



The Relationship Between Diet and Physical Activity and the Incidence of Obesity Among Students

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Abstract

Obesity is a condition where body fat is more than it should be. This situation can be caused by poor diet and lack of physical activity. The purpose of this study was to determine the relationship of diet and physical activity to the incidence of obesity in adolescents 16-17 years at SMAN 7 Bengkulu City. This research is a quantitative research with cross sectional approach. This research was conducted at SMA Negeri 7 Bengkulu City. A sample of 81 students was obtained using random sampling technique. Diet was collected by instrument, with Eating Behavior Patterns Questionnaire (EBPQ), Physical activity using Physical Activity Questionnaire - Adolescent (PAQ-A). Measurement of body weight and height to determine BMI/A. Obtained students with a good diet of (80%), while physical activity is sufficient as much as (84%) and obtained students who were obese as much as (16%), while students who were not obese were (84%). The chi-square results show that there is a relationship between diet and obesity with a p-value ($p=0.003$) and there is a relationship between physical activity and obesity with a p-value ($p=0.005$). Concluded that diet and physical activity can affect the incidence of obesity in adolescents 16-17 years at SMAN 7 Bengkulu City.

Keywords: Adolescent; Diet; Obesity; Physical Activity

INTRODUCTION

The Ministry of Health of the Republic of Indonesia defines adolescents as individuals aged between 10 and 18 years. This developmental stage is critical in facilitating the transition to adulthood, with the goal of developing into healthy, knowledgeable, competent, and productive adults who are actively involved in improving and maintaining personal well-being (Jeki and Wulansari 2023).

Adolescents in this age range are a particularly vulnerable group in terms of nutrition. Several factors contribute to this vulnerability, including increased

nutrient needs, shifts in lifestyle and eating habits, and specific nutrient needs associated with activities such as intense physical activity. It is essential to maintain a balance between energy intake and expenditure, which can be achieved through physical activity, to prevent imbalances that can lead to nutritional disorders (Mutia, Jumiya, and Kusdalinah 2022).

One of the nutritional problems of Indonesian adolescents is malnutrition, anemia and obesity. Obesity is a global health problem and is always growing rapidly. As articulated by the World Health Organization (WHO), the prevalence of overweight

and obesity in the child population, especially children aged 5 to 9 years, has increased significantly, increasing from only 4% in 1975 to 18% in 2016. This related trend is ascertained through the calculation of an individual's Body Mass Index (BMI), where a value exceeding 30 is categorized as obesity (Pratama 2023).

Obesity is defined as a medical condition characterized by abnormal or excessive accumulation of adipose tissue that exceeds conventional health thresholds. This accumulation can pose significant health risks to the individual. Obesity can be caused by a variety of factors, including genetic predisposition and environmental influences. Common contributors include frequent consumption of fast food, an unbalanced diet, excessive macronutrient intake, inadequate physical activity, genetic predisposition inherited from parents, and even a tendency to skip breakfast (Hanum 2023).

Obesity among adolescents can be attributed to limited nutritional knowledge and frequent consumption of fast food. When adolescents have a comprehensive understanding of essential nutrients, they are more likely to make healthier food choices that do not affect their physiological health. Research supports this, showing that applying nutritional knowledge when choosing food significantly influences the amount and type of food consumed by adolescents. The World Health Organization (WHO) has reported a concerning trend: global obesity rates have doubled since 1980. In 2016, approximately 1.9 billion adults were classified as overweight, with more than 600 million categorized as obese. Furthermore, data from the United Nations Children's Fund (UNICEF) in 2016 showed that Indonesia ranked second after Singapore in terms of adolescent obesity rates, at 12.2%. Trailing behind were Thailand at 8%, Malaysia at 6%, and Vietnam at 4.6% (Yarah, Martina, and Benita 2021).

According to the findings of the Basic Health Research conducted in 2018, the prevalence of obesity in Indonesia reached 21.8%, a statistic derived from the measurement of Body Mass Index (BMI). Riskesdas also shows that the proportion of lack of physical activity is quite high. Bengkulu Province, Riskesdas recorded an obesity rate of 2.9% according to BMI/A in adolescents aged 16–18 years, which varies by district or city in the province (Riskesdas 2018).

According to a survey conducted by the Bengkulu City Health Office through a survey from the Community Health Centers, there were four Community Health Centers that reported quite high cases of obesity. The Community Health Centers were Jalan Gedang Community Health Center, Lingkar Barat Community Health Center, Sidomulyo Community Health Center, Jembatan Kecil Community Health Center, and Kuala Lempuing Community Health Center. The survey also found that of the 54 adolescents 16-17 years involved at SMAN 7 Bengkulu City, Lingkar Barat Community Health Center had the highest number of obesity cases among high school students, which was 47 students.

Given the above-mentioned context, the researcher expressed a strong interest in examining the correlation between diet and physical activity on the incidence of obesity among students at Senior High School Bengkulu City. This study focused on the Lingkar Barat area, where the results of the screening found two schools under the Lingkar Barat Health Center, namely High School Number 7 Bengkulu City and High School Sint Carolus. The screening showed a coverage of 92.1%, with a total of 52 obesity cases, of which 38 came from High School Bengkulu City.

The results of Elvir Febriani et al.'s research (2020) found that individuals with obesity tend to eat not only when they feel hungry, and adolescents who

are obese often consume fatty foods in relatively larger amounts compared to consuming fiber, the imbalance between food intake and energy burned causes excess energy accumulation, which can ultimately lead to obesity. The results of Silvia et al.'s research (2021) on the relationship between eating and drinking patterns and the incidence of obesity in Tomohon (Kristiana Pelealu et al. 2021).

This investigation was designed to explain the relationship between dietary habits and physical activity with the incidence of obesity at adolences16-17 years at SMAN 7 Bengkulu City, which is recognized as one of the secondary education institutions that shows a relatively high prevalence of obesity.

METHOD

This research was conducted to determine the effect of diet and physical activity on the incidence of obesity. The investigation used quantitative methodology using a cross-sectional design. This study was conducted at high school located in Lingkar Barat Street, Bengkulu City with implementation taking place between May and June 2024. The target population of the study included all individuals enrolled in grade XI, consisting of 6 science classes and 6 social studies classes. The total sample size for this study was 81 students, selected through random sampling technique. The criteria for inclusion in this study were as follows: 1) Respondents agreed to participate in the study; 2) Respondents were between 16 and 17 years; 3) Respondents were present during the data collection phase. Exclusion criteria set for this study included: 1) Students who suffered from leg injuries; 2) Students who were unhealthy or sick. The instruments used in this study were the Physical Activity Questionnaire for Adolescents (PAQ-A) and the Eating Behavior Patterns Questionnaire (EBPQ) related to dietary habits. The distribution of each variable studied, both independent variables (diet,

physical activity), and dependent variables (Obesity incidence). Eating patterns are divided into 2 categories, namely good eating patterns if the value of the statement is ≥ 2.50 and is said to be a bad eating pattern <2.50 .

Assessment of nutritional status plays an important role in determining the presence of obesity through the BMI/A index, which involves measuring height using a microtoice and weight using a scale. The data obtained from the questionnaire, which underwent validity testing, were analyzed for reliability using the chi-square test, with a significance threshold set at $p < 0.05$ (95% confidence level). This study has received Ethical Approval from the Poltekkes Kemenkes Bengkulu No.KEPK.BKL/465/06/2024.

RESULT AND DISCUSSION

Diet Patterns, Physical Activity and the Incidence of Obesity

Table 1. Respondents' Characteristics

Characteristics	n	%
Program		
Science	40	49
Social	41	51
Total	81	100
Gender		
Male	39	48
Female	42	52
Total	81	100
Age		
16	33	41
17	48	59
Total	81	100
Obesity status		
Obes	13	16
Not obes	68	84
Total	81	100

Table 2. Dietary Patterns, Physical Activity, and Obesity Incidents at SMAN 7 Bengkulu City

No	Variabels	n	%
1	Dietary Habit		
	Not Good	16	20
	Good	65	80
	Total	81	100
2	Physical Activity		

	Not Enough	13	16
	Good	68	84
	Total	81	100
	Obesity incident		
3	Obesity	13	16
	Not Obese	68	84
	Total	81	100

From the data presented in the table, it can be concluded that a diet is considered satisfactory if the score is ≥ 2.50 , while a score < 2.50 indicates an unsatisfactory diet. Among the 81 students evaluated, 80% showed a satisfactory diet, while 20% showed an unsatisfactory diet. The students' dietary patterns showed a general preference for dessert snacks. In response to question number 4, which stated, "Sometimes I eat dessert more than once a day," 42% of respondents indicated strong agreement or agreement. In relation to question number 6, "I like sweet foods" 59% stated strong agreement or agreement. For question number 7, "I eat cake, candy, or ice cream instead of dinner," 15% responded with strong agreement or agreement, and regarding question number 8, "I used to eat candy," 47% of respondents also indicated strong agreement or agreement.

In response to questions regarding fast food consumption, the findings were as follows: For question 1, "I prefer to buy takeout and eat at home rather than prepare my own meals," 22% of participants indicated agreement or strong agreement. In response to question 16, "I eat out because it gives me more pleasure than eating at home," 16% expressed the same sentiment. In response to question 17, "I have stopped on the street to get a fast food breakfast on my way to school," a notable 11.1% indicated agreement or strong agreement. In response to question 18, "When I don't have a meal plan, I resort to fast food," 31% of respondents indicated agreement or strong agreement. In response to question 19, "I patronize fast food establishments at least three times a week," 6.17% indicated agreement. In response to question 20, "I don't like to cook," 11.1% of respondents agreed. In

response to question 23, "If I'm busy, I'll choose a snack instead of a proper lunch," 32% indicated agreement. Regarding question 30, "I often visit fast food restaurants," 6.17% indicated agreement, while for question 34, "I prefer savory food to sweet food," 28% of respondents agreed.

Regarding physical activity, the classification is divided into two categories adequate physical activity and inadequate physical activity. Physical activity is classified as adequate if the score is ≥ 3 , while it is considered inadequate if the score is < 3 . Of the 81 students, 84% showed adequate physical activity, while 16% showed inadequate physical activity. Most students only engage in physical activities provided at school, such as sports held once a week. However, there are some students who also engage in other activities such as gym and roller skating.

Obesity incidents are categorized as obesity if BMI/A $\geq +2SD$, and Overweight $+1SD - +2SD$, while non-obesity incidents are categorized as underweight $\leq -3SD - \leq -2SD$, normal $-2SD - +1SD$. Of the 81 students, it was found that students who experienced obesity were (6%), Overweight (10%), underweight (12%), and normal nutritional status (72%), when compared to the results of the 2023 Indonesian health survey, it was found that the obesity, overweight, and underweight rates were smaller than the results of the study where the results of the survey were obesity survey results of (1.9%), overweight (5.8%), and underweight (3.6%), but in normal nutritional status the survey results were greater than the study because the survey results showed that children who had good nutritional status were (84%).

Diet Pattern and the Incidence of Obesity at Adolence 16-17 Years in SMAN 7 Bengkulu City

The distribution of each variable studied, both independent variables (diet, physical activity), and dependent variables (Obesity incidence). Dietary patterns are divided into 2 categories, namely good.

Table 3. Relationship between Diet Patterns and the Incidence of Obesity at Adolescence 16-17 Years

Dietary Patterns	Obesity Incident				Total		<i>P – value</i>	CI	OR
	Obesity		Not Obese		n	%			
	n	%	n	%					
Not good	7	44	9	56	16	100	0.003	2,092- 27,966	7,648
Good	6	9	59	91	65	100			
Total	13	16	68	84	81	100			

The results show that students who are obese with poor diets are (44%), while students who are not obese with good diets are (56%). Students who are obese with good diets are (9%), and students who are not obese with good diets are (91%). Regarding the investigation of dessert consumption habits as articulated in question number 4, "sometimes - I eat dessert more than once," 42% answered affirmatively, indicating strong agreement. For questions about sweets as asked in question number 6, "I have an interest in sweets," and question number 7, "I eat cakes, candy, or ice cream as a substitute for dinner," the responses to question 6 showed strong agreement and agreement at the level of 59%, while question number 7 received overwhelming agreement and agreement from 15% of respondents, and question number 8 gathered overwhelming agreement and agreement from 47%.

The findings from the data analysis revealed a p-value of 0.003 ($p < 0.05$), revealing that there is a significant correlation between eating patterns and the incidence of obesity among 16-17 years at SMAN 7 Bengkulu City, with an Odds Ratio (OR) of 7.648 indicating that students with poor eating habits face a 7.6-fold increased risk of obesity compared to their peers with satisfactory eating habits.

The Relationship Between Physical Activity and Obesity at SMAN 7 Bengkulu City

The correlation between the independent variable of physical activity and the dependent variable of obesity incidence was evaluated using the chi-square test. Physical activity includes body movements that involve the muscular system, increase energy expenditure, and are usually integrated into daily routines, including sports or physical training.

The investigation used the Physical Activity Questionnaire for Adolescents (PAQ-A) to evaluate participant physical activity levels, either conducted within educational institutions or during domestic settings, with activities carried out from Monday to Sunday or throughout the week.

The results of the analysis of physical activity and obesity incidence among adolescents at high school Bengkulu City are presented in table 3.

Table 3. Relationship between Physical Activity and the Incidence of Obesity in at Adolence 16-17 Years

Physical Activity	Obesity Incident				Total		P – value	CI	OR
	Obesity n	%	Not Obese n	%	N	%			
Not enough	6	46	7	54	13	100	0.005	1,952-28,581	7,469
Enough	7	10	61	90	68	100			
Total	13	16	68	84	81	100			

Findings from the chi-square test using a 2x2 contingency table showed that obese students with reduced physical activity showed a prevalence rate of 46%, while non-obese students with reduced physical activity showed a prevalence of 54%. In contrast, non-obese students who engaged in adequate physical activity reported a prevalence rate of 10%, and their non-obese peers who engaged in sufficient physical activity showed a prevalence rate of 90%. The results of the analysis produced a p value of 0.005 ($p < 0.05$), leading to the conclusion that there is a statistically significant relationship between physical activity levels and the incidence of obesity in adolescents 16-17 years at SMAN 7 Bengkulu City. The Odds Ratio (OR) of 7.469 indicates that students with inadequate physical activity are 7.4 times more likely to be obese compared to their peers who engage in sufficient physical activity.

Eating Patterns

The findings of the study on 81 students SMAN 7 Bengkulu City revealed that most teenagers, especially 19.7% or 16 students were classified as having bad eating habits. Questionnaire analysis showed that these students showed a tendency to consume sweet foods as snacks, in addition to a tendency towards fast food consumption habits, and usually consumed sweet foods in large quantities, had a habit of skipping

breakfast so that at lunch students often consumed large amounts of food to feel full.

The adolescent diet includes a variety of foods and their corresponding processed products, which differ significantly in terms of their nature, quantity, and frequency of consumption. An unbalanced dietary regimen, characterized by the consumption of foods that exceed the recommended levels of nutrient intake and show a lack of variety, increases the likelihood of overnutrition. The onset of obesity can occur when a person consumes foods that are calorie-dense, rich in fat and carbohydrates, but lacking in fiber. In such circumstances, nutrients are converted into adipose tissue that accumulates in the body, caused by the dissonance between calorie intake and energy expenditure (Kristiana Pelealu et al. 2021):

An optimal diet must be complemented by achieving balanced nutrition, which requires meeting the body's nutritional needs from daily food intake. Dietary patterns indicate how a person meets their nutritional needs, including the nature, quantity, and frequency of food consumption. These balanced nutritional sources are categorized into three different groups: sources of energy, sources of building substances, and sources of regulating substances. Food groups include staple carbohydrates, animal protein sources, vegetable protein sources, vegetables, and fruits (Utami, Kamsiah, and Siregar 2020).

Most boys and girls tended to have consistently below-average healthy eating patterns. Others showed less stable patterns, although starting with above-average healthy eating scores, but experiencing a slight decline after adolescence, especially in girls. Most concerning was the increase in Western-style eating patterns in boys, starting at age 16 and above. In girls, Western-style eating patterns actually declined after adolescence. These findings suggest that the majority of adolescents are unable to maintain consistent healthy eating patterns throughout adolescence (Appannah et al. 2021). The study also showed significant correlations between different types of unhealthy foods, such as alcohol and beer, alcohol and fast food, and cookies and fast food. In comparison, significant correlations were also found between healthier foods, such as beans and meat or fish, fish and rice or pasta, and fruits and vegetables (Martín-Rodríguez et al. 2022).

According to the international journal of food and nutrition bulletin. The presence of restaurants within 400 meters of a school child's home was associated with an increased likelihood of being overweight, particularly among children who reported frequent use of these restaurants. This association was seen both when restaurants were analyzed separately and when considering the broader food environment (e.g., presence of other food outlets). In addition, children who lived close to social assistance facilities but did not use them also showed a higher risk of being overweight (Rossi et al. 2023). According to the European journal Fast food choices among adolescent girls in this study may be influenced by taste, convenience, and cost factors. Most fast foods that are preferred because they taste good, are practical, and are cheap, are usually high in fat and sugar and are processed foods, which contribute to unhealthy eating habits. These fast foods are also generally

low in fiber. This eating pattern is considered to be one of the triggers of obesity (G. O. and C. A. 2021).

Physical Activity on Obesity Incidents

Research results on 81 at SMAN 7 Bengkulu City, who have less physical activity as many as (16%) or 13 students. Many students only do light physical activity, because when they get home from school students spend most of their days sleeping and playing online games via gadgets. While for moderate and heavy physical activities are rarely done when not at school, on average adolescence only do sports when entering sports lessons from school. Physical activity refers to any bodily movement produced by skeletal muscles that requires energy expenditure. This involvement includes all forms of movement, whether performed during leisure time periods or integrated into one's work responsibilities (Owen 2016).

Decreased physical activity levels correlate with lifestyle transitions associated with modernization, where advances in practical technology, such as modes of transportation, reduce the frequency of walking due to greater reliance on motorized vehicles. In addition, sedentary lifestyles have become increasingly prevalent, characterized by a greater proportion of daily activities performed while sitting, including reading, watching television, playing video games, and using computers, with minimal physical involvement (Emilia and Cilmiyati 2020). Outdoor activities affect weight management. As described in the materials and methods, more than two hours of television viewing per day was recognized as a significant indicator of physical inactivity. There was a statistically significant difference between physical inactivity and the incidence of overweight and obesity. The investigation revealed that the prevalence of overweight was significantly

increased among adolescents who did less than one hour of physical activity per day, watched television for four hours per day, and consumed chocolate every day (Chincholikar and Sohani 2019).

The Incidence of Obesity in Students at Adolence 16-17 Years

The results of the study on 81 adolence 16-17 Years at SMAN 7 Bengkulu City, some students were obese (6%), overweight (10%). This figure is higher than the results of the 2023 Indonesian health survey Bengkulu province which showed that BMI/U aged 16-18 years was obese with a figure of (1.9%), and overweight with a figure of (5.8%). While the survey results showed that normal nutritional status was obtained at (72%), when compared to the results of the health survey this figure is smaller, but in underweight nutritional status this figure is larger because the results of the study obtained (12%), when compared to the results of the 2023 Indonesian health survey report of (3.6%) for underweight nutritional status (Aulia 2021).

Nutritional status is defined as a condition determined by the level of physical needs for energy and nutrients obtained from food intake, manifesting measurable physical effects. Nutritional status serves as an indicator of the quality of daily food and reflects the body's balance as expressed through certain variables. The nutritional status of adolescents requires special consideration because of its critical role in influencing growth and development in adulthood. In addition to being shaped by health status, knowledge, economic factors, environmental conditions, and cultural influences, nutritional status depends on energy and protein consumption patterns (Khoirunnisa and Kurniasari 2022).

Overweight or obesity is characterized by excessive accumulation of adipose tissue that has adverse effects on health. This condition can affect individuals across all age demographics, including both genders, but is mostly observed among adolescents and adults. Overweight is identified as a state in which the body exhibits excessive fat accumulation, denoted by a Z-Score (BMI-for-Age) exceeding 1 SD to -2 SD. This condition reflects an individual's awareness of their physical health. Health organizations universally recommend involvement in physical activity, as inadequate levels of exercise may increase the risk of obesity among adolescents (Roy et al. 2022).

Contemporary empirical definitions of obesity are primarily assessed by body mass index (BMI), derived by dividing an individual's weight in kilograms by the square of their height in meters. This metric serves as the standard clinical instrument for evaluating overweight and obesity in pediatric populations aged two years and older. However, BMI is only an indication of body fat levels, and while it is fairly reliable for healthy pediatric populations, it may slightly overestimate body fat levels in children who are short or have low muscle mass due to lack of physical activity (Calcaterra et al. 2022).

The Relationship between Diet Patterns and the Incidence of Obesity

Statistical analysis using Chi-square test (0.003) indicating a substantial correlation between dietary practices and obesity prevalence among students in SMAN 7 Bengkulu City. The odds ratio (OR) of 7.648 revealed that students who exhibited inadequate dietary habits faced a 7.6-fold increase in the likelihood of developing obesity compared to their peers who maintained a nutritionally adequate diet. This finding indicated that among students with suboptimal dietary patterns, 44% were

classified as obese, while only 56% of those with non-obese dietary habits fell into the same category; in contrast, 9% of students who followed a healthy diet were characterized as obese, with a significant 91% of those who were not classified as obese also following a nutritious diet. This underscores the potential relationship between dietary practices and the prevalence of overnutrition in the adolescent population. Adolescents who consumed more than three meals per day tended to exhibit increased food intake compared to those who consumed only two, which could ultimately lead to excessive calorie consumption. Increased meal frequency correlated with increased likelihood of malnutrition (Amrynia and Prameswari 2022).

The frequency of food consumption has a more significant influence on daily food consumption choices, while nutrient intake is a direct result of the food selection process. Nutritional status depends on nutrient consumption and the body's physiological capacity to adequately assimilate these nutrients, with adolescents' food choices significantly shaped by their environmental context. Adolescents often show a preference for foods that are rich in sodium and fat but deficient in essential vitamins and minerals. According to the study findings, there is a significant relationship between dietary habits and the incidence of overweight in adolescents attending High School in Jambi. Dietary intake plays a significant role in an individual's growth and development, as factors such as portion size, energy density of foods, eating patterns, meal frequency, and types of foods consumed each day can significantly influence the risk of overweight (Andrini, Aisah, and Ariyanto 2023). This study is in line with research conducted by Purwo Setiya et al. (2020), which showed that junk food consumption and meal frequency correlated with obesity prevalence among 18 junior high school students in Samarinda. These results

imply that such dietary patterns can increase the risk of obesity in later life stages (Nugroho and Hikmah 2020).

The Relationship Between Physical Activity and the Incidence of Obesity at Adolescence 16-17 Years

The results obtained from the chi-square statistical analysis showed a p value of 0.005, a significant relationship between physical activity levels and obesity incidence among students SMAN 7 Bengkulu City. The OR of 7.469 illustrates that students who engage in insufficient physical activity are 7.4 times more likely to be classified as obese compared to those who maintain moderate levels of physical activity. The findings of this investigation revealed that among students with low levels of activity, 46% had a nutritional status categorized as obese, while 54% of the same inactive students were not classified as obese; conversely, among students with adequate levels of activity, 10% were identified as obese, while 84% of those with sufficient levels of activity were not categorized as obese.

The findings of this study are consistent with the statement made by M. Dody Izhar (2020), who argued that involvement in physical activity is an important element that has the potential to increase energy expenditure. As a result, lack of physical activity can increase susceptibility to obesity. Several scientific studies have shown that the habit of watching television for a long time (sedentary behavior) is correlated with an increased incidence of obesity. Conversely, participation in moderate to vigorous physical activity can reduce the likelihood of developing obesity (Izhar 2020).

This study confirms the findings of a study conducted by Komang Ayu et al. (2023), which determined that the obesity rate among adolescents High School in Denpasar during the Covid-19

pandemic reached 16.2%. The proportion of physical activity among adolescents High School in Denpasar during the pandemic was documented at 41.0%, with 59.0% categorized as engaging in light activity, and no examples of moderate or vigorous physical activity were recorded. There was a statistically significant correlation between the level of physical activity and the occurrence of obesity among adolescents High School in Denpasar. Activities such as playing electronic games can increase calorie consumption and reduce metabolic rate. The habit of eating while watching TV is also common among families. In addition, both obese men and women reported eating in response to stress, eating more frequently, and having shorter sleep durations. The percentage of obesity increased significantly with lack of exercise (especially intensive and moderate physical activity) or decreased exercise time per week. Both obese men and women did not walk for 10 minutes (Abdelmalek et al. 2022).

CONCLUSION

The study findings revealed a relationship between diet and physical activity and obesity in adolescence 16-17 years at SMAN 7 Bengkulu City. Recommendations for further research include providing nutrition education to students, thereby increasing the robustness of future investigations.

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