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The effect of cookies moerhi on body weight and macronutrient intake in undernourished adolescent girls

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ABSTRAK

Latar Belakang: *Gizi kurang merupakan salah satu permasalahan gizi yang sering menyerang remaja, khususnya remaja putri. Hal ini disebabkan oleh kurangnya konsumsi energi dan zat gizi dalam memenuhi kebutuhan tubuh. Salah satu strategi mengatasi gizi kurang adalah pemenuhan asupan gizi dengan memberikan suplementasi gizi berupa makanan tambahan yang digemari, misalnya cookies. Cookies Moerhi merupakan cookies yang dibuat dengan tepung ubi jalar putih (Ipomoea batatas L.) dan tepung tempe sebagai pengganti sebagian tepung terigu.*
Tujuan: *Tujuan penelitian ini adalah untuk mengetahui pengaruh Cookies Moerhi terhadap berat badan dan asupan zat gizi makro pada remaja putri gizi kurang.*
Metode: *Desain penelitian quasi experiment dengan pre-test and post-test with control group design. Penelitian dilaksanakan pada bulan Mei-Juni 2024, sampel berjumlah 33 orang yang terbagi menjadi 3 kelompok perlakuan yaitu: 1) kelompok kontrol diberi cookies kontrol dan edukasi gizi; 2) kelompok intervensi 1 diberi Cookies Moerhi formula 1 (20% tepung ubi jalar putih, 10% tepung tempe) dan edukasi gizi; 3) kelompok intervensi 2 diberi Cookies Moerhi formula 2 (10% tepung ubi jalar putih, 20% tepung tempe).*
Hasil: *Hasil penelitian menunjukkan bahwa pemberian Cookies Moerhi formula 1 dan edukasi gizi selama 21 hari dapat meningkatkan rerata berat badan (p=0,009), asupan energi (p=0,007), protein (p=0,014) dan lemak (p=0,003), sedangkan Cookies Moerhi formula 2 dapat meningkatkan rerata asupan lemak (p=0,033). Cookies kontrol dapat meningkatkan rerata berat badan (p=0,006) dan asupan energi (p=0,030).*
Kesimpulan: *Pemberian Cookies Moerhi formula 1 dan edukasi gizi menunjukkan hasil yang lebih baik karena dapat meningkatkan berat badan, asupan energi, asupan protein dan asupan lemak pada remaja putri gizi kurang.*

KATA KUNCI*: asupan zat gizi makro; berat badan; cookies; gizi kurang; remaja*

ABSTRACT

Background: *Undernourished is one of the nutritional problems that often attacks adolescents, especially young women. This is caused by the need for more energy and nutrient consumption to meet the body's needs. One strategy to overcome undernourished is to fulfil nutritional intake by providing nutritional supplements as additional popular food, for example cookies. Cookies Moerhi are made white sweet potato flour (Ipomoea batatas L.) and tempeh flour as a subtitute for some wheat flour.*

Objectives: *This study aimed to determine the effect of Cookies Moerhi on body weight and micronutrient intake in undernourished young women.*

Methods: *The research design was quasi-experimental with pre-test and post-test with control group design. The study was conducted in May-June 2024; a sample of 33 people was divided into three treatment groups:1) the control group was given Cookies Control and nutrition education; 2) intervention group 1 was given Cookies Moerhi formula 1 (20% white sweet potato flour, 10% tempeh flour) and nutrition education; 3) intervention group 2 was given Cookies Moerhi formula 2 (10% white sweet potato flour, 20% tempeh flour).*

Results: *The results showed that giving Cookies Moerhi formula 1 and nutrition education for 21 days can increase the average body weight (p = 0.009), energy intake (p = 0.007), protein (p = 0.014), and fat (p = 0.003), while Cookies Moerhi formula 2 can increase the average fat intake (p = 0.033). Cookies Control can increase the average body weight (p = 0.006) and energy intake (p = 0.030).*

Conclusions: *Giving Cookies Moerhi formula 1 and nutrition education showed better results because it can increase body weight, energy intake, protein intake and fat intake in undernourished adolescent girls.*

KEYWORD*: adolescents; body weight; cookies; macronutrient intake; undernourished*

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INTRODUCTION

Undernourishment is an imbalance of nutrients necessary for growth, cognitive function, and all other aspects of life (1). Undernourishment is one of the nutritional problems that often affects adolescents, especially adolescent girls. This is caused by the lack of consumption of energy and nutrients to meet the body's needs (2). The 2023 Indonesian Health Survey (IHS) results showed that the prevalence of undernourished in Indonesia in adolescents aged 13-15 years was 5.7%. The prevalence of undernourished adolescents in West Nusa Tenggara Province was 7.6%, higher than the national prevalence and among the ten provinces with the highest prevalence in Indonesia (3). Macronutrient intake is a direct factor affecting nutritional status (4). Macronutrients are the main components of various tissues and constitute the total calorie intake, which is the primary source of energy for the body, which can be divided into carbohydrates, proteins, and fats (5). Lack of carbohydrates causes a decrease in energy produced by glucagon, so fat reserves will be used to produce energy when this happens (6). Continued depletion of body fat reserves can lead to weight loss (7). Decreased body mass and problems with absorption of fat-soluble vitamins may also occur due to insufficient fat intake (8). Protein requirements align with a person's body weight; good nutritional status will be obtained if protein intake from food meets the recommended protein adequacy level (9).

Increasing the nutrient content of commonly consumed foods through reformulation and fortification is one promising method to improve the quality of foods consumed by adolescents (10). Providing nutritional supplementation in the form of additional foods or snacks to adolescent girls can help fulfil nutrients. Supplementary food based on local food can cause significant changes in body weight (11). Cookies that usually made use wheat flour can be substituted using flour made from local foods. Cookies Moerhi are cookies made with white sweet potato flour

(Ipomoea batatas L.) and tempeh flour. Sweet potato is one of the food substitutes for rice, and it has a high carbohydrate content that can be a source of energy (12). White sweet potato made into flour contains 84.83% carbohydrates and 4.46% protein (13).

In addition to carbohydrate sources, adolescents also need protein, which acts as a building and maintaining substance for body tissue cells (14). Tempeh is a vegetable protein source with a relatively complete essential amino acid content, including histidine, isoleucine, leucine, lysine, methionine, phenylalanine, and threonine (15). Tempeh contains digestive enzymes that are easier to digest, such as amylase, lipase, and proteinase. Tempeh also contains vitamins A, D, E, K, and B complex, which are found in many animal-based foods (16). Tempeh made into flour contains 45.69% protein, 20.29% carbohydrate and 24.04% fat (17). Giving purple sweet potato biscuits can affect the energy intake, iron intake, and body weight of undernourished children under five (18). Another study that gave pumpkin flour biscuits with a combination of tempeh flour for 21 days affected changes in the body weight of undernourished toddlers, with an average difference in body weight of 0.595 kg (19).

Several studies have shown that energy and nutrient intake in adolescents in Islamic Boarding Schools is classified as lacking. Energy intake, protein intake, fat intake, and carbohydrate intake of most adolescents in the Boarding School are classified as severely deficient (<70%) (20). Other studies have stated that students' energy, carbohydrate, and protein intake at one of the Islamic Boarding Schools in Makassar City is still largely classified as lacking (21). In addition, a study in 2017 also showed that > 52% of energy and macronutrient intake (protein, fat, carbohydrates) were classified as lacking (22). Nutrition screening conducted in 7 (seven) Islamic Boarding Schools in Mataram City in 2024 showed that 30.91% of female adolescents were malnourished (thin). So, it is necessary to improve adolescents' dietary intake in Islamic boarding schools. Based on this background, researchers want to see how the influence of Cookies Moerhi on body weight and macronutrient intake in undernourished adolescent girls at Islamic boarding schools in Mataram City.

MATERIALS AND METHODS

This study was conducted at the boarding school in Mataram City, West Nusa Tenggara Province in May-June 2024, using a quasi-experiment research design with pre-test and post-test with a control group design. The sample amounted to 33 people with inclusion criteria in the form of 1) adolescent girls aged 13-15 years, 2) nutritional status BMI ≤ 18.5 kg/m2, 3) do not have chronic diseases such as diabetes, heart disease or diseases with special diets, and 4) willing to become research subjects. The research subjects were grouped into three treatment groups, namely: control group (given Cookies Control and nutrition education), intervention group 1 (given Cookies Moerhi formula 1 and nutrition education), and intervention group 2 (given Cookies Moerhi formula 2 and nutrition education). The formulation of cookies can be seen in **Table 1**.

Table 1. Formulation of cookies control and cookies moerhi

Ingredient	Cookies Control (F0)	Cookies Moerhi (F1)	Cookies Moerhi (F2)
White sweet potato flour (%)	-	20	10
Tempeh flour (%)	-	10	20
Wheat flour (%)	35	5	5
Egg yolk (%)	15	15	15
Milk (%)	5	5	5
Margarine (%)	25	25	25
Sugar (%)	20	20	20
Total (%)	100	100	100

Decription :
F0 = Formula 0
F1 = Formula 1
F2 = Formula 2

The research instruments were informed consent, a 2X24-hour food recall form, a cookies checklist questionnaire and anthropometric tools. Cookies were given for 21 days as much as 45 gr (3 pieces)/day, while nutrition education was given three times, namely on day 1, day 8, and day 15. Body weight parameters were measured using the results of weighing before and after treatment, while energy intake and macronutrients were measured using the 24-hour food recall method. This study passed the ethical approval from Dr. Moewardi Hospital with number: 907/IV/HREC/2024.

Data were analyzed using SPSS v.26. To compare the means of three unpaired treatment groups using the One Way Anova test if the data were normally distributed and the Kruskal-Wallis test if the data were not normally distributed. In addition, the difference in the mean of two paired groups in each treatment group was seen using the Paired Sample T-test to see if the data was normally distributed and if it was not normally distributed using the Wilcoxon Test.

RESULTS AND DISCUSSIONS

Characteristics Subject

The results of distribution of subjects based on age characteristics, can be seen in **Table 2**. Research subjects in the control group were aged 13 and 14, at 36.4%, while in intervention groups 1 and 2, more were aged 13, namely 54.5% and 45.5%. This shows that undernourished is more common at the age of 13 compared to the ages of 14 and 15.

Table 2. Distribution of subjects based on age characteristics

Age Characteristics (year)	Control		Intervention 1		Intervention 2	
	n	%	n	%	n	%
13	4	36.4	6	54.5	5	45.5
14	4	36.4	3	27.3	2	18.2
15	3	27.3	1	18.2	4	36.4
Total	11	100	11	100	11	100

Description :
Control = Given Cookies Control
Intervention 1 = Given Cookies Moerhi Formula 1 (20% white sweet potato flour,10% tempeh flour)
Intervention 2 = Given Cookies Moerhi Formula 2 (10% white sweet potato flour, 20% tempeh flour)

Nuntritional Content of Cookies

One of the efforts that can be made to help the problem of undernourishment in adolescents is to provide additional food and nutrition education. **Table 3** shows the nutritional content of Cookies Control and Cookies Moerhi. Cookies' energy ranged from 220 - 230 kcal, protein 5 - 8.5 g, fat 11 - 13.5 g, and carbohydrates 20 - 26 g. Cookies Moerhi intervention 1 had the highest energy and protein content, Cookies Moerhi intervention 2 had the highest fat content, and Cookies Control had the highest carbohydrate content.

Daily Intake from Cookies

Table 4 show the average intake of energy, protein, and fat from consuming cookies for 21 days was highest in intervention group 1, which was given Cookies Moerhi formula 1. This is likely because the manufacturer of Cookies Moerhi in this group used the following formula: 20% white sweet potato flour and 10% tempeh flour.

Table 3. Nutritional Content of 1 Pack of Cookies (45 g)

Nutritional Content	Cookies Control (F0)	Cookies Moerhi (F1)	Cookies Moerhi (F2)
Energy (kcal)	227.14	232.47	231.48
Protein (g)	5.07	8.49	6.93
Fat (g)	11.26	13.02	13.57
Carbohydrate (g)	26.37	20.34	20.40

Description:
F0 = Formula 0 (without white sweet potato flour and tempeh flour)
F1 = Formula 1 (20% white sweet potato flour, 10% tempeh flour)
F2 = Formula 2 (10% white sweet potato flour, 20% tempeh flour)

The use of more white sweet potato flour affects the taste of Cookies Moerhi because the total sugar content in cookies made with white sweet potato flour is higher than that of other tuber flours (23). So the more white sweet potato flour is used, the more the tempeh flour taste will be covered. The control group given Cookies Control showed the highest average carbohydrate intake from cookies, because the cookies in this group were made using wheat flour which contains higher carbohydrates. Intervention group 2, which was given Cookies Moerhi formula 2, had the lowest acceptability compared to the other groups. This is likely because Cookies Moerhi was made using the following formula: 10% white sweet potato flour and 20% tempeh flour. Using more tempeh flour makes Cookies Moerhi taste more bitter. Previous research on the organoleptic test of Cookies Moerhi showed that the formula of 10% white sweet potato flour and 20% tempeh flour was the least preferred formula by panelists (24). This is also supported by other research, which shows that adding tempeh flour makes cookies taste bitter and is not liked by panelists (25). Subject compliance in consuming Cookies Moerhi and Cookies Control also influences acceptance of all treatments. Some subjects are starting to get bored, so cookies consumption is included in the less category, but subjects are always given the motivation to consume cookies every time consumption monitoring is carried out, namely every 3 days.

Table 4. Average Daily Intake from Cookies

Intake	Control (Cookies Control)	Intervention 1 (Cookies Moerhi F1)	Intervetion 2 (Cookies Moerhi F2)
Energy (kcal)	204.85	227.77	170.02
Protein (g)	4.57	8.32	5.09
Fat (g)	10.16	12.76	9.97
Carbohydrate (g)	23.78	19.93	14.98

Description:
F0 = Formula 0 (without white sweet potato flour and tempeh flour)
F1 = Formula 1 (20% white sweet potato flour, 10% tempeh flour)
F2 = Formula 2 (10% white sweet potato flour, 20% tempeh flour)

Daily Intake from Food

Table 5 shows that the average daily intake of the control group was 1499.37 kcal of energy, 49.16 g of protein, 49.12 g of fat, and 204.34 g of carbohydrates. The average daily intake in intervention group 1 was 1277.11 kcal of energy, 37.52 g of protein, 56.96 g of fat, and 184.61 g of carbohydrates. The average daily intake in intervention group 2 was 1106.86 kcal of energy, 47.25 g of protein, 38.68 g of fat, and 138.55 g of carbohydrates. The control group had the highest average daily intake, except for fat intake.

The food consumed daily in each Islamic Boarding School is different, thus showing differences in the average daily intake. Each Islamic Boarding School provides three main meals containing staple foods: rice, side dishes, and vegetables. The portion of rice is likely different because it is taken directly by each subject, while the boarding school administrator determines the portion of side dishes. Based on the results of monitoring intake during the study, the menu of animal-based protein sources is less diverse and more often provides a menu of plant-based protein sources. In addition, fruit menus are rarely given to subjects; most subjects consume fruit when given by parents or family when visiting respondents. Each Islamic Boarding School also has a canteen, usually for subjects to buy other snacks.

Body Weight

Table 6 shows the result of the Kruskal-Wallis test, namely p = 0.965, meaning that there was no significant difference in the average body weight between groups after treatment. However, Cookies Moerhi formula 1 given to intervention group 1 showed a significant increase in average body weight of 0.70 kg (p = 0.009). Cookies Control given to the control group showed a significant increase in average body weight of 0.64 kg (p=0,006), but this increase was lower compared to intervention group 1. An increase in body weight also occurred in intervention group 2,

which was given Cookies Moerhi formula 2 of 0.48 kg, although it did not increase significantly (p=0,059). This is likely because the average cookies intake (**Table 4**) showed the highest results in intervention group 2, then the control group and intervention group 2. The poor acceptance in intervention group 2 was because several subjects were sick, so food intake at that time was reduced, including the consumption of Cookies Moerhi. In addition, the average daily intake from food (**Table 5**) showed that the control group obtained a higher intake from food compared to intervention groups 1 and 2. This study's results align with previous studies, which showed that giving tempeh purple sweet potato cookies for 30 days increased the body weight of underweight toddlers by 0.56 kg (26). This study is also in line with other studies, which suggests that biscuits with the essential ingredients of yellow sweet potato and tempeh for 30 days can increase the body weight of underweight toddlers by 0.38 kg (27). Body weight is influenced by several factors, such as diet, physical activity, and genetics (28).

Table 5. Average daily intake from food

Intake	Control	Intervention 1	Intervetion 2
Energy (kcal)	1499.37	1277.11	1106.86
Protein (g)	49.16	37.52	47.25
Fat (g)	49.12	56.96	38.68
Carbohydrate (g)	204.34	184.61	138.55

Description :
Control = Given Cookies Control
Intervention 1 = Given Cookies Moerhi Formula 1 (20% white sweet potato flour, 10% tempeh flour)
Intervention 2 = Given Cookies Moerhi Formula 2 (10% white sweet potato flour, 20% tempeh flour)

An improper diet causes the body to receive nutrients in an unbalanced manner, which can result in undernourishment or excess of certain nutrients (29). Lack of physical activity, if supported by excessive food intake, will cause weight gain. In contrast, if the physical activity is heavy (high-calorie burning) and supported by low food intake, it will cause a calorie deficit, leading to weight loss (30). Genetics is a factor that plays a significant role in weight gain; previous research results state that there several alleles show a tendency to become obese (28).

Being underweight, in general, is not directly associated with increased mortality, but it does result in chronic energy deficiency, which is associated with an increased risk of infectious diseases (31). Underweight adolescents may experience delayed maturation, reduced muscle strength, and limited physical work capacity. They may also have lower bone density, increasing the risk of fractures later in life (32).

A better understanding of how nutrition affects all aspects of growth during adolescence will be critical in responding to the changing food environment for children and adolescents (33). Therefore, this study also provided nutritional education three times during the provision of Cookies Moerhi. The nutritional education provided was related to the amount, type, and frequency of eating according to the "Isi Piringku" guidelines, which aim to improve adolescents' eating patterns.

Energy Intake

Table 7 shows the results of the One Way Anova test, namely p=0.019, meaning that there is a significant difference in the average energy intake between groups after treatment.

Table 6. Mean body weight by treatment group

Group	Mean ± SD (kg)		Difference (kg)	p-value
	Pre	Post		
Control	34.11±2.81	34.75±2.83	0.64	0.006[b]*
Intervention 1	33.68±2.94	34.38±2.83	0.70	0.009[b]*
Intervention 2	33.66±4.25	34.14±4.15	0.48	0.059[b]
p-value	0.897[a]	0.965[a]	0.718[a]	

Description: a= *Kruskal Wallis Test;* b = *Wilcoxon test;* (*) = p < 0.05

Intervention group 1, which was given Cookies Moerhi formula 1, experienced a significant increase in the average energy intake of 644.47 kcal (p=0.007). In contrast, the control group, which was given Cookies Control, increased the average energy intake by 366.61 kcal (p=0.030). The average energy intake increase in intervention group 2 was 157.40 kcal but was insignificant (p=0.053). This is likely because Cookies Moerhi formula 1's energy content is higher than formula 2's and cookies in the control group. This study aligns with previous studies, which stated that giving purple sweet potato biscuits and wheat flour biscuits can significantly increase energy intake (18). The energy content in Cookies Moerhi and Cookies Control can fulfill 11% of the Nutritional Adequacy Rate for adolescent girls aged 13-15. The average energy intake obtained from the consumption of Cookies Moerhi in one day was 227.77 kcal (intervention 1) and 170.02 kcal (intervention 2), while in the control group, Cookies Control, it was 204.85 kcal.

The body uses foods such as proteins, fats, and carbohydrates as energy sources (5). When the body's energy intake is less than needed, the body will use fat and glycogen as energy reserves (6). When stored energy is insufficient, protein is used as an energy source to perform vital functions. Insufficient energy intake results in a lack of total energy for the body, which can cause stunted growth and delayed puberty (34). Lack of energy intake also results in weight loss and other nutrient deficiencies, decreasing work productivity, learning achievement, and creativity (21).

Table 7. Mean energy intake by treatment group

Group	Mean ± SD (kcal)		Difference (kcal)	p-value
	Pre	Post		
Control	1531.80±319.79	1898.41±276.55	366.61	0.030[b]*
Intervention 1	1113.81±361.83	1758.29±686.61	644.47	0.007[b]*
Intervention 2	1192.02±390.89	1349.42±216.97	157.40	0.053[b]
p-value	0.024[a]*	0.019[a]*	0.075[a]	

Description: a= *One Way Anova Test;* b = *Paired Sample T test;* (*) = p < 0,05

Protein Intake

Table 8 shows the results of the One Way Anova test, namely p=0.705, meaning there was no difference in the average protein intake between groups after treatment. However, the administration of Cookies Moerhi formula 1 to intervention group 1 for 21 days caused a significant increase in the average protein intake (p=0.030) of 22.97 g. The control and intervention groups 2 also experienced an increase in the average protein intake of 8.29 g and 2.2 g, but insignificant. This is due to the higher protein content in Cookies Moerhi in intervention group 1 compared to intervention 2 and control group. The protein content in Cookies Moerhi is 8.49 g (intervention 1) and 6.93 g (intervention 2).

In addition, the food consumed in all Islamic Boarding School has the same problem: the lack of animal-based protein consumption. In a day, some boarding schools consume 1-2x animal-based side dishes with fewer portions and not varied.

Table 8. Mean Protein Intake by Treatment Group

Group	Mean ± SD (g)		Difference (g)	p-value
	Pre	Post		
Control	53.09±13.78	61.38±15.19	8.29	0.228[b]
Intervention 1	33.08±12.77	56.06±24.67	22.97	0.030[b]*
Intervention 2	53.13±46.2	55.36±13.09	2.22	0.798[b]
p-value	0.034[a]*	0.705[a]	0.192[a]	

Description: a = *One Way Anova Test*; b = *Paired Sample T test*; (*) = p < 0.05

Because adolescence is a period that demands sufficient food in quantity and quality, the lack of food variety on the daily menu results in a lack of micro and macronutrients that are important for body formation and good body function, which determines nutritional status (35).

This study is in line with previous studies that gave purple sweet potato biscuits to school children aged 7-9 years for 30 days, which showed an increase in the average protein intake (36). The average protein intake obtained from Cookies Moerhi daily was 8.32 g in intervention group 1 and 5.09 g in intervention group 2, while in the control group Cookies Control it was 4.57 g. Protein can affect growth and development because other nutrients cannot replace this nutrient. Protein functions to build and maintain body cells and tissues. Adequate protein intake in adolescents will affect their nutritional status (9). The need for protein in adolescent girls aged 13-15 years is 65 g, meaning Cookies Moerhi can fulfill 10 - 13% of protein daily (37).

Fat Intake

Based on **Table 9**, the results of the Kruskal-Wallis test showed no difference in the average fat intake between groups after treatment (p=0.065). However, giving Cookies Moerhi for 21 days can significantly increase the average fat intake in intervention group 1 (p = 0.003) and intervention group 2 (p=0.033), while the control group did not increase significantly.

Table 9. Mean Fat Intake by Treatment Group

Group	Mean ± SD (g)		Difference (g)	p-value
	Pre	Post		
Control	53.65±12.03	63.30±19.43	9.65	0.182[b]
Intervention 1	43.87±21.57	89.39±37.55	45.52	0.003[b]*
Intervention 2	39.22±17.60	56.80±19.56	17.57	0.033[b]*
p-value	0.122[a]	0.065[a]	0.032[a]*	

Description: a= *Kruskal Wallis Test*; b= *Wilcoxon Test;* (*) = p < 0.05

The most significant increase in average fat intake was seen in intervention group 1, which was 45.52 g, then intervention group 2 was 17.57 g, and the control group was 9.65 g. This is likely because the fat intake in Cookies Moerhi is higher than in Cookies Control. Cookies Moerhi given to intervention group 1 contained 13.02 g of fat, intervention group 2 contained 13.57 g, and Cookies Control contained 11.26 g of fat. The need for fat in adolescent girls aged 13-15 years is 70 g/day, meaning Cookies Moerhi can meet 18% of daily fat needs (37). This study is in line with previous studies who stated that giving Cookies Clarchiz using tempe flour showed a difference in the average fat intake before and after the intervention (38).

The average fat intake obtained from Cookies Moerhi in a day was 12.76 g (intervention 1) and 9.97 (intervention 2), while in the control group given Cookies Control it was 10.16 g. Fat provides the most energy compared to other nutrients at 9 kcal/gram (39). Fat also functions as a solvent and carrier of fat-soluble vitamins, namely vitamins A, D, E, and K, preserves protein, provides satiety and pleasure, regulates body temperature, and protects vital organs (40). Lack of fat causes a decrease in linoleic acid, weight loss and changes in the skin. Therefore, fats should be consumed in recommended amounts (41).

Carbohydrate Intake

Based on **Table 10**, the results of the Kruskal-Wallis test showed no difference in the average carbohydrate intake between groups after treatment. The average carbohydrate intake in each treatment group increased, but statistically, there was no significant increase (p>0.05).

Table 10. Mean carbohydrate intake by treatment group

Group	Mean ± SD (g)		Difference (g)	p-value
	Pre	Post		
Control	204.55±49.36	246.57±47.46	42.01	0.110[b]
Intervention 1	173.39±78.72	219.43±91.00	46.04	0.110[b]
Intervention 2	154.44±84.45	165.33±29.75	10.89	0.594[b]
p-value	0.087[a]	0.014[a]*	0.580[a]	

Description: a = *Kruskal Wallis Test*; b = *Wilcoxon Test*; (*) = p < 0,05

This study is not in line with previous studies, which stated that giving cookies affected carbohydrate intake. Before the intervention, 96.4% of subjects were included in the category of low carbohydrate intake. After the intervention, it changed to 50%, meaning that the subjects experienced increased carbohydrate intake (42). This is likely because the average carbohydrate intake obtained from Cookies Moerhi in a day is still lacking, only able to meet less than 5% of the Nutritional Adequacy Rate for adolescents aged 13-15. The carbohydrate content in Cookies Control is higher than in Cookies Moerhi. The average carbohydrate intake obtained from Cookies Moerhi was 19.93 g (intervention 1) and 14.98 g (intervention 2), while in the control group given Cookies Control it, was 23.78 g. Carbohydrates function as an energy source, help control blood glucose and insulin metabolism, play a role in cholesterol and triglyceride metabolism, and help fermentation (43). Lack of carbohydrates leads to decreased glucagon energy, so fat reserves are burned to produce energy (6).

CONCLUSION AND RECOMMENDATION

Cookies Moerhi formula 1 showed better results because it can increase body weight (p=0.009), energy intake (p=0.007), protein intake (p=0.014) and fat intake (p=0.003) in undernourished adolescent girls. The average daily intake from food showed that the control group obtained a higher intake from food compared to intervention groups 1 and 2. So, Cookies Moerhi can be used as supplementary food to help overcome undernourishment in adolescents. For further research, it is necessary to measure physical activity as a factor that can influence body weight..

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