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The Effect of Providing Balanced Nutrition Education on Nutritional Knowledge, Diet, and Body Mass Index (BMI) in Adolescents

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Abstract: Obesity is an overnutrition problem that has not yet received special attention from the government or society. Adolescents are easily influenced by their peers. Providing balanced nutrition education to adolescents at SMA Negeri 1 Singosari using the peer education method is expected to improve nutritional knowledge, enhance dietary patterns, and reduce the overweight adolescents' body mass index (BMI). A screening was conducted among tenth-grade students, identifying 60 students with a BMI ≥25.1 kg/m^2. The instruments included a nutritional knowledge questionnaire, Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to assess dietary patterns, weight and height measurements to determine BMI. The results showed an increase in knowledge scores; however, it was not statistically significant (p-value = 0.106). There was a significant effect on the reduction of adolescents' BMI (p-value = 0.023). Dietary patterns showed improvement in average daily intake, frequency of consumption, and food preparation methods, although the intake of plant-based proteins, vegetables, and fruits remained below the Balanced Nutrition Guidelines. The results of this study imply that balanced nutrition education using the peer tutor method can be an effective approach to reduce BMI and encourage healthier eating patterns in obesity adolescents.

Keywords: obesity in adolescents, education, peer tutor

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INTRODUCTION

Obesity has not been considered a serious nutritional problem by society. Most people consider being overweight or obese to be common. There are even those who think that it being overweight does not matter as long as one remains healthy. Such a mindset that causes this obesity problem is often ignored (Khoirunnisa & Kurniasari, 2022).

The occurrence of obesity begins with excess food intake and poor diet, accompanied by weight gain to exceeds normal limits. A person is said to be overweight if he has a Body Mass Index (BMI) of more than 25 kg/m2 (Kementerian Kesehatan Republik Indonesia, 2014). Many impacts are had on a person who suffers from obesity. The long-term impact of obesity is bad for health. The accumulation of so much fat in the body can interfere with the performance system of the body's organs, so that it can cause diseases such as heart failure, stroke, diabetes mellitus, and others (Masrul, 2018).

Obesity can occur in all age groups, from children, adolescents, to adults. The age group that needs special attention is adolescents, especially 15 to 18 years old or adolescents who are in high school. At this age, adolescents are considered to be able to manage the pocket money given and make it possible to get the food they want. Daily activities are also spent more in school, and most also participate in additional study programs. This makes parents unable to control or supervise their children's food intake when they are outside the home (Setyawan et al., 2019).

The incidence of obesity in adolescents in Indonesia continues to increase from year to year. In 2007, 2013, and 2018, the proportion of central obesity at the age of ≥15 years was 18.8% respectively 26,6%, and 31.0% (Riskesdas, 2018). In East Java, as many as 1,163,118 or 16% of the population aged ≥15 are obese, with a percentage of 10.72% in men and 15.5% in women. In Malang City, an examination was conducted at 16 health centers, and the percentage of obesity in the age group ≥15 was 8.92% (Dinas Kesehatan Provinsi Jawa Timur, 2018). The school that is the focus of this study is SMA Negeri 1 Singosari, which is a fostered high school of the Ministry of Health of Malang.

Risk factors for obesity in adolescents include excessive food intake, frequent consumption of fast food, lack of physical activity, a history of parents with obesity, and the amount of pocket money (Telisa et al., 2020). In the midst of technological civilization, it is increasingly sophisticated, so access to food is very easy without the need to spend a lot of energy. The sophistication of this technology should also be used to obtain information about nutrition and health. According to Mulyani et al., (2020), knowledge has a meaningful relationship with the incidence of obesity in adolescents. Based on research conducted by Lanita et al., (2015) stated that health education conducted through SMS and booklets increases knowledge and reduces the BMI of overweight and obese adolescents.

Adolescents are easily influenced by their peers. So that an approach is conducted that aims to have a positive impact on adolescents, education is conducted by peers. The selection of this method is considered easier and more effective because it facilitates communication among adolescents and has been proven to improve the quality of life in obese adolescents Jaelani et al., (2018). Therefore, the researcher is interested in conducting research in the form of providing education about balanced nutrition to adolescents at SMA Negeri 1 Singosari with a peer tutor education method, which is

expected to be able to increase nutritional knowledge, improve diet, and reduce body mass index (BMI) in adolescents who are overweight.

The novelty of this study lies in the application of the peer tutoring method in balanced nutrition education tailored to the characteristics of high school adolescents. Unlike previous studies, which mostly used conventional counseling methods or online media such as SMS and booklets (Lanita et al., 2015; Mulyani et al., 2020), this study emphasizes a peer-to-peer approach that allows for two-way communication and emotional closeness between adolescents. Therefore, this study hypothesizes that providing balanced nutrition education through the peer tutoring method has a significant effect on increasing nutritional knowledge, improving eating patterns, and reducing BMI in overweight adolescents.

METHODS

The research was conducted at SMA Negeri 1 Singosari in August – November 2022. This type of research is pre-experimental with a one-group pretest and posttest research design. The parameters measured were knowledge, diet, and Body Mass Index (BMI). Measurement of knowledge was conducted using questionnaires. There are two parts to the questionnaire; the first part is filled in before getting education (pretest), and the second part is filled in after getting guidance (posttest). The questionnaire consisted of 20 closed-ended questions in each section. The weight of the assessment is given a score of 1 (one) if answered correctly, and if it is wrong, it is given a score of 0 (zero). Dietary parameters were measured by Semi Semi-Quantitative Form of Food Frequency (SQ-FFQ) before receiving education and after receiving education. BMI measurements were conducted by weighing body weight using a digital scale with an accuracy level of 0.1 kg and height measurement using a microtoise with an accuracy level of 0.1 cm. BMI measurements were conducted before and after receiving guidance (Lanita et al., 2015).

Nutrition education material was delivered by peers (peer tutors) who had previously received training on Balanced Nutrition and Obesity in Adolescents. The material delivered by peer tutors contains the nutritional status of adolescents, an overview of obesity in adolescents, factors that affect obesity in adolescents, balanced nutrition in adolescents, and recommended physical activities to help with weight loss. Educational provision is conducted in the classroom. The provision of education is divided into 3 (three) sessions. The material of each session is delivered for 45 minutes. At the end of the lecture, question and answer session will be held.

Before sampling, screening was conducted on all tenth-grade students of SMA Negeri 1 Singosari, which amounted to 424 students. A population of 60 (sixty) students was obtained who had a BMI ≥25.1 kg/m2. Then, samples were selected based on inclusion and exclusion criteria. Inclusion criteria include being willing to participate in the research and owning a personal phone. Exclusion criteria include students who are undergoing certain medications, students who are sick or have a history of certain illnesses, and those participating in a muscle mass-building training program or athletes. 50 (fifty) students were selected to be a sample in this study.

This research is quantitative, so the data is analyzed descriptively and statistically tested. After obtaining data before and after treatment, a normality test was conducted using Kolmogorov-Smirnov test first. The requirement for normally distributed data is that it meets the p-value of >0.05.

To find out the changes between the groups before and after treatment, if the data is distributed normally, parametric analysis will be conducted with the Paired Sample T-Test. If the data is not normally distributed, non-parametric statistical analysis is performed with the Wilcoxon Test. There were noticeable changes in the group before and after treatment if a 95% confidence degree or p-value < 0.05 was obtained.

Dietary variables were measured using the *Semi-Quantitative Food Frequency* (SQ-FFQ) form, which was conducted before and after treatment using the interview method. The assessment of diet in the form of a variety of foods consumed by adolescents, the average amount of consumption per day using household size (URT) was then condensed in grams based on the list of food exchangers, and the average frequency of adolescent consumption.

RESULTS AND DISCUSSION

Respondent Characteristics

The respondents were active students of SMA Negeri 1 Singosari and were willing to participate in the entire series of research. The number of respondents in this study was 50 students, consisting of 30 males and 20 females. The data on respondent characteristics are presented in Table 1.

Table 1

Characteristics of Respondents

Characteristic	Total	
	n	%
Gender		
Man	30	60
Woman	20	40
Age		
14 years old	1	2
15 years old	31	62
16 years old	18	36
BMI		
25.1 – 27.0 kg/m2	16	32
>27 kg/m2	34	68

Source: Primary data.

Nutritional Knowledge of Overweight Adolescent

The results of the statistical test of knowledge variables before and after treatment are presented in Table 2. The questionnaire consists of 20 questions. There are six pretest questions that many respondents did not answer correctly. These questions include numbers 1, 2, 4, 6, 9, and 12. Most of the respondents are familiar with the term balanced nutrition, but they do not have a deep understanding of it.

The normality test on the knowledge variables in the group before and after education obtained abnormally distributed data results ($p<0.05$). There was an increase in knowledge scores in some students, but the results of the non-parametric statistical test with the Wilcoxon Test obtained a p-

value of >0.05, which means that the provision of balanced nutrition education with the peer tutor method does not have a significant effect on the improvement of adolescent knowledge.

Table 2

Nutritional knowledge and BMI scores before and after education

Variable	Time	Min	Max	Mean	*p-value*
Nutritional knowledge	Pre-test	35.0	95.0	79.40	0.106
	Post test	35.0	100.0	76.70	
BMI (kg/m2)	Pre-test	25.1	39.5	29.17	0.023
	Post test	24.1	39.1	28.72	

Source: Primary data.

Body Mass Index (BMI) of Overweight Adolescent

The results of the statistical test of BMI variables before and after treatment are presented in Table 2. BMI data both before and after treatment were not normally distributed, so the data were then analyzed using a non-parametric statistical test, namely the Wilcoxon test. The results of statistical analysis with the Wilcoxon test obtained *a p-value* = 0.023 (p<0.05), which means that there is a significant influence on changes in adolescent BMI. The average BMI before treatment was 29.17 kg/m2 and after treatment was 28.72 kg/m2. Adolescent BMI decreased after being educated by *peer tutors* by 0.446 kg/m2.

Dietary Habit of Overweight Adolescents

Main meals

Based on the results of the study on the diet of overweight adolescents, the average consumption of staple foods before the intervention was 263.5 grams/day and after the intervention 246 grams/day, with a very frequent frequency (>1 time/day). The average intake of staple foods decreased by 17.5 grams. The average intake and average frequency of food consumption of the respondents are presented in Table 3.

The average result of the amount of animal side dish consumption before the intervention was 235.4 grams/day, and after the intervention was 173.7 grams/day. The intake of animal side dishes decreased by 61.7 grams and experienced a change in frequency from infrequent (1 – 3 times/week) to very rarely (1 time/month). The average frequency of consumption of vegetable side dishes did not change, but there was a decrease in the average amount of consumption. The average amount of consumption before being educated was 125.1 grams/day to 86.1 grams/day. The intake of animal side dishes decreased by 39 grams. Average consumption of vegetables and fruits has also decreased. Vegetable consumption decreased by 147.2 grams, and fruit consumption decreased by 139 grams. Respondents consumed vegetables and fruits with very little frequency, both before and after education.

Tabel 3

Dietary habit of respondents

Food Type	Average Total Intake (grams/day)		Average Intake Frequency	
	Pre Education	Post Education	Pre Education	Post Education
Staple Foods	263.5	246.0	Very often	Very often
Animal Side Dishes	235.4	173.7	Infrequently	Very Rare
Plant-based Side Dishes	125.1	86.1	Often	Often
Vegetables	248.7	147.2	Very Rare	Very Rare
Fruits	447.1	308.1	Very Rare	Very Rare
Meatballs	166.2	175.0	Infrequently	Infrequently
Siomay	264.2	244.6	Very rare	Very rare
Batagor	258.1	274.6	Very rare	Very rare
Cilok	86.6	85.0	Infrequently	Infrequently
Sempol	57.4	59.6	Very rare	Very rare
Cireng	131.0	145.0	Very rare	Very rare
Instant noodles	89.3	82.5	Infrequently	Infrequently
Margarine	7.4	7.1	Very Rare	Very Rare
Sugar	17.0	12.2	Often	Often

Source: Primary data.

Most of the respondents experienced changes in the amount of food intake after being given balanced nutrition education by their peers. In the staple food group, as many as 17 students (34.0%) experienced a decrease in intake, 26 students (52.0%) did not experience any change, and 7 students (14.0%) experienced an increase. The animal side dish group showed the highest decrease, namely at 30 students (60.0%), while 2 students (4.0%) remained, and 16 students (32.0%) experienced an increase. The intake of plant-based side dishes also tended to decrease in 27 students (54.0%), remained at 8 students (16.0%), and increased in 15 students (30.0%). For vegetable intake, as many as 27 students (54.0%) experienced a decrease, 18 students (36.0%) remained, and only 5 students (10.0%) experienced an increase. Meanwhile, in the fruit group, 25 students (50.0%) experienced a decrease, 3 students (6.0%) remained, and 22 students (44.0%) experienced an increase in intake.

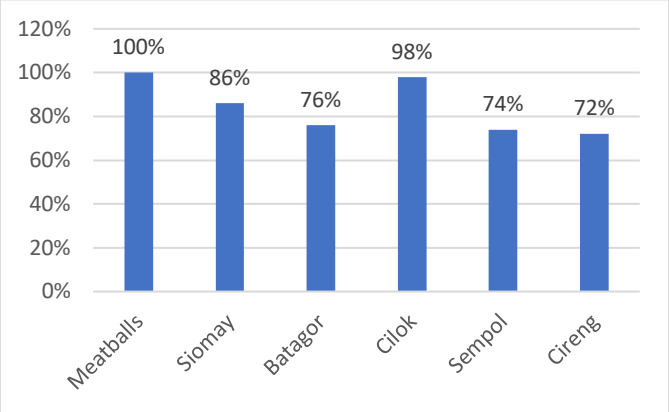
The majority of respondents experienced a decrease in intake in most major food groups, especially animal side dishes, plant-based side dishes, and vegetables. However, fruit intake showed a fairly high increase (44%), indicating a positive change in some adolescents after education was provided.

Snacks

The average amount of snack intake is presented in Table 3. The number of snacks intake that has increased after being given education, includes meatballs, *batagor*, *sempol*, and *cireng*. Meanwhile, snacks that experienced a decrease in intake were *siomay*, *cilok*, and instant noodles. The percentage of snacks that respondents liked the most can be seen in Figure 1.

Figure 1

The Most Preferred Snacks by Respondents



Source: Primary data.

Fat and sugar intake

The average amount of margarine and sugar intake is presented in Table 3. The average amount of margarine intake decreased by 0.25 grams/day. The average amount of sugar intake decreased by 4.75 grams/day. However, there was no change in the frequency of margarine and sugar intake.

Food processing

Tabel 4

Processing of side dishes before and after education

Side dishes processing	Fry	Stir-fry	Boil	Steam
Pre education (%)	100	0	0	0
Post education (%)	70	22	8	0

The food that is most consumed by students is processed by frying. Before being given education on the processing of side dishes, they are all fried (100 %). After being given education, the processing of fried side dishes decreased to 70 %. The percentage of respondents who consumed side dishes with sautéed was 22 % and boiled ones was 8 %.

Vegetable processing has also changed (Table 5). Before being educated by peers, the percentage of vegetable processing by sautéing was 72 % and decreased to 58 % after being given education. Food was processed with coconut milk as much as 2 % before being educated, and after education, none of the respondents consumed vegetables processed with coconut milk. The percentage of vegetable processing by boiling was 26 % in the group before being given education, and increased to 42 %.

Tabel 5

Processing of vegetables before and after education

Vegetable processing	Stir-fry	With coconut milk	Boil
Pre education (%)	72	2	26
Post education (%)	58	0	42

The Effect of Nutrition Education by Peers on Adolescent Knowledge

In this study, peers or *peer tutors* have been given counseling and training related to balanced nutrition materials to prevent obesity. The main task *of a peer tutor* is as an educator to convey a message to respondents or adolescents who have overweight problems. According to Mulyani et al., (2020), a lack of nutrition knowledge is one of the causes of obesity. Good knowledge of balanced nutrition will have a positive impact on a teenager and vice versa.

Based on the results of the study, it is known that the provision of balanced nutrition education by peers (peer tutors) has an insignificant effect on the improvement of adolescent knowledge ($p>0.05$). The average value of knowledge decreased after being educated. The average score decreased due to the absence of repetition of the material, which had an impact on student understanding. Without repetition of the material, it has the potential to fail to increase (or even decrease) the knowledge score, because the material is not really understood and is not reinforced many times (Hasanah et al., 2025).

Educational media can affect adolescents' interest and motivation to learn and understand the material presented. Educational materials are delivered by *peer tutors* using the lecture method. According to (Mutia et al., 2022), the lecture method is considered less effective in improving student knowledge. Education through audiovisual media can effectively increase adolescents' knowledge about obesity (Meidiana et al., 2018). Audiovisual media contain interesting sounds and images so that the message conveyed is easier to understand and remember. Therefore, it is necessary to develop media in the delivery of education.

According to Rohman & Karimah (2018), the time of implementation of education affects the motivation and concentration of students in receiving material. Education delivered before breaks, such as in the fourth and sixth class hours, has the potential to be less than optimal due to the decreased focus of students. This can affect the effectiveness of understanding the material provided.

The Effect of Nutrition Education on Adolescent Body Mass Index (BMI)

Interventions in the form of education delivered by peers can have a significant influence on the reduction of BMI. The results of the Wilcoxon test statistical test showed a p-value = 0.023. These results are in line with the research of Saifah et al., (2019), which shows that the delivery of education by peers has a significant effect on the reduction of the respondents' BMI, as evidenced by 87.5% of respondents experiencing a decrease in BMI.

The different results were shown by the research of Hasniyati and Ismanilda (2021), there was no significant difference between BMI before and after being given nutritional counseling with the lecture method. Different methods used in delivering education can give different results. Adolescents have attachment to their peers and can follow their friends in choosing food (Lestari and Dieny, 2016). Therefore, balanced nutrition education by peers is considered more effective in providing understanding and motivation to respondents to apply balanced nutrition practices in daily life.

The Effect of Nutrition Education on Adolescent Eating Patterns

Dietary variables were measured using a *Semi-Quantitative food Frequency* (SQ-FFQ) questionnaire. SQ-FFQ can be used to find out an overview of individual nutritional intake habits that include the amount and frequency over a certain period of time. The results of the respondents' SQ-FFQ were analyzed descriptively to find out how much the average amount of intake per day and the frequency of intake changed before and after the intervention was given.

Most of the respondents had reduced the amount of food intake after being educated. The results of the study showed that the average amount of intake of the main food decreased. The average amount of food intake is still under the recommendations of the Balanced Nutrition Guidelines (PGS) which should meet 3 – 4 servings of staple foods or equivalent to 300 – 400 grams of rice per day, animal side dishes 2 – 4 servings or equivalent to 80 – 160 grams of chicken meat per day, vegetable side dishes 2 – 4 servings equivalent to 100-200 g (4-8 pieces) of medium-sized tempeh; or 200 – 400 g (4-8 pieces) of medium-sized tofu per day, as well as recommended consumption of vegetables and fruits 4 – 6 servings or equivalent to 400 – 600 g per person per day (Kemeterian Kesehatan Republik Indonesia, 2014).

The consumption of side dishes is very important for adolescents because side dishes are a source of protein that plays a big role in the growth period. Protein deficiency can cause problems such as disorders in bones that cause bones to break easily, a decreased immune system, hair loss, dry skin, easily broken and brittle nails, and cause hunger easily because it can trigger fluctuations in blood sugar levels (Aisyah et al., 2022).

Adolescents are advised to consume side dishes that are high in protein but low in fat, such as skinless chicken, egg whites, lean beef, as well as lean groups such as tofu, tempeh, green beans, and others. Excess consumption of animal side dishes will cause various diseases and obesity (Mutia et al., 2022).

The results of the study showed that the average amount of vegetable and fruit intake in respondents was still less than the PGS recommendation. The average frequency of adolescent intake of vegetables and fruits is also very low and does not change after being educated. Vegetables and fruits are rich in fiber, which is very beneficial for the body. Insufficient fiber intake will harm health. Based on the results of research conducted by Maharani et al., (2015) fiber intake that is less than the AKG has a meaningful relationship with better nutritional status in adolescents. Sufficient fiber intake can cause a longer feeling of fullness, so that it helps to maintain weight and prevent obesity, prevent constipation, control blood sugar and blood cholesterol levels, and reduce the risk of colon cancer (Astuti, 2017).

The average intake of snacks consumed by respondents has not entirely decreased. Only siomay, cilok, and instant noodles experienced a decrease in intake. Snack foods contain high energy and high fat. According to (Dewi and Kartini, 2017), excessive consumption and not accompanied by physical activity, causes obesity in adolescents.

The results of the study showed that the average amount of margarine and sugar intake decreased. PGS recommends that total oil consumption is no more than 5 tablespoons or the equivalent of 67 grams, and sugar consumption is no more than 4 tablespoons or 50 grams per day per person (Kemeterian Kesehatan Republik Indonesia, 2014). The consumption of margarine and sugar in the respondents was still within the recommended limits.

There are improvements in food processing. Before being educated, all respondents ate fried side dishes. After being educated by peers, the selection of fried food processing was reduced. Fried foods will increase the fat content in the food, and the taste of the cuisine tends to be better as well as foods processed with coconut milk. The boiling and steaming method produces lower protein and fat content but causes the taste of food to tend to be less pleasant (Nguju et al., 2018).

CONCLUSION

Providing balanced nutrition education by peers can increase adolescents' knowledge, although it was not statistically significant. There is a significant influence of the provision of balanced nutrition education on adolescent body mass index (BMI). Adolescents' diets tend to change for the better seen from the average and frequency of consumption in each type of food group and the way food is processed. The average amount of adolescent food intake tends to decrease, but the intake of vegetable side dishes, vegetables, and fruits is still under the PGS recommendation.

This research has several limitations, including the fact that it is not accompanied by repetition of material, is conducted at a less-than-optimal time (before the break time), uses a lecture method without supporting media, and is not accompanied by a control group. These limitations can affect the effectiveness of interventions and the interpretation of research results.

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Author Contribution Statement

Azzah Abidah Azro: Conceptualization; Methodology; Data Collection; Data Analysis; Writing Original Draft. **Sutomo Rum Teguh Kaswari**: Project Administration; Validation. **Annasari Mustafa**: Data Curation; Writing, Review & Editing.

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