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Dietary patterns and anthropometric assessment of urban school-going children in Punjab

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Abstract
The present study assessed the dietary patterns and anthropometric measurements of urban school-going children (10-12 years) in Ludhiana district. A total of 400 children were surveyed, comprising 57.5% boys and 42.5% girls. Socio-economic profiling revealed that the majority (62.5%) belonged to the scheduled caste, 60.0% lived in nuclear families, and 58.0% were from low-income households. Most families (88.0%) followed a vegetarian diet, with wheat as the staple cereal, while rice, pulses, green leafy vegetables, and fruits were consumed infrequently. Milk, curd, buttermilk, and ghee formed the primary animal-origin foods. The consumption of protective foods such as fruits and green leafy vegetables was low, reflecting dietary imbalance. Anthropometric assessment showed that boys had significantly higher mean values than girls for height (129.27 cm vs. 123.45 cm; $p<0.01$), weight (29.11 kg vs. 29.08 kg; $p\leq0.05$), mid-upper arm circumference (21.09 cm vs. 19.53 cm; $p<0.01$), waist circumference (57.78 cm vs. 55.95 cm; $p<0.01$), and waist-to-hip ratio (0.90 vs. 0.86; $p<0.01$). No significant gender difference was observed in BMI and hip circumference. The findings highlight socio-economic disparities, predominance of vegetarian diets, limited intake of nutrient-dense foods, and gender variations in growth indicators, emphasizing the need for nutrition awareness and intervention programs to improve the dietary diversity and nutritional status of urban school children.

Keywords: Dietary patterns, nutritional assessment, anthropometric assessment, children

Introduction
Children in the school-going age group represent a crucial phase of growth and development, where optimal nutrition plays a vital role in shaping their physical health, cognitive abilities, and overall well-being. Urbanization and lifestyle transitions have significantly influenced the dietary habits of children, leading to both positive and negative impacts on their nutritional status. While urban areas provide greater access to a wide variety of foods, they are also marked by an increasing dependence on processed, convenience, and fast foods, which may compromise dietary quality. At the same time, urban school-going children often face reduced physical activity due to sedentary lifestyles, academic pressures, and recreational use of digital media, further predisposing them to nutrition-related health issues.
Dietary patterns provide valuable insight into food consumption behavior, nutrient intake, and the adequacy of diets among children. Understanding these patterns is essential for assessing whether their food intake aligns with recommended dietary guidelines. In India, cereals continue to form the staple diet, complemented by pulses, vegetables, fruits, and dairy products. However, variations in consumption frequency, socio-economic disparities, and cultural preferences often determine the nutritional adequacy of children's diets. A shift towards calorie-dense but nutrient-poor diets is increasingly evident in urban contexts, contributing to the double burden of malnutrition, where undernutrition and over nutrition coexist. Children and adolescents who are taught healthy eating habits, encouraged to be physically active, avoid smoking, and learn to cope with stress can reduce the impact of chronic diseases in adults. Eating habits are complex, and many regulatory mechanisms play a role in their development (Patil and Wasnik, 2009) [14].
Anthropometric measurements such as height, weight, body mass index (BMI), mid-upper arm circumference (MUAC), waist circumference, and waist-to-hip ratio serve as reliable indicators of growth patterns and nutritional status. These parameters not only help in identifying underweight, stunting, and wasting but also in detecting emerging risks of

overweight and obesity in children. Regular assessment of anthropometric indices is therefore crucial to monitor growth trends and evaluate the prevalence of malnutrition in different forms. The double burden of malnutrition is increasingly evident in urban India. Khosla, *et al.* (2010) [9] reported that children from low-income families often suffer from undernutrition, reflected through stunting and wasting, while those from affluent families are more likely to face overweight and obesity.

Socio-economic and demographic characteristics, including family structure, parental education, income levels, and occupation, are important determinants of dietary intake and nutritional outcomes. Children from low-income or landless families often experience limited dietary diversity, while those from higher-income groups may be more exposed to processed and high-fat foods. Thus, studying the interrelationship between dietary habits, socio-economic status, and anthropometric indicators offers a holistic understanding of children's nutrition. Behrman, (2022) [1] observed similar trends in developing countries, showing how socio-economic transitions influence child nutrition.

Against this backdrop, the present study focuses on dietary patterns and anthropometric assessment of urban school-going children. The findings are expected to provide valuable insights into the prevailing dietary behaviors, nutritional adequacy, and growth status of children, thereby highlighting areas for nutritional interventions, health education, and policy measures aimed at improving child health in urban India.

Methodology

The present study was undertaken to assess the dietary patterns, nutritional awareness, and anthropometric measurements of urban school-going children in Ludhiana district of Punjab state, which represents a typical urban setting with diverse socio-economic and cultural backgrounds. For the purpose of the study, two blocks from the Ludhiana district were purposively selected. From each selected block, four schools were chosen, resulting in a total of eight schools forming the study area.

Selection of Respondents

From each school, 50 students were randomly selected, making the total sample size400 respondents for the study. This ensured adequate representation of school-going children from the selected urban area.

Data Collection Methods

Both **primary and secondary sources of data** were used to conduct the study:

1. **Primary Data:** Collected through a structured survey administered to the respondents using pre-tested questionnaires.
2. **Secondary Data:** Gathered from relevant literature including journals, books, research theses, government reports, magazines, newspapers, and reliable internet sources.

Data Collection Tools

To achieve the objectives of the study, the following tools were employed:

1. **Nutritional Awareness:** A structured questionnaire was developed and used to evaluate the level of nutritional knowledge and awareness among the respondents.
2. **Food Consumption Pattern:** A food frequency questionnaire (FFQ) was used to assess the dietary habits and frequency of consumption of various food groups.
3. **Nutritional Status:** Anthropometric measurements such as height, weight, waist circumference, and hip circumference were recorded. These were further used to calculate Body Mass Index (BMI) and Waist-Hip Ratio (WHR) to determine the nutritional status of the respondents.

Results

Personal and socio-economic profile of urban going school children

The personal and socio-economic characteristics of urban school-going children are presented in Table 1. Age-wise distribution showed that 49.0% of children were in the 10-11 years' group and 51.0% in the 11-12 years' group. Among the 400 respondents, 57.5% were boys and 42.5% were girls. Caste distribution revealed that 62.5% belonged to the Scheduled Caste (SC), 24.75% to the Backward Class (BC), and 12.75% to the General category. Comparable findings were reported by Soni and Katoch (2024) [19], who observed that 50%, 8%, 17%, and 25% of children in urban Himachal Pradesh belonged to SC, ST, OBC, and General categories, respectively.

Family structure analysis indicated that 60.0% of respondents lived in nuclear families, while 40.0% were from joint families. Nearly half (47.5%) of the children were from medium-sized families, whereas 26.5% and 26.0% belonged to small and large families, respectively. Housing status showed that 60.0% of children lived in pucca houses and 40.0% in mixed houses. These results are in line with Katyal (2014) [8], who also reported that 61% of children lived in nuclear families, while 39% were from joint families. However, Sati (2012) [21] found a higher proportion of children in joint families (55%) compared to nuclear families. Hans (2014) [7] and Katyal (2014) [8] similarly noted that the majority of children were from medium-sized families and lived in mixed-type houses. According to the National Nutrition Monitoring Bureau (2002), nearly two-thirds of respondents lived in semi-pucca houses, with an average family size of five members; about 16% of families had children of fourth or higher birth order, while 37% were third or later born.

Parental education status revealed that 57.5% of mothers had education up to primary level, 34.5% up to matric, and 8.0% up to intermediate. Among fathers, 34.0% were educated up to primary level, 29.5% up to matric, and 12.5% up to intermediate and above. Regarding occupation, 34.0% of fathers were engaged in agriculture, 32.5% in labor, 17.0% in service, and 16.5% in business. Among mothers, 60.0% were working, while 40.0% were housewives.

Landholding data revealed that 79.5% of families were landless, while 20.5% owned agricultural land. Family income distribution showed that 58.0% belonged to the low-income group (≤ ₹4,000/month), 36.0% to the middle-income group (₹4,001-8,000), and only 6.0% to the high-income group (₹8,001-12,000). These findings are consistent with those of Sati (2012) [21] and Sultan, who also reported that the majority of families were landless and

belonged to low-income groups. In contrast, Bhatia and Seshadri (2020) [2] found that 47% of urban families earned more than ₹8,000/month, while 13% had incomes between ₹4,000-6,000/month. Dietary habits indicated that the majority of families (88.0%) were vegetarian, while 12.0% were non-vegetarian. Most children (77.5%) consumed three meals per day, followed by those who consumed four meals daily.

Table 1: Personal and Socio-Economic Profile of Urban School-Going Children

Characteristics	Frequency	Percentage
Age		
7-8 years	196	49.0
8-9 years	204	51.0
Sex		
Male	200	50.0
Female	200	50.0
Caste		
Schedule	250	62.5
Backward	99	24.75
General	51	12.75
Mother's Education		
Up to primary	230	57.5
Up to matric	138	34.5
Intermediate & above	32	8.0
Father's Education		
Upto primary	232	58.0
Upto matric	118	29.5
Intermediate & above	50	12.5
Mother's Occupation		
working	240	60.0
Non-working	160	40.0
Father's Occupation		
Labourer	130	32.5
Business	66	16.5
Farming	136	34.0
Service	68	17.0
Family Type		
Nuclear	240	60.0
Joint	160	40.0
Family size		
Small (Up to 4members)	106	26.5
Medium (5-7 members)	190	47.5
Large (7 & above)	104	26.0
Type of House		
Katcha	0	0.0
Mixed	160	40.0
Pucca	240	60.0
Land		
Land owned	82	20.5
Landless	318	79.5
Income (Rs/month)		
Low (up to 4,000/-)	232	58.0
Middle (4,001-8,000/-)	144	36.0
High (8,001-12,000/-)	24	6.0
Eating habits		
Vegetarian	352	88.0
Non- vegetarian	48	12.0
No. of meals		
2	294	73.5
3	106	26.5

Dietary pattern of urban school-going children

Data on the food frequency of urban school-going children in Ludhiana district are presented in Table 2. In India, cereals constitute the staple component of the diet. Among these, wheat was consumed daily by all respondents. Rice consumption showed variation, with 4.0, 19.0, 30.0, 27.0, and 13.0 per cent of families consuming it daily, on alternate days, weekly, fortnightly, and rarely, respectively. Bajra was mostly consumed weekly (34.0%) and to a lesser extent daily (9.0%), alternately (27.0%), fortnightly (15.0%), and rarely (9.0%), predominantly during the winter season. Maize was consumed rarely (16.0%), also restricted to winter.

Pulses, a major source of protein in Indian diets, were consumed widely. Bengal gram dal was taken weekly by 48.0 per cent of respondents, followed by fortnightly (19.0%), rarely (14.0%), and alternately (12.0%). Black gram dal was consumed primarily on a fortnightly basis

(49.0%), while 15.0 and 13.0 per cent consumed it weekly and rarely, respectively. Green gram dal was most preferred weekly (53.0%), followed by alternately (17.0%), rarely (14.0%), and fortnightly (10.0%). Red gram dal was rarely consumed (43.0%), and only 32.0, 7.0, and 2.0 per cent consumed it fortnightly, weekly, and alternately, respectively. Lentil consumption was rare (38.0%), followed by fortnightly (17.0%), weekly (16.0%), and alternate (5.0%). Soybean was taken rarely (41.0%), fortnightly (23.0%), and weekly (18.0%).

The present findings are in line with earlier studies. Shakti *et al.* (2019) [18] reported that cereals were included in the daily diets of almost all children (99.5%). Sethi (2012) [3] also observed that most children in Sirsa district consumed green gram dal (68%), black gram dal (43%), Bengal gram dal (52%), and soybean (47%) weekly. Murugkar *et al.* (2013) [12] similarly reported that 76 per cent of children consumed pulses on a weekly basis. Consumption of green leafy vegetables showed wide variation. Amaranthus was consumed rarely (29.0%) or fortnightly (28.0%), while 25.0 per cent.

Table 2: Dietary pattern of urban school-going children (n=400)

Food Stuffs	Daily	Alternately	Weekly	Fortnightly	Rarely	Not consumed
Cereals						
Wheat	400(100.0)	-	-	-	-	-
Rice	16(4.0)	76(19.0)	120(30.0)	108(27.0)	52(13.0)	28(7.0)
Bajra	36(9.0)	108(27.0)	136(34.0)	60(15.0)	36(9.0)	24(6.0)
Maize	-	-	-	-	64(16.0)	336(84.0)
Pulses						
Bengal Gram	-	48(12.0)	192(48.0)	76(19.0)	56(14.0)	28(7.0)
Black Gram	-	-	60(15.0)	196(49.0)	52(13.0)	92(23.0)
Green Gram	-	68(17.0)	212(53.0)	40(10.0)	56(14.0)	24(6.0)
Red gram	-	8(2.0)	28(7.0)	128(32.0)	172(43.0)	64(16.0)
Lentil	-	20(5.0)	64(16.0)	68(17.0)	152(38.0)	96(24.0)
Soyabean	-	-	72(18.0)	92(23.0)	164(41.0)	72(18.0)
Green Leafy vegetables						
Amaranthus	-	-	72(18.0)	112(28.0)	116(29.0)	100(25.0)
Bathua leaves	-	-	-	-	156(39.0)	244(61.0)
Coriander leaves	32(8.0)	60(15.0)	188(47.0)	40(10.0)	52(13.0)	28(7.0)
Fenugreek leaves	16(4.0)	48(12.0)	108(27.0)	124(31.0)	84(21.0)	20(5.0)
Bengal gram leaves	-	-	44(11.0)	60(15.0)	140(35.0)	156(39.0)
Mustard	-	-	56(14.0)	148(37.0)	184(46.0)	20(5.0)
Spinach	8(2.0)	44(11.0)	132(33.0)	136(34.0)	68(17.0)	12(3.0)
Roots and Tubers						
Radish	-	100(25.0)	148(37.0)	124(31.0)	28(7.0)	-
Carrot	32(8.0)	116(29.0)	136(34.0)	84(21.0)	32(8.0)	-
Potato	104(26.0)	188(47.0)	72(18.0)	36(9.0)	-	-
Onion	332(83.0)	32(8.0)	16(4.0)	-	-	20(5.0)
Ginger	24(6.0)	48(12.0)	92(23.0)	148(37.0)	56(14.0)	32(8.0)
Garlic	164(41.0)	104(26.0)	76(19.0)	36(9.0)	8(2.0)	12(3.0)
Turnip	-	-	56(14.0)	64(16.0)	156(39.0)	124(31.0)
Other Vegetables						
Tomato	196(49.0)	60(15.0)	84(21.0)	52(13.0)	-	8(2.0)
Cauliflower	-	-	188(47.0)	124(31.0)	48(12.0)	40(10.0)
Cabbage	-	-	184(46.0)	132(33.0)	48(12.0)	36(9.0)
Green chillies	316(79.0)	40(10.0)	24(6.0)	20(5.0)	-	-
Lady finger	-	-	180(45.0)	124(31.0)	76(19.0)	20(5.0)
Peas (Green)	-	44(11.0)	116(29.0)	224(53.0)	28(7.0)	-
Tinda	-	164(41.0)	80(20.0)	124(31.0)	32(8.0)	-
Fruits						
Guava	-	28(7.0)	124(31.0)	188(47.0)	36(9.0)	24(6.0)
Apple	-	-	20(5.0)	112(28.0)	244(61.0)	24(6.0)
Banana	-	-	84(21.0)	152(38.0)	164(41.0)	-
Ber	16(4.0)	60(15.0)	132(33.0)	192(48.0)	-	-
Lemon	28(7.0)	68(17.0)	164(41.0)	120(30.0)	20(5.0)	-
Kinnow	20(5.0)	32(8.0)	156(39.0)	164(41.0)	28(7.0)	-
Papaya	-	32(8.0)	172(43.0)	132(33.0)	64(16.0)	-
Mango	-	36(9.0)	156(39.0)	192(48.0)	16(4.0)	-
Watermelon	-	8(2.0)	140(35.0)	88(22.0)	164(41.0)	-
Milk and Milk Products						
Cow's milk	56(14.0)	68(17.0)	60(15.0)	76(19.0)	116(29.0)	24(6.0)
Buffalo's milk	164(41.0)	112(28.0)	48(12.0)	76(19.0)	-	-
Curd	128(32.0)	148(37.0)	60(15.0)	52(13.0)	12(3.0)	-

Buttermilk	252(63.0)	112(28.0)	32(8.0)	8.0)	-	-
Butter	44(11.0)	56(14.0)	68(17.0)	108(27.0)	124(31.0)	-
Sweets	-	-	60(15.0)	100(25.0)	240(60.0)	-
Fats and Oils						
Desighee	272(68.0)	44(11.0)	16(4.0)	36(9.0)	8(2.0)	28(7.0)
Hydrogenated fat	76(19.0)	68(17.0)	56 (14.0)	20(5.0)	44(11.0)	136(34.0)
Refined oil	60(15.0)	64(16.0)	124(31.0)	40(10.0)	32(8.0)	80(20.0)
Mustard oil	256(64.0)	48(12.0)	52(13.0)	44(11.0)	-	-
Meat products						
Eggs	-	-	-	32(8.0)	34(8.5)	334(83.5)
Meat	-	-	-	-	22(5.5)	378(94.5)

Did not consume it at all. Bathua leaves were avoided by 61.0 per cent, and consumed rarely by the remaining 39.0 per cent. Coriander was frequently used, with 47.0 per cent consuming it weekly, 15.0 per cent alternately, 13.0 per cent rarely, 10.0 per cent fortnightly, and 8.0 per cent daily. Fenugreek leaves were mostly consumed fortnightly (31.0%), followed by weekly (27.0%) and rarely (21.0%). Bengal gram leaves were not consumed by 39.0 per cent, while 35.0 per cent consumed them rarely. Mustard leaves were consumed rarely (46.0%) and fortnightly (35.0%). Spinach was taken fortnightly (34.0%) and weekly (33.0%). Similar observations were made by Eilander *et al.* (2010) [5] who reported weekly consumption of green leafy vegetables in most families.

Roots and tubers formed another important group. Radish (37.0%) and carrot (34.0%) were consumed weekly by the majority. Potato was consumed alternately by 47.0 per cent and daily by 26.0 per cent. Onion was part of the daily diet for most respondents (83.0%). Ginger was consumed fortnightly (37.0%) and weekly (23.0%), while garlic was consumed daily (41.0%) and weekly (26.0%). Turnip was rarely consumed (39.0%), while 31.0 per cent did not consume it at all. Dudi and Punia (2009) [4] also reported potato and onion as the most commonly consumed food items. Katyal (2014) [8] similarly found that onion, potato, ginger, and garlic were consumed daily, while carrot and radish were eaten on alternate days or weekly.

Among other vegetables, tomatoes were widely consumed 49.0 per cent daily and 21.0 per cent weekly. Cauliflower was consumed weekly (47.0%) and fortnightly (31.0%), while cabbage was taken weekly (46.0%) and fortnightly (33.0%). Green chillies were used daily by 79.0 per cent of respondents. Ladyfinger was consumed weekly (45.0%) and fortnightly (31.0%), whereas peas were mostly eaten fortnightly (53.0%). Tinda was consumed alternately (41.0%), fortnightly (31.0%), and weekly (20.0%).

Fruit consumption was limited and not part of the daily diet. Milk and milk products, however, were fairly common. Cow's milk was consumed daily by 14.0 per cent of respondents. Similar findings were reported by Handa *et al.* (2018) [6], who found that fruits were mostly consumed once or twice a week. Buffalo's milk was consumed daily by 41.0 per cent, while buttermilk was taken daily by 63.0 per cent. Desi ghee formed a regular part of the diet for 68.0 per cent of respondents. Manu and Khetarpaul (2006) [11] also reported similar findings.

Mean anthropometric measurements of urban school-going children by gender

The mean anthropometric measurements of urban school-going children (10-12 years) are summarized in Table 3.

- **Height:** The mean height of boys was 129.27 cm, compared to 123.45 cm for girls. Girls had a significantly lower mean height than boys ($p<0.01$).
- **Weight:** The average body weight was 29.11 kg for boys and 29.08 kg for girls. Boys exhibited a significantly higher mean weight than girls ($p\leq0.05$).
- **Body Mass Index (BMI):** The mean BMI values of boys and girls were 15.64 kg/m² and 14.59 kg/m², respectively, with no significant difference between the two groups.
- **Mid-Upper Arm Circumference (MUAC):** The mean MUAC was 21.09 cm for boys and 19.53 cm for girls. Boys had a significantly higher MUAC than girls ($p<0.01$). Bose *et al.* (2008) [20] almost observed similar values of height and weight. Sati and Dahiya (2017) [16] also reported similar range of height, weight and triceps in school children.

Table 3: Mean anthropometric measurements of urban school-going children by gender (n=400)

Anthropometric measurements	Boys (n=257)	Girls (n=143)	t- value
Height (cm)	129.27±11.28	123.45±7.51	3.08*
Weight (kg)	29.11±4.67	29.08±4.24	2.22*
Body mass index (kg/m^2)	15.64±2.29	14.59±1.73	0.14
Mid upper arm circumference (cm)	21.09±1.98	19.53±1.66	4.25*
Waist circumference (cm)	57.78±4.56	55.95±3.92	4.61*
Hip circumference (cm)	71.61±4.60	69.63±4.34	1.08
Waist to hip ratio	0.90±0.05	0.86±0.04	4.55*

Values are Mean ± SD *Significant at 5% level

Waist-Circumference

The mean waist circumference of boys was 57.78 cm, whereas that of girls was 55.95 cm. Boys showed a significantly higher waist circumference compared to girls ($p<0.01$). Consistent with earlier reports (Kumari and Jain 2015; Prajapati *et al.*, 2011; Sethi 2012; Sati and Dahiya, 2012; Murugkar *et al.*, 2013) [10, 21, 3, 12].

Hip-Circumference

The mean hip circumference was 71.61 cm for boys and 69.63 cm for girls. No significant difference was observed between the two groups. The results of present investigation are in accordance with those of earlier workers (Shah *et al.*, 2003; Oninla *et al.*, 2007; Patil and Wasnik 2009) [17, 13, 14].

Waist-to-Hip-Ratio

The mean waist-to-hip ratio was 0.90 for boys and 0.86 for girls, with boys showing a significantly higher ratio than girls ($p<0.01$). The results of present investigation are in accordance with those of earlier workers (Kumari and Jain 2005; Divya Sethi 2012) [10, 3].

Conclusion

The study on the personal, socio-economic, dietary, and anthropometric profile of urban school-going children (10-12 years) revealed that the majority belonged to nuclear, medium-sized families, lived in pucca houses, and were primarily from Scheduled Caste backgrounds. Most families were landless and fell in the low-income category, with mothers largely educated up to the primary level and fathers engaged in agriculture or labor. Dietary habits reflected a predominance of vegetarianism, with wheat as the staple cereal and pulses consumed variably, while green leafy vegetables, roots, tubers, and fruits were less frequently included in the daily diet. Milk and milk products were more common, especially buttermilk and buffalo's milk, whereas desi ghee formed a regular part of the diet.

Anthropometric assessment indicated that boys had significantly higher mean values for height, weight, MUAC, waist circumference, and waist-to-hip ratio compared to girls, though BMI and hip circumference showed no significant difference. These findings suggest that while children's basic dietary patterns ensured cereal and milk intake, inadequate and irregular consumption of pulses, vegetables, and fruits may affect their nutritional adequacy. The socio-economic constraints, particularly low family income and landlessness, appear to influence food choices and nutritional outcomes, highlighting the need for targeted interventions to improve dietary diversity and overall nutritional status of urban school-going children.

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