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Influence of Nutritional Status on Academic Performance: A Study of Schoolchildren in Eastern Morocco

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Abstract: This study investigates the impact of nutritional status on academic performance among schoolchildren in Eastern Morocco. Focusing on the prevalence of overweight, obesity, and their associations with academic outcomes, the research underscores the significance of physical well-being in educational achievement. Conducted as a cross-sectional analysis in March 2022, the survey encompassed eight public and two private schools, selected through random sampling. Classes within these schools were also randomly chosen. Utilizing a self-administered, anonymous questionnaire, completed individually by students in the presence of a trained dietician, the study also involved anthropometric measurements and clinical examinations. Additionally, students' grade point averages (GPAs) were obtained from school records. The survey comprised 596 students, with an average age of 14.86 ± 1.98 years, height of 160.47 ± 11.84 cm, and weight of 51.28 ± 11.49 kg. The prevalence of underweight was recorded at 8.7%, overweight at 10.7%, and obesity at 2.7%. Statistical analysis using the Analysis of Variance (ANOVA) test revealed a significant association between obesity and diminished academic performance, indicating the need for attention to obesity among adolescents in this region. The findings suggest that national-level prevalence determination of overweight and obesity by health policymakers is crucial for this age group. Identifying risk factors associated with these conditions is imperative for effective prevention and early intervention. In this context, the promotion of physical activity and healthy eating habits is vital for fostering healthy, successful school environments. This research contributes to the understanding of how physical health, particularly nutritional status, influences academic outcomes. It highlights the need for integrated approaches that consider the physical well-being of students as a critical factor in educational success. The study's implications extend beyond academic circles, offering insights for policymakers and educators in developing holistic strategies to enhance both health and educational outcomes.

Keywords: Schoolchildren; Academic performance; Nutritional status; Assessment; Morocco

1. Introduction

The efficacy of educational systems is often gauged through learner performance on various standardized national and international assessments. Since 1958, the International Association for the Evaluation of Educational Achievement (IAE) has systematically evaluated student capabilities in diverse subjects, including mathematics and science (as per TIMSS), reading (PIRLS), and civics and civil rights (ICCS and CIVED). In the context of developing countries, Morocco stands out for its relatively modest educational achievements. Despite concerted efforts to uplift educational standards, results from both international and national surveys consistently highlight concerning achievement levels (Mullis et al., 2019).

Academic literature has extensively explored the determinants of academic achievement. Several studies have underscored the influence of students' domestic environments on their academic performance (Axelsson, 2009;

Frederickson & Petrides, 2008; Li et al., 2020; Liu et al., 2020; Sirin, 2005). Concurrently, other research has spotlighted the significant role played by school-related factors (Chen & Weikart, 2008; Donker et al., 2014; Sammons, 1995; Wößmann & West, 2006). A third strand of academic inquiry, not entirely convinced of the overriding impact of familial or educational institutional factors, has delved into individual-centric determinants (Anderson & Good, 2017; Baert et al., 2015; Barbosa et al., 2020; Florence et al., 2008; Lozano et al., 2014; MacLellan et al., 2008; Naik et al., 2015; Pascoe et al., 2018; Pöysä et al., 2020; Sapci et al., 2021; Soares et al., 2015; Tynan et al., 2020).Comprehensive reviews of studies within similar contexts, alongside the findings from both international and national surveys, indicate that enhancing educational quality fundamentally begins with identifying factors influencing learning processes. It has been observed that students within identical classroom settings—sharing the same educational resources, teaching methods, and school environment—demonstrate varying academic performances. This variation has directed the focus of this study towards factors associated with students' lifestyles, particularly the impact of nutritional status on academic achievement. The selection of variables for this study is predicated on the hypothesis that internal factors, namely those inherent to a student's lifestyle within the home environment, play a more substantial role in academic performance than external factors, such as those emanating from the school setting, teachers, and educational resources.

Overweight and obesity are characterized by an excessive accumulation of body fat. Global data indicate a marked increase in the prevalence of these conditions, rising from approximately 4% in 1975 to 18% in 2016. In 2004, overweight and obesity were ranked as the fifth leading risk factor for global mortality (WHO, 2022). By 2019, ischemic heart disease, significantly influenced by overweight and obesity, emerged as the foremost cause of global deaths, with an attributed burden of at least 23% (Whitaker et al., 1997; WHO, 2009). The likelihood of childhood obesity persisting into adulthood is high, with studies showing a continuation probability of up to 70% (Heude & Charles, 2001). Conversely, undernutrition, encompassing conditions like wasting, stunting, and being underweight, detrimentally affects children's potential to achieve optimal physical and cognitive development (Srivastava et al., 2012). The relationship between nutritional status and academic achievement has been extensively documented in the literature (Asmare et al., 2018; Naik et al., 2015; Patsa, 2021). Research in this domain can be broadly categorized into two groups: the first associates' thinness or underweight with lower academic performance (Abebe et al., 2017; Agarwal et al., 2018; Ateillah et al., 2018; Golam et al., 2014; Khan et al., 2020; Seyoum et al., 2019), while the second correlates poorer academic outcomes with obesity and overweight (Anderson & Good, 2017; Li et al., 2008; Ma et al., 2020; Santana et al., 2017).

Previous research in the realm of educational outcomes and nutritional status has predominantly focused on national-level data or regions outside Eastern Morocco. This geographical limitation has resulted in a notable gap in understanding the unique socio-economic and environmental influences prevalent in Eastern Morocco. The absence of region-specific data impedes the formulation of effective, localized intervention strategies that address the distinct needs of this area. Addressing this gap, the current study zeroes in on Eastern Morocco, with a specific emphasis on discerning the moderating factors that may affect the relationship between nutritional status and academic achievement in this region. The objective is to deepen the understanding of how these variables interact within the unique context of Eastern Morocco, thereby aiding in the development of targeted interventions and policies. Such initiatives are anticipated to enhance educational outcomes and further the cause of social equity within the region.

Central to this study is the estimation of the prevalence of malnutrition, including stunting and obesity, which is vital for timely and effective intervention. Additionally, the investigation explores the association between Body Mass Index (BMI) and the academic performance of schoolchildren in both private and public schools in the city of Taza, situated in Eastern Morocco. This focus not only addresses the existing research gap but also provides a foundation for future studies aimed at comprehensively understanding the multifaceted dynamics influencing educational success in diverse regional contexts.

2. Methodology

2.1 Study Design and Population Characteristics

The research was conducted using a cross-sectional design, focusing on the assessment of health and academic performance among adolescents in Eastern Morocco. Data collection was carried out in March 2022, a period chosen for its spring-summer climate which facilitates accurate anthropometric measurements due to lighter clothing. The study encompassed ten schools, including eight public and two private institutions, selected through a random sampling process. Within these schools, classes were also chosen randomly for participation.

A team of trained professionals distributed the self-administered questionnaires anonymously to 610 adolescents. These participants completed the questionnaires individually, under the supervision of a dietician. This dietician was also responsible for collecting anthropometric data. A total of fourteen questionnaires were excluded based on pre-defined criteria. In addition to socio-demographic information, the study evaluated academic outcomes through the GPA of students. This data was procured from the directors of the involved

schools.

2.2 Inclusion and Exclusion Criteria

The analysis phase involved a rigorous examination of the returned questionnaires. Exclusions from the study were made under the following conditions:

- Questionnaires with missing or illegible data.
- Participants outside the age range of 10-19 years.
- Presence of oedema observed during clinical examinations conducted by the dieticians.
- Participants who declined to have their weight and/or height measured.

Conversely, inclusion criteria encompassed all students who attended the designated classrooms for the questionnaire and anthropometric assessments, and whose parents or guardians consented to their participation in the study.

2.3 Variables Measured

Participants' weight was recorded using an electronic scale (Beurer PS160) with a precision of 100g. The survey, conducted during the spring-summer season, facilitated accurate weight measurement due to the lighter clothing worn by subjects. Weights were recorded in kilograms. Heights were measured using a wall-mounted height gauge (Seca 206) to the nearest 220cm in a standing position, with values expressed in centimeters.

BMI for age was calculated for all participants. This calculation involved a Z-score, determined using the WHO AnthroPlus software, which integrates variables such as height, weight, sex, date of birth, and date of measurement. The WHO growth standards (Onis et al., 2007) were employed to classify rates of obesity and overweight among the children.

2.4 Ethical Considerations

In adherence to the principles outlined in the Declaration of Helsinki (WHO, 2022), all measures were taken to safeguard the privacy and confidentiality of the participants' personal information. Informed consent was obtained from the guardians of the participants, who were thoroughly briefed on the research objectives, methods, and the researchers' institutional affiliations.

2.5 Statistical Analysis

The data analysis was conducted using SPSS version 26 and WHO Anthroplus version 1.04 software. Quantitative variables were reported as means and standard deviations, while qualitative variables were expressed in terms of frequencies and percentages. The WHO's 2007 reference standards for gender and age were utilized for categorizing adolescents into four distinct nutritional statuses: underweight (Z Score < -2 standard deviations: SD), normal weight (-2 SD < Z Score < +1 SD), overweight (+1 SD < Z Score < +2 SD), and obese (Z Score > + 2 SD). An association test was employed to investigate potential risk factors related to weight gain. Additionally, an ANOVA test was conducted to examine the relationship between the dependent variable (GPA) and the independent variable (nutritional status).

3. Results

3.1 Characteristics of Participants

The study encompassed a total of 596 students. The average age was determined to be 14.86 ± 1.94 years. The sex ratio (boys to girls) was approximately 0.81. Average height and weight were recorded at 160.47 ± 11.84cm and 51.28 ± 11.49kg, respectively. Regarding BMI, the mean value was 19.81 ± 3.41. The mean GPA of the participants was 13.01 ± 3.57. Detailed characteristics of the participants are presented in Table 1.

3.2 Nutritional Status Assessment

The prevalence of underweight, overweight, and obesity among participants was estimated in accordance with the World Health Organization 2007 standards. The results showed that the prevalence of underweight was 8.7%, overweight was 10.7%, and obesity was 2.7%. A gender-specific analysis of BMI categories indicated a higher prevalence of obesity among females, whereas overweight was more prevalent in males, as detailed in Table 2.

3.3 Association Between Academic Performance and Nutritional Status

To investigate the correlation between students' academic performance and their nutritional status, a one-way ANOVA was conducted. Table 3 presents the means and standard deviations for each nutritional category.

Table 1. Characteristics of respondents by gender

Sex	n (%)	Mean	SD	Minimum	Maximum
Female	328 (55)				
Male	268 (45)				
Age (years)		14.86	1.94	11	19
GPA		13.01	3.57	5.00	19.37
Weight (kg)		51.28	11.49	28.00	98.00
Height (cm)		160.47	11.84	120	186
HAZ		-0.25	1.26	−5.24	3.46
BAZ		-0.20	1.26	−3.67	3.66
BMI (Kg/m^2)		19.81	3.41	13.3	38.2

Note: HAZ - height for age Z-score; BAZ - BMI for age Z-score; SD - standard deviation.

Table 2. Distribution of BMI categories by gender

		BMI/Age (%)			
	N	**Underweight**	**Normal Weight**	**Overweight**	**Obesity**
Combined	596	8.7	77.9	10.7	2.7
Girls	328	8.5	78.7	9.8	3
Boys	268	9	76.9	11.9	2.2

Table 3. GPA distribution according to nutritional status

Nutritional Status	N	Mean	SD
Normal Weight	46	13.18	3.51
Obesity	16	9.65	2.73
Overweight	64	12.82	3.97
Underweight	52	12.84	3.35

Prior to the ANOVA test, the assumption of normality for the dependent variable (GPA) was verified, with the data exhibiting a normal distribution as depicted in Figure 1.

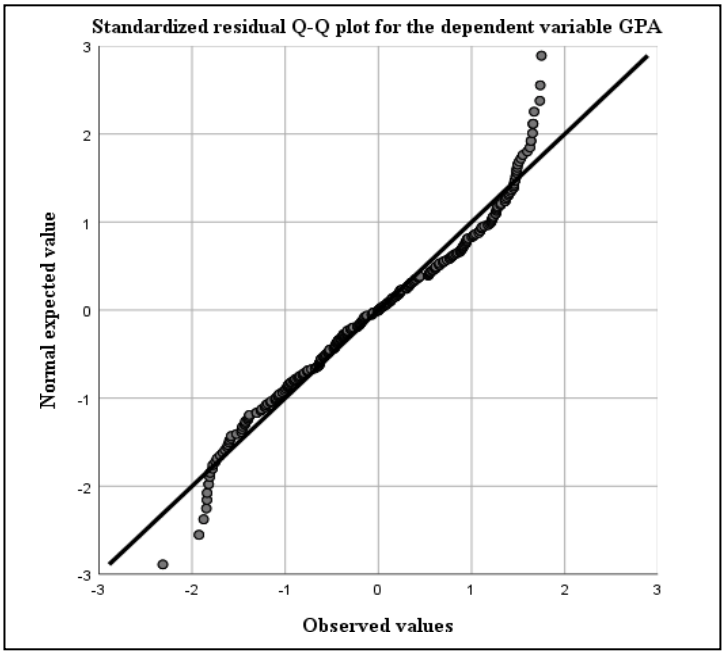

Figure 1. Normality assumption for the dependent variable (GPA)

Levene's test for equality of variances yielded an F-value of Levene F (3,592) = 0.006, which is less than 0.01. Given that the significance value falls below the threshold of 0.05, the null hypothesis pertaining to the homogeneity of variance is rejected. This suggests a significant disparity between the variances of the groups, indicating that the assumption of homogeneity of variance is not satisfied. Consequently, the Welch adjusted F statistic was employed, as it provides a more accurate measure in such instances. The outcomes of this adjustment are detailed in Table 4.

Table 4. Robust test of equality of means

	F	df1	df2	Sig.
Welch Test	8.25	3	55.32	0.000 (<0.001)

Note: F-Welch F statistic; df-degree of freedom; Sig.-significance level.

Subsequent post hoc analyses were conducted using the Games-Howell test to determine the mean differences among the four nutritional groups. The analysis indicated significant disparities, particularly between students of normal weight (Mean = 13.18) and underweight (Mean = 12.84) compared to those categorized as obese (Mean = 9.65). Given the normal distribution of the dependent variables, the calculated effect size (Cohen's d) was 1.6, denoting a large effect. These results are summarized in Table 5.

Table 5. Games-Howell post hoc test results

Group	Mean	1.	2.	3.	4.
1. Underweight	12.84	0.00			
2. Normal Weight	13.18	5.73	0.00		
3. Overweight	12.82	0.02	4.13	0.00	
4. Obesity	9.65	3.19**	3.53*	3.17	0.00

Note: * $p < .05$, ** $p < .01$

4. Discussion

This study documented a prevalence of overweight at approximately 13.1% and obesity at 3%. These findings align with national-level data. El Kabbaoui et al. (2018) reported overweight and obesity prevalences of 7.29% and 3.41%, respectively, in a cohort of 1,818 adolescents aged 12 to 18 years. Sebbani found similar rates of 8% for overweight and 3% for obesity among 1,418 schoolchildren in Marrakech (Sebbani et al., 2013). In a comparable study conducted in Eastern Morocco, prevalence rates of 12.2% for overweight and 3% for obesity were observed, as per the International Obesity Task Force (IOTF) standards (Nouayti et al., 2020). A study in Tunisia involving 715 college students indicated slightly higher obesity and overweight rates of 17.4% and 6.1%, respectively, compared to this study (Badr et al., 2018). Internationally, Juan Ángel Rivera's review of school-age adolescents in Latin America showed overweight and obesity rates ranging from 12.9% to 24.4% and 3.4% to 34.8%, respectively, between 2002 and 2012.

Variations in prevalence rates of obesity across different studies may be attributed to a multitude of factors. These include disparities in sample size, age, gender, ethnicity, socioeconomic and health status of the participants, differing diagnostic criteria, and changes in environmental factors. Such variations necessitate careful consideration when interpreting and comparing obesity prevalence across different studies and populations.

Consistent with findings by Rivera et al. (2014), Hoffman et al. (2006), and Economos et al. (2008), this study observed a higher prevalence of obesity among girls compared to boys. This observation, however, contrasts with the results reported by Jiang et al. (2018) and Cluskey & Grobe (2009). Potential explanations for these gender differences might include variations in growth and hormonal changes during post-puberty, along with socio-cultural factors that influence physical activity levels. Boys, for instance, may engage more frequently in outdoor activities and sports, leading to increased physical activity and energy expenditure compared to girls, especially in contexts where socio-cultural norms limit girls' outdoor mobility.

The study further revealed a significant correlation between nutritional status and academic performance among middle and high school students in Eastern Morocco. Students with a normal nutritional status, as per WHO standards, exhibited superior academic performance compared to their counterparts with abnormal nutritional status, especially obesity. The mean GPA for students with normal nutritional status (M = 13.18) was notably higher than that for obese students (M = 9.65).

The findings of this study align with those of Lu Ma et al., who observed in a cohort of 10,279 middle school students in China that obese students scored lower on standardized tests than their non-obese counterparts (Ma et al., 2020). A systematic review by Santana et al., encompassing 34 studies, noted that 15 of these studies identified a significant negative correlation between obesity and educational outcomes (Santana et al., 2017). Earlier research by Taras and Potts-Datema, reviewing nine studies on the association between obesity and academic performance,

also reported a significant relationship (Taras & Potts-Datema, 2005). Some scholars have proposed psychological factors, particularly related to body image stereotypes, as a potential explanation for this association. Stereotypes portraying overweight and obese individuals as lazy, lacking discipline, or less intelligent (Brownell et al., 2005; Griffiths et al., 2010; Komarraju & Dial, 2014; Krukowski et al., 2009; Langford et al., 2022; Puhl & Heuer, 2010) may adversely impact self-esteem and goal-setting, potentially leading to academic underachievement or school dropout. Li et al. (2008) suggested that adiposity might affect cognitive functions, including learning and memory. Furthermore, the co-morbidities associated with obesity, primarily cardiovascular diseases, may contribute to increased school absenteeism due to medical appointments or recovery periods post-surgery (Santana et al., 2017). The prescription of certain medications, such as opioids, has been reported to negatively affect academic performance (Cotti et al., 2020). Additionally, obesity has been linked to sleep disorders and apnea, potentially affecting alertness and cognitive performance in students (Biller et al., 2022).

The cross-sectional design of this study was aptly chosen to determine the prevalence of malnutrition and its potential association with academic performance in the selected population. While this design is instrumental in providing prevalence data and generating hypotheses, it is important to note that it does not establish causality. The insights gained, however, are valuable for guiding future research, particularly in the development of longitudinal studies that can explore causal relationships.

Existing literature has identified a range of potential mediators in the association between obesity and academic performance. These include factors such as weight-related stigma, self-esteem, depression, socioeconomic status, and cognitive performance. The inability to verify the impact of these mediators in the current study is acknowledged as a limitation. The presence of these factors could potentially act as confounding variables in the observed associations. Future research exploring the impact of obesity on academic performance would benefit from considering these mediators, thereby providing a more comprehensive understanding of the dynamics at play.

5. Conclusions

The findings of this study underscore the critical issue of obesity among adolescents in Eastern Morocco and its detrimental impact on both academic performance and overall health. A comprehensive approach, encompassing individual, educational, and community levels, is imperative to address this challenge effectively. The promotion of healthy eating habits and regular physical activity, coupled with education and support initiatives, is essential for fostering environments that encourage adolescents to make informed health choices and realize their full potential. Investment in the health and well-being of young individuals is pivotal for the future prosperity of Eastern Morocco. Furthermore, for children diagnosed with obesity, it is crucial to implement management strategies aimed at mitigating obesity-related health complications and to establish support programs that enhance self-esteem and motivation.

Author Contributions

Conceptualization, S.B.; methodology, S.B and R.E.C.; software, R.E.C.; validation, S.B.; formal analysis, S.B and R.E.C; investigation, S.B and R.E.C; resources, S.B; data curation.; writing—review and editing, S.B and R.E.C.

Informed Consent Statement

Informed consent was obtained from the guardians, who were properly informed of the objectives, methods, and institutional affiliations of the researchers. Authorization to conduct the survey in public schools in the province of Taza was obtained from the provincial delegation of the Ministry of National Education.

Ethical Approval

This study adheres to strict ethical guidelines, ensuring the rights and privacy of participants. Informed consent was obtained from all participants, and personal information was protected throughout the study. The methodology and procedures of this research have been approved by the appropriate ethics committee. Participants were informed of their rights, including the right to withdraw from the study at any time. All collected data is used solely for the purpose of this research and is stored and processed in a secure and confidential manner.

Data Availability

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

References

Abebe, F., Geleto, A., Sena, L., & Hailu, C. (2017). Predictors of academic performance with due focus on undernutrition among students attending primary schools of Hawa Gelan district, Southwest Ethiopia: A school based cross sectional study. *BMC Nutr., 3*(1), 1-8. https://doi.org/10.1186/s40795-017-0138-2.

Agarwal, A., Jain, S., Garg, S. K., Chopra, H., & Bano, T. (2018). Prevalence of malnutrition and its impact on scholastic performance among 8-12 year children from 2 private schools of urban Meerut. *J. Med. Allied Sci., 8*(1), 3-6. https://doi.org/10.5455/jmas.270017.

Anderson, A. S. & Good, D. J. (2017). Increased body weight affects academic performance in university students. *Prev. Med. Rep., 5*, 220-223. https://doi.org/10.1016/j.pmedr.2016.12.020.

Asmare, B., Taddele, M., Berihun, S., & Wasie, F. (2018). Nutritional status and correlation with academic performance among primary school children, Northwest Ethiopia. *BMC Res. Notes, 11*(1), 805. https://doi.org/10.1186/s13104-018-3909-1.

Ateillah, K., Aboussaleh, Y., & Sbaibi, R. (2018). Évaluation anthropométrique et son impact sur la performance scolaire des lycéens de la commune urbaine Kenitra (Nord-Ouest Marocain). *Antropo,* (39), 71-76.

Axelsson, G. B. M. (2009). Mathematical identity in women: The concept, its components and relationship to educative ability, achievement and family support. *Int. J. Lifelong Educ., 28*(3), 383-406. https://doi.org/10.1080/02601370902799218.

Badr, W., Ghammam, R., Maatoug, J., Ammar, A., Fredj, S. B., & Ghannem, H. (2018). Prévalence de l'obésité et du surpoids chez les adolescents et association avec les facteurs de risques comportementaux Sousse, Tunisie 2016. *Ann. Endocrinol., 79*(4), 504-505. https://doi.org/10.1016/j.ando.2018.06.1028.

Baert, S., Omey, E., Verhaest, D., & Vermeir, A. (2015). Mister Sandman, bring me good marks! On the relationship between sleep quality and academic achievement. *Soc. Sci. Med., 130*, 91-98. https://doi.org/10.1016/j.socscimed.2015.02.011.

Barbosa, A., Whiting, S., Simmonds, P., Scotini Moreno, R., Mendes, R., & Breda, J. (2020). Physical activity and academic achievement: An umbrella review. *Int. J. Environ. Res. Public Health, 17*(16), 5972. https://doi.org/10.3390/ijerph17165972.

Biller, A. M., Meissner, K., Winnebeck, E. C., & Zerbini, G. (2022). School start times and academic achievement - A systematic review on grades and test scores. *Sleep Med. Rev., 61*, 101582. https://doi.org/10.1016/j.smrv.2021.101582.

Brownell, K., Puhl, R., Schwartz, M. B., & Rudd, L. (2005). *Weight Bias: Nature, Consequences, and Remedies*. New York, US: Guilford Publications. https://psycnet.apa.org/record/2005-16248-000.

Chen, G. & Weikart, L. A. (2008). Student background, school climate, school disorder, and student achievement: An empirical study of New York city's middle schools. *J. Sch. Violence, 7*(4), 3-20. https://doi.org/10.1080/15388220801973813.

Cluskey, M. & Grobe, D. (2009). College weight gain and behavior transitions: Male and female differences. *J. Am. Diet. Assoc., 109*(2), 325-329. https://doi.org/10.1016/j.jada.2008.10.045.

Cotti, C. D., Gordanier, J. M., & Ozturk, O. D. (2020). The relationship of opioid prescriptions and the educational performance of children. *Soc. Sci. Med., 265*, 113406. https://doi.org/10.1016/j.socscimed.2020.113406.

Donker, A. S., de Boer, H., Kostons, D., Van Ewijk, C. C. D., & van der Werf, M. P. C. (2013). Effectiveness of learning strategy instruction on academic performance: A meta-analysis. *Educ. Rev., 11*, 1-26. https://doi.org/10.1016/j.edurev.2013.11.002.

Economos, C. D., Hildebrandt, M. L., & Hyatt, R. R. (2008). College freshman stress and weight change: Differences by gender. *Am. J. Health Behav., 32*(1), 16-25. https://doi.org/10.5555/AJHB.2008.32.1.16.

El Kabbaoui, M., Chda, A., Bousfiha, A., Aarab, L., Bencheikh, R., & Tazi, A. (2018). Prevalence of and risk factors for overweight and obesity among adolescents in Morocco. *East Mediterr Health J., 24*(6), 512-521. https://doi.org/10.26719/2018.24.6.512.

Florence, M. D., Asbridge, M., & Veugelers, P. J. (2008). Diet quality and academic performance. *J. Sch. Health, 78*(4), 209-215. https://doi.org/10.1111/j.1746-1561.2008.00288.x.

Frederickson, N. & Petrides, K. V. (2008). Ethnic, gender, and socio-economic group differences in academic performance and secondary school selection: A longitudinal analysis. *Learn. Individ. Differ., 18*(2), 144-151. https://doi.org/10.1016/j.lindif.2005.09.001.

Golam, H., Saimul, I., Enamul, K. H., Ashrufel, I., Asma, M., & Kamruzzaman, M. (2014). Prevalence of underweight and effect of nutritional status on academic performance of primary school children in Chapainawabganj District, Bangladesh. *Malays. J. Nutr., 20*(1), 71-81.

Griffiths, L. J., Parsons, T. J., & Hill, A. J. (2010). Self-esteem and quality of life in obese children and adolescents:

A systematic review. *Int J Pediatr Obes., 5*(4), 282-304. https://doi.org/10.3109/17477160903473697.
Heude, B. & Charles, M. A. (2001). Le devenir à l'âge adulte de l'obésité de l'enfant. *J Pediatr Pueric., 14*(8), 474-479. https://doi.org/10.1016/S0987-7983(01)80129-8.
Hoffman, D. J., Policastro, P., Quick, V., & Lee, S. K. (2006). Changes in body weight and fat mass of men and women in the first year of college: A study of the "freshman 15". *J. Am Coll Health.*, 55(1), 41-46. https://doi.org/10.3200/JACH.55.1.41-46.
Jiang, S., Peng, S., Yang, T., Cottrell, R. R., & Li, L. (2018). Overweight and obesity among Chinese college students: An exploration of gender as related to external environmental influences. *Am. J. Men's Health., 12*(4), 926-934. https://doi.org/10.1177/1557988317750990.
Khan, M., Shanawaz, M., Altoaibi, A. A., Gaba, A. A. B., Saqeeh, O. I., & Mashali, A. R. A. (2020). Assessment of nutritional status and its effect on academic performance in school children of Jazan, Kingdom of Saudi Arabia. *Int. J. Community Med. Public Health, 7*(4), 1234. https://doi.org/10.18203/2394-6040.ijcmph20201425.
Komarraju, M. & Dial, C. (2014). Academic identity, self-efficacy, and self-esteem predict self-determined motivation and goals. *Learn. Individ. Differ., 32*, 1-8. https://doi.org/10.1016/j.lindif.2014.02.004.
Krukowski, R. A., Smith West, D., Philyaw Perez, A., Bursac, Z., Phillips, M. M., & Raczynski, J. M. (2009). Overweight children, weight-based teasing and academic performance. *Int. J. Pediatr. Obes., 4*(4), 274-280. https://doi.org/10.3109/17477160902846203.
Langford, R., Davies, A., Howe, L., & Cabral, C. (2022). Links between obesity, weight stigma and learning in adolescence: A qualitative study. *BMC Public Health, 22*(1), 109. https://doi.org/10.1186/s12889-022-12538-w.
Li, S. F., Xu, Q. Y., & Xia, R. X. (2020). Relationship between SES and academic achievement of junior high school students in China: The mediating effect of self-concept. *Front. Psychol., 10*, 2513. https://doi.org/10.3389/fpsyg.2019.02513.
Li, Y. F., Dai, Q., Jackson, J. C., & Zhang, J. (2008). Overweight is associated with decreased cognitive functioning among school-age children and adolescents. *Obesity., 16*(8), 1809-1815. https://doi.org/10.1038/oby.2008.296.
Liu, J., Peng, P., & Luo, L. (2020). The relation between family socioeconomic status and academic achievement in China: A meta-analysis. *Educ. Psychol. Rev., 32*(1), 49-76. https://doi.org/10.1007/s10648-019-09494-0.
Lozano, J. H., Gordillo, F., & Pérez, M. A. (2014). Impulsivity, intelligence, and academic performance: Testing the interaction hypothesis. *Pers. Individ. Dif., 61*, 63–68. https://doi.org/10.1016/j.paid.2014.01.013.
Ma, L., Gao, L., Chiu, D. T., Ding, Y., Wang, Y., & Wang, W. (2020). Overweight and obesity impair academic performance in adolescence: A national cohort study of 10,279 adolescents in China. *Obesity., 28*(7), 1301–1309. https://doi.org/10.1002/oby.22801.
MacLellan, D., Taylor, J., & Wood, K. (2008). Food intake and academic performance among adolescents. *Can. J. Diet. Pract. Res., 69*(3), 141–144. https://doi.org/10.3148/69.3.2008.141.
Mullis, I. V., Martin, M. O., Foy, P., Kelly, D. L., & Fishbein, B. (2019). *TIMSS 2019 international results in mathematics and science*. Retrieved from Boston College, TIMSS & PIRLS International Study Center. Website: https://timssandpirls. bc. edu/timss2019/international-results.
Naik, S., Itagi, S., & Patil, M. (2015). Relationship between nutritional status and academic achievement of Lambani school children. *Int. J. Recent Sci. Res., 6*(3), 3235-8.
Nouayti, H., Bouanani, N. H., Hammoudi, J., Mekhfi, H., Legssyer, A., Bnouham, M., & Ziyyat, A. (2020). Overweight and obesity in Eastern Morocco: Prevalence and associated risk factors among high school students. *Rev. Epidemiol. Sante Publique, 68*(5), 295–301. https://doi.org/10.1016/J.RESPE.2020.06.007.
Onis, M. D., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bull. World Health Organ., 85*(9), 660-667. https://doi.org/10.2471/BLT.07.043497.
Pascoe, L., Spencer-Smith, M., Giallo, R., Seal, M. L., Georgiou-Karistianis, N., Nosarti, C., Josev, E. K., Roberts, G., Doyle, L. W., Thompson, D. K., & Anderson, P. J. (2018). Intrinsic motivation and academic performance in school-age children born extremely preterm: The contribution of working memory. *Learn. Individ. Differ., 64*, 22-32. https://doi.org/10.1016/j.lindif.2018.04.005.
Patsa M. K. & Mukherjee S. S. (2021). Relationship between nutritional status and academic performance in primary school children in rural Bankura region of West Bengal, India. *Biosc. Biotech. Res. Comm. 14*(2). https://doi.org/10.21786/BBRC/14.2.37.
Pöysä, S., Poikkeus, A. M., Muotka, J., Vasalampi, K., & Lerkkanen, M. K. (2020). Adolescents' engagement profiles and their association with academic performance and situational engagement. *Learn. Individ. Differ., 82*, 101922. https://doi.org/10.1016/j.lindif.2020.101922.
Puhl, R. M. & Heuer, C. A. (2010). Obesity stigma: Important considerations for public health. *Am. J. Public Health, 100*(6), 1019-1028. https://doi.org/10.2105/AJPH.2009.159491.
Rivera, J. Á., de Cossío, T. G., Pedraza, L. S., Aburto, T. C., Sánchez, T. G., & Martorell, R. (2014). Childhood

and adolescent overweight and obesity in Latin America: A systematic review. *Lancet Diabetes Endocrinol., 2*(4), 321–332. https://doi.org/10.1016/S2213-8587(13)70173-6.

Sammons, P. (1995). *Key Characteristics of Effective Schools: A Review of School Effectiveness Research.* London, UK: Information Analyses; Reports – Evaluative.

Santana, C. C. A., Hill, J. O., Azevedo, L. B., Gunnarsdottir, T., & Prado, W. L. (2017). The association between obesity and academic performance in youth: A systematic review. *Obesity Rev., 18*(10), 1191-1199. https://doi.org/10.1111/obr.12582.

Sapci, O., Elhai, J. D., Amialchuk, A., & Montag, C. (2021). The relationship between smartphone use and students' academic performance. *Learn. Individ. Differ., 89*, 102035. https://doi.org/10.1016/j.lindif.2021.102035.

Sebbani, M., Elbouchti, I., Adarmouch, L., & Amine, M. (2013). Prévalence de l'obésité et du surpoids chez les écoliers de primaire à Marrakech, Maroc. *Rev. Épidémiol. Santé Publique, 61*(6), 545-549. https://doi.org/10.1016/j.respe.2013.08.002.

Seyoum, D., Tsegaye, R., & Tesfaye, A. (2019). Under nutrition as a predictor of poor academic performance; the case of Nekemte primary schools students, Western Ethiopia. *BMC Res. Notes, 12*, 1-6. https://doi.org/10.1186/s13104-019-4771-5.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Rev. Educ. Res., 75*(3), 417-453. https://doi.org/10.3102/00346543075003417.

Soares, D. L., Lemos, G. C., Primi, R., & Almeida, L. S. (2015). The relationship between intelligence and academic achievement throughout middle school: The role of students' prior academic performance. *Learn. Individ. Differ., 41*, 73-78. https://doi.org/10.1016/j.lindif.2015.02.005.

Srivastava, A., Mahmood, S. E., Srivastava, P. M., Shrotriya, V. P., & Kumar, B. (2012). Nutritional status of school-age children - A scenario of urban slums in India. *Arch. Public Health, 70*(1), 1-8. https://doi.org/10.1186/0778-7367-70-8.

Taras, H. & Potts-Datema, W. (2005). Obesity and student performance at school. *J. Sch. Health, 75*(8), 291-295. https://doi.org/10.1111/j.1746-1561.2005.00040.x.

Tynan, M. C., Credé, M., & Harms, P. D. (2020). Are individual characteristics and behaviors necessary-but-not-sufficient conditions for academic success?: A demonstration of Dul's (2016) necessary condition analysis., *77*, 101815. https://doi.org/10.1016/j.lindif.2019.101815.

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *N. Engl. J. Med., 337*(13), 869-873. https://doi.org/10.1056/NEJM199709253371301.

WHO. (2009). *Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks*. World Health Organization.

WHO. (2022). *WHO European Regional Obesity Report 2022*. World Health Organization. Regional Office for Europe.

Wößmann, L. & West, M. (2006). Class-size effects in school systems around the world: Evidence from between-grade variation in TIMSS. *Eur. Econ. Rev., 50*(3), 695-736. https://doi.org/10.1016/j.euroecorev.2004.11.005.