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Original Article

School-Based Study to Assess the Nutritional Status (BMI based) of Adolescents of Gojra City of District Toba Tek Singh, Punjab, Pakistan

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ABSTRACT

Adolescence is the make-or-break stage of life. Major physical, mental, and psychological growth takes place at this age. Adequate and balanced nutrition is a vital requirement to support this phase. Adolescents living in developing and low-income countries are more likely to face nutritional challenges. Poor nutritional status during adolescence is an important determinant of health outcomes. **Objective:** To analyze the nutritional status (BMI based) of school-going adolescents in Gojra city, Punjab, Pakistan. **Methods:** A school-based cross-sectional survey was carried out covering 635 (6-8 grade) school-going adolescents (boys and girls) from public schools in Gojra city. Data were collected through anthropometric measures taken. Symptoms of malnutrition were also assessed. *Mean and frequencies were reported for demographic variables and symptoms of malnutrition while two sample Independent T-test was used to compare the means of groups under study using SPSS version-23.* **Results:** The overall prevalence of underweight in boys was found (33.9%) as compared to adolescent girls (32.3%). It was also found that malnutrition and related health complications were higher in adolescents with lower BMI values. **Conclusions:** Adolescent boys and girls were found with a high prevalence of malnutrition along with other symptoms.

INTRODUCTION

Healthy Nutrition results in better growth and development during infancy and adolescence. However, nutritional requirements keep changing through the period of adolescence [1]. In Pakistan, the nutritional status of early adolescents is extremely poor [2]. The adolescence period is one of the crucial periods in human life that greatly impact individuals' health and well-being in the later phases of their lives. According to World Health Organization (WHO), adolescents can be defined as individuals aged 10 to 19 years [3]. The years of adolescence period are generally divided mainly into three stages that are early adolescence (9-14 years), middle adolescence (15-17 years), and late adolescence (18-21 years) [4]. The phase of adolescence constitutes the development of human beings from the

phase of childhood to adulthood which leads to several physical changes along with hormonal, emotional, and cognitive development. This phase increases the human body's nutritional requirements for proper growth and development [5]. There may be several factors that increase the risk of poor nutritional status in adolescents such as poor diet, unavailability of food, non-access to quality food, poor hygiene and sanitation conditions, and several disease and illness. Studies reveal that the low socioeconomic and educational status of parents and poor environmental conditions also cause poor nutritional status in individuals [4, 6, 7]. Poor nutritional status may also be caused by the intake of high-calorie foods, including fast food items, and consuming foods but not

getting an adequate amount of required nutrition [8]. Adolescents having proper dietary intake and better nutritional status are likely to show good performance in schools, have better physical performance, and overall good health status. Poor nutritional status in the adolescent phase can cause retarded physical, hormonal, cognitive, and sexual development among individuals. As found by Arage *et al.*, poor nutritional status among adolescent girls can lead to a cycle of low nutritional status in their coming generations leading to low birth weight of infants and higher child mortality rates [7]. It is also found that adolescent facing nutritional challenges have poor sexual development and reproductive cycle maturation [9]. Over-nutrition and under-nutrition contribute to the increase in the burden of global health challenges for low and middle-income countries like Pakistan. Greater intake of processed foods, high-calorie foods, and drinks causes greater BMI in children, weak bones and teeth, and increased risk of type 2 diabetes and iron deficiency among young children and adolescents [10, 11]. According to two out of three death globally are caused by non-communicable results that are mainly the consequences of poor nutritional status in individuals. High prevalence of vitamin A and B deficiency, anemia, dental caries, and stomatitis were also found in adolescent girls in a school-based study in India [12, 13]. found that bad eating habits in early and middle adolescence lead to obesity and depression issues in later phases of life. The assessment of the nutritional status of adolescents in developing and low-income countries is frequently neglected in clinical programs and research. It causes a problem in analyzing the nutritional status of adolescents. Recent studies also suggest severe consequences of poor nutritional status on the development and growth of adolescents, mainly in developing countries [14]. Most recent health intervention programs also focused on improving health and nutrition for children below the age of 5 years, and less focus is given to adolescents' nutritional status and health consequences in developing countries [15]. According to Baye *et al.*, improving nutrition status is the second in Sustainable Development Goals. However, using different policies and strategies, less priority is given to elevating adolescents' nutritional status in developing countries [13]. Due to the gap in research on this subject, it is important to assess the nutritional deficiencies and over-nutrition status in adolescents between the ages of 10 to 19 years and to provide valuable findings that offer the nutrition status of these individuals and the factors that affect the nutrition status of these individuals. This study aims to assess and analyze the nutritional status of adolescents in Gojra city in the province of Punjab, Pakistan.

METHODS

A quantitative cross-sectional research design was adopted to analyze the nutritional status of adolescents. A pre-tested survey questionnaire was used for data collection. The study was conducted in four (two boys and two girls) different public schools in Gojra city from August 2021 to December 2021. A stratified random sample of size of n=635 school-going adolescent boys and girls from schools in Gojra city, Punjab, Pakistan.

Table 1: Sample Size for Frequency in a Population

Population size (for finite population correction factor or fpc) (N): 1630	
Hypothesized % frequency of outcome factor in the population (p):	42%+/-3
Confidence limits as % of 100(absolute +/- %)(d):	3%
Design effect (for cluster surveys-DEFF):	1
Sample Size(n) for Various Confidence Levels	
Confidence Level (%)	Sample Size
95%	635
80%	350
90%	506
97%	716
99%	855
99.9%	1048
99.99%	1167
Equation	
Sample size $n = [DEFF * Np(1-p)] / [(d^2 / Z^2(1-\alpha/2)^2 * (N-1) + p*(1-p)]$	

The sample size was calculated on the basis of a 42 % prevalence of undernutrition among adolescents. with a 95% confidence level by using the open-epi formula. The required sample was 636 adolescents. The school-going adolescents of both genders studying in 6,7 and 8 grades in the age group of 10-18 years and willing to participate in the study were included. Exclude those students who were below 10 years of age and above 19 years of age group and Students who were on leave, or at home due to any sickness. All elementary boys' and girls' public schools in the city were invited for the study. There were 7 boys and 6 girls' public elementary schools. Out of these Willing schools, two boys (260 boys) and two girls (375) schools were randomly selected to reach calculated sample size. All participants enrolled in the study were from 6-8 grade and who themselves and whose parents gave consent. The participants were briefed about the nature of the study and expected outcomes. The pre-tested questionnaire was used for interview and adolescents were clinically examined for anthropometric measurement by the researcher. Age was estimated by asking for date of birth, and verified with school admission record. For sociodemographic information, a structured questionnaire was used. The BMI of each participant was calculated using age, height, weight, and age. Weight was

measured in kilograms, and the participant stood at the center of the scale, not holding anything, adjusting the scale to zero with minimum clothing and no footwear. Participants' height was measured by standing straight without shoes, and heels together, and looking straight ahead with non-stretchable measuring tape adjusted with the wall. BMI was calculated by using the formula weight (kg)/height (m²) and categorized into different grades of nutritional status according to CDC guidelines. Other malnutrition symptoms like hair fall, dryness of skin and hair, frequent diarrhea, eyes, and nails were also assessed through clinical assessment along with disease reported in the last two weeks at the time of data collection. Descriptive statistics were used to analyze the malnutrition status of the adolescents using Statistical Package for the Social Sciences (SPSS), version-23.0. Comparisons were made between the observed mean scores of the two groups (boys and girls) using two-sample independent t-test. For this study Ethical approval was obtained from Aga Khan University Ethical Review Committee. Permission was also taken from the school authorities.

RESULTS

The data were collected from 635 (boys and girls) adolescents from public schools. Among them, 375 were adolescent girls, and 260 were adolescent boys. About 81.3 % of adolescents were between the age of 10-14 years. The mean age of girls was 12.77 ± 1.52, and 12.64 ± 1.53 of boys, which showed that there was no such variation in the age-gender distribution. The age data were also grouped into three such as early adolescents, mid and late adolescents (Table 2).

Table 2: Distribution of adolescents, boys, and girls according to age group

Parameter	Boys f (%)	Girls f (%)	Total %
Early (10-14 years)	209 (32.9%)	307 (48.3%)	516 (81.3%)
Mid (15-17)	50 (7.9%)	67 (10.6%)	117 (18.4%)
Late (18-19)	1 (0.2%)	1 (0.2%)	2 (0.3%)
Total	260	375	635

By birth category, most of them are ≤ 2 and by the sibling of adolescents, it was found > 5. By category of father occupation, most of them were daily laborers (Table 3).

Table 3: Socio-demographic characteristics of participants

Variables	f (%)	
Total family members of respondents	Three and less	6 (0.9)
	4-5 members	87 (13.7)
	> 6 members	542 (85.4)
Order of respondent	< 2 number	311 (49)
	3-5 number	276 (43.5)
	>6 number	48 (7.5)
	<2	51 (0.80)

Sibling of respondents	3-4	251 (39.5)
	>5	333 (52.5)
Father occupation	Civil servant	50 (7.9)
	Daily laborer	305 (48)
	He does not work	25 (3.9)
	He is not alive	34 (5.4)
	Private employee	96 (15.1)
	I don't know	125 (19.1)
Mother Occupation	Civil servant	9 (1.4)
	Daily laborer	49 (7.7)
	She doesn't work (Housewife)	293 (46.1)
	She is not alive	11 (1.7)
	Private employee	8 (1.3)
	I don't know	265 (41.7)
Father education	Above 12th grade	66 (10.4)
	10th grade	177 (27.9)
	8th Grade	92 (14.5)
	5th Grade	184 (28.9)
	Illiterate	116 (18.3)
Mother education	Above 12th grade	54 (8.5)
	10th grade	122 (19.2)
	8th Grade	92 (14.5)
	5th Grade	204 (32.2)
	Illiterate	163 (25.7)

Participants' mean weight, showed that the boys were more underweight than the girls. The mean height of the respondents was also calculated in which the boys were found with a greater height than girls. The mean BMI of the girls (18.50 ± 3.63) and boys (16.51 ± 2.74) showed that girls possess a normal BMI, but the boys had slightly lower BMI than the normal range (Table 4).

Table 4: Mean of Age, Weight, Height and BMI

Parameter	Girls	Boys
Mean Age	12.77 ± 1.52	12.64 ± 1.53
Mean Weight	41.14 ± 9.54	38.38 ± 8.70
Mean Height	147.85 ± 7.58	150.70 ± 10.13
Mean BMI	18.50 ± 3.63	16.51 ± 2.74

Malnutrition according to the BMI category found that 33.9 % of adolescent boys and 32.3 % of girls were underweight. Only 3.3 % of girls were overweight and 0.6 % were obese. The prevalence of being underweight was found very much similar in both genders. According to the age group, most of the underweight adolescents were found between 10-14 years of age (Table 5).

Table 5: Nutritional status of adolescents (BMI Percentile)

Sex	Underweight (<5 th percentile)	Normal (5 th to 84 th percentile)	Overweight (85 th to 94 th percentile)	Obesity (> 95 th percentile)
Male	215 (33.9%)	39 (6.1%)	5 (0.8%)	1 (0.2%)
Female	205 (32.3%)	145 (22.8%)	21 (3.3%)	4 (0.6%)
Period of adolescents				
Early (10-14 years)	359 (56.5%)	131 (20.6%)	21 (3.3%)	5 (0.8%)
Mid (15-17 years)	60 (9.4%)	52 (8.2%)	5 (0.8%)	0 (0%)
Late (18-19 years)	1 (0.2%)	1 (0.2%)	0 (0%)	0 (0%)
Total	420	184	26	5

As per the data collected and calculated from the symptoms of malnutrition in the underweight and healthy adolescents, it was observed that in the last two weeks at the time of data collection diseases like diarrhea, fever, body aches common cold, etc., were reported in which the ratio of underweight adolescents, was higher as compared to the healthy adolescents. In addition, the percentage of having diseases was almost equal in the ratio of boys and girls (Table 6).

Table 6: Diseases reported in the last two weeks by under-weight and healthy-weight adolescents

Diseases reported in the last two weeks				
Diseases	Underweight		Healthy weight	
	Boys f (%)	Girls f (%)	Boys f (%)	Girls f (%)
Fever	48 (7.6%)	22 (5.8%)	9 (1.4%)	32 (5.0%)
Body ache	56 (8.8%)	26 (7.2%)	10 (1.6%)	36 (5.7%)
Common cold	52 (8.2%)	24 (14.2%)	7 (1.1%)	68 (10.7%)
Jaundice	0 (0.0%)	1 (0.2%)	0 (0.0%)	0 (0.0%)
Itching	40 (6.3%)	19 (4.3%)	7 (1.1%)	20 (3.1%)
Diarrhea	1 (0.2%)	3 (0.5%)	0 (0.0%)	3 (0.5%)

Malnutrition symptoms were also found higher in underweight adolescents as compared to healthy adolescents such as dry hair and skin, eyes, nails, cavities in teeth, plaque on teeth, etc. (Table 7).

Table 7: Symptoms of Malnutrition in Underweight and Healthy Weight Respondents

Clinical Assessment	Underweight		Health	
	Boys f (%)	Girls f (%)	Boys f (%)	Girls f (%)
Frequent diarrhea	13 (2.0%)	22 (3.5%)	3 (0.5%)	22 (3.5%)
Hair fall in a large amount	8 (1.3%)	62 (9.8%)	1 (0.2%)	62 (9.8%)
Skin and hair appear dry	69 (10.9%)	61 (9.6%)	13 (2.0%)	59 (9.3%)
Nails appear brittle and break	48 (7.6%)	7 (1.1%)	8 (1.3%)	3 (0.5%)
Bitot's spot in the eyes	1 (0.2%)	1 (0.2%)	0 (0.0%)	0 (0.0%)
Conjunctiva paler	139 (21.9%)	96 (15.1%)	21 (3.3%)	59 (9.3%)
Ulcer on the tongue and corner of the mouth	1 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cavities in teeth	50 (7.9%)	39 (6.1%)	8 (1.3%)	33 (5.2%)
Plaque on teeth	154 (24.3%)	156 (24.6%)	26 (4.1%)	124 (19.5%)
Goiter	0 (0.0%)	3 (0.5%)	1 (0.2%)	2 (0.3%)

DISCUSSION

In the current study, the data were collected from 635 (boys and girls) adolescents from public schools in the present study. Among them, 375 were adolescent girls, and 260 were adolescent boys. About 81.3 % of adolescents were between the ages of 10–14 years. The mean age of girls was 12.77 ± 1.52 , and 12.64 ± 1.53 of boys, which showed that there was no such variation in the age-gender distribution. By birth category, most of them are ≤ 2 and by the sibling of adolescents, it was found > 5 . By category of father occupation, most of them were daily laborers. A previous study yielded comparable results, revealing that 50.3% of

the participants were male, 61.9% were between the ages of 13 and 15, and 87.1% attended public schools [16, 17]. In another previous study, a comparable total of 655 adolescents attending school took part, with males outnumbering females at 340 (51.9%). In terms of respondents' age, conflicting findings emerged, with the majority (532 (81.2%)) falling within the 15–19-year-old range. The median age of the respondents was 17 years, with an interquartile range (IQR) of 3 years. Additionally, in contrast, approximately half (333 (50.8%)) of the respondents had fathers employed in the government sector [18]. In this current study, about 33.9 % of adolescent boys and 32.3% girls were found underweight. Only 3.3 % of girls were overweight and 0.6 % girls were obese. The prevalence of being underweight was found very much similar in both genders. According to the age group, most of the underweight adolescents were found between 10–14 years of age. A previous study by Nithya and Bhavani discovered consistent findings, revealing that the average BMI Z-scores of teenage boys were lower than the designated threshold ($< -2SD$), indicating that a majority (51%) of them were experiencing under-nutrition in both locations. The BMI Z-scores of teenage girls were also at the edge of the designated limits, suggesting a heightened risk of under-nutrition, with 27% of girls being affected. Contrasting results were observed in terms of age and gender, as the average height-for-age Z-scores fell within the specified limits for both boys and girls. Additionally, it was noted that a higher percentage of adolescent boys (50.7%) experienced stunting compared to girls (27.3%) [19]. The study has significantly helped determine malnutrition symptoms among both genders, including male and female students. The study included body mass index and socio-demographic characteristics of students between 10 to 19 years of age. The results interpretation indicates the underweight and overweight characteristics among different age groups. The results indicated within the study showed a high prevalence of illness among underweight girls and boys as compared to healthy ones. Similarly, the study results also indicated low BMI issues among boys as compared to girls. Moreover, the challenges of malnutrition were found to be more dominating among underweight adolescents as compared to healthy ones. The risk of increased malnutrition among underweight adolescent students was greater, indicating poor diet quality and socioeconomic factors influence their growth and development [20]. Moreover, the increase in malnutrition symptoms among adolescents increases healthcare costs and adversely impacts their cognitive potential. The aim of the study has been significantly achieved by analysing biodata, nutritional status, and clinical assessment of adolescents among 635 sample sizes of the targeted

population. The distribution of students among girls and boys about their mean age helped determine the nutritional needs of adolescents. Moreover, it is reported that adolescents usually have a higher basal metabolic rate compared to old people, indicating more nutrient intake needs. Furthermore, based on the metabolism, the assimilation of power varies from person to person. The significance of using body mass index supported in determining the degree of under-nutrition and over-nutrition values among adolescents, including both male and female gender. Also, it increased the monitoring aspects value of nutrition trends among school-based adolescents. Overweight adolescents showed the prevalence of unhealthy lifestyles or poor diets, having increased levels of fat and sugar adolescents [20]. Similarly, the study by Ahmad *et al.*, indicated an 11.1% prevalence of underweight school-going children and 11.5% of stunted students [21]. The factor of stunting among adolescents causes severe cognitive challenges along with motor and social-emotional development problems. The BMI assessment among school-based adolescents thus promotes identifying the risk of underweight and overweight issues, which adversely impacts the cognitive learning process.

CONCLUSIONS

This study finding revealed that the ratio of under-nutrition among adolescents living in the Gojra was relatively high. As per the findings of the study, mostly boys were more prone to be underweight as compared to girls.

Authors Contribution

Conceptualization: SP, RM

Methodology: RK, RB

Formal analysis: RK, RB

Writing-review and editing: SP, RK, RB, RM

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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