

ORIGINAL ARTICLE

PROFILE OF NON FASTING LIPID LEVELS IN NORMAL WEIGHT AND OBESE SCHOOL CHILDREN OF 6-11 YEARS AGE

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ABSTRACT

Background: Compelling evidence exists that the atherosclerotic process begins in childhood and progresses slowly into adulthood, at which time it leads frequently to coronary heart disease. The present study aims to determine the presence of non fasting hypertriglyceridemia in normal weight and obese primary school children 6-11 years.

Material and Methods: A total of 86 school children with 25 normal weight and 61 obese were included in this study. Body-mass-status was determined according to the WHO, 1995 criteria. Non-fasting blood sample was used for lipid screening including Triglyceride (TG); Total Cholesterol (CH), Low Density and High Density Lipoprotein Cholesterol (LDL-C and HDL-C). TG and CH were assessed by enzymatic and LDL-C and HDL-C through direct method.

Results: Mean, for the TG level was observed higher in normal weight girls (181.30 ± 15.04 mg/dl) than normal weight boys (141.87 ± 37.60 mg/dl). Similar trend was observed in obese children. Mean for the TG concentration in obese girls was assessed higher (238.1 ± 95.2 mg/dl) than (204.15 ± 55.48 mg/dl) in obese boys. The observed value of 170 mg/dl was calculated as normal for non fasting triglyceride in this study. TG level of 200-400mg was taken as high and a risk factor for cardiovascular disease (CVD). Same is recorded as 1.7% in obese girls and 1.4% in obese boys.

Conclusion: The present study has expressed a significant non-fasting hypertriglyceridemia in obese children especially in obese girls. Non fasting lipid screening is a better option especially for children at risk for CVD and avoids the burden of fasting; is convenient both, for children and parents and that it is less costly and time consuming.

KEY WORDS: Child; Cardiovascular Diseases; Triglycerides; Cholesterol, LDL; HDL.

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INTRODUCTION

There is increasing concern about the current and future cardiovascular health of the children and adolescents for a number of reasons i.e. High prevalence of childhood obesity;¹ recognition of hyperlipidemia as a risk factor for cardiovascular disease

(CVD)^{2,3} and availability of treatment modalities for children.⁴ Gravity of the problem was recognized by the American Academy of Paediatrics (AAP) and the American Heart Association to recommend the lipid panel screening for children as young as 2 years who are at risk for developing dyslipidemia.^{5,6}

There is wealth of evidence to recommend the lipid screening of adults and children to fast for 8 to 12 hours because of changes that can occur in the test results during a postprandial test.⁷ A number of difficulties are faced in screening of children for lipid disorders. Majority of children will have no fast before a routine visit to the pediatrician.^{8,9} The current visit has to be postponed; both parents and children have to miss their office and school and is costly. Therefore, most of the visits have to be preplanned.

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Furthermore, enforcing the fast in children is more unpleasant than in adults. These barriers to fasting in children make it difficult for the physician and parents to follow the guidelines for the lipid screening.

In spite of the physiological lipid changes related to fasting status, recent research in adults and children have questioned the importance of fasting before the measurement. A large number of studies have suggested that majority of the people who take in an average size meal; the overall lipid profiles will have minimal postprandial change.¹⁰⁻¹²

The Triglycerides (TGs) reference intervals are higher (male 50–202 mg/dl and female 65–234 mg/dl) during the first year of life (0–12 months). This may be due to the milk-rich feeding. Following first year, TGs values decrease to their lowest levels (male 109–204 and female 114–215mg/dl) at 6–10 years.^{13,14}

Severe hypertriglyceridemia (≥ 2000 mg/dl) is a risk factor for pancreatitis and mild (150–199mg/dl) to moderate (200–499mg/dl) for cardiovascular events through the components of the metabolic syndrome.¹⁵ Hypertriglyceridemia is the result of either increased triglyceride rich lipoprotein production or impaired clearance/catabolism of triglyceride rich lipoprotein (chylomicron and VLDL-C) or both. Factors that contribute to the hypertriglyceridemia are obesity; excess alcohol and fats intake, type-2 diabetes mellitus, presence of metabolic syndrome and genetic disorders.¹⁶⁻¹⁸

There is controversy about the role of TGs as risk factor for CVD. Firstly, TGs is inversely related to the level of High Density Lipoprotein Cholesterol (HDL-C). Adjustment for the HDL-C attenuates the relationship between TGs and CVD. Secondly, there is variability in the postprandial TG levels and depends upon the composition of diet. Fasting state (8–12hrs) is essential to have a more stable concentration of TG for risk assessment. However, postprandial TG rich lipoprotein remnants (Chylomicron and Very Low Density Lipoprotein Cholesterol, VLDL-C) can penetrate the endothelial cell layer and reside in the sub endothelial space and contribute to the formation of foam cells, a hall mark of early atherosclerosis.^{19, 20}

Absence of fasting burden would help both, the parents and physician to reduce the barriers to lipid screening. The objective of the present study was to determine the presence of non fasting hypertriglyceridemia in obese and normal weight school children of 6–11 years of age.

MATERIAL AND METHODS

The present study was carried out in 8 primary schools located in the Municipal area of district Dera Ismail Khan to assess the lipid profile of primary school children (6–11 years). The evaluation was

carried from June 2007 to December 2008. The study was approved by the Institutional Review Board (IRB) and Board of Advanced Studies and Research (BASR), Gomal University, Dera Ismail Khan, Pakistan. Informed consent was obtained both from the parents/legal guardians and heads of the institutions. These schools were having mixed population and included children both from urban and rural areas. Socio-economical status was also variable. Some of the wards belong to the high socioeconomic group. Thirteen hundred and thirty six primary school children were included in this study with 865 boys and 471 girls. Thorough clinical examination excluded those suffering from chronic health problems. Children were lightly dressed without foot wear. Height and weight of each child was taken according to standard anthropometric techniques. Body Mass Index (BMI) of each one was calculated according to Quetelet's Index. BMI number was plotted on the Centre for Disease Control and Prevention (CDC) age and gender specific Growth Charts 2–20 years to have BMI-for-age percentile. Body Mass Status was determined according to the reference data of World Health Organization (WHO). A child was considered Underweight if his BMI-for-age percentile was $< 5^{\text{th}}$ percentile and obese when his BMI-for-age percentile was more than 95^{th} percentile. Normal weight child was having BMI-for-age percentile between 5^{th} and 85^{th} percentile while children having BMI-for-age-percentile between 85^{th} and 95^{th} percentile were categorized as overweight.²¹

Among the 1336 primary school children aged 6–11 years; 179 were underweight, 964 were normal weight, 118 were overweight and 75 were obese. Among the obese children, parents of the 61 children gave the informed consent and were included for the non fasting lipid analysis while among the normal weight children 25 children were randomly selected for the non fasting lipid analysis. The observed values of the non fasting lipid analysis were compared with the National Cholesterol Education Program (NCEP) Report of the Expert panel on Blood Cholesterol Levels in Children and Adolescents, 1991 (NCEP, 1991). The acceptable TC level in children is < 170 mg/dl, border line as 170–199mg/dl and high as > 200 mg/dl. The acceptable LDL-C level in children is > 110 mg/dl, border line as 110–129mg/dl and high as > 130 mg/dl.²² Normal level of HDL-C in children is 35–50 mg/dl.²³ The observed value of 170 mg/dl was taken as normal for non-fasting triglyceride in the present study. Fasting TG level in children and adolescents is 150 mg/dl (NCEP, 2003).¹³

Non fasting blood samples were collected in the afternoon between 5–7 pm. Both parents and children were comfortable after their school and office hours. The samples (without EDTA) were immediately centrifuged to have serum for cold storage.

Lipid levels were measured: Triglyceride (TG) and Total Cholesterol (TC) by enzymatic calorimetric method; LDL-C through direct and HDL-C by non immunologic enzymatic method using cholesterol liquicolor test kit (Human) according to manufacturer's instructions. Absorbance of the samples was read at 546 nm on Microlab 300 (Vital Scientific BV, Spankeren, Netherlands). Data was presented in Mean \pm SD. Data obtained was analyzed by comparing with international values using Student's T-test using Statistical Package for Social Sciences (SPSS) version 16. $P < 0.05$ was considered statistically significant.

RESULTS

The present study assesses the levels of triglycerides in non fasting blood samples among obese and normal weight primary school children (6–11 years) of the local population of Dera Ismail Khan. Table 1 represents the sample distribution according to gender and body mass status. It included 86 primary school children with 25 (29.06%) as normal weight; boys 15 (17.44%) and girls 10 (11.6%) and 61 obese (70.94%) with boys 34 (39.53%) and girls 27 (31.40%).

The result showed that TG levels of normal boys ranged from 112 to 234 mg/dl with a mean of 144.87 mg/dl and a coefficient of variance (CV) of about 24%. TC level varies from 102 to 212 mg/dl with a mean of 142.80 mg/dl and a CV of about 22%. HDL content of normal boys ranged from 32 to 57 mg/dl with a mean of 42.73 mg/dl and a CV of

about 16%. LDL content varied 86.60 to 107.60 mg/dl with a mean of 97.36 mg/dl and a CV of about 7%. Comparing the data values of lipids with the standard criteria (NCEP, 1991), it was observed that about 27% values of TG were above the standard values, 7% of TC values and 40% of HDL values were above safe limits, LDL values were within safe limits (Table 2).

In case of obese boys (Table 3), TG levels ranged from 109–375 mg/dl with a mean value of 204.15 mg/dl and a CV of about 27%. TC levels ranged from 119–230 mg/dl with a mean of 161.03 mg/dl and CV of about 13%. HDL values varied from 25 mg/dl to 47 mg/dl with a mean of 33.79 mg/dl and a CV of about 15%. LDL content ranged from 62.80 mg/dl to 146.80 mg/dl with a mean value of 88.44 mg/dl and CV of 20%. CV of various lipids of normal and obese boys ranged from about 13% to about 27%, which seems reasonable for biological experiments. Comparing the observed value of various lipids in case of obese boys with the standard values (NCEP, 1991 and AHA, 2003), it was found that 100% of cases in TG and about 6% in TC were above the standard values.

As regards normal girls, it can be seen from table 2 that TG ranged from 163 mg/dl to 206 mg/dl with a mean value of 181.30 mg/dl and a CV of about 9%. TC values ranged from 130 mg/dl to 167 mg/dl with a mean value of 153.70 mg/dl and a CV of about 8%. HDL content ranged from 47 mg/dl to 60 mg/dl with a mean value of 52.20 mg/dl and a CV of about 9%. LDL contents ranged from 91.80 mg/dl to 106.41 mg/dl with a mean value of 99.36 mg/dl and

Table 1. Sample distribution of children according to gender and body mass status (n=86)

Body Mass Status	Normal Weight (n = 25)				Obese (n = 61)			
Gender	Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%
Number of children	15	17.44	10	11.63	34	39.53	27	31.40
Total	25 (29.06%)				61 (70.94%)			

Table 2. Lipid Profiles of normal weight school children (n = 25)

Gender	Normal Weight Boys (n = 15)				Normal Weight Girls (n = 10)			
	Mean \pm SD	Range	p Value	CV%	Mean \pm SD	Range	p Value	CV%
TG (mg/dl)	144.87 \pm 37.60	112–234	0.02	25.95	181.30 \pm 16.04	163–206	0.05	8.85
Total CH (mg/dl)	142.80 \pm 31.45	102–212	0.01	22.02	153.70 \pm 11.64	130–206	0.001	7.57
HDL – C (mg/dl)	42.73 \pm 6.95	32–57	0.001	16.26	52.20 \pm 4.61	47–60	0.001	8.83
LDL - C (mg/dl)	97.36 \pm 6.48	86.6–107.60	0.001	6.66	99.36 \pm 4.86	91.8–106.4	0.005	4.89

TG = triglycerides, CH = cholesterol, HDL – C = high density lipoprotein cholesterol, LDL – C = low density lipoprotein cholesterol, CV = Coefficient of Variance

Table 3. Lipid profiles of obese school children (n = 61)

Gender	Obese Boys (n = 34)				Obese Girls (n = 27)			
	Mean \pm SD	Range	p Value	CV%	Mean \pm SD	Range	p Value	CV%
TG (mg/dl)	204.15 \pm 55.48	109–375	0.04	27.18	238.1 \pm 95.2	125–457	0.001	39.98
Total CH (mg/dl)	161.03 \pm 21.19	119–230	0.001	13.16	172.37 \pm 25.4	129–234	0.001	14.53
HDL – C (mg/dl)	33.79 \pm 5.15	25–47	0.001	15.24	42.63 \pm 7.33	29–60	0.001	17.19
LDL - C (mg/dl)	88.44 \pm 17.69	62.8–146.8	0.001	20.00	102.70 \pm 16.09	67–140	0.001	15.86

TG = triglycerides, CH = cholesterol, HDL – C = high density lipoprotein cholesterol, LDL – C = low density lipoprotein cholesterol, CV = Coefficient of Variance

a CV of about 5%. Variabilities in lipids of normal girls were relatively lower than those of normal or obese boys which were less than 20%. Comparing the data values of various lipids of normal girls with the standard criteria (NCEP, 1991 and AHA, 2003), it was observed that about 90% of cases in TG and about 80% in HDL were higher and lower than the standard values respectively, while all the cases were normal as regards TC and LDL.

Regarding the lipid profile of obese girls (Table 3), it was observed that TG values ranged from 125 mg/dl to 457 mg/dl with a mean value of 238.10 mg/dl and a CV of about 40% which is relatively high for biological experiments. TC levels ranged from 129 mg/dl to 234 mg/dl with a mean value of 172.37 mg/dl and a CV of about 15%. HDL-C level varied from 29–60 mg/dl with a mean value of 42.63 mg/dl and a CV of about 17%. LDL levels ranged from 67 mg/dl to 140 mg/dl with a mean value of 102.70 mg/dl with a CV of about 16%. Variability in lipids other than TG was lower than 30%. Comparing the observed values with the standard values (NCEP, 1991 and AHA, 2003), it was observed that 85% cases in TG, about 7% in TC and 37% in HDL were higher than safe limits while all other cases were in safe limits. As regards LDL content, it was found that about 7% cases were very high while 26% were within acceptable limits (Table 2 & 3).

DISCUSSION

Serum triglycerides are commonly measured under fasting conditions to have more stable concentrations for the calculation of LDL-C levels, to prevent the post-prandial lipidemia hypertriglyceridemia and its effect on the measurement of HDL-C, non HDL-C. This provided the basis for the NCEP-ATPIII classification of fasting TGs levels.⁸

The present study was designed to measure the serum TGs levels of school children under non fasting conditions. The observed value of 170mg/dl was calculated as normal for non fasting triglyceride in this study. The findings of the Kolovou et al, 2011²⁴ are consistent with non fasting triglyceride level observed in the present study.

All the normal weight children had TG level within the observed /normal level of 170mg/dl for the present study except 4/15 (26.6%) of normal weight boys and 4/10 (40%) of normal weight girls. Twenty seven out of 34 (79.4%) of the obese boys and 22/27 (81.48%) of the obese girls had elevated TG level (>170mg/dl) compared to the 26.6% of the normal weight boys and 40% of the normal weight girls. Gender difference for the non fasting TGs concentration was observed, both in normal weight and obese children.

The findings of the present study are consistent with one of the Yip, 2006. Serum levels for the TG (male 44–188 mg/dl and female 44–194 mg/dl) and CH (male 109–204 mg/dl and female 114–215mg/dl) at the age of 6–10 years was in agreement with our findings. However, no gender difference was observed.²⁵

TG levels were reported higher in non fasting samples of children under 12 years of age in a cross sectional study by Steiner MJ et al, 2011. Results for TG; TC, HDL-C and LDL-C were available for 12744 children (3–17 years). Non fasting triglycerides were observed higher (7mg/dl) than fasting for \geq 8 hours.⁷ NHANES data indicates, the mean fasting triglycerides are 144mg/dl and 13% of US population has high triglycerides. Mexican-Americans have the highest rates of triglycerides (35.5%), followed by non-Hispanic whites (33.2%) and African-Americans (15.9%).²⁶

The exact level of triglycerides considered being a risk factor for CVDs is unknown, but it may be lower than 150mg/dl in fasting.²⁷ The present study observed elevation of non fasting TGs (>170mg/dl) as 26.6% in normal weight and 79.4% in obese school children. NCEP-ATPIII has proposed the fasting TG level, 200–499mg/dl as high for the clinical diagnosis of hypertriglyceridemia.⁸ Obese school children have expressed high level of triglyceride, 1.7% in boys and 1.4% in girls as risk factor for CVD. This observation is in agreement with the findings of the risk factor in the present study.

CONCLUSION

The present study has expressed a significant non fasting hypertriglyceridemia in obese children especially in obese girls. Non fasting lipid screening is suggested for children at risk for CVD. It avoids burden of fasting, facilitates both parents and children and make them available for office and school. Non fasting hypertriglyceridemia is a stronger predictor for CVD.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.

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None declared.

AUTHORS' CONTRIBUTION

Conception and Design:	MR, MB
Data collection, analysis & interpretation:	MR, FR
Manuscript writing:	MR, MB, FR