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Nutritional Status of School Going Children (6-9 Years Old) In the Western Suburban Slums of Mumbai

Research Article

Abhipsha Gupta* and Reema Mathur

Department of Food Science and Nutrition, SNDT Women's University, Juhu Campus, Mumbai, Maharashtra India

***Corresponding author:** Abhipsha Gupta, Department of Food Science and Nutrition, SNDT Women's University, Juhu Campus, Mumbai, Maharashtra India. E-mail Id:abhipshagupta99@gmail.com

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Abstract

Background: Adequate nutrition during the early school years (6–9 years) is fundamental for supporting optimal growth, cognitive development and academic performance. Children living in urban slums are particularly vulnerable to nutritional deficiencies due to poverty, food insecurity and poor environmental conditions, which may adversely affect their overall health and learning potential. Considering the importance of nutrition for this age group, this study was undertaken to evaluate the nutritional status and dietary intake of school-going children residing in the western suburban slums of Mumbai.

Methods: A cross-sectional study was conducted in the western suburban slums of Mumbai with the aim to assess the malnutrition and dietary status of school going children of 6 to 9 years of age. Data was collected by visiting anganwadi centres to meet the participants or by visiting their houses. Demographic information was collected using a questionnaire and nutritional status was assessed through anthropometric measurements, dietary intake using 24 hour recall and food frequency and medical issues. Descriptive statistics was used and correlations estimated at $p<0.05$ level of significance.

Results: According to BAZ (Body Mass Index for age- Z scores), 39% children were severely underweight and 14% underweight; 37% were stunted (HAZ- Height for Age Z scores) and 35% were thin (MUAC-Mid Upper Arm Circumference). The mean intake of energy for males was 681±261 kcal and 837±322 kcal for females, carbohydrate intake was 80±19 g and 87±12 g, protein intake was 13±5 g and 14±4 g and for fat, intakes was 25±6 g and 24±5 g for males and females respectively. These were all much lower than the EAR values. Iron and zinc intakes were similar in both sexes whereas calcium and vitamin A were only slightly higher in females. Significant differences were observed in the nutrient intakes of the children in the HAZ – Height-for-Age Z-score; MUAC – Mid-Upper Arm Circumference, and BMI –categories with the malnourished having a lower intake.

Conclusions: The school children in this study were malnourished and had nutrient intakes lower than the values recommended by ICMR for this age group.

Keywords: School Children; Malnutrition;Dietary Intake; Anthropometry; Urban Slums; India

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Introduction

School-age children represent the foundation of a nation's future health and productivity. Adequate nutrition during middle childhood is essential for optimal physical growth, cognitive development and academic performance. Nutritional deprivation during this critical period can adversely affect learning ability, immunity and long-term health outcomes. Globally, children face a "double burden of malnutrition," characterised by the coexistence of undernutrition and emerging overweight, which has become a significant public health concern in both developing and developed countries [1].

Childhood and early adolescence are marked by rapid growth and increased nutrient requirements. Inadequate dietary intake during this stage may lead to growth faltering, reduced school attendance and poor scholastic performance [2]. Despite the importance of this age group, school children aged 5-9 years are often underrepresented in national nutrition surveillance systems, which primarily focus on children under five years of age. Consequently, data on the nutritional status of primary school-age children, particularly those living in disadvantaged communities, remain limited.

Children residing in urban slums are especially vulnerable due to overcrowding, poor sanitation, unsafe drinking water, food insecurity and limited access to healthcare services. Such conditions predispose them to recurrent infections, inadequate dietary practices and increased risk of malnutrition [3]. Similar findings have been reported among school-age children living in disadvantaged urban settlements, where a high prevalence of undernutrition and growth deficits has been documented [4].

Studies from resource-limited communities have further demonstrated substantial levels of stunting, thinness and poor anthropometric indicators among school-going children, highlighting the persistent burden of nutritional inadequacy in this age group [5]. School health surveys conducted in Indian states have similarly documented substantial levels of undernutrition and growth faltering among primary school children, emphasizing the continuing burden of malnutrition beyond the under-five age group [6]. Although national surveys such as the National Family Health Survey document undernutrition among under-five children, evidence for school-age children in slum settings remains scarce.

In this context, the present study was undertaken with the objective to assess the nutritional status and dietary intake of school-going children aged 6-9 years residing in a slum area of Mumbai. The study also examined selected socio-economic characteristics and the presence of common morbidities to better understand factors associated with malnutrition in this vulnerable population.

Materials and Methods

Study design and setting

A community-based cross-sectional study was conducted in the western suburban slums of Mumbai to assess the nutritional status and dietary intake of school-going children aged 6-9 years.

Ethical approval

The study protocol was reviewed and approved by the Inter System Biomedica Ethics Committee (ISBEC), Mumbai. Written informed consent was obtained from parents or guardians prior to enrolment.

Participants

Both male and female school-going children aged 6-9 years residing in the selected slum areas were eligible for inclusion. Children with intellectual disability, congenital abnormalities or known genetic disorders were excluded to avoid confounding of growth assessment. A total of 110 children were initially approached; however, complete data were available for 100 participants, comprising 50 boys and 50 girls. The mean age of the study population was 7.17 ± 1.4 years.

Data collection

Non-random purposive sampling was used. Slum was selected based on convenience and all available children in the age-group were approached in Anganwadi or by home visit. Five anganwadis were covered. Sociodemographic details were collected from parents or caregivers using a pretested structured questionnaire. Anthropometric measurements including height, weight, body mass index (BMI), mid-upper arm circumference (MUAC) and waist circumference (WC) were recorded following standardized procedures based on the NHANES 2007 anthropometry manual [7]. Height was measured using a non-stretchable measuring tape with the child standing erect without footwear, and weight was measured using a calibrated weighing scale with light clothing. BMI was calculated as weight (kg)/height (m^2). Nutritional status was classified using Indian Academy of Pediatrics (IAP) growth references and Khadilkar centile charts for BMI-for-age (2007, 2015), MUAC-for-age (2021) and waist circumference (2014) [8, 9, 10]. MUAC was measured on the left arm using a non-elastic measuring tape and recorded to the nearest 0.1 cm, ensuring appropriate tension. Medical history and health-related information were also obtained, including past and present illnesses, immunisation status, history of chronic conditions, age of weaning, participation in supplementation or feeding programmes, and utilisation of anganwadi services.

Dietary assessment

Dietary intake assessment was conducted using standardized food frequency and 24-hour recall approaches consistent with recommended dietary assessment methodologies for low-resource settings [11]. Portion sizes were estimated using household measures, and nutrient intake was computed using Indian food composition tables following FAO dietary assessment guidelines. Nutrient intake was computed using the Indian Food Composition Tables (IFCT, 2017). Intakes were compared with age-appropriate Estimated Average Requirements [5].

Statistical analysis

Data were entered and analysed using SPSS software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequency and percentage. Chi-square test, independent t-test and analysis of variance (ANOVA) were applied to assess differences between groups. A p-value <0.05 was considered statistically significant.

Results

A total of 100 children (50 boys and 50 girls) with a mean age of 7.17 ± 1.40 years were included (Table 1). Five children were not enrolled in formal schooling, most attended government schools (96.8%) or anganwadi centres (3.2%). The majority of respondents were mothers (88%) and for rest, the fathers responded. Most participants belonged to low-income families, with only 5% earning more than Rs. 30,000/month and to joint-family households (73%); 16% lacked personal sanitation or water connections, and only one-quarter utilised ration support.

Mean anthropometric measurements showed that the overall mean weight was 15.9 ± 3.2 kg, with boys weighing more (16.5 ± 3.5 kg) than girls (15.2 ± 2.8 kg). The mean height was 112.23 ± 9.90 cm, with boys being taller (114.59 ± 10.31 cm) compared to girls (109.88 ± 8.97 cm). Mean BMI was comparable between sexes (boys: 12.50 ± 1.58 kg/m²; girls: 12.57 ± 1.53 kg/m²; overall: 12.53 ± 1.55 kg/m²). The overall meal waist circumference was 48.29 ± 5.95 cm, which was higher among boys (49.60 ± 5.03 cm) than girls (46.99 ± 6.55 cm). MUAC values were similar in both sexes (boys: 16.75 ± 1.88 cm; girls: 16.88 ± 1.64 cm; overall: 16.81 ± 1.76 cm).

BMI-for-age classification showed 39% severe underweight and 14% underweight, with 46% normal and 1% overweight (Table 2). Stunting was observed in 37% (Table 3), while thinness based on MUAC-for-age (<25th percentile cut-off) was present in 35% of children (Table 4). None of the participants had waist circumference values above the 70th percentile, indicating absence of abdominal obesity and low risk of over-nutrition (Table 5).

Anaemia was the most prevalent morbidity, affecting 34% of the children, with a markedly higher prevalence among females (60%) compared to males (8%). Dental caries were observed in 28% of participants and were slightly more common among males (32%) than females (24%). Ear, nose and throat problems were reported in 14% of children, with marginally higher occurrence among females (16%) than males (12%). A few isolated conditions were also noted, including skin diseases among three females and other illnesses such as dengue in one male. Nearly half of the participants reported the presence of chronic disorders, including chronic diarrhoea, asthma, type I diabetes and cystic fibrosis, with no substantial gender differences.

Table 1: Age distribution of study participants (n = 100)

Age group (years)	Male n (%) N =50	Female n (%) N=50	Total n (%) N=100
6–7	19 (38.0)	16 (32.0)	35 (35.0)
7–8	14 (28.0)	11 (22.0)	25 (25.0)
8–9	17 (34.0)	23 (46.0)	40 (40.0)

Legend: Age categories represent completed years at the time of survey. Values expressed as frequency and percentage.

Table 2: BMI-for-age (BAZ) classification by gender

Classification	Male n (%) N =50	Female n (%) N=50	Total n (%) N=100
Severe underweight	20 (40.0)	19 (38.0)	39 (39.0)
Underweight	6 (12.0)	8 (16.0)	14 (14.0)
Normal	24 (48.0)	22 (44.0)	46 (46.0)
Overweight	0	1 (2.0)	1 (1.0)

Legend: Classification based on Indian Academy of Pediatrics growth charts.

Table 3: Height-for-age (HAZ) classification by gender

Classification	Male n (%) N =50	Female n (%) N=50	Total n (%) N=100
Stunted	15 (30.0)	22 (44.0)	37 (37.0)
Normal	35 (70.0)	28 (56.0)	63 (63.0)

Legend: HAZ indicates chronic undernutrition.

Table 4: MUAC-for-age classification by gender

Classification	Male n (%) N =50	Female n (%) N=50	Total n (%) N=100
Thinness	19 (38.0)	16 (32.0)	35 (35.0)
Normal	31 (62.0)	34 (68.0)	65 (65.0)

Legend: MUAC assessed using reference centiles for Indian children

Table 5: Gender-wise waist circumference (WC) for age classification

Classification	Male n (%) N =50	Female n (%) N=50	Total n (%) N=100
Normal (<70th percentile)	50 (100.0)	50 (100.0)	100 (100.0)
At risk (>70th percentile)	0 (0.0)	0 (0.0)	0 (0.0)

Legend: Waist circumference (WC) classification based on age-specific percentile cut-offs; values expressed as frequency and percentage, with no child exceeding the 70th percentile, indicating absence of abdominal obesity risk.

All children were fully immunised according to age-appropriate schedules and were reportedly weaned at six months of age. None of the participants were receiving nutritional supplementation through government programmes; however, most attended school or anganwadi feeding services. Dietary patterns were assessed using a qualitative food frequency questionnaire along with a 24-hour dietary recall. Meals were predominantly home-cooked and largely non-vegetarian, with rice forming the staple cereal consumed daily by most children. Pulses such as bengal gram, green gram and lentils were generally consumed weekly or occasionally, while only a few vegetables were eaten daily. Fruit intake was infrequent, and regular consumption of milk and milk products was limited. Eggs and chicken were typically consumed twice weekly, whereas meat and fish intake was mostly weekly or occasional. Most children consumed only two meals per day, reflecting low dietary diversity, and outside or processed foods were consumed infrequently due to economic constraints.

Energy, protein and carbohydrate intakes were comparatively higher among females than males, while fat intake remained similar between both sexes. Iron and zinc intakes were comparable, whereas calcium and vitamin A intake was slightly higher among females (Table 6). Despite similar iron consumption, a greater prevalence of anaemia was observed among girls, which may be attributed to poor sanitation, recurrent infections such as diarrhoea, and overall poor diet quality. Additionally, the high burden of underweight and stunting may have contributed to this trend, consistent with findings reported previously [3].

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Table 6: Daily nutrient intake of participants (mean ± SD)

Nutrient	Males N =50	Females N =50	p-value
Energy (kcal)	681 ± 261	837 ± 322	<0.05
Carbohydrate (g)	80 ± 19	87 ± 12	<0.05
Protein (g)	13 ± 5	14 ± 4	0.08
Fat (g)	25 ± 6	24 ± 5	0.62
Iron (mg)	5.93 ± 1.84	5.38 ± 1.88	—
Zinc (mg)	2.29 ± 0.72	2.29 ± 0.80	—
Calcium (mg)	138.69 ± 92.20	149.25 ± 78.29	—
Vitamin A (µg)	97.21 ± 55.64	100.87 ± 60.18	—

Legend: Values are expressed as mean ± standard deviation. Sample size: males (n = 50), females (n = 50). Nutrient intake was calculated using 24-hour dietary recall and Indian Food Composition Tables. p-values were obtained using independent sample t-tests. "—" indicates not statistically tested or non-significant.

Comparison of nutrient intake with Estimated Average Requirements (EAR) showed that none of the children met the recommended dietary levels. Mean macronutrient intakes generally ranged between approximately 50-80% of the EAR, while micronutrient intakes were more inadequate, largely below 70% of requirements. Stunted children demonstrated poorer intake, with both macro- and micronutrients often falling below 50-60% of the EAR. Although underweight children showed relatively higher macronutrient intake approaching 70–80% of the EAR, this may reflect the smaller sample size rather than true adequacy. Children with normal MUAC-for-age had comparatively better intakes than those with thinness, yet overall consumption across all anthropometric categories remained insufficient to meet recommended requirements, indicating widespread dietary inadequacy.

Lower macronutrient intake observed among children with thinness supports previous evidence that inadequate energy and protein consumption increases the risk of moderate and severe thinness in school-aged children [6]. Children with normal MUAC had significantly higher intakes of energy ($p < 0.05$) and carbohydrate ($p < 0.05$), whereas differences in protein ($p = 0.08$) and fat ($p = 0.62$) intake were not statistically significant. Similarly, micronutrient intakes including iron, zinc, calcium, and vitamin A showed no significant differences between groups. Comparable trends were observed for height-for-age (HAZ) and BMI-for-age (BAZ), where children with normal growth status consumed relatively greater macronutrients, while stunted and underweight children consistently demonstrated lower intakes. Overall, inadequate macronutrient consumption was associated with poorer anthropometric outcomes, reflecting both acute (MUAC) and chronic (HAZ and BAZ) undernutrition.

Discussion

The findings indicate a substantial burden of undernutrition among school-age children living in urban slums. High levels of underweight, stunting and thinness reflect both acute and chronic nutritional deprivation. Despite ongoing school and anganwadi feeding initiatives, dietary inadequacy remains common, suggesting that existing support systems may be insufficient to meet total nutritional requirements. Similar burdens of malnutrition among urban slum school children have been documented in other Indian settings [3].

Socio-economic and environmental constraints likely contribute to poor nutritional outcomes. Limited income, high dependency ratios, inadequate sanitation and restricted dietary diversity may predispose children to recurrent infections and reduced nutrient absorption. Comparable findings have been reported from Bangladesh and other disadvantaged populations [12, 13].

Dietary assessments showed consistently low intake of energy and micronutrients, particularly calcium and vitamin A, with heavy reliance on cereal-based diets. Such patterns are known to predispose children to multiple nutritional deficiencies [14]. The positive association between higher nutrient intake and better MUAC status highlights the usefulness of MUAC-for-age assessment in detecting undernutrition among school-age children [15]. Anaemia, especially among girls, further suggests underlying micronutrient deficiencies and infection-related factors, consistent with regional epidemiological evidence [16]. Nutritional status during late childhood also influences pubertal timing and body composition, with BMI variations known to affect growth and maturation outcomes [17].

Comparable patterns of undernutrition among school-age children living in socio-economically disadvantaged slum environments have also been reported in other South Asian settings [18], indicating that this remains a broader regional public health challenge. Strengthening school feeding programmes, improving access to diverse foods, and integrating nutrition education with sanitation and hygiene interventions may help address these gaps. The cross-sectional design and reliance on single-day dietary recall are limitations; however, the study provides important baseline data for an under-researched age group in urban slums.

Overall, inadequate dietary intake combined with unfavourable living conditions appears to be a key contributor to persistent undernutrition, underscoring the need for targeted community and school-based nutrition strategies.

Conclusion

The present study demonstrated a high burden of undernutrition among school-going children aged 6-9 years residing in urban slums of Mumbai. Anthropometric indicators revealed widespread underweight, stunting and thinness, accompanied by inadequate energy and micronutrient intake. Morbidity, particularly anaemia, was common. Despite utilisation of anganwadi and school meal programmes, dietary intake remained insufficient to meet age-appropriate requirements. Children with better dietary adequacy showed improved anthropometric status, indicating a close association between nutrient intake and growth.

These findings highlight the need for strengthened school feeding initiatives, improved dietary diversity, and community-based nutrition interventions to address persistent undernutrition in this vulnerable population.

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