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# Nutritional Status, Dietary Practices and Physical Activities of Adolescents in Public and Private Schools of Karachi, Pakistan

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## ABSTRACT

A comparative study was undertaken to assess the nutritional status, dietary practices and physical activities of school going adolescents in public and private schools (PPSs) of Karachi, Pakistan. A sample of 101 boys and 100 girls from PPSs was randomly selected for their weight, height, waist and hip circumferences, percent body fat and lean body mass measurements. Adolescent boys and girls were interviewed for their dietary practices, socio-economic status, frequency and type of physical activities and their responses were recorded. Results by gender and school type revealed that both the boys and girls of private schools had a significantly lower mean age but significantly higher mean height-for-age *Z*-score, waist and hip circumferences than the public school adolescents. Food frequency results revealed that the frequency and patterns of breakfast, break-time snack, lunch and dinner of private school going adolescents were more diverse and nutritiously rich. Skipping breakfast was more common among adolescents being higher in girls than boys. Parents of adolescents belonging to private schools had a higher education and socio-economic status. Private school adolescents were physically more active ($p<0.05$) in terms of frequency and type of physical activities. The study concludes that the adolescents of private schools had a better nutritional status, consumed food and beverages of better quality and were physically more active. However, boys and girls of both the public and private schools failed to meet the national and international dietary guidelines of recommended food servings.

**KEYWORDS:** Adolescents; Nutritional Status; Dietary Practices; Physical Activity; Socio-economic Status; Pakistan.

**ABBREVIATIONS:** PPSs: Public and Private Schools; NCHS: National Center for Health Statistics; WHO: World Health Organization; BMI: Body Mass Index; QoL: Quality of Life.

## INTRODUCTION

Adolescence marks a period of transition from childhood to adulthood characterized by rapid physical growth and development, behavioral, emotional and socio-psychological changes.[1] Adolescents are more prone to unhealthy behaviors, poor dietary practices and nutritional compromises, physical inactivity and psychosocial stresses that shape their personalities and lifestyle patterns. Rapid physiological changes affect their body's nutritional demands while lifestyles, beliefs and perceptions about body size and shape influence their dietary choices and practices. The nutrient requirements during adolescence are increased due to accelerated growth and development, hormonal, physical and behavioral changes and are often not met due to inappropriate food choices, peer pressure, unhealthy attitudes and lifestyle practices that

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make adolescents more susceptible to nutritional deficiencies.[2]

Good nutrition is essential for preventing nutritional disorders and averting subsequent incidence of acute and chronic diseases in later life.[3-5] Failure to consume a nutritionally balanced diet at this decisive point in life not only arrests linear growth but also influences the psychomotor functioning of adolescents.[6] Numerous studies and reports[7-11] revealed that adolescents are at a greater risk of nutritional deficiencies and disorders due to their rapid body growth, unhealthy eating habits, psychological, mental and emotional pressures associated with body dissatisfaction and temptations to have a slimmer body. Adolescents also tend to suffer from a variety of eating disorders i.e., anorexia nervosa, bulimia nervosa as well as depression, anxiety and psychological stress.[12]

In developing countries including Pakistan, adolescents' health and nutrition is largely under-researched and has been ignored due to the silent nature of nutritional problems, undocumented evidence of life threatening epidemics, less assertive attitude of adolescents, muted political interest and financial constraints. Lack of data on adolescents' nutritional status, dietary practices and physical activities also make it difficult to draw the attention of Government officials, program managers and policy makers to formulate and develop appropriate adolescent specific strategies for addressing their nutritional and socio-psychological needs. The association between age-specific nutrition and long term health effects has always been of interest, the current study was designed to compare the nutritional status, dietary practices and physical activities of school going adolescent boys and girls of public and private schools (PPSs) of Karachi, Pakistan to generate data which could be useful for program managers and policy makers for developing adolescent specific nutrition strategies to combat malnutrition among this vulnerable group of population.

## METHODS

A comparative study to assess the nutritional status, dietary practices and physical activities of school going adolescents (boys and girls) was carried out in the public and private schools of Karachi. After permission from the school's administration, adolescents aged 10 years and above were identified from the school's admission record and written consent from the enrolled adolescents was obtained. A sample of 201 adolescents, 101 boys (48 from a public and 53 from a private school) and 100 girls (46 and 54 from a public and a private school, respectively) was selected by following a systematic sampling technique.[13]

Weight, height, waist and hip circumference of adolescent boys and girls were taken by following the recommended procedures.[14] The Body impedance analyser, (MD 1500, Body stat Ltd, Douglas, Isle of Man) was used for assessing the body composition of adolescents. A food frequency questionnaire was used to assess the dietary practices of adolescents. Data regarding anthropometry, dietary, body composition, demographic and socio-economic characteristics and physical activities were entered into the computer for statistical analysis using EPI-INFO software.[15] Anthropometric data were compared with the corresponding age reference population i.e., National Center for Health Statistics (NCHS) data to generate *Z*-scores (weight-for-age (WAZ), weight-for-height (WHZ) and height-for-age (HAZ).[16] Adolescents were classified as underweight, normal, over weight and obese by applying the World Health Organization (WHO) body mass index cut-off values and prevalence of malnutrition was computed.[17]

Anthropometric, dietary, socioeconomic and physical activity data were analyzed using SAS version 9.2 (The SAS Institute, Inc., Cary, NC, USA). Simple statistics and bi-variate analysis were carried out on the continuous and ordinal data to examine the mean differences in anthropometric measurements, body composition and dietary data at 5% level of significance between the public and private schools. Pearson product-moment correlation coefficients were determined to examine the relationship between different variables.

## RESULTS

The anthropometric measurements and body composition of school going adolescents by gender and school are shown in Table 1. The mean age of boys of the public school was significantly ($p<0.05$) higher than boys of the private school but there was no significant difference ($p>0.05$) in the mean weight, height, weight-for-height *Z*-score, percent lean body mass, percent body fat, body mass index and body mass index *Z*-score between the boys of public and private schools. However, boys of the private school had significantly higher mean weight-for-age and height-for-age *Z*-scores than boys of the public school ($p<0.05$). The mean waist and hip circumferences and waist-to-hip ratio of boys of the private school were also significantly ($p<0.05$) higher than boys of the public school.

The results of adolescent girls shown in Table 1 revealed that the mean age of girls of the public school was also significantly higher ($p<0.05$) than the girls of the private school but there were no significant differences ($p>0.05$) in the mean weight, height, weight-for-age and weight-for-height *Z*-scores, waist-to-hip ratio, percent lean body mass and percent body fat. However, girls of the private school had significantly ($p<0.05$) higher mean height-for-age *Z*-score, waist and hip circumferences, body mass index and body mass index *Z*-score than girls of the public school. These results reveal that adolescent boys and girls of the private schools of Karachi had better anthropometric and body composition characteristics than those of the public schools.

Table 2 shows the prevalence of malnutrition based on categorization of body mass index (BMI) *Z*-score and school type (public *versus* private). The results revealed that there was no significant association ($p>0.05$) between nutritional status (BMI-Z categorization) and school type. However, under-nutrition prevalence trends were generally higher among adolescents of public schools whereas, the prevalence of overweight

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| Variable | Boys | | p value | Girls | | p value |
|---|---|---|---|---|---|---|
| | Public School (n=48) Mean±SD | Private School (n=53) Mean±SD | | Public School (n=46) Mean±SD | Private School (n=54) Mean±SD | |
| Age (yrs) | 14.50±1.59 | 13.45±1.69 | 0.0021 | 14.04±1.63 | 13.11±1.50 | 0.0064 |
| Weight (kg) | 39.58±8.15 | 42.72±15.18 | 0.1718 | 40.52±10.29 | 43.94±12.44 | 0.1392 |
| Height (cm) | 150.41±16.95 | 152.83±11.84 | 0.2435 | 148.70±8.79 | 150.08±8.25 | 0.5077 |
| Weight-for-age *Z*-score | -1.90±0.79 | -0.83±1.83 | 0.0002 | -0.68±1.72 | -0.51±1.40 | 0.5519 |
| Height-for-age *Z*-score | -2.08±1.83 | -1.04±1.20 | 0.0001 | -1.61±1.44 | -1.11±0.91 | 0.0460 |
| Weight-for-height *Z*-score | -0.92±1.26 | -0.32±2.32 | 0.0754 | -0.37±1.54 | 0.17±1.72 | 0.1055 |
| Waist circumference (cm) | 59.21±5.33 | 64.36±12.01 | 0.0027 | 61.72±8.81 | 65.92±9.77 | 0.0152 |
| Hip circumference (cm) | 67.35±6.66 | 71.47±11.99 | 0.0246 | 72.14±8.38 | 75.92±10.76 | 0.0405 |
| Waist to hip ratio | 0.87±0.04 | 0.89±0.04 | 0.0345 | 0.85±0.03 | 0.86±0.03 | 0.1213 |
| Lean body mass (%) | 34.51±11.11 | 34.75±9.872 | 0.8889 | 31.21±6.30 | 33.88±10.36 | 0.1329 |
| Body fat (%) | 18.33±10.47 | 18.52±9.16 | 0.9113 | 21.78±9.45 | 24.60±8.34 | 0.0981 |
| Body mass index | 17.22±3.21 | 17.91±4.76 | 0.3667 | 17.88±4.10 | 19.64±4.47 | 0.0235 |
| Body mass index *Z*-score | -1.07±2.17 | -0.62±2.58 | 0.2268 | -0.93±1.72 | 0.17±1.81 | 0.0032 |

**Table 1:** Anthropometric measurements and body composition of adolescents by gender and school.

| | | Nutritional Status | | | |
|---|---|---|---|---|---|
| | | Normal | Underweight | Overweight and obese | |
| Gender | School | (-2≤BMIZ<2) N (%) | (BMIZ<-2) N (%) | (BMIZ≥2) N (%) | *p* value |
| Boys | Public School (n=48) | 29 (61) | 16 (33) | 3 (6) | 0.211 |
| | Private School (n=53) | 37 (70) | 10 (19) | 6 (11) | |
| Girls | Public School (n=46) | 30 (65) | 11 (25) | 5 (10) | 0.147 |
| | Private School (n=54) | 37 (69) | 6 (11) | 11 (20) | |

**Table 2:** Prevalence of malnutrition based on BMI *Z*-score and school in boys and girls.

and obesity was almost twofold higher amongst the adolescents of private schools. A similar trend of under and over-nutrition was observed among adolescent girls of the public and private schools (Table 2).

No significant association between the frequency of breakfast consumption and school type among adolescent boys was revealed by the results (Table 3). However, a significant ($p<0.05$) association in the frequency of breakfast consumption among adolescent girls of public and private schools was observed. Skipping breakfast was more prevalent amongst girls than boys i.e., about 50% of the adolescent girls of both public and private schools were skipping breakfast which was 4-5 times higher than the boys belonging to both types of schools.

A significant ($p<0.05$) association in the frequency of breakfast pattern consumed by the adolescents of public and private schools was seen (Table 3). Tea with bread, tea with bread and curry (34% and 36%, respectively) were the most common breakfast items taken by adolescent boys of the public school. Only 4% of the boys belonging to the public school had milk, juice, fruits and cereals for their breakfasts. Tea with paratha (wheat dough baked with fat or vegetable oil) and fried egg remained the most popular choice of boys (23%) of the private school followed by milk, juice, fruits and cereals (22%) for breakfast (Table 3). Like their male school fellows, a greater percentage of girls belonging to the public school had tea with bread (43%) and tea with bread and curry (43%) and a lesser percentage of girls (5%) had milk, juice, fruits and cereals. Conversely, most of the girls of the private school had milk, juice, fruits and cereals (42%) followed by consuming tea with paratha and egg (33%).

The results on frequency of break-time snack consumption by the adolescents presented in Table 3 indicate a significant association ($p<0.05$) in the frequency of snack consumption amongst the boys of public and private schools. A higher percentage (94%) of boys of the private school was taking snacks as compared to boys (72%) of the public school. Conversely, no significant association ($p>0.05$) in the frequency of snack consumption amongst the girls of the public and private schools was noted (Table 3). The pattern of snack consumption by adolescents of public and private schools during the school breaktime was significantly different (Table 3), a higher percentage of

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| Food | Frequency of food consumption | Boys | | Girls | |
|---|---|---|---|---|---|
| | | Public School (n=48) N (%) | Private School (n=53) N (%) | Public School (n=46) N (%) | Private School (n=54) N (%) |
| Breakfast | Daily | 44 (91) | 46 (86) | 25 (54) | 28 (51) |
| | 5-6 Days | 0 (0) | 2 (4) | 6 (13) | 1 (2) |
| | 3-4 Days | 3 (7) | 2 (4) | 2 (5) | 9 (16) |
| | 1-2 Days | 0 (0) | 1 (2) | 4 (9) | 7 (14) |
| | No | 1 (2) | 2 (4) | 9 (19) | 9 (16) |
| | | *p* value=0.053 | | *p* value=0.007 | |
| Pattern of Breakfast consumption | Tea with bread | 16 (34) | 12 (23) | 16 (43) | 2 (5) |
| | Tea with bread and curry | 17 (36) | 8 (16) | 16 (43) | 5 (11) |
| | Tea with bread and egg | 5 (11) | 8 (16) | 1 (4) | 4 (9) |
| | Tea with paratha and egg | 7 (15) | 12 (23) | 2 (5) | 15 (33) |
| | Milk, juice, fruits, cereals | 2 (4) | 11 (22) | 2 (5) | 19 (42) |
| | | *p* value=0.001 | | *p* value=0.001 | |
| Snack Consumption | Yes | 34 (72) | 50 (94) | 42 (91) | 53 (98) |
| | No | 14 (28) | 3 (6) | 4 (9) | 1 (2) |
| | | *p* value=0.002 | | *p* value=0.109 | |
| Snack pattern | Roll, Pakora, Samosa, Papper, Toffees | 4 (12) | 17 (34) | 9 (21) | 19 (36) |
| | Home made paratha, bread | 18 (53) | 12 (24) | 20 (48) | 11 (21) |
| | Soft drinks, ice cream, pizza, choclates | 12 (35) | 21 (42) | 13 (31) | 23 (43) |
| | | *p* value=0.001 | | *p* value=0.001 | |
| Milk and Dairy Products consumption | Daily | 15 (31) | 19 (36) | 7 (15) | 22 (41) |
| | 5-6 Days | 0 (0) | 2 (4) | 0 (0) | 5 (9) |
| | 3-4 Days | 5 (10) | 12 (22) | 9 (20) | 6 (11) |
| | 1-2 Days | 6 (13) | 9 (17) | 4 (8) | 7 (13) |
| | No | 22 (46) | 11 (21) | 26 (57) | 14 (26) |
| | | *p* value=0.001 | | *p* value=0.001 | |
| Meat consumption | Daily | 1 (2) | 4 (8) | 2 (4) | 9 (17) |
| | 5-6 Days | 6 (12) | 9 (17) | 2 (4) | 4 (7) |
| | 3-4 Days | 8 (16) | 18 (34) | 19 (42) | 21 (39) |
| | 1-2 Days | 32 (67) | 19 (36) | 17 (37) | 15 (28) |
| | No | 1 (2) | 3 (5) | 6 (13) | 5 (9) |
| | | *p* value=0.048 | | *p* value=0.121 | |
| Fruit consumption | Daily | 7 (15) | 17 (32) | 7 (15) | 19 (35) |
| | 5-6 Days | 4 (8) | 9 (17) | 7 (15) | 6 (11) |
| | 3-4 Days | 13 (27) | 20 (38) | 15 (33) | 15 (28) |
| | 1-2 Days | 20 (41) | 3 (6) | 13 (28) | 10 (19) |
| | No | 4 (8) | 3 (6) | 4 (8) | 4 (7) |
| | | *p* value=0.001 | | *p* value=0.001 | |

**Table 3:** Frequency and pattern of food consumption by adolescents.

boys (53%) and girls (48%) of the public schools brought home-made snacks with them while a greater percentage of both boys and girls of the private schools preferred to buy snacks from the schools' canteen.

The frequency of milk and dairy products consumption among adolescents reveals that about half of the studied population (46% boys and 57% girls) belonging to the public schools were not taking milk at all while the remaining half of the studied group was taking milk and dairy products at varying frequencies (Table 3). A significant association ($p<0.05$) in the frequencies of dairy consumption by adolescents of the public and private schools was observed, both the adolescent boys and girls of private schools had a higher frequency of dairy consumption than

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their public school counterparts i.e., 36% of the boys and 41% of girls of the private schools consumed dairy products daily as compared to 31% and 15% of their public school counterparts, respectively.

The frequencies of meat consumption by adolescent boys and girls of the public and private schools are shown in Table 3. A negligible percentage of adolescents (2% of the boys and 4% of girls) of the public schools had a daily meat intake while a greater percentage of adolescents (67% of the boys and 37% of girls) of the public school consumed meat twice a week. Conversely, a relatively higher percentage of adolescents (8% of the boys and 17% of the girls) of the private schools reported daily meat intakes, 17% of the boys and 7% of the girls consumed meat on 5-6 days a week while 34% of the boys and 39% of the girls of the private schools consumed meat on 3-4 days a week. A good proportion of adolescents (2-17%) of both the public and private schools didn't eat meat at all.

Results on fruit consumption of adolescents revealed that a higher percentage of boys and girls of private schools were consuming fruits daily (32% boys and 35% girls) as compared to adolescents of public schools (15% of boys and 15% girls). Frequencies of fruit consumption could be used as a proxy indicator of vitamins and minerals intakes which suggest that most of the boys and girls particularly those of the public schools were at a greater risk of vitamins and minerals deficiency.

The demographic-socio-economic and physical activity results by gender and school type (Table 4) revealed a significant association ($p<0.05$) among almost all the demographic and socio-economic variables of adolescents of the public and private schools. A higher percentage of both the boys and girls attending public schools came from families where the parents had a lower level education as compared to the adolescents attending the private schools. Clear differences in the socio-economic status of the adolescents of public and private schools were seen in relation to parental profession. As public schools provide free education, by and large adolescents from underprivileged families are enrolled in these schools while middle to higher income families send their children to private schools that charge a considerable amount of tuition fees. A family's limited income and lower level of parental education could be potential co-determinants for the prevalence of malnutrition among adolescents of these demographics. Strategies to increase family income and initiate safety net programs for lower income families to enroll their children in better education facilities might improve their quality of life (QoL).

The results on physical activity of adolescents revealed that a higher percentage of adolescents of private schools were taking part in physical activities (Table 4). In addition, the types of activities undertaken by adolescents of the private schools were more vigorous and involved greater energy expenditure than the physical activities of their corresponding age counterparts whom attend public schools. A significant association was found between the frequency and intensity of physical activity (Table 4).

Results of correlation analysis between different anthropometric and body composition variables shown in Table 5 indicate a significant ($p<0.05$) association between BMI, percent body fat, waist circumference and hip circumference suggesting that all the four indicators are positively correlated and could be used as a screening tool for over-weight and obesity, however, which one of the four indicators has a stronger association with increased susceptibility to chronic diseases needs to be established through large country specific epidemiological studies.

| | Variable | Boys | | | Girls | | |
|---|---|---|---|---|---|---|---|
| | | Public School (n=48) N (%) | Private School (n=53) N (%) | *p*-value | Public School (n=46) N (%) | Private School (n=54) N (%) | *p*-value |
| Father Education | Nil | 19 (39) | 6 (11) | | 17 (37) | 9 (16) | |
| | Primary | 6 (12) | 1 (2) | | 6 (13) | 1 (2) | |
| | Middle | 11 (23) | 8 (15) | 0.001 | 10 (22) | 2 (4) | 0.001 |
| | Secondary | 5 (10) | 16 (30) | | 4 (9) | 18 (33) | |
| | Bachelor | 4 (8) | 14 (26) | | 7 (15) | 14 (26) | |
| | Master | 3 (6) | 8 (15) | | 2 (4) | 10 (18) | |
| | Jobless | 6 (12) | 1 (2) | | 2 (4) | 0 (0) | |
| | Labourer or Peon or small vendor | 15 (31) | 8 (15) | | 18 (39) | 9 (16) | |
| Father Profession | Office Assistant, or small shopkeeper | 13 (27) | 11 (21) | | 9 (19) | 8 (15) | |
| | Medium scale shopkeeper or small farmer or worker abroad | 4 (8) | 8 (15) | | 7 (15) | 18 (33) | |
| | Officer and high scale shopkeeper, contractor | 4 (8) | 13 (24) | 0.017 | 7 (15) | 6 (11) | 0.008 |
| | Industrialist or large businessman/ landlord | 6 (12) | 12 (22) | | 3 (6) | 13 (24) | |

**Table 4:** Demographic and socio-economic characteristics of adolescent families by gender and school.

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The BMI, waist and hip circumferences could be recognized as reliable surrogates for percent body fat where facilities for estimation of body composition are not available. Interestingly, a non-significant association was found between WHR and body weight, height and percent body fat while a significant association was found between WHR and percent lean body mass suggesting its lack of specificity in identifying visceral obesity.

## DISCUSSION

The results of the current study showed a higher prevalence of under-nutrition among the adolescents of public schools which could adversely affect their scholastic performance and physical outputs. Conversely, adolescents of private schools displayed a higher prevalence of overweight and obesity which could be an increasing risk factor for developing chronic diseases later in life. The relationship between malnutrition and increased susceptibility to infectious and chronic diseases has been well established which could be attributed to impaired enzymatic, hormonal and neural responses, enhanced oxidative stress and compromised immune systems of the malnourished population.[18-22] Our results are consistent with the findings of earlier researchers[23,24] who reported that under-nutrition was more prevalent in adolescents of public schools while over-nutrition was more prevalent in adolescents of private schools. The correlation results are in agreement with the existing literature which reported that BMI, waist circumference, total body fat and percent body fat in girls all increased linearly with age[25] while some researchers recognize BMI as an imperfect measure of body fatness.[26] The anthropometric and body composition findings suggest that nutritional status of adolescents of public and private schools require preventive and therapeutic interventions to prevent and reduce human and capital losses.

When comparing the frequency and pattern of breakfast consumption by adolescents of public and private schools, it was seen that girls skipped breakfast more frequently than boys. Breakfast consumed by adolescents of public schools was nutritiously poor than breakfast consumed by adolescents of private schools. Both the conditions of skipping breakfast and consumption of unhealthy breakfasts by adolescents could be potential risk factors for malnutrition and associated morbidities. The results are consistent with previous studies[27,28] which reveal that breakfast skipping and unhealthy eating practices are common characteristics of adolescents around the world.

Skipping breakfast is a documented trait of adolescents which is observed in many countries, more pronounced in girls who are more prone to engage in unhealthy dietary habits such as skipping meals, binge-dieting and unhealthy food choices which could be due to biological, physiological and psychological reasons, body weight and body image perceptions, peers pressures or parental influences and socio-economic reasons.[29-35] In addition, skipping breakfast has been associated with poor nutritional status, increased body adiposity and risk of chronic diseases.[2,36,37] The results are in agreement with earlier researchers[38-40] who reported that adolescents from affluent families had better quality breakfast than those belonging to the lower socio-economic group and that skipping breakfast unhealthy dietary practices were more prevalent among adolescent girls.

Adolescents from both the school streams showed variations in the frequency and patterns of snack consumption. Both the boys and girls of private schools predominantly consumed more nutrient dense, diverse and expensive snacks than the boys and girls of public schools who relied more on low quality, energy dense oily, sweet and less expensive snacks (paper, samosa, pakora, toffees etc). Due to weak monitoring and lack of enforcement of food safety regulations, snacks are generally poorer in food quality and unhealthy. Little or no fruit consumption was reported by the adolescents as neither the schools' canteens had fruits in their stock nor did the students bring fruits from their

| Variable | Age | Weight | Height | BMI | Waist | Hip | WHR | Body Fat | LBM |
|---|---|---|---|---|---|---|---|---|---|
| **Age** | 1.000<br>0.0 | 0.3864<br>0.0001 | 0.4461<br>0.0001 | 0.1821<br>0.0097 | 0.1884<br>0.0074 | 0.2803<br>0.0001 | -0.2080<br>0.0030 | 0.1389<br>0.0499 | 0.3726<br>0.0001 |
| **Weight** | 0.3864<br>0.0001 | 1.000<br>0.0 | 0.5561<br>0.0001 | 0.8321<br>0.0001 | 0.9173<br>0.0001 | 0.9277<br>0.0001 | 0.1296<br>0.0667 | 0.7624<br>0.0001 | 0.7280<br>0.0001 |
| **Height** | 0.4461<br>0.0001 | 0.5561<br>0.0001 | 1.000<br>0.0 | 0.1276<br>0.0710 | 0.4193<br>0.0001 | 0.4563<br>0.0001 | -0.0253<br>0.7214 | 0.0595<br>0.4023 | 0.6099<br>0.0001 |
| **BMI** | 0.1821<br>0.0097 | 0.8321<br>0.0001 | 0.1276<br>0.0710 | 1.000<br>0.0 | 0.8345<br>0.0001 | 0.8189<br>0.0001 | 0.1966<br>0.0052 | 0.8807<br>0.0001 | 0.5087<br>0.0001 |
| **Waist** | 0.1884<br>0.0074 | 0.9173<br>0.0001 | 0.4193<br>0.0001 | 0.8345<br>0.0001 | 1.000<br>0.0 | 0.9454<br>0.0001 | 0.3138<br>0.0001 | 0.7717<br>0.0001 | 0.6424<br>0.0001 |
| **Hip** | 0.2803<br>0.0001 | 0.9277<br>0.0001 | 0.4563<br>0.0001 | 0.8189<br>0.0001 | 0.9454<br>0.0001 | 1.000<br>0.0 | 0.0010<br>0.9883 | 0.7838<br>0.0001 | 0.6260<br>0.0001 |
| **WHR** | -0.2080<br>0.0030 | 0.1296<br>0.0667 | -0.0253<br>0.7214 | 0.1966<br>0.0052 | 0.3138<br>0.0001 | 0.0010<br>0.9883 | 1.000<br>0.0 | 0.0931<br>0.1897 | 0.1702<br>0.0157 |
| **Body Fat** | 0.1389<br>0.0499 | 0.7624<br>0.0001 | 0.0595<br>0.4023 | 0.8807<br>0.0001 | 0.7717<br>0.0001 | 0.7838<br>0.0001 | 0.0931<br>0.1897 | 1.0000<br>0.0 | 0.3685<br>0.0001 |
| **Lean Body Mass** | 0.3726<br>0.0001 | 0.7280<br>0.0001 | 0.6099<br>0.0001 | 0.5087<br>0.0001 | 0.6424<br>0.0001 | 0.6260<br>0.0001 | 0.1702<br>0.0157 | 0.3685<br>0.0001 | 1.000<br>0.0 |

**Table 5:** Correlation analysis between anthropometric and body composition variables.

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homes due to economic reasons, lack of preference or alternate food choices. The availability and consumption of poor quality snacks by the adolescents in Pakistan and other South East Asian countries have also been reported by other researchers[41,42] which could play a significant role in the development of malnutrition and diseases later in life.

The present results on the consumption of milk and dairy products are in line with others[43] who reported that only 1/3rd of the adolescent boys and 25% of the girls from Saudi Arabia were taking milk daily with variable compliance to the recommended daily values, while the milk intake of adolescents from Poland, Germany and other Eastern countries was sufficient to meet 25-60% of their calcium requirements.[44] These findings suggest that at least 50% of the adolescent boys and girls are at an increased risk of dietary inadequacy of calcium, phosphorus, vitamin D and other essential nutrients required for bone growth and development.

Our findings on meat consumption by adolescents are in line with others[45] who reported that only 13-15% of the Mexican adolescents had a daily consumption of red meat or/ and white meat while rest (85-87%) of them consumed meat infrequently either sometime during the week or occasionally. Likewise, the consumption of meat by adolescents was also dependent upon financial resources; adolescents belonging to families with a low socio-economic status can't afford to consume meat frequently.[46] As meat is a rich source of protein, iron, zinc and other nutrients its consumption is very important to meet the physiological requirements of the body. With the onset of adolescence, the need for iron increases due to rapid body growth, expansion of blood volume and muscle mass, thus the imbalance between requirements and intake makes adolescents particularly girls more vulnerable to nutritional anaemia.

Our findings on the consumption of fruits by adolescents are in fair agreement with other researchers[47] who reported that about 25% of the Bahraini adolescents were consuming fruits daily; 32% 1-3 times a week; 15% 5-6 times a week and 27% were taking fruits rarely. However, these results showed that the fruit consumption of Pakistani's adolescents is much lower than the New Zealand, US and European adolescents.[48-50] The dietary assessment results revealed that a large number of adolescents abstain from consuming healthy foods (such as fruits, vegetables, and meat and dairy products) which need interventions to promote healthy eating practices and lifestyles to prevent and reduce nutritional deficiencies and diseases.

Our correlation results of anthropometry and body composition are in close conformity with others[51] who reported a strong association between BMI, WC and percent body fat in Moroccan adolescents. In men, waist circumference was found to be the best predictor of elevated blood pressure while in women waist circumference was recognized as the best predictor of elevated fasting blood glucose. In addition, the odds of metabolic syndrome were multiplied by a combination of body obesity indices such as BMI, WC, WHtR and visceral adiposity.[52]

A significant association between the markers of socio-economic variables (father education, father profession, mother education and mother profession) and school status (public *versus* private) indicate that the socio-economic status of parents could be a driving force for better nutritional status and education of their children as a greater percentage of parents of the adolescents of private schools had higher levels of education and superior professional jobs. High education with superior jobs and income allow parents to invest more on their children's education and food. Thus children of higher socioeconomic standing are nutritionally better, contribute more towards societal development and spend better quality life. The results have been validated by earlier findings[53,54] which showed that higher education and income were associated with a greater consumption of good quality foods, decreased consumption of energy dense foods and reduced risk of overweight and obesity. Gaps found in the educational and professional levels of the parents of adolescents attending public and private schools need to be plugged in through socio-economic development programs by investing more in social sectors i.e., education, nutrition, health, safe and clean drinking water, hygiene and sanitation and safety nets to combat food insecurity and poverty.

## CONCLUSION

The study concludes that adolescents studying in private schools had a better nutritional status, dietary habits and physical activity practices than those of public schools. Parental education and income were found to be partially responsible for their better performance. The results also showed that adolescent girls of both the public and private schools were more vulnerable to nutritional deficiencies due to inappropriate dietary practices which could be ascribed to negative perceptions and behaviors, peer influences, food preferences, autonomy to select junk snacks and avoiding healthy foods or gender bias of parents by giving more preferential treatments to boys. Poor nutritional status and unhealthy dietary practices of adolescents of public schools need be studied closely to improve their nutritional well being through comprehensive nutrition interventions. Appropriate dietary practices and healthy lifestyles may be promoted through mass awareness, nutrition education campaigns employing the print and electronic media, conducting seminars and workshops at a community level and launching special supplementary food and social protection programs for adolescents.

## IMPLICATIONS OF THE RESEARCH STUDY

The study identifies inappropriate dietary practices of school children in both public and private schools that are associated with impaired child growth and compromised nutritional status. The adverse consequences of poor nutritional status are manifested in the form of irritable child behavior with impaired scholastic performance, frequent illnesses, increased school absenteeism and dropouts. As there is no school health and nutrition

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policy nor are there any health and nutrition screening programs in the country, thousands of school children are suffering from both under-nutrition (underweight and stunting) and over-nutrition (overweight, obesity). Poor nutritional status is associated with co-morbidities that predispose children to chronic diseases later in life. There is a dire need to draw the attention of policy makers and Government functionaries to formulate appropriate health and nutrition policies for school children to prevent the irreparable loss of human capital and reduce the sufferings of vulnerable population.

## AUTHORS CONTRIBUTION

The authors of the manuscripts have made the following contributions in carrying out the field work and writing of the research paper for publication:
(PIP) conceptualized, designed and supervised the study; (SB) conducted field work; (SIP) assisted PIP in manuscript drafting and critically reviewing the paper; (FV) provided technical inputs in all stages of research; (IAK) monitored field work and assisted SB in data collection; (ZUD) did the statistical analysis of the data; (NIAM) helped in data management and writing the research paper.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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