Dietary patterns and academic performance among Moroccan adolescents: a cross-sectional study

Patrones dietéticos y rendimiento académico entre adolescentes marroquíes: un estudio transversal

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Abstract

Introduction: Nutrition quality has been consistently linked to academic outcomes. Studies across different cultural contexts suggest that adolescents with balanced diets tend to show better well-being and school adjustment.
Objective: This study aimed to examine the associations between adolescents' regular eating habits and their academic performance in the Beni Mellal-Khénifra region of Morocco.
Methodology: A descriptive cross-sectional study was conducted with 439 students aged 14 to 20 years. Eating habits were assessed using the Arab Teens Lifestyle Study (ATLS) questionnaire, and academic performance was measured via overall grade point average. Statistical analyses using SPSS explored correlations between dietary patterns and school achievement. Results: The participants' average age was 15.02 years (43.7% male, 56.3% female). Descriptive analysis showed that fries, fast foods, and sweet drinks were frequently consumed, while fruits, vegetables, and breakfast at home were less common. Spearman's correlation revealed a positive association between healthy eating (Factor 2) and academic performance (ρ = 0.166, 95% CI [0.08, 0.25], $p < 0.001$), indicating a small but meaningful effect. Unhealthy food consumption (Factor 1) was not significantly related to GPA. Regression analysis confirmed that higher healthy eating scores predicted better academic performance (B = 0.472, 95% CI [0.214, 0.729], $p < 0.001$), while unhealthy eating did not show a significant effect, even after controlling for gender, age, education level, and area of residence.
Discussion: These findings align with previous research showing links between diet quality and school performance. The small effect size suggests that healthier eating is associated with modest differences in academic outcomes, highlighting that school performance is influenced by multiple factors, including psychosocial and environmental aspects.
Conclusions: The study identified significant associations between eating habits and academic performance among adolescents in the Beni Mellal-Khénifra region. Considering dietary patterns in adolescent development research appears valuable. Further longitudinal or experimental studies are recommended to clarify these relationships.

Keywords

Adolescent; academic performance; diet; healthy foods; Morocco.

Resumen

Introducción : La calidad de la nutrición se ha relacionado de manera consistente con los resultados académicos. Estudios en diferentes contextos culturales sugieren que los adolescentes con dietas equilibradas tienden a mostrar un mayor bienestar y mejor adaptación escolar.
Objetivo : Este estudio tuvo como objetivo examinar las asociaciones entre los hábitos alimentarios regulares de los adolescents y su rendimiento académico en la región de Beni Mellal-Khénifra, Marruecos.
Metodología : Se realizó un estudio transversal descriptivo con 439 estudiantes d'entre 14 y 20 años. Los hábitos alimentarios se evaluaron mediante el cuestionario Arab Teens Lifestyle Study (ATLS), y el rendimiento académico se midió a través del promedio general de calificaciones. Los análisis estadísticos realizados con SPSS exploraron las correlaciones entre los patrones dietéticos y el logro escolar.
Resultados : La edad promedio de los participantes fue de 15,02 años (43,7 % hombres, 56,3 % mujeres). El análisis descriptivo mostró que las papas fritas, la comida rápida y las bebidas azucaradas eran consumidas con frecuencia, mientras que las frutas, verduras y el desayuno en casa eran menos comunes. La correlación de Spearman reveló una asociación positiva entre la alimentación saludable (Factor 2) y el rendimiento académico (ρ = 0,166, IC 95 % [0,08, 0,25], $p < 0,001$), indicando un efecto pequeño pero significativo. El consumo de alimentos poco saludables (Factor 1) no se relacionó significativamente con el promedio de calificaciones. El análisis de regresión confirmó que mayores puntajes en el patrón de alimentación saludable predicen un mejor rendimiento académico (B = 0,472, IC 95 % [0,214, 0,729], $p < 0,001$), mientras que la alimentación poco saludable no mostró un efecto significativo, incluso después de controlar por género, edad, nivel educativo y zona de residencia.
Discusión : Estos hallazgos coinciden con investigaciones previas que muestran vínculos entre la calidad de la dieta y el rendimiento escolar. El tamaño de efecto pequeño sugiere que una alimentación más saludable se asocia con diferencias modestas en los resultados académicos, destacando qu'el rendimiento escolar está influenciado por múltiples factores, incluidos aspectos psicosociales y ambientales.
Conclusiones : El estudio identificó asociaciones significativas entre los hábitos alimentarios y el rendimiento académico entre adolescentes de la región de Beni Mellal-Khénifra. Considerar los patrones dietéticos en la investigación sobre el desarrollo adolescente resulta valioso. Se recomiendan estudios longitudinales o experimentales adicionales para clarificar estas relaciones.

Palabras clave

Adolescente; rendimiento académico; dieta; alimentos saludables; Marruecos.

Introduction

During adolescence, individuals develop behavioral patterns that often persist into adulthood and influence long-term health. Understanding these habits is essential to promoting healthy lifestyles (Rodero et al, 2025).

Nutrition is one of the key determinants of physical and cognitive functioning. International health reports underline that adolescents' well-being is shaped by several lifestyle factors, including diet quality and physical activity (World Health Organization, 2013). Research has also shown that engaging in regular physical activity and consuming nutrient-rich foods contribute positively to overall health factors (Donnelly et al., 2016).

In recent years, the consumption of unhealthy foods has increased due to their appealing taste, their frequent availability in school environments (Monteiro et al., 2018), and their generally lower cost compared to healthier options (Gupta et al., 2019) . The negative health impacts of these foods are well documented. Diet has been identified as a major factor influencing both health and academic performance (Jukes M et al, 2007). Several studies have highlighted its role in the development of chronic diseases, endocrine disruption, and increased cancer risk. Diet can contribute to endocrine disruption through exposure to pesticides and additives (André Cicolella, 2013). Poor nutritional quality has also been associated with weight gain and chronic disease (Fardet & Rock, 2020). A large prospective study conducted among more than 100,000 participants reported an increased overall cancer risk associated with high consumption of ultra-processed foods (Debras et al., 2022).

Eating habits have also been linked to cognitive functions such as concentration and memory. An unhealthy diet can lead to unstable blood sugar levels, resulting in mental fatigue and reduced attention (Francis & Stevenson, 2013). Other studies have shown that excessive intake of red meat, saturated fats, and simple carbohydrates is associated with impairments in learning and memory (Morris et al., 2004). Additional findings indicate that students with high-calorie, low-fiber, and high-fat diets tend to achieve lower grades in language subjects and overall academic performance , (Correa-Burrows et al., 2016).

Although many studies have emphasized the importance of nutrition for academic performance, few have specifically examined the types of foods consumed by students. The increasing presence of unhealthy foods in adolescents' daily diets remains insufficiently documented, particularly within school settings.

This study investigates how adolescents' dietary patterns, particularly the balance between healthy and unhealthy food consumption, are associated with their academic performance in the Beni Mellal–Khénifra region of Morocco.

We hypothesize that a higher consumption of healthy foods will be positively associated with academic performance, whereas a higher consumption of unhealthy foods will be negatively associated with academic performance.

To explore these relationships, dietary patterns were summarized using Principal Component Analysis (PCA), and their associations with academic performance were analyzed through correlation and regression methods.

These methods were selected to systematically reduce the dimensionality of dietary data, explore initial bivariate relationships, and subsequently model multivariate associations while controlling for potential confounders, thereby providing a robust analysis of the complex interplay between diet and academic outcomes.

This research aims to contribute to the growing body of literature on adolescent nutrition by identifying local dietary patterns and assessing their potential impact on educational outcomes.

Method

Study Design

This study adopted a descriptive cross-sectional design, conducted among adolescents enrolled in schools in the Khouribga province, Beni Mellal–Khénifra region, Morocco, during the 2024/2025 academic year. This design allows for describing dietary habits and exploring their associations with academic performance.

Sample Type and Selection

The sample was selected using random class sampling, taking into account school availability and cooperation. This type of sampling was chosen to ensure feasibility of data collection and balanced representativeness according to sex, school grade, and geographic area (urban/rural).

Inclusion criteria: students aged 14 to 20 years, enrolled in the participating schools, and willing to complete the questionnaire.

Exclusion criteria: students with cognitive impairments, special dietary needs, or those who refused to participate voluntarily. Incomplete or noncompliant questionnaires were also excluded from the final analysis.

Participants

A total of 439 adolescents (43.7% male, 56.3% female) were included. The distribution by school grade was: 34.0% in first year, 33.2% in second year, and 32.8% in third year. The majority resided in urban areas (58.5%) and 41.5% in rural areas. The participant selection process is presented in the flow diagram (Figure 1).

Missing data handling: incomplete questionnaires (>10% missing data) were removed. For isolated missing values, mean imputation was applied where appropriate.

Instruments

Dietary-habits:

Dietary habits were assessed using the Arab Teens Lifestyle Study (ATLS) (Al-Hazzaa et al., 2014), validated in several Arab countries and adapted to the Moroccan context. Internal consistency was acceptable ($\alpha = 0.744$). Contextual and regional validity is supported by previous (Al-Hazzaa et al., 2011); Hamid et al., 2021). Participants reported the weekly frequency of consumption of different food groups, ranging from 0 (never) to 7 days per week.

Academic-performance:

Academic performance was measured via the annual overall grade point average (GPA), obtained from official school records or provided by the schools.

Procedures

Data were collected from five secondary schools in the province, covering 12 classes, after obtaining official authorization and informed consent from participants and their parents/guardians.

Instructions were given to participants to avoid collecting data during hot, humid, or very cold months (El Oirdi et al., 2023) and during national and regional exam days, as these conditions can have a negative effect on physical activity levels and eating behavior (El Oirdi et al., 2024).

Statistical Analyses

Data were analyzed using SPSS software. The normality of distributions was verified using the Kolmogorov–Smirnov test, and the assumptions of linearity and homoscedasticity were checked before performing inferential analyses.

Spearman's correlation analyses were conducted to explore the relationships between individual food consumption frequencies and students' Grade Point Averages (GPA).

A Principal Component Analysis (PCA) with Varimax rotation was then applied to identify underlying dietary patterns, yielding two factors labeled as "Unhealthy" and "Healthy", according to their most representative food items.

Finally, multiple linear regression models were used to examine the associations between these dietary factors and GPA, controlling for potential confounders such as sex, age, education level, and area of residence.

All results are presented with both standardized (β) and unstandardized (B) coefficients, 95% confidence intervals, and corresponding effect sizes, ensuring a transparent and interpretable assessment of the associations between dietary habits and academic performance.

Ethical considerations

Before the start of this study, we ensured full compliance with the ethical requirements specific to scientific research. The necessary authorizations were obtained from the relevant school authorities, allowing official access to the participating schools. Students were clearly informed about the purpose of the study, the nature of the information collected, and their rights, including the possibility of withdrawing at any time without consequence. Parents or guardians were also informed about the conduct and objectives of the research. All data collected was treated confidentially, guaranteeing the anonymity of participants and its exclusive use for scientific purposes. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki, and each participant gave their informed consent to take part.

Results

The participant diagram (Figure 1) clearly illustrates the selection process, as well as the number of students included and excluded at each stage of the study.

Figure 1. Participant selection flow

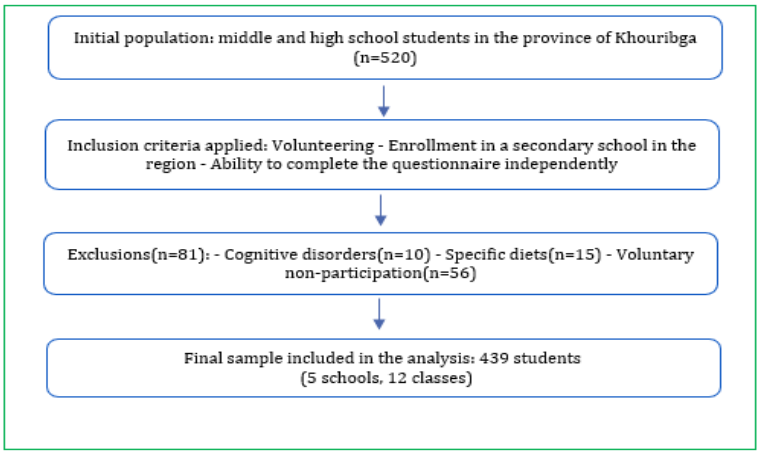

Table 1 presents the sociodemographic characteristics of the participants. The sample is predominantly female (56.3 %) and urban (77.2 %), with most adolescents aged between 14 and 17 years. These distributions are important for contextualizing dietary behaviors and potential disparities in academic performance. The observed variability in sex, age, and area of residence allows these factors to be included as covariates in subsequent analyses, ensuring that the associations between diet and academic performance are not confounded by demographic differences.

Table 1. Distribution of the sample by gender and area of residence

Variable	Frequency	Percentage %
Gender		
Male	192	43.7
Female	247	56.3
Age		
14 years old	222	50.56
15 to 17 years old	157	35.77
18 to 20 years old	60	13.67
Area of residence		
Urban	339	77.2
Rural	100	22.8
Education level		
Year 2 of middle school	198	45.1
Year 3 of middle school	105	23.9
10th grade	24	5.5
1st year of high school A	26	5.9
1st year of high school B	36	8.2
2nd year of high school A	24	5.5
2nd year of high school B	26	5.9

Source: Own elaboration (A-Literary stream B-Scientific stream)

Table 2 summarizes the frequency of food consumption among students. Unhealthy foods such as fries and chips (23.7 %) and fast foods (18.7 %) are the most commonly consumed items, whereas healthy options like fruits, vegetables, and dairy products are less frequent (5–11 %). This imbalance in eating habits provides an overview of adolescents' nutritional profiles, which forms the basis for examining how these behaviors may relate to academic achievement in subsequent analyses.

Table 2. Students' Food Consumption Frequency (= 3 Times per Week)

Type of Food	Frequency	Percentage %	Total participants
Breakfast at home	33	8.2	439
sweet drinks	67	15.3	439
vegetables	23	5.2	439
Fruit	36	8.6	439
Dairy products	48	10.9	439
Fast foods	82	18.7	439
Fries and Chips	104	23.7	439
Biscuits and beignets	57	13	439
candy and chocolate	54	12.3	439
Energy drinks	39	8.9	439

Source: Own elaboration

Table 3 provides descriptive statistics for dietary variables and academic performance. On average, students report consuming fruits and vegetables slightly more often than fast foods, with a mean GPA of 13.64 (SD = 2.76), indicating moderate variability in academic achievement. These descriptive findings establish the quantitative context necessary for the correlation and regression analyses that follow.

Table 3. Descriptive Statistics of Dietary Habits and Academic Performance

Variable	Mean	SD	N
Breakfast at home (per week)	4.39	2.756	439
Sweet drinks (per week)	3.49	2.392	439
Vegetables (per week)	5.69	2.094	439
Fruit (per week)	5.72	1.884	439
Dairy products (per week)	4.48	2.415	439
Fast foods (per week)	2.75	2.237	439
Fries and chips (per week)	3.56	2.180	439
Biscuits & beignets (per week)	4.62	2.342	439
Candy & chocolate (per week)	4.50	2.506	439
Energy drinks (per week)	1.34	1.932	439
GPA	13.64	2.764	439

GPA: Grade Point Average
Source: Own elaboration

Spearman correlations reveal weak but significant associations for certain dietary habits. For instance, breakfast at home showed a positive correlation with academic performance (ρ = 0.133, p = 0.005, 95% CI [0.042, 0.222]), and fruit consumption also positively correlated with GPA (ρ = 0.166, p = 0.001, 95% CI [0.076, 0.254]). Conversely, energy drink consumption was negatively associated (ρ = –0.140, p = 0.003, 95% CI [–0.230, –0.050]). These results suggest that healthy dietary habits may positively contribute to academic outcomes, even if effect sizes remain modest.

Table 4. Spearman Correlation Between GPA and Dietary Habits

		GPA		
Dietary Habit	ρ (Spearman)	p-value	N	95% CI for ρ
Breakfast at home	0.133	0.005	439	0.042 – 0.222
Sweet drinks	0.008	0.871	439	–0.080 – 0.096
Vegetables	0.084	0.079	439	–0.010 – 0.177
Fruit	0.166	0.001	439	0.076 – 0.254
Dairy products	0.065	0.172	439	–0.028 – 0.157
Fast foods	-0.074	0.123	439	–0.166 – 0.019
Fries & Chips	0.021	0.655	439	–0.071 – 0.113
Biscuits & Beignets	0.009	0.852	439	–0.083 – 0.101
Candy & Chocolate	0.003	0.958	439	–0.089 – 0.095
Energy drinks	-0.140	0.003	439	–0.230 – –0.050

GPA: Grade Point Average
Source: Own elaboration

A Principal Component Analysis (PCA) with Varimax rotation was used to identify distinct dietary patterns based on food consumption frequency. Two interpretable profiles were derived: an "Unhealthy foods" factor (fast foods, fries, chips, sugary drinks) and a "Healthy foods" factor (fruits, vegetables, breakfast at home, dairy products). These patterns were subsequently used as composite variables in regression models to examine their associations with academic performance

Table 5. Factor Loadings of Food Items for Identified Dietary Patterns (Unhealthy - Healthy)

Food Item	Factor 1 (Unhealthy)	Factor 2 (Healthy)
Breakfast at home	0.294	0.552
Sweet drinks	0.704	-
Vegetables	-	0.645
Fruits	0.168	0.720
Dairy products	0.153	0.575
Fast foods	0.656	-
Fries & chips	0.700	-
Biscuits & doughnuts	0.709	0.218
Candy & chocolate	0.654	0.299
Energy drinks	0.482	-

Source: Own elaboration

Linear regression analysis, adjusted for sex, age, educational level, and area of residence, shows that the 'healthy foods' factor is positively associated with academic performance (B = 0.472, β = 0.171, 95% CI [0.214, 0.729], p < 0.001), whereas the 'unhealthy foods' factor shows a negative but non-significant trend (B = –0.176, β = –0.064, 95% CI [–0.440, 0.089], p = 0.193). Sex also emerged as a significant predictor, with girls having higher grades than boys (B = 0.867, β = 0.156, 95% CI [0.342, 1.391], p = 0.001).

Table 6. Association of Dietary Patterns Identified by Principal Component Analysis with Students' Academic Performance: A Linear Regression Analysis

Variables	B	SE	β	t	p-value	95% CI for B
Constant	13.809	1.867	—	7.396	<0.001	10.139 – 17.478
Factor 1 (Unhealthy foods)	– 0.176	0.135	– 0.064	–1.304	0.193	– 0.440 – 0.089
Factor 2 (Healthy foods)	0.472	0.131	0.171	3.603	<0.001	0.214 – 0.729
Gender	0.867	0.267	0.156	3.248	0.001	0.342 – 1.391
Age	– 0.091	0.129	– 0.063	–0.702	0.483	– 0.344 – 0.163
Education level	0.103	0.102	0.093	1.014	0.311	– 0.097 – 0.303
Area of residence	– 0.430	0.323	– 0.065	–1.331	0.184	– 1.066 – 0.205

Source: Own elaboration

The findings indicate that adolescents' dietary habits are selectively associated with academic performance. Specifically, regular consumption of healthy foods, such as fruits, vegetables, and dairy products (Factor 2), is positively associated with GPA, with a moderate effect size as indicated by the regression coefficient (β = 0.171, 95% CI [0.214 – 0.729]). In contrast, the intake of unhealthy foods (Factor 1) showed no significant association with academic performance (β = –0.064, p > 0.05). These associations remain significant after adjusting for potential confounders, including sex, age, educational level, and area of residence. Overall, the results highlight that dietary choices favoring nutritious foods may be associated with measurable, albeit modest, differences in academic outcome, which can inform strategies promoting healthy lifestyles among adolescents. Nutrition workshops.

Discussion

The present study examined the associations between adolescents' dietary habits and academic performance in Morocco. Among the analyzed variables, the strongest association was observed for the consumption of healthy foods (Factor 2), including fruits, vegetables, dairy products, and breakfast at home. Conversely, Factor 1 (unhealthy foods), characterized by fast food, sweet drinks, and snacks, showed weaker and non-significant associations with academic performance. This hierarchy indicates that balanced dietary patterns are more closely related to academic outcomes.

Overall, the findings reveal that a higher consumption of healthy foods such as fruits, vegetables, breakfast at home, and dairy products (Factor 2) is positively and significantly associated with students' grade point averages (B = 0.472, 95 % CI: 0.214–0.729, p < 0.001). In contrast, the intake of unhealthy foods (Factor 1) shows a negative but non-significant trend (B = –0.176, 95 % CI: –0.440–0.089, p = 0.193).

Observed correlations, particularly for breakfast at home (ρ = 0.133) and fruit consumption (ρ = 0.166), suggest a measurable yet modest relationship between balanced dietary habits and academic performance. These results underscore the practical importance of promoting healthy eating among adolescents in connection with academic achievement.

These findings are consistent with several international studies showing that balanced diets support cognitive functions, including attention, memory, and learning (Rodero et al., 2025 ; Nyaradi et al., 2013). Similarly, (Florence et al., 2008) and (Iglesias et al., 2019) reported that students with higher fruit, vegetable, and dairy intake tend to perform better academically. (Burrows et al., 2017) also found that regular breakfast consumption combined with limited processed food intake was associated with higher school performance. Collectively, these findings reinforce the hypothesis that nutrient-rich diets promote optimal cognitive functioning and concentration, thereby facilitating learning and academic achievement.

These findings are also consistent with evidence from studies conducted in Morocco. For instance, (Hamid et al., 2023) found a positive correlation between healthy dietary habits and grade point average (r = 0.15; p < 0.001), while (Bouchefra et al., 2024) reported that obesity was associated with lower academic performance.

Similarly, (Hioui et al., 2011) showed that malnutrition in rural areas negatively affected students' learning outcomes.

Collectively, these national data confirm that balanced nutrition is a significant determinant of educational success among Moroccan adolescents.

However, our results differ from some previous studies that reported strong and statistically significant negative associations between unhealthy dietary patterns and academic outcomes (Jara, 2025 ; Kim et al., 2016) . In our sample, the association between unhealthy food consumption and academic performance was negative but non-significant, suggesting that the strength of this relationship may vary across contexts.

This finding is in line with prior research indicating that low fruit and vegetable intake, often accompanied by higher consumption of unhealthy foods, is associated with poorer school results, (Roldán González et al., 2025) suggested that such unfavorable eating behaviors could be influenced by factors such

as health education and physical activity, which may moderate the relationship between diet and academic outcomes.

It is important to recognize that academic performance is determined by a combination of biological, psychological, and social factors. Family support, mental health, and lifestyle behaviors interact with diet to shape students' learning abilities (World Health Organization., 2019). Therefore, dietary habits should be considered within this broader developmental framework rather than as isolated predictors.

This study presents several limitations that must be acknowledged. First, the use of self-reported questionnaires may have introduced recall bias and social desirability bias. Errors in estimating portion sizes or frequencies could have affected the accuracy of dietary data. Second, the cross-sectional design prevents the establishment of causal relationships. Third, selection bias may exist, as participants were volunteers from selected schools, which may limit external validity. Finally, unmeasured confounders such as learning disorders, mental health status, or detailed socioeconomic indicators could have influenced the observed associations.

Despite these limitations, our findings provide relevant insights for public health and education policies. They highlight the potential benefits of implementing school-based nutrition programs aimed at reducing ultra-processed food consumption while encouraging daily intake of fruits, vegetables, and dairy products. Effective interventions could combine nutrition education with practical cooking workshops, family involvement, and regular physical activity sessions. Integrating these actions into existing school health frameworks could strengthen students' well-being and academic engagement.

Future research should prioritize longitudinal and intervention studies to explore the causal mechanisms linking diet quality to cognitive performance. Such studies could assess how specific nutrients, such as omega-3 fatty acids or micronutrients, influence executive functioning and concentration, while controlling for lifestyle and psychosocial factors.

In summary, this study emphasizes that healthier dietary habits particularly frequent consumption of fruits, vegetables, dairy products, and breakfast are positively associated with better academic outcomes among Moroccan adolescents. The observed associations, though modest, highlight the importance of balanced nutrition as a component of students' overall development. Conversely, the effects of unhealthy dietary patterns appear to be mediated by contextual factors such as physical activity, sleep, and family environment, underscoring the complex and multifactorial nature of academic performance.

Conclusions

The results of this study indicate a positive association between Factor 2, characterized by higher consumption of minimally processed foods such as fruits, vegetables, and dairy products, and students' overall academic average (GPA). The strength of this association is moderate ($\beta = 0.171$; $\rho = 0.166$), suggesting that adolescents with dietary patterns favoring minimally processed foods tend to report slightly higher academic performance.

Several limitations should be noted. Dietary habits were not assessed according to seasonal variations, academic performance was measured solely through the overall GPA, and certain unmeasured factors such as learning difficulties or mental health status could also be associated with the observed variables.

Overall, this study provides descriptive insights into the correlation between dietary patterns and school performance. These findings highlight the relevance of further research using longitudinal or experimental designs to explore these relationships in more depth and to better understand the underlying mechanisms.

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