

# Prevalence of Body Mass Index and Associated with Demographic Factors among Pakistan School-Aged Adolescents

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## ABSTRACT

**Aim:** To investigate the most recent estimates of underweight, overweight, and obesity prevalence in Pakistani school-aged adolescents aged 12 to 17 years,

**Methods:** A cross-sectional study was conducted using a convenience sampling approach with 2100 Pakistani from 24 schools in central Punjab province. The CDC US 2000 was used to define underweight < 5th percentile, overweight > 85th to < 95th percentile, and obese equal or greater than 95th percentile, the Chi-square test was used. The Pearson correlation coefficient (r) was used to determine the correlation. The statistical significance level was set at  $p < 0.05$ .

**Results:** prevalence of underweight U/W, overweight O/W, and obesity O/B was (21.9%, 5.8%, and 5.4%, respectively. The BMI had a positive relationship with gender, residency school kind and school level.

**Conclusion:** Underweight, overweight, and obesity were prevalent among Pakistani school-aged adolescents. Girls were significantly more than boys to be overweight and obese. Students in urban regions were more likely than those in rural areas to be overweight. The relationship between BMI, behavioral, and other health variables should also be investigated in future research using longitudinal or interventional approaches.

**Keywords:** Body Mass Index, School-aged adolescents, demographic

## INTRODUCTION

Excess body weight in adolescence has become one of the world's most important public health issues over time<sup>1</sup>. In both high- and low-income nations, childhood obesity has reached epidemic proportions, with the incidence of overweight and obese adolescence having doubled or even tripled since 1970<sup>2</sup>. According to the World Health Organization (WHO), 18% of children and adolescents aged 5–19 years were overweight or obese globally in 2016, with considerable regional differences in obesity rates<sup>3</sup>. Most significantly, childhood obesity and overweight have serious short- and long-term effects for a child's physical, mental, and emotional health<sup>1</sup>. Studying the role of demographic factors and prevention of adolescent overweight and obesity has become increasingly essential, because these behaviors and habits are developed early in life and can be reversed, albeit with difficulty, in the future. Furthermore, dealing with obesity and losing weight as an adult is considerably more difficult, particularly after the age of 35<sup>4</sup>. Obesity is on the rise across the globe<sup>5</sup>. Pakistan is a low income country<sup>6</sup> with 54 percent of the population between the ages of 0 and 19<sup>7</sup>. In the global hunger index for 2021, Pakistan is placed 92nd out of 116 countries, indicating a major hunger problem<sup>8</sup>. Pakistan is dealing with both over- and under-nutrition. In terms of obesity, Pakistan is rated tenth out of 188 nations, with 50% of the population being overweight or obese<sup>9</sup>. Over time, both males and females in Pakistan are experiencing a rise in the frequency of early mortality related to obesity<sup>10</sup>. 5.4 million Pakistani school-aged children will be obese by 2030, according to the World Obesity Federation<sup>11</sup>. Pakistan has yet to adopt a policy to tackle overweight and obesity, as well as physical inactivity, according to the WHO Diabetes country profiles<sup>12</sup>. There is still a vacuum despite Pakistan's little research on the topic. In order to assess the prevalence of obesity among Pakistani school-aged adolescents, baseline data is required<sup>13,14</sup>. This can offer public health insights into how to prevent underweight, overweight, and obesity in Pakistan. The aim of this study was to estimate the prevalence of weight status of Pakistani adolescents aged 12 to 17

years old, as well as to further investigate its association with demographic factors, in order to contribute to the development of evidence-based recommendations for the prevention and management of underweight, overweight, and obesity in this age group.

## METHODS

**Study design, setting, and participants:** In the summer of 2021, a convenience sampling strategy<sup>15</sup> was used to perform a cross-sectional survey among school-aged children and adolescents from central Punjab area. Adolescents in (grades 6 -8 middle), (grades 9-10 secondary), and (grades 11-12 higher secondary) were sampled.

Public schools were selected after receiving permission from the Punjab school education department; they were given a letter of permission, whilst private school administrations obtained permission on their own. If the school's administration refused to take part in the research, an alternative institution was picked at random. Rescue-1122 departments volunteered to participate in this survey.

The Shanghai University of Sport, Institutional Review Board authorized the study protocol [1816111009-2019], and permission to conduct the study was acquired from the participating schools' teachers and principals. All of the children and adolescents in the study, as well as their parents or guardians, were told that participation was completely voluntary.

**Measure:** Sampled schools were visited on pre-arranged dates. In the classroom, members of Rescue-1122 took anthropometric weight and height measurements. For students, the questionnaire was written in English and read aloud to them. First, the students' weight and height were measured. Students then completed the survey questionnaire on paper in a classroom environment. Students self-reported questionnaire paper version were used. Demographic information about adolescents from public and private schools, as well as school levels (primary, middle, secondary, and higher secondary), was used, including gender (boy or girl), age (12 to 17) years, grades (6 to 12), religion (Muslim or Non-Muslim), and residence location (urban or rural).

**Weight status:** BMI weight to the nearest 0.1 kg for the purpose of the measured weight and height to the nearest 0.5 cm<sup>16</sup>. BMI was

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calculated as body weight (kg) divided by height (m) squared (kg/m<sup>2</sup>). Underweight, normal weight, overweight, and obese classifications were based on BMI percentiles based on age and gender (CDC-US 2000). Underweight (<5th percentile), healthy weight (5th BMI to <85th percentile), overweight (85th BMI <95th percentile), and obese ( $\geq$ 95th percentile) BMI for children and adolescents aged 2 to 20 years<sup>17</sup>. Trained rescue professionals took all of the measurements.

**Statistical Analysis:** IBM SPSSv.26 Statistical Analysis was used to analyze the data. Underweight (<5th percentile), healthy weight (5th BMI to <85th percentile), overweight (85th BMI <95th percentile), and obese ( $\geq$ 95th percentile) BMI calculated using the CDC US 2000 BMI chart Children and adolescents between the ages of 2 and 20<sup>18</sup>. For the present prevalence of body-weight status, a frequency distribution analysis was performed. To compare the prevalence of body-weight status (dependent variable) with demographic parameters such as gender, residence, and religion (independent variables) using the chi-square test as the trend test<sup>19</sup>. To measure the relationship between the dependent and independent variables, The Pearson correlation coefficient (*r*) was used to determine the degree of correlation between independent variables with body-weight dependent variable. Linear regression analysis was used to explore the predictive power of, demographic factors as (independent variables) in relation to body-weight (dependent variable). The statistical significance was determined using  $p < 0.05$ .

## RESULTS

Table 1 showed sample sizes and weighted demographic information for all four levels of schools in the research population. primary 195 (9.3%), middle 855 (40.7%), secondary 741 (35.3%), and higher secondary 309 (14.7%). boys 54.4% of the participants, while girls were 65.9%. Students 61.7% of urban areas and 38.3% from rural areas. Muslims were 95.9% of students, while non-Muslims were 4.1%. Students from 78.1% public schools and 21.9% from private schools.

Fig. 1 depicts the current prevalence of body mass index among Pakistani school-aged adolescents. depending on the total number ( $N = 2100$ ): (Underweight 24.0%), (Overweight 4.3%), and (Obesity 6.7%).

According to Table 2 BMI and gender ( $r = 0.118^{**}$ ), school kind ( $r = 0.078^{**}$ ), and school level ( $r = 0.118^{**}$ ) had a significant positive relationship with body-weight. Status.

Table 3 showed that girls were 15.4% O/W and O/B. at the age of 12-17 among urban areas. girls were 12.6% O/W and O/B in rural areas. among the religions specific the girls were more O/W and O/B 14.7% in Muslim students while the non-Muslim boys 13.8% were overweight and obese. Girls were more O/W and O/B 16.1% among public schools and among the private schools boys were more O/W and O/B 18.3%. Girls were more O/W and O/B 5.6% among primary schools and among the middle schools girls

were more O/W and O/B 13.8%. Girls were more O/W and O/B 16.1% among secondary schools and among the higher secondary schools girls were more O/W and O/B 16%.

Table 4 showed that boys were more underweight with 31.6% vs 17.1%. in rural areas 22.0% vs 16.2% where more boys underweight. among the religions specific the Muslim boys were 27.5% vs 16.3% underweight. Among the non-Muslim students' boys were more underweight 32.8% vs 27.6%. among the public schools' boys specific were more underweight 29.9% vs 16%. among the private schools' girls were more underweight 18.8% vs 18.3%. among the primary schools' boys were more underweight 49.6% vs 29.6%, among middle schools' boys were 26.3% vs 17.3%. among secondary schools' boys were 26.8% vs 14.5% and among higher secondary schools' boys were more underweight 17.9% vs 14.4%.

In this study, the demographic factors were used as the predictors and the BMI as the dependent variable for regression analysis. The regression analysis model, the tolerance is greater than 0.2, and the VIF values are all less than 8, so they can be ranked Multicollinearity problems for independent variables in the regression model. The impact of family demographic factors influences on school-aged students body-weight; the  $R^2$  value of 0.033 indicated that the predictors explained 3.3% variance in the outcome variables, with  $F(5, 2094) = 14.500$ ,  $p < 0.001$ . The data showed that gender ( $\beta = 0.114$ ,  $p < 0.001$ ), school kind ( $\beta = 0.070$ ,  $p = 0.002$ ), and school level ( $\beta = 0.114$ ,  $p < 0.001$ ) had a positive significant effect on BMI, hypotheses 2 and 3 were not appear to had a significant association with BMI, according to the data.

Figure 1 Descriptive Statistics analysis for current Prevalence of body mass index among Pakistani school aged adolescents ( $N=2100$ ).

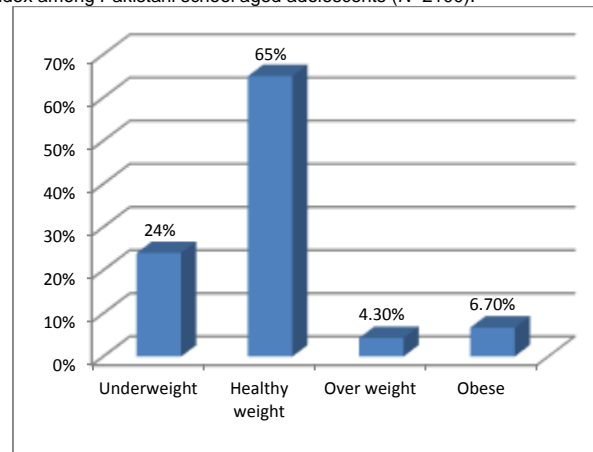


Table 1 Descriptive statistics on demographic characteristics of Pakistani school-aged adolescents aged 12–17 years ( $n$  (%)). ( $N=2100$ )

Variable	Primary School	Middle School	Secondary School	H-Secondary school
Sample size 3551 ( $n$ %)	195 (9.3)	855 (40.7)	741 (35.3)	309 (14.7)
Age (year, mean $\pm$ SD)	12.43 $\pm$ 0.75	13.51 $\pm$ 1.77	15.34 $\pm$ 1.17	16.86 $\pm$ 0.38
<b>Gender</b>				
Boy	141 (10.2)	566 (40.9)	493 (35.6)	184 (13.3)
Girl	54 (7.5)	289 (40.4)	248 (34.6)	125 (17.5)
<b>Religion</b>				
Muslim	181 (9.0)	814 (40.4)	715 (35.5)	303 (15.1)
Non-Muslims	14 (16.1)	41 (47.1)	26 (29.9)	6 (6.9)
<b>Residence</b>				
Urban	157 (12.1)	465 (35.9)	545 (42.1)	128 (9.9)
Rural	38 (4.7)	390 (48.4)	196 (24.3)	181 (22.5)
<b>School kind</b>				
Public	176 (10.7)	666 (40.6)	501 (30.5)	298 (18.2)
Private	19 (4.1)	189 (41.2)	240 (52.3)	11 (2.4)
BMI (kg/m <sup>2</sup> , mean $\pm$ SD)	16.06 $\pm$ 2.48	17.91 $\pm$ 3.24	19.37 $\pm$ 3.87	20.30 $\pm$ 3.39

Table 2: The correlation between Body mass index and demographic factors in Pakistani school-aged adolescents was studied using the Pearson correlation coefficient (r).

	Mean	SD	1	2	3	4	5	6
BMI (category)	1.94	0.73	1					
Gender	1.34	0.47	.128**	1				
Religion	1.04	0.19	-.008	-.003	1			
Residence	1.38	0.48	.009	-.057**	.013	1		
School kind	1.22	0.41	.078**	.111**	.052*	.247**	1	
School level	2.55	0.85	.118**	.056*	-.068**	.085**	-.015	1

Note: N=2100; \*p < 0.05, \*\*p < 0.01

Table 3 Chi-square test to compare the prevalence body mass index by gender with demographic variables, residence, religion, school kind, and school level (independent variable) (N = 2100).

Characteristics	Gender	Body Mass Index			χ <sup>2</sup>	P-value
		Under weight n (%)	Healthy weight n (%)	Overweight+obese n (%)		
<b>Residence</b>						
Urban	Boys	261 (31.6)	486 (58.8)	79 (9.6)	36.30 <sup>b</sup>	0.000***
	Girls	80 (17.1)	317 (67.6)	72 (15.4)		
Rural	Boys	123 (22.0)	386 (69.2)	49 (8.8)	5.44 <sup>c</sup>	0.066
	Girls	40 (16.2)	176 (71.3)	31 (12.6)		
<b>Religion</b>						
Muslim	Boys	365 (27.5)	841 (63.4)	120 (9.0)	39.37 <sup>b</sup>	0.000***
	Girls	112 (16.3)	474 (69.0)	101 (14.7)		
Non-Muslim	Boys	19 (32.8)	31 (53.4)	8 (13.8)	1.45 <sup>c</sup>	0.483
	Girls	8 (27.6)	19 (65.5)	2 (6.9)		
<b>School-kind</b>						
Public	Boys	337 (29.9)	709 (62.9)	81 (7.2)	56.62 <sup>b</sup>	0.000***
	Girls	82 (16.0)	349 (67.9)	83 (16.1)		
Private	Boys	47 (18.3)	163 (63.4)	47 (18.3)	6.51 <sup>c</sup>	0.039*
	Girls	38 (18.8)	144 (71.3)	20 (9.9)		
<b>School-level</b>						
Primary	Boys	70 (49.6)	65 (46.1)	6 (4.3)	6.37 <sup>b</sup>	0.042*
	Girls	16 (29.6)	35 (64.8)	3 (5.6)		
Middle	Boys	149 (26.3)	377 (66.6)	40 (7.1)	16.21 <sup>c</sup>	0.000***
	Girls	50 (17.3)	199 (68.9)	40 (13.8)		
Secondary	Boys	132 (26.8)	294 (59.6)	67 (13.6)	14.15 <sup>d</sup>	0.001**
	Girls	36 (14.5)	172 (69.4)	40 (16.1)		
H-Secondary	Boys	33 (17.9)	136 (73.9)	15 (8.2)	4.80 <sup>e</sup>	0.091
	Girls	18 (14.4)	87 (69.6)	20 (16.0)		
<b>Total</b>		504 (24.0)	1365 (65.0)	231 (11.0)		

Note, p < 0.05\* p < 0.01\*\* p < 0.001\*\*\* 2-tailed

Table 4 linear regression analysis of demographic factors (independent variables) and body mass index (dependent variable) was conducted.

Variables	Unstandardized Coefficients		Standardized Coefficients				Collinearity Statistics			
	B	SE	β	t	Sig.	R <sup>2</sup>	Radj <sup>2</sup>	F	Tolerance	VIF
Constant	1.331	.120		11.097	0.000***					
Gender	.177	.034	.114	5.220	0.000***				.976	1.025
Religion	-.013	.080	-.003	-.160	0.873				.993	1.007
Residence	-.017	.034	-.011	-.502	0.615	0.033	0.031	14.500	.923	1.083
School kind	.126	.040	.070	3.135	0.002**				.920	1.087
School level	.099	.019	.114	5.258	0.000***				.983	1.018

Note, p < 0.05\* p < 0.01\*\* p < 0.001\*\*\*

## DISCUSSION

According to current estimates, 24% among Pakistani school-aged adolescents were underweight, normal weight 65%, overweight 4.3%, and 6.7% were obese. Another study conducted was in Another study from the Hyderabad urban region in 2013 found that 12% of students in grades 6 to 10 were obese, and 8% were overweight<sup>20</sup>. An additional study conducted in Karachi among school children aged 11 to 15 years old found that 19.1% of the children were overweight and 10.8% were obese<sup>14</sup>. A local survey conducted in Lahore founded that 11.9% of students in private schools in grades 6 and 7 were obese, while 21.8% were overweight<sup>21</sup>. In 2018, another local study was conducted on children aged 3 to 18 years in Multan, with the results showed that 10% of the students were overweight and 5% were obese<sup>22</sup>. According to the World Obesity Federation estimated in 2018, that 6.6% of Pakistani children were obese, and 10.7% were overweight<sup>23</sup>.

The current study is a comprehensive examination of all demographic factors, try to include minorities, urban and rural areas, age, public and private schools, and the four levels of education. Based on this foundation, BMI correlates of demographic characteristics in Pakistani school adolescents can be used to develop intervention programs for afflicted children and to inform the development of official guidelines for the treatment and prevention of BMI difficulties in Pakistani school adolescents using empirical data.

First, it is impossible to draw any causal conclusions about the structural associations that have been discovered due to the cross-sectional data. The second issue is that children were not patriated in this study. Therefore, particular socio-demographic influences of school- or community-related factors among Pakistani school-aged adolescents are yet unknown, necessitating further research.

## CONCLUSIONS

The data revealed that Pakistani school-aged adolescents were underweight, overweight, and obese, which is a severe concern. According to the study, body mass index had a significant relationship with gender, school kind, and school level. Boys were more likely to be underweight, whereas girls were more likely to be overweight and obese.

Encouragement of physical activity among Pakistani adolescents, according to our findings, is crucial since it may improve their long-term health outcomes. To increase individual and community health by providing a safe and supportive environment for all students, as well as a variety of opportunities for physical activity in their daily life. Once a year, all schools should be required to do anthropometric surveys. future research should use longitudinal or interventional approaches.

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**Data Availability Statement:** The corresponding author can provide the data used in this work upon request.

**Competing interests:** The authors have declared they have no competing interests.

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