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Determinants of Dietary Quality Intake among Adolescent Girls in Indonesia: The Role of Parental Education, Media Exposure, and Pocket Money

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Abstract

Background of study: high prevalence of undernutrition and high prevalence of overnutrition are particularly prevalent among adolescent girls in Indonesia. This study aims to identify factors associated with the dietary quality of adolescent girls in Tasikmalaya City.

Methods: a cross-sectional design was used, involving 366 junior high school female students aged 13–15 years. Independent variables included parental occupation and education, family income, family size and type, physical activity, screen time, and pocket money. Data were collected using questionnaires, food recall forms, the Physical Activity Questionnaire (PAQ), stadiometers, and digital weighing scales. Data analysis included univariate (frequency), bivariate (Chi-Square test), and multivariate (logistic regression) methods. Data on respondent characteristics were collected and analyzed.

Result: the majority of parents, both mother and father, had low education levels (77.9%, and 78.8% respectively). Most mothers were non-working (74.0%), while nearly all fathers were employed (98.1%). Over 50% of families had incomes below the minimum wage. Family size was mostly large, with 51.1% in larger families. Most respondents lived in nuclear families (91.5%). Physical activity was mostly in low category (95.4%), screen time was high in the category (88.3%), and pocket money was relatively low (69.1%). Most respondents had poor dietary quality intake (90.7%). Chi-Square analysis indicated significant associations between dietary quality and father's education, screen time, and pocket money. Logistic regression confirmed that these factors collectively influenced dietary quality.

Conclusion: These findings highlight the need for interventions targeting parental education, media exposure, and financial resources to improve adolescent dietary habits.

A. Introduction

Adolescent growth refers to a rapid and intense increase in height and weight that occurs during the adolescent stage of the human life cycle. Increased energy, protein, and micronutrient requirements are necessary to support the rapid growth experienced during adolescence, which significantly impacts the nutritional status of adolescents, particularly adolescent girls (Soliman et al., 2022). Adolescence is a critical period for developing healthy eating habits; however, it is also a phase of life characterized by

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poor dietary quality intake (Savage et al., 2017). The transition from childhood to adolescence often leads to a decline in healthy eating behaviors, resulting in lower food intake (Roura et al., 2016). In fact, good dietary quality intake is essential for adolescents to support their rapid growth and maintain optimal nutritional status (Singh Sandhu, 2019). Poor dietary quality during adolescence can increase the risk of various nutritional problems (Mumena et al., 2023). Adequate nutritional status among adolescent girls is a critical public health concern, as insufficient nutrient intake may adversely affect the health and development of the next generation. Deficiencies in essential nutrients, particularly iron and folic acid, have been associated with adverse birth outcomes, including impairments in intellectual and cognitive development. Therefore, addressing nutritional problems among females is of the utmost importance to prevent long-term declines in the quality of future generations (Parajuli & Prangthip, 2025).

Double burden malnutrition is a public health problem in developing countries (Pencil et al., 2024). It refers to the high prevalence of undernutrition, but also accompanied by a high prevalence of overnutrition. This problem is particularly prevalent among adolescent girls in low-income and middle-income countries. Therefore, efforts are needed to reduce malnutrition rates and also prevent obesity and overweight, especially among adolescents (Caleyachetty et al., 2018). Several countries that experience double burden malnutrition include Pakistan, where approximately 11.8% of adolescent girls are underweight (Zafar et al., 2025). In Ethiopia, more than 73.0% of adolescent girls still show insufficient nutrient intake (Caleyachetty et al., 2018). Research in India shows that the proportion of undernutrition and overweight has a similar prevalence, at 13.3% (Balasubramanya et al., 2024). A similar situation also occurs in Kenya, where overweight adolescents are increasing due to a high-calorie, low-nutrient diet, but malnutrition is still common among adolescents (Takeuchi et al., 2022).

Currently, Indonesia has a total of 128.1 million women, 17.5% of whom are adolescents (22.4 million) (WHO-SEARO, 2018), who are facing the challenge of a double burden of malnutrition (Maehara et al., 2019). West Java, the most densely populated province in Indonesia, has a prevalence of overweight among adolescent girls of 12.6% and stunting of 24.1%. Sundanese ethnic group in West Java is known for a diet predominantly based on plant-based foods (Khusun et al., 2022). However, another study found that the prevalence of overweight among adolescent girls was 18.3% (Hidayanti et al., 2023), prevalence of anemia among adolescent girls remains at 32.4% (Rahfiludin et al., 2021). This research was conducted on adolescent girls in Tasikmalaya City because data indicate that dietary quality is a crucial issue that requires attention, and it has been proven associated with the incidence of anemia among adolescent girls (Hidayanti et al., 2024).

Previous research involving 1,055 university students in Spain demonstrated that low levels of physical activity, smoking behavior, poor sleep habits, sedentary lifestyle, and psychological distress were significantly associated with diet quality (Ramón-Arbués et al., 2021). In Malaysia, studies have shown that diet quality is positively correlated with regular physical activity, social media use, and self-efficacy for healthy eating (Rezali et al., 2015). Research conducted in Turkey indicated that parental educational level was positively associated with diet quality (Acar Tek et al., 2011). Furthermore, a European study involving 3,389 healthy adolescents aged 12.5–17.5 years who participated in the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study reported a significant association between dietary quality index for adolescents (DQI-A) scores and dietary awareness levels among adolescents (Vanhelst et al., 2017).

Based on these data and issues, the researcher considers it necessary to conduct a study on the factors associated with dietary quality among adolescent girls. This study offers novel insights by specifically focusing on adolescent girls in a low and middle income setting and by applying a comprehensive dietary quality index with an empirically derived cut-off. By integrating individual, familial, and environmental determinants, the findings extend existing evidence and provide context-specific implications for targeted nutritional interventions. This research aims to support efforts in preventing anemia and other health disorders that may affect adolescent girls. Poor dietary quality in this group can lead to a decline in their quality of life, which may ultimately impact the well-being of future generations.

B. Methods

This study was an analytical research with a cross-sectional design, where both independent and dependent variables were measured simultaneously. The independent variables in this study include parental occupation (father and mother), parental education, family income, number of family members, family type, physical activity, screen time, and pocket money. The dependent variable in this study was dietary quality intake, specifically the dietary quality of adolescent girls. Dietary quality intake was measured using the Dietary Quality Index for Adolescents (DQI-A) based on a 2x24 hour food recall. The Diet Quality Index for Adolescents (DQI-A) consists of three components: dietary quality (DQ), dietary diversity (DD), and dietary equilibrium (DE). The overall DQI-A score was calculated by summing the scores of these three components and then dividing the total by three. A cut-off score of ≥60 indicates good dietary quality, while a score below this threshold indicates poor dietary quality intake (Susetyowati et al., 2025). Dietary quality comprises four main categories: variety, adequacy, moderation, and overall balance. High dietary quality is associated with an adequate intake of macronutrients, ensuring neither deficiency nor excess, and sufficient micronutrient intake.

Parental education levels were categorized into two groups: low education (elementary school and junior high school) and high education (senior high school and higher education/university level). Average monthly household income was categorized into two groups based on the Tasikmalaya City minimum wage, as stipulated in the Decree of the Governor of West Java Number 561.7/Kep.776-Kesra/2022, amounting to Indonesian Rupiah (IDR) 2,533,341. The categories were income below the minimum wage (<IDR 2,533,341) and income equal to or above the minimum wage (≥IDR 2,533,341). Physical activity was categorized into two levels: low activity (scores<3) and high activity (scores≥3), based on the normative and criterion-referenced PAQ values used to standardize the categorization of PAQ scores in studies involving children and adolescent populations (Benítez-Porres et al., 2016). Pocket money, defined as money given by parents, was categorized into two groups based on the mean as the cut-off point. Low pocket money was defined as an amount of < IDR 21,786.00, while high pocket money was defined as an amount of ≥IDR 21,786.00. Screen time was categorized into two levels: low if the duration was <3 hours per day, and high if the duration was ≥3 hours per day (Votsi & Koutelidakis, 2025). The instruments used for data collection in this study included: Research questionnaires, food recall forms to obtain dietary intake data, PAQ questionnaire to assess physical activity, Stadiometer to measure height, and Seca 803 digital scale to measure body weight. This study has several potential sources of bias that need to be considered when interpreting the findings, namely when collecting dietary intake data using a recall method which allows for memory bias and reporting bias.

The study population consists of all female students aged 13-15 years enrolled in public junior high schools in Tasikmalaya City. There are 21 public junior high schools, and 30% of the schools (7 schools) were selected as the sample. The schools were selected randomly. The total study population consists of 2,325 female students. The sample size was calculated using Slovin's formula with a 5% margin of error, yielding a required sample size of 341.49, which was rounded to 342 students. To account for 5-10% non-response, an additional 24 participants were included, resulting in a final total sample of 366 subjects. The inclusion criteria for the study sample were: being in good health, aged 13-15 years, and the exclusion criterion was: unwillingness to participate in the study. In this study, proportional random sampling was used to select participants. The number of respondents from each school was determined proportionally based on the number of female students and selected using a random sampling method. The allocation of female students was calculated by dividing the number of adolescent girls in each school by the total population and multiplying the result by the required sample size.

The study was conducted from October 2023 to June 2024 in Tasikmalaya City. Data collection involved questionnaires, anthropometric measurements, and interviews to assess the dietary quality of adolescent girls. Data collection was assisted by trained student enumerators who received an explanation and standardization, regarding the research questionnaires, as well as training on conducting anthropometric measurements. The data analysis methods used in this study included: univariate, bivariate, and multivariate analysis.

Univariate analysis to describe the frequency distribution of independent variables, the dependent variable, and subject characteristics. Since all data were categorical, results were presented in frequency

distribution tables. Bivariate analysis using the Chi-Square test to determine the relationship between independent and dependent variables, both of which are categorical, with a significance level of p-value<0.05. Multivariate analysis using logistic regression modeling, where only variables with a p-value <0.25 were included in the final model.

C. Results and Discussion

This study was conducted on 366 adolescent girls in Tasikmalaya City, as shown in Table 1. The results indicate that the majority of mothers had a low level of education (77.9%), as did fathers (78.8%). Most mothers were unemployed (74.0%), while nearly all fathers were employed (98.1%). More than 50% of families had an income below the regional minimum wage. The distribution of family size was relatively balanced, with 51.1% classified as large families and 48.9% as small families. The majority of respondents belonged to nuclear families (91.5%). Regarding physical activity, most respondents had low levels of physical activity (95.4%). A high percentage (88.3%) reported excessive media use, while 69.1% of respondents had limited pocket money. In terms of dietary quality, the majority of respondents (90.7%) had poor dietary quality intake.

Table 1. Respondent Characteristics and Research Variables (n = 366)

Variables	f	%
Mother's education		
Low	285	77.9
High	81	22.1
Father's education		
Low	288	78.8
High	78	21.3
Mother's occupation		
Unemployment	271	74.0
Employment	95	26.0
Father's occupation		
Unemployment	7	1.9
Employment	359	98.1
Family income		
< Minimum wage	235	64.2
≥ Minimum wage	131	35.8
Number of family member		
Big (>4 members)	187	51.1
Small (≤ 4 members)	179	48.9
Family type		
Nuclear	355	91.5
Non-nulear	31	8.5
Physical activity		
Low (< 3)	349	95.4
High (≥ 3)	17	4.6
Screen time		
Low (<3 hours/day)	43	11.7
High (≥ 3 hours/day)	323	88.3
Pocket money		
Low (<IDR 21.786.-)	256	69.1
High (≥IDR 21.786.-)	110	30.1
DQI-A*		
Poor (<60)	332	90.7
Good (≥60)	34	9.3

*DQI-A= Dietary Quality Index-Adolescent;

The relationship between independent and dependent variables was presented in Table 2. The dependent variable in this study is dietary quality intake, categorized as poor or good. It shows that adolescents whose fathers had higher education were more likely to have better dietary quality (OR = 2.93, 95% CI:

1.41–6.12, p = 0.006). Adolescents who had screen time ≥ 3 hours/day were more likely to have poorer diet quality. Likewise, adolescents who had pocket money higher than IDR 21,786 were more likely to have better dietary quality. The other independent variables, such as: mother's education and occupation, father's occupation, family income, number of family members, family type, and physical activity, were not significantly associated with dietary quality intake (p-value>0.05). In multivariate analysis, logistic regression analysis revealed that father's education level, screen time, and pocket money significantly influenced dietary quality index as follows: (Table 3)

DQI-A = -2.587 + 0.989 (Paternal Education) – 1.299 (Screen time) + 0.999 (Pocket Money).

The model's predictive ability was 91.0%, with 32 respondents classified as having good dietary quality intake. The omnibus test of model coefficients resulted in a Chi-square value of 21.396 and p<0.01. This indicates that at least one independent variable (paternal education, screen time, or pocket money) significantly influences dietary quality index among adolescent girls.

According to the model summary, -2 Log Likelihood value was 204.930, and the Nagelkerke R-Square value was 0.123, meaning that paternal education, pocket money, and screen time or media usage duration collectively explain 12.3% of the variation in the dietary quality index. The constant value (-2.587) indicates that if all independent variables remain unchanged, the baseline DQI-A score is -2.587. Paternal education level has a positive coefficient (0.989), meaning that for each one-unit increase in paternal education level, assuming all other variables remain constant, the likelihood of having better dietary quality intake increases by 0.989. Screen time has a negative coefficient (-1.299), indicating that higher media usage is associated with lower DQI-A. Pocket money has a positive coefficient (0.999), meaning that as pocket money increases, DQI-A also tends to improve.

Table 2. Cross-table Relationship between Independent and Dependent Variables*

Independent Variables	DQI-A				p value
	Poor		Good		OR
	f	%	f	%	(95% CI)
Mother's education					1.000
Low	259	90.9	73	9.1	1.09
High	73	90.1	8	9.9	(0.47-2.51)
Father's education					0.006**
Low	268	93.1	20	6.9	2.93
High	64	82.1	14	17.9	(1.41-6.12)
Mother's occupation					0.272
Unemployment	249	91.9	22	8.1	1.64
Employment	83	87.4	12	12.6	(0.78-3.45)
Father's occupation					0.498
Unemployment	6	85.7	1	14.3	0.607
Employment	326	90.8	33	9.2	(0.07-5.20)
Family income					0.381
< Minimum wage	216	91.9	19	8.1	1.47
≥ Minimum wage	116	88.5	15	11.5	(0.72-3.00)
Number of family members					0.260
Big (>4 members)	166	88.8	21	11.2	0.62
Small (≤ 4 members)	166	92.7	13	7.3	(0.30-1.28)
Family type					0.189
Nuclear	306	91.3	29	8.7	2.03
Non-nuclear	26	83.9	5	16.1	(0.72-5.68)
Physical activity					0.386
Low (< 3)	315	90.3	34	9.7	
High (≥ 3)	17	90.7	0	0	-
Screen time					0.010**
Low (< 3 hours/day)	34	79.1	9	20.9	0.32
High (≥ 3 hours/day)	296	92.3	25	7.7	(0.14-0.74)
Pocket Money					0.004**

Low (<IDR 21.786.-)	240	93.8	16	6.3	2.94
High (≥IDR21.786.-)	92	83.6	18	16.4	(1.44-6.00)

DQI-A= Dietary Quality Index-Adolescent; OR=Odd Ratio; CI=Confidence Interval
* derived from Chi Square Test
** significant at p<0.01

Table 3. Multivariate Analysis

Predictors	β	SE	Wald	p-value	Adjusted OR	95% CI	
						LL	UL
Father's education	0.989	0.392	6.372	0.012	2.690	1.248	5.798
Screen time	-1.299	0.450	8.349	0.004	0.273	0.113	0.658
Pocket money	0.999	0.379	6.943	0.008	2.716	1.292	5.710
Constant	-2.587	1.015	6.500	0.011	0.075		

SE=Standard Error; OR=Odd Ratio; CI=Confidence Interval; LL=Lower Level; UP=Upper Level

This study used a multidimensional approach encompassing variety, adequacy, moderation, and balance, providing a comprehensive understanding of adolescent dietary patterns. Although maternal nutritional knowledge is often assumed to influence children's nutritional quality, this study found no significant association, suggesting a transition toward greater adolescent autonomy in food choices, particularly in environments with high digital media exposure and peer influence. In contrast, paternal education emerged as a significant predictor, suggesting that fathers may play a significant role in shaping eating behaviors through decision-making, financial provision, and guidance on time management. The integration of screen time into the analysis further strengthens these findings, as longer duration of media use was consistently associated with poorer nutritional quality, likely through increased exposure to unhealthy food marketing and decreased physical activity. Pocket money also contributed independently to nutritional quality, reflecting adolescents' purchasing power and their ability to access food during school hours, although excessive autonomy may encourage disordered eating patterns. By examining these factors simultaneously using multivariate analysis, this study provides strong evidence that adolescent diet quality is influenced by interrelated family, behavioral, and economic factors.

Maternal education is expected to contribute to the dietary quality of their children. Mothers' knowledge of nutrition can provide a variety of foods for their families, thereby improving the quality of meals and potentially enhancing overall dietary quality, however, this study showed there is no significant difference between maternal knowledge and children's dietary quality index. In this study, adolescents already have their own knowledge of nutrition, so the quality of the food they eat does not depend on their mothers' knowledge (Gbratto-Dobe & Segnon, 2025). This aligns with research conducted on nutritional knowledge among adolescents (Suci et al., 2025). Nutritional problems among adolescents may be influenced by a lack of knowledge and perception. Most adolescents demonstrated a lack of knowledge about nutrition, which can lead to maladaptive eating practices and adverse health outcomes such as malnutrition or obesity (Vasquez-Mamani et al., 2025). When nutritional knowledge is low, adolescents tend to be unable to distinguish between healthy and unhealthy food choices, resulting in food decisions that often do not support the body's nutritional needs.

Dietary quality of adolescents was influenced by parental education levels, where higher education levels facilitate better information, particularly the information regarding balanced nutrition. Low parental education is a fundamental factor affecting resource management for acquiring food (Syauqan & Muzayanah, 2024). Children with well-educated parents are more likely to have a good nutritional status due to their parents' knowledge, motivation, and ability to provide quality food. Consequently, occupation type influences one's ability to meet the family's nutritional needs. Parental education levels impact their understanding of optimal nutritional status for children's development (Dungga et al., 2022). Nutritional intake in adolescents with working mothers has a diet and snack consumption pattern that is lower in nutrient density for iron and thiamine compared to adolescents with non-working mothers. Adolescents

with employed mothers tend to have lower dietary nutrient quality compared to adolescents with non-employed mothers (Lee et al., 2025).

This finding contrasts with literature reviews stating that parental income affects children's nutritional status. It stated that variations in family income are closely associated with changes in nutritional intake and overall dietary quality (Sepriadi et al., 2024). Lower income levels are consistently linked to poorer diet quality index. However, different income sources do not contribute equally to improvements in dietary patterns (Wang et al., 2024). Research in Bali found a correlation between family size and food diversity (Utami & Ani, 2023).

Low physical activity among adolescents is due to increased gadget use, leading to a sedentary lifestyle. Physical activity and sedentary behavior are closely interrelated in adolescent populations, particularly among girls. Sedentary lifestyle refers to prolonged sitting or low energy expenditure activities such as screen time, which may coexist with insufficient moderate to vigorous physical activity. Evidence suggests that high sedentary time is associated with lower overall physical activity levels, partly through behavioral displacement mechanisms, where time spent on screens reduces opportunities for active engagement. Furthermore, low physical activity combined with high sedentary exposure may contribute to unhealthy behaviors, including irregular eating patterns and poorer dietary quality (Suhendra et al., 2026).

Screen time among adolescents has shown a growing trend. The study results indicate that most adolescent girls spend a relatively long duration browsing social media. Similarly, those who used media for a relatively short duration also exhibited poor dietary quality. The analysis concludes that there is a significant correlation of screen time and dietary quality among adolescents. Adolescents with higher media usage durations tend to have poor dietary quality. These findings align with research conducted on adolescents in Jakarta, which revealed a correlation between social media usage and eating behavior (Idzhni et al., 2023). Adolescents who had a higher frequency of exposure tended to make the same food choices accessed on social media, and ate outside the home, mostly in coffee shop chains. They also sought information about a restaurant or cafe. They tried to find popular food and drinks from social media, then went together with their friends. They enjoyed high-energy foods and high-energy drinks were popular. Social media's effect on adolescents showed that social media's impact was positive for unhealthy food but negative for healthy food (Adiba et al., 2020).

Adolescent girls with limited pocket money have lower dietary quality than those with larger amounts of pocket money. Excessive pocket money allows adolescents to purchase nutritious food in addition to covering transportation costs to school. Conversely, with limited pocket money, adolescents face restrictions in selecting high-quality and nutritionally adequate foods. This research aligns with research conducted on junior high school students in Surabaya. Adolescents with more pocket money may have increased autonomy in making food purchasing decisions. They may be more likely to purchase energy-dense, low nutrient snacks or sugary drinks rather than consume structured main meals. The ease of access to ready-to-eat meals in school cafeterias, convenience stores, or online food delivery services can further reinforce irregular eating patterns. Furthermore, higher pocket money may be associated with more frequent eating out with peers, resulting in frequent lunch skipping and poor dietary status (Nur Aprillia et al., 2024). Based on the regression model results, dietary quality decreases with longer media usage duration, while higher paternal education levels and sufficient pocket money contribute to better dietary quality. Fathers with higher levels of education can act as role models and decision-makers within the family. This parental role can be strengthened by providing workshops on family nutrition to strengthen parents' influence on adolescent dietary quality (So et al., 2024).

Increased media usage duration leads to reduced physical activity and, in some cases, causes adolescents to neglect their meals. However, if the father has a high education level, he can remind his child to manage their time effectively when using gadgets or social media. Adequate pocket money supports better dietary quality by providing adolescents with purchasing power for nutritious food. Although excessive pocket money may lead some adolescents to skip breakfast, they still have the ability to buy food at school as a substitute meal. These findings suggest that improving paternal education, limiting media usage, and increasing pocket money may contribute to better dietary quality intake among adolescent girls.

Since maternal knowledge was not significantly associated with adolescent diet quality, interventions should be directed at adolescents. School-based nutrition education programs should emphasize practical skills, including meal planning, understanding food labels, identifying components of a balanced diet, and making healthy food choices within a limited budget. Interactive approaches such as peer education, digital learning modules, and social media campaigns promoting healthy eating patterns may be more effective, given adolescents' high exposure to digital platforms. Critical thinking skills in adolescents need to be improved, particularly regarding food and beverage product marketing on social media. This can help adolescents distinguish between promotions and information about good nutrition and reduce the influence of unhealthy food advertisements (Raut et al., 2024).

This study had several limitations. First, due to its cross-sectional design, it was not possible to establish a causal relationship. Second, the use of the recall method may have introduced memory bias. However, this finding provides important information on parental involvement in guiding adolescents' spending of pocket money, particularly in encouraging the selection of healthier foods through the appropriate use of pocket money. In addition, this study provides evidence supporting the need for the development of evidence-based nutritional interventions, particularly targeting adolescent girls, to improve healthy eating behaviors.

Meanwhile, this study has several important strengths. It provides a comprehensive assessment of adolescent girls' diet quality using multidimensional indicators. It uniquely highlights the role of paternal education, rarely examined in adolescent nutrition research, thus broadening understanding of family influences beyond maternal factors. By integrating behavioral (screen time), socioeconomic (pocket money), and parental education variables into a multivariate logistic regression model, the study identifies independent predictors of diet quality while reducing confounding effects. Furthermore, the focus on adolescent girls and the examination of contemporary factors such as social media exposure enhances the relevance and timeliness of the findings for public health, providing valuable evidence to inform adolescent-centered nutrition interventions.

D. Conclusion

Adolescents' dietary quality is most strongly influenced by their father's education, the amount of screen time they spend, and the amount of daily pocket money they receive. Conversely, maternal education level, maternal occupation, father's occupation, family type, family size, household income, and physical activity were not significantly associated with dietary quality. The association between paternal education and dietary quality may reflect the father's role in shaping household decision-making, access to food resources, and health-related values within the family. Higher screen time can increase adolescents' exposure to food advertising and sedentary behavior, which can influence food preferences and dietary choices. Pocket money can also impact adolescents' autonomy in purchasing food, often leading to greater consumption of energy-dense and nutrient-poor foods. Improving dietary quality among adolescent girls requires a multidimensional approach involving adolescents, parents, especially fathers, schools, and policymakers.

Future research should further investigate additional determinants of nutritional quality among adolescent girls to provide a more comprehensive understanding of the factors influencing their eating behaviors. Potential variables that need further exploration include adolescents' nutritional knowledge, body image perceptions, peer influence, the school food environment, and mothers' skills in selecting and preparing nutritious meals for the family. Longitudinal studies are also recommended to better understand the causal relationships between behavioral, socioeconomic, and environmental factors and nutritional quality over time. Furthermore, future research could focus on developing and evaluating school-based nutrition interventions, including nutrition education programs, healthy school food environments, and policies regulating the availability of unhealthy foods around schools.

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F. Author Contribution Statement

GY conceived and designed the study. GY and LH developed the methodology and collected the data, conducted the statistical analysis and interpreted the results. GY prepared the original draft of the manuscript. GY and FF reviewed, edited, and approved the final version of the manuscript. All authors declare no conflict of interest.

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