
Dragon fruit extract	4.3
Lemon juice	2.6
Sorbitol	1.7
Agar powder	0.9
Vanilla essence	0.2
Total	100

Nutrient content analysis was carried out at Saraswanti Indo Genetech (SIG) Laboratory, Bogor. The analysis of proximate including ash, water, and fat was referred to SNI 01-2891-1992, while protein content was done according to AOAC 2001.11. 2005 and SNI 01-2891-1992. Carbohydrate content was determined using calculation by-difference methods, while the total calories were done through a calculation based on BPOM (National Agency of Drug and Food Control) formula (15).

Bioactive components of purple okra pudding were analyzed quantitatively, including antioxidant activity, total flavonoid, and quercetin content. The analysis was done at the Nutrient and Biochemistry Analysis Laboratory, IPB University. The sample used for bioactive component analysis was methanol-extracted purple okra pudding. The pureed purple okra pudding was firstly macerated using methanol (1:2.5) for 2 hours at room temperature to then centrifuged at 2500 rpm. The supernatant was dried using a rotary evaporator (60°C, 72 mbar).

The measurement of antioxidant activity was carried out using the DPPH method (2,2-Diphenyl-1-picrylhydrazyl) referring to Hwang (2009) in Cahyana (2017) with slight adjustments in terms of concentration of ascorbic acid as standard and the λ (14). In this study, the absorbance was measured using a microplate reader at the λ of 492 nm. The value of antioxidant activity using the DPPH method was expressed as % inhibition

which referred to the ability of the antioxidant compounds in the sample to scavenge free radicals. The total flavonoid content analysis procedure referred to Ghasemi et al. (2009) procedure using the colorimetric method with modification in terms of concentration of quercetin as a standard solution, and the wavelength (16). This study used a microplate reader at the λ of 492 nm to measure the absorbance. Total flavonoids were calculated as mg quercetin equivalent per gram of purple okra pudding extract (mg QE/g).

The Quercetin content of purple okra pudding was quantified using the High-Performance Liquid Chromatography (HPLC) method. Analysis was performed using an LC-20 AD from Shimadzu (Japan), equipped with a quaternary pump and autosampler. Quercetin was separated from the sample solutions using a C18 column (4.6×125 mm I.D., 5 µm particle size, Shim-pack GIST), with a mobile phase consisting of methanol (B) and water (A), at 25℃. The flow rate was 1.0 mL/min and injections were of 20 µL in volume. A low-pressure gradient was used as follows: 3 min 100% B; 3 min 95% B; and 3 min 90% B. Chromatograms were collected in the λ of 370 nm. The prepared sample was diluted in methanol and filtered through a durapore 0.45 µm PVDF membrane filter prior to injection.

Furthermore, microbial analysis was carried out to analyze the safety aspect of purple okra pudding. The microbial tests were done at Saraswanti Indo Genetech (SIG) Laboratory, Bogor S, and carried out using the pour plate method consisting of the Total Plate Count (TPC) (SNI ISO 4833-1:2015), Enterobacteriaceae (SNI ISO 21528-2:2017), and Salmonella sp. (ISO 6579-1:2017/Amd 1:2020).

RESULTS AND DISCUSSIONS

Nutrient Content

Table 2 displayed the result of the nutrient content analysis of purple okra pudding. The water contained in purple okra pudding was greater than in green okra pudding developed by Giyatmi et al. 2022 (82.0-84.3 g/100 g) (17). Other than water, the other liquid-form ingredients, namely skimmed milk, lemon juice, dragon fruit extract, as well as okra mucilage also constituted the high amount of the pudding's water content. Okra pod itself has high water content ranging from 87.98-90.60 g/100 g (18).

Table 2. Nutrient content of purple okra pudding

Parameter	Unit	Amount
Water	g/100 g	92,86
Ash	g/100 g	0,40
Total fat	g/100 g	<0,02
Carbohydrate	g/100 g	5,84
Protein	g/100 g	0,91
Energy	kcal	26,98

Therefore, there was a need to store purple okra pudding at a cool temperature to prevent spoilage.

The ash content of purple okra pudding was lower compared to green okra pudding (0.6-0.7%). The higher composition of okra the higher the ash content (17). Ash content represents the total mineral content in a product remaining after the combustion or complete acid-facilitated oxidation in food (19). Okra contains minerals including Ca, Cu, K, P, Na, Mg, Zn, Fe, and Mn that possibly decrease due to the cooking process (20). During the making of purple okra pudding, the blanching step possibly reduced all levels of mentioned minerals except Mg (21).

Purple okra pudding has a lesser fat content than green okra pudding (2.7-2.9 g/100 g) (17). This was because of the use of different kinds of milk as an ingredient in each product. Purple okra pudding used skimmed milk while green okra pudding used whole milk that has higher fat content (22). From the okra itself, the seed was the contributor to fat contained in okra as it was constituted by oil reaching 20-40 g/100 g of its total composition (23). According to BPOM (2022), purple okra pudding met the standard of a fat-free product that made it a healthier snack alternative for low-fat diets, such as hyperlipidemia and diabetes relevant to okra's proven hypolipidemic effect in preclinical and limited clinical studies (24,25).

The carbohydrate contained in purple okra pudding was almost half of the green okra pudding (11.7-14.0 g/100 g). This was due to the form and the amount of sweetener used in the products. The granulated sugar added to the green okra pudding by Giyatmi et al. 2022 has higher carbohydrate levels compared to sorbitol used for the purple okra pudding (17,26).. In addition, sorbitol consumption will result in incomplete absorption in the small intestine and lead to eliciting low glycemic and insulinemic responses (26). This made the use of sorbitol a choice for diabetics and low carbohydrate diets people (26). The okra itself contributed to the total carbohydrate of the pudding due to its carbohydrate content, primarily galactose (25%), galacturonic acid (27%), as well as rhamnose (22%) (21).

The protein contained in purple okra pudding (**Table 2**) came from skimmed milk and the okra itself. Okra has protein content reaching as much as 2 g/100 g raw okra (21). This formulated purple okra pudding was lesser in protein than green okra pudding (17). Purple okra pudding's total calorie was counted using BPOM's formula energy and could contribute up to 1,25% of general daily needs (15).

Bioactive Components

Table 3. Bioactive components of purple okra pudding

Component	Unit	Amount
Total flavonoid content	mg QE/g extract	31.66±0.92
Quercetin	mg/g extract	1.01±0.04
Antioxidant activity	%inhibition	53.66

1 g extract ≈ 50 grams of purple okra pudding

Antioxidant activity

A systematic review proposed that okra parts and products including powder, ethanolic or aqueous extract, subfractions, and antioxidants ingredients may have advantageous effects on health including hyperglycemia and hyperlipidemia conditions due to their antioxidant compounds and other components (25). Therefore, purple okra pudding was evaluated for its antioxidant activity using the DPPH assay to see the antioxidative potential. The result showed that purple okra pudding could inhibit 53,66% DPPH radical at 1 mg/mL extract concentration. In comparison, the variability in antioxidant activities of fresh immature okra fruit using the same method ranged from 60.40% to 92.71% at 1 mg/mL (27). This was relevant to the percent DPPH inhibition of Indiana accession of okra that reached 55.97% with a correspondent antioxidant activity of 1829.58±438.00 mg/g (28). Other than that, defatted okra seeds recorded a %Inhibition of 46.38-64.00% at 50 µg/mL concentration (29). In addition, an extract product of red okra pods has an inhibition percentage of 184.93%, 59.67%, and 57.96% for ethanol, n-hexane, and ethyl acetate extract consecutively at a concentration of 150 µg/mL (30).antioxidant activity of 1829.58±438.00 mg/g (28). Other than that, defatted okra seeds recorded a %Inhibition of 46.38-64.00% at 50 µg/mL concentration (29). In addition, an extract product of red okra pods has an inhibition percentage of 184.93%, 59.67%, and 57.96% for ethanol, n-hexane, and ethyl acetate extract consecutively at a concentration of 150 µg/mL (30).

The biggest compositions of purple okra pudding after water were purple okra fruit and its extracted mucilage that contributed to its antioxidant activity. Okra is a rich source of flavonoid compounds, namely hyperoside, coumarin scopoletin, hydroxycinnamic derivatives, oligomeric catechins, and flavonols that lead to its antioxidative characteristic (25). These antioxidants scavenge radicals and inhibit chain initiation or break chain propagation (31). A study found that the administration of different

doses of peel and seed powder of okra significantly increased liver, kidney, and pancreas superoxide dismutase, catalase, glutathione peroxidase, reduced glutathione levels, and decreased thiobarbituric acid reactive substances (TBARS) ($P < 0.001$) levels in diabetic rats compared to diabetic control rats (32).

Total Flavonoid Content

Flavonoids are phenolic compounds that are highlighted for their antioxidant activity as well as the most abundant polyphenolic compounds in okra (33,34). A qualitative-quantitative study using LC-DAD-MS by Panighel et al. has identified that glycosylated flavonoids were found in both okra leaf and fruit (35). The most abundant flavonoid compounds of okra are flavonols, specifically quercetin and its derivatives (36). Moreover, red/purple okra pods have also xenobioticsidants (anthocyanin) that are responsible for the pods' red color. Purple okra extract contains anthocyanin with higher antioxidant and quercetin content than green okra (30,37).

In this study, a content of 31.66±0.92 mg quercetin equivalent/g purple okra pudding extract was identified. One gram of purple okra pudding extract was equivalent to 50 grams of purple okra pudding. Okra powder used in a Randomized Controlled Trial (RCT) contained 2.6 mg/100 g of flavonoid resulting in a significant decrease in fasting plasma glucose, homeostatic model of assessment for insulin resistance, quantitative insulin sensitivity check index, triacylglycerol, total cholesterol, as well as low-density lipoprotein cholesterol after 8 weeks intervention (38).

Quercetin Content

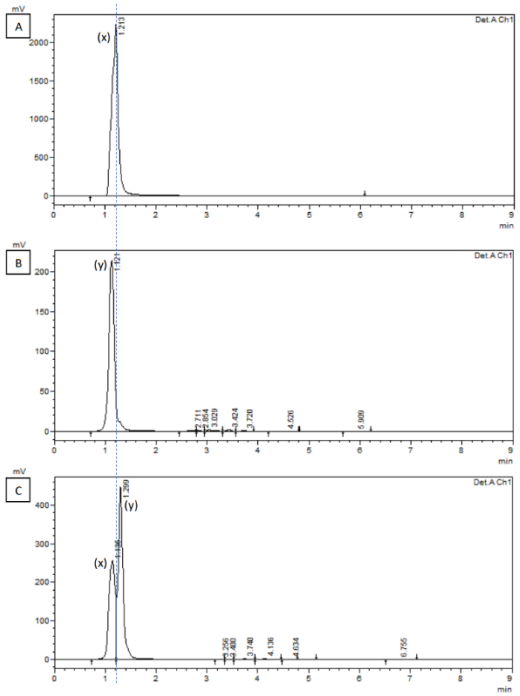

Figure 1. Chromatogram using HPLC of (A) Quercetin standard, (B) Purple okra pudding, (C) Spiked purple okra pudding by standard, with x = quercetin standard peak and y = suspected quercetin derivative peak.

Other studies indicated that okra fruit extract contained 0.8 mg/g of glycosylated flavonoids, while extracted okra leaf has a content of 70-210 mg/g (35). Yang et al. also found that the number of total flavonoids contained in hydro-ethanol extracted okra pod ranged from 4.12664−4.87355 mg/g dry weight (34).

Flavonoids play some roles in preventing injury induced by free radicals. Flavonoids stabilize the reactive oxygen species by being oxidized by the radicals that result in stable and less reactive radicals (39). Other than that, flavonoids exhibited an additive effect on endogenous scavenging compounds when the production of free radicals increased and caused the depletion of the compounds, called flavonoid-protein interactions (40). Flavonoids can also promote the activity of antioxidant enzymes through enzyme gene activation with various signaling cascades involving phytochemicals from red okra that induces the Keap1/Nrf2/ARE pathway (41,42). On the other hand, flavonoids can avoid the formation of free radicals due to their ability to inhibit the enzymes involved in the production of the free radicals or directly chelate the involved metal ions involved (43).

Studies have identified quercetin derivatives and epigallocatechin as major antioxidant compounds in okra (31). The fact was that 70% of the total antioxidant activity comes due to the quercetin derivatives (11). In this study, after spiking the sample with the quercetin standard, the identified compound was suspected to be the quercetin derivative whose peak appeared prior to the quercetin standard. A content of 1.01±0.04 mg/g purple okra pudding extract of the compound was expected to be quercetin-3'-O-sulphate which was identified to appear before quercetin with a 1.117 min retention time difference in taxifolin sample (44). According to another study, it could be expected as quercetin rhamnoside-(feruloyl-hexoside) which took shape 0.6 min retention time difference before quercetin in a combination of habanero white and capsicum annuum peppers sample (45). USDA stated that the quercetin content of okra was 5.75 mg/100 g (46).

Some studies discovered main individual flavonoid in okra was quercetin-3-O-gentiobioside (34,47,48), followed by isoquercetin, quercetin-3-sambubioside (Q3S), quercetin-3-malonylglucoside (Q3M), rutin, quercetin-7-glucoside (Q7G) consecutively (34). An in vitro microtetrazolium experiment indicated that okra's four main flavonoids (Q3G, Q3S, ISO, and Q3M) performed good inhibitory effects on the proliferation of several tumor cell lines that were associated with their glycoside derivatives (34,49). Other than that, the high content of quercetin3-O-gentiobioside and catechin derivative in okra plays an important role in the a-amylase and a-glucosidase inhibition effect (36).

Purple okra quercetin content (0.45 mg/g extract) was higher than that of green okra (0.27 mg/g extract) (50). The administration of purple okra extract with doses of 5 and 10 mg quercetin/kgBW was found to improve malondialdehyde and blood glucose levels of diabetic mice significantly (50). Another study identified a content of 147 mg quercetin/g of dry okra extract and suggested a potential inhibition of PPAR-α and PPAR-γ in the pancreas (51). Another study indicated that ethanol-extracted okra could improve serum lipid levels in diet-induced obese mice through its flavonoids, isoquercitrin, and quercetin-3-O-gentiobioside (52).

Microbiological properties

The microbial analysis was conducted in regard to the food safety aspect as required by BPOM. Based on the result presented in Table 4, purple okra pudding was in accordance with BPOM standards for maximum limits of microbial contamination in processed food (53).

Table 4. Microbiological properties of purple okra pudding

Parameter	Unit	Result	Standard
Enterobacteriaceae	colony/g	<10	$5x10^2$
Salmonella sp.	/25 g	negative	negative
TPC	colony/g	$1x10^1$	$5x10^5$

CONCLUSIONS AND RECOMMENDATIONS

Purple okra pudding has a water content of 92.86 g/100 g, ash of 0.4 g/100 g, total fat of <0.02 g/100 g, protein of 0.91 g/100 g, carbohydrate of 5.84 g/100 g, as well as energy of 26.98 kcal/100 g. The microbiological characteristics of purple okra pudding were in accordance with BPOM standards for maximum limits of microbial contamination in processed food. Antioxidative properties identified in purple okra pudding were 53.66% inhibition of radical scavenging activity, 31.66±0.92 mg QE/g extract of total flavonoid, and 1.01±0.04 mg/g extract of suspected quercetin derivative that made purple okra pudding a potential antioxidative functional food. It was recommended to continue further research to prove the antioxidative properties of purple okra pudding both in vitro and in vivo.

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The role of nutritional status in mediating the relationship between dietary patterns and work productivity in workers at factory X

Nadya Meilinda TS[1], Sapja Anantanyu[2], and Tri Rejeki Andayani[3]

[1]Master Program of Nutrition Science, School of Postgraduate, Universitas Sebelas Maret; Jl. Ir. Sutami No.36, Surakarta 57126
[2]Department of Development and Community Empowerment Extension, Faculty of Agriculture, Universitas Sebelas Maret; Jl. Ir. Sutami No.36, Surakarta 57126
[3]Department of Psychology, Faculty of Psychology, Universitas Sebelas Maret; Jl. Ir. Sutami No.36, Surakarta 57126

*Correspondence: meilindanadia1@gmail.com

ABSTRAK

Latar Belakang: *Salah satu masalah yang sering dialami oleh pekerja pabrik adalah penurunan produktivitas kerja yang disebabkan oleh pola makan yang kurang maupun status gizi yang buruk atau berlebih. Penurunan produktivitas kerja akan berdampak buruk bagi perusahaan.*
Tujuan: *Penelitian ini bertujuan untuk menganalisis peran status gizi sebagai mediator antara pola makan dan produktivitas kerja pada pekerja di Pabrik X.*
Metode: *Penelitian ini menggunakan jenis penelitian kuantitatif dengan rancangan Cross Sectional. Populasi penelitian ini sebanyak 206 pekerja pabrik. Sampel pada penelitian ini yaitu 136 peserta dengan Teknik Simple Random Sampling. Penelitian ini dilakukan bulan Agustus 2022 di salah satu Pabrik Daerah Palur, Karanganyar. Analisis data pada penelitian ini menggunakan Path Analysis.*
Hasil: *Hasil penelitian ada hubungan secara langsung antara pola makan dengan produktivitas kerja (β=0.332;p=0.000), antara status gizi dengan produktivitas kerja (β=-0.284;p=0.001) pola makan dengan status gizi (β=0.421;p=0.000), maupun peran status gizi dalam hubungan idak langsung antara pola makan dengan produktivitas kerja (β=-0.119;p=0.006).*
Kesimpulan: *Status gizi terbukti berperan sebagai mediator dalam hubungan pola makan dengan produktivitas kerja.*

KATA KUNCI*:* *pola makan; produktivitas kerja; status gizi*

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ABSTRACT

Background: *One of the problems that is often experienced by workers is a decrease in work productivity caused by an inadequate dietary pattern or poor or excessive status. A decrease in work productivity will have a negative impact on the company.*
Objectives: *This study aimed to analyze the role of nutritional status as a mediator between dietary patterns and work productivity in workers at Factory X.*
Methods: *This study used a type of quantitative research with a cross- sectional design. The population of this study was 206 factory workers. The samples in this study were 136 participants using a Simple Random Sampling Technique. This research was conducted in August 2022 at one of the Palur Regional Factories, Karanganyar. Data analysis in this study used Path Analysis.*
Results: *The results showed that there was a direct relationship between dietary pattern and work productivity (β=0.332;p=0.000), between nutritional status and work productivity (β=-0.284;p=0.001), dietary pattern and nutritional status (β=0.421;p=0.000), and the role of nutritional status in the indirect relationship between dietary pattern and work productivity (β=0.119;p=0.006).*
Conclusions: *Nutritional status is proven as a mediator between dietary patterns and work productivity.*

KEYWORD*:* *dietary patterns; nutritional status; work productivity*

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INTRODUCTION

Factory workers are a group that is vulnerable to work problems. One of the problems often experienced by factory workers is work productivity (1). According to The World Bank (2021), world work productivity growth reached 2% in 2018 (2). According to the APO (Asian Productivity Organization) (2020), the total work productivity of ASEAN in 2018 was 1% (3). The Covid-19 pandemic greatly impacted worker productivity in Indonesia due to reductions in working hours, layoffs, quarantine, and massive business closures (4). The percentage of work productivity in Indonesia decreased by around 3.55% in 2020 compared to 2019 (5). According to Ningrum and Muniroh (2017), in research conducted on 39 workers, as many as 21.1% or 8 workers experienced problems with low productivity (6). The results of a preliminary study by researchers at a textile factory producing napkin products in December 2021 showed that the productivity level of 185 workers, amounting to 38% with 71 people, was classified as low (7).

One factor that affects factory workers' work productivity is dietary patterns (8). Dietary patterns affect nutritional status and impacts factory workers' productivity (9)(10). Good factory worker's dietary patterns will affect the quality and quantity of food and drink consumed, impacting nutritional status (11). Fulfillment of good nutrition based on the type of food ingredients, frequency, and amount of food consumed by factory workers will form a balance of nutrients in the body (12). The balance of quality and quantity of food and drink consumed impacts nutritional status (11).

Work productivity is directly affected by the nutritional status of workers. Research conducted

by Shafitra et al., (2020) showed a relationship between nutritional status, dietary patterns, and physical activity on work productivity at PT. Gatra in 2019 (10). Suppose the body gets adequate balanced nutrition from food. In that case, the nutritional status of factory workers will be good and optimal so that workability, health, and physical growth will be at a fairly high level. Conversely, if the body experiences a deficiency of one or more of the nutrients needed, the nutritional status of workers becomes less. (13). The body's condition when it lacks nutrients, especially energy, will result in energy reserves in the muscles being used continuously (14). If it lasts for a long time, lack of energy intake will result in weight loss and poor nutritional status (15). This situation, if sustained, can result in a decrease in work productivity (16).

Previous research only focused on the direct relationship between dietary patterns and work productivity. In contrast, this study focused on the relationship between dietary patterns and work productivity with nutritional status as a mediator variable. In addition, no research examines the relationship between dietary patterns and nutritional status in factory workers. Based on this description, this study aimed to analyze the relationship between dietary patterns, nutritional status, and work productivity of workers at Factory X.

MATERIALS AND METHODS

The study design, time of reseacrh and participants characteristic

This study used quantitative research with a Cross-sectional design. Subjects were factory workers in one of the Palur Regional Factories, Karanganyar Regency, who have passed the inclusion and exclusion criteria. This research was conducted in August 2022. Inclusion criteria in this study were workers of productive age aged 18-64 years and having work targets. Exclusion criteria in this study were workers who were pregnant and workers who refused to be respondents in the study. The research was conducted after the approved by the Faculty of Medicine Universitas Sebelas Maret with register number 85/UN27.06.11/KEP/EC/2022.

Sampling procedures & sampling size

The population in the study was 206 people. The sample selection was done by selecting workers with work targets and who were of productive age. 185 people were found. After that, the Simple Random Sampling technique was carried out. Subjects obtained based on inclusion and exclusion criteria were 136 workers in one of the Palur Regional Factories, Karanganyar.

The sample was calculated based on the following formula (17) :

n=N/(1+Ne2)
n=206/(1+ (206 (0.05)2)
n=206/(1+(206 x 0.0025)
n=206/(1.515)
n=135.9 = 136
Notes:
N = Population Size/Total Population
n = Number of Samples
e = Error tolerance limit of 5% or 0.05

Measuring instrument

Dietary patterns were measured using the SQ-FFQ Form (Semi-Quantitative Food Frequency Questionnaire). This questionnaire was used to determine the frequency, type of food ingredients, and amount of food consumed containing 156 items. Dietary patterns are said to be more if it is >100% RDA, 80-100% RDA is enough, and less if <80% (18).

Nutritional status was calculated using a scale for weight and a microtoise for height. After that, it was followed by using the BMI (Body Mass Index) formula: body weight (kg) divided by height (m)2 (11). The classification of nutritional status is said to be thin <18.5 kg/m2, normal> 18.5-25 kg/m2, and mild fat> 25 kg/m2 (11).

Measuring work productivity can be done by looking at the results of the product produced/working hours (in a unit of workers), and this is compared with the target/working hours (in a unit of workers). The results of productivity if the product produced is less than the specified working hours, then productivity is low. Conversely, if the product produced is the same as the work target/working hours, the productivity is moderate, and if it is more than the target, it is high productivity (19).

Data analysis

The data analysis technique in this study used path analysis using STATA 14 with significance level of 5%, which is useful for testing the correctness of structural models. Path analysis is a special form of linear regression method. This technique is used to determine the magnitude of the influence of a variable, either directly or indirectly, one of which is through intervening variables or mediators. The path coefficient itself has no units, so it can be concluded that the greater the path coefficient, the greater the influence given to this variable.

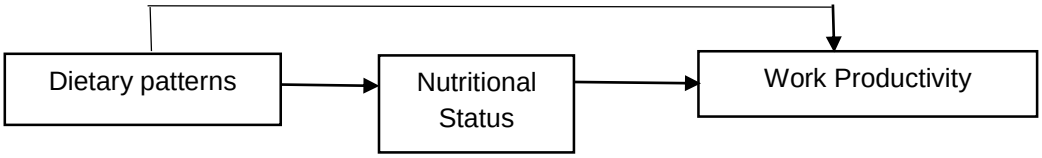

Figure 1. Graphic illustration of the relationship between dietary patterns, nutritional status, and work productivity

RESULTS AND DISCUSSIONS

Table 1. Characteristics of Respondents

Characteristics of Respondents	Total Number (n)	Percentage (%)
Age		
Late teens (17-25 years)	25	18
Early adulthood (26-35 years)	22	16
Late adulthood (36-45 years)	41	30
Early Elderly (46-55 years)	41	30
Late Elderly (56-64 years)	7	5
Gender		
Female	111	82
Male	25	18
Level of education		
No school	1	1
Public Primary School/Islamic Elementary School/ equivalent	25	18
Junior High School/Islamic Junior High School/equivalent	38	28
Senior High School/Islamic Senior High School/Vocational School/equivalent	70	51
D3	2	1
Years of service		
New (1-5 years)	41	30
Moderate (6-10 years)	21	15
Old (>10 years)	74	54

Characteristics of Respondents	Total Number (n)	Percentage (%)
Nutritional status		
Thin	23	17
Fat	48	35
Normal	65	48
Dietary patterns		
Less (< 80% RDA)	17	13
Enough (80-110% RDA)	52	38
More (>110% RDA)	67	49
Work productivity		
Low (< target)	55	40
Moderate (= target)	64	47
High (> target)	17	13

Table 1 shows the frequency distribution of age, gender, education level, years of service, nutritional status, frequency of meals, types of foodstuffs, amount of food, overall eating patterns, and work productivity. Most are in late adulthood (30%) and early elderly (30%). The highest gender is female (82%). The highest level of education is Senior High School/Islamic Senior High School/Vocational School/equivalent (51%). The highest working period is >10 years (54%). The highest nutritional status is in the fat category (35%). The highest eating pattern is in more category (49%). The highest productivity is medium (47%).

This test used path analysis with the Stata 14 application there is a direct effect between dietary patterns affects to work productivity, nutritional status affects to work productivity and dietary patterns affects to nutritional status and there is an indirect effect between dietary patterns and work productivity through nutritional status mediators. This can be seen in **Table 2**. This causes a condition of reduced muscle glycogen which can cause fatigue and will be directly proportional to the decrease in muscle glycogen levels. Fatigue is often experienced by someone after doing activities. Tiredness, drowsiness, boredom, and thirst usually accompany symptoms of fatigue (8). Work fatigue is one of the common problems often encountered in the workforce. Work fatigue can affect occupational health and reduce work productivity (21).

Dietary patterns will affect the balance of nutrients. Balanced nutrition will form optimal nutritional adequacy so that it will affect a person's nutritional status (22).

Table 2. Direct and Indirect Effect Between Variables

Direct Effect between Variables	β	p-value
Dietary patterns → Work Productivity	0.332	0.000
Nutritional Status → Work Productivity	-0.284	0.001
Dietary patterns → Nutritional Status	0.421	0.000
Indirect Effect Between Variables		
Dietary patterns → Nutritional Status → Work Productivity	-0.119	0.006

A person's nutritional status will affect health status and nutritional status. Health status and nutritional state will affect the body's capacity and endurance, so it impacts work productivity (10).

Nutritional status affects work productivity with a p-value of 0.001 ($p<0.05$) and a beta coefficient of -0.284. Nutritional status has a negative relationship with work productivity, where the value of nutritional status increases, or the fatter a person is, the productivity decreases. This is in accordance with research (Maghfiroh, 2019), undernutrition or excess nutritional status has less physical ability and lacks enthusiasm, is slow, can reduce work productivity (23). Poor nutrition reflects a lack of intake of nutrients in the body so it produces less energy production. As a result, the body becomes lethargic, less enthusiastic about carrying out various activities from such a condition of the body, which will cause many losses (sensitive to various diseases), laziness to work, which will ultimately reduce work productivity (10). Meanwhile, a worker who has excessive nutritional intake can cause the worker to be unable to achieve good work productivity. This is related to nutritional status: the balance between the food that enters the body (nutrient input) and the body's needs (nutrient output) for these nutrients (24)(25). Excessive energy intake in the long term can cause a person to have more nutritional status or be overweight to obesity. A worker with more nutritional status can cause his work productivity to decrease, as can be seen by slow movements, less agile, and easily tired (26). Workers with good nutritional conditions will also have better work capacity and endurance because the nutrients from their food are balanced (27). According to Ravika et al., (2022), workers with good nutritional conditions will also have better work capacity and body resistance because the nutrients from their food are balanced (28). Workers' health must also be considered because it can affect physical fitness and mental ability to work more actively, productively, and thoroughly.

Dietary patterns have a direct effect on nutritional status with a p-value of 0.000 ($p<0.05$) and a beta coefficient of 0.421. According to the research results by Katmawanti et al., (2019), dietary patterns are the most important behavior that can affect nutritional status (22). This is because the quantity and quality of food and beverages consumed are in accordance with balanced nutrition guidelines. The balance of food intake will affect the level of nutritional adequacy in the body (29). Based on the general message of balanced nutrition, the quality of nutrition and the completeness of nutrients are influenced by the variety of food consumed. The more complete the food consumed the easier it is to meet nutritional needs (30)(31). When nutrients from food are consumed in full, it will be easier for the body to obtain various other useful substances. Adequate nutrition will have a good impact on nutritional status. This situation is called nutritional status (32).

Nutritional status as a mediator of the indirect effect between dietary patterns and work productivity has a p-value of 0.006 ($p<0.05$) with a beta coefficient of -0.119. In accordance with the research of Katmawanti et al., (2019), dietary patterns are related to nutritional status. Good dietary patterns will improve a person's nutritional status (22). Meanwhile, according to research by Fransiske et al., (2022), nutritional status correlates with work productivity, where normal nutritional status will increase worker productivity (33). Dietary patterns show how to meet a person's nutritional needs, manifested in the form of consumption of types of food, amount of food, and frequency of eating (34). Good dietary patterns should be in conjunction with a balanced nutritional pattern so that the adequacy of the nutrients needed by the body is met through daily food. Foodstuffs that are sources of balanced nutrition are grouped: sources of energy, builder substances, and regulatory substances. Foodstuffs are staple foods, animal and vegetable protein side dishes, vegetables, and fruits (35).

Adequacy of nutrients will have an impact on the nutritional status of a worker (6). This is in line with field research, where workers with sufficient energy consumption, good frequency, and complex food ingredients have good nutritional status and good productivity. This will impact the work performed, where workers who have good nutritional status on average carry out the tasks assigned according to the target. According to Farikha & Ardyanto's research (2017), obese workers experience a decrease in quantity in achieving production targets (36). Meanwhile, according to Shafitra et al., (2020), workers who experience malnutrition are 5x slower to work than those with normal nutritional status (10). The nutritional status will describe the good or bad nutritional status of a person, whether the person is sick or healthy so that it impacts the capacity and resilience of the worker's body. In addition, nutritional status describes the level of food consumption, especially energy intake (19). Deficiency or excess of energy in the body will affect the level of energy reserves in cells. Improper consumption of food for a certain period will have a negative effect on the nutritional status of workers. Workers who eat less food with poor nutritional status will become sluggish, inactive, have work accidents, fatigue,d or absence from work (37). This condition will lead to physical fitness and mental power to work more actively, productively, and thoroughly. Unproductive workers will impact the daily production target, so that there is a decrease in work productivity. This can reduce the target owned by a company (26).

CONCLUSIONS AND RECOMMENDATIONS

This study concludes a direct relationship between dietary patterns and nutritional status with work productivity and dietary patterns with nutritional status. There is an indirect relationship between dietary patterns and work productivity, with nutritional status as a mediator. The suggestion from this study is that it is necessary to conduct further research to find out other factors that affect work productivity with SEM (Structural Equation Model) analysis because this research does not compile direct or indirect relationships with other variables that affect work productivity besides dietary patterns and nutritional status.

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Recovery of vitamin d levels by cholecalciferol supplementation on obese rats

Dea Anenta[1*], Budiyanti Wiboworini[1], Muthmainah[1]

[1]Clinical Nutrition Department, Postgraduate Program, Sebelas Maret University, Indonesia

**Correspondence*: deaanentav@student.uns.ac.id

ABSTRAK

Latar Belakang: *Obesitas disebabkan oleh penumpukan lemak dalam tubuh karena faktor biologis, psikososial, dan perilaku. Prevalensi obesitas mencapai 42,24% di Amerika Serikat, sementara overweight dan obesitas mencapai 59% di Eropa. Obesitas dapat menyebabkan defisiensi vitamin D melalui berbagai mekanisme.*
Tujuan: *Untuk mengatahui pengaruh pemberian suplementasi cholecalciferol terhadap kadar 25(OH)D pada tikus obesitas.*
Metode: *Dalam penelitian ini, kami melakukan penelitian true experiment with. pre-post test control group design. Penelitian ini menganalisis 3 kelompok tikus galur Sprague Dawley jantan yang diinduksi dengan diet tinggi lemak tinggi fruktosa (HFHF) menjadi tikus obesitas. Masing-masing kelompok mendapatkan cholecalciferol sebanyak 2,500 IU/200gr/hari pada kelompok P1, 5,000IU/200gr/hari pada kelompok P2, dan 10,000 IU/200gr/hari pada kelompok P3 selama 8 minggu. Tikus kemudian dianalisis kadar serum 25(OH)D sebelum dan sesudah perlakuan.*
Hasil: *Suplementasi cholecalciferol secara signifikan meningkatkan kadar vitamin D pada setiap kelompok intervensi yang diberikan cholecalciferol. Rerata kadar 25(OH)D kelompok P1,P2, dan P3 sebelum perlakuan berturut-turut adalah 29,43±0,83 ng/mL, 28,61±1,57 ng/mL, dan 28,86±1,46 ng/mL. Rerata kadar 25(OH)D setelah suplementasi cholecalciferol untuk kelompok P1,P2, dan P3 berturut-turut adalah 74,27±0,77 ng/mL, 100,30±1,48 ng/mL, dan 126,73±2,30 ng/mL. Ada perbedaan yang signifikan antara nilai 25(OH)D sebelum dan sesudah perlakuan pada ketiga kelompok intervensi dengan nilai (p<0,05).*
Kesimpulan: *Pemberian cholecalciferol mampu meningkatkan kadar 25(OH)D pada tikus jantan yang diinduksi obesitas.*

KATA KUNCI*: cholecalciferol; obesitas; vitamin D*

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ABSTRACT

Background: *Obesity is caused by the accumulation of fat in the body due to biological, psychosocial and behavioral factors. The prevalence of obesity reaches 42.24% in the United States, while overweight and obesity reaches 59% in Europe. Obesity can cause vitamin D deficiency through various mechanisms.has an impact on poor diet quality, in the long term, it can affect the nutritional status.*
Objectives: *To determine the effect of cholecalciferol supplementation on 25(OH)D levels in obese mice.*
Methods: *: In this research, we conducted a true experiment research with pre-post test control group design. This study analyzed 3 groups of male Sprague Dawley rats that were induced by a high-fat, high-fructose (HFHF) diet to become obese rats. Each group received 2,500 IU/200gr/day of cholecalciferol in group P1, 5,000IU/200gr/day in group P2, and 10,000 IU/200gr/day in group P3 for 8 weeks. The mice were then analyzed for serum 25(OH)D levels before and after treatment.*
Results: *Cholecalciferol supplementation significantly increased vitamin D levels in each intervention group given cholecalciferol. The mean 25(OH)D levels in groups P1, P2, and P3 before treatment were 29.43 ± 0.83 ng/mL, 28.61 ± 1.57 ng/mL, and 28.86 ± 1.46, respectively. ng/mL. The mean 25(OH)D levels after cholecalciferol supplementation for groups P1, P2, and P3 were 74.27±0.77 ng/mL, 100.30±1.48 ng/mL, and 126.73±2 respectively. .30 ng/mL. There was a significant difference between the 25(OH)D values before and after treatment in the three intervention groups with values (p<0.05).*
Conclusions: *Administration of cholecalciferol can increase 25(OH)D levels in male mice that are induced by obesity.*

KEYWORD*:* *Premarital women of reproductive age; body image; skipping meals behavior*

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INTRODUCTION

Obesity occurs when there's excess fat accumulation which increases risk for adverse health outcomes. According to WHO, obesity is defined as an increase in body mass index of more than 30 kg/m². There are various factors that causes obesity including an individual's genetic predisposition and environmental influences (1). The condition of obesity may cause risk of various noncommunicable disease, such as metabolic syndromes, type-2 diabetes mellitus, cardiovascular diseases, non-alcoholic fatty liver disease, cancer, sleep apnea, and various abnormalities of the reproduction organ (2).

The problem of obesity is present in multiple age groups, starting from toddlers, school-aged children, teenagers, adults, and the elderly (3). In the year 2018, the prevalence of obesity reached 42,24% of the total population in USA, while in 2022 in Europe the obesity or overweight prevalence reached 59% (4). In 2019, almost half of Asian children suffers from obesity or overweight, while in China over 2,15% to 13,99% of the total population suffers from obesity (5). According to 2018 Basic Health Research of Indonesia, the prevalence of obesity in Indonesia at the age of 18 and over is 21.8%. The highest prevalence was in North Sulawesi (30.2%), DKI Jakarta (29.8%), East Kalimantan (28.7%), West

Papua (26.4%), Riau Islands (26.2%), and followed by other provinces. This data increased from 2007, which was 10.5% to 11.5% in 2013 and 21.8% in 2018 (6).

The causes of obesity are multifactorial, involving biologic, psychosocial, and behavioral factors (7). One such factors is the condition of vitamin D deficiency. The prevalence of vitamin D deficiency has been reported to rise simultaneously with obesity prevalence in the World (8). The Evidence from National Health and Nutrition Examination Survey (NHANES) and Framingham study also found that the risk of obesity increases by vitamin D deficiency (9). The condition of vitamin D can also rise to abnormalities in lipid profiles marked by lower HDL and increases in tryglicerides. Conversely, obesity can also cause vitamin D deficiency which may be caused by volumetric dilution, low UV light exposure, and faster metabolism clearance (10,11). It is estimated that 20-100% of elderly in the US, Canada, and Europe suffers from vitamin D deficiency and about 1 billion people in the world suffers from vitamin D deficiency or insufficiency (12).

There is a consensus that severe vitamin D deficiency should be corrected (13). Increasing vitamin D levels has been reported to produce positive effects on BMI reduction, where a study found that vitamin D supplementation can significantly reduce body weight, BMI, waist circumference, and hip circumference (14). Deficiency of vitamin D and excessive accumulation of fat have negative effects resulting excessive metabolic processes and disruption of enzymes, resulting in accumulation of inactive forms and reduced bioavailability of vitamins D. In obesity, vitamin D affects insulin secretion, tissue sensitivity to insulin, and systemic inflammation. The direct and paracrine effects of vitamin D lead to VDR activation in pancreatic beta cells, CYP27B1 expression, and local synthesis of 1,25(OH)2D (15). Vitamin D correction was reported to also be able to provide beneficial effects on metabolic disturbances (16). In this study, the author is interested in finding the correlation between cholecalciferol supplementation on vitamin D (25(OH)D) levels on obesity model rats.

MATERIALS AND METHODS

Animal Preparation

We analyzed the effect of cholecalciferol supplementation on vitamin D levels of thirty male Sprague-Dawley rats aged 6-8 weeks. Rats were obtained from the Laboratory of the Center for Food and Nutrition Studies, Gadjah Mada University. Rats were divided into 5 treatment groups, each group consisted of 6 rats. The groups were normal control (KN), negative control (K-), and intervention groups which are P1, P2, and P3 groups. The rats were adapted for 7 days in laboratory environment before given intervention. Every rat was given standard feeding and free access to water during the study. The cages were made of hygienic polypropylene, had a 12-hour light and dark cycle, and houses 6 rats each. To achieve obesity status, the rats were given High fat high fructose (HFHF) which were comprised of B2-2 food (32 grams), duck egg yolk (28 grams), chicken liver (12 grams), and butter (4 grams) for 30 days. Fructose content of 10% is also given by dissolving 20 ml of 55% high fructose syrup on 100 ml aquadest until achieved homogeneity. Rats were declared obese if the Lee obesity index value was > 300 The Lee Obesity index is determined by the equation Lee Obesity Index=$\sqrt[3]{}$(Body weight (g))/(Nasoanal length (mm))

Vitamin D Supplementation And Intervention Evaluation

Cholecalciferol is given in the form of a soft gel, the dose of which has been converted to an animal dose given via gastric probe once every 08.00 WIB. Rats in the KN group only received BR-2 pellet and PAM ad libitum throughout the study. The rats on K- group were given HFHF diet for 28 days. Rats in the P1 group received HFHF for the first 28 days then receive 2500 IU cholecalciferol, while P2 groups received 5000 IU of cholecalciferol, and P3 received 10000 IU of cholecalciferol. The HFHF were given on day 8-36, then the cholecalciferol was given on day 38-87.

Measurement of 25(OH)D Levels

The free form of 25(OH)D was measured using the ABclonal ELISA kit. On day 37 and day 88, blood samples were taken through the retro-orbitalis vein. The rats were conditioned as comfortable as possible by being held and clamped at the nape. Rats were injected intramuscularly with ketamine. Medial canthus, the part under the eyeball, then scratched using a microhematocrit tube until it hits the retro orbital vein. The blood sample that comes out is collected in a microtube as much as 10-15% of the total blood volume. Using the blood sample, 25(OH)D levels are measured using ABclonal ELISA kit.

Statistical Analysis

Results of the research data were processed using SPSS version 16. The normality test used the Shapiro-Wilk test. Meanwhile, for homogeneity of variance between groups, the Levens test is used. Data is said to be normally distributed if $p > 0.05$ and is said to be homogeneous if $p > 0.05$. Statistical analysis was used to determine the differences between 25 (OH)D before and after using the parametric paired t-test. Test to see the differences between each group for normally distributed and homogeneous data using the One Way ANOVA par-ametric test. If the data is significant $p < 0.05$, continue with the Post Hoc LSD test

This research has obtained an ethical clearance letter number 17/ UN27.06.11/KEP/EC/2023 from the Ethics Commission of Faculty of Medicine of Sebelas Maret University.

RESULTS AND DISCUSSIONS

Animal Characteristics

The average body weight of the rats after adaptation (before the mice were induced by obesity) did not differ between groups. This indicated that the weight of the mice was the same or homogeneous, both in the control mice and in the treatment mice. All rats fed by HFHF has acquired obesity state. The highest increase in body weight occurred in the P3 groups, namely 32.66 ± 1.21 and the lowest occurred in the normal control group, namely 14.00 ± 0.63. There was a significant increase in body weight ($p < 0.001$) in both the control group and the treatment group after being given the HFHF diet for 28 days.

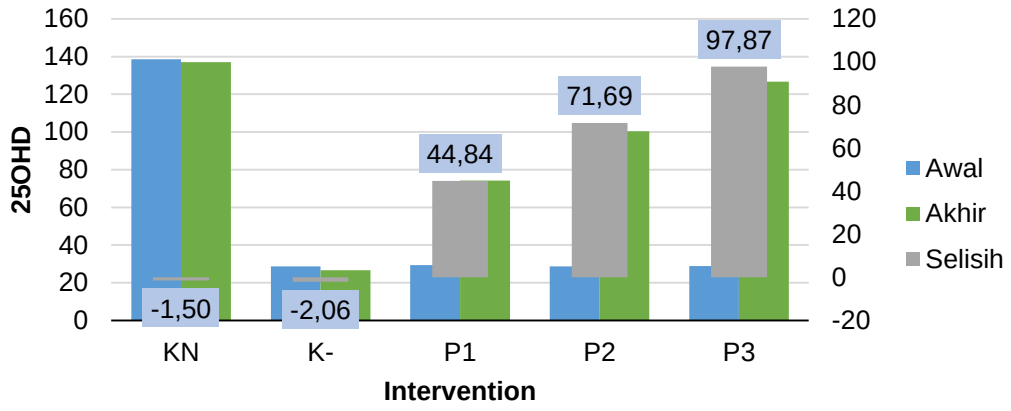
Table 1. Mean difference in 25(OH)D with of rats before and after administration of cholecalciferol with ELISA

Group	25 (OH)D (ng/dL)			p^a
	Before Intervention	After Intervention	Δ 25 (OH)D	
KN	138.57±3.97	137.07±4.04	-1.50±0.23	<0.001*
K-	28.68 ±1.06	26.67±0.86	-2.00±0.63	0.001*
P1	29.43±0.83	74.27±0.77	44.84±0.26	<0.001*
P2	28.61±1.57	100.30±1.48	71.68±0.27	<0.001*
P3	28.86±1.46	126.50±2.42	97.86±2.87	<0.001*
P^b	0.007*	< 0.001*	< 0.001*	

Description: KN: Normal male rats; K(-): Obese male rats ; P1: Obese male rats + cholecalciferol 2,500 IU/200 g/day; P2: Obese male rats + cholecalciferol 5,000 IU/200 g/day; P3: Obese mice + cholecalciferol 10,000 IU/200 g/day; Δ 25 (OH)D : Average increase before and after treatment; *: There is a significant difference ($p<0.05$); pa: Statistical results of paired t-test (difference before and after treatment); pb: Statistical results of comparison between groups using the One Way ANOVA test

25(OH)D Levels After Administration of Supplements

Free 25(OH)D levels analysed using ELISA in obesity-induced rats on the K(-) group were found to be worse than non-obesity rats in the KN group. Mean values of 25(OH)D on the cholecalciferol intervention groups were found to be significantly higher than rats that were not supplemented by cholecalciferol. The mean values of 25(OH)D on the KN group were 137.06 ng/ml, while in the K(-) group were 26.67 ng/ml. Mean values of 25(OH)D levels on P1,P2,P3 groups before supplementation were 29.43±0.84 ng/mL, 28.61±1.57 ng/mL, and 28.87±1.46 ng/mL respectively. The mean 25(OH)D values on the P1,P2,P3 intervention groups after cholecalciferol supplementation were 74.27 ng/ml, 100.30 ng/ml, 126.73 ng/ml respectively. There were significant difference between mean values of 25(OH)D before cholecalciferol supplementation and after cholecalciferol supplementation in the P1,P2,P3 groups ($p<0.05$). Analysis of Variance (ANOVA) showed a significant difference between mean 25(OH)D values of the 5 study groups ($p<0.05$).



Levels in the different experimental groups, p = 0.000; (KN: Normal Control group; K(-): Negative control group; P1: Intervention group using 2500 IU Cholecalciferol; P2: Intervention group using 5000 IU cholecalciferol; P3: Intervention group using 10000 IU cholecalciferol)

Figure 1. Mean values of 25(OH)D

Vitamin D is an unique vitamin made from skin exposure to sunlight in the form of vitamin D3 when the skin is exposed to UVB light. Vitamin D in its active form exerts various actions in the human body, such as to inhibit angiogenesis, inhibits renin production, induces terminal differentiation, and stimulates macrophage cathelicidin production (17). Vitamin D has been also reported to assist on prevent or treat obesity. Obesity was found to be associated with low vitamin D status, but weight loss has little effect on improving vitamin D levels (18). The serum 25-hydroxyvitamin D (25(OH)D) concentration has long been used as a parameter of choice for the assessment of vitamin D status. Vitamin D deficiency was reported in another study to be elevated in obese subjects, in which prevalence of vitamin D deficiency was 35% higher in obese subjects (19). Although the presence of vitamin D deficiency on obese subjects is a well-documented finding, there are still yet a definitive answer whether vitamin D causes or the consequence of obesity (10). Vitamin D can inhibit adipogenesis from anti-adipogenic and pro-lipolytic hormone interaction. Vitamin D increase lipolysis with adrenergic stimulus that result in increasing hormone sensitive lipase and lipoprotein lipase, thus leads to suppression of the vitamin D receptor of PPARγ, regulation of adipogenesis and lipogenesis in 3T3-L1 adipocytes. The supplementation of vitamin D were also reported to provide beneficial effects on obese subjects experiencing weight loss such as decrease of weight, fat mass, and MCP-1, thus suggesting the synergistic effect of weight loss and vitamin D supplementation (18).

Supplementation of vitamin D, together with exercise or mild caloric restriction, had been shown to improve markers of inflammation (20). Hanafy and Elkatawy stated that vitamin D acts through an intracellular increase in ionized calcium, thus stimulate the apoptosis of adipocytes through sympathetic nervous system activation to augment diet-induced thermogenesis and fat oxidation. As the results, vitamin D increase the energy expenditure. Vitamin D effect to weight loss also come from their act in gastrointestinal tract, which enhance fecal fat excretion and control the appetite hormone (16).

In our study, we have analyzed the effect of cholecalciferol supplementation on 25(OH)D levels, which we have found a significant increase of 25(OH)D levels on all three intervention groups given cholecalciferol either in 2500 IU, 5000 IU, or 10000 IU. ($p<0.05$). The highest increase occurred in obese rats that received 10,000 IU of cholecalciferol, with an average change of 97.86 ± 2.87 ng/ml. The lowest increase occurred in rats that received 2,500 IU of cholecalciferol with a mean change of 44.84 ± 0.26 ng/ml. This result is in accordance with several other studies, such as a report from Sekel et al which found which found that daily dosage of 10,000 IU vitamin D3 supplementation for 5 months mitigated the high prevalence of vitamin D deficiency (21). Zmitek et al also reported a significant increase in 25-OH-VitD levels of vitamin D deficient subjects supplemented with 1000 IU cholecalciferol for 2 months (25 µg daily) (22). Quraishi et al also found similar result where high-dose cholecalciferol supplementation (200,000 IU and 400,000 IU) rapidly and safely improves 25-hydroxyvitamin D levels in severe sepsis or septic shock patients (23). A higher dose of cholecalciferol appears to give a higher increase in 25(OH)D as well, according to the results of this study (24).

Literature characterising the dose-response curve to vitamin D shows varied results. Clinical studies investigating these relationships vary in dosing regimen, administrative routes, assay methods for 25(OH)D and demographics as well as control of endogenous vitamin D production. There is no agreement on the dose that will bring individual patients to that level. The pharmacokinetics of vitamin D distribution must take into account absorption, distribution, metabolism, and excretion, as well as varied methods of delivery (25).

Vitamin D deficiency may be treated with supplementation of cholecalciferol or calcifediol. Cholecalciferol was found to be more likely to achieve normal serum levels of 25(OH)D (25-hydroxy-vitamin D). Calcifediol is reserved for patients with liver failure or severe intestinal malabsorption syndrome (26). The mechanism of how obesity causes vitamin D deficiency may be caused by volumetric dilution of fat volumes into the serum liver, and muscle (10). Obesity may also cause the state of vitamin D deficiency from lifestyle factors such as reduced sun exposure of obese people which causes the reduction of vitamin D synthesis in the skin (11). A study by Carelli et al have reported that obese people have a higher vitamin D as reserves, which may explain the reduction amount of circulating serum 25(OH)D (27). Vitamin D supplementation may provide various benefits for the obese population, such as correcting lipid profiles and reduce inflammation markers (28,29).

CONCLUSIONS AND RECOMMENDATIONS

Cholecalciferol supplementation can improve 25(OH)D levels. Restoring vitamin D levels in vitamin D deficiency population can provide various benefits such as improving metabolic parameters and reducing inflammation markers. There are still paucity of studies analysing the causality of vitamin D and obesity. Future studies should analyse whether vitamin D is the causative factor of obesity or the consequence of obesity.

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Risk factors of undernutrition among under-two children in West Java (SSGI 2021)

Fithriani Batubara[1], Cesillia Meti Dwiriani[1*], Hadi Riyadi[1]

[1]Department of Community Nutrition, Faculty of Human Ecology, IPB University Bogor, West Java, 16680, Indonesia

**Correspondence*: cmdwiriani@apps.ipb.ac.id

ABSTRAK

Latar Belakang: *: Permasalahan gizi di Jawa Barat masih tinggi. Berdasarkan Survei Status Gizi Indonesia (SSGI) tahun 2021 prevalensi stunting, wasting dan underweight pada balita di Jawa Barat yaitu 20.5%. 5.3% dan 15%. Faktor risiko yang mempengaruhi kekurangan gizi beragam dan berpotensi berubah dari waktu ke waktu. Oleh karena itu, sangat penting untuk menilai status gizi untuk meninjau kesenjangan dalam faktor risiko.*
Tujuan: *Penelitian ini dilakukan untuk menganalisis faktor risiko stunting, wasting, dan underweight pada baduta di Jawa Barat.*
Metode: *Penelitian ini menggunakan studi cross sectional menggunakan data sekunder yang terdiri dari 1203 subjek baduta usia 6-23 bulan di Jawa Barat. Faktor risiko stunting. wasting. dan underweight di analisis menggunakan regresi logistik.*
Hasil: *Prevalensi stunting, wasting, dan underweight pada baduta usia 6-23 bulan berturut-turut sebesar 20.5%, 5.7% dan 11.6%. Faktor risiko stunting adalah usia 12-23 bulan (AOR=3.10 CI 95% 2.16-4.45), panjang lahir pendek (AOR=1.85 CI 95% 1.30-2.62), tingkat pendidikan ibu rendah (AOR=1.97 CI 95% 1.45-2.68) dan tidak menyusui (AOR= 0.46 CI 95% 0.31-0.68). Faktor risiko wasting adalah tingkat pendidikan Ibu (AOR=0.5 CI 95% 0.34-0.94). Faktor risiko underweight adalah usia 12-23 bulan (OR=1.92 CI 95% 1.25-2.95) dan tidak ASI eksklusif (AOR=0.54 CI 95% 0.35-0.83).*
Kesimpulan: *Faktor yang memengaruhi stunting yaitu usia, panjang lahir, tingkat pendidikan ibu, dan status menyusui. Faktor yang memengaruhi wasting yaitu tingkat pendidikan ibu. Faktor yang memengaruhi underweight yaitu usia dan riwayat ASI eksklusif.*

KATA KUNCI*: baduta; faktor risiko; gizi kurang; Jawa Barat*

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ABSTRACT

Background: *: Nutritional problems in West Java are still high in number. According to the 2021 Indonesian Nutrition Status Survey (SSGI) the prevalence of stunting, wasting and underweight in under-five children in West Java are stated as 20.5%. 5.3% and 15% whereas the risk factors affecting malnutrition are diverse and have the potential to change over time. Therefore, it is very important to assess current nutritional status to review gaps in risk factors.*
Objectives: *This research was conducted to analyze the risk factors for stunting, wasting and underweight in under-two children of West Java.*
Methods: *This research is a cross-sectional study using secondary data consisting of 1203 under-aged subjects (6-23 months) in West Java. Risk factors of stunting, wasting. and underweight were analyzed using logistic regression.*
Results: *The prevalence of stunting, wasting and underweight among children aged 6-23 months were 20.5%, 5.7% and 11.6%, respectively. The risk factors for stunting are age 12-23 months (AOR=3.10 CI 95% 2.16-4.45), short birth length (AOR=1.85 CI 95% 1.30-2.62), mother's low education level (AOR=1.97 CI 95% 1.45-2.68) and not breastfeeding (AOR= 0.46 CI 95% 0.31-0.68). The risk factor for wasting is the level of education of the mother (AOR=0.5 95% CI 0.34-0.94). The risk factor for underweight is age 12-23 months (OR=1.92 95% CI 1.25 -2.95) and does not have exclusively breastfed (AOR=0.54 CI 95% 0.35-0.83).*
Conclusions: *Influential factors to stunting are age, birth length, mother's education level, and breastfeeding status. Factor influences wasting is the education level of the mother. Factors influence underweight are age and history of exclusive breastfeeding.*

KEYWORD***:*** *risk factors; undernutrition; under-two children; West Java*

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INTRODUCTION

In 2045 Indonesia will heading to a demographic bonus, a condition that occurs when a country has a higher number of productive age population than non-productive age population. If human assets of Indonesia are not high in quality no benefit can be gained from our demographic bonus, only a big burden for the country. Therefore, it requires various efforts to realize the era of Indonesia golden generation, namely future human resources, which have a very strategic role in the success of national development. Nutritional problems are still a real challenge in Indonesia. In the world, there are 149.2 million children under five years old who experiencing stunting and 45.4 million children experiencing wasting (23). Stunting, wasting and underweight are growth disorders in children under five years old due to malnutrition. In the First Thousand Days of Life (1000 HPK), malnourished children are most likely to experience cognitive development problems when appropriate early intervention is not carried out. Malnutrition has a role not only in increasing morbidity and mortality, but also in disturbing psychosocial aspects and intellectual development.

There are three criteria for malnutrition; stunting, wasting and underweight which reflected a growth failure both in the past and in the present time. These three malnutrition problems are

interrelated. Malnutrition can affect anyone in society, but infants and toddlers are the most vulnerable group to malnutrition since this group requires high level nutrients for their growth and development. However, nutrition deficiencies in the 1000 HPK period can still be corrected.

West Java Province becomes the benchmark for managing stunting since it has the largest population in Indonesia of almost 50 million people. West Java is a province with a quite large under-five population also the province with the highest number of under-five population in Indonesia 4,308,604 children (4). If West Java can reduce its nutritional problems (stunting, wasting and underweight) significantly, then of course the prevalence of nutritional problems at the national level will also decrease significantly.

The nutritional problems in West Java still existed in high number. According to 2021 Indonesian Nutritional Status Survey (SSGI), prevalence of stunting, wasting and underweight in West Java are stated as follow: 24.5%, 5.3%, and 15%. However, in 2022, stunting and underweight prevalence declined into 20.2% and 14.2%. These figures are in contrast to wasting prevalence that experiencing increase percentage by 6%. It illustrates the same phenomenon to an increase in the wasting prevalence at national level. It showed the under-five malnutrition problem in Indonesia particularly in West Java keep alarming so this problem needs a serious attention from the government.

Stunting, wasting and underweight can be influenced by many factors, both direct and indirect factors include the individual and household level factors. Risk factors affected malnutrition are diverse and potentially able to change over time. Researches examine risk factors for stunting and malnutrition in under-two children in Indonesia had been conducted by Titaley et.al (2019), Sudikno et.al (2022), and Nahdiyah et.al (2014) meanwhile for researches related to risk factors for wasting and underweight for under-two children are still limited.

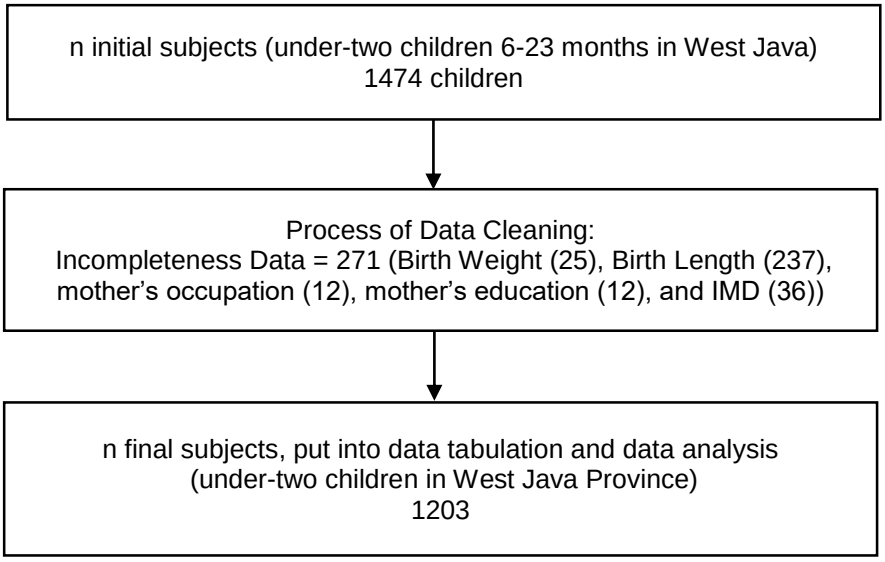
Research in analyzing risk factors for stunting, wasting and underweight in under-two children into one study is still limited. This study uses more independent variables than previous one and we include consumption of unhealthy snacks which rarely analyzed variable. Hence, it is very important to assess current nutritional status to review gap in risk factors for designing the effective intervention strategies. Therefore, it is important to analyze risk factors for malnutrition/undernutrition status (stunting, wasting, and underweight) to under-two children in West Java Province.

MATERIALS AND METHODS

This study is applying a cross-sectional design by using secondary data from the 2021 Indonesian Nutrition Status Survey (SSGI). The subject of SSGI 2021 is under-five, while this study uses the subject of under-two children (6-23 months) in West Java and that has never been processed. West Java is the province with the highest number of under-fives. Data processing and data analysis in this study were carried out from June 2023 to August 2023 in Bogor. The process of selecting subjects for SSGI 2021 was taken by a stratified two stage sampling. The inclusion criteria established for this study is households that have children 6-23 monts age and have a complete data. The stages of subject screening are shown in **Figure 1**.

Dependent variables of this study are stunting, wasting and underweight meanwhile the independent variables consisted of: (1) subject characteristics (age, gender, birth weight and birth length), (2) family socioeconomic characteristics (number of family members, number of under-two children in the family, parents' employment status, parents' education level, ownership of wealth assets and area of residence), (3) environmental sanitation (condition of drinking water and toilet/latrines), (4) parenting patterns (Early Breastfeeding Initiation/IMD, history of exclusive breastfeeding, history of weaning/complimentary food, breastfeeding status, food consumption diversity and unhealthy snacks), and (5) infectious diseases (diarrhea and ARI). (6) Data analysis employing univariate, bivariate, and multivariate logistic regression.

Figure 1 Stages of Subject Selection



RESULTS AND DISCUSSIONS

Total subjects of this study were 1203 children under the age 6-23 months. The prevalence of stunting, wasting and underweight among children of age 6-23 months are stated in order of 20.5 %, 5.7%, and 11.6 %, as presented in Table 1. The age of most subjects were 12-23 months (66.7%), male children (52.1%), normal birth weight (94.9%), and normal birth length (82%). Most of the fathers had low education level (58.8%), mother had low education level (56.9%), fathers are working (93.5%), mothers do not work (80%), small families (51.9%), and have >1 under-two children in the family (93.4%). Economic status seen from the wealth asset of the family were categorized into: high wealth asset (41.5%), medium wealth asset (20.2%), and low wealth asset (38.3%). According to the area of residence, most subjects live in urban areas (67.2%).

Most subjects (51.9%) did not experience Early Breastfeeding Initiation (IMD), got exclusive breastfeeding (68.2%), have their first weaning/complementary foods at the age of >6 months (68.2%) and subject still breastfeeding (75.8%). Most subjects (63.8%) consumed unhealthy snacks (puff/dry/hollow snacks/extrudates such as crackers, cheese ball, and others), and subject already consumed a variety of foods or > 5 food groups (63.8%).

Most subjects (64.1%) did not experience ARI, however, there were still 432 children (35.9%) experienced ARI for the past one month. Based on SSGI data (2021) this figure is higher than ARI prevalence of under-five children at the national level (24.1%) and also higher than ARI prevalence of under-five children in West Java (33.5%). Most subjects (81.5%) did not experience diarrhea, but there were 223 children (18.5%) who had diarrhea last month. According to data of 2021 Indonesian Nutritional Status Survey (9) this figure is higher than the prevalence of diarrhea in toddlers at the national level (9.8%) and also higher than the ARI prevalence in under-five children in West Java (5.4%).

Environmental sanitation is observed from the condition of drinking water and toilets/latrines. Most subjects (65.6%) have access to inadequate drinking water, where this figure is higher than access to inadequate drinking water at the national level (33.7%). For drinking water source was dominated by refill water, and most subjects (76.1%) already have decent toilets/latrines, however, this figure is still lower than the national level access to proper toilets/latrines (81.9%).

Table 1. Characteristic of subject of the study

Characteristics	n=1203	(%)	Mean±SD
Nutritional Status			
Stunting	247	20.5	
Not s*tunting*	956	79.5	
Wasting	69	5.7	
Not w*asting*	1134	94.3	
Underweight	139	11.6	
Not u*nderweight*	1064	88.4	
Age			14.49 ± 5.08
12-23 months	803	66.7	
6-11 months	400	33.3	
Gender			
Male	627	52.1	
Female	576	47.9	
Birth Weight (gram)			3137.86 ± 429.88
<2500 gram	61	5.1	
≥2500 gram	1142	94.9	
Birth Length (cm)			48.95 ± 2.23
<48 cm	216	18.0	
≥48 cm	987	82.0	
Father Education Level			
Low	707	58.8	
High	496	41.2	
Mother Education Level			
Low	684	56.9	
High	519	43.1	
Father Employment Status			
Working	1125	93.5	
Not Working	78	6.5	
Mother Employment Status			
Working	240	20.0	
Not Working	963	80.0	
Number of Member of the Family			4.73 ±1.50
≥ 8	56	4.7	
5 – 7	523	43.5	
≤ 4	624	51.9	
Number of Toddlers			1.17 ± 0.41
>1	1124	93,4	
1	79	6,6	
Wealth Assets			
Low	461	38.3	
Middle	243	20.2	
High	499	41.5	
Residence Area			
Rural	395	32.8	
Urban	808	67.2	
Food Consumption Diversity			4.94 ±1.61
<5 (Diverse)	436	36.2	
≥ 5 (Not Diverse)	767	63.8	

Characteristics	n=1203	(%)	Mean±SD
Early Breastfeeding/IMD			
No	624	51.9	
Yes	579	48.1	
History of Exclusive Breastfeeding			
No	383	31.8	
Yes	820	68.2	
First Complementary/Weaning Food (months)			5.91 $\pm$ 2.84
< 6 months	383	31.8	
$\geq$ 6 months	820	68.2	
Breastfeeding Status			
No	291	24.2	
Yes	912	75.8	
Unhealthy Snack Consumption			
Yes	735	61.1	
No	468	38.9	
ARI			
Yes	432	35.9	
No	771	64.1	
Diarrhea			
Yes	223	18.5	
No	980	81.5	
Water Consumption Condition			
Not healthy	789	65.6	
Healthy	414	34.4	
Toilet/Latrine Condition			
Poor condition	288	23.9	
Decent condition	915	76.1	

Result of multivariate analysis is presented in **Table 2**, showing the subjects with age of 12-23 months become a risk factor for stunting. Subject of age group 12-23 months have a bigger risk to experience stunting 3.10 times greater than age group of 6-11 months (AOR=3.10 95% CI: 2.16-4.45). Result analysis of this study are in line with research in Indonesia which showing the age of 12-23 months is a risk factor for stunting (AOR=1.89 95% CI: 1.54-2.32) (18). Same result was also reported from a study from three provinces in Indonesia (NTT, Papua and Central Java) where children of age 12-23 months were a risk factor for stunting (AOR=4.40; 95% CI: 2.97-6.53) (20). It also strengthened by a systematic review report, as the children gets older, this increasing age is a risk factor for stunting (2). From Akombi *et al*. (2017) stated that older children already able to crawl and walk, and they begin to receive weaning or complementary food. Moreover, older children are more susceptible to get contamination from water, food, soil that enter their mouth. So, they are susceptible to infection which then reduce their food appetite and food consumption (5).

Table 2. Multivariate analysis of stunting, wasting, and underweight to under-two children (6-23 months)

Variable	p-value	AOR (95% CI)
Stunting		
Age		
6-11 months		1
12-23 months	<0.001	3.10 (2.16-4.45)
Birth Length		
≥48 cm		1
<48 cm	0.001	1.85 (1.30-2.62)
Mother Education Level		
High		1
Low	<0.001	1.97(1.45-2.68)
Breastfeeding Status		
Yes		1
No	<0.001	0.46 (0.31-0.68)
Wasting		
Mother Education Level		
High		1
Low	0.029	0.57(0.34-0.94)
Underweight		
Age		
6-11 months		1
12-23 months	0.003	1.92 (1.25-2.95)
History of Exclusive Breastfeeding		
Yes		1
No	0.005	0.54 (0.35-0.83)

This study found the subjects with birth length <48 cm were a risk factor for stunting. Subjects with birth length <48 cm had a 1.85 greater risk of stunting than the group with birth length >48 cm (AOR=1.85 95% CI: 1.30-2.62). The results of study analysis is in line with a study from rural Purwokerto which reported children with birth length <48 cm have a 16.4 times greater risk of experiencing stunting at the age of 12 months when compared to children who born with normal birth length (11). In addition, it was strengthened by another research using Indonesian Basic Health Research (Riskesdas) data 2018 that showed the birth length <48 cm was a risk factor for stunting (AOR=1.50 95% CI: 1.35-1.66) (17). In preventing a short birth length, good nutritional status from the expectant mother is needed in before and during the pregnancy period and to have Antenatal Care (ANC) visits at least 4 times during pregnancy. Nutritional status of the mother before pregnancy has 76 % effect to the baby's birth length (13).

In this study, it was found the mother's education level influencing the stunting occurrence. A low education level of the mother is a risk factor for stunting (AOR=1.97 95% CI: 1.45-2.68) which means the low education mother has 1.97 times more at risk of having stunted children. These results are in line with studies in Central Java and NTT that reported mother education was a risk factor for stunting (8,18). These results were also strengthened by research based on Riskesdas data in 2013 and 2018 which showed mother's low education was a risk factor for stunting (21,1).

Mothers with low level of education do not prepare variety of diets for their children so they are at risk of stunting (3). Mother's education can influence nutrition knowledge, the parenting patterns in appropriate feeding and health care so it can stimulate optimal growth of children

(6,7). The mother's education can influence decisions in determining children health since the mother will be more selective in providing good and nutritious food to their children. In addition, it will also affect the application of parenting and the application of proper food for their children (15).

Non-breastfeeding status in children is a protective factor for stunting (OR=0.46 95% CI: 0.31-0.68) which means mother who do not breastfeed their children have a 0.46 times lower risk of having stunted children. This is evidenced by the mean HAZ in subjects who were still breastfed being 0.39 lower than those who were not breastfed. This showed mothers who are still breastfeeding their children do not guarantee their children will not experience stunting. It is presumably happened since stunting is a chronic nutritional status, so children who are breastfed or having a breastfeeding status do not guarantee that the children able to avoid stunting. Most children (63.8%) who are still breastfed are aged of 12-23 months. This result is in line with a systematic review stated that long duration of breastfeeding (>12 months) is a factor associated with stunting (2). It can be caused by the longer the baby is breastfed, the quality of breast milk will decrease. After 6 months, the quality of breast milk decreases and the mother's nutrition intake will greatly determine quality of breast milk (22). However, this study could not analyze the mother's nutrition intake. In addition, the study found that mothers who were currently breastfeeding had more children who were not exclusively breastfed compared to mothers who were not currently breastfeeding (77.5% vs 61.2%).

Most percentage of mother's education in the study was found in the low category (56.9%), but majority of wasting children had mothers with higher education (58%). In this study, it was found the mother's education level influencing the wasting occurrence (p=0.013). Mother's low education level is a protective factor for wasting (AOR=0.57 95% CI: 0.34-0.94) meaning that mothers with low education are 0.57 times protected to have wasting children. This is evidenced by the mean value of WHZ in subjects from highly educated mothers being 0.17 lower compared to subjects with low educated mothers.It showed that a high education level from the mother does not guarantee the children will not experience wasting. It presumed mother with low education in this study were more likely to have unemployment status (88.9%). Furthermore, mothers who do not work have more time to care for their children (14). This study also found that more highly educated mothers were employed compared to low-educated mothers (31.6% vs. 11.1%). In addition, it was found that more highly educated mothers did not breastfeed their children to date compared to less educated mothers (27.7% vs 21.5%).

This study found the subjects with age of 12-23 months were a risk factor for underweight. The subjects aged 12-23 months were at risk of underweight 1.92 times greater than the age group of 6-11 months (AOR=1.92 95% CI: 1.25-2.95). These results are in line with research in Kongo that reported children aged 12-23 months was a risk factor for underweight (AOR=3.29 95% CI: 1.39-7.79) (10).

This study also found the subject who were not have exclusive breastfed became a protective factor against underweight (AOR=0.54 95% CI: 0.35-0.83) meaning that children without exclusive breastfed were protected 0.54 times against underweight incidence. This is evidenced by the mean value of WAZ in children who are exclusively breastfed being 0.35 lower than children who are not exclusively breastfed. This is presumably caused by the subjects already consumed sufficient food that reflected in their food diversity consumption although in minimum category. Most subjects (63.8%) have consumed variety of foods with the average consumption of the food group was 4.94 +1.61. Most subjects who did not receive exclusive breastfeeding consumed a variety of foods (53%). It is also suspected that subjects who received exclusive breastfeeding are given low quality and low quantity of complementary

foods, however was cannot be analyzed in this study. Children with poor nutritional intake are 2.46 times at risk of experiencing underweight (16). This study also found that subjects who were exclusively breastfed consumed more unhealthy snacks compared to subjects who were not exclusively breastfed (63.8% vs 55.4%).

CONCLUSIONS AND RECOMMENDATIONS

Prevalence of stunting, wasting and underweight among children of 6-23 months were 20.5%, 5.7% and 11.6 % respectively. As an accumulation, the risk factor for stunting found in this study were: (a) age 12-23 months (AOR=3.10 CI 95% 2.16-4.45), (b) short birth length (AOR=1.85 CI 95% 1.30-2.62), (c) mother's low education level (AOR=1.97 CI 95% 1.45-2.68), and (d) not breastfeeding (AOR= 0.46 (0.31-0.68). Meanwhile, as the risk factor for wasting was the education level from the mother (AOR=0.5 95% CI 0.34-0.94). The risk factor for underweight was age 12-23 months (OR=1.92 95% CI 1.25 -2.95) and not having exclusive breastfeeding (AOR=0.54 CI 95% 0.35-0.83). Based on this research, intervention programs for improving the nutritional status of women before and during pregnancy require special attention. It is important to encourage pregnant women to have an adequate Antenatal Care (ANC) and mother education intervention regarding parenting feeding patterns which must be carried out in more efficient and effective ways.

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