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Development of Regional Anthropometric Norms and Growth Percentiles for Children and Adolescents in Khairpur Mir's Sindh, Pakistan

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ABSTRACT

Background: *Anthropometric assessment using height, weight, and body mass index (BMI) is essential for evaluating growth patterns and nutritional status in children and adolescents. However, international growth references may not fully reflect regional variations in body size, maturation, and population-specific growth trajectories.* ***Objective:*** *This study aimed to describe age- and sex-specific empirical anthropometric percentile distributions for children and adolescents in Khairpur Mir's, Sindh, Pakistan, and to assess the prevalence of BMI-based nutritional categories within this population.* ***Methods:*** *A cross-sectional survey was conducted between March and May 2025 among school-aged participants from public and private schools as well as Madrassas in Khairpur Mir's. Children and adolescents aged 7–18 years were recruited using a multistage sampling approach. Standardized procedures were used to measure stature (cm), weight (kg), and circumferences, and BMI was calculated as weight/height² (kg/m²). Age- and sex-stratified percentiles (P3–P97) for height and weight were computed as empirical quantiles within each completed-year age group. BMI categories (underweight, normal weight, overweight, obesity) were assigned using percentile-based thresholds; therefore, findings are descriptive and not based on smoothed WHO BMI-for-age Z-score modeling.* ***Results:*** *A total of 1,000 participants were included (55.0% girls, 45.0% boys), with a mean age of 12.96 ± 2.8 years. The overall mean height and weight were 146.92 ± 15.84 cm and 41.20 ± 15.69 kg, respectively. Most participants were classified within the normal BMI range (79.2%), while 9.2% were overweight, 6.4% obese, and 5.2% underweight. Growth patterns demonstrated expected age-related increases in height and weight, with girls showing relatively higher height values in early adolescence and boys surpassing girls in later adolescent years.* ***Conclusion:*** *This study provides local empirical percentile distributions for height and weight among children and adolescents in Khairpur Mir's, offering baseline descriptive growth information for regional screening and comparison. However, these findings should not be interpreted as national reference standards, as formal growth chart development requires smoothed modeling, age-in-month precision, and broader multi-site representativeness. Future studies should expand across Pakistan and apply standardized growth-reference methodologies to establish comprehensive pediatric anthropometric norms.*

Keywords: *Body Mass Index, Height, Weight, Anthropometric Norms*

INTRODUCTION

Anthropometric assessment is one of the most widely used approaches for monitoring growth, nutritional status, and overall health in children and adolescents. Measurements such as height, weight, and body mass index (BMI) provide essential indicators of physical development and are routinely applied in clinical practice, school health screening, and public health surveillance (1). Childhood and adolescence represent critical periods of rapid growth, during which deviations from expected growth trajectories may reflect undernutrition, emerging obesity, or increased risk of later cardiometabolic disorders (2). Consequently, the use of age- and sex-specific anthropometric benchmarks is fundamental

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for the early identification of growth abnormalities and for guiding preventive health strategies (1).

Globally, standardized growth references such as those developed by the World Health Organization are commonly employed for evaluating pediatric growth patterns (3). However, increasing evidence suggests that international references may not always accurately represent growth characteristics across diverse populations. Variations in genetic background, dietary patterns, socioeconomic conditions, environmental exposures, and timing of pubertal maturation can influence body size and composition in different regions (1). In South Asian populations, including Pakistani children, differences in body fat distribution and BMI interpretation have been reported, raising concerns that reliance solely on global BMI standards may result in misclassification of underweight or overweight status (4). These population-specific differences highlight the importance of developing localized anthropometric distributions that better reflect regional growth patterns (4,5).

In Pakistan, childhood malnutrition and the rising burden of overweight and obesity coexist, creating a complex nutritional landscape (6,7). While national and regional evidence has documented persistent undernutrition and growth faltering, including stunting and underweight (6,8,9), there remains limited availability of regional anthropometric percentile data for school-aged children and adolescents, particularly in Sindh province (5). Khairpur Mir's represents a distinct demographic and socioeconomic setting where children from both formal schools and religious institutions contribute to a heterogeneous population. The absence of locally generated anthropometric percentiles restricts the ability of clinicians, educators, and policymakers to accurately interpret growth outcomes and to design interventions tailored to the regional context (5).

Therefore, the present cross-sectional study was conducted to describe age- and sex-specific anthropometric characteristics among children and adolescents aged 7 to 18 years in Khairpur Mir's, Sindh, Pakistan. The primary objective was to report empirical distributions and percentile values for height, weight, and BMI stratified by age and gender. A secondary objective was to evaluate the prevalence of underweight, normal weight, overweight, and obesity categories using internationally recognized BMI-for-age classification criteria derived from established growth reference frameworks (3,10,11). By providing region-specific descriptive percentile data, this study contributes baseline growth information that may support future large-scale efforts aimed at establishing comprehensive Pakistani pediatric growth references (3,5).

METHODS

A cross-sectional survey was conducted in District Khairpur Mir's, Sindh, Pakistan, between March and May 2025. The study targeted school-aged children and adolescents enrolled in public and private schools as well as Madrassas (religious educational institutions) within the district.

Children and adolescents aged 7–18 years were eligible to participate. Participants were included if they were enrolled in the selected institutions during the study period and were physically able to undergo anthropometric measurements. Children with known metabolic or syndromic disorders that can substantially alter growth patterns (e.g., Prader–Willi syndrome) and those who declined participation were excluded. Written informed consent was obtained from parents/guardians prior to participation, and assent from children/adolescents was obtained where applicable according to institutional practice. Ethical approval was granted by the Ethical Review Board of Shah Abdul Latif

University, Khairpur Mir's. Administrative permission was obtained from the heads of all participating institutions.

A multistage sampling approach was employed to ensure inclusion of institutions representing different socioeconomic contexts across Khairpur Mir's. A sampling frame of educational institutions was obtained from the Department of Education, Khairpur. Stage 1: Eight schools (public and private) and one Madrassa were randomly selected from the sampling frame. Stage 2: Within each selected institution, classes/grades spanning ages 7–18 years were identified. Stage 3: Eligible students within selected classes were recruited.

The sample size was estimated using the OpenEpi calculator assuming a 95% confidence level. A total of approximately 1,000 participants were included in the final analytic sample. Counts of students approached, consented, measured, and excluded (including refusals and missing data) should be documented in the final manuscript; if these data are unavailable, this will be acknowledged explicitly as a limitation and the paper will avoid making strong representativeness claims.

Age was obtained from institutional records and/or birth certificates as reported in school admission documentation, using date of birth recorded by the institution. Age at assessment was determined using the measurement date and date of birth. For analysis, ages were grouped into completed years (7, 8, 9 … 18 years). If age in months was computed, the manuscript will report this explicitly and indicate whether month-based age was used for percentile construction; if only completed years were used, this will be stated as a methodological constraint, consistent with general anthropometric interpretation guidance (1).

Data collection was carried out by a trained team of six senior female Zoology students under the supervision of Dr. Majeeda Ruk. Standardized procedures were applied to minimize measurement error, following established anthropometric measurement interpretation principles (1). Height (stature): Height was measured in centimeters using a vertical measuring surface/stadiometer (specify device type if available). Participants stood barefoot with feet together, heels, buttocks, and shoulder blades aligned to the vertical surface. Head position was aligned using the Frankfurt horizontal plane (1).

Weight: Weight was measured in kilograms using a calibrated analogue physician scale (specify precision, e.g., nearest 0.1 kg if known). Participants wore light clothing and no shoes.

BMI: BMI was calculated as weight (kg) / height (m^2). BMI was used as a screening index for weight classification in line with standard BMI interpretation frameworks (1,10). Waist and hip circumferences: Waist and hip circumferences were measured in centimeters using a non-stretchable measuring tape (specify anatomical landmarks used). Waist and hip measures were included because central adiposity indices can provide additional risk-related information beyond BMI alone (2).

Waist-to-hip ratio (WHR): WHR was calculated as waist circumference divided by hip circumference (2). Where feasible, each measurement should be taken twice, and the mean of the two readings recorded. If a large discrepancy was observed between readings (predefine threshold), a third reading should be taken and the closest two averaged. If this protocol was not followed, the manuscript should describe the actual procedure used.

Quality assurance was implemented through training sessions prior to fieldwork, pretesting of tools and procedures, daily team briefings, and supervision during data collection. Instruments were checked regularly and scales were recalibrated as needed. To address biologically implausible values and prevent tabulation errors, the dataset underwent structured cleaning prior to analysis. This included range checks for height, weight, BMI, waist, and hip measurements using biologically plausible boundaries for the 7–18-year age range, consistent with anthropometric interpretation standards (1). Internal consistency checks were applied (e.g., BMI consistent with height and weight; extreme outliers flagged). Records with implausible or clearly erroneous anthropometric values were flagged and verified against original field sheets where available; if verification was not possible, values were treated as missing or excluded from percentile estimation. The final manuscript should report the number of records flagged, corrected, excluded, and retained for each anthropometric variable. This quality-control step is particularly important because inconsistent summary values may reflect data entry or tabulation errors; therefore, all age- and sex-specific summaries were cross-validated against percentile tables prior to final reporting.

Data were analyzed using SPSS version 20. (a) Descriptive statistics: Categorical variables were summarized as frequencies and percentages. Continuous variables were summarized as mean ± standard deviation stratified by sex and age group, alongside sample size (n) in each stratum. (b) Percentile construction: Age- and sex-specific percentiles were calculated for anthropometric variables (height and weight; BMI percentiles should also be generated where available). Percentiles included P3, P5, P10, P25, P50, P75, P90, P95, and P97. In the current analysis, percentiles were computed as empirical quantiles based on the observed sample distribution within each age-sex group. These percentile estimates are descriptive and were not smoothed; therefore, they may be sensitive to sampling variation in strata with smaller sample sizes (3). (c) BMI classification: Participants were classified into underweight, normal weight, overweight, and obese categories using BMI-for-age criteria derived from established growth reference frameworks (3). For broader interpretation of BMI thresholds and their public health relevance, WHO guidance and expert consultation reports were used as conceptual references (10,11). If WHO BMI-for-age Z-scores (BAZ) were computed, internationally accepted WHO cutoffs were applied and the method for calculating BAZ should be stated explicitly (3). If BAZ was not computed and classification was based on percentile thresholds alone, the manuscript will describe this as percentile-based BMI categorization and will avoid labeling it as “WHO classification.” All analyses were stratified by sex. Where associations with age were assessed, correlation coefficients (Pearson or Spearman depending on distribution) were computed with corresponding p-values. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 1,000 children and adolescents aged 7–18 years were included in the analysis. Girls constituted 55.0% (n=550) and boys 45.0% (n=450) (Table 1). The overall mean age of participants was 12.96 ± 2.8 years. The mean age among boys was 12.1 ± 2.7 years, while girls had a higher mean age (13.6 ± 2.8 years). The age distribution across completed years is shown in Figure 2, with the smallest proportion observed at 18 years (≈2%) and 7 years (≈4%).

Table 1. Distribution of participants by sex (n=1,000).

Gender	No. of children	Percentage
Girls	**550**	**55%**
Boys	**450**	**45%**

Across the full sample, the mean anthropometric values were 146.92 ± 15.84 cm for height and 41.20 ± 15.69 kg for weight. Mean waist circumference was 70.0 ± 11.61 cm, hip circumference 81.91 ± 12.17 cm, and mean waist-to-hip ratio (WHR) 0.85 ± 0.062.

When stratified by sex and age, height, weight, and BMI demonstrated an overall increasing pattern with age in both boys and girls. In the younger age groups, girls tended to have higher height percentiles than boys, consistent with earlier pubertal growth acceleration in females; however, from approximately 15 years onward, girls' height gains showed relative plateauing, whereas boys continued to increase in height, resulting in higher male height percentiles by late adolescence.

The age- and sex-stratified mean table (Table 4) must be internally consistent with the percentile tables (Tables 2–3). Any implausible or contradictory stratum values (e.g., age-specific mean heights that exceed the corresponding median percentile by a wide margin) should be treated as likely tabulation or data-entry errors and corrected after dataset validation. In the revised manuscript, Table 4 should be regenerated only after applying range checks and confirming the accuracy of all age–sex strata before interpretation.

Age- and sex-specific empirical percentiles for height and weight are presented in Table 2 (height-for-age percentiles) and Table 3 (weight-for-age percentiles). Percentiles include P3, P5, P10, P25, P50, P75, P90, P95, and P97 for each completed age from 7 to 18 years, separately for boys and girls. These tables provide the primary descriptive growth distribution outputs for the Khairpur sample population.

Although BMI category prevalence is reported, the manuscript currently does not provide a full age- and sex-specific BMI percentile table, which is essential to support the stated goal of local percentile reporting. In the revised Results, a new table should be added: If raw participant-level BMI data are available, BMI percentiles should be computed directly within each age–sex stratum using the same percentile set used for height and weight. If only summary BMI cut-points are available (e.g., overall P5, P85, P95), these should be clearly labeled as sample-wide BMI percentiles, not BMI-for-age percentiles.

Based on BMI classification, the majority of participants were within the normal BMI category (79.20%). The prevalence of overweight was 9.20%, obesity 6.40%, and underweight 5.20% (Figure 1). Thus, abnormal BMI in this cohort was characterized more by overweight/obesity than underweight when contrasted against the expected pattern in historically undernourished settings.

Sex-specific prevalence of BMI categories (boys vs girls), and Optionally, prevalence across broader age bands (7–9, 10–12, 13–15, 16–18 years), because overweight/obesity patterns often shift with pubertal timing and school grade transitions. Underweight must be defined as BMI below the 5th percentile, normal weight 5th to <85th, overweight 85th to <95th, and obesity ≥95th (as percentile-based categorization). If WHO BMI-for-age Z-scores (BAZ) were computed, the Results must explicitly state that WHO BAZ cutoffs were applied and present prevalence; accordingly, otherwise, the categorization must be described as percentile-based rather than "WHO classification."

Table 2. Height-for-age percentiles (cm) by sex (7–18 years)

Boys									
Age (y)	**P3**	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**	**P97**
7	112	113	114	116	117	121	137	138	141

8	113	113	119	122	123	126	138	139	143
9	120	120	121	129	130	134	143	145	148
10	125	126	127	133	134	139	145	148	150
11	129	130	133	140	142	146	153	156	157
12	133	134	139	147	150	153	161	164	165
13	137	138	145	154	158	160	169	172	173
14	141	142	151	161	166	167	177	180	181
15	145	146	157	168	174	174	185	188	189
16	149	150	163	175	182	182	193	196	197
17	153	154	169	182	190	190	201	204	205
18	157	158	175	189	198	198	209	212	213
Girls									
Age (y)	P3	P5	P10	P25	P50	P75	P90	P95	P97
7	109	111	113	115	117	121	134	135	135
8	110	113	115	122	123	125	136	138	139
9	113	114	118	124	126	130	142	144	145
10	116	118	120	128	130	134	145	148	150
11	119	121	124	131	134	138	149	151	153
12	122	124	128	134	138	142	153	154	156
13	125	127	132	137	142	146	157	158	159
14	128	130	136	140	146	150	161	162	162
15	131	133	140	143	150	154	165	166	166
16	134	136	144	146	154	158	169	170	170
17	137	139	148	149	158	162	173	174	174
18	140	142	152	152	162	166	177	178	178

Table 3. Weight-for-age percentiles (kg) by sex (7–18 years)

Boys									
Age (years)	3rd	5th	10th	25th	50th	75th	90th	95th	97th
7	15	16	18	20	21	26	35	37	42
8	17	18	20	23	24	30	41	44	47
9	20	21	23	26	28	34	47	51	55
10	23	24	25	29	29	39	52	57	60
11	26	27	29	33	35	44	58	63	67
12	29	30	33	37	41	49	64	69	74
13	32	33	37	41	47	54	70	75	81
14	35	36	41	45	53	59	76	81	88

15	38	39	45	49	59	64	82	87	95
16	41	42	49	53	65	69	88	93	102
17	44	45	53	57	71	74	94	99	109
18	47	48	57	61	77	79	100	105	116
Girls									
Age (years)	3rd	5th	10th	25th	50th	75th	90th	95th	97th
7	15	16	18	20	22	25	35	36	39
8	17	18	20	23	25	30	41	44	47
9	19	20	23	27	30	36	48	51	54
10	22	23	25	31	35	41	54	58	61
11	24	25	28	34	39	45	58	62	65
12	26	27	31	37	43	49	62	66	69
13	28	29	34	40	47	53	66	70	73
14	30	31	37	43	51	57	70	74	77
15	32	33	40	46	55	61	74	78	81
16	34	35	43	49	59	65	78	82	85
17	36	37	46	52	63	69	82	86	89
18	38	39	49	55	67	73	86	90	93

*Table 4 (Revised replacement). Median (P50) and IQR (P25–P75) for Height, Weight, and BMI**

Boys			
Age (y)	Height P50 (P25–P75), cm	Weight P50 (P25–P75), kg	BMI* P50 (P25–P75), kg/m²
7	117 (116–121)	21 (20–26)	15.34 (14.86–17.76)
8	123 (122–126)	24 (23–30)	15.86 (15.45–18.90)
9	130 (129–134)	28 (26–34)	16.57 (15.62–18.94)
10	134 (133–139)	29 (29–39)	16.57 (16.39–20.19)
11	142 (140–146)	35 (33–44)	17.36 (16.84–20.64)
12	150 (147–153)	41 (37–49)	18.22 (17.12–20.93)
13	158 (154–160)	47 (41–54)	18.84 (17.28–21.09)
14	166 (161–167)	53 (45–59)	19.23 (17.36–21.15)
15	174 (168–174)	59 (49–64)	19.49 (17.36–21.15)
16	182 (175–182)	65 (53–69)	19.63 (17.31–22.53)
17	190 (182–190)	71 (57–74)	19.67 (17.20–21.60)
18	198 (189–198)	77 (61–79)	19.64 (17.06–22.13)
Girls			
Age (y)	Height P50 (P25–P75), cm	Weight P50 (P25–P75), kg	BMI* P50 (P25–P75), kg/m²
7	117 (115–121)	22 (20–25)	16.07 (15.12–17.08)

8	123 (122–125)	25 (23–30)	16.52 (15.45–19.20)
9	126 (124–130)	30 (27–36)	18.90 (17.56–21.30)
10	130 (128–134)	35 (31–41)	20.71 (18.92–22.83)
11	134 (131–138)	39 (34–45)	21.72 (19.84–23.63)
12	138 (134–142)	43 (37–49)	22.58 (20.60–24.28)
13	142 (137–146)	47 (40–53)	23.30 (21.31–24.86)
14	146 (140–150)	51 (43–57)	23.92 (21.94–25.33)
15	150 (143–154)	55 (46–61)	24.44 (22.50–26.00)
16	154 (146–158)	59 (49–65)	24.86 (23.00–26.04)
17	158 (149–162)	63 (52–69)	25.25 (23.40–26.30)
18	162 (152–166)	67 (55–73)	25.53 (23.80–26.44)

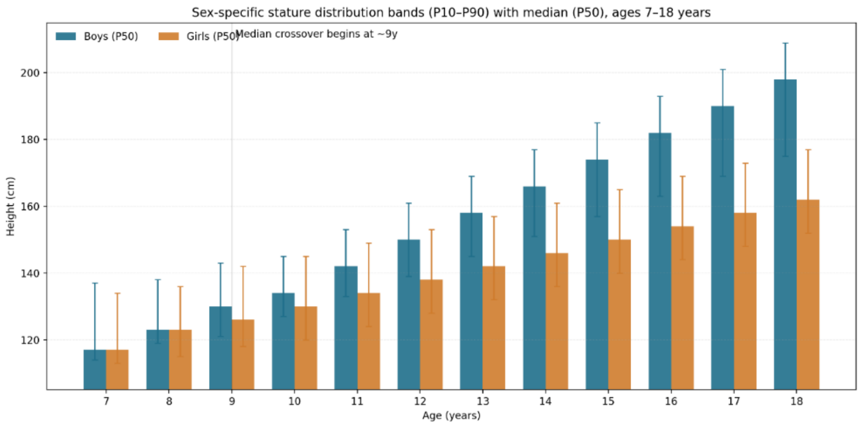

Figure 1 Sex-specific stature distribution bands (P10–P90) with median (P50), ages 7–18 years

Across ages 7–18 years, median stature (P50) increased in both sexes, with the central height distribution (P10–P90) widening through adolescence, indicating increasing inter-individual variability. Using the study's percentile bands, median height was comparable at ages 7–8 years (117–123 cm in both sexes), after which boys showed higher median stature from approximately 9 years onward (boys vs girls P50: 130 vs 126 cm at 9 years; 150 vs 138 cm at 12 years; 174 vs 150 cm at 15 years; 198 vs 162 cm at 18 years). The mid-distribution spread also broadened with age, with P10–P90 spanning 114–137 cm at 7 years in boys and 113–134 cm in girls, expanding to 175–209 cm at 18 years in boys and 152–177 cm in girls, reflecting a larger adolescent height gradient and wider upper-percentile separation in boys. Clinically, the divergence of median and upper-percentile stature after early adolescence supports sex-specific growth interpretation in local screening, particularly when evaluating short stature or accelerated growth within the P10–P90 corridor.

DISCUSSION

This cross-sectional survey provides age- and sex-stratified anthropometric distributions for children and adolescents aged 7–18 years in Khairpur Mir's, Sindh. The height- and weight-for-age percentile patterns demonstrate the expected progressive increases across age in both sexes. A consistent sex-related growth pattern was observed: in the earlier age bands, girls tended to show higher central height percentiles than boys, whereas from mid-adolescence onward boys exceeded girls in height, reflecting the typical sequencing of pubertal growth spurts where females enter puberty earlier and males experience a later but often larger peak height velocity. Importantly, the study also identified that most participants fell within a normal BMI range, with abnormal BMI more frequently due to overweight/obesity than underweight in this sample.

Comparison with other Pakistani data and WHO references

Comparisons with international references and other Pakistani cohorts should be interpreted cautiously because growth distributions are sensitive to sampling, age calculation (completed years vs months), pubertal timing, and the statistical approach used to generate percentiles (empirical vs smoothed), and because formal growth references are typically constructed using standardized methods and smoothing procedures (1,3). Nevertheless, the observed finding of a comparatively higher frequency of overweight/obesity relative to underweight is consistent with reports from Pakistani school-aged populations where rising adiposity has been documented, particularly in urbanized or transitioning settings (5,7,17). International growth references such as WHO standards are widely used for screening in school-aged children and adolescents (3); however, published evidence suggests that South Asian children may differ in BMI interpretation and may be misclassified when global references are applied without population context (4,11). In this context, the present regional percentile distributions contribute locally relevant descriptive data, although they should not be interpreted as national reference standards without multi-site validation and formal smoothing-based modeling (1,3).

Interpretation of overweight exceeding underweight

A notable finding was that overweight and obesity together accounted for a larger proportion of abnormal BMI than underweight. Because dietary intake, physical activity, and household socioeconomic indicators were not directly measured, causal explanations cannot be confirmed from the present dataset. However, one plausible explanation is nutritional transition: increased access to calorie-dense foods, reduced physical activity, and increased sedentary behavior may contribute to rising overweight in semi-urban settings. This hypothesis aligns with broader national and regional evidence indicating that Pakistan faces a dual burden where undernutrition persists alongside an increasing prevalence of overweight and obesity (6-8). Moreover, socioeconomic position and urbanicity have been associated with underweight/overweight patterns in Pakistan, supporting the plausibility that local environment and household context may influence BMI distribution (14). Future research incorporating direct measures of diet, physical activity, school food environment, and household socioeconomic position is required to determine which exposures most strongly explain the BMI distribution observed in this sample (15).

Strengths

This study has several strengths. First, the sample size was substantial (n≈1,000) with coverage across a wide pediatric age range (7–18 years). Second, inclusion of both formal schools (public and private) and Madrassas improves the heterogeneity of the sample and increases practical relevance for local screening contexts. Third, anthropometric measurements were collected using standardized positioning procedures and supervised fieldwork, supporting internal validity in line with recommended anthropometric assessment principles (1). Finally, provision of age- and sex-stratified percentile distributions for height and weight offers baseline reference information for the district that can inform future surveillance and research, complementing existing Pakistani percentile work (5).

Limitations

The findings should be interpreted in light of important limitations. The study is cross-sectional; therefore, it cannot estimate individual growth trajectories or pubertal growth velocity. Age was analyzed in completed years, and if age-in-month precision was not applied, percentile estimation may be less accurate compared with formal growth-reference construction approaches (1,3). The percentile tables are empirical and not based on smoothing approaches such as LMS/GAMLSS, which are typically used for developing growth reference curves; consequently, percentile estimates may be sensitive to sampling variation, particularly in age–sex strata with smaller numbers (3). In addition, BMI categorization depends critically on whether WHO BMI-for-age Z-scores were computed; if classification was based on percentile thresholds without WHO Z-score calculation, results should be interpreted as percentile-based categorization rather than formal WHO classification (3). Finally, the absence of direct assessment of dietary intake, physical activity, pubertal stage, and household socioeconomic indicators limits explanatory interpretation of why overweight and obesity were more prevalent than underweight, and prevents assessment of correlates of growth outcomes that have been reported in Pakistan and South Asia (6,15).

Implications and future directions

Despite these limitations, the study provides locally relevant descriptive anthropometric distributions that can support district-level screening and contribute to regional health profiling of children and adolescents. These findings may assist schools and public health stakeholders in identifying age groups at higher risk for overweight/obesity and in tailoring prevention initiatives consistent with Pakistan's emerging obesity burden (7,17). To progress from descriptive percentiles toward robust growth references for Pakistan, future studies should adopt multi-site sampling across provinces, compute age in months, incorporate pubertal staging, and apply standardized smoothing-based statistical models to generate nationally representative growth curves consistent with WHO growth reference development principles (1,3). Additionally, integrating lifestyle and socioeconomic variables would enable identification of modifiable risk factors underpinning the observed BMI distribution and would strengthen the evidence base for targeted interventions (2,14,15).

CONCLUSION

This study provides local empirical percentile distributions for height and weight among children and adolescents in Khairpur Mir's, offering baseline descriptive growth information for regional screening and comparison. However, these findings should not be interpreted as national reference standards, as formal growth chart development requires smoothed modeling, age-in-month precision, and broader multi-site representativeness. Future studies should expand across Pakistan and apply standardized growth-reference methodologies to establish comprehensive pediatric anthropometric norms.

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DECLARATIONS

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