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REVIEW ARTICLE

Assessment of Dietary Patterns, Physical Activity & Nutritional Status of Adolescents Studying in Private Schools of Lahore, Pakistan

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ABSTRACT

A cross-sectional study was conducted among a sample of 400 adolescents studying in private schools of Lahore, Pakistan and data was collected through a self-structured questionnaire, composed of three parts (personal information, dietary history & physical activity patterns). For BMI calculation, height and weight were measured. Data analysis was done through SPSS version 23. The study indicates that 58.3% of adolescents had a normal BMI, 27.5% were underweight, 10.5 % were overweight, and 3.8% were obese. From all the individuals 65.0% skipped meals whereas only 47.3% consumed breakfast regularly. Moreover, consuming snacks per day (64.0%) and eating junk food once per week (73.8%) was common among adolescents. Furthermore, 23.3% of adolescents engaged in low levels of physical activity, 65.0% in moderate levels, and only 11.8% had high physical activity levels. Approximately half of the adolescents studying in private schools of Lahore had a normal nutritional status while the other half were either undernourished (underweight, 27.5%) or overnourished (overweight, 10.5%; obese, 3.8%). More than half of the adolescents skipped breakfast daily, ate junk food once a week and followed a lifestyle consisting of low-moderate physical activity. Therefore, to reduce the double burden of malnutrition, it is necessary to spread awareness and educate adolescents and the community about healthy dietary and lifestyle practices.

KEY WORDS: Adolescents; Nutritional Status; Dietary Patterns; Physical Activity; Pakistan

1. INTRODUCTION

Malnutrition refers to deficiencies or excesses in nutrient consumption, imbalance of vital nutrients, or decreased nutrient utilisation according to the World Health Organisation (WHO). Furthermore, one out of every three people are diagnosed with malnutrition, and poor dietary intake is responsible for one in five deaths around the globe (Khan et al., 2021). Like other developing countries, Pakistan, with a population of 220 million, is facing the double burden of malnutrition (DBM) (Khan et al., 2016; Rahim & Lassi, 2021). The most important cause of malnutrition among the Pakistani population is the increased prevalence of food insecurity (Sultan & Afshan Iram, 2023). Over the years, many studies have been conducted on the nutritional status of children under the age of 5; however, one of the major problems being ignored is the occurrence of malnutrition among adolescents (Khan et al., 2021). Approximately, 21% of Pakistan's total population consists of adolescents (Abdullah & Tasneem Shaikh,

2023). WHO defines adolescence as the phase of life between the ages of 10 and 19. This period comprises prompt physical growth and is associated with behavioural, and psychological transformations (Amjad et al., 2022). During this phase of life, adequate nutrition is extremely necessary. Yet, adolescents are susceptible to unhealthy dietary practices and sedentary lifestyles, thus contributing to macro- and micronutrient deficiencies (Paracha et al., 2016). Furthermore, health-related habits including dietary habits established during this phase tend to persist into the later years of life (Daly et al., 2021). Therefore, a healthy dietary pattern during adolescence is important as it contributes towards the adolescent's nutritional status, prevents certain diseases and impacts their overall health (Afzal et al., 2018).

Additionally, physical activity (PA) holds immense importance during adolescence, contributing to decreased chronic disease risk and providing primary disease prevention when integrated into one's lifestyle (Haverkamp et al., 2020; Lear et al., 2017). Studies also indicate a positive correlation between dietary behaviours and PA (Wadolowska et al., 2016). Unfortunately, global analyses indicate over 80% of adolescents worldwide do not meet the recommended levels of daily physical activity, compromising their health and highlighting the prevalence of unhealthy lifestyle behaviours in this age group (Guthold et al., 2019). Lastly, nutritional status is an acknowledged key indicator of health, diagnosed through anthropometric measurements, biochemical markers, clinical signs, and dietary history (Bhattacharya et al., 2019; Singh et al., 2014). It is influenced by both dietary patterns and PA, thus assessing both these factors will help identify adolescents' nutritional status (Grygiel-Górniak et al., 2016).

Due to the scarcity of research conducted in Pakistan, little information regarding the dietary practices, lifestyle and nutritional status of adolescents is known. Furthermore, most studies previously focused on public school students or general adolescent populations, overlooking adolescents in private schools who often come from higher socioeconomic backgrounds. Such differences may influence their dietary habits, lifestyle choices and associated health risks. Thus, the foremost aim of this study was to thoroughly assess the dietary patterns, physical activity and nutritional status of adolescents studying in private schools of Lahore, Pakistan. Additional aims included: 1) evaluating the relationship between the dietary patterns and nutritional status of adolescents, and 2) determining the relationship between PA and nutritional status of adolescents studying in private schools of Lahore, Pakistan.

2. Methodology

2.1 Study Design & Setting

This study was based on the properties of qualitative research and the cross-sectional study design was implemented in this research. It was conducted within the premises of two private schools of Lahore; The International School of Choueifat, Lahore and The National School.

2.2 Sample Selection

A sample size of 400 was determined using OpenEpi software and the sample was selected by the simple random sampling technique.

The following equation was used to calculate the sample size;

$$n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$$

Inclusion criteria were as follows: *1)* students between the ages of 10-19; *2)* students studying in Grades 10, 11, 12 or 13; *3)* students studying for O' levels, AS levels, A' levels, or Advanced Placements (AP's). Whereas, exclusion criteria were as follows: *1)* students above the age of 19; *2)* students in any other grade than the above mentioned; *3)* students who were studying Matric or Intermediate.

2.3 Data Collection

The data was collected using a structured questionnaire, consisting of three sections; demographic information (including anthropometric measurements), dietary patterns and behaviours, and physical activity. The demographic section was developed by the researchers. The dietary section included common dietary behaviour questions and a food frequency table adapted from Rafique et al. (2020). The physical activity section employed the validated Physical Activity Questionnaire - Adolescents (PAQ-A) (Da Costa Pereira De Arruda Neta et al., 2021; Martínez-Gómez et al., 2009). The final, combined questionnaire was reviewed by subject experts and their recommendations were incorporated before data collection.

2.4 Demographic Information of Participants

The first part of the questionnaire collected the personal information of the participants, which consisted of each participant's: gender, age, contact number, school, grade, father's occupation and monthly income. Anthropometric measurements were also taken.

2.5 Anthropometrics and Derivative Calculations

The height of each participant was measured by using the gold standard method utilising a portable stadiometer (Warrier et al., 2022). Their weight was measured using digital weighing scales. Trained research staff followed standardised procedures, ensuring participants were measured without shoes and in light clothing. The equipment was calibrated daily to ensure accuracy. Lastly, the BMI was calculated from the participants' weight (kg) divided by the square of the height (m) (Deurenberg et al., 1991).

2.6 Assessment of Dietary History

Common dietary behaviour questions and a food frequency table were included to assess the participant's dietary patterns. The food frequency questions included the number of food items consumed per day (zero times a day, once a day, 2-3 times a day, 4-5 times a day, 6 or more times a day) for whole grains, refined grains, white meat, red meat, eggs, lentils/beans, fruits, vegetables, milk and milk products, desserts and oils. The food frequency table utilised in this research was a modified version of the FFQ used by Rafique et al. (2020).

2.7 Assessment of Physical Activity

The physical activity levels of the adolescents were assessed by the Physical Activity Questionnaire – Adolescents (PAQ-A) (Da Costa Pereira De Arruda Neta et al., 2021; Martínez-Gómez et al., 2009). The PAQ-A was categorised into three levels, a mean score of $\leq$1.9 indicated low physical activity, a mean score of $\geq$2 and <4 indicated moderate physical activity and a mean score of $\geq$4 was classified as high physical activity (Roura et al., 2016). Low physical activity levels correspond to sedentary behaviour; moderate PA levels suggest occasional activity and high PA levels indicate frequent participation in sports or exercise.

2.8 Statistical Analysis

Statistical Package for Social Sciences (SPSS) Version 23 was used for the analysis of collected data. Descriptive statistics were calculated for all variables. To examine associations between categorical variables, crosstabulation and chi-square tests were applied whereas correlation analysis was used to assess relationships between continuous variables. A p-value of <0.05 was considered statistically significant.

3. Results

Table 1 shows various characteristics of the participants' including their gender, age, family medical history, body mass index (BMI) and physical activity levels (PAL). Out of the 400 adolescents, 275 (68.8%) were male whereas, 125 (31.3%) were female. The mean age of the sample was 15.62, with the adolescents ages varying from 14 to 19 years old. Most of the adolescents (90.5%) had no known family medical history (FMH), 5.8% stated a FMH of Diabetes, 2.0% mentioned hypertension, and 0.8% recorded a FMH of arthritis. The Body Mass Index (BMI) was used to assess the adolescents' nutritional status. Majority of the adolescents, 58.3%, were within the normal range of BMI, 27.5% were underweight, 10.5% were overweight and 3.8% were obese. Furthermore, 23.3% of the total participants had low physical activity levels, 65.0% were moderately active and only 11.8% were highly active.

Table 1

Characteristics of participants (N = 400)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	275	68.8
	Female	125	31.3
Age	14	102	25.5
	15	96	24.0
	16	84	21.0
	17	90	22.5
	18	25	6.3
	19	3	0.8
Family Medical History	No known history	362	90.5
	Diabetes	23	5.8
	Hypertension	8	2.0
	Arthritis	3	0.8

	Other	4	1.0
Body Mass Index	Underweight	110	27.5
	Normal	233	58.3
	Overweight	42	10.5
	Obese	15	3.8
Physical Activity Level	Low	93	23.3
	Moderate	260	65.0
	High	47	11.8

Note. n = frequency; % = percentage

Table 2 displays the participants' dietary behaviours. Of the total 400 adolescents, 260 (65.0%) had a tendency to regularly skip a meal whereas, only 189 (47.3%) ate breakfast daily. Most of the adolescents (64.0%) consumed snacks per day and 295 (73.8%) consumed junk food once per week. Intake of nutritional supplements was not common among the adolescents, with only 34.0% consuming them. Majority of the adolescents (58.3%) drank the recommended 8-10 glasses of water regularly and only a small percentage, 15.5%, had a food intolerance or allergy.

Table 2

Distribution of dietary behaviours of adolescents studying in private schools of Lahore

Dietary Behaviour	**Yes**		**No**	
	n	**%**	**n**	**%**
Skip meals	260	65.0	140	35.0
Eat breakfast daily?	189	47.3	211	52.8
Consume snacks per day?	256	64.0	144	36.0
Consume junk food once per week?	295	73.8	105	26.3
Consume any Nutritional Supplements?	136	34.0	264	66.0
Food intolerances or allergies?	62	15.5	338	84.5
Drink 8-10 glasses of water per day?	233	58.3	167	41.8

Note. n = frequency; % = percentage

Table 3 demonstrates the adolescents' frequency of consumption of certain foods. According to the results, 62.0% of the adolescents either did not consume fruits or only consumed them once a day. Similarly, 21% of adolescents did not consume vegetables regularly and 55% only ingested vegetables once per day. Dairy consumption was also relatively low with only 33.8% consuming it 2 or more times day. Whereas, consumption of refined cereals and white meat was higher than the consumption of whole grains and red meat, respectively.

Table 3

Distribution of food frequency questionnaire responses by adolescents

Food Item	**Consumption Frequency**				
	Zero times/day n (%)	Once/day n (%)	2-3 times/day n (%)	4-5 times/day n (%)	6 ≥ per day n (%)
Cereals/Whole Grains	**156(39.0%)**	**195(48.8%)**	**47(11.8%)**	**2(0.5%)**	**0**

Refined Cereals/Grains	56 (14.0%)	252(63.0%)	89 (22.3%)	3(0.8%)	0
White meat (Chicken, Fish)	63 (15.8%)	219(54.8%)	106(26.5%)	12(3.0%)	0
Red Meat (Mutton, Beef)	126(31.5%)	203(50.7%)	56(14.0%)	15(3.8%)	0
Eggs	101(25.3%)	216(54.0%)	66(16.5%)	6(1.5%)	11(2.8%)
Lentils, Beans	183(45.8%)	159(39.8%)	42(10.5%)	16(4.0%)	0
Fruits	34(8.5%)	214(53.5%)	104(26.0%)	38(9.5%)	10(2.5%)
Vegetables	84(21.0%)	220(55.0%)	79(19.8%)	7(1.8%)	10(2.5%)
Milk and Milk Products	50(12.5%)	215(53.8%)	98(24.5%)	24(6.0%)	13(3.3%)
Desserts, Sweets, Chocolates etc.	89(22.3%)	213(53.3%)	64(16.0%)	23(5.8%)	11(2.8%)

Note. n = frequency; % = percentage

Table 4 displays the results of correlation analysis between the body mass index and various dietary behaviours of adolescents. The results indicate a significant negative correlation between the BMI and skipping meals (p-value < 0.01). On the other hand, significant positive correlations were identified between the BMI and eating breakfast daily, consuming snacks per day and food allergies or intolerances of adolescents (p-value < 0.01). In a contrast, no correlation was identified between BMI and drinking 8-10 glasses of water daily.

Table 4
Correlation between body mass index and dietary behaviours

Variable	1	2	3	4	5	6	7	8
1. BMI	-							
2. Skip meals	-.220**	-						
3. Eat breakfast daily	.205**	-.681**	-					
4. Consume snacks per day	.174**	-.015	-.114*	-				
5. Consume junk food once per week	-.081	.122*	-.152**	.097	-			
6. Consume nutritional supplement	.052	.095	-.140**	.011	-.028	-		

7. Food intolerances or allergies	.118*	.083	-.101*	.105*	.036	.188**	-	
8. Drink 8-10 glasses of water per day	-.017	-.069	.040	-.022	.002	-.099*	-.128*	-

Note. BMI = Body Mass Index
** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table 5 displays the combined results of crosstabulations and chi-square tests between the nutritional status (NS) of adolescents and their intake of whole grains, refined grains, white meat, red meat, eggs, lentils, fruits, vegetables, milk products and desserts. A positive association was identified between NS and the consumption of whole grains and refined grains (p-value < 0.005). The results indicated that from all the adolescents who consume whole grains once per day, 67.2% were within the normal range of BMI. Similarly, all the adolescents who consume whole grains 4-5 times per day had a normal nutritional status. Indicating that increased consumption of whole grains leads to a better nutritional status in adolescents. Furthermore, it is evident in that with the increased consumption of refined cereals/grains the number of normal weight individuals decreased while the number of overweight and obese individuals increased.

The results in Table 5 also indicated a significant association between the NS and consumption of white meat, red meat and eggs. Out of all the participants, 63 adolescents did not eat white meat every day, 219 ate it once a day whereas 118 consumed it more than twice per day. Moreover, an increase in consumption of red meat led to an increase in overweight and obesity as well. The results showed that 126 participants did not consume red meat per day, 203 consumed it once a day, 56 ate it 2-3 times per day and 15 stated that they ate red meat 4-5 times a day. Additionally, majority of the participants (216) consumed eggs once per day whereas approximately 1/4th (101) of the individuals did not eat eggs daily.

Table 5 also shows that as the consumption of fruits increased the number of obese individuals decreased whereas, the number of normal weight individuals increased. 34 adolescents did not intake fruits per day, 214 adolescents ate fruits once per day, 38 ate fruits 2-3 times per day and only 10 consumed fruits more than 6 times per day. Majority of the adolescents (76%) had a low intake of vegetables according to the USDA food guide pyramid. Furthermore, an inverse relation was identified between increased vegetable intake and overweight/obesity. Overall, a strong association was apparent between the NS of adolescent's and their consumption of fruits and vegetables.

Lastly, a total of 50 participants did not drink milk or eat dairy products on a regular basis. Underweight, normal weight, overweight and obesity was prevalent among 32.0%, 56.0%, 6.0% and 6.0% individuals, respectively. From all the individuals who drank milk or ate dairy products six or more times per day 23.1% were obese. However, no association was determined between nutritional status of adolescents and the consumption or dairy products.

Table 5
Association between nutritional status and various food items frequency

Food	Frequency (per day)	Nutritional Status				Total
		UW	Normal	OW	Obese	
Whole grains	Zero times	51	71	25	9	156
	Once	50	131	11	3	195
	2-3 times	9	29	6	3	47
	4-5 times	0	2	0	0	2
	≥ 6 times	0	0	0	0	0
		p-value = 0.002*				
Refined	Zero times	13	34	9	0	56

grains	Once	72	154	20	6	252
	2-3 times	25	45	10	9	89
	4-5 times	0	0	3	0	3
	≥ 6 times	0	0	0	0	0
			p-value = 0.000*			
White meat	Zero times	10	50	3	0	63
	Once	72	122	22	3	219
	2-3 times	25	55	14	12	106
	4-5 times	3	6	3	0	12
	≥ 6 times	0	0	0	0	0
			p-value = 0.000*			
Red meat	Zero times	28	87	8	3	126
	Once	66	106	25	6	203
	2-3 times	13	28	9	6	56
	4-5 times	3	12	0	0	15
	≥ 6 times	0	0	0	0	0
			p-value = 0.004*			
Eggs	Zero times	22	68	8	3	101
	Once	75	114	18	9	216
	2-3 times	7	43	13	3	66
	4-5 times	3	0	3	0	6
	≥ 6 times	3	8	0	0	11
			p-value = 0.000*			
Lentils, Beans	Zero times	44	110	20	9	183
	Once	46	91	16	6	159
	2-3 times	13	23	6	0	42
	4-5 times	0	0	0	0	0
	≥ 6 times	7	9	0	0	16
			p-value = 0.532			
Fruits	Zero times	4	12	12	6	34
	Once	75	112	24	3	214
	2-3 times	24	71	3	6	104
	4-5 times	7	28	3	0	38
	≥ 6 times	0	10	0	0	10
			p-value = 0.000*			
Vegetables	Zero times	19	36	20	9	84
	Once	62	140	15	3	220
	2-3 times	22	47	7	3	79
	4-5 times	3	4	0	0	7
	≥ 6 times	4	6	0	0	10
			p-value = 0.000*			
Milk and Milk Products	**Zero times**	**16**	**28**	**3**	**3**	**50**
	Once	56	127	26	6	215

	2-3 times	31	57	7	3	98
	4-5 times	3	15	6	0	24
	≥ 6 times	4	6	0	3	13
			p-value = 0.007			
Desserts, Chocolates, Sweets etc.	Zero times	14	58	14	3	89
	Once	65	123	19	6	213
	2-3 times	28	27	3	6	64
	4-5 times	3	17	3	0	23
	≥ 6 times	0	8	3	0	11
			p-value = 0.000*			

Note: UW = Underweight, OW = Overweight

Table 6 displays the results of a crosstabulation between physical activity and the nutritional status of adolescents. Of all the 400 participants, 93 had low physical activity levels, 260 had moderate and 47 had high physical activity levels. The prevalence of normal weight individuals remained approximately the same throughout the different levels of activity (58.1%, 58.1%, 59.6%), however surprisingly, of all the individuals who performed high physical activity 19.1% were overweight. Furthermore, a significant association exists between physical activity and nutritional status (p-value < 0.005).

Table 6
Association between nutritional status & physical activity

Physical Activity Level (PAL)	**Nutritional Status (N=400)**				**Total n (%)**
	UW	**Normal**	**OW**	**Obese**	
Low PAL	36	54	3	0	93 (23.3)
Moderate PAL	64	151	30	15	260 (65.0)
High PAL	10	28	9	0	47 (11.8)
		p-value = 0.001*			

Note: UW = Underweight, OW = Overweight, PAL = Physical Activity Level

4. Discussion

The findings of this study revealed that more than half of the adolescents (58.3%) studying in private schools of Lahore, Pakistan were within the normal range of BMI. However, the remaining were malnourished; 27.5% were underweight, 10.5% overweight and 3.8% were obese. The prevalence of malnourished adolescents, both under and over-nourished evidences that Pakistan is indeed facing the DBM like various other developing countries. This prevalence may contribute to an increased risk of developing neurodevelopmental and behavioural problems in the later years of life, as supported by recent research (Galler et al., 2017).

However, in comparison to another study conducted by Amjad et al. (2022) in Lahore, a significant difference can be seen in the number of adolescents who are underweight and a slight difference in overweight individuals. Their results indicated that 46.2% of adolescents were underweight, 6.2% were overweight, and 2.3% were obese. This difference may have occurred due to the difference in the study population. The study population of Amjad et al.'s (2022) research consisted of adolescents studying in both public and private schools of Lahore, whereas, this study consisted only of adolescents studying in private schools of Lahore, Pakistan.

These differences may reflect the socioeconomic variations between public and private school adolescents. Adolescents studying in private schools generally come from higher socio-economic backgrounds, which can affect both their dietary choices and physical activity levels. On the other hand, adolescents in public schools may face greater food insecurity and have fewer recreational resources, leading to variations in dietary patterns and activity levels (Paracha et al., 2016; Rahim & Lassi, 2021).

Additionally, the assessment of the dietary behaviours of the adolescents showed that they did not follow healthy dietary patterns as 65% of all the

participants skipped meals and less than 50% ate breakfast regularly. These results are consistent with various studies which have indicated that adolescents have a habit of skipping meals, specifically breakfast (Amjad et al., 2022; Souza et al., 2021). In contrast, our study shows that 73.8% of adolescents consume junk food once per week which is significantly higher than other studies. Studies conducted in Turkey and Iran indicated that only 34% and 19.4% of adolescents consumed junk food once per week, respectively (Akman et al., 2010; Mirhadyan et al., 2020).

Our findings on the consumption of whole and refined grains and its relation with the nutritional status of adolescents are consistent with previous research. We identified that with an increase in whole grain consumption, a better nutritional status was identified. Similarly, according to a study conducted by Albertson et al. (2015), various analyses indicated a significant inverse relationship between overweight and obese percentages and whole grain intake as the p-value was less than 0.05. Similarly, a systematic review concluded that increased consumption of whole grains was associated with better body weight measures (Kissock et al., 2021).

Furthermore, this study revealed that the consumption of fruits and vegetables is also low. The majority of the adolescents did not consume the recommended amounts of fruits and vegetables on a regular basis (62% and 76%, respectively). The results are similar to another study that concluded that the majority of Palestinian students skip breakfast and consume fewer fruits and vegetables (Nubani-Husseini et al., 2023). However, this study also indicated that the consumption of fruits among Pakistani adolescents is significantly lower than the consumption of fruits by US and European adolescents (Paracha et al., 2016).

This study revealed only 11.8% of the adolescents performed high levels of physical activity while 23.3% performed low levels of physical activity and 65% had moderate physical activity levels. Additionally, a significant association was seen between physical activity and the nutritional status of adolescents (p-value = 0.001). However, the results of our study differ significantly from another study carried out in Indonesia, whose results indicated that there is no significant relation between nutritional status and physical activity (p-value = 0.757) (Solikah & Nurwijayanti, 2023). This difference may have occurred due to the different ways used to analyse the physical activity levels of adolescents.

Similar to all research, this study also has some limitations. First, because of the cross-sectional study design, we cannot draw firm conclusions about cause and effect between dietary patterns, physical activity, and nutritional status. Second, all the data on dietary patterns and physical activity were collected through a self-reported questionnaire, which might be subject to recall and reporting biases. Finally, since the study population was limited to only adolescents studying in private schools of Lahore, the findings may not be generalisable to the overall adolescent population of Pakistan. Despite these limitations, the study provides important insights into the nutritional status, dietary patterns and physical activity levels of a relatively under-researched population.

5. Conclusion

In conclusion, it is evident that Pakistan is facing the double burden of malnutrition and the nutritional status of adolescents is significantly associated with dietary patterns and physical activity (p-value < 0.05). However, the issue of DBM, specifically among adolescents' is being overlooked, and a lot more research is required regarding the nutritional status of adolescents. The poor nutritional status and unhealthy dietary patterns of adolescents need to be investigated thoroughly to improve their overall health and well-being through nutrition interventions. Furthermore, it is necessary to spread awareness and educate adolescents about healthy dietary and lifestyle practices through nutrition education campaigns specifically through social media, conducting seminars and workshops at a community level and introducing special fortified food and protection programs for adolescents.

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