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The Frequency of Dyslipidemia in Young Overweight and Obese Students (Age 10-16 Years) in Schools of Swat, Pakistan

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Abstract

Obesity is a multifaceted disease caused by hormonal imbalance. There is a significant increase in the prevalence of childhood obesity across the globe. The study was conducted to estimate the frequency of Pediatric dyslipidemia. The Prevalence of obesity was determined by serum lipid concentrations of students in Private Schools of Swat. The cross-sectional analytical study enrolled 1374 Students, both boys (870) and girls (504). Detailed history of the students were recorded through a survey, which included student's sociodemographic and clinical variables. BMI of students were calculated by the formula BMI=weight/height (kg/m2). The analysis of the data was done through SPSS Version 22. The students enrolled in this study were grouped on gender basis i.e, male (68) and female (31). The Prevalance of dyslipidemia was measured to be 42.4%. Significant association was found between the rate of dyslipidemia and BMI (59.5% in obese and 40.5% in overweight). No significant gender differences were found in serum lipid levels. The rate of dyslipidemia was measured to be a slightly increased in boys as compared to girls but not statistically significant.

Keywords: Pediatric; obesity; dyslipidemia; Lipid profile.

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1. Introduction

The prevalence of obesity has been increased across Europe, Africa, America and Asian countries. Significant increase in weight in early childhood is predictive of obesity development as depicted by Baird and his colleagues [1]. Several comorbid conditions are associated with obesity e.g hypertension, nonalcoholic fatty liver disease (NAFLD), dyslipidemia, hyperglycemia and other metabolic syndromes. Dyslipidemia is detected in almost one third of the population of developed countries as mentioned by Goff and his colleagues in 2006 and later by Iqbal and his colleagues in 2019 [2, 3], but the frequency varies depending upon which shows wide variation in Asian countries depending on lifestyle practices habitat and socio economic status [4]. It has been evident from various studies that South Asians are at risk of developing obesity related comorbidities at lower levels of waist circumference (WC) and body mass index (BMI) shown in [5]. In contrast to white Caucasians, South Asians have higher body fat at a given value of BMI [6, 7]. Depending upon these reports there is some debate that whether BMI cut-offs for diagnosis of obesity and overweight should be lower for Asian populations than given in international guidelines [8]. The WHO expert consultative committee estimated the correlation in 2004 between Asian populations and BMI, difference in percentage of body fat and health risks as compared to European populations [9]. BMI cut offs must be equal to or greater than 23-24.9 kg/m_2 for overweight, and equal to or greater than 25 kg/m* for obese [10]. Lipoproteins are molecules in which both proteins and lipids are present [11]. The covalent bonds and non-covalent bonds are used by proteins for attachment to lipids or its derivatives [12]. Various enzymes, transport proteins, antigens, adhesions are involved. Low density lipoproteins and high density lipoproteins assist in transport of fats in the blood [13]. Some other examples include the chloroplast, the mitochondrial proteins (transmembrane) and lipoproteins of bacteria [14]. Generally cholesterol and lipid molecules are not dissolved in the blood, but it is the main function of the lipoproteins to carry them in blood [15]. Cholesterol is the main constituent of cells, to synthesize different membranes that are used for controlling water content and various water soluble substances in the interior and therefore create their enzymatic system more systematic [16]. Phospholipids, cholesterol and apo-lipoproteins which are hydrophilic, are present towards outside in the lipoprotein structure [17]; that provides solubility in the salt-water based blood stream. The apo-lipoproteins and the phospholipids monolayer serve as a shield assist in the protection of internally present cholesterol esters and triglyceride-fats from the surrounding water [18]. Since cholesterol is carried around (like all fat molecules) the body in lipoprotein particles. High levels of cholesterol (hypercholesterolemia) potentially offers a lower rate to detect high levels of LDL particles; possibly even low levels of functional HDL particles, both of these variants are strongly linked with cardiovascular diseases because LDL particles promote atherosclerosis [19]. Myocardial infarction and peripheral vascular disease result due to this atherosclerotic plaque, if present for decades. As the high levels of LDL-C is responsible for atheroma formation more than the cholesterol content in the HDL particles [20], LDL particles are typically called "bad cholesterol" since they have been associated with atheroma formation. As functional HDL can eliminate cholesterol from atheroma and cells, its high levels provide protection against CVDs and are often called as "good cholesterol"[18]. Triglycerides, as major components of very-low-density lipoprotein (VLDL) I and chylomicrons, play an important role in metabolism as energy sources and transporters of dietary fat [21]. They contain more than twice as much energy (approximately 9 kcal/g or 38 kJ/g) as carbohydrates (approximately 4 kcal/g or 17kJ/g) [22]. Increased triglycerides levels in the blood have been associated with atherosclerosis, cardiac disease risk and stroke [23]. However, relatively negative effect of high triglycerides level in contrast to that of LDL: HDL ratios is still not known. The risk is partly attributable to the fact that triglyceride level has acquired a strong inverse relationship with HDL-cholesterol level [24]. Triglyceride level is raised by diets which contain high quantity of refined carbohydrates, in which carbohydrates account for over 60% of the total energy intake. It is noteworthy that there is a strong association for those having greater BMI (28+) and insulin resistance (more common among overweight and obese) is a primary suspect cause of this phenomenon of carbohydrate-induced hypertriglyceridemia [25]. Evidence shows that high glycemic index with utilization of carbohydrates, causes overproduction of insulin along with increased levels of triglyceride [26]. In order to maintain a persistent weight, there must be an energy balance that is, intake of energy must be equal to its expenditure. The possibility of gaining or losing fat depends on rise and fall of insulin, which is the main stimulus to gain weight. World health organization has particularly identified the fiber content and energy density of the diet as key factors to determine the obesity risk [27]. The study shows the prevalence of overweight adults in Pakistan is 21 percent while that of obesity is 9 percent, that is we have 30 percent of our adult population is excess weight index (Figure 1). These results show a high prevalence of overweight and obesity in Pakistan which is a crucial finding of the present study. Khyber Pakhtunkhwa (KPK) has the highest proportion of obese individuals than Punjab and Balochistan. Adult males and females of rural residents are 0.8 times less likely to have gained weight than urban residents. So, in order to understand various factors contributed in pediatric obesity in urban residents of highly effected province (KPK) of Pakistan, this study was conducted. Our findings related to hyperlipidemia and its association with obesity could be reasonably beneficial for the early steps in prevention and management of dyslipidemia leading to cardiovascular diseases and other comorbidities in KPK.

1. Material and Methods

The study conducted was a cross sectional study carried out in the private and public sector schools of urban area of Swat Valley i.e. Swat Public School (SPS), Al-Madina Public School Swat and The City School District Swat, Khyber Pakhtunkhwa (KPK). The analytical work was done in statistics department/PMRC of Khyber medical college and institute of basic medical sciences (IBMS), Khyber Medical University, Peshawar.

2.1 Study Population

Subjects include obese students from the above mentioned schools of District Swat with age from 10 to 16 years.

2.2 Sample Size

Non-probability convenience sampling technique was used. A convenience sample of 100 male and female students from the above three schools of District Swat were selected for the present study. A total number of 100 participants from various regions of Swat in these schools were issued the questionnaires which was filled and completed by them.

2.3 Sampling Techniques

The study conducted was a questionnaire based cross-sectional survey. A self-managed poll was circulated among three schools understudied. The survey incorporated the demographic profile of understudies including age, sex, and training inquiry identified. An enlightening study was directed preceding the start of the organization of the last survey. The poll was circulated in every school in the vicinity of their executive. Moral prerequisite including the organization of composed educated assent and the procurement of classification were guaranteed.

2.4 Inclusion criterion

- Children and young students in different private schools of Swat who are either overweight or obese.
- Age group: 10 to 16 years.
- Either gender.

2.5 Exclusion criterion

- Obese and overweight students having age either below 10 or above 16 years.
- Obese students having some medical problem causing dyslipidemia like diabetes mellitus, heart diseases and renal diseases, etc.

2.6 Aims and objectives

- To determine the prevalence of obesity in students of private schools of Swat.
- To find out the frequency of dyslipidemia in school going young obese and overweight students in private schools of District Swat.

2.7 Duration of the Study

The study was carried out in six months after endorsement of proposition began from March 2015 to November 2015.

2.8 Data collection

Data on dyslipidemias, was collected by distributing structured and pre-tested questionnaires which were prepared by review of the literature so as to address the objectives of the study. The following considerations were undertaken:

- Permission was taken from the concerned schools in charge.
- Participants who were fulfilling the inclusion criteria were included in the study.
- Detailed information was provided to the participants and informed consents were taken from their parents.

2.9 Variables

History of the students were taken, with contained information about socio-demographic characteristics, dietary habits, hobbies, family history of diabetes, hypertension, kidney diseases and dyslipidemia etc.

2.10 Specimen Collection

Venous blood sample was taken from all the students with the help of expert technicians. For blood collection, aseptic techniques and tourniquet was applied. About 4 ml blood was collected in a vacutainer tube. Blood serum was separated from each sample at 3000 rpm in a micro centrifuge (Centrifuge 80-2A). Lipoproteins including Total Cholesterol (TC), Triglycerides (TG), Low Density Lipoprotein Cholesterol (LDL-C), Very Low Density Lipoprotein Cholesterol (VLDL-C) and High Density Lipoprotein Cholesterol (HDL-C), were analyzed enzymatically by using an Automatic Chemistry Analyzer (Cobas-Clll Japan). Measurement of serum Total Cholesterol, Triglycerides and HDL was measured by enzymatic method of Roche Diagnostic kits of Japan. Frederickson-Friedwald's formula was used to calculate LDL as follow. LDL-C = TC - HDL cholesterol VLDL cholesterol. VLDL was measured as 1/5 of triglycerides.

2.11 Body Mass Index (BMI)

The formula used to calculate the BMI of weights and heights:

BMI = Weight in Kg/Heights in (m) 2.

2.12 Determination of Serum Total Cholesterol (TC)

The reagents used for (TC) PAP, Enzymatic Calorimetric Method were of Roche Diagnostic kit (Japan), measured by an Automatic Chemistry Analyzer (Cobas-Clll Japan) at 500 nm. To calculate cholesterol, the relationship used was OD Sample x n, where n= standard concentration (200 mg/dL)

2.13 Determination of High Density Lipoprotein Cholesterol (HDL-C)

For HDL-C determination method by using an Automatic Chemistry Analyzer (Cobas-Cl 11 Japan), its absorbance was measured at546nm.

2.14 Determination of Triglycerides (TG)

For Triglyceride enzymatic liquid colorimetric test, GPO-PAP method, the reagents (Roche Diagnostic kits, Japan) used were obtained by using an Automatic Chemistry Analyzer (Cobas-Cl 11 Japan), measurement of quinine absorbance was done at 546 nm. Concentration of the sample (mg/dL) = Absorbance of Sample x Concentration of Standard /Absorbance of Standard.

2.15 Determination of Low Density Lipoprotein Cholesterol (LDL-C)

The following formula is used to find out LDL-C: LDL cholesterol (mg/dl) = TC - HDL-cholesterol- TG/5.

2.16 Determination of Very Low Density Lipoprotein Cholesterol (VLDL-C)

Determination of VLDL-C levels was carried out by derivation from the following formula: VLDL-C cholesterol (mg/dl) = 1/5th of Triglycerides or Triglycerides/5.

2.17 Statistical Analysis

Data was statistically analyzed through SPSS version 22. For evaluation of mean differences, the Student's t test was used. To determine the relative association of lipid profile with Age, Obesity, BMI, diet and Family History and lipids and lipoproteins concentrations, logistic regression method was applied for calculation of maximal probability estimates for the coefficients and their standard errors were used to calculate odd ratio (OR) and 95% confidence interval (CI).

3. Results

The results were evaluated to determine the relative association of lipid profile with demographic and clinical variables of the isolated subjects through logistic regression method. There were 42(42.4%) dyslipidemic while 57(57.6%) participants were normal. The following pie chart clearly shows the percentage distribution of dyslipidemia verses normal.

Table 3.1: Dyslipidemia vs BMI

Parameter	Dyslipidemia	Normal	Chi.sq	p.value
Obese	25	16	9.860[a]	.002
Overweight	17	41		
Total |	42	57		

Table 3.1 showed the frequency of dyslipidemia vs BMI in 99 participants. There were 42 (42.4%) dyslipidemia students in which 25 were obese and 17 were overweight, while 57 (57.6%) participants were normal in which 16 were obese and 41 were overweight. Chi-Squared value has been calculated to check the association between dyslipidemia and BMI. A highly significant p-value indicated strong association between dyslipidemia. Dyslipidemia cases have been observed in greater number in obese students as compared to overweight. Conclusively, there are more chances of dyslipidemia in obese students. The following pie chart clearly shows the percentage distribution of dyslipidemia versus BMI.

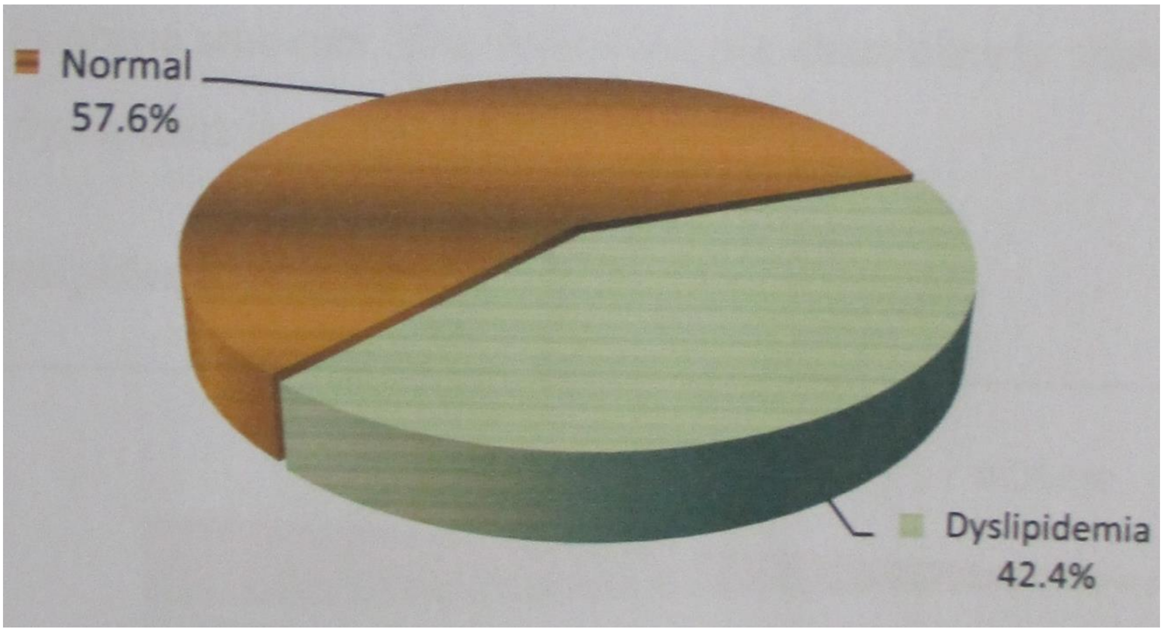

Figure 1: Dyslipidemia wide distribution

Table 3.2: Dyslipidemia vs Gender

Parameter	Dyslipidemia	Normal	Chi. Sq	p. value
Female	12	19	0.255[a]	0.614 in
Male	30	38		
Total	42	57		

Table 3.2 showed the frequency of dyslipidemia vs gender in total participants. Out of the observed subjects, 31 female participants 12 dyslipidemic and 19 were normal while 68 were male, in which 30 were noted to have dyslipidemia and 38 were normal. An insignificant chi-square value has been obtained while checking the association between dyslipidemia and gender. Generally dyslipidemia occurs in male and female with the same frequency but the percentage of dyslipidemia is insignificantly higher in males (78.95%) as compared to females (63.16%). The cut-off point for lipid concentrations in children and adolescents has been adjusted to three levels. Desirable level (< 170 mg/dL), borderline level (170-200 mg/dL) and undesirable level (> 200 mg/dL). Out of total participants, 93(93.9%) showed desirable levels, 4(4.0%) were on Borderline levels while 2(2.0%) showed undesirable levels of cholesterol in mg/dl.

Table 3.3: Cholesterol vs BMI

Dyslipidemia	Obese	Overweight	Chi. Sq	p. value
Desirable level	37	56	Referral	
Borderline level	2	2	0.17	0.683 in
Undesirable level	2	0	Not Calculated	
Total	41	58		

Table 3.3 showed the cholesterol level versus BMI. From the total participants, 93(93.9%) showed desirable levels in which 37 were obese and 56 were overweight, 4(4.0%) were on borderline levels in which 2 were obese and 2 were overweight, while 2 (2.0%) showed undesirable levels of cholesterol in mg/dl, both of which were obese. An insignificant chi-square value has been obtained while checking the association between serum cholesterol level and BMI. Generally dyslipidemia due to abnormal cholesterol level occurs in obese and overweight with the same frequency but according to our data the percentage of dyslipidemia due to undesirable cholesterol level is higher in obese as compared to overweight participants though not significant. The cut-off points for triglyceride concentrations in children and adolescents has been adjusted to desirable level (<125 mg/dL), borderline level (125mg/dL) and undesirable level (>125 mg/dL). So, from the observation, 68(68.7%) showed desirable levels, none of the subjects were on borderline level while 31(31.3%) showed undesirable levels of triglyceride in mg/dl.

Table 3.4: TG vs BMI

Dyslipidemia	Obese	Overweight	Chi. Sq	P.value
Desirable level	22	46	7.35	0.006 sig
Borderline level	--	--		
Undesirable levels	19	12		
Total	**41**	**58**		

Table 3.4 showed triglyceride concentrations in children and adolescents versus BMI. After calculated participants, 68(68.7%) showed desirable levels in which 22 were obese and 46 were overweight. None of the subjects showed borderline levels while 31(31.3%) showed undesirable levels in which 19 were obese and 12 were overweight. A highly significant p-value showed an association between TG and BMI (weight of a person) i.e dyslipidemia cases have been observed in greater number in obese students as compared to overweight. Thus there might be more chances of dyslipidemia due to abnormal TG levels in obese students. The cut-off points for High Density Lipoprotein (HDL) concentrations in children and adolescents are desirable level (>45 mg/dL), borderline level (35-45 mg/dL) and undesirable level (<35 mg/dL). Out of total participants, 4 of them showed desirable levels, 68 were found on borderline levels while 27 showed undesirable levels of HDL in mg/dl.

Table 3.5: HDL vs BMI

Dyslipidemia	Obese	Overweight	Chi. Sq	p.value
Desirable level	2	2	Referral	
Borderline level	21	47	0.64	0.425

Undesirable level	18	9	0.42	0.515
Total	**41**	**58**		

In table 3.5, HDL concentrations in children and adolescents versus BMI has been shown. Out of total participants, 4 showed desirable levels in which 2 were obese and 2 were overweight, 68 were found on borderline levels in which 21 were obese and 47 were overweight, while 27 showed undesirable levels of HDL in mg/dl in which 18 were obese and 9 were overweight. An insignificant chi-square value has been obtained while analyzing the association between HDL and BMI. Due to abnormal HDL level. dyslipidemia occurs in obese and overweight with the same frequency but according to our data the percentage of dyslipidemia due to abnormal HDL-C is insignificantly higher in obese as compared to overweight individuals. The values or levels for Low Density Lipoprotein (LDL) concentrations in children and adolescents are indicative as desirable level (<110 mg/dL), borderline level (110-129mg/dL) and undesirable level (>130 mg/dL). Frequency shows that Out of total 99 participants, 94 of them showed desirable levels, 4 were found on borderline levels while 1 showed undesirable level of LDL in mg/dl.

Table 3.6: LDL vs BMI

Dyslipidemia	**Obese**	**Overweight**	**Chi. Sq**	**p. value**
Desirable level	38	56	Referral	
Borderline level	2	2	0.15	0.702in
Undesirable level	1	0	Not Calculated	
Total	41	58		

Table 3.6 suggested HDL concentrations in children and adolescents versus BMI. 94 subjects showed desirable levels in which 38 were obese and 56 were overweight, 4 were found on borderline levels in which 2 were obese and 2 were overweight, while one participant showed undesirable levels of LDL in mg/dl. Only one subject was obese and no one found to be overweight. An insignificant chi-square value has been obtained while examining the association between LDL and BMI. Due to irregular LDL level, dyslipidemia occurs in obese and overweight with the same frequency but according to our data the percentage of dyslipidemia had increased in obese as compared to overweight but insignificant.

Table 3.7: General Characteristics and Biomedical Parameters

Parameters	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age 1	10	16	13.86	1.53
Weight	25.00	115.00	65.88	16.92
Hem	102.00	225.00	174.45	27.06
BMI	20.06	36.81	26.16	3.22
Choi	80.0	236.0	122.43	29.96
TG	27.0	353.0	109.38	58.94
HDL	19.0	49.0	37.87	6.97

VLDL	5.4	70.6	21.86	11.78
LDL	28.0	164.6	62.68	24.63

Table 3.7 showed minimum, maximum and mean values of biomedical parameter and general characteristics. The age were 10-16 (mean 13.86) year, weight were 25-115 (Mean 65.88) kg, height 102 - 225 (mean 174.45) cm, BMI 20.06 -36.81 (mean 26.16), cholesterol were 80 - 236 (mean 122.43)mg/dl, TG were 27 -353 (mean 109.38) mg/dl, HDL were 19-49 (mean 37.87)mg/dl, LDL were 28 -64.6 (mean 62.68) mg/dl. VLDL 5.4 - 70.6 (mean 21.86) mg/dl. Table 3.14 shows BMI vs general characteristics. The age of obese were 13.9+1.38 and overweight were 13.7+1.64 year, Weight of obese were 65.7+14.07 and overweight were 65.9+18.80 kg, height of obese were 176.4+24.10 and overweight were 173.0+29.10 cm, BMI of obese were 28.7+2.91 and overweight were 24.3+1.98 , cholesterol levels of obese werel36.5+34.04 while overweight were 112.4+22.07 mg/dl, TG of obese were 133.7+68.89 and overweight were 92.1+43.72 mg/dl, HDL of obese were 35.1+8.07 and overweight were 39.8+5.37 mg/dl, LDL of obese were 74.6+26.71 and overweight were 54.2+19.18 mg/dl. VLDL of obese were 26.7+13.76 while overweight were 18.4+8.75 mg/dl respectively. Chi-Squared value has been calculated to check the associations between general characteristics and BMI. A highly significant p-value of TC, TG, HDL, LDL and VLDL suggested a strong association between biochemical parameters with BMI.

Table 3.8: Gender wise general characteristics and biomedical parameters

Parameters	**Male**	**Female**	**t. test**	**P .value**
	Mean ± SD	*Mean ± SD*		
Age	13.7+1.53	14.0+1.54	-.898	.371
Weight	64.4+17.57	69.0+15.19	-1.278	.204
Height	172.2+29.33	179.2+20.92	-1.187	.238
IBMI	26.1+3.41	26.2+2.81	-.138	.891
Choi	124.0+31.60	119.0±26.18	.768	.444
TO	114.0+63.50	99.2+46.76	1.160	.249
HDL	37.6±7.00	38.3±7.02	-.456	.649
VLDL	22.712.69	19.8±9.35	1.144	.256
LDL	63.5+25.74	60.7±22.28	.520	.604

Table 3.8 showed mean and standard deviation of BMI vs general characteristics and lipid profile of respondents. The mean age of male with standard deviation were 13.7+1.53 and female were 14.0+1.54 years, mean weight of male with standard deviation were 64.4+17.57 and female were 69.0+15.19 kg, Mean height of male with standard deviation were 172.2+29.33 and female were 179.2+20.92 cm, Mean BMI of male with standard deviation were 26.1+3.41 and female were 26.2+2.81, mean cholesterol level of male with standard deviation were 124.0+31.60 and female were 119.0+26.18 mg/dl, mean TG of male with standard deviation were 114.0+63.50 and female were 99.2+46.76 mg/dl, mean HDL of male with standard deviation were 37.6+7.00 and female were 38.3+7.02 mg/dl, mean LDL of male with standard deviation were 63.5+25.74 and

female were 60.7+22.28 mg/dl, mean VLDL of male with standard deviation were 22.7+12.69 and female were 19.8+9.35 mg/dl respectively. An insignificant chi-square value has been obtained while checking the association between gender versus general characteristics and biochemical parameters showed no significant variation. The frequency of respondents according to consumption of junk and fast-food intake has also been considered e.g, burgers and pizzas. Out of total participants, 3 were eating burger/pizza daily, 50 of them 2 -3 times in a week, 7 of them eating > 2-3 times in a week while 39 of them eating no burger/pizza at all.

Table 3.9: Lipid parameter BMI vs Burger / Pizza

Use	Lipid Profile					
	BMI (Mean +SD)	**TC (Mean +SD)**	**TG (Mean +SD)**	**HDL (Mean +SD)**	**VLDL (Mean +SD)**	**LDL (Mean +SD)**
Daily	27.4+3.11	193.0+3X4 0	203.3+130.3 1	32.0+10.53	40.6+26.06	120.3+44.60
2—3 time in a wk	26.0+3.57	118.9+29.3 4	104.8+51.87	38.9+6.42	20.9+10.35	59.0+22.30
> 2-3 times in a wks	25.6+2.37	138.4+31.4 6	156.2+98.50	36.0+7.39	31.2+19.72	71.2+27.45
No	26.3+2.94	118.5+22.4 5	99.5+42.83	37.3+7.26	19.9+8.57	61.3+20.11

Table 3.9 showed the relation of burger/pizza vs BMI and lipid profile with mean and standard deviation. Those individuals who consumed burger/pizza on daily basis have high BMI and Lipid profiles as compared to other groups. An insignificant chi-square value has been obtained while checking the association between age versus gender distribution and showed no significant variation. Table 3.10 showed the frequency of respondents according to consumption of pasta and potato chips. Out of total 99 participants, 21 were eating daily, 55 of them 2 -3 times in a week, 9 of them eating > 2 - 3 times in a week while 14 of them eating no Pasta/potato chips at all. The following table shows the relation of Pasta/potato chips vs BMI and lipid profile with mean and standard deviation. The following table clearly shows that those participants who consume Pasta/potato daily have high BMI and Lipid profile as compared to other groups. Chi-Squared value has been calculated to check the association between dyslipidemia and BMI. A highly significant p-value shows that there is association between lipid parameter with Pasta/chips which shows a strong relation with weight, Height and HDL.

Table 3.10: Lipid parameter and BMI vs Pasta and Potato chips

Use	Lipid Profile					
	BMI (Mean +SD)	**TC (Mean +SD)**	**TG (Mean +SD)**	**HDL (Mean +SD)**	**VLDL (Mean +SD)**	**LDL (Mean +SD)**
Daily	27.1+3.09	133.7+38.6	124.0+71.75	36.5+7.81	24.7+14.33	72.3+31.47
2-3 time in a week	25.7+3.29	116.1+25.3	108.2+56.98	38.8+6.50	21.6+11.38	55.6+19.93
> 2-3 times in a weeks	24.2+1.32	136.5+32.55	99.1+69.37	40.4+5.68	19.8+13.88	76.2+26. 59
No	27.5+3.24	121.2+25.02	98.6+35.59	34.3+7.27	19.7+7.11	67.2+21.28

Table 3.11: Lipid parameter and BMI vs Soft drink (Coke/Pepsi)

Use	Lipid Profile					
	BMI (Mean +SD)	TC (Mean +SD)	TG (Mean +SD)	HDL (Mean +SD)	VLDL (Mean +SD)	LDL (Mean +SD)
Daily	27.0+3.86	124.9+39.40	122.5+78.13	36.2+8.04	24.4+15.62	64.1+30.18
2—3 time in a week	25.6+2.79	120.3+25.60	105.5+48.54	38.2+6.53	21.1+9.70	61.0+22.55
> 2-3 times in a weeks	25.2+2.27	124.7+25.27	88.7+43.73	41.7+2.75	17.7+8.69	65.2+20.41
No	26.3+3.41	123.2+26.10	106.0+52.65	38.1+7.22	21.1+10.54	63.9+22.84

Table 3.11 showed the frequency of respondents according to consumption of soft drinks (Coke/Pepsi). Out of total participants, 29 taking it daily, 49 of them use it 2-3 times in a week, 7 of them taking > 2 - 3 times in a week while 14 of them taking no drinks (Coke/Pepsi) at all. The following table shows the relation of drink (coke/Pepsi) vs BMI and lipid profile with mean and standard deviation. Individuals consuming drink (coke/Pepsi) daily have high BMI and Lipid profile as compared to other groups. An insignificant chi-square value has been obtained while checking the association between biochemical parameters with soft drinks and showed no significant variation. However significantly high HDL values were noted which shows a strong relation with soft drinks.

Table 3.12: Lipid parameters and BMI vs Sweets (toffees / Bakery products)

Use	Lipid Profile					
	BMI (Mean ±SD)	TC (Mean ±SD)	TG (Mean ±SD)	HDL (Mean ±SD)	VLDL (Mean ±SD)	LDL (Mean ±SD)
Daily	26.0±SD	126.9±33.84	118.9+68.04	38.0±7.56	23.7±13.59	65.0±26.94
2-3 time in a week	26.1±2.42	116.4±22.02	101.3±45.62	38.0±6.49	20.2±9.11	58.2±19.80
> 2-3 times in weeks	24.8±4.96	108.5±29.56	65.2±25.82	39.1±5.61	13.0±5.16	56.3±28.80
No	27.5±3.33	130.8±30.62	124.1±57.42	36.0±7.24	24.8±11.48	69.9±24.43

Table 3.12 showed the frequency of respondents according to consumption of sweet toffees/bakery products. Out of total 99 participants, 46 were consuming daily, 33 of them 2 -3 times in a week, 8 of them eating > 2 ~ 3 times in a week while 12 of them eating no sweet toffees/bakery products at all. The following table shows the relation of sweet toffees/bakery products vs BMI and lipid profile with mean and standard deviation. The following table clearly shows that those participants who consume sweet toffees/bakery products daily have high BMI and Lipid profiles as compared to other groups. An insignificant chi-square value has been obtained while checking the association between sweet distributions with lipid parameters and showed no significant relation. The frequency and percentage of family history of participants with clinical variables has been observed besides dyslipidemia i.e., blood Pressure, diabetes, heart disease and renal disease. 61(61.6%) of them have high blood Pressure in their family while 38 (38.4%) have no history of blood pressure, 13 (13.1%) have dyslipidemia while 86(86.9%) have no dyslipidemia in their family, 25 (25.3%) have diabetics in their family while 74 (74.7%) have no diabetics in family, 14 (14.1%) have history of heart Disease in family while 85 (85.9%) have no such history, 13 (13.1%) have history of renal Disease in their family while 86 (86.9%) have no family history of renal disease. An insignificant chi-square value has been obtained while checking the association between blood pressure, diabetes mellitus, and heart disease with lipid parameters and showed no significant relation. While kidney diseases have strong relation with cholesterol and LDL.

4. Discussion

People of South Asian countries are facing growing epidemics of increasing obesity and dyslipidemia. Various factors which have emerged as major contributory factors include rapid urbanization, demographic changes, industrial global diet, social and cultural factors and sedentary lifestyle along with genetic predisposition. The south Asian citizens are increasingly consuming the diets which are high in cholesterol, saturated fats, and refined carbohydrates and low in fiber and polyunsaturated fatty acids. The industrial global diets and fast food restaurants gained population in this regard. The science behind our body metabolism needs to be understand by our nation in order to establish a healthy environment. Because of decreased use of traditional foods, migration from the rural areas to urban areas, increasing industrialization, and more frequent consumption of fatty and fast foods, the level of cholesterol is increasing in children and adolescents of many countries which is a risk factor for CVD. There are genetic, behavioral, metabolic and hormonal effects on body weight. Obesity occurs when all these factors are disturbed. The genes may affect the total body fat storage, and its distribution in the body. Genetics may also play a role in how our body changes food into energy, how body regulates our appetite and burn calories during physical activities. The blood lipid profiles should be screened in adolescents and children as early as possible to find out any imbalances. More over the data which is available on characterization of lipid profiles in children is very limited especially in South Asian countries. The main finding which was observed in this study was that about 42.4% of adolescents and children in the age group of 10 to 16 years belonging to district Swat (KPK Province of Pakistan) had at least one abnormal lipid concentration i.e. dyslipidemia. This result is comparable to the results (43% dyslipidemia prevalence) of the study which was conducted on 823 obese children and adolescents, in the age group of 2-18 years at Ankara Children's Hematology - Oncology Training and Research Hospital Pediatric Endocrinology Clinic (Turkey)[28]. The study provided the evidence of being obese and inattentiveness shown by authorities. Another study was conducted by Cizmecioglu and his colleagues [29] on Turkish children, reported the dyslipidemia prevalence of

42.9% in 112 school aged obese children, a finding which is also very near to our results. Our dyslipidemia prevalence is higher than the reported prevalence data obtained from studies in the state of Pernambuco, brazil and city of Salvador, Bahia (private schools students) [30] where the prevalence of dyslipidemia was 30% and 25.5% respectively, while the prevalence is less than that of Iranian students 69.5% (85) where the children adopted cardiovascular diseases along with dyslipidemia. The most common dyslipidemia in this study was the high TG levels (31.3%) thus having similarity to the findings of both the Latin American [31] and of the non-Latin American [32] adolescents and children, both having increased TG levels. Their findings only suggested the lipid profile data comparison. The TG levels in children and adolescents of Swat were 114mg and 99.2mg/dl for boys and girls respectively. In Birjand (Iran), the TG levels were reported as 94.7mg and 88.1mg/dl for 11-14 years and 15-18 years old students respectively, while mean was 92.1mg/dl [33]. The TG levels in an American study conducted on children and adolescents were measured as 63mg, 72mg for 10-14 years and 78mg, 73mg/dl for 15-19 years old boys and girls respectively. In Korean adolescents, mean TG levels were reported at 89mg/dl. These data clearly indicated that the mean TG levels in overweight/obese children and adolescents of Swat were found considerably higher than the children/adolescents of Birjand (Iran), America and Korea. The hormones are directed from our brain to function our body. The possibility of gaining or losing fat depends on rise and fall of insulin, which is the main stimulus to gain weight. Therefore, insulin stimulating food are characteristically more fattening e.g. candies, cookies, cakes, donuts, soda drinks etc. Insulin signals our body to store food energy in the form of body fat. Body is capable of maintaining insulin level and other hormones but exceeding levels may results in complications. In teenager girls the hormonal changes are acting as a safety factor against the changes in lipid profile. Just before and after the age of menarche, changes in lipid profiles are sensitive to the influence of sex hormones, especially estrogen, which has a favorable effect on the levels of lipoproteins by decreasing LDL-C and increasing HDL-C levels. In this way, girls are having an advantage during adolescence and adulthood. It is known for long time that high-carbohydrate contents in the diet has strong association with the raised TG levels. This observation has been noted both in children as well as adults. Our study at Swat also proved that the use of soft drinks had significant effect, decreasing the HDL-C of the students. Regarding the distribution of dyslipidemia components, no significant gender differences were found in this study though dyslipidemia was raised in boys as compared to girls. With the exception of HDL-C, the TC, TG and LDL-C Levels were increased in boys as compared to girls but not statistically significant. These observations are comparable to those found in Northern Mexican children and adolescents. However, gender differences results regarding TC, TG, HDL-C, LDC-C levels have been very controversial in the literature. In our study the other most common findings were that the highest rate of abnormal lipid levels was found in obese children as compared to overweight, and also increased TG and low levels of HDL-C. The levels of TC, LDL-C, TG and HDL-C in overweight students were determined at 112.4mg, 54.2mg, 92.1mg and 39.8mg/dl respectively while in obese these values were measured as 136.5 mg, 74.6mg, 133.7mg and 35.1mg /dl respectively. These results showed marked elevation of all the lipid levels (except HDL-C) in obese students compared to overweight which were statistically very significant (p value<0.0001). So sedentary life style along with unhealthy diets including sugary beverages and high fat milk which are below the recommendations may explain the high abnormal lipid values in children/adolescents. As already mentioned, the rate of dyslipidemia in Swat was considerably high in obese as compared to overweight, irrespective of gender and age. Around 59.5% of obese and 40.5% of overweight children and adolescents had at least one type of dyslipidemia.

Results of our study are strongly comparable with the results of other studies which showed an increased frequency of dyslipidemia in obese children. Apart from these, a high incidence of abnormal lipid levels were seen in the obese students of Turkey having high BMI [33]. Those children has developed joints pain, cardiovascular risk factors and diabetes.

We also compared the prevalence of dyslipidemia components of children enrolled in this study with data of some other countries in Europe, North and South America and Asia. The prevalence of low HDL-C in overweight and obese children and adolescents of Swat is quite higher than many countries including German children (7% in Germany) while 27.2% in Swat. Similar findings have been reported by study in Iran. Approximately half of the adolescents aged 10-19 years reported decreased HDL-C levels as the leading cause responsible for dyslipidemia. Prevalence of high TC and LDL-C levels is higher in western countries, as high TC levels are responsible for 26% cases of dyslipidemia while increased LDL-C levels have been reported in 20% of cases [34]. There are some indications of atherosclerosis in reported children. Furthermore, atherosclerotic plaques increase with age. Another study conducted in Brazil reported that increased TC levels (27.9%) and increased LDL-C levels (26.4%) are the foremost contributing factors in the causation of dyslipidemia in children and adolescents. A negative correlation was found in our study between the BMI and HDL-C levels. It means as the BMI increased, the level of HDL-C levels decreased significantly. Mean HDL-C levels in overweight were 39.8 ± 5.37 while in obese children this level was 35.1 ± 8.07 and this finding is statistically very significant ($P < 0.001$). Adolescents of reported subjects have high prevalence of dyslipidemia.

5. Conclusion

The serum lipid levels has been controlled in children and adolescents by dietary manipulation and thus reducing long-term complications in adulthood. It has been reported by some studies (NHANES) that there has been an improvement in the serum lipid levels of children and adolescents of America through meals and exercise plans. The present study in Swat showed a sufficiently high prevalence of obesity and dyslipidemia in young students. Our findings related to hyperlipidemia and its association with obesity could be reasonably beneficial for the early steps in prevention and management of dyslipidemia leading to cardiovascular diseases and other comorbidities.

6. Limitations of the study

Due to limitations in financial support, the study conducted unable to include the other private and government sector schools of Khyber Pakhtunkhwa (KPK). The schools of other provinces of Pakistan should also be compared in order to control child obesity in Pakistan.

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7. Conflict of interest

The authors declares that he has no conflict of interest.

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