The Effect of Providing Mackerel Croquettes on Malnutrition Status in Junior High School Students in Bitung City

Vera T. Harikedua, Meildy E. Pascoal*, Olfie Sahelangi, Mhyzomela JP Palamia, Irza Nanda Ranti, Jufri Sineke

Department of Nutrition, Health Polytechnic, Ministry of Health, Manado

***Correspondent Author**

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ABSTRACT

Nutritional status is a factor that exists at the individual level, a factor that is directly influenced by the amount and type of food intake and the condition of infection. The low nutritional status of school children will have a negative impact on improving the quality of Human Resources (HR). Nutritional problems such as malnutrition basically arise from unbalanced eating behavior. Nutritional knowledge provides children or adolescents with provisions on how to choose healthy foods and understand that food is closely related to nutrition and health.

The aim is to determine the difference in giving mackerel croquettes to the nutritional status of junior high school students. MethodThis type of research is pre-experimental, namely with a design before and after the intervention using one group or called one group pre and post test design. The sample consisted of 25 people, namely students at SMP N 3 Bitung City.Univariate data analysis, namely describing frequency distribution data, statistical tests using bivariate tests, namely paired t-tests to see the influence provision of interventions on nutritional status. Criteria for paired t-test results p-value 0.000<0..

Results show There is a difference in average body weight (p-value = 0.000), energy intake (p-value = 0.000), protein (p-value = 0.000) before and after the intervention of providing mackerel croquettes to undernourished students at Junior High Schools in Bitung City.

Conclusion: In the provision of intervention of Mackerel Fish Croquettes, there was a difference in the average body weight, protein energy intake before and after the intervention of providing mackerel fish croquettes to students with malnutrition.

Keywords: Nutritional Status, School Children, Croquettes, Mackerel.

INTRODUCTION

Human resources are the most important asset in national development efforts, and Indonesia's current demographic structure has a high proportion of working age population (15-65 years), including teenagers.(BPS, 2022). Adolescence lasts between the ages of 10 and 19 years(Dieny, 2014);(Viera & Garcia, 2022), is a transition period from childhood to adulthood which is characterized by accelerated growth(Choirul et.al 2022);(Februhartanty et al., 2019).

One of the key factors for adolescent health and productivity is the fulfillment of proper nutritional needs (Viera & Garcia, 2022). Adolescents need optimal nutritional intake and proper knowledge to support their growth and development.(Fikawati et al., 2017). Nutritional problems in adolescents affect nutritional status and cause health problems. The condition of the body is reflected in the nutritional status due to the utilization of nutrients from the food consumed.(Grace, 2022). The importance of nutritional status is related to intelligence, productivity, and competitiveness which have a direct impact on the quality of the younger generation.(Abdullah et al., 2022). Poor nutrition can increase the risk of infectious diseases and reduce academic achievement, and overweight and obesity can contribute to degenerative diseases.(Charina et al., 2022); Grace, 2022)

Indonesia is experiencingtriple burden of malnutritionamong the younger generation: malnutrition leading to

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anemia, micronutrient deficiencies, and obesity.(Februhartanty et al., 2019):(Unicef, 2021). Ironically, adolescence is a critical period in the formation of health and nutritional behavior. Based on Riksudas data in 2018, around 25.7% of Indonesian adolescents aged 13 to 15 years have very low and poor nutritional status, compared to 26.9% in the 16 to 18year age group. The prevalence of adolescents with very low body weight and underweight is 8.7% in adolescents aged 13 to 15 years and 8.1% in adolescents aged 16 to 18 years. Regarding the nutritional status of the obese population, the proportion is 6.7% in the 13-15 year age group and 4.5% in the 16-18 year age group (Ministry Of Health, 2018)(Ministry of Health of the Republic of Indonesia, 2018). If not handled effectively, nutritional problems in adolescents today can be a risk factor for chronic diseases in adulthood (Directorate of P2P, 2020).

Preventive measures are very important to avoid health and nutritional problems when entering adulthood. Efforts to prevent nutritional problems in adolescents can be done through balanced nutritional education which aims to change adolescent eating habits.(Dervina et al., 2022). This education is important because adolescents' knowledge about balanced nutrition is related to their nutritional status.(Jayanti & Novananda, 2017);(Megawati, 2016), and accurate information helps teens understand optimal nutrition.(Prasetya et al., 2023). As part of this service, an assessment of the nutritional status and knowledge of the younger generation will be conducted as a first step to take further action.

The problem of malnutrition is a national problem that has not been resolved. It is known that malnutrition not only has an impact on health problems, but also reduces the quality of human resources (HR) which can have an impact on the future of society.(Kamila et al., 2018).Malnutrition problems are caused by various direct and indirect factors. The causes include diets that do not meet the needs required due to lack of energy and protein intake in daily food, inadequate nutritional intake, and lack of food and drink due to loss of appetite. This has a negative effect on the body, causing a decrease in appetite, thus causing a decrease in food intake in the body. This can cause people to become malnourished. (Auliya et al., 2015).

Unbalanced diet and lack of exercise are factors that cause nutritional problems in adolescents. Consuming less varied foods, in small amounts, can result in a lack of energy expenditure and lead to malnutrition in adolescents (Mega Humanity, 2019).

Adolescent consumption patterns determine the amount of nutrients needed for growth and development. Improper consumption habits affect nutritional intake in adolescents, resulting in suboptimal growth and development and increasing susceptibility to chronic diseases such as cardiovascular disease, cancer, and osteoporosis in adulthood. Therefore, to overcome these problems, a healthy diet and knowledge of what is needed by a balanced diet, and the nutritional status of adolescents are very important in supporting growth and development. Good nutrition occurs when the body receives sufficient nutrients that are used efficiently to enable optimal physical growth, brain development, work capacity, and health.

Various efforts have been made by the Government to overcome nutritional problems in adolescents, one of the effective programs is the Provision of Additional Food (PMT) using local food ingredients available in each region. Seeing the importance of Provision of Additional Food (PMT) in adolescents, researchers are interested in providing additional food in the form of croquettes made from mackerel. Mackerel contains vitamins B1, B2, B3, B6, B12, and D. In terms of macronutrients, mackerel has a higher macronutrient content, namely 20.48% protein and 3.32% fat.

Croquettes are the name of a food originating from the Netherlands. However, croquettes sold in Indonesia are similar to French croquettes. In the Netherlands, croquettes are ragout coated with egg white and breadcrumbs and then fried. In Indonesia, croquettes are usually pieces of mashed potatoes filled with seasoned ground meat or fish and mixed with vegetables such as carrots or green beans.

This study was conducted with the approval of the Health Research Ethics Committee of the Manado Ministry of Health Polytechnic No. KEPK.01/12/465/2023. November 19, 2023.

METHOD

The type of research is research *quasi experimental* with a one group pre-test and post-test design. This research

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was conducted at SMP Negeri 3 Bitung, North Sulawesi Province, Indonesia on February 13, 2024 to February 26, 2024. The independent variables in this study aremackerel croquettes, while the dependent variable isnutritional status in junior high school children who are malnourished. The population of this study is140 students at SMP Negeri 3 Bitung.Therefore, the sampling technique used is*Stratified Random Sampling*which is a sampling process through the process of dividing the population into strata, selecting a simple random sample from each stratum to obtain a proportional sample from each class. The number of samples in each treatment and control group was 50 people. The instrument used wasinformed consent sheet, body weight data, energy and protein intake before and after administration of mackerel croquettes. The research will be conducted for 14 days. Organoleptic data will be obtained from the organoleptic test form. Data analysis will beThe parametric test used is the paired T-test which is analyzed to see the difference in pretest and posttest results on the independent variable against the dependent, where if the p value <α (0.05) then it is concluded that there is an effect of giving mackerel croquettes on the nutritional status of malnourished students. And if the results obtained p> α (0.05) then there is no effect of giving mackerel croquettes on the nutritional status of malnourished students at SMP Negeri 3 Bitung City.

RESULTS AND DISCUSSION

Respondent Characteristics

The respondents studied were female adolescents who attended SMP Negeri 3 Bitung who were selected using the Stratified Random Sampling technique. The respondents who were sampled in this study amounted to 40 people and were divided into 2 groups, namely the treatment group and the control group. The characteristics of the respondents can be seen in table 1.

Table 1. Respondent Characteristics

Characteristics			n	%
Gender		Woman	20	80
		Man	5	20
		Total	25	100
Age		12 years old	10	40
		13 years old	9	36
		14 years	6	24
		Total	25	100

Based on Table 1, it can be seen that the gender of the respondents is 20 female (80%), and 5 male (20%), for the age of 12 years there are 10 people (40%), for the age of 13 years there are 9 people (36%) and for the age of 14 years there are 6 people (24%).

Organoleptic Test Results

Organoleptic tests were conducted on 2 samples of mackerel croquette products with different compositions. Product 1 with a composition of 100 gr mackerel, 150 gr potatoes, 80 gr carrots, 150 gr wheat flour, 100 gr starch, 60 gr chicken eggs, 100 gr breadcrumbs, 20 gr coconut oil, spring onions to taste, salt to taste, 15 gr garlic, celery leaves to taste. Product 2 with a composition of 100 gr mackerel, 150 gr potatoes, 80 gr carrots, 150 gr wheat flour, 100 gr starch, 60 gr chicken eggs, 100 gr breadcrumbs, coconut oil 20 gr, spring onions to taste, salt to taste, 15 gr garlic, celery leaves to taste and 40 gr cheese. The results of the organoleptic assessment of 30 panelists showed that product 1 was preferred and product 1 was used as an intervention product in the

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research sample. The organoleptic test results can be seen in the table below.

Table 2. Organoleptic Test Results of Mackerel Croquettes

Flavor	Formula 1		Formula 2	
	N	%	n	%
Do not like	0	0	0	0
Somewhat Dislike	0	0	0	0
Neutral	2	7	18	60
Kinda Like	10	33	8	26
Like	18	60	4	14
Total	30	100	30	100
Aroma	Formula 1		Formula 2	
	N	%	n	%
Do not like	0	0	0	0
Somewhat Dislike	0	0	0	0
Neutral	5	17	4	14
Kinda Like	5	17	13	43
Like	20	66	13	43
Total	30	100	30	100
Color	Formula 1		Formula 2	
	N	%	n	%
Do not like	0	0	0	0
Somewhat Dislike	0	0	0	0
Neutral	2	7	0	0
Kinda Like	5	17	14	46
Like	23	76	16	54
Total	30	100	30	100
Texture	Formula 1		Formula 2	
	N	%	n	%
Do not like	0	0	0	0

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Somewhat Dislike	0	0	0	0
Neutral	1	5	9	30
Kinda Like	1	5	17	56
Like	27	90	4	14
Total	30	100	30	100

Based on the table above, the results of the organoleptic test on taste, it can be seen that the most preferred flavor of mackerel croquettes is formula 1 with 18 people (60%), while formula 2 has 4 people (14%). The results of the organoleptic test on aroma show that the most preferred aroma of mackerel croquettes is formula 1 with 20 people (66%), while formula 2 has 13 people (43%). The results of the organoleptic test on color show that the most preferred color of mackerel croquettes is formula 1 with 23 people (76%), while formula 2 has 16 people (54%). The results of the organoleptic test on texture show that the most preferred texture of mackerel croquettes is formula 1 with 27 people (90%), while formula 2 has 4 people (14%).

1. Body Weight Before and After Intervention

Table 3. Descriptive Statistics Initial and Final Body Weight (Before and After Intervention)

Weight	n	Minimum	Maximum	Mean	Difference
Initial Body Weight (Before)	25	26.3	36.7	32.0	1.0
Final Weight (After)	25	26.6	37.0	33.0	

Table 4. Paired Samples Test Body Weight

	Mean	95% Confidence Interval of the Difference		Sig. (2-tailed)
		Lower	Upper	
Weight Before	-0.42	0.34	0.49	0.000
Weight After				

Based on table 3 above, there are 25 respondent samples. Before the intervention, the mean weight was 32.0 kg, while after the intervention, the final weight was 33.0 kg. For a difference in weight of 1.0 kg. While the results of the statistical test are 0.000 <0.05, it can be interpreted that there is a difference in weight before and after the intervention.

Mackerel is a food source that is rich in nutrients and has long been part of people's consumption. Mackerel contains high protein and omega-3 fatty acids, while peanuts are rich in healthy fats, which are very beneficial in supporting growth and repair of body tissues in toddlers who are malnourished. This finding is in line with previous studies which stated that supplementation of foods rich in protein and calories can significantly increase the weight of children with malnutrition status, with an average increase of 0.2 kg (p = 0.001). Macronutrient nutritional content plays an important role in the process of increasing body weight(Zhang et al., 2021).

In line with previous research from(Pascoal et al., 2017) who researched changes in nutritional status in undernourished toddlers who received PMT in the Tuminting Health Center work area, which stated the results of his research that there is a change in body weight in malnourished toddlers with an average weight gain in

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the first administration of 0.38333 where the results of the statistical test obtained a significant value of 0.000 (p <0.05). The same thing in the research conducted by(Yusnidaryani et al., 2023) that there was an increase in body weight with a significance value of p-value of 0.000 <0.05, so it can be concluded that there is an influence of biscuits formulated with moringa leaves (moringa oleifera) and mackerel (rastrelliger brachysoma) on increasing the weight and height of two-year-old babies with stunting.

2. Energy Intake Before and After Intervention

Table 5. Descriptive Statistics of Energy Intake Before and After Intervention

Energy Intake	n	Minimum	Maximum	Mean	Difference
Energy Before	25	676.0	988.3	817.8	103.3
Energy After	25	779.0	1,091.6	921.1	

Based on The table above contains 25 respondent samples. Before the intervention, the minimum energy intake was 676.0 kcal and the maximum was 988.3 kcal with a mean value of 817.8 kcal, while after the intervention, the drinking energy intake was 779.0 kcal and a maximum of 1,091.6 kcal with a mean value of 921.1 kcal. The difference in energy intake was 103.3 kcal.

Table 6. Paired Samples Test of Energy Intake

	Mean	95% Confidence Interval of the Difference		Sig. (2-tailed)
		Lower	Upper	
Energy before	-1.03	-1.23	-1.49	0.000
Energy after				

Based on the table above, the Sig value (2-tailed) is 0.002 < 0.05.The mean paired differences value is -1.03. This value shows the difference between the average energy intake before and the average energy intake after and the difference is between -1.23 to -1.49 (95% Confidence Interval of the Difference Lower and Upper).

Based on table 5The average energy intake of malnourished students before the intervention was 817.8 kcal and after the intervention was 921.1 kcal. With a difference in energy intake before and after in malnourished students of 103.3 kcal. Statistically, the Sig.2 value (2-tailed) is 0.000 < 0.05, so it is rejected and$H_0 H_1$accepted. So it can be concluded that there is an average difference between energy intake before and energy intake after and it means that there is an effect of giving mackerel croquettes on energy intake in malnourished students at SMP Negeri 3 Bitung City.

Energy is obtained from the metabolism of protein, fat and carbohydrates.(Fitriani, 2020). If energy intake is inadequate over a prolonged period of time, the body will rely on energy reserves stored in the muscles, which can potentially lead to malnutrition and weight loss, which in turn can have a negative impact on growth and development.(Parewasi et al., 2021). Conversely, increased energy consumption can lead to various other health problems, including obesity.(Herawati, 2023).

Insufficient energy intake in school-age children can cause children to experience malnutrition which can have an impact on inhibited physical growth and cognitive development in children. Conversely, if energy intake is excessive and not accompanied by good energy expenditure from physical activity, it will be at risk of being overweight in children. Lack and excess energy are both not good if they occur in school-age children.(Riani et al., 2019). Research by (Jauhari et al. 2022) thatSchool-age children experience a 35% energy intake deficit and a 20% protein intake deficit from the Nutritional Adequacy Rate. In addition, 20% of children have a habit of eating less than three times a day.(Jauhari et al., 2022).

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3. Protein Intake Before and After Intervention

Table 7. Descriptive Statistics of Protein Intake Before and After Intervention

Protein Intake	N	Minimum	Maximum	Mean	Difference
Protein Before	25	28.4	48.3	36	7
Protein After	25	37.2	56.3	43	

Based on The table above contains 25 respondent samples. Before the intervention, the minimum protein intake was 28.4 grams and the maximum was 48.3 grams with a mean value of 36 grams, while after the intervention, the protein intake was 37.2 grams and the maximum was 56.3 grams with a mean value of 43 grams. The difference in protein intake was 7 grams.

Table 8. Paired Samples Test of Protein Intake

	Mean	95% Confidence Interval of the Difference		Sig. (2-tailed)
		Lower	Upper	
Pre Treatment	-8.62	-8.25	-8.98	0.000
Post Treatment				

Based on the table above, the Sig value (2-tailed) is 0.000 < 0.05. The mean paired differences value is -8.62. This value shows the difference between the average protein intake before and the average protein intake after and the difference between -8.25 to -8.98 (95% Confidence Interval of the Difference Lower and Upper).

Protein intakein students with malnutrition before being given intervention 36 gr and after being given intervention 43. With a difference in protein intake before and after in students with malnutrition of 7 gr. Statistically the Sig.2 value (2-tailed) is 0.000 < 0.05, so it is rejected and$H_0 H_1$accepted. So it can be concluded that there is an average difference between protein intake before and protein intake after and it means that there is an effect of giving mackerel croquettes on protein intake in malnourished students at SMP N 3 Bitung City.

Proteins play a crucial role as structural and regulatory elements, and function as essential components in body cells.(Thalacker-Mercer et al., 2020). Protein sources can be obtained from plant and animal materials. Animal protein has superior quality compared to plant protein, due to its complete and optimal essential amino acid content to meet human needs.(Machado et al., 2020). In addition to the quality aspect, the amount or quantity of protein intake also deserves serious attention. Protein needs during adolescence experience a significant increase, caused by the growth of muscle mass, the need for erythrocytes and myoglobulin, and hormonal changes that occur.(Ozdemir, 2016).

Research conducted by Lin et al. (2015) identified a positive correlation between animal protein consumption and Body Mass Index (BMI) and body fat percentage.(Lin et al., 2015). The amino acid content such as arginine, histidine, and leucine found in animal protein can stimulate insulin secretion and contribute to fat metabolism.(Bujnowski et al., 2011). On the other hand, excessive protein consumption can result in the process of amino acid deamination.(Febriany et al., 2019), where nitrogen will be eliminated from the body, while carbon residues will be converted into acetyl CoA which can then be synthesized into triglycerides through lipogenesis, which has the potential to cause accumulation of fat tissue and increase the risk of malnutrition.(Rosati et al., 2013). Adolescents who consume more vegetable protein than animal protein show lower body fat percentage and BMI. Therefore, increasing vegetable protein intake as a substitute for animal protein in adolescents can contribute to obesity control and have positive effects on cardiovascular factors.(Lin et al., 2015).

CONCLUSION

During school age, children who are classified as teenagers are vulnerable to changes in food consumption which have an impact on a person's nutritional status. Based on the results of research that has been conducted, it shows thatthere is a difference in the average intake of energy, protein and body weight before and after the intervention of giving mackerel croquettes to malnourished students. Students at schoolmust pay attention to food intake by choosing healthy, varied, and nutritious types of food in order to meet nutritional needs through the role of teachers and parents, to maintain good nutritional status it is necessary to consider other factors such as physical activity in addition to controlling daily consumption of macronutrient intake according to recommendations.

Conflict of Interest

The authors declare no conflict of interest.

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