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Changes in knowledge of mothers who have stunting and not stunting toddlers using booklet, flipchart and poster media

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ABSTRAK

Latar Belakang: *Berdasarkan data Riskesdas 2018, prevalensi stunting di Indonesia meningkat pada tahun 2010 dari 35,6% menjadi 37,2% pada tahun 2013 dan pada tahun 2018 menurun menjadi 30,8% Anak stunting berasal dari ibu yang memiliki pengetahuan gizi yang kurang pada kelompok ibu yang tidak mendapatkan edukasi gizi Ibu yang diberikan intervensi gizi mengalami perubahan pengetahuan dan praktik dalam menyediakan makanan sumber protein dan energi. Poster sebagai media edukasi gizi memberikan perubahan pengetahuan bagi para ibu.Booklet, poster dan lembar balik merupakan media cetak yang sering digunakan untuk menyampaikan edukasi kesehatan.*
Tujuan: *Tujuan dari penelitian ini adalah untuk mengetahui perbedaan pengetahuan ibu yang memiliki balita stunting dan tidak stunting setelah diberikan booklet, lembar balik, dan poster.*
Metode: *Penelitian ini menggunakan studi kuasi eksperimen dan uji Wilcoxon. Kriteria inklusi pada penelitian ini adalah ibu yang berusia 20-35 tahun, memiliki anak balita, aktif mengikuti posyandu dan bersedia mengikuti kegiatan penelitian selama 1 tahun. Kriteria eksklusi penelitian ibu yang pindah dari Kecamatan Pasir Putih dan tidak hadir ke Posyandu selama 3 bulan berturut-turut. Teknik pengambilan sampel menggunakan simple random sampling dimana data ibu diperoleh dari kehadiran di Posyandu di setiap RW. Sebelum penelitian dilakukan, kuesioner penelitian telah melalui tahap uji validitas dan reliabilitas dengan menggunakan software komputer.*
Hasil: *Terdapat perbedaan pengetahuan ibu sebelum dan sesudah diberikan edukasi gizi dengan menggunakan booklet (pvalue 0,000), menggunakan lembar balik (pvalue 0,000) dan menggunakan media poster (pvalue 0,000).*
Kesimpulan: *Edukasi gizi efektif digunakan sebagai upaya promotif pada ibu dalam pencegahan stunting, hal ini dapat dilihat dari peningkatan pengetahuan dan asupan gizi sebelum dan sesudah diberikan edukasi.*

KATA KUNCI: *booklet; ibu; lembar balik; poster; stunting*

ABSTRACT

Background: *According to 2018 Riskesdas data, the prevalence of stunting in Indonesia increased in 2010 from 35.6% to 37.2% in 2013 and in 2018 it decreased to 30.8%%. Research in Dakar, Senegal found that 45% of stunted children came from mothers who had insufficient nutritional knowledge in a group of mothers who did not receive nutritional education.Mothers who were given nutritional intervention experienced changes in knowledge and practice in providing food sources of protein and calories. Posters as a media for nutrition education provide changes in knowledge for mothers.Booklets, posters and calendars are print media that are often used to convey health education.*

Objectives: *The aim of this research is to compare mothers' knowledge between stunted and non-stunted children who have been given nutrition education from three different education media : booklets, calendars and posters.*

Methods: *This research used a quasi-experimental study and the Wilcoxon test. The inclusion criteria in this study were mothers aged 20-35 years, having children under five, actively participating in Posyandu and willing to take part in research activities for 1 year. The mother's research exclusion criteria were moving from Pasir Putih Subdistrict and not attending Posyandu for 3 consecutive months. The sampling technique uses simple random sampling where maternal data is obtained from attendance at the Posyandu in each RW. Before the research was carried out, the research questionnaire went through a validity and reliability testing stage using computer software.*

Results: *There was a difference in mothers' knowledge before and after being given nutrition education using booklet (pvalue 0.000), using calendar (pvalue 0.000) and using poster media (pvalue 0.000).*

Conclusions: *Nutrition education effectively used as promotive efforts on mother in the prevention of stunting, it can be seen from the improvement of knowledge and nutritional intake before and after being given education*

KEYWORD*:* *booklet; calendar; mother; poster; stunting.*

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INTRODUCTION

Stunting is the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation. Stunting in early life, particularly in the first 1000 days from conception until the age of two, impaired growth has adverse functional consequences on the child. Some of those consequences include poor cognition and educational performance, low adult wages, lost productivity and, when accompanied by excessive weight gain later in childhood, an increased risk of nutrition-related chronic diseases in adult life (1). According to 2018 Riskesdas data, the prevalence of stunting in Indonesia increased in 2010 from 35.6% to 37.2% in 2013 and in 2018 it decreased to 30.8% (2) Stunted children came from mothers who had insufficient nutritional knowledge in a group of mothers who did not receive nutritional education (3). Mothers who were given nutritional intervention experienced changes in knowledge and practice in providing food sources of protein and calories. Posters as a media for nutrition education provide changes in knowledge for mothers (4) (5)Booklets, posters and calendars are print media that are often used to convey health education (6).

The stunting rate in Indonesia has decreased from 24.4% in 2021 to 21.6% in 2022. The government has set a target for stunting prevalence in Indonesia in 2024 to 14% and requires an acceleration action of stunting

reduction of 3.8% per years to achieve this target (7). Stunting in Indonesia is known as dwarf and midget. Stunting is perceived as something normal and a hereditary factor, having no impact on cognitive, health and productivity. Nutrition education regarding stunting needs to be carried out to change wrong perceptions regarding stunting (8). Nutrition education was the most common nutrition strategics used for management child malnutirion in the Eastern Mediterranean Region (EMR) (9). The prevalence of stunting in Indonesian children was high and was strongly associated with child morbidity (10). The provision of health information provided to mothers can improve feeding behavior. Nutrition education effectively used as promotive efforts on mother in the prevention of stunting, it can be seen from the improvement of knowledge, attitudes and behavior of respondents before and after being given education. Providing nutrition education is related to feeding children, a mother who gets nutrition education will increase knowledge related to feeding with balanced nutrition so that children will fulfill their nutrition (11). Based of several problem above, this research to compare mothers' knowledge between stunted and non-stunted children who have been given nutrition education from three different education media : booklets, flipchart and posters.

MATERIALS AND METHODS

This research used a quasi-experimental research design. The inclusion criteria in this study weremothers who had stunted toddlers and mothers who had non-stunted toddlers, , aged 20-35 years, actively participating in Posyandu and willing to take part in the research for 1 year. The exclusion criteria in this study were mothers who moved from Pasir Putih sub-district Province West Java, did not attend Posyandu for 3 consecutive months and asked to leave the study. The sampling technique for this research was simple random sampling where a list of mothers was obtained from the Posyandu data area from each RW for the last 1 year. The media used in this research are booklets, flipchart and posters. The total number of mothers who took part in this research was 223 people and were divided into 3 groups, namely the group of mothers who received booklet, calendar and poster interventions. The intervention was carried out with counseling classes which were held twice with an interval of approximately one month. During the counseling, knowledge was measured (using pre and post questionnaires) and a 2x24 hour recall of the child's eating as an illustration of the food intake consumed by the child.

The analysis used uses computersoftwar namely Statistical Product and Service Solution (SPSS). The tests carried out were univariate and bivariate tests using the Wilcoxon and Mann Whitney tests. The Wilcoxon test was carried out to see differences in knowledge before and after nutrition education in the three media groups. Apart from that, we looked at the differences in energy, carbohydrate and protein intake before and after the nutrition education class. The Mann Whitney test was carried out to see the differences between groups given the booklet, flipchart and poster intervention.

RESULTS AND DISCUSSIONS

The following is data on the characteristics of the mother and child:

Table 1. Characteristics of the mother and child

Variable	n	Frequency(%) or mean ±SD
Mother's Education		
Elementary school graduate	31	13.9
Junior high school graduates and equivalent	60	26.9
High school graduates and equivalent	87	39
Higher Education / College	45	20.2
Mother's Age	223	32.843 ± 3.436
Child's Age		
< 12 Month	4	1.8
12 – 24 Month	43	19.3
24 – 60 Month	176	78.9

Variable	n	Frequency(%) or mean ±SD
Height for Age Z-score	223	0.00 ± 1
Stunted	90	40.35
Normal	133	59.65
Mother's Occupation		
Honorary Teacher	2	0.9
Housewife	202	90.5
Cadre	5	2.2
Employee	5	2.2
Not Working	6	2.7
Self-employed	3	1.3
Nutrition Education		
Yes	100	44,8
Never	123	55,2
Maternal Nutrition Knowledge		
Less	117	52.5
Good	106	47.5

Based on **Table 1**, it shows that the majority of mothers graduated from high school (39%), The average maternal age is 33 ± 3,44 years and the average age of children is 2.8 ± 1.08 years. The majority of mothers were a housewive (90.5%). In the category of having received counseling, it was found that the majority of respondents had never received nutritional counseling, namely 123 people (55.2%). In the category of maternal nutritional knowledge, it was found that the majority of mothers had nutritional knowledge in the poor category, namely 117 people (52.5%). The following is the difference in knowledge scores before and after the group given the booklet, flipchart and poster media.

Table 2. Differences in Booklet, Flipchart and Poster Knowledge Scores

Variabels	Booklet (n=74)				Flipchart (n=74)				Poster (n=75)			
	min	max	SD	*P*	min	max	SD	*P*	min	max	SD	*P*
Stunting												
Pre	0	90	27.4	0.000	10	80	24.30	0.000	0	70	18.67	0.000
Post	0	100	15.6		40	100	16.73		50	100	14.67	
Awareness of Proportion Food												
Pre	0	90	27.4	0.000	10	80	17.31	0.000	10	80	18.48	0.000
Post	40	100	13.6		40	100	12.51		40	90	11.07	

Booklets are book-shaped media used to convey health messages, often accompanied by writing and pictures. Information in booklet media is usually more complete and easier to understand and the design is more attractive. Posters are media that contain messages or information which are generally printed and pasted on walls or public transportation. A flip chart is a flip sheet media that contains messages or images related to the message or information you want to convey. However, calendars or flipcharts require special storage space and require special skills in designing them (6). A literature study conducted by Gina found that the use of booklets, posters and flipchart could increase mothers' knowledge (12). Apart from media use, changes in maternal knowledge are also influenced by the mother's education level (4).The higher the mother's education level, the higher the knowledge score and feeding practice score by mothers who take part in nutrition education (3). The sample in this study were mothers who actively participated in Posyandu. Stunting is often found in mothers who have low educational status (13). According to research by West J. et al, Posyandu is the government's front guard in overcoming nutritional problems and almost 80% of mothers receive information regarding stunting at Posyandu (14).

Based on **Table 2**, the results show differences in knowledge scores between booklet, flipchart and poster media. In the booklet media, the results of the analysis using Wilcoxon on

knowledge about stunting and Awareness of Food Proportion resulted in a p-value = 0.000. This indicates that there is a significant difference between knowledge before the intervention and after the intervention using booklet media. The results of pre-test and post-test analysis on booklet media showed that the minimum and maximum values regarding stunting were 0 and 90, while the minimum and maximum values regarding Awareness of Proportion Food were 0 and 100. Research on nutrition education in Bau Bau City also found that there were differences in knowledge, attitudes and actions between groups of mothers who received booklet media. Changing maternal knowledge is expected to change the way mothers care for, prepare food and monitor children's growth and development (15).

In flipchart media, the results of the analysis using Wilcoxon on knowledge about stunting and Awareness of Food Proportion resulted in a p-value = 0.000. This indicates that there is a significant difference between knowledge before the intervention and after the intervention using flipchart media. The results of the pre-test and post-test analysis on flipchart media showed that the minimum and maximum scores regarding stunting were 10 and 80, while the minimum and maximum scores regarding Awareness of Proportion Food were 40 and 100. Primary research in Arcamanik found that there were differences in the knowledge of mothers who received posters and flipcharts (16).

In poster media, the results of the analysis using Wilcoxon on knowledge about stunting and Awareness of Food Proportion resulted in a p-value = 0.000. This indicates that there is a significant difference between knowledge before the intervention and after the intervention using poster media. The results of pre-test and post-test analysis on poster media showed that the minimum and maximum values regarding stunting were 0 and 70, while the minimum and maximum values regarding Awareness of Food Proportion were 50 and 100.

Changes in knowledge occurred in all mothers who received booklets, posters and calendars flipchart in this study. Changes in maternal knowledge can influence maternal feeding practices (3). A mother must be provided with adequate information to improve their knowledge and improve their attitudes (17). A mother's knowledge can influence toddlers' food consumption patterns and toddlers' nutritional status. Mothers with an adequate level of knowledge regarding nutrition will apply the knowledge gained into their parenting patterns, especially in providing food that is in accordance with the nutritional needs of toddlers so that toddlers do not experience food intake deficiencies (18). Insufficient food and nutritional intake in toddlers can have an impact on the incidence of stunting in toddlers (19). Increasing nutritional knowledge in mothers can be done by providing nutritional education. Providing nutrition education to mothers has proven effective in improving feeding practices in several countries (20).

In general, the knowledge scores of mothers from all groups increased after being given the intervention. An increase in knowledge shows the success of a media in nutrition education activities (21). The results of the analysis carried out showed that there were significant differences regarding maternal knowledge using the three types of intervention media ($p<0.05$). The results of statistical tests in the three intervention groups, namely using booklet, flipchart and poster media, obtained a value of $p=0.000$ which can be concluded that there is an influence of using these three media in the intervention in increasing maternal nutritional knowledge related to stunting and awareness of food proportion. This is in line with research conducted by Listyarini and Fatmawati (2020) which shows that there is an influence of the use of booklet media on nutritional interventions (22) . Research (Siregar et al, 2021) shows that there is an influence of using calendar and poster media in increasing respondents' knowledge (23). Research in Madagascar found that changes in mothers' knowledge regarding the positioning of children will have an impact on changes in feeding practices (20). Based on Table 3, the results show differences in energy, carbohydrate, protein and fat intake scores for each media. The results of the analysis using Wilcoxon for energy intake in the intervention group regarding stunting and awareness of proportion food showed p-value = 0.074 in booklet media, p-value = 0.171 in flipchart media, and p-value = 0.584 in poster media. This indicates that

there is no significant difference between the mother's child's energy intake before the intervention and after the intervention using booklets, flipchart and posters. The results of the energy intake analysis showed that the minimum intake was 63 kcal in the intervention group using flipchart media and the maximum intake was 13,557 kcal in the intervention group using poster media.

The results of the analysis using Wilcoxon for children's carbohydrate intake in the intervention group regarding stunting and awareness of proportion food showed p-value = 0.041 in booklet media, p-value = 0.682 in flipchart media, and p-value = 0.115 in poster media. This indicates that there is a significant difference between carbohydrate intake before the intervention and after the intervention using booklet media, but there is no significant difference between carbohydrate intake before the intervention and after the intervention using flipchart and poster media. The results of the analysis of carbohydrate intake showed that the minimum intake was 15 grams in the intervention group using poster media and the maximum intake was 2016 grams in the intervention group using flipchart media.

The results of the analysis using Wilcoxon for children's protein intake in the intervention group regarding stunting and Awareness of Proportion Food showed p-value = 0.350 in booklet media, p-value = 0.126 in flipchart media, and p-value = 0.926 in poster media. This indicates that there is no significant difference between protein intake before the intervention and after the intervention using booklets, flipchart and posters. The results of the protein intake analysis showed that the minimum intake was 5 grams in the intervention group using booklet media and the maximum intake was 607 grams in the intervention group using booklet media.

The results of the analysis using Wilcoxon for children's fat intake in the intervention group regarding stunting and Awareness of Proportion Food showed p-value = 0.311 in booklet media, p-value = 0.185 in flipchart media, and p-value = 0.950 in poster media. This indicates that there is no significant difference between fat intake before the intervention and after the intervention using booklets, flipchart and posters. The results of the fat intake analysis showed that the minimum intake was 3 grams in the intervention group using booklet and calendar media and the maximum intake was 168 grams in the intervention group using poster media.

Low knowledge of mothers regarding the practice of feeding children is one of the factors causing the incidence of malnutrition in children. Maternal knowledge regarding nutrition is very important in feeding children which includes the quality and quantity of children's food (24). Apart from knowledge, providing nutritional education is also useful in increasing awareness and changing behavior to achieve optimal nutritional conditions, such as paying attention to nutritional intake, especially macronutrients.

The results of the analysis show that there is an effect of providing nutritional education using booklet media on carbohydrate intake after being given the education. However, there was no effect of providing nutritional education using booklet media on energy, protein and fat intake after being given the education. The results of the analysis also show that there is no effect of providing nutrition education using calendars and posters on energy, carbohydrate, protein and fat intake after being given the education. This is in line with research conducted in Bengkulu which showed that there was an effect of providing education on carbohydrate intake, but there was no effect of providing education on energy, protein and fat intake (25). Other research that supports this research is research conducted by Sely et al2020) which shows that there is no effect of providing nutritional education on the level of macronutrient intake (26).

Overall, there was almost no difference in the intake of energy, carbohydrates, protein and fat in the booklet, leaflet and calendar groups. Some of the mothers in this study complained that they did not have enough time and felt tired because some of the mothers worked and had other children who needed attention. This condition is similar to research in Madagascar where the role of the father or husband is needed in supporting the wife in preparing food preparation. Apart from that, economic conditions play an important role in the mother's ability to choose food and the availability of a variety of foods in the household (20).

Table 3. Differences in children's energy, carbohydrate, protein and fat intake before and after mothers are given intervention

Variabels	Booklet (n=74)				Flipchart (n=74)				Poster (n=75)			
	min	max	SD	P	min	max	SD	P	min	max	SD	P
Calories												
Calories 1	199	7996	989.30	0.074	63	2535	488.59	0.171	178	13557	1549.9	0.584
Calories 2	199	3297	562.74		202	2743	503.09		190	3092	631.3	
Carbohydrate												
Carbohydrate 1	28	350	71.27	0.041	27	323	63.03	0.682	15	594	87.43	0.115
Carbohydrate 2	29	415	73.16		18	2016	241.91		17	393	84.21	
Proteins (P)												
Proteins 1	8	607	20.35	0.350	11	175	24.48	0.126	6	138	24.62	0.926
Proteins 2	5	96	69.43		6	100	20.88		8	143	24.79	
Fat (F)												
Fat1	4	118	25.14	0.311	3	129	24.56	0.185	6	168	28.18	0.950
Fat2	3	156	26.74		3	164	27.26		6	119	27.08	

Consumption of proteins such as eggs is also very low, found in households with low economic conditions (27). The following are differences in knowledge, energy, carbohydrate, protein and fat intake in groups given booklets, calendars and posters:

Tabel 4. Differences in knowledge, energy intake, carbohydrate, protein and fat in booklet, flipchart and poster media

Variabel	Media	Mean	Pvalue
Knowledge	Booklet	76.76	0.3
	Poster	75.2	
	Flipchart	75.54	
Calories (Kkal)	Booklet	951.75	0.02
	Poster	1200.05	
	Flipchart	1016.76	
Carbohydrate (Gr)	Booklet	123.21	0.004
	Poster	163.62	
	Flipchart	167.38	
Proteins (Gr)	Booklet	33.41	0.022
	Poster	43.09	
	Flipchart	38.13	
Fat (Gr)	Booklet	39.38	0.18
	Poster	47.03	
	Flipchart	41.81	

Based on **Table 4**, the results of the Kruskal Wallis test on knowledge (pvalue= 0.3), energy intake (pvalue=0.02), carbohydrates (pvalue= 0.004), fat (pvalue= 0.18) and protein (pvalue= 0.022) are obtained. on booklets, posters and flipchart. This shows that there is no difference in mothers' knowledge and toddlers' fat intake when mothers are given booklet, poster and flipchart interventions. Apart from that, the research results also showed that there were differences in toddlers' energy, carbohydrate and protein intake when mothers were given booklets, posters and flipchart. In this study, using the Wilcoxon test, there was a change in knowledge before and after the three media. However, during the Kruskall Wallis test, there was no difference in knowledge between the three media. This happens because the three media provide changes in knowledge to mothers. This is proven by the post test scores on the three media, there were quite significant changes.

In this study, the majority of mothers had a senior high school education so that the group of mothers had no difficulty in participating in nutrition education activities. The research lasted for approximately 3 months so there were differences in knowledge (**Table 2**) and intake of carbohydrates, energy and protein. Mothers have an important role in making decisions regarding the beginning of a child's life starting from breastfeeding, giving MP-ASI, immunization, giving vitamin A (28). Research in Tanzania in 2023 found that there were differences in energy consumption (p 0.02), protein (p 0.001) and fat (p 0.03) using booklets (4)(27). Research in Cambodia found that nutritional education in mothers can increase the diversity of foods consumed by children, including staple foods, fruit and vegetables (24). Nutrition education needs to be carried out continuously in the community and groups need to be formed and lay people trained so that the nutrition education process can be sustainable. Differences in energy, carbohydrate and protein intake occur due to changes in the mother's knowledge regarding feeding practices in the mother's feeding practices. Changes in food intake are expected to provide changes in children's growth so that they can suppress and reduce stunting in children (29). Providing positive nutritional education and self-efficacy to mothers will have a positive impact on meal preparation practices in children. This will increase food intake in children which is related to the child's nutritional status (TB/U) (5).

Adequate macronutrients which include energy, carbohydrates, fat and protein influence

the incidence of stunting in toddlers. Inadequate energy intake can cause an energy imbalance in the body. Prolonged energy imbalances cause nutritional problems in toddlers. Toddlers with low levels of energy intake affect the function and structural development of the brain, which can result in stunted growth and cognitive development and the risk of stunting (30).

Carbohydrates are the main energy provider, if carbohydrate needs are not met then protein and fat will play a role in the process of providing energy for the body (31). Long-term lack of carbohydrates causes protein to be converted into an energy source so that protein cannot carry out its function as a building material and has an impact on children's growth being hampered (32). Lack of protein intake can interfere with the formation of antibodies, which makes toddlers vulnerable to infectious diseases. Toddlers who are exposed to infectious diseases are at risk of stunting. Insufficient protein intake will also affect the production and work of the IGF-1 hormone. The IGF-1 hormone itself is in the process of growth so low protein intake can increase the risk of stunting. Fat has a role as a transporter and solvent for fat-soluble vitamins in the body, where these functions greatly influence the growth of toddlers (33). From the discussion above, it can be concluded that fulfilling macronutrient intake (energy, carbohydrates, protein and fat) according to needs can prevent stunting.

CONCLUSIONS AND RECOMMENDATIONS

The group of mothers experienced changes in knowledge before and after being given nutrition education classes using booklets, posters and flipchart. There were no differences between the three media, including booklets, posters and flipchart, because each media provided changes in knowledge, but there were significant changes in the post test results for the three media. There were differences in children's energy, carbohydrate and protein intake between mothers who received booklets, flipchart and posters.

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The influence of skipping exercise to body composition and cardirespiratory fitness index in overweight female adolescents

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ABSTRAK

Latar Belakang: *Prevalensi overweight di Indonesia dari tahun 2013 ke 2018 meningkat secara signifikan pada remaja usia 13-15 tahun sebesar 8.3% meningkat hingga 11.2% dan pada usia 16-18 tahun sebesar 5.7% meningkat hingga 9.5%. Peningkatan aktifitas fisik dan perbaikan asupan makan merupakan salah satu strategi yang dapat menurunkan prevalensi obesitas pada remaja putri. Metode latihan skiping dapat meningkatkan tingkat aktifitas fisik pada remaja putri yang mampu mendorong perbaikan komposisi tubuh dan kebugaran kardiorespiratori pada remaja putri.*
Tujuan: *Menganalisis pengaruh skiping terhadap perubahan komposisi tubuh dan kebugaran kardiorespiratori pada remaja putri overweight dengan metode intervensi.*
Metode: *Subjek adalah 28 siswi Sekolah Menengah Atas yang overweight berusia 15-17 tahun dan bersedia mengikuti penelitian. Desain penelitian ini adalah quasy experiment design pada 14 subjek kelompok intervensi dan 14 subjek kelompok kontrol. Kelompok intervensi diberikan latihan skiping selama 4 sampai 8 menit, 3 kali seminggu selama 8 minggu. Sebelum dan setelah intervensi dilakukan pengukuran komposisi tubuh (berat badan, persen lemak tubuh, massa lemak tubuh dan massa bebas lemak) menggunakan BIA dan indeks kebugaran kardiorespiratori dengan metode modifikasi Harvard Step Test pada subjek.*
Hasil: *Terdapat pebedaan yang signifikan pada komposisi tubuh (berat badan, persen lemak tubuh, massa lemak tubuh dan massa bebeas lemak) dan indeks kebugaran kardiorespiratori sebelum dan setelah intervensi pada kelompok skiping ($p<0.05$) sedangkan pada kelompok kontrol tidak terdapat perbedaan yang signifikan ($p>0.05$). Metode skiping dapat mempengaruhi penurunan komposisi tubuh dan peningkatan indeks kebugaran kardiorespiratori ($P<0.05$: R2).*
Kesimpulan: *Program latihan skiping memiliki dampak signifikan terhadap komposisi tubuh dan kebugaran kardiorespiratori. Latihan skiping efektif dalam memperbaiki komposisi tubuh dan kebugaran kardiorespiratori terkait body image dan pentingnya makan secara teratur guna mencegah masalah gizi pada masa kehamilan pada kegiatan bimbingan perkawinan.*

KATA KUNCI: *komposisi tubuh; kebugaran kardiorespiratori; overweight; skiping*

ABSTRACT

Background: *The overweight prevalence of adolescents in Indonesia from 2013 to 2018 experienced a significant rising as seen in 13-15 years old age group (expressed in percentage of 8.3 % in 2013 to 11.2 % in 2018) also in the 16-18 years old age group (expressed in percentage of 5.7 % in 2013 to 9.5 % in 2018). An increase of physical activity and improvement of food intake become one solid strategy to reduce the obesity prevalence on female adolescents. Skipping exercise method is able to increase the physical activity level on female adolescents and able to promote the improvement of body composition as well as cardiorespiratory fitness on female adolescents.*

Objectives: *analyzes the effect of skipping exercise to changes of body composition and cardiorespiratory fitness on overweight female adolescents by intervention method.*

Methods: *subjects in this study were 28 female students from Junior High which experiencing overweight status and have age ranging from 15-17 years old and willing to participate in this research. Design of this study was a quasi experimental applied to 14 subjects within 1 skiping group and 14 subjects within 1 control group. The intervention group received skipping exercise with 4-8 minutes time duration, 3 times in a week for 8 weeks. Prior to intervention and after the intervention, subjects underwent a body composition measurement (body weight, body fat percentage, fat mass, and fat free mass) by employing the BIA, and a cardiorespiratory fitness index measurement by employing a modified Harvard Step Test method.*

Results: *according to statistical test, there are significant differences found on body composition (body weight, body fat percentage, fat mass, and fat free mass) also in the cardiorespiratory fitness index, in before and after intervention to skipping group ($p<0.05$), while no significant difference found in control group ($p>0.05$). Skipping exercise method able to influence the reduction of body composition and an increase to cardiorespiratory fitness index ($P<0.05$: R2).*

Conclusions: *Skipping exercise program has a significant effect on the body composition and on the cardiorespiratory fitness index. The skipping exercise is effective for improving body composition and cardiorespiratory fitness index.*

KEYWORD*:* *body composition; cardirespiratory fitness; overweight; skipping*

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INTRODUCTION

Overweight and obesity are body conditions of being too heavy due to excessive fat storage. Overweight and obesity can be seen from result measurement of Body Mass Index (BMI) calculation according to age (BMI/Age) and will be classified as overweight if the z-score results >+1SD or classified as obesity when the z-score results >+2SD (1). WHO stated that proportion of children and adolescents from age 5 to 19 years old with overweight condition including obesity has increased from 8 % in 1990 to approximately 20 % in 2022 (2). Indonesia prevalence of overweight including obesity in adolescents was 16 % among adolescents aged of 13-15 years old and 13.5 % for older adolescents ged 16-18 years old (3). The result of Basih Health Research (Riskesdas) in 2018 showed that the prevalence of 16-18 years old overweight adolescents in West Sumatra was 7.78% while the prevalence of obesity was 3.72 % (4).

There are several risk factors for overweight in adolescents, such as food intake, breakfast habit, sleep duration and socio-economics (5). Lack of physical activity is one of many causal factors to the rising of obesity prevalence among adolescents. More than 340 million children and adolescents with age of 5 to 19 years old were

overweight or obese in 2016 (2). In addition, based on the Global Status Report on Physical Activity 2022 from WHO, more than 80 % of adolescents and 27 % of adults do not meet the appropriate level of physical activity as recommended (6). According to Riskesdas, proportion of less physical activity in population with age of ≥10 years old in Indonesia is 33.5 %, while in West Sumatra, population with age of ≥10 years old with insufficient physical activity reaches 39.42 % (3,4).

Obesity as one of risk factors for non-communicable diseases such as diabetes mellitus, cardiovascular disease, cancer, hypertension and arthritis increasing (7,8). In order to minimize the prevalence of non-communicable diseases, it is crucial to prevent and manage overweight and obesity . Physical activities including sports plays vital role in preventing obesity among children and adolescents (9). Sport is a body activity involves several body muscles. In general, adolescents (13-17 years old) need 60 minutes to do physical activities with moderate to vigorous intensity every day (10). One type of sport activity that can be carried out anywhere with easy, effortless, and affordable also can be done together in one room is skipping.

Skipping is an aerobic exercise with the involvement of one or more individuals who jump over a rope and swings in such a way that it passes under the feet and over the head of these individuals in continuous movement (11). Several studies had reported the impact of jumping rope on health. Such as result taken from previous research on school-aged-children showed a change of standard deviation in Body Mass Index that decreased after the jump rope intervention (12). While other research also reported result of a jump rope intervention 12 week intervention to female adolescent subjects that showed significant changes in body fat percentage, waist circumference, systolic blood pressure, blood sugar insulin level and HOMA-IR (13). In addition, other research also reported there is an effectiveness in skipping for increasing the body fitness index and lung function (14).

Nevertheless, only few studies addressed an increase of duration and intensity of skipping during intervention to attain time effectiveness during intervention that able to promote changes in body composition and cardiorespiratory fitness in overweight female adolescents. Therefore, the researchers in this study were interested in examining the skipping effect on body composition and cardiorespiratory fitness in overweight female adolescents. This study has a purpose to analyze the skipping effect on changes in body composition and cardiorespiratory fitness in overweight female adolescents by intervention method.

MATERIALS AND METHODS

The research design was a quasy experiment design to subject study consisted of a skipping group and a control group. The subject of the study were female students of SMAN 1 West Sumatra who were included into the skipping group and female students of SMAN 1 Batipuh who were included into the control group. There is no intervention in control group. The inclusion criteria for this study were female adolescents with age of 15 – 17 years old that have a z-score >+1SD, currently not following a particular diet program, not smoking, and willing to take part in every research stages, do not attend regular sport classes, do not go to school by bicycle or on foot (>2 km) and has no complaint or history of leg injury. Subject selection through screening with BMI/age before intervention. Based on obtainable equation formula, number of subjects for each treatment was 13 female adolescents, we added 10 % subject as drop out value, the final participants for each group were 14 female adolescents . However, during the intervention program, each group has one subject dropped out, so the total number of subjects who accomplished this research was 28 subjects.

This research was conducted on October to December 2023. The skipping activity was performed for 4-8 minutes, 3 times per week for 8 weeks on non-consecutive days. The intervention was carried out by adding the exercise duration time every 2 weeks with a workout to rest ratio stated as 20/10 seconds with an increase of 2 minutes every 2 weeks. Prior to main exercise and after the main exercise, the subjects performed warm up and cool down activities. Skipping was held together in one room.

Before carrying out the intervention activity, first week was designated for initial training to prepare

the subjects with basic movements for skipping group. At baseline, the body composition (body weigh, percent body fat) was measured using BIA (Bioelectrical Impedance Analysis) with omron hbf 375 brand while the cardiorespiratory fitness index was measured by modified Harvard Step Test method and calculated with formula (15) CFI: (100 × L)/(5.5 × p), where L is the duration of the test (L = 300 s) and p is the number of heartbeats in the 1.5 min after the participant completed the test. on the subjects. Skipping was carried out and aided by video recorder media that displays video of skipping movement played on a laptop and speakers. A jump rope as research equipment was needed to follow the skipping direction, so the intervention in this study can be more valid and subjects felt easier to follow the skipping movement so the quality of the intervention is guaranteed. Subjects' food consumption data for characteristics were also looked at. Data collection using semi-quantitative food frequency and for the level of intake adequacy refer to the nutritional adequacy rate and for physical activity data refer to physical activity level with 1x24 hour recall.

Univariate analysis was selected to be used for determining the data distribution descriptively and followed by bivariate analysis through differential test and simple linear regression test to prove the research hypothesis. This research has received ethical clearance from Airlangga University under approval letter number 1143 / HRECC. FODM / X /2023. The test used to determine the normality of the data was Kolmogorov Smirnov (16).

RESULTS AND DISCUSSIONS

Data of respondent characteristics is used to determine respondents' diversity data based on age, weight, body fat percentage, fat mass, fat free mass, fitness index, nutritional status, daily physical activity level, total intake and intake level based on the groups. These data will provide description of respondents' condition and its relationship to the research problem along with the research objectives in a clear explanation. There were 28 female adolescents participated in this research, where the subject characteristics by groups is presented in **Table 1** below.

Table 1. Characteristics of Subjects

Characteristics	Skipping (n=14)	Control (n=14)	*P*
	Mean ± SD	Mean ± SD	Value
Age (year)	16.45 ± 0.52	15.8 ± 0.33	0.001
Body Weight (kg)	69.72 ± 13.84	70.16 ± 7.45	0.848
Nutritional Status (BMI/age)	1.42±0.64	1.35 ± 0.49	0.891
Body Fat (%)	30.67 ± 2.52	30.29 ± .28	0.681
Fat Mass (kg)	21.67 ± 5.92	21.39 ± 3.66	0.847
Fat Free Mass (kg)	48.05 ± 8.00	48.77 ± 3.96	0.741
Fitness Index	47.89 ± 6.02	46.32 ± 4.56	0.511
Nutritional Status (kg/m^2)	1.42±0.64	1.35 ± 0.49	0.891
Physical Activity Level	1.44 ± 0.05	1.42 ± 0.06	0.241
Energy Intake (kkal)	1552.33 ± 416.56	1674.55 ± 510.87	0.613
Protein Intake (g)	58.67 ± 17.15	61.84 ± 19.43	0.713
Fat Intake (g)	57.52 ± 18.71	57.66 ± 20.70	0.985
Energy Adequacy Level (%)	73.92 ± 19.83	79.74 ± 24.32	0.613
Protein Adequacy Level (%)	97.79 ± 28.58	103.06 ± 32.39	0.713
Fat Adequacy Level (%)	82.18 ± 26.73	82.38 ± 29.57	0.985

SD: standard deviationi, P-Value: no significant difference (p>0.05) (*independent t test*)

All subjects in both groups have an average age of 15 -17 years old. There was age difference between the average/mean age in skipping group (16.45 years ± 0.52) with the control group (15.8 years ± 0.33). Whereas body weight of subjects has no difference between two groups; the average body weight in skipping group stated as 69.72 kg ± 13.84 and in control group stated as

70.16 kg ± 7.45. Same result was found in the nutritional status from subjects, where there was no difference between both groups; the average value of BMI/age for skipping group was 1.42 sd ± 0.64 while the average value of BMI/age for the control group was 1.35 ± 0.49. According to the average BMI/age , all subjects were overweight (15).

There was no difference found in the average percentage of body fat between both groups, the average percentage for skipping group was 30.67% ± 2.52 while the average percentage for control group was 30.29% ± 2.28. According to the Indonesian Ministry of health, body fat percentage of more than 25 % for women is categorized as obese (16). For the fat mass characteristic from subjects, there were no difference found in both groups with the average value for skipping group was 21.67kg ± 5.92 and average value for control group was 30.29% ± 2.28. The fat free mass characteristic from subjects also has no differences among both groups with the average value of skipping group was 48.05 kg ± 8.00 while the average value of control group was 48.77 kg ± 3.96. Female adolescents storing their excess energy in the form of body fat and as a consequence female adolescents tend to overeat, while male adolescent use their excess energy to synthetize protein. Therefore, when female adolescent reaches her physical maturity, the amount of body fat is twice higher than the body fat of male adolescent (17).

There was no significant difference found in the fitness index for both groups, the average value for skipping group was 47.89 ± 6.02, while the average value for control group was 46.32 ± 4.56. Table 1 described no significant difference found in the physical activity level from subjects in both groups; the average value of skipping group was 1.44 ± 0.05 while the average value of control group was 1.42 ± 0.06. According to FAO/WHO/UNU (2001) level of physical activity value of ≤16.69 is included in a light/mild category, so all subjects of this study had physical activity level that belongs to light/mild category. The physical activity and basal metabolism are prominent variables for calculating energy consumption. Energy consumption can be one example of energy necessity of an individual to live a quality life thoroughly (18).

There was no difference found in energy, protein and fat intakes for all subjects included in both groups. For the skipping group, the average amount of energy, protein and fat intakes were stated as order; (1552.33 kcal ± 416.56), (58.67 g ± 17.15), and (57.52 g ± 18.71), meanwhile, the average amount of energy, protein and fat intakes from control group were stated as order; (1674.55 kcal ± 510.87), (61.84 g ± 19.43), and (57.66 g ± 20.70). Aside from the intake amount, no significant difference also present in the level of intake adequacy, whether in the energy, protein and fat levels within the skipping group or in control group. In the skipping group, the level of energy, protein and fat adequacy were stated in order of (73.92% ± 19.83), (97.79% ± 28.58) and (82.18 % ± 26.73) while the level of energy, protein and fat adequacy of control group were stated in order of (79.74 % ± 24.32), (103.06 % ± 32.39) and (82.38 % ± 29.57). The subjects' adequacy level of energy based on RDA was classified as deficit, while the adequacy level for protein and fat were classified as sufficient.

A significant difference was found in body composition (body weight, body fat, fat mass and fat free mass) of subjects in skipping group and control group before (pretest) and after (posttest) receiving the exercise intervention, which verified by calculations using paired differential tests. Then, for identifying whether there was a difference in effect between the skipping (treatment) group and the control group, a differential test was carried out with the results presented in **Table 2** below.

Tabel 2. Effects of the Intervention on Body Composition

Variables	Skipping	Control	*P* Value[1]
BW (kg)			
Pretest	69.72 ± 13.84	70.16 ± 7.45	
Posttest	67.50 ± 13.55	69.97 ± 7.86	0.000*
Changes	-2.2 ± 0.86	-0.18 ± 0.60	

Variables	Skipping	Control	*P* Value[1]
p-*value*[2]	0.000*	0.270	
PBF (%)			
Pretest	30.67 ± 2.52	30.29 ± 2.28	0.013*
Posttest	30.13 ± 2.45	30.55 ± 2.22	
Changes	-0.53 ± 0.79	0.26 ± 0.60	
p-*value*[2]	0.026*	0.125	
FM (kg)			
Pretest	21.72 ± 5.93	21.36 ± 3.64	0.000*
Posttest	20.62 ± 5.68	21.48 ± 3.71	
Changes	-1.04 ± 0.54	0.12 ± 0.38	
p-*value*[2]	0.000*	0.388	
FFM (kg)			
Pretest	48.00 ± 7.99	48.80 ± 3.97	0.007*
Posttest	46.87 ± 7.92	48.49 ± 4.37	
Changes	-1.17 ± 0.88	-0.31 ± 0.65	
p-*value*[2]	0.000*	0.158	

BW (Body Weight), BF (Body Fat), FM (Fat Mass), FFM (Fat Free Mass) [1]*independent test* [2]*paired t test* * paired t-test results significantly different between measurements, significant between groups (p≤0,05)

The result of analysis in before and after the intervention on subjects' body weight showed a significant difference for treatment group where the body weight reduction reached 2.0 kg when compared to the body weight of subjects in control group that only experiencing a weight loss of 0.18 kg. There was a reduction in body fat percentage variable in the treatment group (in before and after the intervention) reaching 0.53 %, in contrast to the control group which experienced an increase for 0.26 %. The changes in average body weight in before and after 8 weeks intervention for skipping group was 69.72 kg ± 13.84 before intervention, then decreased to 67.50 kg ± 13.55 after the intervention. Meanwhile for the control group, the average body weight before intervention was 70.16 kg ± 7.45 and 69.97 kg ± 7.86 after intervention. The average percentage of body fat for skipping group before the intervention was 30.67% ± 2.52 and decreased into 30.13% ± 2.45 after the intervention. It showed a significant difference in before and after the intervention (P<0.05). Other than that, there was an increase in percentage of body fat before intervention (30.29% ± 2.28) to (30.55% ± 2.22) after intervention for the control group, but no significant difference found (P>0.05).

This research is in line with result of research by Kim et al (2020) with jump rope intervention carried out by young women which showed significant changes in body fat percentage (13). Apart from that, result from other studies also reported that skipping intervention for shool-aged children changes the standard deviation score of body mass index from high to low value (12). Physical activity or exercises have many benefits for individual with excessive nutritional status, in particular for helping with weight loss, body fat reduction, visceral fat reduction and weight maintenance after weight loss (19). Skipping exercise also an effective training program to increase the body mass without fat (lean body) and to reduce the fat mass and central adiposity in female adolescents. The result of this study is in line with previous research (20). Other findings also suggest skipping exercise as useful non-pharmacological intervention for managing risk factor associated with CVD and body composition, which may mediate the observed improvements in academic self-efficacy (13). This research is also in line with

previous research that stated skipping exercise accompanied by music is more effective in improving the body composition (21).

The average amount of fat mass for the skipping group before intervention was 21.72 kg ± 5.93 and amount of fat mass for control group before intervention was 21.36 kg ± 3.64, meanwhile after the intervention, the amount of fat mass for skipping group became 20.62 kg ± 5.68 and the amount of fat mass for control group became 21.48kg ± 3.71. Meanwhile, the average amount of fat free mass for skipping and control groups before the intervention was stated as follow; (48.00 kg ± 7.99) and (48.80 kg ± 3.97), then the average amount of fat free mass after the intervention for skipping and control groups became (46.87 kg ± 7.92) and (48.49 kg ± 4.37).

The research result exhibited significant difference found in body composition variables (body weight, percent body fat, fat mass and fat free mass) before and after the intervention for the skipping group ($P<0.05$). On the contrary, there was no significant difference found in before and after intervention in the control group ($P<0.05$). Furthermore, from the result of the independent test, it also can be seen there was a difference existed between the skipping group and the control group ($P<0.05$) in the body composition variable.

Physical exercise or sport is the most important component in energy expenditure since it can affect the balance of body energy. High level of physical activity able to reduce appetite resulting in less energy intake (22). Moreover, the energy expenditure increases through physiological processes and cellular mechanisms that accelerate the expenditure of the main energy stores (glycogen and triacylglycerol) which causes weight loss. In particular, exercise accelerates glycogenolysis in muscle and liver through the glycolysis processes, and fastening cycle of citric acid and oxidative phosphorylation in muscles also lipolysis in adipose tissue as well as the fatty acid oxidation in muscle. These effects mentioned above are achieved through stimulation of hormone secretion and changes within substrate concentration leading to enzyme activation that catalyze important steps in the above-explained catabolic pathways (23). Apart from that, improving risk factors for obesity and cardiovascular disease during adolescence period is crucial since obesity in adolescence is strongly associated to an increased risk of death from cardiovascular disease in adulthood.

Significant difference of changes in cardiorespiratory fitness index (in before and after intervention) between skipping group and control group is verified by data calculation using paired differential test. Then, to witness any differences between the treatment groups, a differential test was carried out which the following data as the calculation result is presented in **Table 3**.

Tabel 3 Effects of the Intervention on the Cardiorespiratory Fitness Index

Fitness Index	Skipping	Control	*P* value[1]
Pretest	47.89 ± 6.02	46.32 ± 4.56	
Posttest	51.82 ± 6.94	45.88 ± 5.26	0.113
Changes	3.92 ± 7.90	-0.44 ± 6.06	
p-*value* [2]	0.050*	0.638	

*paired t-test results significantly different between measurements;[1]*independent test*;[2]*paired t-test*

Result of the analisis showed that there was a significant difference in cardiorespiratory fitness index variable found in the skipping group, while no significant difference found in before and after the intervention in the control group. However, result from independent test showed no significant differences found between the skipping group and the control group. The average value of cardiorespiratory fitness index in the skipping group before the intervention was 47.89 ± 6.02 and the value for control group was 46.32 ± 4.56. After the intervention, the average value of cardiorespiratory fitness index in the skipping group changed into 51.82 ± 6.94 and the

value for control group changed into 45.88 ± 5.26.

This research is in line to research by Stelle Tinia et al (2021) which reported that physical fitness index in the skipping and Tabata training group increased significantly. This research also in line with previous research that reported a skipping intervention carried out for 8 weeks was effective in improving the cardiovascular fitness of the subject study (24). To support these findings, other research also stated that skipping exercise accompanied by music was able to increase circulation of cardiovascular system through dynamic movements and strengthen deep breathing by activating the respiratory muscle movements to improve respiratory circulation (21). This physical activity compels subject to increase basic physical strength and endurance in obese subjects (21). Physical exercise will increase blood circulation that carries oxygen and nutrients needed by the body during exercise (14). Moreover, repeated physical activity increases blood circulation in healthy individuals thereby supporting maximum increase in cardiac output to improve the optimal delivery of oxygen to body tissues (25).

Exercise promotes myokines release from skeletal muscle which able to mediate cardiovascular health benefits through its anti-inflammatory action, also able to increase the glucose uptake and increase the insulin secretion and sensitivity. Moreover, sport also supports cardiovascular health through the mechanism of mitochondrial biogenesis, fatty acid oxidation, and blood vessel dilation. These mechanisms can improve the cardiovascular function (26).

The influence of skipping intervention to changes found in BB, BF, FM, FFM and FI was tested by using simple regression linear method resulted in several equations as presented in **Table 4**. The result from simple regression linear test showed that the biggest effect of skipping was found in the changes of subjects' body weight. Data interpretation from meaning of each outcome equation are stated as follow: 66.9 % explains skipping treatment has an effect on weight loss in overweight female adolescents thus there are 33.1 % is influenced by factors aside the variables studied.

Tabel 4. Influence of Intervention on body composition and cardiorespiratory Fitness Index

Outcomes	Equality	P Value	R^2
BW (kg)	(Y) delta BB = -4.271 + 2.043 (skipping and control)	0.000	0.669
BF (%)	(Y) delta BF = -1.336 + 0.800 (skipping and control)	0.006	0.256
FM (kg)	(Y) delta FM = -2.222 + 1.172 (skipping and control)	0.000	0.624
FFM (kg)	(Y) delta FM = -2.044 + 0.865 (skipping and control)	0.007	0.249
Fitness Index	(Y) delta FM = 8.297 + -4.369 (skipping and control)	0.113	0.094

*R^2: Regresi Linear Test

According to result studies conducted by previous researchers, the risk factor for overweight in children and adolescents are obese parents, sleep duration, birth weight, eating habit, and family size (27). A significant/real relationship was found ($p<0.05$) in a form of negative relationship between the weight delta of overweight female adolescents after receiving the skipping intervention thus giving a real reduction of body weight of the overweight female adolescents.

The skipping training had effect on reducing body fat percentage as stated by 25.6 % which leaves the rest of percentage (74.4 %) influenced by factors other than the studied variables. Skipping also had effect on reducing fat mass as stated by 62.4 % and effect on reducing fat free mass as stated by 24.9 % in the subjects of this study. According

to Suryana (2017), another factor that influences body fat percentage is the level of physical activity, where light physical activity can cause body fat accumulation within the body. Furthermore, teenagers with less fiber intake tend to consume high fat and high calories foods such as foods made from flour, sweet foods and fried foods which have type of fatty acids for different usage, thus, it can trigger changes in adipose tissue, mitochondrial and insulin function and occurring changes in body composition (28,29). A significant/real relationship ($p < 0.05$) was found in a form of negative relationship between delta percent of body fat, fat mass and fat free mass of overweight female adolescents after receiving the skipping intervention. Thus, skipping treatment has a real decreasing effect on the PBF, FM, and FFM of the overweight female adolescents.

The skipping training had an effect on changes in IKK of overweight female adolescents as stated by 9.4 % which leaves the rest of percentage (90.6 %) influenced by factors other than the studied variables. According to previous research, other factors that able to influence increase in the cardiorespiratory fitness index are gender, age, BMI, waist circumference, percent body fat, in addition to birth weight, length of pregnancy, and gestational diabetes in pregnant woman that able to predict a low cardiorespiratory fitness during adolescence (30,31). There was no significant/real relationship ($p > 0.05$) between the IKK delta of overweight female adolescents after receiving skipping intervention. So, the skipping intervention does not increase the IKK of overweight female adolescents.

CONCLUSIONS AND RECOMMENDATIONS

A physical exercise program in a form of skipping training method held for 3 times in a week with gradual increase of 2 minutes time duration for every 2 weeks with a work ratio of 20/10 seconds rest for female adolescents aged 15-17 years had a significant impact on body composition (body weight, body fat percentage, fat mass and fat free mass) and cardiorespiratory fitness. Skipping exercise is an effective way to improve body composition and cardiorespiratory fitness. Regular exercise program can reduce the problem of obesity and NCDs, which become the global problem affecting society in a whole. It requires awareness from respondents to monitor their body weight regularly, to increase physical activity by skipping exercise to maintain ideal body composition and improve cardiorespiratory fitness. The authors recommend a larger sample size and longer intervention time for future research so it could produce an optimal improvement in body composition and cardiorespiratory fitness. The limitation of this study is that it only focuses on providing physical activity but there are no other interventions such as dietary management and nutrition education for subjects during the intervention period, so that some variables do not have a significant effect on the interventions provided and the subject's understanding of weight control and obesity prevention cannot be known.

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WhatsApp-based intervention to promote tea consumption and healthy lifestyle in Indonesian's adult

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ABSTRAK

Latar Belakang: *: Flavonoid yang terkandung dalam teh telah terbukti mengurangi risiko Penyakit Kardiovaskular, dan konsumsi teh dapat membantu mengurangi masalah tersebut di masyarakat. Sementara konsumsi teh di kalangan masyarakat Indonesia masih jarang dan dalam jumlah sedikit.*
Tujuan: *Tujuan dari penelitian ini adalah untuk mengevaluasi pengaruh intervensi pendidikan berbasis WhatsApp program "HaH (Heart at Home)" yang bertujuan untuk meningkatkan KAP (Knowledge, Attitude, Practice) untuk mencegah CVD dengan menerapkan pola hidup sehat dan mendorong konsumsi teh.*
Metode: *Subyek adalah perempuan/laki-laki yang sudah menikah, anggota YJI (Yayasan Jantung Indonesia), berusia 25-50 tahun, memiliki dan menggunakan ponsel dalam kehidupan sehari-hari. Jumlah subjek dalam penelitian ini sebanyak 80 orang. Desain penelitian adalah intervensi pre-post yang dilakukan secara online menggunakan WhatsApp selama 21 hari. Intervensi pada penelitian ini berupa postingan video/gambar dan diskusi online melalui WhatsApp. Uji Wilcoxon dan McNemmar digunakan untuk menguji perbedaan KAP subjek sebelum dan sesudah intervensi.*
Hasil: *Subjek terbanyak adalah perempuan (96,3%), berusia 25-40 tahun (78,8%), dan ibu rumah tangga (67,5%). Skor pengetahuan meningkat sekitar 17,5% ($p<0,05$). Lebih dari 10% subjek mengalami peningkatan pengetahuan terkait risiko CVD. Hampir seluruh subjek sudah memiliki sikap positif pada awal (94%) dan sedikit meningkat menjadi 97,0% ($p<0,05$). Setelah intervensi, praktik kesehatan positif seperti olahraga, konsumsi sayur, relaksasi, dan tidur meningkat, sedangkan praktik negatif seperti merokok, gejala stres, dan konsumsi makanan tinggi kolesterol mengalami penurunan.*
Kesimpulan: *Penelitian ini menunjukkan bahwa program online efektif meningkatkan KAP subjek, meskipun hal ini dapat dimaksimalkan dengan lebih banyak berinteraksi dengan subjek.*

KATA KUNCI*: hidup sehat; minum teh; pendidikan gizi; penyakit kardiovaskuler; WhatsApp*

ABSTRACT

Background: *Tea flavonoids have been shown to reduce Cardiovascular Disease (CVD) risks, and tea consumption might help reduce the problem in the community. Meanwhile, tea consumption among Indonesian people is still rare and in small quantities.*

Objectives: *This research aimed to evaluate the effect of a WhatsApp-based education intervention, "HaH (Heart at Home)," a program that aims to increase KAP (Knowledge, Attitude, Practice) to prevent CVD by practicing a healthy lifestyle and encouraging tea consumption.*

Methods: *Subjects were women/men who are married, members of IHF (Indonesia Heart Foundation), aged 25-50 years old, own and used a smartphone in their daily life. A total of 80 adults was participated in this study. The study design was pre-post intervention conducted online using WhatsApp for 21 days. The intervention included videos/ picture posts and online discussion through WhatsApp. Wilcoxon and McNemmar tests were used to examine the differences in subjects' KAP before and after the intervention.*

Results: *Most subjects were women (96.3%) aged 25-40 years (78.8%) and housewives (67.5%). The knowledge score increased by about 17.5% ($p<0.05$). More than 10% of subjects increased their knowledge of CVD risk. Almost all subjects already had a positive attitude at baseline (94%) and was slightly increased to 97.0% ($p<0.05$). After the intervention, positive health practices such as exercise, consuming vegetables, relaxation, and sleep were increased. In contrast, harmful practices such as smoking, stress symptoms, and consuming high-cholesterol food were decreased.*

Conclusions: *The present study showed that an online program effectively increases the KAP of subjects, although this can be maximized by having more interaction with subjects.*

KEYWORD*:* *coronary vascular disease; drinking tea; healthy lifestyle; WhatsApp-based education*

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INTRODUCTION

The prevalence of Non-Communicable Diseases (NCDs), particularly Cardiovascular-Diseases (CVDs), increases yearly in the world, including Indonesia. Worldwide, CVD prevalence has increased from 271 million in 1990 to 523 million in 2019 (1). In Indonesia, the prevalence is also increasing. In the past 15 years, stroke prevalence has increased from 7.0‰ in 2013 to 10.9‰ in 2018. Likewise, the prevalence of hypertension increased from 25.8% in 2013 to 34.1% in 2018 (2). The diseases are closely associated with unhealthy lifestyles; hence, dietary modification has been proposed as one of the strategies to reduce the prevalence.

A previous study has shown that consuming foods rich in antioxidants protects blood vessels and prevents CVD (3). Flavonoid is a subclass of phytonutrients that humans widely consume, and its function as an antioxidant is correlated with free radical-fighting properties, which has been shown to reduce the risk of NCDs. A study conducted among subjects aged 19 years showed that flavonoid intake was able to reduce the risk of cancer by 41%, Coronary Heart Disease (CHD) by 18%, hypertension by 9%, Diabetes Mellitus by 8%, heart failure by 19%, and stroke by 10% (4–8). Research in the United States showed that intake of flavonoids of more than 359.7 mg/day reduced the risk of cardiovascular disease by 38% (9). The estimation of the flavonoid intake of Indonesians was predicted to be only 25.02 mg/day (10). Recent studies have also shown that the intake of flavonoids in Kendari and Karawang Regency is 142.26 mg/day and 171.9 mg/day, respectively (11,12). These results indicate that the amount of flavonoid intake is lower than the

suggested amount needed to prevent and reduce the risk of CVD.

The alternative to increasing flavonoid intake is increasing the beverage consumption of flavonoid sources such as tea. Tea is a source of flavonoids containing 118.35 mg/100 g (11). Tea can improve nitric oxide status and endothelial function, significantly mediating blood vessel dilatation (13). The habit of drinking tea has a lower risk of CHD, which is proven by a study in China that showed that people who consume tea at least 236.6 mL/day had a 4% lower risk of CVD mortality and a 2% lower risk of CVD (14). Recent studies depict that people consume tea for various reasons, including as a thirst quencher, to socialize with close people or colleagues, to fill their spare time, as a work partner, or because of its benefits related to health (15–18).

Although tea is the most consumed beverage in Indonesia, only about 30% of Indonesians consume tea, with an average consumption per person of 1.6 g/day (19). Leonardo et al. (2017) revealed that tea consumption per capita in Indonesia has decreased significantly compared to 2002, which reached 0.77 kg/cap/year to 0.18 kg/cap/year (20). This low tea consumption is affected by inadequate knowledge about tea (21,22). Proper knowledge and attitude toward nutrition are essential factors in implementing dietary habits (23). Knowledge improvement needs comprehensive steps. For instance, promoting systematic intervention using the findings and other evidence-based practice into routine practice will increase the quality and effectiveness of health services (24). In the implementation process, knowledge develops a positive attitude toward health behavior. Thus, this positive attitude can maintain and increase healthy dietary habits (23).

Recently, after the covid-19 pandemic, most people could use social media more quickly, including WhatsApp (25,26). By July 2022, WhatsApp will be the third most-used social media in the world. Nowadays, most people look for the information they need through the internet. In a study by Kranthi (2021), most subjects used WhatsApp to access their health information (27).

These facts established the impact of WhatsApp on the communities' daily lives. Related to this advantage, nutrition education using WhatsApp has enormous opportunities to empower the community. The digitalization of nutrition education has been widely used worldwide (25). Unfortunately, the studies that discussed education intervention to knowledge, attitude, and practice correlated to the antioxidant intake, particularly tea consumption, was still limited. Therefore, it is necessary to implement a nutrition education program to improve behavior (knowledge, attitudes, and practices) about the benefits and consumption of tea in the prevention of CVD. PT initiated the "Heart at Home" (HaH) program. Unilever Indonesia participated in reducing the incidence of CHD in Indonesia through a family approach. This study aimed to identify the effectiveness of nutrition education to improve knowledge, attitude, and practice through the HaH program.

MATERIALS AND METHODS

Design

To investigate the effect of the HaH program, a pre-post intervention study involving one group was conducted. Data were collected through a self-reported questionnaire using the online questionnaire Google Forms. This study was conducted from August to September 2022.

Subjects

The subjects of the study were a couple who were members of the Indonesian Heart Foundation (Yayasan Jantung Indonesia). The subjects in this study were chosen using accidental sampling. Based on the formula of Lemeshow for experimental study, a minimum of 114 people as the subjects were needed. All subjects were assessed prior to the start of the program and a day after completing the HaH Program. The complete steps of subject recruitment were performed in Figure 1. The assessment before the intervention was divided into two steps. First of all, the subjects' data are collected, including their socio-demographic background and their willingness to join the program, using an online questionnaire (Google Form) and informed consent. This step was performed to filter the subjects who were eligible for the study based on the following inclusion criteria: (1) Member of the Indonesian Heart Foundation; (2) aged 25-50 years; (3) already married. Secondly, the pre-test

questionnaire was used to assess the baseline knowledge, attitude, and behavior of healthy lifestyles and tea consumption of the subjects. The total of people who filled out this questionnaire was 259, and we excluded 106 ineligible people based on the screening test at first. Hence, the total of 153 subjects were participated in the baseline. The number of these subjects at baseline was more than the minimum sample. During the intervention, 73 subjects were excluded by the reason of their absence (**Figure 1**).

Intervention

The intervention given in the HaH program was nutrition education with three indicators to be identified they were Knowledge, Attitudes, and Practices (KAP). The program provided information related to a healthy lifestyle, mainly to prevent CHD. All of the materials were provided with infographics and a comprehensive explanation through the WhatsApp Group. Its material was delivered through WhatsApp Group for 21 days with seven topics:

1. The role of the partner in the health of the family
2. The most dangerous disease in Indonesia
3. The factors that correlated with cholesterol and heart disorders
4. Heart at Home Program
5. Healthy lifestyle
6. The myths and facts about tea
7. Daily healthy beverages menu

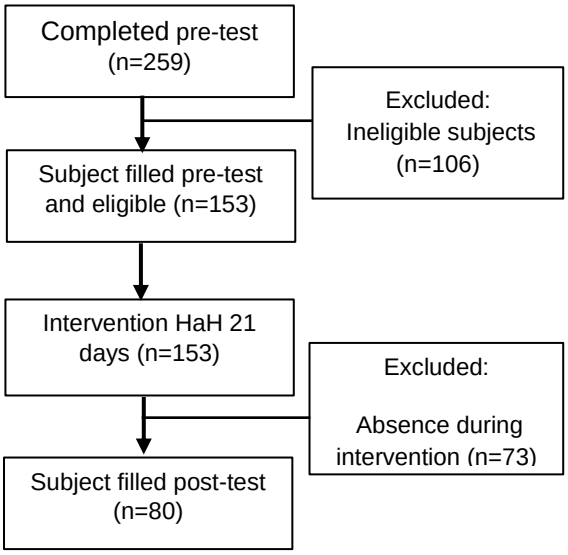

Figure 1. Flowchart of the subjects' recruitment

In this study, all of the subjects were divided into 10 WhatsApp Groups. Each groups contain 15-16 subjects. The subjects for each group were selected randomly. One field coordinator handled each group. While nutrition education was carried out, the field coordinator checked the presence of subjects by viewing uploaded photos in a small group of WhatsApp every day, then administrated them on Google Sheets for subjects who attended and uploaded photos every day. The photos shared in the Whatsapp group vary per day, depending on the educational material provided.

In addition, to providing the educational materials, during the intervention period, subjects were also given the challenge to serve and drink tea for themselves and their families according to the educational materials provided, which were uploaded via Instagram. Uploading photos on Instagram must also add a caption and Hashtag #HeartAtHomeSariwangiYJI, which was uploaded on Saturday for each week. A method to maintain the compliance of the subjects was determined by how often they opened WhatsApp Groups for "Heart at Home" activities. In the WhatsApp Group, subjects received educational materials and interacted with the facilitator. As many as 85% of subjects stated that they had never failed to open the WhatsApp Group, and only 11.3% had failed to open it twice (days) during the 21 days of the program. During the program, 13 educational material infographics were delivered by the administrator of the WhatsApp Group. The average number of infographics that subjects had never read was 3.6 ± 3.8 materials. Regarding the use of this media, 20% of subjects had never read 7-13 infographics.

Questionnaire Development.

The structured questionnaire was applied to collect data. The socioeconomic and demographic characteristics were collected only at baseline. Knowledge, attitude, and practices regarding healthy lifestyle were collected at both baseline and end line by using 15, 15, and 10 questions, respectively. A questionnaire to measure nutritional knowledge, attitude, and practice was tested for validity and reliability before being used. The test was conducted online on 41 people with similar characteristics to the subjects. In this study, Cronbach's alpha test was performed at 0.586, and the Pearson correlation was 0.510; thus, the

questionnaire that was used was valid and reliable.

Nutritional knowledge was assessed with 15 close-end questions with four multiple-choice answers. For all questions, the correct answer is given 1 point, and the others get 0 points. The total score ranged from 0 to 15 points, with higher scores meant higher nutritional knowledge. The questions of the questionnaire were based on the topic that was explained during the intervention. The categorization of knowledge was divided into three levels according to the percentage of correct answers: "low" (<60%), "moderate" (60-80%), and "high" (>80%) (28). The attitude assessment contained 13 positive statements and two opposing statements. The answers for each clause were provided as "disagree," "neutral," and "agree ."The scores were given based on their type (positive or negative). In a positive statement, each item is composed of 3 levels' answers ("agree," "neutral," and "disagree") corresponding to 1, 2, and 3 scores, respectively. In contrast, negative statements were given the opposite scores with positive statements. The total score was ranging from 15 to 45. The attitude of the subjects was categorized based on total score as "positive" (>80%), "neutral" (60-80%), and "negative" (<60%) (29). In the practice dimension, the questions on the questionnaire had multiple-choice answers according to specific purposes and references.

Data Analysis

The statistical analysis was performed to evaluate the KAP baseline (before intervention) and end line (after intervention). All of the data were analyzed by the statistical software SPSS (version 20.0). The numeric data of this study were not normally distributed; thus, the non-parametric tests were chosen. A Wilcoxon test was used to compare the KAP baseline and end line with a numeric scale. The Mc-Nemmar test was used for the variable with the categorical scale. The test level was as follows: α =0.05, with a 95% Confidence Interval.

RESULTS AND DISCUSSIONS

The primary purpose of this program was to educate subjects about the prevention of Coronary Heart Disease (CHD) through WhatsApp. In addition, we also collected data about the subjects' medical history. However, all subjects in this program stated that they did not have parents at risk for heart disease and had never been diagnosed with CHD (Table 1). Subjects in the "Heart at Home" program who filled out both baseline and end-line questionnaires were 80 subjects. Almost half of the subjects were excluded because of their absence during the 21-day intervention. It showed low motivation among the subjects. Nutrition education is a step of the learning process, which is affected by intrinsic motivation and extrinsic motivation. Both of these motivations were positively related to subjects' engagement level in learning (30). Motivation is the process by which goal-directed behaviors are started and maintained. According to the expectancy-value theory, motivation is a function of perceived value and success expectations. The focus of attribution theory is on the causal explanations that students construct to explain the outcomes of activity, and it categorizes these explanations according to their locus, stability, and controllability (31). The average age of the subjects was 31 years, with an age range of 25-50 years. Most of the subjects (78.8%) were in the age group of 25-40 years. The mean oldest member of the family was 48 years old, with the maximum age in the family being 77 years old. The low participation of the elderly was correlated with demographic factors, internal factors, environmental or infrastructure, and the social network they had; hence, the participation of the elderly in this study is less than that of adults (32,33). Previous studies showed that social participation in the elderly is beneficial to improving their cognitive function and well-being and also serves as a mediator for better quality of life (34,35).

However, most of the subjects (58.9%) came from West Java and DKI Jakarta. The other subjects (less than 10%) came from Sumatra, Central Java, East Java, Bali, and Nusa Tenggara Barat (NTB). This result showed that the motivation to participate in educational activities still tends to be more in urban communities than in rural communities. A systematic review study revealed that urban inhabitants have more health literacy than rural ones (36). Chen et al. (2018) stated that the barriers in rural areas to getting healthy information are structural barriers and

Characteristics	n	%
Age		
Adults (25-40 years old)	63	78.8
Pre-elderly (41-50 years old)	17	21.3
Gender		
Female	77	96.3
Male	3	3.8
Districts		
Sumatera	8	10.0
West Java and Jakarta	47	58.8
Central Java and Yogyakarta	9	11.3
East Java, Bali, and Nusa Tenggara Barat	16	20.0
Occupation		
Housewife	54	67.5
Entrepreneur	17	21.3
Private employee	9	11.3
Educational background		
Elementary school	1	1.3
Junior high school	5	6.3
High school	41	51.3
College	33	41.3
Monthly expenses (Rupiah)		
< 1 million	13	16.3
1-2 million	30	37.5
2-3 million	19	23.8
3-4 million	12	15.0
>4 million	6	7.5
Number of family members		
<3	15	15.0
4-5	50	50.0
>5	15	15.0
Total	**80**	**100.0**

limited mass media (37). According to that study, rural residents prefer to access healthy information from search engines and family, unlike urban residents who can gain the information through the communities or corporations (37). As we know, health literacy is a step toward empowering individuals and communities to have more advantages over a variety of social and environmental factors that affect their health (38). Low health literacy can be an obstruction to accessing and accepting appropriate and safe health care (39). Furthermore, the present study used digital technology to deliver the information, so there might be barriers to technology, like mobile phone or internet services were not available or reliable in some rural areas. The socio-economic and demographic characteristic profiles of subjects are presented in Table 1. Almost all subjects (96.3%) were female. The gender distribution of the present study was similar to a previous study, which was 72.2% female and 27.8% male subjects (40). The average amount of participating family members is 4 people, with a fairly wide age range between 2-9 family members. For the occupation, most of the subjects were housewives (67.5%), this might be because the majority of subjects were women. The rest of the subjects' jobs were entrepreneurs (21.3%) and private employees (11.3%). Half of the subjects graduated from high school (51.3%) and 41.3% of subjects graduated from college. The subjects who graduated from elementary school and junior high school were fewer than those from high school and college. According to previous studies, the dissemination of health information was associated with education level, this was related to their motivation and their capability to accept and implement the knowledge from the nutrition education process (41,42). The range of spending money for monthly expenses in

the program was quite wide, the majority (61.3%) were between 1-3 million rupiah per month, 16.3% of subjects had monthly spending of less than 1 million, and 7.5% spent more than 4 million (equivalent to the minimum wage in urban cities). This result is similar to the average expenditure per capita of Indonesia's population, which was for about 1.3 million rupiah, based on the Consumption Expenditure of Population of Indonesia (2022). Table 2 revealed that the knowledge of the subjects in the end line, both based on categorization and average, was more significant than the baseline (p-value <0.05). Based on the knowledge category, there was a significant decrease in the number of subjects who were "low" from 50% to 29%. On the other hand, there was an increase in the number of subjects whose knowledge was "good" from 6% to 24% and those with "moderate" knowledge from 44% to 47%. Based on the results of the Mc-Nemmar Test, the change in the proportion of changes in the number of subjects whose knowledge improved was statistically very significant (p<0.05). In addition, the significant increase in knowledge (p <0.05) was due to the intervention based on the mean ± SD value, which was initially 56±17 to 68±17. The median value of the knowledge score of subjects before the program was 57 (min-max: 20-90). Meanwhile, the end-line knowledge score was 67 (min-max: 20-100). That result is quite different from the attitude since, at the baseline, most of the subjects had a positive attitude. Even so, there are significant differences in the attitudes of the subjects based on the average value and standard deviation (p-value <0.001).

Table 2. The Differences of Knowledge and Attitude Before and After the Program

Variable	Baseline		End line		*p*-value
	n	%	n	%	
Knowledge					
Low	40	50	23	29	<0.001[a]
Moderate	35	44	38	47	
High	5	6	19	24	
Mean±SD	56 ±17		68 ± 17		<0.001[b]
Median (Minimum-Maximum)	57 (20-93)		67 (20-100)		
Attitude					
Negative	0	0	0	0	0.250
Neutral	5	6	2	3	
Positive	75	94	78	97	
Mean±SD	90±7		93±6		<0.001[b]
Median (Minimum-Maximum)	91 (66-100)		94 (71-100)		

[a] Significance at *p*-value < 0.05 based on Mc-Nemmar Test
[b] Significance at *p*-value < 0.05 based on Wilcoxon Test

The results of this study were in accordance with the research of Wardhani et al. (2021), which showed that providing nutrition education interventions through the WhatsApp Group was able to increase subjects' nutritional knowledge (43). Knowledge is the result of humans sensing an object through the senses, especially the senses of sight and hearing. Knowledge is also an important domain in the formation of open behavior (44). Its mechanism is affected by the role of knowledge in self-awareness empowerment so that someone would behave according to the knowledge they have. Behavior changes related to knowledge improvement, awareness, and positive attitudes were more lasting because they were based on their awareness and not coercion (45).

Tabel 3.The Difference of Practices Before and After the Program

	Questions	Baseline [n(%)]	Endline [n(%)]	*p*-value
1	How many times did you exercise for 30 minutes during the past week?			
	Never	1 (1.2)	0	0.004*
	1-2 times/week	30 (37.5)	18 (22.5)	
	3-5 times/ week	41 (51.2)	49 (61.2)	
	>5 times/ week	8 (10.0)	13 (16.2)	
2	How many times have you smoked in the past week?			
	Never	73(91.2)	77 (96.2)	0.096
	Once time/week	4 (5.0)	1 (1.2)	
	2-4 times/week	3 (3.8)	2 (2.5)	
3	How many times have you eaten vegetables in the past week?			
	Never	1 (1.2)	0	0.004*
	1-3 times/week	15 (18.8)	5 (6.2)	
	4-6 times/ week	22 (27.5)	29 (36.2)	
	1-3 times/ day	42 (52.5)	46 (57.5)	
4	How many times have you eaten fruits in the past week?			
	Never	1 (1.2)	0	0.006*
	1-3 times/week	20 (25.0)	12 (15.0)	
	4-6 times/ week	28 (35.0)	30 (37.5)	
	1-3 times/ day	31 (38.8)	38 (47.5)	
5	How have you experienced stress symptoms (sleep difficulties, gastric disorders, anxiety, sadness, etc) during the last month?			
	Never	11 (13.8)	19 (23.8)	0.001*
	1-3 times/ month	40 (50.0)	51 (63.8)	
	≥4 times/month	29 (36.2)	10 (12.5)	
6	How many times have you done relaxation to reduce/remove stress during the past month?			
	Never	2 (2.5)	6 (7.5)	0.870
	1-3 times/ month	36 (45.0)	29 (36.2)	
	≥4 times/month	42 (52.5)	45 (56.3)	
7	How many times did you get enough sleep (7-9 hours/day) during the past week?			
	Never	1 (1.2)	1 (1.2)	0.117
	1-3 times /week	59 (73.8)	51 (63.8)	
	Everyday	20 (25.0)	28 (35.0)	
8	How many times have you eaten sources of cholesterol (fried, meat, coconut milk foods/drinks) during the past week?			
	Never	0	2 (2.5)	0.073
	1-6 times /week	72 (90.0)	74 (92.5)	
	Once /day	6 (7.5)	4 (5.0)	
	≥2 times /day	2 (2.5)	0	
9	How many times did you drink tea in the past week?			
	Never	2 (2.5)	0	0.010*
	1-6 times /week	46 (57.5)	34 (42.5)	
	Once /day	25 (31.2)	37 (46.2)	
	≥2 times /day	7 (8.8)	9 (11.2)	
10	How much money did you spend on tea in the past week?			
	0-9.000 rupiah	21 (26.2)	50 (62.5)	0.000*
	9.001-14.500 rupiah	19 (23.8)	12 (15.0)	
	14.501-23.750 rupiah	20 (25.0)	11 (13.8)	
	>23.750 rupiah	20 (25.0)	7 (8.8)	

*Significance at *p*-value < 0.05 based on Mc-Nemmar Test

*paired t-test results significantly different between measurements;[1]*independent test*;[2]*paired t-test*

Table 3 revealed the comparison of practice before and after intervention. The practice of exercising 30 minutes with a frequency of 3-5 times/week in the end line increased by 10%, and exercise frequency > 5 times/week was increased by 6.2%. Vegetable consumption practices increased by 5% at a frequency of consumption of 1-3 times/day and 8.7% at a frequency of consumption of 4-6 times/week. Fruit consumption practices increased by 8.7% at a frequency of consumption of 1-3 times/day and 2.5% at a frequency of consumption of 4-6 times/week. Although there was no significant difference in the practice of relaxing the subjects, there was a tendency to increase the frequency of relaxation by around 3-8% and the increase in the frequency of sufficient sleep (7-9 hours) by subjects by around 10%. Likewise, there was an increase in the average frequency of drinking tea from 5.1 times/week to 7.1 times/week. Hence, there are six categories of practices with significant changes.

Furthermore, during the program, the subjects were also asked to take photos of the activity of a healthy lifestyle and serve tea at home. The average frequencies of subjects

share photos to the WhatsApp Group 1.3 times with a range of 0-21 times. It means that there was indeed very diverse participation between the subjects. In this case, some subjects never sent any photos of their activities. Uploading these photos to Instagram apparently could not be used as an indicator of participation because not all subjects have Instagram accounts; 53.8% of subjects never uploaded photos to Instagram. Hence, many subjects only uploaded them to WhatsApp Groups.

In this study, there were several components used in the assessment of nutritional knowledge. These components consisted of exercise, smoking, stress, vegetable consumption, fruit consumption, consumption of food sources of fat, sleep, and relaxation. Changes in subjects' knowledge that were quite significant, the awareness improvement after the program including the risk of CHD due to smoking and lack of exercise, as well as the CHD protective effect by consuming vegetables/fruits and reducing oil. These results indicate that the research subjects were able to receive, understand, and recognize the information provided.

The educational process provides an opportunity for a person or community to learn and try to understand or deepen knowledge (46). In this study, information related to nutrition was presented in the infographics. The frequency of giving messages was carried out every day for 21 days; the concept of this activity was able to increase exposure and understanding of the information provided so that there was a significant increase in the knowledge value of the subjects. Attitude is a psychological construction, a mental and emotional entity that is attached to or characterizes a person, which shows a personal view of something. Attitude involves a person's mindset, views, and feelings obtained from experience (47,48). In the present study (Table 2), most of the subjects (94%) already had a positive attitude toward the risk factors for CHD and their preventive behavior before the program started. After giving the program, there was only a slight increase (p-value >0.05) of subjects with a positive attitude (from 94% to 97%). However, based on the median attitude score, there was a significant change after the program started, from a score of 91 to 94 (p-value <0.05). Based on the assessment of the answers, quite a lot of positive attitude changes were found in the statements about drinking tea for family time, acceptance of packaged tea, approval of tea as CHD prevention, and feeling relaxed effects after drinking tea. This result was in line with previous research, which showed that giving booklets was able to improve the attitudes of the subjects significantly (49).

In this study, there was an increase in CHD prevention practices after the program. It was indicated by a significant increase in sports activity, vegetable consumption, fruit consumption, relaxation, enough sleep, and drinking tea (p-value <0.05). Furthermore, practices that significantly decreased (p-value<0.05) were the frequency of stress symptoms and money to buy tea. The decrease in money spent on tea might be influenced by the provision of kits in the form of tea as one of the facilities during the intervention. In addition, there was a reduction in smoking rates, stress symptoms, and consumption of foods high in cholesterol. The frequency of smoking decreased by about 1-5% in the post-test compared to the pre-test.

In general, the results of this study indicate that the Heart at Home program is capable of facilitating behavior change in program subjects. A person's behavior is influenced by predisposing factors such as knowledge, attitudes, beliefs, values, and perceptions (48). Previous research has shown that knowledge and attitudes can increase motivation for behavior change. An approach based on principles involving subjects' participation can help them to identify individual barriers, motivate subjects, and improve their ability to act (50).

Nutrition education is an alternative to increase health literacy in the community. This activity provides subjects with cognitive and social skills. These skills support the improvement of individual motivation and abilities in increasing access so that subjects can understand and use information with the aim of improving health (51). Health literacy can increase awareness about health and can facilitate individuals to modify health determinants.

The limitation of this study was the low subject compliance. However, when the intervention was implemented, subject absences were greater than expected. Although methods to maintain subject compliance have been implemented, many subjects do not actively participate daily. The lack of face-to-face meetings during the intervention period may have had an impact on this, therefore it can be challenging to establish effective communication. However, because the findings of the statistical analysis provide a clearer picture of the phenomena that occurred during the intervention, we think it is important to describe these phenomena. As a final point, we emphasize that although interventions can result in changes in knowledge, attitudes, and practices, much research remains to be done regarding the multifactorial elements of these measures.

CONCLUSIONS AND RECOMMENDATIONS

The subjects' knowledge of the prevention of CVD improved significantly after the HaH program. Meanwhile, attitudes towards an effort to prevent CVD had a slight increase. There were 20-25% of the subjects agreed that consuming tea would make them feel more relaxed. Inclining practice scores were shown by additional time spent exercising, consuming more vegetables, relaxing, and having enough sleep. There was a declining score for smoking, having stress symptoms, and consuming high-cholesterol food. The frequency of tea consumption also rose from 5.1 times/week to 7.1 times/week. There is a need to increase knowledge by educating the community, which can be done online or offline to increase awareness of CVD risk factors.

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Effect of GANIME form and it's efficacy on Lee index and albumin levels in rats with energy-protein deficiency (PED)

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ABSTRAK

Latar Belakang: *Prevalensi Kekurangan Energi Protein (KEP) meningkat selama dekade terakhir. Penyebab utama KEP yaitu asupan makanan tidak adekuat dan penyakit infeksi. Pengaturan klinis balita KEP menggunakan makanan komersil yang harganya mahal. Ganyong, ikan patin, dan kacang merah sebagai bahan pangan lokal dengan kandungan gizi tinggi berpotensi menjadi makanan tambahan bagi anak KEP.*
Tujuan: *Penelitian ini bertujuan untuk menguji pengaruh bentuk formula GANIME dan efikasinya terhadap indeks massa tubuh (BMI) dan kadar albumin pada tikus model dengan PED.*
Metode: *Penelitian terdiri dari dua tahap yaitu menganalisis kandungan proksimat GANIME dan melakukan penelitian in vivo pada sepuluh ekor tikus Wistar jantan berumur 3 minggu (50-100 gram). Tikus dibagi secara acak menjadi dua kelompok yaitu G1 (pelet GANIME) dan G2 (bubur GANIME) dan diamati selama 14 hari. Berat badan (BB), BMI, dan albumin diukur sebelum dan sesudah perlakuan. Uji t-berpasangan dilakukan untuk membandingkan hasil sebelum dan sesudah pengobatan, sedangkan perbedaan antar kelompok dinilai menggunakan uji One-way Analysis of Variance (ANOVA).*
Hasil: *Formula GANIME yang optimal diidentifikasi pada P3, dengan kandungan protein tertinggi (24,55%). Tikus G1 menunjukkan berat rata-rata 78,00 ± 15,52 g, tidak berbeda nyata dengan G2 (70,50 ± 2,12 g) (p = 0,565). Peningkatan bobot badan lebih besar pada tikus G1 dibandingkan G2 (12,67 g). Rata-rata BMI tikus G1 adalah 256,16 ± 25,57, tidak berbeda nyata dengan G2 (258,18 ± 2,59) (p = 0,923). Tikus G1 juga menunjukkan peningkatan BMI yang lebih besar dibandingkan dengan P2 (14,28). Rerata kadar albumin pada tikus G1 adalah 3,15 ± 0,56 g/dL, serupa dengan G2 (2,95 ± 0,36 g/dL) (p = 0,683). Tikus G1 mengalami penurunan albumin lebih kecil dibandingkan tikus G2, dengan selisih 0,08 g/dL.*
Kesimpulan: *Pemberian pelet formula GANIME lebih efektif meningkatkan berat badan dan IMT serta penurunan albumin yang lebih kecil pada tikus model KEP.*

KATA KUNCI*: kekurangan energi protein (KEP); albumin; indeks massa tubuh (IMT),; makanan local; GANIME*

ABSTRACT

Background: *The prevalence of Protein Energy Deficiency (PED) has increased over the past decade. Inadequate food intake and infectious diseases are the primary causes of PED. Clinical management of toddlers with PED often involves costly commercial foods. Ganyong, catfish, and red beans as local food ingredients with high nutritional content have the potential to be additional food for children with PED.*

Objectives: *This study aims to examine the effect of GANIME formula form and it's efficacy on body mass index (BMI) and albumin levels in the rats model with PED.*

Methods: *The study consisted of two phases: analyzing the proximate content of GANIME and conducting in vivo research using ten male Wistar rats aged 3 weeks (50-100 grams). The rats were randomly divided into two groups, G1 (GANIME pellets) and G2 (GANIME porridge), and were observed for 14 days. Body weight (BW), BMI, and albumin were measured before and after treatment. Paired t-tests were conducted to compare pre-and post-treatment results, while inter-group differences were assessed using One-Way Analysis of Variance (ANOVA) tests.*

Results: *The results showed that the optimal GANIME formula was identified at P3, with the highest protein and energy content. The G1 group of rats experienced a greater increase in body weight and BMI than the G2 group of rats but the increase was not significant ($p > 0.05$). Each group did not differ statistically significantly (0.644). Albumin in each group experienced a non-significant decrease ($p > 0.05$) and the two were not statistically different (0.690).*

Conclusions: *Administering the GANIME formula in pellet form exhibited superior efficacy because it's consumed more so it can increase body weight and BMI, and produce a lower decrease in albumin levels in rats model with PED.*

KEYWORD*:* *protein-energy deficiency (PED), albumin, body mass index (BMI), local food, GANIME formula*

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INTRODUCTION

In the past decade, the number of cases involving toddlers with Protein-Energy Deficiency (PED) has surged by 59 million cases (1). PED, characterized by unintentional weight (BW) loss and muscle mass reduction due to inadequate food intake, is responsible for a staggering 45% of under-five mortality worldwide (2). In Indonesia, the prevalence of undernourished children under five stands at 13.8%, with 3.9% of them experiencing malnutrition (3). PED during toddlerhood can significantly impede future growth and development, with malnutrition leading to diminished physical and cognitive functions (4).

Physical manifestations of PED in toddlers encompass parched and wrinkled skin, fragile hair and nails, an appearance of weakness and lethargy, and a gaunt physique (5). Children with PED also experience a decline in serum proteins like albumin and prealbumin (6). Albumin, the principal constituent (60%) of total plasma protein, is produced by the liver and normally ranges from 3.8 to 4.8 g/dL (7). Over decades, albumin has been utilized as a key biomarker for PED. A decrease in albumin levels can be attributed to inflammation (8). Elevated pro-inflammatory mediators like tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) lead to reduced m-RNA albumin levels (9). The repercussions of PED on albumin intake are twofold, impacting both weight and muscle mass (10). Decreased muscle mass accompanies reduced nutrient absorption (11). The criteria for malnutrition, as established by ASPEN, encompass insufficient energy intake, reduced body weight and muscle mass, loss of subcutaneous fat, reduced fluid retention, and weakened grip strength. The diagnosis of PED is

confirmed when two of these six conditions are met (12).

The ongoing government program aimed at addressing PED in toddlers involves providing supplementary food (PMT) in the form of biscuits (13). This program constitutes a targeted nutritional intervention directly delivered to toddlers (14). However, the PMT provision has yet to effectively combat this issue. New cases of PED are emerging at an alarming rate, indicating that the response's effectiveness is limited. Consequently, the prevalence of PED among children under five remains relatively unchanged (7). Alternative interventions are imperative to supplement this initiative. Modifying the PMT approach has proven effective in ameliorating the nutritional status of toddlers afflicted by PED (15). Indonesia, an agricultural nation, boasts abundant natural resources, including ganyong. Ganyong (Canna edulis Ker.), a tropical plant with high carbohydrate content (18.4%), holds potential as an alternative food source to replace rice (16). Carbohydrates serve as the primar energy source for metabolic systems. The country's fishing potential is substantial, reaching 12.54 million tons annually, with catfish (Pangasius sp.) being one of the notable varieties (17). Indonesia's waters teem with catfish, which are rich in protein (17%). This protein content is comparable to catfish (17.7%) and surpasses that of carp (16%) (16). Proteins function as energy sources, supplying amino acids essential for synthesizing cell proteins, hormones, and metabolic enzymes (18). Amino acids also contribute to the repair of damaged tissues in children with PED. The nation's legume potential is vast, with legumes constituting a prominent agricultural output (19). Despite the copious red bean (Phaseolus vulgaris) production, utilization remains suboptimal, necessitating optimization efforts. Red beans, boasting high protein content (22.1%), are rich in arginine, an activator of the growth hormone (Human Growth Hormone) and a guardian of immunity (16).

The direct administration of the GANIME formula to toddlers with PED is unfeasible due to its novelty and lack of prior utilization. Establishing rats as a toddler model for PED serves to offer a comprehensive portrayal of the interventions' impact during the clinical research phase (20). With this background in mind, the primary objective of this study is twofold: to assess the nutritional composition of the GANIME formula and to evaluate its efficacy when presented as pellets and porridge on various parameters, including body weight, Body Mass Index (BMI), albumin levels, physical-clinical attributes, and feed intake in the rats model with PED.

MATERIALS AND METHODS

Design, location, and time

The GANIME formulation consists of three distinct formulas, each containing a specific ratio of canna flour, catfish flour, and red bean flour—namely, P1 (40, 20, and 40)%, P2 (45, 25, and 30)%, and P3 (50, 30, and 20)% respectively. This formulation is developed considering the nutritional content of each ingredient, referencing the 2018 Indonesian Food Composition Table. The estimated nutritional content calculations for the GANIME formula are tailored to rat requirements. Nutritional content analysis for the GANIME formula was conducted in February 2023, under test number 02/LHA/LA/02/2023, at the Food Chemistry and Biochemistry Laboratory, Food Technology Study Program, Faculty of Agriculture, Universitas Sebelas Maret.

This study serves as a preliminary exploration into the effects of GANIME porridge consumption on amylase activity, albumin levels, and body weight in a rats model with PED. The care and treatment of experimental animals occurred at the Unit Pelayanan Teknis Laboratorium Terpadu Hewan Coba, Universitas Sebelas Maret, from February to April 2023. This research adopts an experimental laboratory approach, aiming to assess the efficacy of both GANIME pellets and porridge. The sample size was determined using the Festing formula, resulting in 5 rats for each treatment group (21). The entire research process obtained ethical approval from the Komisi Etik Penelitian, Faculty of Medicine, Universitas Sebelas Maret, under the designation 33/UN27.06.11/KEP/EC/2023.

Materials and tools

The core constituents of the GANIME formula encompass canna flour, catfish flour, and red bean flour. Canna flour and red bean flour were procured from online retailers, namely Riveroshop (Surabaya City, East Java) and

Nefababystore (Semarang City). Meanwhile, researchers manually prepared catfish flour using fresh catfish sourced from the Balekambang Fish Market in Surakarta City.

Preparatioan Rats Model with PED

The subjects enlisted for this study were male Wistar strain white rats, approximately three weeks old, and weighing between 50-100 grams. Rats exhibiting symptoms of diarrhea or illness were excluded based on predetermined criteria. The cages used in the experiment were made of plastic measuring 47 cm x 33 cm x 15 cm equipped with a water bottle and a standard feed container. The study commenced with seven days of acclimatization for the rats. The rat model used for PED was adapted from Agustina (2020) research, involving standard feed restrictions and modifications to the duration of modeling to 14 days (22).

Intervention

The allocation of subjects to groups was conducted randomly, forming treatment groups G1 (intervention involving GANIME pellets) and G2 (intervention involving GANIME porridge). The quantity of GANIME formula provided to rats was calculated at 10% of their body weight. Rearing cages were cleansed every three days to maintain a sanitary environment. The initial stage of modeling encompassed feed restrictions of 30% and 40% over four days, followed by 50% and 60% feed restrictions over three days in the subsequent stage.

Procedure

The methodology for fish meal production draws inspiration from Ningrum et al., (2017), with temperature and baking time modifications, specifically setting them at 125°C for approximately 5 hours (23). The determination of water, mineral, carbohydrate, protein, and fat content involves several distinct methods: thermogravimetry, dry method, difference method, kjeldahl method, and soxhletation.

Antropometry Measure

The observational aspect of the study encompasses multiple facets, including anthropometry, biochemistry, physical clinical assessments, and feed intake evaluation. BW and Body Mass Index (BMI), collected twice for each measurement (before treatment and after). Weights are recorded using a digital scale (Joil), while naso-anal length is measured with a measuring tape. BMI calculations are executed using the Lee Index formula (24).

$$\text{Lee Inde} = \left\{ \frac{body\ weight\ (g)^{1/3}}{naso - anal\ length\ (cm)} \right\} x\ 10^3$$

Albumin Levels

Albumin levels was conducted before and post-treatment. Blood samples for albumin testing were collected via the retroorbital plexus, with a volume of two mL per rat. Analysis of albumin levels in the rats model with PED measured by at the Labolatorium Penelitian dan Pengujian Terpadu, Univerisitas Gajah Mada with photometric method using bromocresol blue (25).

The Physical-clinical Attributes

The physical-clinical attributes that were selected as PED biomarkers for this study encompassed skin condition, fur quality, ocular state, and behavioral traits (26). Regular daily observations were made regarding the physical and clinical aspects of the rats (27). An evaluation of feed intake centered on administration, consumption levels, and remaining feed was performed both pre-and post-treatment. Rats experiencing a 10% reduction in body weight along with albumin levels below 3.8 mg/dL and displaying passive movement were included as research subjects (26) (7) (28).

Data analysis

The nutritional content data for the GANIME formula, biomarkers, and physical observations of the rats model with PED are presented as percentages, means and standard deviations, as well as data categories. Data processing was executed using Statistical Program. The assessment of data normality was conducted through the Shapiro-Wilk test ($n \leq 30$). Statistical analysis of the BW, BMI, and albumin levels for the rats model with PED encompassed paired t-tests for pre-post comparisons, and One-Way ANOVA tests were utilized ($p < 0.05$).

RESULTS AND DISCUSSIONS

The GANIME formulation boasts elevated protein levels, positioning it as a viable

supplementary food option for PED sufferers. Nutritional composition of GANIME formula is presented in **Table 1**. There is no significant different on nutritional composition on GANIME formula ($p > 0.05$). The formula 3 GANIME (P3) tend to highest on protein (24.55%) and energy (361.35 kcal) than other formula. The GANIME formula aligns with Indonesian National Standard (SNI) 01-7111.1-2005 for instant baby food, meeting numerous SNI criteria including ash, fat, protein, and carbohydrate content, except moisture. GANIME formula's moisture content stands at 10.70%, exceedingly recommended of SNI threshold of < 4% (29). The protein content surpasses the Ministry of Health's PMT (8-12%) but fat and carbohydrate content falls below, with GANIME formula registering an average protein content of 22.52% (30)

Table 1. GANIME Formula Nutrition Content per 100 gram

Parameters	Formulas			*p-value**
	P1	P2	P3	
Moisture (%)	10.66	10.72	10.71	0.357
Ash (%)	2,45	2.29	2.16	0.102
Fat (%)	2.55	2.35	2.57	0.165
Protein (%)	21.14	21.87	24.55	0.156
Carbohydrate (%)	63.20	62.77	60.01	0.180
Energy (kcal)	360.29	359.78	361.35	0.003

*Data are presented as mean (n=2). Kruskal-Wallis (α=5%)

This phenomenon is likely attributed to amylopectin's water-binding capability when subjected to heat, leading to an increase in moisture content. The primary source of amylopectin in the formula is canna flour, which contains a substantial proportion of amylopectin (76%). Regrettably, the heightened water content introduces an elevated risk of quicker spoilage. Persistent biological activity is fostered by the sustained presence of moisture, enabling the accelerated spoilage of products (31). The GANIME formula's ash content conformed to the normal parameters stipulated by SNI (≤ 3.5%) (29). It is conjectured that a considerable portion of the ash content emanates from red beans. Consequently, the inclusion of red beans in the formula is presumed to influence the ash content. This finding is congruent with the previous research of which elucidated that the introduction of turi bean flour can escalate ash content (32). The ash content is intricately connected to the product's mineral composition. Given that minerals play a pivotal role in averting mineral deficiencies among PED patients, their presence is of paramount importance.

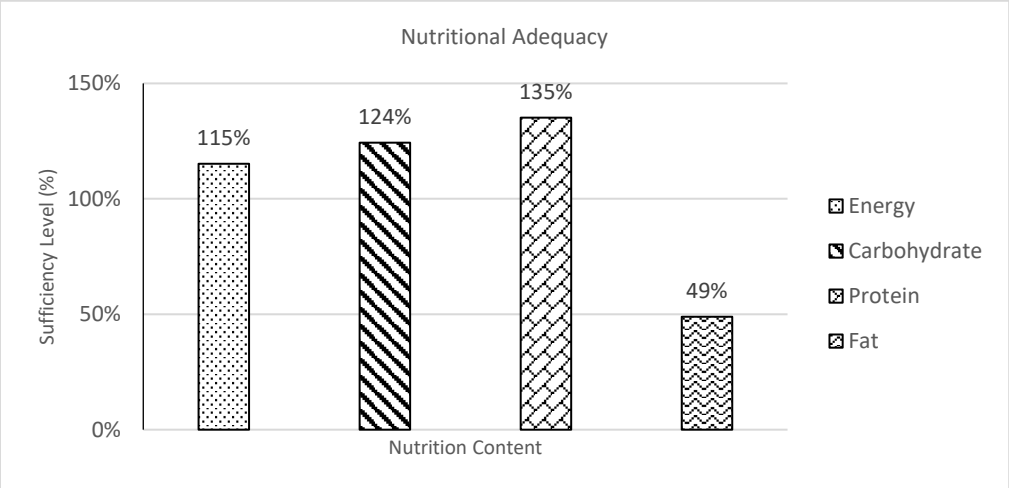

Figure 1. Nutrition Adequacy of Rats Model with PED fed the GANIME Formula. Determination of the amount of feed based on 10% BW of Rats.

Figure 1 demonstrates the extent of nutritional fulfillment within the PED rat model when fed with the GANIME formula at 10% of body weight. The preliminary research focused on the utilization of Formula 1, or P1 GANIME, due to its elevated energy and protein content. Although a majority of the nutritional constituents within GANIME Formula 1 align with the rats' nutritional requirements, the fat content only satisfies 49% of their needs.

The primary contributor to the fat content within the GANIME formula is believed to be catfish meal, given that catfish flour possesses a higher fat content (6.6%) (16). The fat content across all three GANIME formula variations surpasses the parameters stipulated by the Indonesian National Standard (SNI) of 1.5% (29). The high fat content in the ingredients can trigger adverse effects, because its changes during storage can endanger the health and longevity of the product. Protein content of GANIME formula adheres to the requisites outlined by SNI 2005 (minimum 8%) (29). This protein originates predominantly from catfish flour and red beans. Catfish is a source of animal protein (17%), while red beans are a vegetable source, (22.1%) (16). Protein plays an important role in new tissue formation, growth, maintenance, and various physiological functions of the human body. The carbohydrate content within the GANIME formula aligns with SNI standards for instant baby food (minimum 30%) (29). The components responsible for carbohydrate supply within the formula are ganyong and red beans. Ganyong boasts a relatively high carbohydrate content of 18.4%, while red beans offer an even higher carbohydrate content of 56.2% (16). It is noteworthy that the carbohydrate content's increase runs inversely proportional to the inclusion of canna flour but directly proportional to the addition of red beans. A diet enriched with high-carbohydrate foods proves beneficial for individuals grappling with PED as these foods provide essential glucose support for bodily functions and activities. Given that carbohydrates stand as the primary energy source, any curtailment in their intake can potentially impact the growth and development of children (11).

Characteristics of Rats

Indications of PED in rats encompassed a decline in both BW and BMI, sub-optimal of albumin levels, atypical physical-clinical states, and inadequate Intake The outcomes of the analysis of study rats characteristics post-14 days are illustrated in **Table 2.**

Table 2. Characteristics of Rats Model with PED

Biomarkers	(Mean ± SD)		*p-value**
	G1	G2	
Body weight (g)	52.60 ± 2.07	51.40 ± 5.77	0.673
BMI	243.43 ± 6.17	247.59 ± 9.37	0.432
Albumin (g/dL)	3.26 ± 0,18	3.12 ± 0.30	0.419

*Data are presented as mean ± standar deviatin (s.d) (n=10). G1 (fed with GANIME pellets), G2 (fed with GANIME porridge), BMI (Body Mass Index) using the Lee Index. *Paired t-test (α=5%)

Statistically, variables such as BW, BMI, and albumin levels of the research rats exhibited homogeneity ($p > 0.05$). The mean weight and albumin levels within the G1 group surpassed those of the G2 group, yet the G1 group's BMI was tent to inferior to that of G2.

Table 3.Physical Observation of Rats Model with PED

Physical Observation	Observation Treatment	Observation Day-		
		1	2-7	8-14
Hair	G1	N	NN	NN
	G2	N	NN	NN
Skin	G1	N	N	N
	G2	N	N	N
Eye	G1	N	N	N
	G2	N	N	N

Physical Observation	Observation Treatment	Observation Day- 1	2-7	8-14
Behavior	G1	N	N	NN
	G2	N	N	NN

N (Normal), TN (Not Normal).

Table 3 showcases the results of physical observations conducted on the research rats' condition, inclusive of hair, skin, eyes, and behavior, after the 14-day modeling period. Initial physical observations of the study rats exhibited normal conditions across all groups on the first day. However, by the seventh day, physical assessments disclosed aberrant conditions, characterized by disheveled and shedding fur, while the state of skin, eyes, and behavior still appeared normal. The behavioral aspect of the study rats appeared to be passive after the 14-day modeling period, as they exhibited a propensity for tranquility, tending to occupy corners within their cages.

After food restriction treatment, the rats prominently exhibited signs indicative of PED. Several PED criteria were conspicuous, such as, dwindling BW along with BMI, suboptimal albumin levels and manifestly irregular physical conditions. A 7% reduction in rat weight materialized on the 9th day of the modeling phase. As the modeling extended to the 14th day, the rats encountered a pronounced BW reduction, with the maximum decrease reaching 23%. This conspicuous dip in BW serves as a clear indication of PED manifestation in the rodents. Furthermore, the BMI calculation performed on the 14th day of modeling across both groups yielded an average of 248.57, thus establishing a reference for rat models experiencing PED. Biochemical scrutiny unveiled that albumin levels among the groups were as follows: G1 (3.26 ± 0.18 g/dL) and G2 (3.12 ± 0.30 g/dL), both falling beneath the standard threshold (3.8 g/dL). The rats' physical condition presented a visibly emaciated appearance, complemented by subdued movements, signifying a passive demeanor. Given these observations, the researchers confidently concluded that the rats had indeed developed PED following the 14-day modeling period.

Table 4. Changes in albumin, body weight, and BMI of Rats Model with PED Before and After Treatment

Variabel	(Mean ± SD) G1	G2	*p-value**
BW (gram)			
Before	65.33 ± 4.50	63.00 ± 5.65	0.639
After	78.00 ± 15.52	70.50 ± 2.12	0.565
Δ BW	12.67 ± 13.32	7.50 ± 3.54	0.644
*p-value***	(p=0.241)	(p=0.205)	
BMI			
Before	241.88 ± 13.82	248.58 ± 7.45	0.586
After	256.16 ± 25.57	258.18 ± 2.59	0.923
Δ BMI	14.28 ± 15.02	9.60 ± 4.86	0.711
*p-value***	(p=0.241)	(p=0.219)	
Albumin (g/dL)			
Before	3.23 ± 0.21	3.22 ± 0.32	0.963
After	3.15 ± 0.56	2.95 ± 0.36	0.683
Δ Albumin	-0.08 ± 0,34	-0.27 ± 0.67	0.690
*p-value***	(p=0.736)	(p=0.674)	

*: One-way ANOVA test, **: Paired T-Test, Significance ($p < 0.05$).

The average BW and BMI of the rats model with PED Analyzing Table 4, it becomes apparent that there existed an inconsequential increase in BW and BMI ($p > 0.05$) after treatment. The most substantial BW and BMI augmentation was observed within Group G1, each of 12.67 grams and 14.28. The inter group distinctions on all phases, encompassing pre, during and post-

treatment remained statistically insignificant ($p > 0.05$).

Rats consume approximately 15.6 g/day of feed, which equates to roughly 10% of their overall BW. This amount content about of 72 kcal of energy which is able to meet the calorie needs of rats (62.56 kcal/day) (33). The BW of rats experiences an uptick when calorie intake surpasses expenditure. Furthermore, the complete amino acid profile in the GANIME formula significantly contributes to the increase in BW. This synergistic amalgamation of amino acids sourced from catfish and red beans engenders a complementary interplay within the product (34).

Increases in BMI typically correlate with food intake (35). BMI serves as a metric to gauge healthy weight levels. To calculate the rats' BMI, their length and body weight were factored in drawing upon the Lee Index (24). Evidently, the rats' BMI surged, presumably due to their consumption of the GANIME formula, which exceeded their caloric requirements. Various additional factors contribute to fluctuations in BMI, encompassing physical activity, genetic predisposition, medical conditions, and lifestyle habits (36).

Average Albumin of the rats model with PED

Table 4 showcases an insubstantial decline in albumin levels within both groups ($p > 0.05$) during the intervention. Intriguingly, the most minimal albumin reduction surfaced within Group G1, registering at -0.08 g/dL. Across the treatment groups, statistically insignificant disparities persisted ($p > 0.05$) throughout all stages encompassing pre, during and post-treatment.

After treatment, rats model with PED exhibited a discernible decrease in albumin levels. This dip in albumin is not consistent with earlier research that entailed administering mocaf to rats models of PED (37). The suboptimal albumin levels detected in the PED rat models can be attributed to insufficient feed intake and prevailing infectious diseases. PED sufferers often endure concurrent infections due to their association with child malnutrition. The albumin decline post-treatment is conjectured to be a consequence of pathological disturbances within the rats models with PED. The mitigation of low albumin levels cannot solely be achieved by augmenting protein intake; it necessitates a comprehensive approach addressing the underlying pathological condition (38). This albumin decrease is likely attributable to the utilization of protein from the GANIME formula for the repair of muscle tissue damaged by the prevailing PED conditions (39). Figure 2 illustrates the outcomes of assessing GANIME formula consumption in rats modeling PED throughout the treatment period. In the initial week, all groups displayed a 100% consumption rate of the GANIME formula feed, indicating full consumption. As the second week progressed, the G1 group showcased the most substantial feed intake, equivalent to 77.7%. In the first week, no leftover feed remained within any treatment group in the first week, signifying complete consumption. However, in the second week, the G1 group exhibited the lowest remaining feed, tallying at 5.2 grams.

The nutritional composition of the GANIME formula appears to adequately fulfill the nutritional requisites of the rats model with PED. The decline in feed consumption witnessed during the intervention can be attributed to the rats' intrinsic tendency to curtail their food intake upon meeting their energy demands (40). It is postulated that the GANIME formula feed encompasses elevated sugar levels, potentially influencing the satiety center within the hypothalamus. The notable sugar content in the feed might impact the entromedial sensor, consequently inducing a reduction in appetite and subsequently leading to diminished food intake (33).

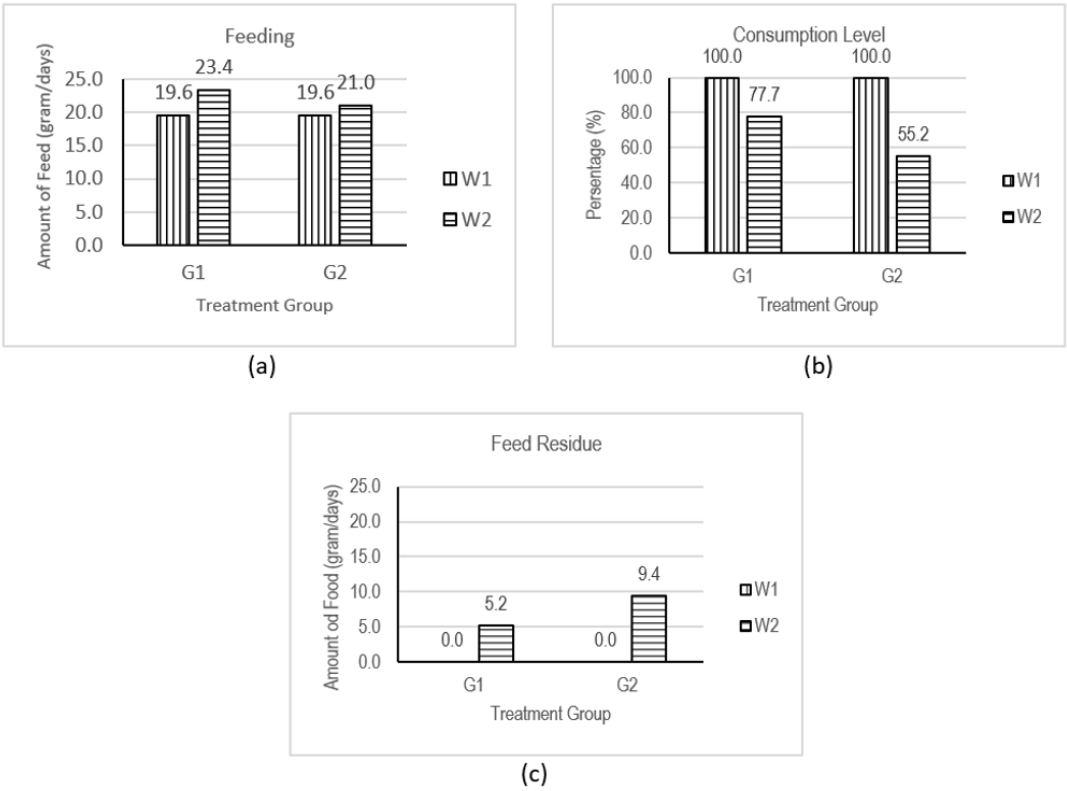

Figure 2. GANIME Intervention Feed Intake. (a) feeding, (b) feed consumed, and (c) remaining food that is not consumed by given to the rats model with PED, M1 (first week), M2 (second week).

CONCLUSIONS AND RECOMMENDATIONS

The GANIME formula, with a composition ratio of 50:30:20, emerges as the optimal formulation due to its high protein (24.55%) and carbohydrate (60.01%) content that fulfills the daily requirements. Administering the GANIME formula in pellet form exhibited superior efficacy because it's consumed more so it can increase body weight and BMI, as well as produce a lower decrease in albumin levels in rats model with PED. Further research on the GANIME formula needs to be carried out to reduce the water content, increase the fat and carbohydrate content.

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Effect of GANIME form and it's efficacy on Lee index and albumin levels in rats with energy-protein deficiency (PED)

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ABSTRAK

Latar Belakang: *Prevalensi Kekurangan Energi Protein (KEP) meningkat selama dekade terakhir. Penyebab utama KEP yaitu asupan makanan tidak adekuat dan penyakit infeksi. Pengaturan klinis balita KEP menggunakan makanan komersil yang harganya mahal. Ganyong, ikan patin, dan kacang merah sebagai bahan pangan lokal dengan kandungan gizi tinggi berpotensi menjadi makanan tambahan bagi anak KEP.*
Tujuan: *Penelitian ini bertujuan untuk menguji pengaruh bentuk formula GANIME dan efikasinya terhadap indeks massa tubuh (BMI) dan kadar albumin pada tikus model dengan PED.*
Metode: *Penelitian terdiri dari dua tahap yaitu menganalisis kandungan proksimat GANIME dan melakukan penelitian in vivo pada sepuluh ekor tikus Wistar jantan berumur 3 minggu (50-100 gram). Tikus dibagi secara acak menjadi dua kelompok yaitu G1 (pelet GANIME) dan G2 (bubur GANIME) dan diamati selama 14 hari. Berat badan (BB), BMI, dan albumin diukur sebelum dan sesudah perlakuan. Uji t-berpasangan dilakukan untuk membandingkan hasil sebelum dan sesudah pengobatan, sedangkan perbedaan antar kelompok dinilai menggunakan uji One-way Analysis of Variance (ANOVA).*
Hasil: *Formula GANIME yang optimal diidentifikasi pada P3, dengan kandungan protein tertinggi (24,55%). Tikus G1 menunjukkan berat rata-rata 78,00 ± 15,52 g, tidak berbeda nyata dengan G2 (70,50 ± 2,12 g) (p = 0,565). Peningkatan bobot badan lebih besar pada tikus G1 dibandingkan G2 (12,67 g). Rata-rata BMI tikus G1 adalah 256,16 ± 25,57, tidak berbeda nyata dengan G2 (258,18 ± 2,59) (p = 0,923). Tikus G1 juga menunjukkan peningkatan BMI yang lebih besar dibandingkan dengan P2 (14,28). Rerata kadar albumin pada tikus G1 adalah 3,15 ± 0,56 g/dL, serupa dengan G2 (2,95 ± 0,36 g/dL) (p = 0,683). Tikus G1 mengalami penurunan albumin lebih kecil dibandingkan tikus G2, dengan selisih 0,08 g/dL.*
Kesimpulan: *Pemberian pelet formula GANIME lebih efektif meningkatkan berat badan dan IMT serta penurunan albumin yang lebih kecil pada tikus model KEP.*

KATA KUNCI*: kekurangan energi protein (KEP); albumin; indeks massa tubuh (IMT),; makanan local; GANIME*

ABSTRACT

Background: *The prevalence of Protein Energy Deficiency (PED) has increased over the past decade. Inadequate food intake and infectious diseases are the primary causes of PED. Clinical management of toddlers with PED often involves costly commercial foods. Ganyong, catfish, and red beans as local food ingredients with high nutritional content have the potential to be additional food for children with PED.*

Objectives: *This study aims to examine the effect of GANIME formula form and it's efficacy on body mass index (BMI) and albumin levels in the rats model with PED.*

Methods: *The study consisted of two phases: analyzing the proximate content of GANIME and conducting in vivo research using ten male Wistar rats aged 3 weeks (50-100 grams). The rats were randomly divided into two groups, G1 (GANIME pellets) and G2 (GANIME porridge), and were observed for 14 days. Body weight (BW), BMI, and albumin were measured before and after treatment. Paired t-tests were conducted to compare pre-and post-treatment results, while inter-group differences were assessed using One-Way Analysis of Variance (ANOVA) tests.*

Results: *The results showed that the optimal GANIME formula was identified at P3, with the highest protein and energy content. The G1 group of rats experienced a greater increase in body weight and BMI than the G2 group of rats but the increase was not significant ($p > 0.05$). Each group did not differ statistically significantly (0.644). Albumin in each group experienced a non-significant decrease ($p > 0.05$) and the two were not statistically different (0.690).*

Conclusions: *Administering the GANIME formula in pellet form exhibited superior efficacy because it's consumed more so it can increase body weight and BMI, and produce a lower decrease in albumin levels in rats model with PED.*

KEYWORD*:* *protein-energy deficiency (PED), albumin, body mass index (BMI), local food, GANIME formula*

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INTRODUCTION

In the past decade, the number of cases involving toddlers with Protein-Energy Deficiency (PED) has surged by 59 million cases (1). PED, characterized by unintentional weight (BW) loss and muscle mass reduction due to inadequate food intake, is responsible for a staggering 45% of under-five mortality worldwide (2). In Indonesia, the prevalence of undernourished children under five stands at 13.8%, with 3.9% of them experiencing malnutrition (3). PED during toddlerhood can significantly impede future growth and development, with malnutrition leading to diminished physical and cognitive functions (4).

Physical manifestations of PED in toddlers encompass parched and wrinkled skin, fragile hair and nails, an appearance of weakness and lethargy, and a gaunt physique (5). Children with PED also experience a decline in serum proteins like albumin and prealbumin (6). Albumin, the principal constituent (60%) of total plasma protein, is produced by the liver and normally ranges from 3.8 to 4.8 g/dL (7). Over decades, albumin has been utilized as a key biomarker for PED. A decrease in albumin levels can be attributed to inflammation (8). Elevated pro-inflammatory mediators like tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) lead to reduced m-RNA albumin levels (9). The repercussions of PED on albumin intake are twofold, impacting both weight and muscle mass (10). Decreased muscle mass accompanies reduced nutrient absorption (11). The criteria for malnutrition, as established by ASPEN, encompass insufficient energy intake, reduced body weight and muscle mass, loss of subcutaneous fat, reduced fluid retention, and weakened grip strength. The diagnosis of PED is

confirmed when two of these six conditions are met (12).

The ongoing government program aimed at addressing PED in toddlers involves providing supplementary food (PMT) in the form of biscuits (13). This program constitutes a targeted nutritional intervention directly delivered to toddlers (14). However, the PMT provision has yet to effectively combat this issue. New cases of PED are emerging at an alarming rate, indicating that the response's effectiveness is limited. Consequently, the prevalence of PED among children under five remains relatively unchanged (7). Alternative interventions are imperative to supplement this initiative. Modifying the PMT approach has proven effective in ameliorating the nutritional status of toddlers afflicted by PED (15). Indonesia, an agricultural nation, boasts abundant natural resources, including ganyong. Ganyong (Canna edulis Ker.), a tropical plant with high carbohydrate content (18.4%), holds potential as an alternative food source to replace rice (16). Carbohydrates serve as the primar energy source for metabolic systems. The country's fishing potential is substantial, reaching 12.54 million tons annually, with catfish (Pangasius sp.) being one of the notable varieties (17). Indonesia's waters teem with catfish, which are rich in protein (17%). This protein content is comparable to catfish (17.7%) and surpasses that of carp (16%) (16). Proteins function as energy sources, supplying amino acids essential for synthesizing cell proteins, hormones, and metabolic enzymes (18). Amino acids also contribute to the repair of damaged tissues in children with PED. The nation's legume potential is vast, with legumes constituting a prominent agricultural output (19). Despite the copious red bean (Phaseolus vulgaris) production, utilization remains suboptimal, necessitating optimization efforts. Red beans, boasting high protein content (22.1%), are rich in arginine, an activator of the growth hormone (Human Growth Hormone) and a guardian of immunity (16).

The direct administration of the GANIME formula to toddlers with PED is unfeasible due to its novelty and lack of prior utilization. Establishing rats as a toddler model for PED serves to offer a comprehensive portrayal of the interventions' impact during the clinical research phase (20). With this background in mind, the primary objective of this study is twofold: to assess the nutritional composition of the GANIME formula and to evaluate its efficacy when presented as pellets and porridge on various parameters, including body weight, Body Mass Index (BMI), albumin levels, physical-clinical attributes, and feed intake in the rats model with PED.

MATERIALS AND METHODS

Design, location, and time

The GANIME formulation consists of three distinct formulas, each containing a specific ratio of canna flour, catfish flour, and red bean flour—namely, P1 (40, 20, and 40)%, P2 (45, 25, and 30)%, and P3 (50, 30, and 20)% respectively. This formulation is developed considering the nutritional content of each ingredient, referencing the 2018 Indonesian Food Composition Table. The estimated nutritional content calculations for the GANIME formula are tailored to rat requirements. Nutritional content analysis for the GANIME formula was conducted in February 2023, under test number 02/LHA/LA/02/2023, at the Food Chemistry and Biochemistry Laboratory, Food Technology Study Program, Faculty of Agriculture, Universitas Sebelas Maret.

This study serves as a preliminary exploration into the effects of GANIME porridge consumption on amylase activity, albumin levels, and body weight in a rats model with PED. The care and treatment of experimental animals occurred at the Unit Pelayanan Teknis Laboratorium Terpadu Hewan Coba, Universitas Sebelas Maret, from February to April 2023. This research adopts an experimental laboratory approach, aiming to assess the efficacy of both GANIME pellets and porridge. The sample size was determined using the Festing formula, resulting in 5 rats for each treatment group (21). The entire research process obtained ethical approval from the Komisi Etik Penelitian, Faculty of Medicine, Universitas Sebelas Maret, under the designation 33/UN27.06.11/KEP/EC/2023.

Materials and tools

The core constituents of the GANIME formula encompass canna flour, catfish flour, and red bean flour. Canna flour and red bean flour were procured from online retailers, namely Riveroshop (Surabaya City, East Java) and

Nefababystore (Semarang City). Meanwhile, researchers manually prepared catfish flour using fresh catfish sourced from the Balekambang Fish Market in Surakarta City.

Preparatioan Rats Model with PED

The subjects enlisted for this study were male Wistar strain white rats, approximately three weeks old, and weighing between 50-100 grams. Rats exhibiting symptoms of diarrhea or illness were excluded based on predetermined criteria. The cages used in the experiment were made of plastic measuring 47 cm x 33 cm x 15 cm equipped with a water bottle and a standard feed container. The study commenced with seven days of acclimatization for the rats. The rat model used for PED was adapted from Agustina (2020) research, involving standard feed restrictions and modifications to the duration of modeling to 14 days (22).

Intervention

The allocation of subjects to groups was conducted randomly, forming treatment groups G1 (intervention involving GANIME pellets) and G2 (intervention involving GANIME porridge). The quantity of GANIME formula provided to rats was calculated at 10% of their body weight. Rearing cages were cleansed every three days to maintain a sanitary environment. The initial stage of modeling encompassed feed restrictions of 30% and 40% over four days, followed by 50% and 60% feed restrictions over three days in the subsequent stage.

Procedure

The methodology for fish meal production draws inspiration from Ningrum et al., (2017), with temperature and baking time modifications, specifically setting them at 125°C for approximately 5 hours (23). The determination of water, mineral, carbohydrate, protein, and fat content involves several distinct methods: thermogravimetry, dry method, difference method, kjeldahl method, and soxhletation.

Antropometry Measure

The observational aspect of the study encompasses multiple facets, including anthropometry, biochemistry, physical clinical assessments, and feed intake evaluation. BW and Body Mass Index (BMI), collected twice for each measurement (before treatment and after). Weights are recorded using a digital scale (Joil), while naso-anal length is measured with a measuring tape. BMI calculations are executed using the Lee Index formula (24).

$$\text{Lee Inde} = \left\{ \frac{body\ weight\ (g)^{1/3}}{naso - anal\ length\ (cm)} \right\} x\ 10^3$$

Albumin Levels

Albumin levels was conducted before and post-treatment. Blood samples for albumin testing were collected via the retroorbital plexus, with a volume of two mL per rat. Analysis of albumin levels in the rats model with PED measured by at the Labolatorium Penelitian dan Pengujian Terpadu, Univerisitas Gajah Mada with photometric method using bromocresol blue (25).

The Physical-clinical Attributes

The physical-clinical attributes that were selected as PED biomarkers for this study encompassed skin condition, fur quality, ocular state, and behavioral traits (26). Regular daily observations were made regarding the physical and clinical aspects of the rats (27). An evaluation of feed intake centered on administration, consumption levels, and remaining feed was performed both pre-and post-treatment. Rats experiencing a 10% reduction in body weight along with albumin levels below 3.8 mg/dL and displaying passive movement were included as research subjects (26) (7) (28).

Data analysis

The nutritional content data for the GANIME formula, biomarkers, and physical observations of the rats model with PED are presented as percentages, means and standard deviations, as well as data categories. Data processing was executed using Statistical Program. The assessment of data normality was conducted through the Shapiro-Wilk test ($n \leq 30$). Statistical analysis of the BW, BMI, and albumin levels for the rats model with PED encompassed paired t-tests for pre-post comparisons, and One-Way ANOVA tests were utilized ($p < 0.05$).

RESULTS AND DISCUSSIONS

The GANIME formulation boasts elevated protein levels, positioning it as a viable

supplementary food option for PED sufferers. Nutritional composition of GANIME formula is presented in **Table 1**. There is no significant different on nutritional composition on GANIME formula ($p > 0.05$). The formula 3 GANIME (P3) tend to highest on protein (24.55%) and energy (361.35 kcal) than other formula. The GANIME formula aligns with Indonesian National Standard (SNI) 01-7111.1-2005 for instant baby food, meeting numerous SNI criteria including ash, fat, protein, and carbohydrate content, except moisture. GANIME formula's moisture content stands at 10.70%, exceedingly recommended of SNI threshold of < 4% (29). The protein content surpasses the Ministry of Health's PMT (8-12%) but fat and carbohydrate content falls below, with GANIME formula registering an average protein content of 22.52% (30)

Table 1. GANIME Formula Nutrition Content per 100 gram

Parameters	Formulas			*p-value**
	P1	P2	P3	
Moisture (%)	10.66	10.72	10.71	0.357
Ash (%)	2,45	2.29	2.16	0.102
Fat (%)	2.55	2.35	2.57	0.165
Protein (%)	21.14	21.87	24.55	0.156
Carbohydrate (%)	63.20	62.77	60.01	0.180
Energy (kcal)	360.29	359.78	361.35	0.003

*Data are presented as mean (n=2). Kruskal-Wallis (α=5%)

This phenomenon is likely attributed to amylopectin's water-binding capability when subjected to heat, leading to an increase in moisture content. The primary source of amylopectin in the formula is canna flour, which contains a substantial proportion of amylopectin (76%). Regrettably, the heightened water content introduces an elevated risk of quicker spoilage. Persistent biological activity is fostered by the sustained presence of moisture, enabling the accelerated spoilage of products (31). The GANIME formula's ash content conformed to the normal parameters stipulated by SNI (≤ 3.5%) (29). It is conjectured that a considerable portion of the ash content emanates from red beans. Consequently, the inclusion of red beans in the formula is presumed to influence the ash content. This finding is congruent with the previous research of which elucidated that the introduction of turi bean flour can escalate ash content (32). The ash content is intricately connected to the product's mineral composition. Given that minerals play a pivotal role in averting mineral deficiencies among PED patients, their presence is of paramount importance.

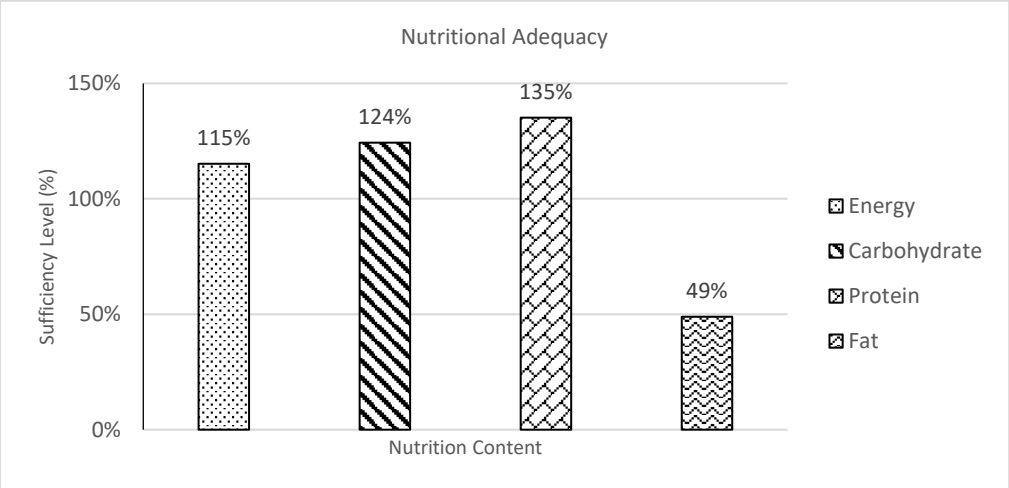

Figure 1. Nutrition Adequacy of Rats Model with PED fed the GANIME Formula. Determination of the amount of feed based on 10% BW of Rats.

Figure 1 demonstrates the extent of nutritional fulfillment within the PED rat model when fed with the GANIME formula at 10% of body weight. The preliminary research focused on the utilization of Formula 1, or P1 GANIME, due to its elevated energy and protein content. Although a majority of the nutritional constituents within GANIME Formula 1 align with the rats' nutritional requirements, the fat content only satisfies 49% of their needs.

The primary contributor to the fat content within the GANIME formula is believed to be catfish meal, given that catfish flour possesses a higher fat content (6.6%) (16). The fat content across all three GANIME formula variations surpasses the parameters stipulated by the Indonesian National Standard (SNI) of 1.5% (29). The high fat content in the ingredients can trigger adverse effects, because its changes during storage can endanger the health and longevity of the product. Protein content of GANIME formula adheres to the requisites outlined by SNI 2005 (minimum 8%) (29). This protein originates predominantly from catfish flour and red beans. Catfish is a source of animal protein (17%), while red beans are a vegetable source, (22.1%) (16). Protein plays an important role in new tissue formation, growth, maintenance, and various physiological functions of the human body. The carbohydrate content within the GANIME formula aligns with SNI standards for instant baby food (minimum 30%) (29). The components responsible for carbohydrate supply within the formula are ganyong and red beans. Ganyong boasts a relatively high carbohydrate content of 18.4%, while red beans offer an even higher carbohydrate content of 56.2% (16). It is noteworthy that the carbohydrate content's increase runs inversely proportional to the inclusion of canna flour but directly proportional to the addition of red beans. A diet enriched with high-carbohydrate foods proves beneficial for individuals grappling with PED as these foods provide essential glucose support for bodily functions and activities. Given that carbohydrates stand as the primary energy source, any curtailment in their intake can potentially impact the growth and development of children (11).

Characteristics of Rats

Indications of PED in rats encompassed a decline in both BW and BMI, sub-optimal of albumin levels, atypical physical-clinical states, and inadequate Intake The outcomes of the analysis of study rats characteristics post-14 days are illustrated in **Table 2.**

Table 2. Characteristics of Rats Model with PED

Biomarkers	(Mean ± SD)		*p-value**
	G1	G2	
Body weight (g)	52.60 ± 2.07	51.40 ± 5.77	0.673
BMI	243.43 ± 6.17	247.59 ± 9.37	0.432
Albumin (g/dL)	3.26 ± 0,18	3.12 ± 0.30	0.419

*Data are presented as mean ± standar deviatin (s.d) (n=10). G1 (fed with GANIME pellets), G2 (fed with GANIME porridge), BMI (Body Mass Index) using the Lee Index. *Paired t-test (α=5%)

Statistically, variables such as BW, BMI, and albumin levels of the research rats exhibited homogeneity ($p > 0.05$). The mean weight and albumin levels within the G1 group surpassed those of the G2 group, yet the G1 group's BMI was tent to inferior to that of G2.

Table 3.Physical Observation of Rats Model with PED

Physical Observation	Observation Treatment	Observation Day-		
		1	2-7	8-14
Hair	G1	N	NN	NN
	G2	N	NN	NN
Skin	G1	N	N	N
	G2	N	N	N
Eye	G1	N	N	N
	G2	N	N	N

Physical Observation	Observation Treatment	Observation Day- 1	2-7	8-14
Behavior	G1	N	N	NN
	G2	N	N	NN

N (Normal), TN (Not Normal).

Table 3 showcases the results of physical observations conducted on the research rats' condition, inclusive of hair, skin, eyes, and behavior, after the 14-day modeling period. Initial physical observations of the study rats exhibited normal conditions across all groups on the first day. However, by the seventh day, physical assessments disclosed aberrant conditions, characterized by disheveled and shedding fur, while the state of skin, eyes, and behavior still appeared normal. The behavioral aspect of the study rats appeared to be passive after the 14-day modeling period, as they exhibited a propensity for tranquility, tending to occupy corners within their cages.

After food restriction treatment, the rats prominently exhibited signs indicative of PED. Several PED criteria were conspicuous, such as, dwindling BW along with BMI, suboptimal albumin levels and manifestly irregular physical conditions. A 7% reduction in rat weight materialized on the 9th day of the modeling phase. As the modeling extended to the 14th day, the rats encountered a pronounced BW reduction, with the maximum decrease reaching 23%. This conspicuous dip in BW serves as a clear indication of PED manifestation in the rodents. Furthermore, the BMI calculation performed on the 14th day of modeling across both groups yielded an average of 248.57, thus establishing a reference for rat models experiencing PED. Biochemical scrutiny unveiled that albumin levels among the groups were as follows: G1 (3.26 ± 0.18 g/dL) and G2 (3.12 ± 0.30 g/dL), both falling beneath the standard threshold (3.8 g/dL). The rats' physical condition presented a visibly emaciated appearance, complemented by subdued movements, signifying a passive demeanor. Given these observations, the researchers confidently concluded that the rats had indeed developed PED following the 14-day modeling period.

Table 4. Changes in albumin, body weight, and BMI of Rats Model with PED Before and After Treatment

Variabel	(Mean ± SD) G1	G2	*p-value**
BW (gram)			
Before	65.33 ± 4.50	63.00 ± 5.65	0.639
After	78.00 ± 15.52	70.50 ± 2.12	0.565
Δ BW	12.67 ± 13.32	7.50 ± 3.54	0.644
*p-value***	(p=0.241)	(p=0.205)	
BMI			
Before	241.88 ± 13.82	248.58 ± 7.45	0.586
After	256.16 ± 25.57	258.18 ± 2.59	0.923
Δ BMI	14.28 ± 15.02	9.60 ± 4.86	0.711
*p-value***	(p=0.241)	(p=0.219)	
Albumin (g/dL)			
Before	3.23 ± 0.21	3.22 ± 0.32	0.963
After	3.15 ± 0.56	2.95 ± 0.36	0.683
Δ Albumin	-0.08 ± 0,34	-0.27 ± 0.67	0.690
*p-value***	(p=0.736)	(p=0.674)	

*: One-way ANOVA test, **: Paired T-Test, Significance ($p < 0.05$).

The average BW and BMI of the rats model with PED Analyzing Table 4, it becomes apparent that there existed an inconsequential increase in BW and BMI ($p > 0.05$) after treatment. The most substantial BW and BMI augmentation was observed within Group G1, each of 12.67 grams and 14.28. The inter group distinctions on all phases, encompassing pre, during and post-

treatment remained statistically insignificant ($p > 0.05$).

Rats consume approximately 15.6 g/day of feed, which equates to roughly 10% of their overall BW. This amount content about of 72 kcal of energy which is able to meet the calorie needs of rats (62.56 kcal/day) (33). The BW of rats experiences an uptick when calorie intake surpasses expenditure. Furthermore, the complete amino acid profile in the GANIME formula significantly contributes to the increase in BW. This synergistic amalgamation of amino acids sourced from catfish and red beans engenders a complementary interplay within the product (34).

Increases in BMI typically correlate with food intake (35). BMI serves as a metric to gauge healthy weight levels. To calculate the rats' BMI, their length and body weight were factored in drawing upon the Lee Index (24). Evidently, the rats' BMI surged, presumably due to their consumption of the GANIME formula, which exceeded their caloric requirements. Various additional factors contribute to fluctuations in BMI, encompassing physical activity, genetic predisposition, medical conditions, and lifestyle habits (36).

Average Albumin of the rats model with PED

Table 4 showcases an insubstantial decline in albumin levels within both groups ($p > 0.05$) during the intervention. Intriguingly, the most minimal albumin reduction surfaced within Group G1, registering at -0.08 g/dL. Across the treatment groups, statistically insignificant disparities persisted ($p > 0.05$) throughout all stages encompassing pre, during and post-treatment.

After treatment, rats model with PED exhibited a discernible decrease in albumin levels. This dip in albumin is not consistent with earlier research that entailed administering mocaf to rats models of PED (37). The suboptimal albumin levels detected in the PED rat models can be attributed to insufficient feed intake and prevailing infectious diseases. PED sufferers often endure concurrent infections due to their association with child malnutrition. The albumin decline post-treatment is conjectured to be a consequence of pathological disturbances within the rats models with PED. The mitigation of low albumin levels cannot solely be achieved by augmenting protein intake; it necessitates a comprehensive approach addressing the underlying pathological condition (38). This albumin decrease is likely attributable to the utilization of protein from the GANIME formula for the repair of muscle tissue damaged by the prevailing PED conditions (39). Figure 2 illustrates the outcomes of assessing GANIME formula consumption in rats modeling PED throughout the treatment period. In the initial week, all groups displayed a 100% consumption rate of the GANIME formula feed, indicating full consumption. As the second week progressed, the G1 group showcased the most substantial feed intake, equivalent to 77.7%. In the first week, no leftover feed remained within any treatment group in the first week, signifying complete consumption. However, in the second week, the G1 group exhibited the lowest remaining feed, tallying at 5.2 grams.

The nutritional composition of the GANIME formula appears to adequately fulfill the nutritional requisites of the rats model with PED. The decline in feed consumption witnessed during the intervention can be attributed to the rats' intrinsic tendency to curtail their food intake upon meeting their energy demands (40). It is postulated that the GANIME formula feed encompasses elevated sugar levels, potentially influencing the satiety center within the hypothalamus. The notable sugar content in the feed might impact the entromedial sensor, consequently inducing a reduction in appetite and subsequently leading to diminished food intake (33).

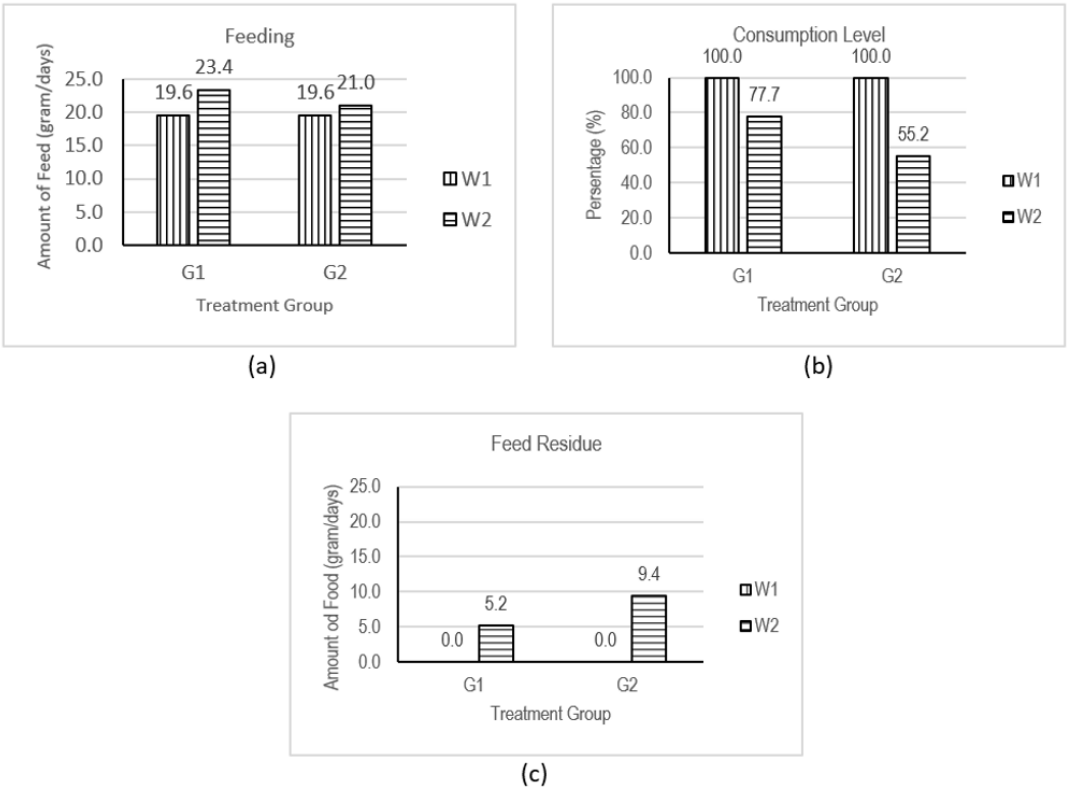

Figure 2. GANIME Intervention Feed Intake. (a) feeding, (b) feed consumed, and (c) remaining food that is not consumed by given to the rats model with PED, M1 (first week), M2 (second week).

CONCLUSIONS AND RECOMMENDATIONS

The GANIME formula, with a composition ratio of 50:30:20, emerges as the optimal formulation due to its high protein (24.55%) and carbohydrate (60.01%) content that fulfills the daily requirements. Administering the GANIME formula in pellet form exhibited superior efficacy because it's consumed more so it can increase body weight and BMI, as well as produce a lower decrease in albumin levels in rats model with PED. Further research on the GANIME formula needs to be carried out to reduce the water content, increase the fat and carbohydrate content.

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The relationship between body image perception and eating patterns

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ABSTRACT

Background: *Perception of body image and eating patterns in adolescents are two important aspects of health that play a significant role in their development. Body image reflects an individual's perception of their physical appearance, while eating patterns refer to their daily food consumption habits. Female students in high school (SMA) often experience pressure to meet beauty standards set by social media, peers, and other factors. The quantity and quality of food and drinks consumed can impact nutritional intake and overall health of individuals and society.*
Objectives: *To determine the relationship between perceived body image and eating patterns among female SMAS Kesuma Bangsa Londut students.*
Methods: *This research was conducted at SMAS Kesuma Bangsa Londut in January-February 2024 on female students. The research used a cross-sectional design method. Data collection was carried out using a Body Image questionnaire based on the theory of Thomas F. Cash 1989, the Multidimensional Body-Self Relations Questionnaire-Appearance Scale (MBSRQ-AS) theory, and an eating pattern questionnaire (Food Frequency Questionnaire). Data were analyzed using the Chi-Square test to determine the relationship between two variables in the same category.*
Results: *The research results show that there is a significant relationship between body image and eating pattern (p-value = 0.001, OR = 6.514, 95% CI = 1.979-21.442).*
Conclusions: *There is a significant relationship between body image and eating patterns among adolescent girls at SMAS Kesuma Bangsa Londut. It is hoped that students can manage their eating patterns better by consuming a variety of foods and drinks so that they provide good benefits for their health.*

KEYWORD*:* *adolescent girls; body image; eating patterns; perception*

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INTRODUCTION

Teenagers are individuals aged between 10 and 18 years old. Adolescent health efforts aim to prepare teenagers to become healthy, intelligent, qualified, and productive adults and to participate in maintaining and improving their health. The Indonesian Ministry of Health emphasizes that adolescent health is strongly influenced by a healthy eating pattern and regular physical activity (1).

Nutritional problems that often occur in adolescents include anemia, obesity, and undernutrition due to pursuing body goals with an improper eating pattern. Perceptions of body image and eating pattern in adolescents are two very important aspects of health in their development. Body image reflects an individual's view of their physical appearance, while eating pattern refers to daily food consumption habits that can affect overall health. Adolescents, especially high school students, often experience pressure to achieve beauty standards set by social media, peers, and other factors.

Body image is a component of self-concept that is influenced by cognitive growth and physical development. Thus, it can be said that body image is a collection of conscious and unconscious attitudes of individuals towards their bodies, including past and present perceptions, as well as feelings about the size, function, appearance, and potential that individuals have physically (2).

Body image is a complex construct formed from beliefs, thought patterns, perceptions, behaviors, and feelings. The way a person sees themselves and their body affects their health, mental health, and relationships with others. Eating disorders are psychiatric diseases that can occur due to genetic factors or environmental influences. Common eating disorders include anorexia nervosa, binge-eating disorder (BED), and bulimia nervosa (3).

Body image is very important for women, especially during adolescence, which is a period of significant change. This is a time when the transition from childhood to adolescence occurs, and often adolescents look up to idols for inspiration in terms of appearance and body shape. Additionally, paying attention to appearance is seen as a way to attract the opposite sex. In contrast to adolescent men, changes in body shape are more satisfying for them when muscle mass increases (4).

There are two dimensions to the understanding of body image: one related to one's own experience of the body and the other to other people's (social) judgments about the physical appearance of the body, including shape, size, and weight. The second dimension shows that the body is evaluated and continuously monitored socially. There is an inequality where the ideal body image is emphasized more for women than for men. Women become accustomed to paying more attention to their bodies than men, including regarding the ideal body image that must be achieved (5).

Eating pattern is a way or effort to regulate the amount and type of food intake to maintain health, nutritional status, and prevent or help cure diseases (6). Eating pattern is the most important behavior that can affect the state of nutrition. This is because the quantity and quality of food and beverages consumed will affect nutritional intake, which in turn impacts individual and community health. Optimal nutrition is essential for normal growth, physical development, and intelligence in infants, children, and all age groups. Good nutrition helps maintain a normal or healthy body weight, reduces susceptibility to infectious diseases, increases work productivity, and protects against chronic diseases and premature death (7).

There are many factors that affect nutritional status, namely the eating pattern consumed. If the daily eating pattern is less diverse, there will be an imbalance between the input and nutritional needs required for a healthy and productive life (8). Based on the results of research conducted by researchers on 101 female students, it showed that 23 female students (52.3%) had a positive body image with a good eating pattern, 21 female students (47.7%) had a positive body image with a bad eating pattern, 17 female students (29.8%) had a negative body image with a good eating pattern, and 40 female students (70.2%) had a negative body image with a poor eating pattern (9).

The purpose of this study was to determine the relationship between body image perception and eating pattern in high school students of Kesuma Bangsa Londut. The results of this study

are expected to provide a deeper understanding and insight into the factors that can affect the health and well-being of adolescents, who are still easily influenced by social and environmental factors during adolescence.

MATERIALS AND METHODS

This study uses a correlational descriptive design method with a cross-sectional approach where data concerning independent variables or risks and dependent variables or consequent variables will be collected at the same time (10). This research was conducted at SMAS Kesuma Bangsa Londut, Kualuh Hulu District, North Labuhanbatu Regency. The study was conducted in January-February 2024.

The sample, according to (11), is a part of the number and characteristics possessed by the population. The sample size is a step to determine the size of the sample taken in carrying out a study. The formula used to determine the sample size is the Lemeshow formula. Based on the results of the calculation of the number of samples, the number of samples obtained was 155,653, rounded to 155 samples to represent the population in this study.

Data collection was carried out using the Body Image questionnaire based on the theory of Thomas F. Cash (1989), the Multidimensional Body-Self Relations Questionnaire-Appearance Scale (MBSRQ-AS), and a eating pattern questionnaire (Food Frequency Questionnaire). The use of the MBSRQ-AS was tailored to meet the researchers' needs, as it is an assessment tool for appearance scales to obtain scores based on the perceptions of each female student.

Data analysis in this study is divided into univariate analysis and bivariate analysis. Univariate analysis aims to explain or describe the characteristics of each research variable. Bivariate analysis is conducted on two variables that are thought to be related. The results of this statistical test were analyzed using the Chi-Square test, which is useful for testing the relationship between two categorical variables, variable X and variable Y (10).

RESULTS AND DISCUSSIONS

Univariate Analysis

The results of data collection from 155 respondents, who ranged in age between 15 and 19 years, are presented in Table 1. The table shows the frequency distribution of respondents' age categories, with the majority of respondents being 16 years old (43.9%) and the fewest respondents being at least 19 years old (1.3%). Based on the results of **Table 1**, a picture of the characteristic of respondents in the adolescent category emerges. At this age, adolescents are very brave to take risks to achieve what they want, such as engaging in extreme diets in order to attain a good and ideal body.

Table 1. Characteristics of Subjects

Characteristics	Frequency Dustribution	
	n	%
Age (years)		
15	34	21.9
16	68	43.9
17	41	26.5
18	10	6.5
19	2	1.3
Body Image		
Positive	13	8.4
Negative	142	91.6
Eating Patterns		
Good	36	23.2
Bad	119	76.8

The data showed that many female students had a negative body image, with 142 respondents accounting for 91.6%, while only 13 respondents, accounting for 8.4%, had a positive body image, it shows that many respondents have a negative body image, indicating that the majority of respondents are less satisfied with their body shape. Body satisfaction in adolescents can be influenced by many factors, ranging from peers, social media/culture, TV ads/magazine covers, and others. This is what causes most adolescents to have a negative body image, even though they already have an ideal body according to age and body mass index calculations.

The results of data from 155 respondents were categorized based on the distribution of respondents' frequency into good eating pattern and bad eating pattern. The majority of respondents had a bad eating pattern, with 119 respondents accounting for 76.8%, while 36 respondents had a good eating pattern, accounting for 23.2%. the majority of respondents have a poor eating pattern, illustrating a lack of concern for what respondents consume. In adolescence, most of them tend to prefer foods and drinks with a sweet taste, leading to a preference for snacks and less concern about their eating pattern.

Bivariate Analysis

In **Table 2**, the results from 155 respondents were analyzed to examine the relationship between body image and eating pattern. The majority of respondents reported having a negative body image coupled with a poor eating pattern, with 114 respondents falling into this category. Only 5 respondents reported having a positive body image despite having a poor eating pattern.

Based on **Table 4**, the majority of respondents have a negative body image and a poor eating pattern. This indicates that respondents are less satisfied with their bodies and less concerned about their eating pattern.

Figure 1. The Relationship between Body Image and Eating Pattern in Adolescent Girls at SMAS Kesuma Bangsa Londut

Body Image	Eating Patterns						P Value	OR (CI 95%)
	Good		Bad		Total			
	n	%	n	%	n	%		
Positive	8	61.5	5	38.5	13	8.4		
Negative	28	19.7	114	80.3	142	91.6	0.001*	6.514 (1.979-21.442)
Total	**36**	**23.2**	**119**	**76.8**	**155**	**100**		

*) analyzed using Chi Square Test

However, there are also respondents who have a positive body image and a good eating pattern, illustrating that there are still respondents who are satisfied with their bodies and care about their eating pattern.

Adolescent Girls Age Category

Based on the results of research conducted at SMAS Kesuma Bangsa Londut, **Table 1** shows that the respondents were adolescent girls aged 15 years, with 34 students (21.9%); adolescent girls aged 16 years, with 68 students (43.9%); adolescent girls aged 17 years, with 41 students (26.5%); adolescent girls aged 18 years, with 10 students (6.5%); and adolescent girls aged 19 years, with 2 students (1.3%) Adolescence is a time when a person begins to gradually change and care about their appearance, including their body shape and other aspects that are important to them. This is done to provide self-satisfaction and to attract the opposite sex. Adolescent girls are often more prone to changing their desires frequently, but this is a way for them to explore themselves and establish their identity and confidence. It is not uncommon for many adolescent girls to set goals to go on extreme eating pattern in order to achieve the ideal body, and to cut and dye their hair as a way to boost their self-confidence.

Body Image of Adolescent Girls

Based on research conducted at SMAS Kesuma Bangsa Londut, **Table 2** shows the results of research on body image in adolescent girls at SMAS Kesuma Bangsa Londut. It is known that the majority of respondents who have a negative body image are 142 female students (91.6%). This can be seen from the answers to the questionnaire statement where as many as 51% prefer statement number 12, which is "I use any care product that is useful regardless of the shape and type." This happens because the majority of adolescent girls want an ideal, slim, and attractive body shape.

Basically, all humans are created as well as possible, but not infrequently we still encounter many adolescent girls who lack confidence in their appearance, either due to slightly dark skin color, less than ideal height, or body shape that they think is not good (12). Many adolescent girls assume that beauty standards for women must be white, tall, and have an ideal body. This leads teenagers to adopt a single standard that applies to all. Adolescence is a time of puberty for children, so it is not uncommon for them to envy their friends' appearances and even receive mocking words from friends as motivation to change (13).

Most subjects with negative body image consider body image to be unimportant (70.0%). Adolescents' perception and evaluation of body image are influenced by several conditions. First, there are changes in cognitive functions in adolescents who are able to define and reinterpret their theories about the body in new and different ways (14). Changes in cognitive function can be influenced by physical changes. Physical changes that occur in adolescents can affect the psychological development of adolescents, including self-concept in forming body image, which is a person's assessment of body shape and size. Second, physical and cognitive changes occur frequently with increasing issues of conformity with peers or peer groups. In addition to peer influence, family also influences the emergence of body image disturbance (15).

Adolescent Girls Eating Pattern

Based on research conducted at SMAS Kesuma Bangsa, **Table 1** shows the results of a study on the eating pattern of adolescent girls at SMAS Kesuma Bangsa Londut. Out of 155 female students, it was found that 119 female students (76.8%) had a poor eating pattern. This can be observed from the students' responses on the questionnaire statement sheet, where 16.3% more frequently chose statement number 7, which is "I consume chicken meatballs >1x a day." Adolescent girl often consume chicken meatballs more than once a day at school and outside of school.

This evaluation can help the school monitor and improve the eating pattern of female students to support their growth and development. Maintaining a healthy di eating pattern et can have a positive impact on students at school. This is particularly important during adolescence when the body is still growing and developing (16).

The Determinants of Quality Adolescents Survey in the Globalization Era: The Case of Medan City conducted by the LIPI Population P2 research team in 2017 also explored information related to respondents' eating pattern. Eating pattern is one of the important aspects studied in this research, especially the eating pattern of adolescent girls. This is because of the crucial role of a healthy eating pattern in adolescent girls as one of the factors in preparing themselves so that when they grow up, they have adequate nutrition to become a healthy generation of mothers (17).

Bad eating habits that stem from unhealthy family eating habits ingrained since childhood may persist into adolescence. Adolescents may eat without understanding the importance of various nutrients and the consequences of not meeting their nutritional needs on their health (18).

A poor eating pattern can have a serious impact. If the eating pattern is not improved, it can lead to various health problems, including being underweight due to lack of intake, overweight due to excess food consumption, and other eating pattern related health issues. Therefore, it is crucial to maintain a balanced

eating pattern to ensure proper body intake. In addition to eating pattern, engaging in physical activity is also important to promote a strong and healthy body (19).

The Relationship between Body Image and Eating pattern in Adolescent Girls

Based on **Table 4** of statistical test results in this study using Chi-Square, which shows that the p-value results of 0.001 < 0.05, H0 can be accepted and Ha rejected. This means that there is a relationship between body image and eating pattern in adolescent girls at SMAS Kesuma Bangsa Londut. The analysis of the risk amount yielded an odds ratio (OR) value of 6.514 with a confidence interval of 1.979-21.442. This indicates that respondents with a negative body image (either good or bad) had a 6.514 times greater risk compared to those with a positive body image (either good or bad).

Based on the results of research conducted by researchers on 155 female students, it showed that 8 female students (61.5%) had a positive body image with a good eating pattern, 5 female students (38.5%) had a positive body image with a bad eating pattern, 28 female students (19.7%) had a negative body image with a good eating pattern, and 114 female students (80.3%) had a negative body image with a poor eating pattern.

Based on **Table 2**, it can be seen that there are 5 female students who have a positive body image but have a bad eating pattern. This indicates that these 5 female students are satisfied with their appearance and accept their body shape but do not care about their eating pattern. Consuming diverse foods with the appropriate number of servings can provide good benefits to the body. This bad eating pattern is caused by many female students who do not understand the importance of maintaining a healthy eating pattern, so most of them consume only the foods and drinks they like without considering the impact on their health and shape. Additionally, there were 28 female students with a negative body image but had a good eating pattern. This means that some female students were not satisfied with their body shape, but their food intake consisted of a variety of foods in the right portions.

Table 2 shows the very high level of dissatisfaction of SMAS Kesuma Bangsa Londut students with their body image. There are many factors that cause high negative body image, such as culture, peers, and one of them can be caused by social media. Social media can have a negative impact that makes adolescents perceive body image based on what they see. On social media, many people display ideal body shapes, which are often imitated and followed by adolescents. What they see becomes a desire that must be achieved. Not infrequently, teenagers resort to various methods such as eating pattern, reducing food intake, increasing physical activity, and other measures to achieve the desired ideal body (20). However, this does not rule out the possibility of obtaining different results in various locations with varying numbers of respondents. Therefore, this research can hopefully serve as a reference and evaluation material for respondents and the school.

Nutritional problems in adolescence are important not only because adolescence is an important period to form one's own views and socio-cultural relationships, but also because the onset of puberty results in body changes (21). In addition to the cognitive and psychological development of adolescents who are prone to depression due to body image problems, modern lifestyles are also a risk factor for nutritional problems in adolescents. A practical lifestyle is considered to have many benefits but also raises new problems, namely the increasing number of overweight individuals, commonly known as obesity. Previous research has shown that there are negative consequences of depression and obesity on work, somatic health, and lifestyle (15).

Factors related to the body image of health workers include gender, food consumption behavior, and interpersonal relationships. Age and medical conditions do not show a relationship with body image. The dominant factor influencing body image in health workers at Meuraxa Hospital in Banda Aceh City is consumption behavior (22).

The results of the research analysis provided a general picture of body image among active Instagram users. Interpersonal experience factors were found to be the most

significant factor affecting body image in active Instagram users at SMA Negeri 1 Kutacane, accounting for 39.93% of the total. Frequency analysis showed a high effect on 24 people (33.5%), a moderate effect on 28 people (39%), and a low effect on 20 people (27.9%). According to the research analysis, physical characteristics were the second most influential factor on body image in active Instagram users at SMA Negeri 1 Kutacane, accounting for 37.49% of the total. Frequency analysis revealed a high effect on 22 people (30.7%), a moderate effect on 32 people (44.5%), and a low effect on 18 people (25.2%) (23).

CONCLUSIONS AND RECOMMENDATIONS

Based on the research conducted and the results obtained from the Chi-Square test, a significant relationship between body image and eating pattern in adolescent girls at SMAS Kesuma Bangsa Londut has been identified. The study revealed that the majority of adolescent girls at SMAS Kesuma Bangsa Londut have a negative body image, indicating a strong desire for an ideal, slim, and attractive body. Additionally, many of these adolescent girls frequently consume certain foods, such as chicken meatballs, more than once a day. The study also found that adolescent girls at SMAS Kesuma Bangsa Londut have a diverse age distribution, with the majority being 16 years old. Furthermore, the test results indicated that the eating pattern of these adolescent girls tends to be poor, and there is a correlation between negative body image and unhealthy eating pattern habits. Conversely, adolescent girls with a positive body image are more likely to have a healthy eating pattern.

It is expected that students will regulate their eating pattern better by consuming a variety of foods and drinks to meet the intake of micronutrients such as vitamins and minerals, as well as macronutrients such as carbohydrates, fats, and proteins, as stated in the contents of MyPlate. This will help meet energy needs to carry out daily physical activities. Consuming a variety of foods will ensure the body receives adequate nutritional intake. A balanced eating pattern, combined with sufficient physical activity, can also help maintain an ideal body weight.

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Acceptability and iron content mochi filled red beans and raisins

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ABSTRACT

Background: *In 2018, 32% of teenagers in Indonesia experienced anemia due to iron deficiency. Adolescence is one of the periods characterized by accelerated growth and development, leading to increased iron requirements in the body. Healthy and nutritious foods, including snacks, can be significant contributors to meeting the nutritional needs of iron-deficient teenagers. Red beans and raisins are among the food ingredients that can increase iron levels in the body; therefore, these food ingredients can be processed into the filling of a mochi that contains relatively high iron content.*
Objectives: *To determine the relationship between perceived body image and eating patterns among female SMAS Kesuma Bangsa Londut students.*
Methods: *This research is an experimental study. Acceptance testing was conducted organoleptically using a hedonic test method. The acceptance testing was conducted on 30 untrained panelists, namely female teenagers from SMAS Kesuma Bangsa Londut, and nutritional content analysis was performed at the Medan Industrial Research and Standardization Institute Laboratory. This research was conducted from January to March 2024.*
Results: *Organoleptic test results showed that the panelists liked the color, aroma, texture, and taste of the red bean and raisin-filled mochi. The iron content test results in 120 grams of the product showed 37.4 mg. The red bean and raisin-filled mochi given to the panelists was 30 grams, meaning it contained 9.35 mg of iron.*
Conclusions: *Red bean and raisin-filled mochi have good acceptance among teenage girls and also contain relatively high iron content.*

KEYWORD*:* *mocha; red beans; raisins; iron*

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INTRODUCTION

Iron is a mineral essential for our body's growth and development. The body utilizes iron to produce hemoglobin, a protein found in red blood cells. Hemoglobin carries oxygen from the lungs to all parts of the body. Iron deficiency may lead to iron-deficiency anemia. Initially, this condition may show no symptoms, but over time, it can result in fatigue, shortness of breath, and issues with memory and concentration. Treatment for low iron and iron-deficiency anemia typically involves iron supplementation (1).

Adolescence is a period marked by accelerated growth and development, leading to increased iron requirements in the body (2). In adolescent girls, iron is also needed to replenish iron lost during menstruation. Anemia is one of the diseases that should be monitored, with iron deficiency being one of its causes (3). Based on the Basic Health Research data from 2007, 2013, and 2018, there has been an increasing trend in the prevalence of anemia among adolescents. In 2018, 32% of adolescents in Indonesia were affected by anemia due to iron deficiency. This implies that approximately 7.5 million Indonesian adolescents are at risk of growth and developmental delays, cognitive impairments, and susceptibility to infections (4).

Seeing these conditions, efforts to provide Blood Supplement Tablets (TTD) are important to give to young women in their growth process. Apart from minimizing the potential for anemia to have an impact on health and performance at school, giving blood supplement tablets is also to prepare the health of young women before they become mothers. Giving TTD to young women is to prevent mothers from giving birth to babies with short bodies (stunting) (3). Healthy and nutritious foods, including snacks, can be significant contributors to meeting the nutritional needs of iron-deficient adolescents (5).

Red beans (Phaseolus vulgaris) are a source of plant protein and a food item rich in non-heme iron, containing 10,3 mg of iron per 100 grams (6).In Indonesia, red bean production was 67,862 tons in 2018, decreased to 61,517 tons in 2019, and then increased to 66,210 tons in 2020 (7). In Indonesia, the processing of red beans is still relatively low. Red beans are consumed by the public by being processed into vegetables, ice cream toppings, and cake fillings (8).

Raisins are small, dried grapes. The small black grapes used to make raisins originally came from Greece (9). Currently, several grape varieties can produce small, dark blue, tasty, seedless raisins. Good-quality raisins should be thick, round, full-bodied, clean, uniformly sized, and dark blue (10). Raisins contain a type of iron called non-heme iron. The amount of non-heme iron absorbed during digestion is influenced by various natural substances found in food. This means that raisins, containing 0,8 mg of iron per small box, provide a high source of iron only when consuming 2 to 4,5 small boxes (11).

Raisins are considered a rich source of iron. 100 grams of raisins contain about 1,3 mg of iron, or 7% of the recommended daily intake for most women (12). Based on research conducted by Rodhiyah, (2021) the most preferred organoleptic assessment of MOPINK mochi formulations with the addition of red bean paste and guava was formulation MP2 (1:1) with an iron content of 72,15 mg/kg. The most preferred mochi formulation is MP2, and the highest iron content is in the control formulation. Organoleptic tests are needed to measure the acceptance of mochi filled with red beans and raisins by young women at SMAS Kesuma Bangsa as well as identifying areas of improvement in the development of mochi filled with red beans and raisins. This research will involve organoleptic tests to assess young women's preferences for mochi filled with red beans and raisins, as well as laboratory analysis to assess the iron content in it. The results of this research will provide useful data for the development of food products that are healthy and liked by young women.

Based on the results of research conducted by Afiska et al., (2021), the analysis of the nutritional needs of red bean pudding snacks shows that per 100 grams, there are 107,74 calories, while the calorie value for snacks is 210 calories. This is still insufficient for its energy needs as a snack, but in terms of its iron content, per 100 grams of snack contains 1,5 grams of iron, while the proximate analysis result is 1,33 in red bean pudding, meeting the requirements as a snack for adolescent girls with anemia.

Based on the analysis of variance conducted by Richard Randi, I Wayan Sudiarta dan I Nyoman Rudianta, (2022), it is seen that the treatment of adding CMC and storage duration, as well as the interaction between the two treatments, had no significant effect (p>0,05) on the water content in red bean milk. From the data analysis results, the highest water content can be obtained with the addition of 0,08% CMC, which is 91,76%. Meanwhile, the lowest water content can be obtained with the addition of 0,04% CMC, which is 91,32%, but statistically different insignificantly from other treatments. This means that the higher the addition of CMC, the tendency for a decrease in water content.

One interesting snack option is red bean and raisin-filled mochi. Mochi is a Japanese food made from steamed glutinous rice filled with various ingredients, such as red beans and raisins. Red beans and raisins are food items that can increase iron levels in the body. Red bean and raisin-filled mochi has the advantage of being an anemia-preventive snack due to its high iron content (16).

The aim of this research is to analyze the acceptability and iron content of red bean and raisin-filled mochi. By better understanding consumer preferences for this food, we can develop options that not only provide enjoyment but also make a positive contribution to the health of adolescent girls.

MATERIALS AND METHODS

R Research Location and Time

This study on the preparation of red bean and raisin-filled mochi was conducted at the Londut Plantation, Kualuh Hulu District, North Labuhanbatu Regency. The acceptance test of red bean and raisin-filled mochi was conducted at SMAS Kesuma Bangsa Londut, while the nutritional content test was performed at the Laboratory of the Medan Research and Standardization Institute on Jl. Sisingamangaraja No.24, Pasar Merah Baru, Medan Kota. This research was carried out from January to March 2024. This test has passed the health research ethics test of the Lubuk Pakam Medistra Health Institute with number No: 017.D/KEP-MLP/IV/2024.

Procedure

This research employed an experimental design. Experimental design is a traditional approach to conducting quantitative research with the main characteristic being intervention or treatment so that the causal relationship between the independent variable and the dependent variable is known (17). In making the mochi itself, the researchers repeated it 3 times before submitting it and testing it to the laboratory. The ingredients used in making mochi filled with red beans and raisins in this study were sticky rice flour, red beans, raisins, cooking oil, vanilla powder, sweetened condensed milk, tapioca flour, pandan leaves, pink food coloring, granulated sugar, salt and water.

The tools used to make mochi filled with red beans and raisins consist of a bowl, spoon, pan, skillet, spatula, stove, kitchen scale, baking sheet and knife. The tool used for organoleptic test research is a questionnaire distributed to young women. The iron test method uses Atomic Absorption Spectrophotometry (AAS). AAS is a method based on the principle of measuring the amount of electromagnetic radiation absorbed by atoms or minerals in the gas phase. When analyzing minerals in food ingredients or products, this method is usually used because it is simple, easy to use, can detect dangerous heavy metals, has a fast analysis time and has high sensitivity (18).

In making mochi filled with red beans and raisins there are several steps, soak 125 grams of red beans for 24 hours, then boil the red beans for 45 minutes until the red beans are tender, then drain the red beans in a container and immediately mash them. while it's warm so that the texture doesn't harden. Next, add 14,3 grams of vanilla powder and granulated sugar, then stir until mixed and evenly distributed. Once mixed and the texture is smooth, the next step is to make peanut balls and add 3 raisins to the peanut balls, then to make moci skin, the first step is to mix 100 grams of sticky rice flour plus 40 grams of sweetened condensed milk and 1 gram of salt and 13 grams of oil. fry and 1 gram of vanilla powder, 0,5 gram of food coloring and 50 ml of water, then stir until thickened, then transfer the mixture to a heat resistant container and steam the mixture for 35 minutes. For the coating flour mixture, roast 30 grams of tapioca flour then add

2 pandan leaves, roast over low heat until fragrant, then remove the steamed dough, then knead the dough until it takes an elongated shape and cut the moci dough into 30 pieces, then flatten the dough. moci then add the red beans that have been rounded earlier while adding a little tapioca flour all over the surface of the moci, and the red bean moci filled with raisins are ready to eat.

Analysis Method

Mochi filled with red beans and raisins has successfully passed the iron (Fe) content testing stage carried out in the laboratory by analysis by the Medan Industrial Standardization and Services Agency. After passing a rigorous testing process, this mochi has been officially accredited and has been given a certificate number No. 0359/BSKJI/BSP JI-Medan/MS-P/III/2024 as proof of safety and quality. The untrained panelists consist of 25 lay people who can be selected based on ethnicity, social level and education. These trained panelists are only allowed to assess simple organoleptic tools such as liking traits, but cannot use discrimination test data (19).

Researchers added the panelists to 30 untrained panelists, all of whom were students from SMAS Kesuma Bangsa Londut. The researcher added the panelists to 30 untrained panelists, all of whom were students from SMAS Kesuma Bangsa Londut. The characteristics of untrained panelists, namely young women, are able to assess color, aroma, texture and taste. The acceptance test was conducted organoleptically by the panelists, who evaluated the mochi filled with red beans and raisins based on four parameters: color, aroma, texture, and taste. Organoleptic testing methods include hedonic testing (ranking method), descriptive testing, and discriminative testing (triangle test, duo-trio, paired comparison, ranking, and scoring). The researchers used the hedonic testing method, which is a sensory organoleptic analysis method used to compare quality. The level of preference is expressed on a hedonic scale, such as extremely dislike, dislike, like, and extremely like (20).

RESULTS AND DISCUSSIONS

Based on its levels, the level of acceptance can be determined using the following **Table 1**.

Table 1. Hedonic Scale of Panelist Acceptance Level for Red Bean and Raisin-filled Mochi

Parameter	Hedonic Scale	Numeric Scale
Color	Very Dislike	1
	Dislike	2
	Like	3
	Very Like	4
Scent	Very Dislike	1
	Dislike	2
	Like	3
	Very Like	4
Texture	Very Dislike	1
	Dislike	2
	Like	3
	Very Like	4
Taste	Very Dislike	1
	Dislike	2
	Like	3
	Very Like	4

Acceptance of Color Parameter

The panelists' assessment based on the acceptance level of color in red bean and raisin-filled mochi can be seen in the table below:

Table 2. Panelists' Assessment Based on Color Acceptance Level of Red Bean and Raisin-filled Mochi

Hedonic Scale	Panelists	Percentages
Very Dislike	0	0%
Dislike	4	13.3%
Like	20	66.7%
Very Like	6	20%
Quantity	**30**	**100%**

In red bean and raisin-filled mochi products, color is the first sensory parameter assessed in an organoleptic test because it gives the primary impression to the panelists. Generally, the color of the resulting product is milky white, influenced by the raw materials used. To make panelists interested in red bean and raisin-filled mochi products, researchers added pink food coloring. As seen in Table 2, 20 panelists liked the color of red bean and raisin-filled mochi with a percentage of 66,7%, while 6 panelists very much liked the color, accounting for 20%, and 4 panelists

disliked the color, accounting for 13,3%. Panelists in the study showed a higher preference for bright and cheerful colors for the product.

This is consistent with previous research that color in food greatly influences attractiveness and taste preferences. Color itself is a difficult pattern to measure, resulting in different assessments when evaluating its quality. Differences in color assessments occur because each person has different vision and taste preferences as well (21).

Acceptance of Scent Parameter

The panelists' assessment based on the acceptance level of aroma in red bean and raisin-filled mochi can be seen in the table below:

Table 3. Panelists' Assessment Based on Aroma Acceptance Level of Red Bean and Raisin-filled Mochi

Hedonic Scale	Panelists	Percentages
Very Dislike	0	0%
Dislike	9	30%
Like	19	63.3%
Very Like	2	6.7%
Quantity	**30**	**100%**

Scent is one of the crucial factors in food because the perceived scent can stimulate appetite and have a positive impact on the product. Besides appearance, color, and taste, scent also plays a significant role. Often, many products fail to thrive due to unfavorable food scents, while some foods are well-accepted due to their pleasant scent, enhancing appetite even if the food itself is ordinary. Generally, the resulting product has the scent of glutinous rice flour, influenced by the raw materials used. To give red bean and raisin-filled mochi a distinct scent, researchers used roasted flour coating with pandan leaves. As seen in Table 3, 19 panelists liked the scent of red bean and raisin-filled mochi, accounting for 63,3%, while 2 panelists very much liked the scent, accounting for 6,7%, and 9 panelists disliked the scent, accounting for 30%. Panelists liked the scent of red bean and raisin-filled mochi because of the pandan scent, making this mochi different from the usual mochi.

This research aligns with previous studies that pandan leaves have a distinctive scent, and pandan leaves are often used to give food or drinks a natural scent. With the content of tannins, glycosides, and alkaloids, pandan leaves are beneficial for health (22).

Acceptance of Taste Parameter

The panelists' assessment based on the acceptance level of taste in red bean and raisin-filled mochi can be seen in the table below:

Table 4. Panelists' Assessment Based on Taste Acceptance Level of Red Bean and Raisin-filled Mochi

Hedonic Scale	Panelists	Percentages
Very Dislike	0	0%
Dislike	3	10%
Like	17	56.7%
Very Like	10	33.3%
Quantity	**30**	**100%**

Taste is the key factor in a food product. Teenagers are synonymous with sweet foods, making sweet foods easier to accept by teenagers. However, it may not be accepted by adults or parents, and it also needs to be appropriate for the area and situation, such as Javanese culture being synonymous with sweetness, while Batak culture is synonymous with spicy food. Taste is thus also an important factor in the acceptance of food, not only because of its appearance but also because taste needs to be carefully considered. The taste of this mochi is not too sweet, unlike typical mochi, which is intentionally done by the researchers to provide an interesting product variation for the panelists.

As seen in Table 4, 17 panelists liked the taste of red bean and raisin-filled mochi, accounting for 56,7%, while 10 panelists very much liked the taste, accounting for 33,3%, and 3 panelists disliked the taste, accounting for 10%.

Based on previous research, organoleptic test results by 30 students of the Makassar Health Polytechnic found that a concentration of 10% was the most preferred formula in terms of

color, aroma, texture, and taste, with an average score of 4,07. The 10% concentration is dark brown with black raisins, with the most prominent aroma being milk and honey, a crunchy texture that is not easily brittle, and a sweet taste from honey and sour taste from raisins. However, some panelists commented that the raisin taste was stronger and they didn't particularly like the raisin taste after consuming the 10% concentration snack bar (23).

Acceptance of Texture Parameter

The panelists' assessment based on the acceptance level of texture in red bean and raisin-filled mochi can be seen in the table below:

Table 5. Panelists' Assessment Based on Texture Acceptance Level of Red Bean and Raisin-filled Mochi

Hedonic Scale	Panelists	Percentages
Very Dislike	0	0%
Dislike	7	23.3%
Like	13	43.4%
Very Like	10	33.3%
Quantity	**30**	**100%**

Texture is the last assessment where an older person would often prefer soft-textured foods, while conversely, teenagers would prefer crunchy foods. A suitable texture will provide its own appeal when the food is consumed. The texture of this mochi is chewy due to the use of glutinous rice flour in its production.

As seen in Table 5, 13 panelists liked the texture of red bean and raisin-filled mochi, accounting for 43,4%, while 10 panelists very much liked the texture, accounting for 33,3%, and 7 panelists disliked the texture, accounting for 23,3%. Panelists liked the texture of red bean and raisin-filled mochi because of its chewy and easy-to-eat texture, while some panelists did not like the mochi texture because most of the teenage girls at Kesuma Bangsa Londut High School preferred a chewy texture.

Nutritional Content Analysis of Red Bean and Raisin-filled Mochi

The results of the nutritional content analysis of red bean and raisin-filled mochi can be seen in the table below:

Table 6. Nutritional Content of Red Bean and Raisin-filled Mochi

Sample Weight	Test Parameter	Unit	Test Result	Test Method
120 g	Iron (Fe)	mg/kg	37.4	AAS

Based on **Table 6**, the iron content test results in red bean and raisin-filled mochi show 37,4 mg for a sample weight of 120 grams. This indicates that the combination of red beans with raisins processed into mochi filling does not diminish the iron content therein. The sufficiency of iron in red bean and raisin-filled mochi products can be analyzed in the context of daily recommended intake. According to the Minister of Health Regulation of the Republic of Indonesia Number 28 of 2019 concerning Recommended Nutritional Adequacy Figures for the Indonesian Population, the recommended iron consumption for adolescent females aged 16-18 years is 15 mg. The mochi provided to the panelists weighs 30 grams, meaning it contains 9,35 mg of iron. This means that panelists still need 5,65 mg of iron to meet the recommended intake.

Red bean and raisin-filled mochi also contain non-heme iron, which is a plant-based source of iron. Although the absorption of non-heme iron is not as efficient as the absorption of heme iron found in meat, the combination of non-heme iron in red beans with non-heme iron from raisins can enhance iron absorption in the body.

This is consistent with previous research; red beans are one of the foods containing minerals that are beneficial in increasing hemoglobin levels. In 10 grams of red beans or 1 cup serving of red beans containing iron, copper, and zinc, can help increase hemoglobin levels. Red beans also contain folic acid, which functions in red blood cell formation (24). Raisins are dried grapes rich in iron. Every 100 grams of raisins contain 1,9 grams of iron (2)

CONCLUSIONS AND RECOMMENDATIONS

Red bean and raisin-filled mochi have good acceptance among adolescent girls and also contain a high amount of iron. Through organoleptic testing, it can be observed that the panelists liked the cheerful pink color, distinctive pandan aroma, slightly sweet and sour taste, and chewy texture of the red bean and raisin-

filled mochi. Red bean and raisin-filled mochi have a significant iron content, with 37,4 mg in 120 grams of the product . According to the Minister of Health Regulation of the Republic of Indonesia Number 28 of 2019 concerning Recommended Nutritional Adequacy Figures for the Indonesian Population, the recommended iron consumption for adolescent females aged 16-18 years is 15 mg. The researchers provided mochi for the panelists to consume, weighing 30 grams, which contained 9,35 mg of iron. This means there is still 5,65 mg of iron that has not been fulfilled.

It is hoped that future researchers will create mochi filled with red beans and raisins containing 15 mg of iron to meet the iron needs of adolescent girls. It is also hoped that future researchers will develop other products that are rich in iron and meet the recommended iron intake for adolescent girls. This can be achieved by creating creative and engaging promotions about the benefits of red bean and raisin-filled mochi using posters or educational content that can be widely shared on social media platforms such as TikTok and YouTube. Additionally, collaboration with the food industry to develop iron-rich food products preferred by teenagers, such as cereal products, snacks, or beverages rich in iron, could be beneficial.

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