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Determinants of diet quality among boarding school adolescents

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ABSTRACT

Background: Adolescents at boarding schools encounter organized food conditions that may affect dietary quality and, if inadequate, elevate the risk of long-term health issues. This study aimed to analyze Determinants of Diet Quality among Islamic Boarding School Adolescents.

Methods: A cross-sectional study of 153 teenagers attending a boarding school was carried out. Based on important food group components, a composite diet quality score was used to evaluate the quality of the diet. Structured questionnaires were used to gather data on sociodemographic traits, health-related variables, fasting habits, and monthly allowance. To find factors influencing food quality, bivariate relationships were examined using Pearson correlation tests and then multiple linear regression using a stepwise method.

Results: Overall, the mean total diet quality score was 42.95 ± 2.82, which, according to the Healthy Eating Index (HEI) classification applied in this study (poor <51; moderate 51–80; good >80), indicates a poor or unhealthy diet quality among the boarding school adolescents. A Pearson correlation analysis found that a strong negative correlation was observed between sex and type of school ($r = -0.767$, $p < 0.01$), indicating a high degree of collinearity between these variables, which was considered in subsequent multivariate analyses. In a multivariate analysis, nutrition quality was significantly predicted by sex ($\beta = 0.362$, $p < 0.05$) and school type ($\beta = 0.831$, $p < 0.01$). Other characteristics that had little influence on diet quality were food allergies, medical history, fasting habits, age, and monthly allowance. The final regression model explained 31.5% of the variation in the diet quality scores.

Conclusion: Diet quality among boarding school teenagers remains inadequate, and it is strongly impacted by school type and gender. These findings emphasize the relevance of school-based nutrition policy and gender-sensitive interventions for improving food quality in boarding school settings.

KEYWORDS

Healthy Eating Index, closed school environment, institutionalized adolescents, sociodemographic factors, school nutrition, Indonesia.

INTRODUCTION

Adolescence is an important time for the establishment of eating habits and, to some large extent, the development of the body[1]. These early eating habits affect the adult life of people and the risks of developing various chronic diseases[2,3]. Adolescents who fail to eat healthy food choices will encounter negative effects, as they avoid eating fruits, vegetables, and high fiber diets but rather consume sugar-sweetened drinks and processed food more often[4]. This scenario is a global concern to those in the field of health care. These poor food choices of adolescents increase the chances of having health problems during their adulthood life[5]. These food choices have long-term effects concerning the overall well-being of the individual[6]. It is vital for adolescents to eat enough fruits and vegetables as well as fiber diets in order to develop strong and healthy bodies[7]. These food choices and their availability to the adolescent are highly influenced by the environments where the adolescents spend most of their valu-

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able time[8]. The school environment represents the most important setting where children spend most of their time.

Boarding schools provide a unique and often unexamined environment in which studies on adolescent nutrition can be conducted. In contrast to commuting students, boarders spend their time in an atmosphere that has strict supervision, where the school primarily arranges what is cooked and how and at what time meals are served[9]. This "food system" creates a unique dynamic insofar as family and out-of-school food availability are weak, while peers and school environment have considerable influence[10]. This means that what affects the quality of nutrition for this group can be considered different from what affects the overall teen demographic.

There is research involving adolescents which indicates various factors that impact their eating well, which include personal, social, as well as environmental concerns. In terms of personal concerns, for instance, gender, age, food preference, as well as health-related concerns like food allergies are some of those that influence adolescents' eating practices[11]. Studies reveal that teen girls tend to develop better dietary habits. Various factors, namely socioeconomic status within the environment, for instance, factors related to or involving the school environment itself, such as access to healthy food at school, or food policies at school, have been observed to exert a positive influence on healthy dietary practices[12,13].

Even with more information available about the factors that impact teenage consumption, there are still many areas where the strength of these influences is unknown when the controlled school environment of the boarding school is factored into the equation. Where current studies have largely focused on either day students or those that live at home, factors such as the family unit and external dining influences can become a factor here[14]. The scoping literature search for studies examining the interaction of mix-and-match factors such as school type (public, private), religious observances (fasting), personal allowance, and health factors and their combined predictive ability for the quality of the diet of boarding school children is limited. The research question as to whether the institutional factors (for instance, the nature of private schools) can dominate and moderate the role of individual factors in this regard has not yet been resolved. Aiming to address this gap, this research was conducted to analyze factors associated with diet quality among santri in Islamic boarding schools.

METHODS

Study Design and Setting

This study employed a cross-sectional study design. The study was conducted at four senior high schools (SMA) boarding schools located in East Lampung Regency. The selected schools had buffet-style meals served within the school, and the principals expressed their willingness to participate in the study. Data collection took place from January to February 2025.

Study Participants and Sampling

The subjects of this study were adolescents aged 15–17 years attending a boarding school (total N = 153 students). Participants were recruited using purposive sampling based on class of recommendations from the school principal and dormitory headmaster. Although purposive sampling based on recommendations from school authorities facilitated access and logistical feasibility, this approach may introduce selection bias, as students perceived as more compliant or academically active may have been preferentially included. Consequently, the sample may not fully represent the broader population of boarding school adolescents, which should be considered when interpreting the findings.

The inclusion criteria for this study were active adolescents in grades 10 or 11 who were living full-time in the dormitory at the time of the study. All students regularly participated in school meals, which primarily consisted of meals from the school cafeteria. They were willing to participate in the study by providing written informed consent from both the student and the dormitory principal. Furthermore, only students with complete data on sociodemographic characteristics, health status, and dietary quality assessments were included in the analysis. Exclusion criteria included students who were absent or withdrew during the data collection period, had severe chronic illnesses or medical conditions that significantly affected their diet, and were on a specific therapeutic diet for medical reasons. Students with incomplete or invalid data, as well as those who did not consistently participate in school meals, were also excluded from the study.

Data Collection Tools and Technique

The primary outcome was dietary quality, measured using the Healthy Eating Index (HEI) adapted from the Balanced Nutrition Guidelines. The Healthy Eating Index (HEI) adapted for this study comprised 13 components, consistent with the HEI-2015 framework, covering both adequacy and moderation domains, with a total score ranging from 0 to 100. The 13 components included total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids ratio, refined grains, sodium, added sugars, and saturated fat[15,16]. Diet quality was evaluated using the Healthy Eating Index (HEI), which reflects the degree of compliance with established dietary guidelines. An HEI total score, which ranges from 0 to 100, was created from each respondent's dietary intake data; higher scores denote greater adherence to healthy eating guidelines. HEI scores were divided into three groups for analytical and interpretive purposes. Low adherence to suggested dietary patterns was indicated by a score of less than 51, which was classified as poor diet quality. Partial adherence to dietary recommenda-

tions was indicated by scores between 51 and 80, which were categorized as moderate diet quality. High adherence to healthy eating guidelines was indicated by scores between 80 and 100, which were classified as excellent diet quality.[16,17].

Data collection involved direct weighing of individual food consumption using calibrated 5-kg digital scales (±0,1g accuracy). Each participant's intake was measured for three consecutive days (including one weekend day) during a single observation period. To minimize the Hawthorne effect, participants were acclimatized to the weighing procedure during two practice days before actual data collection. Research assistants discreetly weighed plates before and after meals using standardized protocols, with waste recorded separately.

Data Analysis

Data were analyzed using SPSS version 25. Kolmogorov-Smirnov tests confirmed normality. Descriptive statistics summarized participant characteristics. Person tests were conducted to examine the relationship between independent variables and diet quality scores. Multiple linear regression analysis using a stepwise method was performed to identify factors associated with diet quality among boarding school students. Regression coefficients (B), standardized beta coefficients (β), and p-values were reported. The level of statistical significance was set at $p < 0.05$, and model fit was assessed using the adjusted R^2 and overall model p-value. To ensure the robustness of the regression model, multicollinearity diagnostics were performed using VIF and tolerance criteria (VIF > 5 or tolerance < 0.20 indicating concern). None of the independent variables exceeded these thresholds, supporting the stability of the regression estimates.

Ethical Statement

The study received ethical approval from the Research Ethics Committee of Universitas Lampung (Approval No: 94/UN26.18/PP.05.02.00/2025). Written informed assent was obtained from participants and consent from parents/guardians. Participants could withdraw at any time without penalty. Data were anonymized and stored securely. Results were shared with participating schools to inform their nutrition programming.

RESULTS

Knowing the participants is important within the context of the factors at play regarding the quality of the dietary regimen the boarding school pupils follow. Considering the potential sociodemographic structure of the participants, the variable factors associated with accessing, consuming, and finally, the dietary choices made within the fixed structures of the environment within which they reside could include age, gender, school, and monthly allowance, which have been associated with the dietary habits of the adolescents. Some factors, which could include health needs and practices like fasting and dieting, could also have an impact on the dietary choices and manner of consuming the food they have chosen. In view of the factors at play, the sociodemographic parameters of the participants are treated extensively below as the conceptual foundation for the next segment regarding the quality of the dietary habits of the participants.

A total of 153 boarding school students were included from Table 1. Slightly more than half were enrolled in public board-

Table 1. Sociodemographic Characteristics of Boarding School Students (n = 153)

Characteristics	n	%
Type of School		
Public	80	52.3
Private	73	47.7
Sex		
Male	93	60.8
Female	60	39.2
Age (years)		
15	51	33.3
16	75	49.0
17	27	17.7
Mean ± SD		15.84 ± 0.69
Monthly Allowance		
< IDR 500,000	121	79.1
≥ IDR 500,000	32	20.9
Mean ± SD (IDR)		437,171 ± 228,332
Food Allergy		
No	139	90.8
Yes	14	9.2
History of Disease		
No	145	94.8
Yes	8	5.2
Fasting Practice		
No	137	89.5
Yes	16	10.5
Currently on a Diet		
No	153	100.0
Yes	0	0.0

ing schools, 52.3%, while the remainder were in private institutions, 47.7%. Thus, the distribution was relatively evenly matched by type of school. Most participants were male in nature, 60.8%, while females constituted 39.2%. This particular group was skewed toward mid-adolescence, with approximately half the age of 16, 49.0%, followed by 15-year-olds, 33.3%, and 17-year-olds, 17.7%. The overall mean age was 15.84 ± 0.69 years.

In relation to the socio-economic factors, most students receive their monthly allowance below IDR 500,000 (approximately 79.1%), with less than 20.9% of the students receiving that amount and above. The average monthly allowance amounts to IDR 437,171, with large variations (standard deviation of around ±228,332), indicating the presence of real diversity in the level of accessibility the students have. On the health aspects, most students have no food allergies (90.8%) or personal disease (94.8%), implying the students have no major diseases. They also rarely fast (89.5%), with no students being on a diet during the time of the study. In summary, the findings indicate the students constitute a fairly healthy population with minimal dietary restrictions and comparable living standards within the boarding environment.

Table 2 showed the details of the scores obtained by adolescents in the boarding schools in the various domains of diet quality. Overall, the total score for diet quality was an average of 42.95 ± 2.82, which indicates moderate quality overall. The scores for total fruits(1.44 out of 5), fruits (2.89 out of 5), and vegetables showed low scores overall, with each and every individual scoring less than the highest score in those domains. The scores for vegetables, although not bad, showed poor performance for greens and beans, averaging 2.49 out of 5.

The grain food habits appear a little amiss since all participants scored zero for both whole grain foods and refined grain foods. This immediately points to the absence of whole grain foods in the diet and the preference for refined carbohydrates. Notably, several key components, including whole grains, fatty acids ratio, and saturated fat, yielded null scores across all participants. This uniform pattern suggests that the low scores in these components are unlikely to reflect individual dietary choices alone, but rather indicate structural limitations in the food supply and menu composition provided by the boarding schools. The absence of variability in these components implies restricted availability of whole grains and healthy fat sources within the institutional food environment.

The dairy foods appear to be in low quantity since the average scoring was merely 1.94 points on a scale of 10. This means a majority of the students are not getting adequate amounts of dairy foods. The protein foods appear to be the better side of the food since the participants scored high in the total protein foods (4.98 out of 5) and the seafood and

Table 2. Diet Quality Scores of Adolescents

No.	Component	Mean Score	Score Range	n (%)	Maximum n (%)	Total (%)
1	Total Fruits	1.44	0–5	153 (100)	0 (0)	0 (0)
2	Whole Fruits	2.89	0–5	153 (100)	0 (0)	0 (0)
3	Total Vegetables	4.47	0–5	72 (47.1)	81 (52.9)	0 (0)
4	Greens and Beans	2.49	0–5	153 (100)	0 (0)	0 (0)
5	Whole Grains	0.00	0–10	153 (100)	0 (0)	0 (0)
6	Dairy Products	1.94	0–10	153 (100)	0 (0)	0 (0)
7	Total Protein Foods	4.98	0–5	2 (1.3)	151 (98.7)	0 (0)
8	Seafood and Plant Proteins	4.72	0–5	22 (14.4)	131 (85.6)	0 (0)
9	Fatty Acids Ratio (PUFA + MUFA / SFA)	0.00	0–10	153 (100)	0 (0)	0 (0)
10	Refined Grains	0.00	0–10	153 (100)	0 (0)	0 (0)
11	Sodium	10.00	0–10	0 (0)	153 (100)	153 (100)
12	Added Sugars	10.00	0–10	0 (0)	153 (100)	153 (100)
13	Saturated Fat	0.00	0–10	153 (100)	0 (0)	0 (0)
	Total Diet Quality Score	**42.95 (SD 2.82)**				

plant-based protein foods (4.72 out of 5) since almost all participants scored the maximum in these components.

In relation to the fat quality and moderation scores, all participants scored zero in the ratio of PUFA + MUFA to SFA and in the saturated fat area, indicating a less desirable ratio in the fatty acid composition of the students' diets. On the other hand, all students obtained the highest score in the sodium and added sugars components, indicating their intake of these aspects remained within the recommended levels according to the scoring guidelines. Highlighting the overall results, results indicate a relatively good performance in the areas of protein intake and the management of sodium and added sugars, but not in the overall diet in boarding school adolescents in relation to the intake of fruits, whole grains, dairy products, greens, and beans, as well as the quality of their fat intake.

Table 3 shows the relationship between scores on dietary quality and other variables. Dietary quality generally increases with specific types of schools ($r = 0.503$, $p < 0.01$) and age ($r = 0.283$, $p < 0.01$). It generally decreases when considering gender ($r = -0.243$, $p < 0.01$), indicating a gender difference between those of male and female students on dietary quality. No significant relationships were observed between dietary quality scores or between dietary quality scores and monthly allowance, history of food allergies, medical history, or fasting practices ($p > 0.05$). Highly complex relationships also existed between specific independent variables, specifically between type of school and gender ($r = -0.767$, $p < 0.01$), indicating relationships between variables that should have been considered during multivariable analyses.

Table 4 showed the outcome of the stepwise multiple linear regression analysis conducted to determine the factors associated with the diet quality of boarding school students. The model is very significant, $p < 0.001$, and the variables explain 31.5% of the variation in the scores associated with diet quality, as evident from the adjusted R^2 of the model. The so-

Table 4. Factors Associated with Diet Quality among Boarding School Students

Variable	Diet Quality		
	B	Beta	sig.
Constant	32,445		0,000
Type of School (0 = public; 1= private)	4,681	0,831	0,000**
Sex (0 = male; 1 = female)	2,091	0,362	0,001*
Food Allergy (0 = no; 1 = yes)	-1,342	-0,138	0,058
History of Disease (0 = no; 1 = yes)	-0,124	-0,010	0,888
Fasting Practice (0 = no; 1 = yes)	-0,808	-0,088	0,319
Age (years)	0,183	0,045	0,608
Monthly Allowance	5,936	0,048	0,504
Adj. R^2		0,315	
sig. Model		0,000**	

Multiple linear regression using a stepwise method. Significance: ** $p \leq 0.01$; * $p \leq 0.05$.

Table 3. Pearson Correlation Matrix between Diet Quality Score and Independent Variables

Variables	Diet Quality Score	Type of School	Sex	Age	Monthly Allowance	Food Allergy	History of Disease	Fasting Practice
Diet Quality Score	1	0.503**	−0.243**	0.283**	−0.079	−0.072	0.074	0.043
Type of School	0.503**	1	−0.767**	0.441**	−0.270**	0.151	0.128	0.358**
Sex	−0.243**	−0.767**	1	−0.415**	0.247**	−0.069	−0.068	−0.274**
Age	0.283**	0.441**	−0.415**	1	−0.152	−0.091	0.137	−0.260**
Monthly Allowance	−0.079	−0.270**	0.247**	−0.152	1	0.018	−0.142	−0.178*
Food Allergy	−0.072	0.151	−0.069	−0.091	0.018	1	0.027	0.336**
History of Disease	0.074	0.128	−0.068	0.137	−0.142	0.027	1	−0.080
Fasting Practice	0.043	0.358**	−0.274**	−0.260**	−0.178*	0.336**	−0.080	1

Pearson correlation analysis was performed; Significance levels: *$p < 0.01$; $p < 0.05$ (*two-tailed*). Sex was coded as 0 = male, 1 = female; Type of school as 0 = public, 1 = private; Food allergy, history of disease, and fasting practice as 0 = no, 1 = yes.

ciodemographic variables introduced into the model have managed to explain a fair element of the variation associated with the diet quality of the adolescents.

Among all the variables that were taken into consideration for the model, the type of school was found to be the predictor that tends to explicitly highlight a greater level of diet quality among students at private boarding institutions when compared to those in public institutions (B = 4.681; β = 0.831; p < .001). Gender was identified as the other predictor that tends to highlight a higher level of diet quality for girls when compared to that of boys (B = 2.091; β = 0.362; p = .001).

Some health and behavioral factors did not relate meaningfully to diet quality. For example, food allergy was inclined to lower diet quality, but the numbers barely miss significance: B = −1.342; β = −0.138; p = 0.058, indicating that this may be more a question of a trend than a proper effect. Similarly, disease history, fasting behavior, age, and monthly allowance were not related to diet quality in a statistically reliable way. In summary, place of residence and sex are more relevant to diet quality for students in a boarding school than individual health or pocket money.

Table 5 showed multicollinearity diagnostics using Variance Inflation Factor (VIF). Multicollinearity was further assessed using Variance Inflation Factor (VIF) and tolerance values. All predictors showed VIF values below 5 and tolerance values above 0.2, indicating the absence of problematic multicollinearity. Although type of school and sex exhibited relatively higher VIF values, these remained within acceptable limits, confirming that the regression model was statistically stable.

Table 5. Multicollinearity Diagnostics Using Variance Inflation Factor (VIF)

Variable	Tolerance	VIF
Type of School	0.46	2.17
Sex	0.45	2.22
Age (years)	0.78	1.28
Monthly Allowance	0.82	1.22
Food Allergy	0.91	1.10
History of Disease	0.93	1.08
Fasting Practice	0.87	1.15

DISCUSSION

The research conducted a stepwise multiple linear regression test that resulted in a statistically significant model (p-value = 0.000), with an Adjusted R-squared of .315. In simplest terms, some 31.5% of the variability with regard to diet quality among boarders can be attributed to variables included within the equation. While not a particularly robust Adjusted R-squared, it does not conflict with existing research indicating diet quality variables can be influenced by a multitude of attributes: individual characteristics, as well as wider social and environmental contexts[18,19]. The stepwise regression procedure allowed for an easier discernment of high predictor variables, but with certain drawbacks, particularly overfitting in the absence of external testing[20].

The major determinant for diet quality was school type, public and private, exhibiting a very high beta coefficient (Beta 0.831, p = 0.001). The next was sex, which showed high beta coefficient values (Beta 0.362, p = 0.001). Private school students generally showed better diet quality compared to public school students, which might be attributed to the eating facilities and their socioeconomic backgrounds as well. This is consistent with previous studies conducted in Malaysia, where private schools generally provide students with a better-controlled and healthy eating atmosphere[21]. It is also consistent in implying that female students showed better diet quality compared to their male counterparts, which is consistent internationally as women generally focus more on healthy eating habits and have better-controlled eating patterns[22,23].

A food allergy is slightly associated with poor diet quality, as shown by Beta = -0.138 at p = 0.058, while the history of disease does not reach statistical significance, p = 0.888. What this means is that allergies can actually constrain dietary variety and nutritional adequacy, although the effect isn't strong. The previous study demonstrated that individuals with food allergy problems often cannot meet their micronutrient needs because they avoid whole food groups[24]. This may contrast with the lack of significance regarding the history of disease, probably showing either a generally healthy sample or just the fact that this variable has been captured in a yes/no way without detailing the disease type or severity[25].

In this model, fasting behaviors, age, and monthly allowance did not appear to have an obvious association with how good the diet is. A lack of effect for fasting may represent how people compensate for these differences through different eating behaviors outside of fasting, as shown in a study for Muslim teens voluntarily fasting without affecting their overall diet quality[26]. Similarly, an indication that age and allowance do not affect overall diet quality can indicate that in a boarding school environment, more overall factors (such as type of school attended) and gender can predict overall food choices compared to individual age or economic factors[10,12,27].

The current study has a number of limitations. First, the cross-sectional nature makes it difficult to establish cause and effect. Even though the Adjusted R^2 has been significant in

establishing the impact, it seems that approximately 68.5% of the data on the quality of dietary habits appears susceptible to the influence of the fact that we have chosen variables that were untested in the group such as the influence of company at school or food choices out in the environment. Longitudinal studies and more objective measures would improve these outcomes and include nutritional biomarker related to food options taken in by the subject. Also, the results could well be specific to the group in boarding school students and their specific sociodemographic characteristics.

CONCLUSION

This study identifies two key drivers of improved eating among boarding school students: school type (private versus public) and sex. Based on these findings, what can be inferred is that boarding schools, most especially the public ones, have the opportunity to improve the diet quality of students by changing the food environment. This can include healthier options for cafeterias, clear nutrition policies, and interactive nutrition education. Policies should be gender-sensitive, adopting a communication approach that can appeal to both boys and girls. And for students with food allergies, targeted support will be critical in helping them maintain a balanced diet within the strict bounds of their allergy.

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