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Comparative Analysis of Diet Quality Among Junior High School Students Receiving and Not Receiving Free Nutritious Meals in Bogor City

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ABSTRACT

Adolescents are a group of people undergoing transitional growth, during which their nutritional needs increase significantly. Based on DQI-A, the diet quality of adolescents aged 13–15 years in Bogor is classified as poor, at only 32.2%. The Free Nutritious Meals (MBG) program aims to ensure that adolescents consistently consume a balanced diet at school. This study aims to analyze the differences in diet quality among junior high school adolescents who are recipients (88 students from SMP PGRI 6) and non-recipients (88 students from SMP PGRI 5) of the free nutritious meals program at school. A cross-sectional comparative design was used involving 176 students selected purposively. Data on individual and family characteristics were collected through structured questionnaires; dietary intake was assessed by two non-consecutive 24-hour recalls conducted by trained interviewers using food photographs and the DQI-A method to measure the quality of the subjects' diets, including dietary quality, dietary diversity, and dietary equilibrium. Data were analyzed using the Mann–Whitney test and the independent-sample t-test. Results showed no significant differences in individual and socioeconomic characteristics between groups ($p>0.05$). However, significant differences were found in all DQI-A components, including dietary quality, dietary diversity, and dietary equilibrium ($p<0.001$). The MBG group had a higher average total DQI-A score (49.81%) compared with the non-MBG group (39.15%). These results show that the MBG program helps teens eat better. Recommendations include strengthening the availability and variety of nutritious foods in school meal programs, enhancing nutrition education in schools, and encouraging collaboration among schools, parents, and policymakers. Future researchers are advised to

examine the long-term effects of the MBG program on both nutritional status and academic performance.

Keywords
Free nutritious meal program
Comparative analysis
Diet quality
Adolescents

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Introduction

Adolescents are people who are going through a change in their physical, mental, and emotional growth from being a kid to being an adult. At this point, their dietary needs go up a lot to help them grow, develop their brains, and mature their reproductive organs [1], [2]. But a lot of teens have trouble getting the nutrients they need every day because they don't eat regularly, they like fast food, and they don't know how important it is to maintain a balanced diet [3]. Based on research by Devie and Dwiriani (2020), the quality of consumption among adolescents aged 13–15 years in Bogor, based on DQI-A, is classified as poor diet quality, which is only 32.2%. In this study, the consumption of foods that are sources of fat was excessive, at 11.05 servings (the recommended amount is 6 servings), while other food groups, namely sources of carbohydrates, animal protein, vegetable protein, milk, vegetables, and fruit, were still below the recommended amount, with the lowest consumption being vegetables, at only 0.06 servings [4]. The intake of vegetables and fruits was particularly low, while consumption of fatty foods exceeded recommendations. This condition highlights the need for strategic interventions aimed at improving adolescents' dietary behaviors.

School settings play a vital role in shaping healthy eating habits because adolescents spend a substantial portion of their time there. International evidence has shown that free school meal programs can significantly improve students' nutritional intake, diet diversity, academic performance, and even school attendance [5], [6], [7]. For instance, studies in the United States through the National School Lunch Program (NSLP) demonstrated that program participants had higher diet quality scores than nonparticipants [8]. In Brazil, the National School Feeding Program (PNAE) increased the consumption of fresh and minimally processed foods while reducing the intake of ultra-processed items [9]. Similarly, free healthy school meal programs in Norway have been shown to improve fruit and vegetable consumption among school-aged children [10]. These findings suggest that structured food provision programs can effectively support improved dietary patterns among adolescents.

Healthy eating habits during adolescence can optimize health, growth, and cognitive development and can contribute to the prevention of chronic diseases later in life. Research shows that nutritional behavior continues from adolescence into adulthood, and thus it is important to establish healthy eating habits early on [2], [11], [12]. In Indonesia, the government introduced the Free Nutritious Meals (MBG) program as part of an effort to ensure that students receive balanced meals at school. However, the implementation of MBG is relatively new, and empirical evidence regarding its impact on adolescent diet quality is still limited. Research evaluating the effectiveness of such programs, particularly in the Indonesian context, is therefore essential to guide policy development and program improvement. The comparison between MBG-recipient and non-recipient schools within the same urban environment provides an ideal context to examine the program's impact while minimizing confounding differences. Moreover, previous studies in Bogor have consistently reported inadequate diet quality among adolescents, reinforcing the relevance and urgency of conducting this evaluation.

Bogor City was chosen as the research location because it represents an urban setting with diverse socioeconomic characteristics and has implemented the MBG program for more than six months in selected schools. The novelty of this study lies in its assessment of the MBG program using the Diet Quality Index for Adolescents (DQI-A), an instrument that has been validated internationally but rarely applied to evaluate school-based nutrition interventions in Indonesia. Additionally, no prior comparative study in Bogor has specifically analyzed differences in dietary quality, diversity, and equilibrium between adolescents receiving and not receiving MBG. This creates a research gap that the present study aims to fill.

The quantity and quality of food consumption are greatly influenced by household availability and access, and providing nutritious meals at school is a government effort to improve the availability of quality food [13], [14]. Therefore, this study aims to evaluate the effectiveness of free nutritious meals programs in schools in improving the quality of diets among adolescents by comparing students who receive and do not receive free nutritious meals from the government.

Material and Methods

This study employed a cross-sectional comparative design to assess differences in diet quality between adolescents receiving and not receiving the Free Nutritious Meal (MBG) program in Bogor City. The research was conducted at two purposively selected junior high schools, SMP PGRI 6 and SMP PGRI 5. SMP PGRI 6 was selected because it was the only school

in Bogor City that had participated in the MBG program for more than six months, meeting the minimum duration required to evaluate the impact of the program, while SMP PGRI 5 served as a comparable control school that had not received the MBG program and was located closest to SMP PGRI 6 Bogor. Both schools are located in similar urban environments in Bogor City, which minimizes variations in socioeconomic and environmental factors and strengthens internal validity. Thus, it is expected that these two schools represent the entire population of junior high school students in Bogor City, and their similarities make them suitable for controlled comparison.

The study population consisted of all eighth-grade students in both schools. The study population consisted of all eighth-grade students in both schools, totaling 348 students. The sample size was determined using the Lemeshow formula with a poor diet quality proportion of 32.2%, resulting in a minimum requirement of 83.86 students per group. To anticipate potential dropouts, 88 students were selected from each school, bringing the total sample to 176 students. Data were collected on individual characteristics (age, gender, pocket money) and family socioeconomic characteristics (parental education, parental occupation, family income, and family size) using validated questionnaires. Dietary intake was assessed by two non-consecutive 24-hour recalls conducted by trained interviewers using food photographs, and the DQI-A method was used to measure the quality of the subjects' diets, including the components of dietary quality, dietary diversity, and dietary equilibrium [15]. The DQ score ranges from -100 to 100%. The weighting factor consists of +1 (preference group), 0 (intermediate group), and -1 (low-nutrient, energy-dense group). Foods included in the preference group are those with low energy density (<1.5 kcal/g); the intermediate group includes foods with moderate energy density (1.5–4 kcal/g); and the low-nutrient, energy-dense group includes foods with high energy density and low nutrient content (> 4 kcal/g [16].

Statistical analysis was performed using Statistical Program for Social Science (SPSS) version 27.0 for Windows. Statistical tests conducted included normality tests (shapiro-wilk) and difference tests to examine the distribution of interval and ratio scale data, namely individual characteristics, family characteristics, and diet quality. The difference test used the independent-sample T-test (parametric) for normally distributed data, while the Mann-Whitney test (non-parametric) was used for non-normally distributed data. This study has been approved by the Research Ethics Committee of Airlangga University with number 0676/HRECC.FODM/VI/2025.

Results and Discussions

This study concentrated on eighth-grade junior high school students, specifically comparing two cohorts: 88 students from PGRI 6 Junior High School in Bogor City, who engaged in the MBG program, and 88 students from PGRI 5 Junior High School in Bogor City, who did not participate in the MBG program.

Data on subject characteristics were collected to provide an overview of the students' demographics and socioeconomic status. Table 1 contains information regarding the characteristics of the subjects and the socioeconomic status of their families.

Table 1. Characteristics of subjects and family socioeconomic status

Characteristic	MBG		Non MBG		*p-value*
	n	%	n	%	
Sex					
Male	40	45,5	35	39,8	0,446
Female	48	54,5	53	60,2	
Age					
12	1	1,1	1	1,1	
13	74	84,1	76	86,4	0,679
14	12	13,6	10	11,4	
15	1	1,1	1	1,1	
Mean	13,15		13,13		
Pocket money					
< Rp 20.000	42	47,7	44	50,0	0,562
≥ Rp 20.000	46	52,3	44	50,0	
Mean	Rp17.943		Rp 18.772		
Father's education					
No school	1	1,1	1	1,1	
Elementary School	2	2,3	6	6,8	0,659
Junior high school	13	14,8	10	11,4	
High school	53	60,2	53	60,2	
University	19	21,6	18	20,5	
Father's job					
Laborer/farmer	19	21,6	19	21,6	
Employee	41	46,6	34	38,6	0,223
PNS/TNI/Polri	9	10,2	7	8,0	
Entrepreneur	13	14,8	25	28,4	
Others	6	6,8	3	3,4	
Mother's education					
No school	1	1,1	1	1,1	0,142
Elementary School	5	5,7	15	17,0	
Junior high school	10	11,4	11	12,5	
High school	54	61,4	50	56,8	
University	18	20,5	11	12,5	
Mother's work					
IRT/not working	62	70,5	70	79,5	0,164
Work	26	29,5	18	20,5	
Monthly income					0,444

<Rp5.126.897	54	61,4	49	55,7	
≥Rp5.126.897	34	38,6	39	44,3	
Large family					
≤4 person	48	54,5	38	43,2	0,119
>4 person	40	45,5	50	56,8	
Mean	4,41		4,67		

Based on the results of the analysis of the individual characteristics of the subjects, it was found that the distribution of gender in both groups was predominantly female, namely 54.5% in the MBG group and 60.2% in the non-MBG group. Based on age, most respondents were 13 years old in both groups, namely 84.1% in the MBG group and 86.4% in the non-MBG group. Based on daily pocket money, both groups had a majority pocket money distribution of ≥ Rp 20,000, with an average pocket money for respondents in the MBG group of Rp 17,943 ± 6,731, while in the non-MBG group it was Rp 18,772 ± 8,195. Research conducted by Sahara shows that age, gender, and the amount of money an individual has affect the quality of their diet [17].

Parental education shows that the majority of fathers and mothers of respondents have a high school education or equivalent, with 60.2% of fathers in both groups having a high school education, while 61.4% of mothers in the MBG group and 56.8% in the non-MBG group have a high school education. Most fathers work as private employees, namely 46.6% in the MBG group and 38.6% in the non-MBG group, and the majority of mothers are housewives, namely 70.5% in the MBG recipient group and 79.5% in the non-MBG group. More than half of the families in both groups had incomes below the Bogor City minimum wage (Rp5,126,897), namely 61.4% in the MBG group and 55.7% in the non-MBG group. In addition, most families had ≤4 members, namely 54.5% in the MBG group and 43.2% in the non-MBG group. People from low socioeconomic groups typically consume high-energy, low-nutrient foods, while a healthy diet is generally correlated with prosperity, and products such as fruits, vegetables, low-fat milk, and fish are typically consumed by higher socioeconomic groups [18].

The results of this analysis show that there are no statistically significant differences between the MBG and non-MBG adolescent groups in all characteristics analyzed, both individual and family socioeconomic characteristics. These similarities indicate that both groups come from homogeneous backgrounds, so that comparisons between them can be considered valid and unbiased by differences in these basic factors.

Table 2 shows the data on the difference in average diet quality based on DQI-A among adolescents who received the MBG program and those who did not. Based on the results of the comparison analysis of diet quality scores using the Diet Quality Index for Adolescents (DQI-A), there was a statistically significant difference between the MBG and non-MBG adolescent

groups in all components measured. The normality test (Shapiro–Wilk) showed that the distribution of Dietary Quality Index - Adolescence (DQI-A) and Dietary Equilibrium (DE) in both the MBG and non-MBG groups followed a normal distribution ($p > 0.05$). The homogeneity test using Levene's test indicated that the data variance across groups was homogeneous ($p > 0.05$). For variables that did not meet normality assumptions dietary quality and dietary diversity using Mann–Whitney tests were used.

The average Dietary Quality (DQ) score in the MBG group was 53.22 ± 15.78, much higher than the non-MBG group, which was only 38.71 ± 25.54. The Dietary Diversity (DD) score, which represents the diversity of foods consumed, was also significantly higher in the MBG group (62.96 ± 6.63) than in the non-MBG group (54.0 ± 6.68). In addition, the Dietary Equilibrium (DE) score, which reflects the balance between food intake and nutritional needs, was also better in the MBG group with an average of 33.25 ± 6.06 compared to the non-MBG group, which only scored 24.83 ± 7.62. Overall, the average total DQI-A score in the MBG group was 49.81 ± 6.92, significantly higher than the non-MBG group, which only obtained an average score of 39.15 ± 10.26 with a p-value based on the Mann-Whitney test of < 0.001.

Table 2. Differences in average DQI-A scores between adolescents who received and did not receive the MBG program

Category DQI-A	MBG (n=88)	Non MBG (n=88)	*p*
Dietary Quality (±SD)	53,22 (±15,7)	38,71 (±25,5)	<0,001[a*]
Dietary Diversity (±SD)	62,96 (±6,63)	54,0 (±6,68)	<0,001[a*]
Dietary Equilibrium (±SD)	33,25 (±6,06)	24,83 (±7,62)	<0,001[b*]
Total DQIA	49,81(±6,92)	39,15 (±10,26)	<0,001[a*]

Note: *significant if p<0.05 [a]Mann Whitney test, [b]Independent Sample T-test

The results of the DQI-A score analysis show that students who participate in the Free Nutritious Meals (MBG) program have a significantly better diet quality than students who do not. These findings are consistent with previous studies showing that students participating in the National School Lunch Program (NSLP) had higher diet quality scores than students who did not participate in the NSLP, where diet quality was measured using the Healthy Eating Index (HEI)-2010 [8]. Higher DQI-A scores in the MBG group reflect greater nutritional diversity and balance, as well as better diet quality in line with the principles of balanced nutrition. A study by Boklis-Berer et al. (2021) concluded that school meal consumption is associated with better diet quality among Brazilian adolescents, where participation in school meal programs is linked to healthier eating patterns, including greater consumption of fruits and vegetables [9], [19].

The higher dietary diversity component in the MBG group indicates that this program is likely successful in encouraging the consumption of various types of food from different food groups. This aspect is important because dietary diversity is a strong indicator of nutritional adequacy, especially in meeting micronutrient requirements. A study in Sidama, Ethiopia, found that the School Feeding Program (SFP) significantly increased dietary diversity and the intake of certain micronutrients among adolescent girls [20], [21]. In this study, girls who were program recipients had higher average diversity scores than non-recipients. Consistent with research in Ghana, free lunch programs for high school seniors increased daytime DDS (7.5 vs. 6.5) and overall daily DDS (11.5 vs. 9.3) compared to non-recipients [22].

A study of 7- to 13-year-olds found that when schools provided free meals, the quality of students' lunches improved significantly compared to when students brought lunch from home or purchased it [11]. This is particularly relevant to MBG, as the MBG program exempts students from fees and facilitates access to nutritious food at school. Significant differences in the DQI-A components (quality, diversity, and balance) can explain access to healthier, nutritionally balanced meals in more controlled quantities and varieties because they are directly regulated and supervised by nutritionists.

Based on research by Devie and Dwiriani, the quality of consumption among adolescents aged 13–15 in Bogor based on DQI-A is classified as poor, which is only 32.2% [4] not much different from the results of this study in the group of adolescents who did not receive the free nutritious meal program, which was 39.15. Meanwhile, the diet quality score based on DQIA among adolescents receiving the free nutritious meal program was higher, at 49.81. The study's results reveal a significant relationship between the Free Nutritious Meals (MBG) program and the dietary quality of adolescents. Adolescents who received MBG had a significantly higher proportion of high DQI-A scores compared to the non-recipient group ($p<0.001$). DQI-A is an indicator used to assess the suitability of dietary patterns with modifications to balanced nutrition guidelines, which include consumption of water, carbohydrates, animal-based side dishes, plant-based side dishes, vegetables, fruits, milk and dairy products, fats and oils, and restrictions on consumption of snacks, candy, and sweetened beverages.

Table 3. Differences in average portion sizes consumed by adolescents who are and are not recipients of the MBG program.

Food Group	Recommended Serving Size	MBG	Non MBG
Recommended Foods			
Water (ml)	2000	1295,9	1109,4

Carbohydrates	4,5-6,5	4,99	4,56
Animal-based side dishes	3	3,07	2,76
Plant-based side dishes	3	0,3	0,31
Vegetables	3	0,38	0,23
Fruits	4	0,89	0,37
Milk and dairy products	1	0,63	0,33
Fats and oil	5-6	5,02	4,37
Foods that are not recommended			
Snacks & candy	< 50 g	57,58	68,72
Sweetened beverages	<300 ml	140,47	187,01

An analysis of the average intake of food groups revealed differences in consumption patterns between the MBG group and the non-MBG group. The average water consumption in the MBG group was 1295.9 ml, while in the non-MBG group it was 1109.4 ml, both of which were still below the recommended 2000 ml per day. The carbohydrate intake in the MBG group was 4.99 servings, slightly higher than the non-MBG group at 4.56 servings, and met the recommendation of 4.5–6.5 servings per day. The average consumption of animal-based side dishes in the MBG group was 3.07 servings, and in the non-MBG group, it was 2.76 servings. These results indicate that the animal protein intake of adolescents in the MBG group was higher and met the daily requirement of 3 servings. The average consumption of plant-based side dishes in both groups was still low, at 0.30 servings in the MBG group and 0.31 servings in the non-MBG group, still far below the recommendation of 3 servings per day.

The average vegetable consumption in the MBG group was higher at 0.38 servings and in the non-MBG group at 0.23 servings, while fruit consumption in the MBG group was 0.89 servings and in the non-MBG group at 0.37 servings. Although fruit and vegetable intake in the MBG group was higher than in the non-MBG group, the values were still far from the recommended 3 servings of vegetables and 4 servings of fruit per day. The average consumption of dairy products and their derivatives in the MBG group was 0.63 servings, and in the non-MBG group, 0.33 servings, which was close to the recommended 1 serving per day. Oil consumption in the MBG group was 5.02 servings, while in the non-MBG group it was 4.37 servings, and both were in line with the recommendation of 5–6 servings per day. In both groups, consumption of foods that are not recommended exceeded the recommended limit of less than 50 grams per day; specifically, snack and candy consumption in the MBG group was 57.58 grams, while in the non-MBG group it was 68.72 grams. Sugary drink consumption in the

MBG group was 140.47 ml, lower than the non-MBG group at 187.01 ml, but both were still within the recommended limit of <300 ml per day.

The results of this study indicate that the MBG group has a better consumption pattern approaching the Balanced Nutrition Guidelines compared to the non-MBG group. The consumption of carbohydrates, animal protein, dairy products, and oil in the MBG group is more in line with the recommended intake, while the consumption of unhealthy foods such as snacks and sugary drinks is lower compared to the non-MBG group. These findings suggest that participation in the MBG program has a positive impact on food consumption behavior. In line with the school meal program in Brazil, the National School Feeding Program (PNAE) positively influences overall diet quality, increasing the consumption of healthy foods and reducing the consumption of unhealthy foods. This study compares the dietary patterns of adolescents attending schools without meals provided by PNAE (private schools) with those provided by PNAE (public schools), showing that Brazilian adolescents in schools without PNAE are more likely to consume salty foods and soft drinks ≥ 5 times/week. Additionally, children who consume school meals show higher consumption of fresh and minimally processed foods and experience a significant decrease in ultra-processed foods compared to students who do not consume school meals [5]. Water consumption in both groups was still below the recommended 2,000 ml per day. This condition indicates that adolescents have not yet optimally formed the habit of drinking enough plain water, as also reported in the study Briawan et al, that 37.3% of adolescents in Bogor consumed less than 8 glasses of plain water per day [23]. Vegetable and fruit intake in both groups was also far from the recommended amount. This statistic is consistent with data from Riskesdas 2018, which states that 95.5% of Indonesians consume vegetables and fruits less than recommended [24]. However, vegetable and fruit consumption in the MBG group was higher than in the non-MBG group, The results of this study are in line with research conducted on a one-year free healthy school meal program that increased fruit and vegetable intake in schools in Norway [10]. A systematic review in the United States shows that universal free school meal programs (UFSM) increase consumption of fruits, vegetables, fish, whole grains, low-fat protein, and low-fat milk, while reducing consumption of sugar, sodium, and saturated fat [25]. Nevertheless, food consumption in the MBG (sugary snacks and drinks) group was recorded as lower compared to the non-MBG group.

Conclusion

The research results indicate that there were no statistically significant differences between the MBG program recipients and non-MBG groups across all analyzed characteristics, including individual and family socioeconomic characteristics. This similarity in characteristics

indicates that both groups come from a relatively similar background. The results of the comparative analysis of diet quality scores using the Diet Quality Index for Adolescents (DQI-A) showed significant differences between MBG and non-MBG adolescent groups across all measured components, including dietary quality, dietary diversity, and dietary equilibrium. Overall, the average total DQI-A score in the MBG group was 49.81%, which was significantly higher than the non-MBG group, which only scored average of 39.15%. These results of this study have important implications for the development of MBG program policies at the regional and national levels. The finding that MBG recipients have better diet quality indicates that this program has the potential to be an effective strategy in promoting healthy eating behaviors among adolescents.

Based on the research results, several recommendations can be proposed for policymakers and relevant stakeholders. First, the continuation and expansion of the MBG program should be considered, especially to schools with high nutritional risk, as the program has shown measurable benefits in improving diet quality. Second, it is recommended that the government enhance the nutritional composition of MBG meals, particularly by increasing the inclusion of fruits, vegetables, and plant-based proteins, which were still below recommended intake levels. Third, schools and local health offices should strengthen nutrition education activities to build long-term healthy eating habits among adolescents. Fourth, collaboration among schools, parents, nutritionists, and food providers needs to be improved to ensure that healthy eating practices are supported both in school and at home. Finally, future evaluations should monitor MBG implementation regularly to ensure quality control, identify challenges, and adjust program strategies based on evidence. For future researchers, further studies are needed to evaluate the long-term impact of MBG on the nutritional status, academic achievement, and health of adolescents, as well as to conduct research in a wider area so that the research results are more representative. Qualitative research also needs to be conducted to explore the experiences of students, teachers, and program managers in order to understand the supporting factors and obstacles in the implementation of MBG so that it can be used as a basis for program improvement in the future.

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Conflict of Interest

The authors declare no conflict of interest.

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