

Prevalence of Malnutrition and Its Association with Academic Performance Among 6-12-Year-Old School Going Children Using WHO Z-Score (BMI for Age)

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Abstract

Background and Objectives:

Malnutrition remains a significant yet underrecognized barrier to both the health and academic performance of school-aged children in Pakistan. This study aimed to assess the prevalence of malnutrition among school-going children in Taxila Cantonment and to explore its association with socio-demographic factors and academic performance.

METHODS

A cross-sectional study was conducted from January to August 2025 on 161 children aged 6-12 years from public schools in Taxila through multistage random sampling technique. Data were collected using a self-structured questionnaire which includes sociodemographic, anthropometric and academic performance variables. Nutritional status was assessed using WHO BMI-for-age Z-score classifications and academic performance through last school test results. Statistical analysis was performed using SPSS version 26.0. For continuous variables, mean and standard deviation and for categorical variables frequency and percentages were calculated. Association between malnutrition and academic performance were seen using chi-square tests and Spearman's rho correlation.

Results

Nearly half of children (49.1%) were under-weight, including 26.1% severely thin, while only 6.2% overweight and 1.2% obese. Boys were more affected than girls. Academically, 77.6% scored 60% and below ($\leq C$ grade) and only 6.2% achieved more than 90% (A+). Statistically significant association of malnutrition was observed with younger age, particularly 6–7 years ($p = 0.001$) and low household income ($p = 0.025$), while no relationship observed with other sociodemographic variables ($p > 0.05$). The Spearman's rho correlation results show a **positive and statistically significant relationship** between BMI category and overall academic performance, with a correlation coefficient of **0.183** and a p-value of **0.020**.

Conclusion

Almost half of school-aged children were undernourished, age and household income identified as key risk factors. Children with better nutritional status generally performed better academically. Long-term, multi-sectoral strategies are essential to support both the health and academic potential of children in similar settings.

Keywords: Malnutrition, academic performance, WHO Z Score, children 6-12 year,

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Introduction

Malnutrition is a pressing global public health problem and it remains a significant challenge in developing and underdeveloped countries, which are facing double burden of malnutrition (DBM),^{1,2} leading to various short term and long-term comorbidities and mortality.³ Malnutrition is responsible for higher mortality among women of reproductive age and children under 5 and attributing to nearly half of children's death globally.⁴ According to World health organization (WHO) "Malnutrition is "deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization".⁵

Malnutrition manifest in form of; stunting, wasting, underweight, overweight, and obesity in children. The prevalence of all forms of malnutrition in Pakistan, India, and Bangladesh has been over the acceptable threshold limits of 30% stunting, 15% wasting, and 10% underweight.⁶

The 2025 UNICEF Joint Child Malnutrition Estimates reveal persistent global malnutrition, with 150.2 million children under 5 stunted, 42.8 million wasted, and 35.5 million overweight, highlighting insufficient progress towards 2030 targets⁷

The nutrition of primary school children is vital and active part for their physical and mental development (2,8). Mostly eating and workout habits acquired by youngsters during this period stay with them throughout their lives. If they adopt healthful habits, they are much less susceptible to illnesses and acquire good cognitive abilities (9). Numerous studies have indicated that malnutrition impacts children's physical and cognitive development, work productivity, learning capacity and their academic performance.^{2,5,6,10}

Low- and middle-income countries, including Pakistan, face a double burden of malnutrition (DBM), with both undernutrition and overnutrition straining health system. Pakistan's National Nutrition Survey reports 11.8% of adolescent girls and 21.1% of boys are underweight, while 5.5% of girls and 7.7% of boys are obese, highlighting a serious public health concern.¹¹ Another recent analysis by Integrated Food Security Phase Classification (IPC) revealed that 2.14 million children in various regions of Pakistan suffer from acute malnutrition. The analysis highlights poor food quality and scarcity, coupled with inadequate healthcare-seeking behavior and suboptimal sanitation, as critical contributors. Additionally, malnutrition is highly prevalent among pregnant and lactating mothers, often exacerbated by poor

breastfeeding techniques, **underscoring** the need for comprehensive intervention.¹²

Malnutrition remains a significant public health concern, particularly in developing countries like Pakistan, where a substantial proportion of children are at risk. Adequate nutrition is critical for physical development and cognitive functioning, both of which influence academic performance. Malnourished children often face challenges such as impaired cognitive abilities, reduced concentration, and diminished energy levels, which can negatively affect their learning outcomes.

While most previous studies have concentrated on children under five years of age, limited evidence exists for those aged 6–12 years. This study addresses a critical knowledge gap by focusing on school-aged children (6–12 years) in Taxila, a population that has been often overlooked in national nutrition surveys. To the best of our knowledge, no study has been conducted in Taxila Cantt to examine the prevalence of malnutrition and its association with academic performance. The findings are expected to provide evidence to policymakers and educators for addressing malnutrition through targeted interventions, ultimately improving educational outcomes.

Methodology

This cross-sectional study was conducted from January-July 2025 on 6–12-year-old school-going children, enrolled in two public schools of Taxila Cantt, to assess the prevalence of malnutrition and its association with socio-demographic factors and academic performance. A multistage Random sampling technique was employed. In first stage, out of 7 schools, two public schools were selected randomly and in the second stage, class sections and in the final stage, individual students were selected randomly. The calculated sample size was 161, with a 95% confidence interval, 5% margin of error (alpha), and an estimated prevalence of 24.4%,¹³ with the raosoft sample size calculator. Ethical approval was obtained from the Institutional Review Board (IRB) of HITEC Institute of Medical Sciences (HITEC-IRB-44-2025). **Written informed consent** translated in Urdu was obtained from parents or legal guardians of each child before actual day of data collection, and **verbal assent** was acquired from all participating students. Confidentiality and anonymity of the data was maintained. Children with chronic disease, physical disabilities and had recent surgery were excluded from the study.

A self-structured proforma was used for data collection, which consisted of three sections (1) socio-

demographic data, (2) anthropometric measurements, and (3) academic performance. Height was measured in centimeters (cm), weight in kilograms (kg), and Body Mass Index (BMI) for age was calculated. Anthropometric data were collected by trained researchers using **standard digital weighing scales** and **measuring tape with 160 cm**. Measurements were taken with children barefoot and in light clothing, leaned against a wall and looking straight ahead, ensuring that the legs are straight, following WHO guidelines. The BMI values were transformed into WHO Z-score which were then compared with the WHO Growth Reference chart (5-19 years).¹⁴ Academic performance of the students was assessed by the percentage scored by the students in their last term exam which was then graded as A+ (91%–100%), A (81%–90%), B+ (71%–80%), B (61%–70%), C+ (51%–60%), C (<50%).

Results:

Total of 161 participants enrolled, boys constituted 73.3% (n=118) of the sample and girls comprised 26.7% (n=43). Mean age of the participants was 10.53 (SD± 2.17). Two third 138(85.7%) of the participant's mother were housewife while 54% (n=87) participant's father were government employ. Nearly 66(41%) of the children's father had secondary education, 16(9.9%) had Bachelor education, and only 2(1.2%) were illiterate. Similarly, 55 (34.2%) mothers had secondary education and only 16(9.9%) were illiterate. Less than half of the participants 47.2% (n=76) reported a monthly income between PKR 30,001-50,000 and only 10.6%(n=17) reported more than 100,000 PKR. Mean height of study population was 1.39m(SD± .13) and mean weight was 31.41kg (SD+10.95). In the Boys Mean height was 1.39m (±SD.13) and mean weight was 31.10 kg (SD± 11.5). In Girls the Mean height was 1.406m (±SD .128) and mean weight was 32.27 kg (SD±9.23).

Based on the BMI-for-age analysis of 161 school-going children aged 6 to 12 years, we found that nearly half of the children 49.1% (n=79) were undernourished. Specifically, 26.1% (n=42) were classified as *severely thin* (< -3 SD), and 23%7(37) were *thin* (between -3 and -2 SD), according to the WHO reference growth standards. Meanwhile, 43.5% (70) of the children fell within the *normal* BMI range (-2 to +1 SD). Additionally, 6.2% (10) were categorized as *overweight* (BMI-for-age between +1 and +2 SD), and 1.2% (2) were classified as *obese* (above +2 SD). These findings indicate a significant burden of undernutrition in this population, highlighting the need for targeted nutritional interventions. (Figure:1)

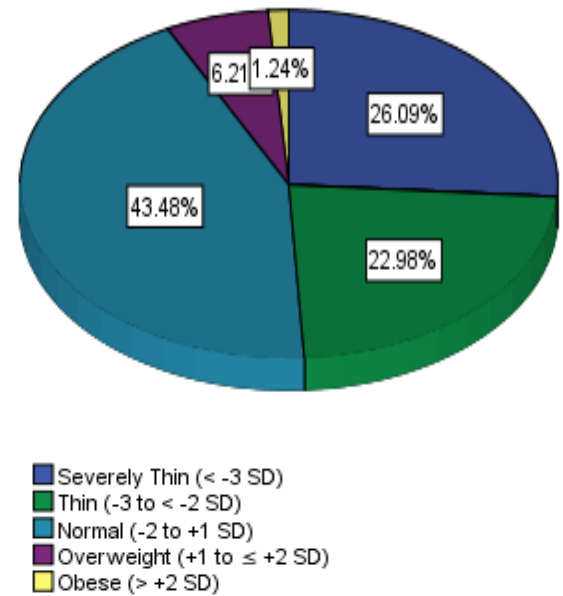


Figure 1: Distribution of malnutrition among the participants

A pronounced gender disparity was evident, with 54.2% of boys compared to 35.0% of girls falling within the underweight category. Detailed description is given in Table:1.

Table 1: Distribution of malnutrition among gender

Variable		Boys Freque y (%)	Girls Freque y (%)
BM I	Severely Thin (< -3 SD)	36(30.5%)	6(14.0%)
	Thin (-3 to < -2 SD)	28(23.7%)	9(20.9%)
	Normal (- 2 to +1 SD)	44(37.3%)	26(60.5%)
	Overweigh t (+1 to ≤ +2 SD)	8(6.8%)	2(4.7%)
	Obese (> +2 SD)	2(1.7%)	0(0%)
	Total	118(100%)	43(100%)

In our study, 49% of the children have scored more than 50% in their exams. Of them 6.21% have score more than 90% and above, 10% have scored between 80% and 89% whereas 51% have scored less than 50%. (Figure:2)

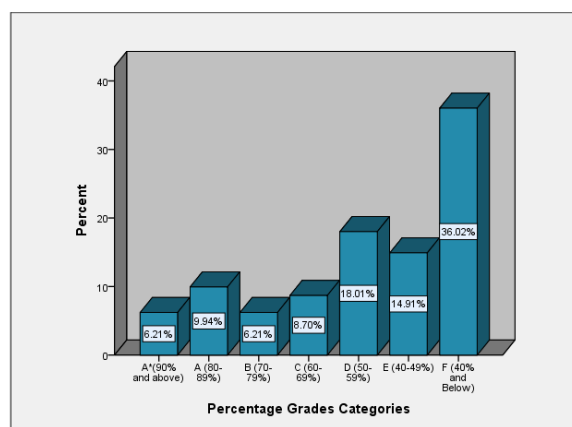


Figure 2: Distribution of grades among the participants

Study observed statistically significant association of malnutrition with age group of 6-7 year and household monthly income. No other sociodemographic variable was found to be significantly associated with malnutrition (Table:3).

Table 3: association between malnutrition with sociodemographic variables

Variable	Socio-demographic variable							
	Age	Gender	Education of Father	Education of mother	Occupation of father	Occupation of Mother	No of siblings	HH monthly income
	P value	P-value	P value	P value	P value	P value	P value	P value
Malnutrition	<0.000**	<0.082	<0.36	<0.632	<0.462	<0.998	<0.660	<0.037*

The Spearman's rho correlation results show a **positive and statistically significant relationship** between BMI category and overall academic performance, with a correlation coefficient of **0.183** and a p-value of **0.020**. Although the strength of the correlation is weak, the significance at the 0.05 level indicates that the association is unlikely to be due to chance. This suggests that with an increase in BMI category, there is a slight improvement in academic performance, highlighting that nutritional status may play a role in students' educational outcomes.

Variable	Correlation Coefficient	Sig. (2-tailed)	N
BMI Category	1.000	—	161
Overall Academic Performance	0.183*	0.020	161

*Correlation is significant at the 0.05 level (2-tailed). It was observed that children in the **severely thin BMI-for-age category (< -3 SD)** performed academically better, with **11.9% achieving A*** and another **11.9% scoring an A**. Students in the **thin**

BMI category (-3 to -2 SD) showed mixed results, with **13.5% reaching Grade A** but nearly 30% falling into Grade F. The normal BMI group (-2 to +1 SD) was the largest, yet it also had the highest proportion of failing grades (42.9%). Students in the overweight BMI category (+1 to +2 SD) majority 8(80%) scoring below 40%. Meanwhile, the small group of obese students (> +2 SD) showed no failures but had limited representation across higher grades. Overall, the findings suggest that BMI is linked to academic achievement, with severely thin students tending to perform better at the top levels, while overweight students were more likely to struggle academically

Discussion:

This study identified weak **positive but statistically significant relationship** between BMI category and overall academic performance, among 6-12 years school going children. Increase in BMI was linked with slight improvement in academic performance, highlighting the key role of nutritional status in students' educational outcomes.

In our study, approximately half of children (49.1%) were found to be undernourished, which is marginally higher than the 46.1% and 45% reported in previous studies.^{15,16} Although the difference is not very large, it highlights that undernutrition remains a significant public health concern across similar populations. The slight variation may be attributed to differences in socioeconomic conditions, dietary practices, or methodological approaches between the two studies. However, our findings contrast with similar studies that reported only 19%¹⁷ and 25.3% of children aged 4–16 years as underweight.¹⁸ Similarly, another study from Bangladesh showed much higher rates, with 62.1% of children severely underweight and 65.6% moderately underweight.¹⁹ The percentage of undernourished boys (%) were more as compared to girls (%) in our study, similar to findings of study conducted in Islamabad.¹⁸ However, study conducted in Abbottabad revealed contrasting results where the girls undernourished percentage (67.7) was more than the boys (55.4).²⁰ The difference could be due to large presentation of boys in our sample.

Statistically significant relationship of malnutrition with age and household income was observed, results are aligned with several previous studies.^{17,21} The effect of household income on nutritional status can be well defined as the high income is directly linked to increase buying power which promotes and has beneficial impact on child's health and nutrition. No significant links were found with parental education, occupation, or number of siblings, highlighting poverty as the dominant factor.

The relationship between nutritional status and academic performance was also examined, which revealed weak positive but statistically significant

relationship. These findings suggest that while the effect may be subtle, nutritional status does influence academic capacity, likely through its impact on cognitive development, concentration, and school attendance. This aligns with the evidence provided in previous researches.^{22,23}

In light of these findings, several recommendations are proposed to address malnutrition and its broader implications. Targeted nutrition screening and supplementation programs should prioritize young children, particularly boys and those from households earning less than PKR 50,000 per month. Strengthening mid-day meal programs in public schools and fortifying food with essential micronutrients could play a vital role in improving dietary intake among vulnerable children population.

Recommendation

Based on result of our study, we highly recommend These findings point to the **urgent need for integrated, multi-sectoral interventions**—including school-based nutrition programs, income support for vulnerable families, and community health education—targeted specifically at young, economically disadvantaged children.

Limitation

The study has few limitations. Causal link between malnutrition and academic performance cannot be established due to cross-sectional design. Secondly, the study was conducted on public schools children, excluding out-of-school children, who may represent a more vulnerable nutritional group. Additionally, **grades from a single term were used to assess academic performance**, which may not reliably reflect overall academic performance.

Conclusion

Almost half of school-aged children were undernourished, age and household income identified as key risk factors. Children with better nutritional status generally performed better academically. Long-term, multi-sectoral strategies are essential to support both the health and academic potential of children in similar settings. In conclusion, malnutrition remains a silent barrier to both health and education. Addressing it holistically is essential not only for improving the well-being of individual children but also for advancing broader societal development and equity in Pakistan.

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