

OPEN ACCESS



Body Mass Index (BMI) Dependent Dietary Status Frequency and Association with Eating Habits among Schoolchildren in Urban Jamshoro and Hyderabad, Sindh

Shakil Ahmed Shaikh¹, Kulsoom Jawed², Rehana Siddiqui³, Aqeela Memon⁴, Muhammad Muqem Mangi⁵, Salma Farukh Memon⁶

	Authors' Contribution
1 Associate Professor, Department of Physiology, Suleman Roshan Medical College, Tando Adam Pakistan	Write up, Data analysis
2 Assistant Professor, Department of Community Medicine, Suleman Roshan Medical College, Tando Adam Pakistan	Data collection
3 Assistant Professor, Department of Community Medicine, Suleman Roshan Medical College, Tando Adam Pakistan	Data collection
4 Assistant Professor, Department of Community Medicine, Suleman Roshan Medical College, Tando Adam Pakistan	Data collection
5 Professor, Department of Physiology, Suleman Roshan Medical College, Tando Adam Pakistan	Data analysis
6 Professor, Department of Physiology, Liaquat University of Medical & Health Sciences, Jamshoro Pakistan	Critical analysis, and final approval
<i>Dr. Shakil Ahmed Shaikh</i> Correspondence: Associate Professor, Department of Physiology, Suleman Roshan Medical College, Tando Adam Pakistan Email: sshakilonly@hotmail.com	
Submitted for Publication: 10-01-2026 Revision Received: 27-04-2026 Accepted for Publication: 04-05-2026	

ABSTRACT

Background: Child malnutrition in developing countries is a major public health concern, encompassing both overnutrition and undernutrition. **Objective:** To investigate the frequency of BMI by age- dependent dietary status of schoolchildren aged 12-16 years in selected low-income urban areas of Jamshoro and Hyderabad, Sindh, and to explore the distribution of selected nutritional habits in the two groups of underweight and non-underweight. **Study Design:** Cross-sectional study. **Settings:** Two government schools in Jamshoro and Hyderabad Pakistan. **Duration:** 1st June to 31st December 2024. **Methods:** A total of 106 students between the ages of 12 and 16 years were recruited using stratified random sampling by sex and grade. The height and weight were measured by the standard method and the BMI as per WHO standards. Selected dietary habits were measured by using a structured questionnaire. Data analysis was done in descriptive form using SPSS version 24.0. **Results:** 62.5% of 160 respondents were found to be underweight, 30.6 % of the respondents were found to be normal weight, and 5% of the respondents were found to be overweight, with 1.9% of the respondents being obese. Underweight was more common in females (68.9%) than in males (56.9%). Underweight status distribution was generally similar in terms of the incidence of underweight, which was high in low-income urban schoolchildren of Jamshoro and Hyderabad. **Conclusion:** This study concluded that the incidence of underweight was high in low-income urban schoolchildren of Jamshoro and Hyderabad, and the girls dominated.

Keywords: Malnutrition, Schoolchildren, Eating habits, Dietary status.

How to Cite: Shaikh SA, Jawed K, Siddiqui R, Memon A, Mangi MM, Memon SF. Body Mass Index (BMI) Dependent Dietary Status Frequency and Association with Eating Habits among Schoolchildren in Urban Jamshoro and Hyderabad, Sindh. APMC 2026;20(2):118-122. DOI: 10.29054/APMC/2026.1871

This is an open access article distributed under the terms of the Attribution Creative Commons-Noncommercial (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Malnutrition among children remains a major public health problem worldwide, affecting growth, cognitive development, and long-term health outcomes.¹ It includes undernutrition and overnutrition, including stunting, wasting, underweight, overweight, and obesity. Millions of schoolchildren around the world still suffer nutritional deficiencies, with more being exposed to diets rich in energy and low in nutrients, leading to a continuous increase in the combined burden of malnutrition.²

Child malnutrition is very high and has been a persistent public health challenge in Pakistan.³ National surveys have reported high levels of stunting, wasting, and underweight children,

which is indicative of food insecurity, poverty, and insufficient access to health and nutrition services.⁴ These nutritional challenges adversely impact physical growth, academic performance,⁵ and overall well-being of young people in school age.⁶

In the Sindh province, especially in low-income urban areas, socio-economic inequality, inappropriate dietary patterns, and access to basic services contribute to malnutrition and create threats of underweight and emerging overweight and obesity among schoolchildren.^{7,8} Yet despite urban residence, most of the families in Sindh province are food insecure, and poor living conditions present them with the risks of malnutrition and the emergence of overweight and obesity among schoolchildren.⁹

Malnutrition has quantifiable effects on schoolchildren. Undernutrition is connected with poor mental development and poor academic performance among children. Malnourished children are also forgetful and have problems concentrating and solving problems, which also has negative implications on their education system.⁸ Furthermore, child malnutrition lowers immunity, and children are more vulnerable to infections and diseases, which also impacts their education.¹⁰ Rising trends of obesity in urban Hyderabad are also a worrying health issue. The epidemic of overweight and obese schoolchildren appears to be a combination of unhealthy and low-nutrition foods that have high-calorie content and a lack of physical activity. This malnutrition dual burden is a complex issue, difficult to handle by the public health officials and policymakers.¹¹

This study aimed to determine the prevalence of BMI-based nutritional status among 12-16-year-old schoolchildren living in urban Jamshoro and Hyderabad. To determine the association between selected dietary habits and underweight among children of this age. The emphasis on this age group is due to the crucial developmental period of adolescence, during which nutritional imbalances can affect long-term health and academic achievement. However, limited information exists on the nutritional status of urban adolescents in low-income areas of Sindh, particularly in Jamshoro and Hyderabad, although malnutrition is reported to have a high burden among younger children.¹² That adolescence represents a critical growth period where nutritional imbalances have lasting effects on health and academic performance.¹³

METHODS

After approval from the University of Sindh Research Ethics Committee (letter no. DRGS/105, dated 10/06/24), this cross-sectional study was conducted from June 1 to December 31, 2024, in two government schools in the urban areas of Hyderabad and Jamshoro, Sindh, Pakistan. Both schools were chosen due to the lower-socioeconomic nature of their population, that is, the families of daily wage workers, low-paid employees, and households living in overcrowded urban areas with a lack of access to healthcare, sanitation, and food. Epi Info online calculator was used to obtain the sample size; furthermore it was consistent with past school-based studies conducted in Pakistani adults evaluating BMI-for-age and nutritional status, and hearing in school-aged children.^{13,14,15,16}

A self-structured questionnaire was constructed to collect information on the eating patterns and the lifestyles of school children. In the present research, nutritional status was measured by anthropometric measurements. A stadiometer was utilized to measure height in meters, and a calibrated digital weighing scale was used to measure weight in kilograms, with the students being lightly clothed and barefoot. Body Mass Index (BMI) was computed as a result of dividing body weight in kilograms by height in meters squared (kg/m^2).

The operational definition of malnutrition was based on sex- and age-specific BMI-for-age reference values from the World Health Organization (WHO).

The study targeted students aged 12–16 years (Grades 7–10). Using stratified random sampling by academic grade and sex,

approximately 20 students per class were selected from available sections to ensure representation, yielding a final sample of 160 (86 males, 74 females) using the Epi-Info online calculator. Inclusion Criteria: Children aged 12 to 16 years residing in Jamshoro and Hyderabad districts. Both male and female children. Children who attended schools were available during the study period. Written assent from students and written informed consent from parents/guardians were obtained, as both are required for the 12-16-year age group. Children who were apparently healthy and not suffering from any acute illness at the time of data collection. Exclusion Criteria: Children with chronic illnesses or congenital disorders (e.g., cardiac disease, renal disease, endocrine abnormalities) that could affect growth or nutritional status. Children on long-term medication influencing weight, height, or metabolism (e.g., corticosteroids). Children who were absent during anthropometric assessment or whose data were incomplete. Children whose parents or guardians declined to participate.

Height was measured using a stadiometer, and weight was measured using a calibrated digital weighing scale. Measurements were taken with students wearing light clothing and no shoes. BMI was calculated as weight (kg) divided by height squared (m^2).

Nutritional status was classified according to WHO age- and sex-specific BMI-for-age reference standards as underweight, normal weight, overweight, or obese.

Selected dietary habits, including breakfast consumption, dairy intake, and meat consumption, were assessed using a structured questionnaire developed for descriptive purposes. Dietary data were not used to determine nutritional status.

Data were entered and analyzed using SPSS version 24. Continuous variables were summarized as means and standard deviations, while categorical variables were presented as frequencies and percentages. Analyses were primarily descriptive. Comparisons by sex and dietary categories were exploratory and interpreted cautiously.

RESULTS

Table 1 summarizes the participants' nutritional status. Among the 160 students, 62.5% were underweight, 30.6% had normal weight, 5.0% were overweight, and 1.9% were obese. Underweight was more common among females than males, while overweight and obesity were observed in a small proportion of both sexes.

Table 1: Distribution of BMI-for-age categories by sex

Nutritional Status	Male (n = 86) n (%)	Female (n = 74) n (%)	Total (n = 160) n (%)
Underweight	49 (56.9%)	51 (68.9%)	100 (62.5%)
Normal weight	31 (36.0%)	18 (24.3%)	49 (30.6%)
Overweight	5 (5.8%)	3 (4.0%)	8 (5.0%)
Obese	1 (1.2%)	2 (2.7%)	3 (1.9%)
Total	86 (100%)	74 (100%)	160 (100%)

Table 2 presents the relative distribution of BMI-for-age categories between male and female students. The proportions of underweight, normal weight, overweight, and obese were broadly similar between sexes. Differences observed across individual BMI categories were small, and the confidence intervals around the estimates were wide, reflecting limited precision due to small sample sizes in some categories.

Table 2: Nutritional status in females compared to males

Nutritional Status	Odds Ratio (95% CI)	p-value
Underweight	0.60 (0.31 – 1.15)	0.12
Normal weight	1.75 (0.88 – 3.50)	0.10
Overweight	1.46 (0.34 – 6.33)	0.60
Obese	0.42 (0.04 – 4.77)	0.47

Table 3 presents the distribution of underweight status by selected dietary habits, including breakfast consumption, dairy intake, and meat consumption. The proportion of malnourished children was comparable among those who reported regular breakfast consumption and those who did not. Similarly, the prevalence of underweight did not differ markedly between children who reported consuming dairy products and those who did not. Meat consumption patterns were also similar across underweight and non-underweight groups.

Table 3: Distribution of underweight status by selected dietary habits

Variable	Under-weight n (%)	Non-Under-weight n (%)	χ^2	p-value
Breakfast	Yes: 91 (91.0%)	51 (85.0%)	0.82	0.35
	No: 9 (9.0%)	9 (15.0%)		
Dairy Products	Yes: 57 (57.0%)	36 (61.9%)	0.04	0.84
	No: 43 (43.0%)	24 (38.1%)		
Meat Consumption	Yes: 92 (92.0%)	52 (91.2%)	0.67	0.27
	No: 8 (8.0%)	8 (8.8%)		

DISCUSSION

This study assessed the nutritional status of schoolchildren in government schools in low-income urban areas of Jamshoro and Hyderabad, using BMI. The findings indicate that underweight was the most prevalent BMI category, with approximately two-thirds of participants classified as underweight, and underweight was more frequent among female participants. Conversely, a small percentage of the participants showed overweight and obesity, which heightens the importance of underweight as the most significant nutritional problem with implications for the intervention and policy development.

This study reported a higher prevalence of malnutrition among schoolchildren in Jamshoro and Hyderabad, specifically underweight. The underweight rates among male students were 56.97%, and they were even higher among females (68.91%). These are much higher than those in other regions, which were 23.05%, 19.5%, and 26%.¹⁶⁻¹⁸ For instance, a study conducted in central Punjab found that 21.9% of schoolchildren were

underweight.¹³ In our study, a higher frequency of underweight females contributes to the gender disparities in the distribution of food and cultural dietary restrictions.

Normal weight among children was also not very high, with only 36% of males and 24.3% of females in the normal weight range. These data indicated significant deviation from normal growth patterns, which may have long-term effects on cognitive and physical development.^{19,20} The fact that the percentage of normal weight is lower than that of males is another indication of the fact that there is a form of nutritional inequality based on gender in the South Asian population.²¹

Overweight and obesity were less common: 5.8% of male participants and 4.04% of female participants were overweight, with 1.16% and 2.7% of female participants obese, respectively. These percentages are not particularly high relative to undernutrition rates, but they still indicate the emerging dual burden of malnutrition in Pakistan. Where underweight and obesity coexist. In a study conducted in Karachi, 19.1% of children were found to be overweight, and 10.8% were obese.¹³ This marginal predominance of obesity among females was associated with a reduced level of physical activity, preference for certain diets, and socioeconomic factors.^{22,23}

It is believed that breakfast is an important meal in ensuring healthy growth and energy levels in children. Findings from our study showed that most underweight (91%) and normal-weight (89.7%) children reported having regular breakfasts. However, a notable proportion (9% underweight and 10.2% normal weight) reported skipping breakfast. Among overweight and obese children, breakfast consumption was slightly lower: 62.5% and 66%, respectively, reported regular intake. Previous studies suggest that skipping breakfast is associated with poor cognitive function and increased risk of metabolic disorders.^{23,24}

Dairy consumption is essential for bone development and overall growth in children. However, only 40% of underweight children reported regular dairy consumption, whereas 31% reported no dairy consumption, and 29% reported irregular consumption. The pattern was slightly better among normal-weight children, with 40.8% consuming dairy regularly. A similar trend was observed among overweight and obese children, with higher proportions (57.1% and 66.6%, respectively) reporting regular dairy intake. The low intake of dairy products among underweight children may contribute to nutritional deficiencies, particularly in calcium and protein, which are essential for growth.^{3,25}

For physical growth and muscle development, protein intake from meat is essential. The majority of underweight (92%) and normal-weight (89.7%) children consumed meat, while overweight (100%) and obese (100%) children also showed complete meat consumption. This indicated that although protein intake from meat is relatively higher across all groups, other dietary factors, such as caloric intake and macronutrient balance, may be influencing patterns of malnutrition. Studies suggest that excessive reliance on processed meat or unbalanced diets can contribute to either undernutrition or obesity.^{26,27}

Our study is also consistent with third-world countries, where females are more malnourished than male children.²⁸ The possible interpretation is that society is male-dominated, where females are not given equal preferences with male children.

CONCLUSION

This study demonstrates a high prevalence of underweight, as assessed by BMI-for-age, among school-aged children in low-income urban areas of Jamshoro and Hyderabad, with a higher proportion observed among females. Overweight and obesity were present in a small proportion of participants, indicating the coexistence of underweight with emerging excess weight within the same population. The distribution of underweight children was broadly similar across selected dietary habits, suggesting that these individual practices alone do not explain the observed nutritional patterns. Overall, the findings highlight the need for nutrition strategies that address the broader socio-economic and dietary context of school-aged children, with particular attention to girls in disadvantaged urban settings.

LIMITATIONS

It has a number of limitations that should be considered. The research only examined two schools in urban shantytowns, so one cannot generalize this to all children in Sindh or Pakistan. Second, a cross-sectional design will only provide a correlation and not causality. Third, the self-reported food intake could be biased by recall, and the questionnaire did not provide quantitative data on nutrient intake. Finally, the sample size was small and lacked statistical power, and possibly the reason was the non-significance of the trends.

SUGGESTIONS / RECOMMENDATIONS

There should be further studies with an increased population and diversification of the population in rural and urban areas to comprehend the regional differences. Longitudinal research is required to shed light on causal mechanisms among socioeconomic status, dietary patterns, and nutritional outcomes. The priority of interventions should be the provision of nutrient adequacy through school-based feeding programs and community-based education on balanced diets. Notably, there is a need to incorporate gender sensitive approaches that help to meet the disproportionality between undernutrition in girls. To address malnutrition in Pakistan at a policy level, there is a need to fight food insecurity and encourage healthy eating habits to stop the occurrence of malnutrition as well as obesity in the most vulnerable population.

CONFLICT OF INTEREST / DISCLOSURE

We declare no conflict of interest.

FUNDING SOURCE

None.

ACKNOWLEDGEMENTS

We are thankful to parents, teachers, staff, and school administrations of both schools.

REFERENCES

1. Menghwar B, Laghari ZA, Memon SF, Warsi J, Shaikh SA, Baig NM. Prevalence of malnutrition in children under five years' age in District Tharparkar Sindh, Pakistan. *J Pak Med Assoc.* 2022 Jan;72(1):33-6.
2. Tzioumis E, Adair LS. Childhood dual burden of under- and overnutrition in low- and middle-income countries: a critical review. *Food Nutr Bull.* 2014 Jun;35(2):230-43.
3. Ali A. Current status of malnutrition and stunting in Pakistani children: what needs to be done? *J Am Coll Nutr.* 2021 Feb;40(2):180-92.
4. Islam M, Ali S, Majeed H, Ali R, Ahmed I, Soofi S, et al. Drivers of stunting and wasting across serial cross-sectional household surveys of children under 2 years of age in Pakistan: potential contribution of ecological factors. *Am J Clin Nutr.* 2025 Mar;121(3):610-9.
5. Mengal A, Ansari A, Mangi MA, Memon SF, Shaikh SA. Role of calcium in mental development and intelligence of school-aged children of District Hyderabad, Sindh. *Ann Punjab Med Coll.* 2024 Sep;18(3):196-200.
6. Saavedra JM, Prentice AM. Nutrition in school-age children: a rationale for revisiting priorities. *Nutr Rev.* 2023 Jul;81(7):823-43.
7. Carducci B. The relationship between food environments and nutritional status of school-aged children and adolescents in low- and middle-income countries: evidence from Pakistan [dissertation]. Toronto (ON): University of Toronto; 2022.
8. Samo A, Laghari Z, Memon A, Baig N, Memon S, Shaikh S. Prevalence and sociodemographic factors associated with stunting and thinness in adolescent females: a cross-sectional study from Pakistan. *J Pak Med Assoc.* 2022 Mar 1;72(3):471-6.
9. Crouch E, Abshire DA, Wirth MD, Hung P, Benavidez GA. Rural-urban differences in overweight and obesity, physical activity, and food security among children and adolescents. *Prev Chronic Dis.* 2023 Aug;20:E92.
10. Morales F, Montserrat-De la Paz S, Leon MJ, Rivero-Pino F. Effects of malnutrition on the immune system and infection and the role of nutritional strategies regarding improvements in children's health status: a literature review. *Nutrients.* 2023 Dec;16(1):1.
11. Wells JC, Marphatia AA, Amable G, Siervo M, Friis H, Miranda JJ, et al. The future of human malnutrition: rebalancing agency for better nutritional health. *Glob Health.* 2021 Apr;17:1-25.
12. Talpur MA, Channar HB, Junejo Z, Chandio IA, ul Haque M, Shahok S. Factors associated with malnutrition under five years children at Liaquat University Hospital, Hyderabad. *Front Med Health Res.* 2025;3(10):133-40.
13. Tanveer M, Hohmann A, Roy N, Zeba A, Tanveer U, Siener M. The current prevalence of underweight, overweight, and obesity associated with demographic factors among Pakistan school-aged children and adolescents—an empirical cross-sectional study. *Int J Environ Res Public Health.* 2022 Sep;19(18):11619.
14. Bhatti MA, Shaikh SA, Memon SF, Aamir K, Ramzan A, Shah H. Frequency of hearing impairment in school-going children of District Hyderabad, Sindh, Pakistan. *Pak J Health Sci.* 2024;6:10.
15. Perveen S, Karmaliani R, Barolia R, Mistry R. School-based study to assess the nutritional status (BMI based) of adolescents of Gojra City of District Toba Tek Singh, Punjab, Pakistan. *Pak J Health Sci.* 2023;4(5):263.
16. Zafar S, Shaikh BT, Malik ZI, Ahmad AMR. Determinants of school-going adolescent girls' health and nutritional status in District Malir, Karachi: a baseline cross-sectional study. *Front Nutr.* 2025;11:1510183.
17. Perveen S, Karmaliani R, Barolia R, Mistry R. School-based study to assess the nutritional status (BMI based) of adolescents of Gojra City of District Toba Tek Singh, Punjab, Pakistan. Karachi: School of Nursing and Midwifery; 2023.
18. Verma M, Sharma P, Khanna P, Srivastava R, Sahoo SS. Nutrition status of school children in Punjab, India: findings from school health surveys. *J Trop Pediatr.* 2021 Feb;67(1):fmaa068.
19. Spinelli A, Buon cristiano M, Nardone P, Starc G, Hejgaard T, Júlíusson PB, et al. Thinness, overweight, and obesity in 6- to 9-year-old children from 36 countries: the World Health Organization European Childhood Obesity Surveillance Initiative (COSI) 2015–2017. *Obes Rev.* 2021 Jul;22:e13214.
20. Soliman A, Itani M, Jour C, Shaat M, Elsiddig S, Souiek F, et al. Relation between changes in weight parameters and height parameters in prepubertal children: daily weight gain and BMI changes in relation to linear growth during nutritional rehabilitation of underweight children. *Acta Biomed.* 2019 Dec;90(Suppl 8):7.
21. Mahmud I, Das S, Khan SH, Faruque A, Ahmed T. Gender disparity in care-seeking behaviours and treatment outcomes for dehydrating

- diarrhoea among under-5 children admitted to a diarrhoeal disease hospital in Bangladesh: an analysis of hospital-based surveillance data. *BMJ Open*. 2020 Sep;10(9):e038730.
22. Hashan MR, Rabbi MF, Haider SS, Das Gupta R. Prevalence and associated factors of underweight, overweight and obesity among women of reproductive age group in the Maldives: evidence from a nationally representative study. *PLoS One*. 2020 Oct;15(10):e0241621.
 23. Okobi OE, Ajayi OO, Okobi TJ, Anaya IC, Fasehun OO, Diala CS, et al. The burden of obesity in the rural adult population of America. *Cureus*. 2021 Jun;13(6).
 24. López-Gil JF, Smith L, López-Bueno R, Tárraga-López PJ. Breakfast and psychosocial behavioural problems in young population: the role of status, place, and habits. *Front Nutr*. 2022 Apr;9:871238.
 25. Khan DSA, Das JK, Zareen S, Lassi ZS, Salman A, Raashid M, et al. Nutritional status and dietary intake of school-age children and early adolescents: systematic review in a developing country and lessons for the global perspective. *Front Nutr*. 2022 Jan;8:739447.
 26. Ahmed A, Maham K, Afzaal M, Saleem MA, Nadeem M, Saeed F, et al. The consequences of poor dietary patterns on the proliferation of non-alcoholic fatty liver disease. *Cogent Food Agric*. 2024;10(1):2325206.
 27. Aziz T, Hussain N, Hameed Z, Lin L. Elucidating the role of diet in maintaining gut health to reduce the risk of obesity, cardiovascular and other age-related inflammatory diseases: recent challenges and future recommendations. *Gut Microbes*. 2024;16(1):2297864.
 28. Rahman M. Assessment of nutritional status of primary school going children in island and hill-tract area of Bangladesh: a cross-sectional study [dissertation]. Chittagong (BD): Chittagong Veterinary and Animal Sciences University; 2022.