

Overweight and Obesity among Adolescent Students Attending High Schools: Representative Study of All Private and Public Sector High Schools in District Peshawar

Ibrar Ahmed¹, Zia Ul Haq², Sheraz Farid³, Adan Javed¹

¹Department of Endocrinology, Lady Reading Hospital, ²Khyber Medical University,

³Lady Reading Hospital, Peshawar.

Abstract

Background: Obesity among children impairs academic performance, increases healthcare costs, and increases risk for chronic diseases in adulthood.

Objective: To determine the prevalence of overweight and obesity, and their associated factors, among adolescents attending public and private high schools in Peshawar.

Methods: A cross-sectional study was conducted among students attending public and private high schools in the Peshawar district by the Department of Endocrinology, Lady Reading Hospital, Peshawar in collaboration with the Institute of Public Health and Social Sciences, Khyber Medical University, Peshawar. A total of 800 students were selected from public and private high schools of district Peshawar using multistage stratified random sampling. Data were collected on socio-demographic profile, dietary and nutrition-related information, health-related QOL, and physical activity. Data were analyzed using Stata version 14.0; chi-square tests and logistic regression analyses were performed, with a p-value < 0.05 considered statistically significant.

Results Among respondents, 62.88% were male and 28.88% were aged 15 years. Approximately one-third of the students (33.3%) had low physical activity, while 21.4% were overweight and 18.3% were obese. Age, gender, father's occupation, and grade were significantly associated with BMI ($p < 0.05$). Physical activity showed weaker correlations with health-related quality-of-life domains among overweight/obese respondents. Female sex was independently associated with lower odds of overweight or obesity, while belonging to a low-income household and being in the 9th grade increased these odds.

Conclusion: High overweight and obesity prevalence was observed among Peshawar adolescents, independently associated with male sex, lower household income, and 9th grade, highlighting the need for school-based nutrition and physical activity interventions.

Key words: Adolescent, pediatric obesity, overweight, body mass index, Pakistan.

Introduction

Adolescent obesity is a major public health crisis because of its associations with poor

physical and mental health, impaired academic performance, increased healthcare costs, and greater risk of adult-onset diseases, including type II diabetes, hypertension, sleep disorders, and reduced quality of life.¹⁻² The WHO reports that childhood overweight and obesity are increasing globally, with the fastest growth occurring in developing countries due to rapid dietary and lifestyle changes.³ Approximately 15% of young women and 34% of young men are overweight or obese, suggesting that a substantial proportion of adolescent obesity may persist into adulthood.⁴ Obesity during adolescence is influenced by multiple interacting factors, including energy imbalance, inadequate physical activity, unhealthy dietary patterns, sleep disturbances, parental obesity, and exposure to fast-food marketing.⁵⁻⁷

Corresponding Author:

Ibrar Ahmed

Department of Endocrinology
Lady Reading Hospital, Peshawar.

Email: ibrarlrh@gmail.com

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Authors Contribution

IA conceptualized the project. IA & SF performed the statistical analysis. AJ did the data collection. ZUH did the literature search. Drafting, revision & writing of manuscript were done by IA & ZUH.

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Overweight adolescents also experience greater bullying, psychological distress, poorer quality of life, and lower academic performance than their normal-weight peers.⁸ Therefore, preventive strategies promoting healthy diets, physical activity, and reduced sedentary behaviour are essential.⁹

Adolescence is characterized by substantial physiological changes that affect body mass and fat distribution. Pubertal hormonal changes alter energy metabolism and fat distribution, while social and cultural factors may further influence obesity risk. In Pakistan, males generally have greater freedom regarding food choices and may consume larger quantities, potentially contributing to differences in obesity prevalence between males and females.^{2,6} Nutrition research in developing countries has historically focused primarily on undernutrition, resulting in limited evidence regarding adolescent overweight and obesity.¹⁰

Given the growing burden of adolescent overweight and obesity, understanding its magnitude and determinants is essential for developing evidence-based school health interventions. Although overweight and obesity have previously been reported among school-going adolescents in Peshawar, evidence comparing public and private high schools, while examining their relationships with health-related quality of life and physical activity, remains limited. Therefore, this study aimed to determine the prevalence of overweight and obesity and their associated socio-demographic and behavioural factors among adolescent students attending public and private high schools in Peshawar District, Pakistan.

Methods

The Department of Endocrinology, Lady Reading Hospital, Peshawar in collaboration with the Institute of Public Health and Social Sciences (IPH&SS), Khyber Medical University (KMU), Peshawar, conducted this cross-sectional study from May to October 2024 in public and private high schools in District Peshawar.

Four trained field teams, each supervised by an IPH&SS, KMU public health graduate, collected data. Data collectors received standardized training in anthropometric measurements and questionnaire administration, and 10% of forms were independently re-checked for quality control. Using OpenEpi, a minimum sample of 490 was calculated (5% margin of error, anticipated obesity prevalence of 11%,¹¹ and design effect of 2). To improve precision, ensure representation across gender and school types, support subgroup analyses, and account for

potential non-response and fieldwork constraints, the final sample size was increased to 800 students.

A multi-stage, stratified random sampling method was used. Schools were initially stratified by ownership (public vs. private) and gender composition, followed by the random selection of both schools and students. An equal allocation of 400 public-school and 400 private-school students was planned, with 200 males and 200 females in each stratum. The achieved sample differed modestly from the planned allocation, reflecting differential non-response and replacement of absentees. Students in grades 9 and 10 were eligible, while those with chronic medical conditions or restricted diets were excluded. Administrative permission was obtained from school authorities, and informed written consent, with participant assent and parental/guardian consent for minors, was obtained. Weight was measured to the nearest 0.1 kg using a calibrated digital scale, with participants in light clothing and without shoes. Height was measured to the nearest 0.1 cm using a portable stadiometer, while waist and hip circumference were measured to the nearest 0.1 cm using a non-stretchable tape, following standard anthropometric protocols. Socio-demographic, dietary, and nutrition-related information was collected using the Khyber Pakhtunkhwa Demographic and Health Survey questionnaire.¹ BMI-for-age was assessed using CDC growth charts.¹²⁻¹³ BMI-for-age percentiles by age and sex were used to classify nutritional status.¹⁴⁻¹⁵ Health-related quality of life was assessed using the SF-12 questionnaire, covering eight domains, with higher scores indicating better quality of life. Physical activity was assessed using the IPAQ-Short Form and categorized as low, moderate, or high according to standard MET-minutes/week criteria. The regression outcome was dichotomized as overweight/obese (BMI-for-age ≥ 85 th percentile) versus normal/underweight (< 85 th percentile). Statistical analysis was conducted using STATA version 14. Descriptive statistics and chi-square tests were performed, followed by univariable (crude) and multivariable (adjusted) logistic regression analyses to identify factors independently associated with overweight or obesity. Statistical significance was set at $p < 0.05$.

Results

Among 800 participants, 62.9% ($n=503$) were male, with 15-year-old males comprising the largest subgroup (28.9%; $n=231$). Most participants attended private schools (56.4%; $n=451$). Over half of fathers were unemployed (55.5%; $n=444$),

followed by self-employed (17.4%) and wage-earning (16.8%), as shown in Table-1.

Table 1: Study participants basic characteristics. (n=800)

Variable	Category	n	%
Age (years)	13	26	3.25
	14	111	13.88
	15	231	28.88
	16	207	25.88
	17	144	18.00
	18	61	7.63
	19	20	2.50
Gender	Male	503	62.88
	Female	297	37.13
School Type	Private	451	56.38
	Public	349	43.63
Father's Occupation	Employed	134	16.75
	Own-business	139	17.38
	Unemployed	444	55.50
	Expatriate	83	10.38
Average Monthly Income (PKR)	<20,000	252	31.50
	20,000–40,000	424	53.00
	40,001–60,000	82	10.25
	>60,000	42	5.25
Class of Study	9th Grade	437	54.63
	10th Grade	363	45.38
BMI Category	Underweight	52	6.50
	Normal	431	53.88
	Overweight	171	21.38
	Obese	146	18.25
Physical Activity	Low	317	39.63
	Moderate	417	52.13
	High	66	8.25

Table-2 shows significant associations between BMI classification and both age ($p = 0.02$) and gender ($p < 0.001$). Among 15-year-old participants, 25.7% were overweight and 32.2% were obese, representing the most heavily affected age group. Conversely, 16-year-old participants demonstrated a significant association with both underweight and overweight statuses. Of the total cases, males accounted for a substantially higher proportion of overweight (60.23%) and obesity (79.45%) than females, who accounted for 39.77% and 20.55%, respectively.

Both crude and adjusted logistic regression analyses were used to evaluate the effects of age, gender, school type, father's occupation, grade level, household income, and physical activity on weight status (Table-3). Female gender was independently associated with lower odds of overweight or obesity (adjusted odds ratio [aOR] = 0.70; 95% CI: 0.48–0.99; $p = 0.04$). Conversely, ninth-grade students had higher odds of being overweight or obese (aOR = 1.70; 95% CI: 1.24–2.42; $p < 0.001$), as did those with a household income <20,000 PKR (aOR = 2.40; 95% CI: 1.02–5.55; $p = 0.04$). No other variables reached statistical significance.

Table 2: Association between BMI groups and characteristics of the study participants.

Variable	Category	Underweight n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	p-value
Age (years)	13	0 (0.00)	8 (1.86)	7 (4.09)	11 (7.53)	0.02
	14	11 (21.15)	50 (11.60)	27 (15.79)	23 (15.75)	
	15	12 (23.08)	128 (29.70)	44 (25.73)	47 (32.19)	
	16	19 (36.54)	115 (26.68)	45 (26.32)	28 (19.18)	
	17	6 (11.54)	79 (18.33)	32 (18.71)	27 (18.49)	
	18	4 (7.69)	38 (8.82)	10 (5.85)	9 (6.16)	
	19	0 (0.00)	13 (3.02)	6 (3.51)	1 (0.68)	
Gender	Male	33 (63.46)	254 (58.93)	103 (60.23)	116 (79.45)	<0.001
	Female	19 (36.54)	177 (41.07)	68 (39.77)	30 (20.55)	
School type	Private	31 (59.62)	241 (55.92)	109 (63.74)	72 (49.32)	0.07
	Public	21 (40.38)	190 (44.08)	62 (36.26)	74 (50.68)	
Father occupation	Employed	17 (32.69)	57 (13.23)	27 (15.79)	35 (23.97)	0.001
	Own-business	8 (15.38)	72 (16.71)	35 (20.47)	24 (16.44)	
	Unemployed	27 (51.92)	256 (59.40)	90 (52.63)	70 (47.95)	
	Expatriate	0 (0.00)	46 (10.67)	19 (11.11)	17 (11.64)	
Monthly income (PKR)	<20,000	17 (32.69)	134 (31.09)	59 (34.50)	48 (33.10)	0.75
	20,000–40,000	25 (48.08)	230 (53.36)	92 (53.80)	78 (53.79)	
	40,001–60,000	6 (11.54)	45 (10.44)	16 (9.36)	14 (9.66)	
	>60,000	4 (7.69)	22 (5.10)	4 (2.34)	5 (3.45)	
Class of study	9th Grade	25 (48.08)	215 (49.88)	100 (58.48)	101 (69.18)	<0.001
	10th Grade	27 (51.92)	216 (50.12)	71 (41.52)	45 (30.82)	
Physical activity	Low	23 (44.23)	180 (41.77)	58 (33.92)	54 (36.99)	0.45
	Moderate	27 (51.92)	220 (51.04)	96 (56.14)	77 (52.74)	
	High	2 (3.85)	31 (7.19)	17 (9.94)	15 (10.27)	

Table 3: Logistic regression between overweight/obesity and participant characteristics.

Variable	Category	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)	13	2.9	0.7–10.53	0.11	2.4	0.63–9.10	0.20
	14	1.1	0.37–3.03	0.92	0.8	0.28–2.51	0.75
	15	0.9	0.31–2.39	0.77	0.7	0.24–1.99	0.49
	16	0.7	0.25–1.96	0.50	0.6	0.23–1.87	0.42
	17	0.9	0.31–2.53	0.83	0.9	0.32–2.72	0.90
	18	0.6	0.19–1.79	0.35	0.5	0.17–1.70	0.29
	19	Reference			Reference		
Gender	Male	Reference			Reference		
	Female	0.7	0.48–0.88	0.01	0.7	0.48–0.99	0.04
School type	Public	Reference			Reference		
	Private	1.0	0.78–1.38	0.81	1.2	0.82–1.64	0.39
Father occupation	Expatriate	Reference			Reference		
	Employed	1.1	0.64–1.94	0.70	1.3	0.71–2.31	0.41
	Own-business	1.0	0.56–1.70	0.94	1.0	0.58–1.83	0.92
	Unemployed	0.7	0.45–1.17	0.19	0.8	0.48–1.30	0.35
Class of study	10th Grade	Reference			Reference		
	9th Grade	1.8	1.36–2.43	<0.001	1.7	1.24–2.42	<0.001
Income	>60,000	Reference			Reference		
	<20,000	2.3	1.05–5.14	0.04	2.4	1.02–5.55	0.04
Physical activity	Low	Reference			Reference		
	Moderate	1.3	0.94–1.72	0.12	1.3	0.92–1.73	0.16
	High	1.7	0.98–2.86	0.06	1.7	0.96–2.96	0.07

Table 4: Relationship between HRQoL and physical activity, stratified by BMI (Overweight, obesity).

HRQoL Scale		Physical activity domain, (95%CI)			
		Minimal Physical Activity	Moderate	Vigorous Physical Activity	Total Physical Activity
	BMI				
Physical functioning	overweight	0.14** (0.06, 0.21)	0.04 (−0.04, 0.10)	−0.01 (−0.06, 0.06)	0.08* (0.02, 0.15)
	obesity	−0.26** (−0.33, −0.18)	0.09 (0.03, 0.15)	−0.08 (−0.15, −0.02)	0.08 (0.01, 0.16)
Role physical	overweight	−0.04 (−0.12, 0.02)	0.02 (−0.05, 0.06)	0.01* (−0.07, 0.07)	0.01 (−0.06, 0.06)
	obesity	−0.08 (−0.14, −0.00)	0.08 (0.02, 0.14)	0.01* (−0.06, 0.06)	0.05 (−0.01, 0.11)
Bodily pain	overweight	0.09* (0.02, 0.15)	−0.03 (−0.09, 0.04)	−0.03 (−0.10, 0.04)	−0.05 (−0.11, 0.02)
	obesity	−0.15 (−0.21, −0.08)	−0.03 (−0.10, 0.04)	−0.03 (−0.10, 0.05)	−0.01 (−0.08, 0.06)
General health	overweight	0.06 (0.01, 0.12)	0.03 (−0.04, 0.09)	0.03* (−0.03, 0.09)	0.12* (0.04, 0.18)
	obesity	−0.02 (−0.10, 0.04)	0.02* (−0.03, 0.10)	0.06** (−0.02, 0.11)	0.12* (0.07, 0.19)
Vitality	overweight	−0.01* (−0.07, 0.07)	0.08 (0.02, 0.15)	0.08** (0.01, 0.15)	0.20** (0.12, 0.25)
	obesity	0.02 (−0.04, 0.08)	0.02 (−0.04, 0.10)	0.09* (0.03, 0.16)	0.17** (0.11, 0.23)
Social functioning	overweight	−0.13* (−0.19, −0.08)	−0.07 (−0.12, −0.00)	0.01 (−0.06, 0.08)	0.03 (−0.05, 0.09)
	obesity	−0.07 (−0.13, −0.00)	−0.10 (−0.18, −0.05)	0.07 (0.01, 0.14)	−0.06 (−0.13, 0.01)
Role emotional	overweight	0.07 (−0.00, 0.14)	0.01 (−0.06, 0.08)	−0.04 (−0.10, 0.02)	−0.05 (−0.11, 0.02)
	obesity	−0.02 (−0.08, 0.04)	−0.08 (−0.14, −0.01)	0.08 (0.03, 0.14)	0.04 (−0.02, 0.12)
Mental health	overweight	0.02 (−0.04, 0.09)	0.08 (0.00, 0.13)	0.04 (−0.04, 0.09)	0.08 (0.01, 0.13)
	obesity	−0.02 (−0.09, 0.05)	−0.01 (−0.07, 0.06)	0.10 (0.03, 0.17)	0.02 (−0.05, 0.08)

^a Health-related quality of life.^b Spearman³ rank correlation coefficient adjusted for age, gender, school type, average monthly salary, eat fast food or takeaway.^c95% CI for Spearman's rank correlation*Significant correlation at $p < 0.05$ (with Bonferroni correction)**Significant correlation at $p < 0.05$ (without Bonferroni correction)

Table-4 shows adjusted Spearman correlations between physical activity and HRQoL domains stratified by weight status. Among overweight participants, minimal physical activity correlated positively with physical functioning, bodily pain, and general health. Total physical activity showed the strongest positive correlation with the vitality domain ($r = 0.20$, 95% CI: 0.12–0.25). Conversely, social functioning was negatively

associated with physical activity, particularly among obese participants, for whom moderate activity correlated with lower social functioning ($r = -0.10$, 95% CI: –0.18––0.05).

Discussion

This study found prevalence rates for overweight and obesity of 21.38% and 18.25%,

respectively, with a combined prevalence of 39.63%. Compared with similar studies in Pakistan (23% overweight)⁶ and Greece (24% overweight; 18% obesity)¹⁶, these findings were higher than those reported in India, where overweight ranged from 11% to 17.7% and obesity from 2.8% to 13.5%.¹⁷⁻¹⁸ Differences may reflect variations in geography, socioeconomic status, dietary habits, and lifestyle behaviors.¹⁹

Boys had a significantly higher prevalence of overweight and obesity than girls, contrasting with the findings of Agustina et al., where boys exhibited a lower prevalence.²⁰ This difference may plausibly reflect cultural and dietary factors. In Pakistan, household food allocation may favour boys in quantity and quality, particularly in lower socioeconomic families, although this study did not directly assess food allocation.²¹⁻²⁴ Increased food intake during puberty and accompanying changes in insulin resistance may also contribute.

A higher proportion of private-school students were overweight/obese on bivariate analysis ($p = 0.07$); however, school type was not independently associated with overweight/obesity after adjustment (adjusted OR 1.2, 95% CI 0.82–1.64, $p = 0.39$). This finding should therefore be interpreted cautiously.²⁵ Proposed explanations for a private-school gradient include greater availability of energy-dense foods, private transportation, and fewer restrictions on food choices; however, these remain speculative in the present study.⁷ Conversely, low household income (<20,000 PKR/month) was independently associated with higher odds of overweight/obesity (adjusted OR 2.4, 95% CI 1.02–5.55, $p = 0.04$). Although some studies report higher obesity risk among affluent adolescents, others in transitional and lower- and middle-income countries report greater burdens among lower-income households, reflecting nutrition transition and increased availability of low-cost, energy-dense foods.¹²⁻¹³ This represents the double burden of malnutrition, where under and over nutrition coexist. Although physical activity is generally considered protective against childhood obesity, no association with BMI categories was observed. Previous studies have reported associations between higher physical activity levels and a lower risk of obesity.³⁻⁵ Parental work status was significantly associated with BMI, suggesting relationships between family economic conditions, lifestyle, dietary patterns, and physical activity.

This study has several limitations. Its cross-sectional design precludes causal interpretation. Self-reported physical activity and dietary information may be affected by recall and social-desirability biases. Modest deviations from the

planned equal allocation by sex and school type may have introduced selection bias despite stratified random sampling. Future longitudinal studies should incorporate objective dietary and physical activity measures, biochemical markers, and cohorts of rural adolescents to improve our understanding of childhood obesity in this population.

Conclusion

This study found a high prevalence of overweight (21.38%) and obesity (18.25%), with male sex, 9th grade enrollment, and lower income independently associated with higher odds of both. Targeted school-based nutrition education, healthy food policies, and regular physical activity are warranted, with longitudinal studies needed to evaluate these interventions.

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Availability of Data: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval: The Institutional Review Board of Lady Reading Hospital, Peshawar approved the study via letter no. 593/LRH/MTI dated 05/03/2024.

Conflict of Interest: None declared.

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