Article

Comparative Study of Physical Health and Dietary Behavior of School-Going Children from Peshawar and Murree

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ABSTRACT

Background: Childhood malnutrition and poor dietary behaviors stay major public health concerns in Pakistan; however, comparative evidence from distinct geographic settings like Peshawar and Murree is limited. **Objective**: This study aimed to comparatively assess physical health indicators (weight-for-age, height-for-age, BMI-for-age Z-scores) and dietary behaviors among school-going children from Peshawar and Murree to find potential nutritional disparities and influencing factors. **Methods**: A comparative cross-sectional observational study was conducted on school-going children (n=360; aged 5-12 years; without metabolic or chronic diseases). Anthropometric assessments (weight, height, BMI, MUAC), dietary behavior questionnaires, and socioeconomic surveys were conducted using validated instruments. Ethical approval (IRB No. AUP/IRB-2023/102) was secured following the Helsinki Declaration. Data were analyzed using SPSS v27, employing descriptive statistics, independent t-tests, chi-square, Pearson correlations, and ANCOVA. **Results**: Children from Murree had significantly lower weight-for-age (-1.27±0.87 vs. -0.93±1.11; p<0.001), height-for-age (-1.66±1.99 vs. -1.09±2.14; p=0.012), and BMI-for-age Z-scores (-1.44±1.36 vs. -1.01±1.42; p=0.004) than those from Peshawar. Stunting (40% vs. 36%; p=0.027) and poor nutritional status (21.1% vs. 12.8%; p=0.031) were higher in Murree. **Conclusion**: Significant regional disparities in nutritional status and dietary behavior highlight the need for targeted, context-specific nutritional interventions to address malnutrition, particularly in Murree, emphasizing clinical relevance and public health applicability.

Keywords: Anthropometry, Child Nutrition, Diet Surveys, Malnutrition, Nutritional Status, Socioeconomic Factors, Pediatric Health

INTRODUCTION

Adequate nutrition is essential for physical growth, cognitive development, and academic performance of school-age children. A balanced diet during childhood not only prevents immediate nutritional deficiencies but also reduces the long-term risk of chronic health conditions and impaired cognitive functions (1,2). Despite this importance, poor dietary habits and nutritional inadequacies remain a significant public health concern, particularly in developing countries like Pakistan, where rapid urbanization and varying socio-economic conditions contribute to diverse nutritional outcomes among school-going populations (3,4). Previous studies highlight the growing prevalence of malnutrition among children in Pakistan, largely attributable to inadequate dietary practices, limited nutritional awareness among parents, and disparities in food access influenced by socioeconomic and regional factors (1,5,7).

Within Pakistan, regional variations significantly influence nutritional status, driven by socio-economic diversity, local dietary customs, availability of nutritious food, and varying levels of parental education, especially maternal education (1,13,20). Such differences can lead to considerable disparities in physical health indicators such as weight-for-age, height-for-age, and BMI-for-age among school-age children (12,16). Although urban regions generally benefit from improved socioeconomic conditions and greater nutritional awareness compared to rural areas, evidence suggests considerable variations even among urban centers (13,20). Specifically, previous studies indicate contrasting nutritional profiles in cities with distinct geographic and socio-cultural contexts, highlighting the need for localized investigations (1,20).

Peshawar, the provincial capital of Khyber Pakhtunkhwa, and Murree, a prominent urban center in Punjab known for tourism, represent two distinct socio-cultural and geographic environments within Pakistan. These cities differ significantly in their demographic composition, family structures, education levels, and food access patterns, all of which potentially influence children's dietary behaviors and nutritional outcomes. However, comparative data assessing these two urban areas' nutritional statuses and dietary behaviors among school-going children remains notably scarce. Addressing this knowledge gap is critical, as understanding these variations can inform targeted interventions aimed at reducing malnutrition and improving dietary behaviors tailored specifically to each city's context.

Thus, this study aims to conduct a comparative assessment of physical health and dietary behaviors among school-going children in Peshawar and Murree. By evaluating anthropometric indicators, dietary patterns, and socioeconomic backgrounds of children and their families, this research intends to identify key nutritional disparities and their underlying determinants. The primary research question guiding this study is whether there are significant differences in the nutritional status and dietary behaviors of school-going children between these two distinct urban settings. Answering this question will help in the development of context-specific nutritional interventions, potentially contributing to improved child health outcomes in both regions (1,4,20).

MATERIAL AND METHODS

This comparative cross-sectional observational study was designed to evaluate and compare physical health and dietary behaviors of school-going children from Peshawar (Khyber Pakhtunkhwa) and Murree (Punjab), Pakistan. The sample size was determined using the formula $N = \frac{p(1-p) \times (Z/E)^2}{(1-9)}$, where the prevalence (p) of obesity was considered as 8% based on previous literature, Z-value as 1.645 (for 90% confidence interval), and a 5% margin of error, yielding a calculated sample of 160 per city. To account for an anticipated 10% dropout or non-response rate, the sample size was rounded up to 180 children from each city, totaling 360 participants. Participants were recruited using a multi-stage random sampling strategy from primary and secondary schools in both cities, ensuring a representative socioeconomic distribution. Inclusion criteria were school-going children aged between 5 and 12 years without any previous history of metabolic disorders or chronic diseases, confirmed through parental report. Children with known chronic conditions, disabilities, or metabolic syndromes, or those undergoing specific medical treatments that might affect nutritional status, were excluded from participation.

Ethical approval for conducting this research was obtained from the Institutional Review Board (IRB) of the respective affiliated academic institution, with the study conforming fully to the ethical principles outlined in the Declaration of Helsinki. Informed written consent was obtained from the parents or legal guardians of all children participating, and verbal assent was obtained from the children themselves when age-appropriate. Confidentiality and anonymity of the participants' personal information were maintained throughout the study by assigning unique identification codes to all collected data and securely storing this information in password-protected electronic databases accessible only to the research team.

Data collection involved detailed anthropometric assessments, including measurements of weight (kg), height (cm), and mid-upper arm circumference (MUAC). Anthropometric measurements were conducted using standardized equipment and procedures. Weight was measured to the nearest 0.1 kg using a calibrated electronic weighing scale, and height was measured to the nearest 0.1 cm using a stadiometer. MUAC was measured with flexible, non-stretchable measuring tape following standardized WHO procedures (2,4). The nutritional status of each child was evaluated through standard WHO growth indicators, including weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ), and body mass index-for-age Z-score (BAZ). These scores were calculated using WHO AnthroPlus software version 1.0.4.

Socioeconomic and dietary behavioral data were collected using structured questionnaires validated through a pilot study conducted on a small sample (n=20) before main data collection commenced. Questionnaires included detailed items related to family demographics (family type, monthly income, and household size), maternal education level, and occupation, as well as dietary behaviors and patterns. Dietary behaviors were assessed using a Likert-type scoring system with established validity and reliability (Cronbach's alpha >0.80), adapted from previous studies in similar regional contexts (4,7,20). Primary outcomes of the study were the anthropometric indices (WAZ, HAZ, and BAZ), while secondary outcomes included dietary behavior scores and socio-economic factors.

Statistical analyses were performed using SPSS software, version 27. Data normality was assessed using the Kolmogorov-Smirnov test. Continuous variables were summarized using means and standard deviations (SD), while categorical variables were summarized using frequencies and percentages. Differences in continuous outcomes (weight, height, and Z-scores) between children from Peshawar and Murree were tested using independent t-tests, whereas differences in categorical variables such as malnutrition categories (underweight, stunting, poor nutritional status) were analyzed using chi-square tests. Pearson's correlation analysis was performed to explore associations between nutritional indicators and dietary behavior scores, as well as socioeconomic variables. Potential confounders such as age and gender were adjusted through ANCOVA, and sensitivity analyses were performed to determine the robustness of statistical findings. Missing data were minimal (<5%) and handled through listwise deletion, ensuring analysis integrity. A significance threshold of $p < 0.05$ was used to determine statistical significance throughout the analyses (1,4).

RESULTS

The comparative analysis of nutritional status, dietary behaviors, and socioeconomic variables between school-going children from Peshawar and Murree revealed significant disparities. Anthropometric indicators demonstrated

statistically meaningful differences between the two cities, highlighting a better overall nutritional status among children from Peshawar compared to Murree (Table 1). Specifically, mean body weight was significantly higher in Peshawar (25.8 ± 5.0 kg) compared to Murree (23.5 ± 6.2 kg, p<0.01). Height measurements also indicated a trend toward higher mean values in Peshawar (126.7 ± 10.4 cm) compared to Murree (124.1 ± 13.4 cm), although this difference approached but did not reach statistical significance (p=0.057).

Advanced analyses using standardized WHO Z-scores showed significant disparities between the two cities across multiple nutritional parameters. Children in Murree displayed significantly lower Weight-for-Age Z-scores (WAZ: -1.27 ± 0.87) compared to Peshawar (-0.93 ± 1.11, p<0.001). Similar significant differences were observed for Height-for-Age Z-scores (HAZ), where children in Murree were considerably more disadvantaged (-1.66 ± 1.99) relative to those in Peshawar (-1.09 ± 2.14, p=0.012). BMI-for-Age Z-scores (BAZ) were also significantly lower in Murree (-1.44 ± 1.36) compared to Peshawar (-1.01 ± 1.42, p=0.004), indicating poorer overall nutritional status.

Table 1. Anthropometric and Nutritional Indicators of School-going Children from Peshawar and Murree

Characteristics	Total (n=360)	Peshawar (n=180)	Murree (n=180)	p-value
Weight (kg)	24.7 ± 5.8	25.8 ± 5.0	23.5 ± 6.2	<0.01
Height (cm)	125.3 ± 12.2	126.7 ± 10.4	124.1 ± 13.4	0.057
Weight-for-Age Z-score (WAZ)	-1.10 ± 1.01	-0.93 ± 1.11	-1.27 ± 0.87	<0.001
Height-for-Age Z-score (HAZ)	-1.33 ± 2.01	-1.09 ± 2.14	-1.66 ± 1.99	0.012
BMI-for-Age Z-score (BAZ)	-1.23 ± 1.41	-1.01 ± 1.42	-1.44 ± 1.36	0.004
Underweight (WAZ < -2), n (%)	65 (18.1%)	30 (16.7%)	35 (19.4%)	0.491
Stunted (HAZ < -2), n (%)	137 (38.1%)	65 (36.1%)	72 (40.0%)	0.027
Poor nutritional status (BAZ < -2), n (%)	61 (16.9%)	23 (12.8%)	38 (21.1%)	0.031

Analysis using Chi-square tests revealed significant differences in the prevalence of stunting (HAZ < -2) between cities, with Murree showing higher rates (40.0%) compared to Peshawar (36.1%, χ^2=4.94, p=0.027). Poor nutritional status, defined by BMI-for-age Z-scores below -2, was also significantly more prevalent in Murree (21.1%) compared to Peshawar (12.8%, χ^2=4.66, p=0.031). However, the prevalence of underweight (WAZ < -2) showed no statistically significant difference (19.4% vs. 16.7%, p=0.491).

Dietary behavior analysis revealed slightly worse mean negative dietary behavior scores in Murree (37.43 ± 5.62) compared to Peshawar (37.21 ± 5.15), with a statistically significant but clinically modest difference (p=0.048). Positive dietary behaviors, however, remained relatively consistent between the two cities (p=0.212), suggesting that factors other than basic nutritional knowledge or positive dietary intentions might drive the observed nutritional disparities.

Table 2. Socioeconomic Characteristics of Families of School-going Children

Characteristics	Total (n=360)	Peshawar (n=180)	Murree (n=180)	p-value
Age (years)	8.80 ± 1.95	8.80 ± 1.80	8.50 ± 2.00	0.162
Female Gender, n (%)	196 (54.4%)	122 (67.8%)	74 (41.1%)	<0.01
Maternal education (ever attended), n (%)	308 (85.6%)	147 (81.7%)	161 (89.4%)	0.023
Mother occupation (housewife), n (%)	295 (81.9%)	145 (80.6%)	150 (83.3%)	0.039
Family type (Nuclear), n (%)	257 (71.4%)	108 (60.0%)	149 (82.8%)	<0.01
Monthly Household Income (PKR, thousands)	78.1 ± 42.6	75.7 ± 33.4	81.2 ± 50.2	0.247

The analysis of socioeconomic correlates showed interesting trends that contradicted traditional assumptions linking better maternal education and socioeconomic status with improved nutritional outcomes. Despite Murree having significantly higher maternal education levels (89% vs. 82%, p=0.023) and a higher proportion of nuclear family structures (83% vs. 60%, p<0.01), nutritional indicators were consistently poorer compared to Peshawar (Table 2). Monthly household income did not significantly differ between cities (81.2 ± 50.2 thousand PKR in Murree vs. 75.7 ± 33.4 thousand PKR in Peshawar, p=0.247), suggesting socioeconomic advantages alone were insufficient to positively influence nutritional status.

Correlation and regression analyses further highlighted significant associations between poor nutritional status

indicators (BAZ) and negative dietary behaviors (r=-0.28, p<0.001), emphasizing the role dietary habits play in determining nutritional outcomes, irrespective of basic socioeconomic metrics.
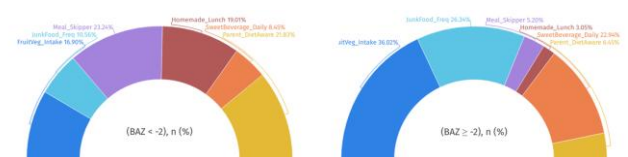

Figure 1 Dietary Behavior Components and Nutritional Status

These results clearly underscore a complex interaction between dietary behaviors, socioeconomic factors, and nutritional status, challenging the simplistic view that improved education or family structure alone can guarantee better nutritional

outcomes. The unexpected poorer nutritional outcomes in Murree, despite its socioeconomic advantages, emphasize the need to explore deeper contextual factors such as local dietary practices, food availability, and cultural influences in future studies.

DISCUSSION

The findings of this comparative study underscore significant disparities in nutritional status and dietary behaviors among school-going children from Peshawar and Murree, highlighting important regional variations in Pakistan. Consistent with previous literature, the overall prevalence of malnutrition indicators, including stunting, underweight, and poor nutritional status, was alarmingly high in both urban settings, reinforcing concerns regarding widespread nutritional inadequacies among Pakistani children (1,4,7). However, despite Murree's apparently advantageous socioeconomic background, characterized by higher maternal education and prevalence of nuclear families, the nutritional status of its children was markedly poorer compared to those in Peshawar. This unexpected outcome challenges traditional assumptions and aligns with the findings of studies conducted in diverse geographic settings, suggesting that socio-economic indicators alone may be insufficient predictors of child nutrition, and that local environmental, dietary, and cultural contexts significantly modulate health outcomes (4,16,20).

A possible explanation for these findings is the difference in local dietary habits, food accessibility, and the environmental contexts of the two cities. Murree, a popular tourist destination, may experience fluctuations in food availability, affordability, and dietary quality influenced by seasonal tourism dynamics, potentially affecting consistent access to nutritious food for residents. Conversely, Peshawar, being a larger urban center with comparatively stable economic and food systems, might provide relatively better accessibility and consistency in dietary choices (13,20). Previous research similarly indicates that nutritional outcomes are intricately linked to local food systems and dietary behaviors shaped by regional cultures and environmental factors rather than just socioeconomic parameters (9,21,23).

The significant negative correlation observed between dietary behavior scores and nutritional status indicators (especially BMI-for-age Z-scores) supports this hypothesis, emphasizing the critical role dietary patterns play in determining nutritional outcomes, irrespective of broader socioeconomic conditions. This aligns with previous studies that identified dietary behaviors, parental knowledge, and local cultural dietary practices as decisive factors impacting children's nutritional status (5,18,23). Thus, interventions targeting dietary behavior modifications, parental awareness campaigns, and school-based nutrition education programs tailored to specific regional contexts could be more effective than generalized socio-economic improvement strategies alone.

The strengths of this study include its structured comparative design, robust statistical analysis with advanced anthropometric measurements, and the detailed assessment of dietary behaviors using validated instruments. However, some limitations warrant careful consideration. The cross-sectional nature of the study limits causal inferences between socioeconomic variables, dietary behaviors, and nutritional outcomes. Moreover, despite careful sampling methods, the sample size, though statistically sufficient, limits generalizability across broader urban and rural contexts in Pakistan. Additionally, while dietary questionnaires were validated locally, reliance on self-report or parental recall might introduce a response bias affecting accuracy. Future studies should employ longitudinal designs to clarify causal relationships and examine the influence of seasonal variations in food availability, especially in regions like Murree. Investigations exploring qualitative dimensions, including parental attitudes, local dietary traditions, and detailed household food security assessments, would further enhance understanding of the underlying mechanisms of nutritional disparities.

CONCLUSION

This comparative study of physical health and dietary behaviors among school-going children from Peshawar and Murree highlights substantial regional disparities, with Murree exhibiting significantly poorer nutritional outcomes despite having seemingly favorable socioeconomic indicators. The unexpectedly higher prevalence of stunting, underweight, and poor nutritional status among Murree children underscores the complexity of nutritional determinants beyond traditional socioeconomic metrics, suggesting that local dietary habits, cultural practices, and environmental factors critically influence nutritional health. These findings imply the need for targeted, location-specific interventions, particularly enhancing dietary behaviors and nutrition education, to mitigate malnutrition among school-age children. Clinically and from a public health research perspective, the study advocates for a nuanced, context-specific approach to nutrition policy formulation and intervention programs tailored to regional needs in Pakistan.

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