

# WAIST CIRCUMFERENCE AND LIPID PROFILE AMONG PRIMARY SCHOOL CHILDREN

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## ABSTRACT

**Objective:** To explore the association of lipids and lipoprotein levels with large waist circumference in obese primary school children of Dera Ismail Khan.

**Methodology:** This study explores the frequency of adverse level of waist circumference in primary school children and associated high serum concentration of lipids and lipoproteins to identify children at risk for cardiovascular disease.

**Results:** The study involved 86 primary school children, (Obese: 61 (70.93%), Normal weight: 25 (29.06%)). Adverse level of waist circumference (WC) was observed in 32% normal weight and 78.69% in obese children. Gender difference for higher level of WC, was observed in obese children (boys = 42%, girls = 36 .68%). Higher level of lipids (Triglyceride and Total Cholesterol) and lipoproteins (High Density Lipoprotein Cholesterol and Low Density Lipoprotein Cholesterol) was noted in children with higher WC (Normal weight 6 (24%), Obese 48 (80%)) compared with children having low level of WC (normal weight <61cms and obese <71cm).

**Conclusion:** The adverse level of waist circumference was observed in most of the obese children and a higher level of lipids and lipoproteins was also noted in children with adverse level of waist circumference.

**Key words:** School children, Waist circumference (WC), Lipid levels, Lipoproteins, Cardiovascular risk.

## INTRODUCTION

Increased weight is associated with adverse levels of lipids and lipoproteins, higher levels of Triglycerides (TG); Low Density Lipoprotein Cholesterol (LDL-C) and low levels of High Density Lipoprotein Cholesterol (HDL-C) in adults<sup>1</sup>. Lipid alterations are primarily related to the amount of visceral fat as measured by computed tomography. Obese men with lesser amount of visceral fats however, do not express lipid abnormalities like non obese subjects<sup>2</sup>. Greater deposition of visceral fats in children, as measured by Dual X ray absorptiometry (DEXA) was associated with altered plasma lipid and lipoprotein concentrations, blood pressure and left ventricular mass<sup>3</sup>, but there was no influence of visceral fat, as assessed by Magnetic Resonance Imaging on serum lipids<sup>4</sup>.

Although; Dual x ray-absorptiometry and other imaging techniques exactly measure the visceral fat, yet they are not available for routine clinical practice and screening. They are expensive; require high technical skill and may impart radiation. Instead, Waist circumference is simple; non invasive, requires average technical skill and is available for mass screening of children for evaluation of obesity and cardiovascular risk factors<sup>5</sup>. Waist circumference is a surrogate of visceral adipose tissue and was found in children to be correlated with high levels of plasma lipids and lipoprotein levels<sup>6,7</sup>.

## METHODOLOGY

The present study was carried out in 8 primary schools of Dera Ismail Khan City to assess the waist circumference and lipid profile of school children (6-11 years). These schools had

mixed population while some of the schools had wards of high socioeconomic group. A total of 1336 school children were included in this study with 865 boys and 471 as girls. Thorough clinical examination excluded those suffering from chronic health problems. The evaluation was carried out in school year 2007-2008. The subjects included 61 (70.93%) obese and 25 (29.06%) normal weight children. Among obese children; 34 were boys and 27 girls. Normal weight children included 15 boys and 10 girls. Children were from mixed population and included children from urban and rural areas. Informed consent was obtained from the parents or legal guardians. Children were lightly dressed without shoes. Height and weight of each child was taken according to standard anthropometric techniques. Body Mass Index of each one was calculated according to Quatelet's Index. BMI number was plotted on 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 reference data of World Health Organization (WHO). A child was considered underweight if his BMI-for-age-percentile was <5<sup>th</sup> percentile and obese when his BMI-for-age-percentile was 95<sup>th</sup> percentile. Normal weight child was having BMI-for-age-percentile between 5<sup>th</sup> and 85<sup>th</sup> percentile<sup>8</sup>.

Waist circumference was measured (on bare skin) at the narrowest part of the torso between the lowest rib margin and the iliac crest at the end of gentle expiration<sup>9</sup>. Non fasting blood sample was used to determine the lipids (Triglyceride (TG) and Total Cholesterol (TC) by enzymatic method; LDL-C through direct and HDL-C by non immunologic enzymatic method).

## RESULTS

The aim of this study was to investigate the frequency of adverse levels of waist circumference (WC) in primary school children (6-11 years) of Dera Ismail Khan (NWFP) Pakistan. It included randomly selected 86 school children, with 61 (70.93%) obese and 25 (29.06%) normal weight children. Among obese children, 34 were boys and 27 girls, while normal weights included 15 boys and 10 girls (Table 1).

The observed WC range, for the normal weight children was 47.00-74.00cm and 47.00-66.00cm in boys and girls respectively. WC was more variable in normal weight boys than normal weight girls. WC, was centered at 59.27cm and 52.80cm for normal weight boys and girls respectively. Range and mean of the WC for normal weight boys was observed higher than normal weight girls (Table 2).

WC range, for obese children was observed 60.00-93.00cm and 63.00-88.00cm in boys and girls respectively. Mean value for the obese children was centered at 75.29cm and 75.52cm in boys and girls respectively. There was no gender difference for the mean WC in obese children. Range and mean for the WC in obese children, was recorded higher as compared with normal weight children. Obese children, therefore, possess the adverse risk profile for the CVD as for as the WC is concerned (Table 3).

The observed mean for the TG and TC, was recorded higher in normal weight and obese girls than normal and obese boys. LDL-C concentration was noted higher in normal and obese girls as compared with normal and obese boys. Serum level of HDL-C was observed lower

**Table 1: Distribution of the Children (6-11 years) according to Age, Body Mass Status and Gender (n = 86)**

Age (years)	Body Weight Status			
	Obese		Normal Weight	
	Boys	Girls	Boys	Girls
11 years	12	05	05	01
10 years	06	07	03	03
09 years	07	05	00	01
08 years	02	03	02	02
07 years	05	04	01	01
06 years	02	03	04	02
<b>TOTAL</b>	<b>34 (39.53%)</b>	<b>27 (31.39%)</b>	<b>15 (17.44%)</b>	<b>10 (11.62%)</b>
	<b>61 (70.93%)</b>		<b>25 (29.06%)</b>	
<b>Mean ± SD</b>	9.35 ± 1.65	8.89 ± 1.67	8.80 ± 2.15	8.50 ± 1.78

**Table 2: Descriptive Statistics of Normal Weight Children (n = 25)**

Gender	Boys (n=15)		Girls (n=10)	
Variables	Mean ± SD	Range	Mean ± SD	Range
WC (cm)	59.27 ± 9.91	47-74	52.80 ± 5.27	47-66
TG (mg/dl)	144.87 ± 37.60	112-234	181.30 ± 16.04	163-206
TC (mg/dl)	142.80 ± 31.45	112-234	153.70 ± 11.64	130-167
HDL-C (mg/dl)	42.73 ± 6.95	32-57	48.33 ± 4.61	47-60
LDL-C (mg/dl)	97.36 ± 6.48	86-107	99.36 ± 4.86	91-106

Abbreviations: Waist Circumference=WC, Triglyceride= TG, Total Cholesterol=TC, High Density Lipoprotein Cholesterol= LDL-C, Low Density Lipoprotein Cholesterol= LDL-C (Normal range of TG = 150mg/dl, Normal range of HDL= 35mg/dl)

**Table 3: Descriptive Statistics of Obese Children (n = 61)**

Gender	Boys (n = 34)		Girls (n = 27)	
Variables	Mean ± SD	Range	Mean ± SD	Range
WC (cm)	75.29 ± 8.25	60-93	75.52 ± 7.15	63-88
TG (mg/dl)	204.15 ± 55.48	109-375	238.10 ± 95.	125-475
TC (mg/dl)	161.03 ± 21.19	119-230	172.37 ± 25.04	129-234
HDL-C (mg/dl)	33.79 ± 5.151	25-47	42.63 ± 7.33	29-60
LDL-C (mg/dl)	88.44 ± 17.69	62-146	102.70 ± 16.29	67-140

Abbreviations: Waist Circumference=WC, Triglyceride= TG, Total Cholesterol=TC, High Density Lipoprotein Cholesterol= LDL-C, Low Density Lipoprotein Cholesterol= LDL-C

in normal weight and obese boys (42.73mg/dl, 33.79mg/dl) than normal weight and obese girls (48.33mg/dl, 42.63mg/dl). Adverse level of lipids and lipoproteins (TG, TC, LDL-C and HDL-C) was recorded in children with higher level of WC (Obese 78.68%, normal weight 32%) (Table 2, 3).

**DISCUSSION**

Higher serum levels of lipids (TG and TC) and lipoproteins (LDL-C and HDL-C) were observed both in normal weight and obese children having higher WC than those with normal WC. Higher serum lipids levels were noted more frequently in obese children (42.62% in boys and 36.06% in girls) than the normal weight children (boys 4%, girls 00%). Significant gender difference was observed both in normal weight and obese children. Lipids investigated were TG, TC, LDL-C, HDL-C.

The association of higher level of lipids with the adverse level of WC; was observed also in chinese school children; in a cross sectional study by Ailing Liu et al, 2010<sup>10</sup>, involving 5529 children (2830 boys and 2690 girls) aged 6-12 years. A sub group of 1845 children was further investigated for Blood Pressure (BP), fasting TG, LDL-C, HDL-C and glucose to develop cut points for WC to predict cardiovascular risk factors clustering. The prediction of CV risk factor clustering was noted for WC at 90<sup>th</sup> and 84<sup>th</sup> percentile.

The findings of the present study can also be compared with the study carried out by Watts et al, 2008<sup>11</sup>, in Aurtalia, involving 148 (9.6±1.9 years) children (70 normal weight, 50 overweight and 28 obese). A subgroup of 119 children was selected for further assessment. All the children were medically assessed including physical examination, WC and blood pressure, and investigated for total glycated hemoglobin, TG, TC, LDL-C, HDL-C, glucose and homocysteine. WC was the only anthropometric predictor of lipids profile (TG, LDL-C), Insulin and Systolic blood pressure. Higher WC, was associated with higher lipid level. WC, is a better anthropometric indicator than BMI for the prediction of lipids and other CV risk factors. Claudio Maffeis et al, 2001<sup>12</sup>, had reported association between Anthropometric variables and adverse lipid levels and blood pressure. This was a cross sectional study involving 818 prepubertal children (ages 3-11 years). Height, weight, triceps and subscular skin fold thickness, WC and blood pressure were measured. Plasma levels for TG, TC, LDL-C, Apo A1 and Apo B1 were determined. Multivariate linear model analysis showed that ApoA1/ApoB1, HDL-C, TC/HDL-C ratio as well as Diastolic BP were significantly associated with WC and skin folds independenly of age, gender and BMI.

Similar views have been expressed by Naile Bilgili et al, 2009<sup>13</sup>, in a study involving 159 school children (6-11years). They have

investigated 119 primary school children for anthropometric measurements (WC, W/H ratio) and serum analysis for lipids. WC and BMI were positively correlated to TC and negatively correlated to HDL-C and fat mass. No such correlation was observed in obese girls. Boys, expressed higher levels of lipids and cardiovascular risk factors than girls.

The relationship between circumferences and skin fold thickness, total lipids and insulin concentration in children was investigated by Freedman et al, 1999<sup>7</sup> in Bogalusa Heart Study among 2996 children and adolescents (5-17 years). The study revealed adverse levels of TC, HDL-C and Insulin. These associations were independent of race, sex, age, weight and height. Compared with a child at 10<sup>th</sup> percentile of WC, a child at 90<sup>th</sup> percentile, was estimated to have, on average, higher concentrations of TG, TC, LDL-C and Insulin and lower concentrations of HDL-C. These differences were independent of weight, height and were significant at the 0.001 level and were consistent across race-sex group. These findings emphasize the importance of WC, in obtaining information on body fat distribution; waist circumference particularly in children. WC is easy to measure and, may help to identify children likely to have adverse concentrations of lipids and Insulin.

However, Cuestas et al, 2007<sup>14</sup>, observed that there was no difference of lipid profile between obese and normal weight prepubertal children. The study carried out in Argentina, have explored the relationship between WC and lipid concentrations and blood pressure in prepubertal children (2-9 years), and to assess the importance of WC in identifying certain CV risk factors in this age group. The study involved 240 children (123 boys (53.3%) and 117 girls (48.8%)), age 2-9 years. Children were assessed for height; weight, triceps skin fold thickness, BMI, WC, systolic and diastolic blood pressure. Plasma concentration of TG, TC, HDL-C, LDL-C and glucose were determined. WC was associated with elevated values of TG, TC and hypertension. There was no significant difference in lipid profile between obese and normal weight children. TG was higher in girls than boys.

**CONCLUSION**

The present study concludes that the adverse level of waist circumference was observed in most of the obese children. Higher level of lipids and lipoproteins was noted in children with adverse level of waist circumference (80%) compared with 24% in normal weight children.

It is important to have information on body fat distribution and waist circumference particularly in children. Waist circumference, which is relatively easy to measure, may help to identify children likely to have adverse concentrations of lipids.

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