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CENTRAL ADIPOSITY AND CARDIOMETABOLIC RISK FACTORS

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ABSTRACT

Objective: To estimate the prevalence of central adiposity and to compare the correlation of various measures of fatness with cardiometabolic risk among school age Pakistani children.

Material and Methods: A cross-sectional sample of 85 Pakistani children, ranging in age from six to twelve years, was selected, the study was conducted from January 2011 to November 2011, height, weight, waist circumference, and blood pressure were measured after parental consent, and investigation requests for fasting lipid profile and blood glucose were given. Children with known metabolic disorders or metabolic profile altering medication were excluded.

Results: A total of 26 (30.6%; 95% CI: 20.6 – 40.6%) children had waist circumference above 75th percentile. Triglycerides ($p < .001$), systolic blood pressure ($p < 001$), and diastolic blood pressure ($p = .013$) were significantly higher among those with waist circumference in the highest quartile. Central adiposity, as defined by waist circumference in the highest quartile, showed the strongest correlation with higher values of triglycerides to HDL-c ratio.

Conclusion: Among the various measures of fatness, central adiposity has the strongest association with cardiometabolic risk as measured by elevated triglycerides and reduced high density lipoproteins.

Key Words: Adiposity, cardiometabolic, HDL, Triglycerides.

INTRODUCTION

A global increase of overweight and obesity in childhood and adolescence has been observed over the last two decades[1-3], while central adiposity has been found to be associated with atherogenic lipoprotein profile, Insulin resistance, prothrombotic and proinflammatory metabolic states and has been found to be associated with increased vulnerabilities to diabetes and cardiovascular disease in adulthood[4-8].

Two measures of central adiposity, Waist Circumference (WC) and Waist-Height Ratio (WHtR) have been used in research and clinical contexts[9], out of which, WC is said to be the best simple index of fat distribution[10], since it is least affected by gender, race, and overall adiposity in children and young adults[11].

Waist Circumference correlates with intra-abdominal and subcutaneous fat, as measured by magnetic resonance imaging, in youth[12], and it has been adopted as sine qua non criterion for the diagnosis of metabolic syndrome by the International Diabetes Federation, stipulating that any two of the other four components, namely: elevated Fasting Blood Glucose (FBG), elevated Blood Pressure, elevated Triglycerides and reduced High Density Lipoprotein-cholesterol (HDL-c), in addition to a high WC are necessary for the diagnosis of Metabolic Syndrome[13].

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For adults, WC is measured and evaluated according to gender and race[14]. However, in children and adolescents, because the measurements change as part of natural growth, the cut-off values are provided as percentiles, with 90th percentile and above considered as diagnostic of central obesity in most studies[15-19], except by de Ferranti et al, who used 75th percentile as the cutoff point[20]. Among the four sites generally used for measuring waist circumference … immediately below the lowest ribs, the narrowest waist, the midpoint between the lowest rib and the iliac crest, and immediately above the iliac crest … there is evidence that the best site might be midway between iliac crest and the lowest rib laterally, with a non-stretchable tape and measured in the horizontal plane directly on the skin to the nearest 0.1 cm in a relaxed standing position with slight expiration[21].

In adults, because of ethnic differences in physique, International Diabetes Federation (IDF) proposed special cut-off values for WC of European, South Asian, Chinese and Japanese adults[14]. In children, although similar differences have been reported, different cutoff points suggested[22,23], and disparities in diagnosis of the metabolic syndrome components documented[24], WC is the only measure of central adiposity that appears to show consistent relationship with cardiometabolic risks across racial backgrounds[25,26].

The other measure of central obesity, WHtR, has been considered by some to be the best indicator of central adiposity, in both genders, for adolescents[27], and reported as better than WC for identifying central adiposity and cardiovascular disease risk factors[28].

Contrary to these findings, the author has found WHtR to have a weaker correlation with Triglycerides to HDL-c Ratio compared to WC[29].

This study was done to assess the prevalence and distribution of increased waist circumference compared to other covariates of cardiometabolic risk, as part of the author's personal initiative to estimate the prevalence of Metabolic Syndrome among Pakistani children from her clinic's catchment area[30].

MATERIAL AND METHODS

This is a cross-sectional study consisting of a sample of eighty five school age Pakistani children, chosen from the families of the clientele of the primary author's clinic, accrued from January 2011 to November 2011. Families of children with known diabetes or lipid disorders were excluded. Based on an empirical estimate of the prevalence of obesity at 8%[31,32], in order to estimate the population proportion with a 6% margin of error, a sample size of 79 would be required for a confidence level of 95%[33].

Parental consent was taken before examining the children. Height, weight, waist circumference, and blood pressure were documented. Waist was measured at a point midway between the lowest rib laterally and the Iliac crest, with the child standing. Investigation requests were given for early morning fasting blood glucose, triglycerides, and high density lipid cholesterol, the child fasting overnight.

Data were entered in the computer using Epidata software[34]. For statistical analysis, R version 2.1[35], and Stata version 8.2[36] software programs have been used. Means ± standard deviation, are reported as summary measures for continuous variables. Proportions are presented as percentages. Group comparisons regarding continuous variables are done using t tests for independent samples. Two sample t tests with unequal variances are used where standard deviations for the variables differ significantly. Z-approximation of binomial distribution and chi square tests are used for comparing categorical variables. Pearson's product-moment correlation coefficient has been used to assess correlations between continuous variables. All tests of significance are two-tailed and a significance level of 0.05 has been used. Both 75th and 90th percentile cutoffs have been used as clinical markers of increased cardiometabolic risk in various definitions of the metabolic syndrome. A cutoff point of 75th percentile has been used for the purpose of analysis in this study.

RESULTS

The sample consisted of 42 (49%) male and 43 (51%) female children, ranging in age from 6 to 12 years. Mean height of these children was 132.3 ± 10.9 cm, Mean weight being 29.6 ± 10.4 kg, and BMI 16.6 ± 3.7 kg/m2. None of these morphometric measures differed significantly between the genders. Based on the last suggested cutoff points of overweight and obesity[39], a total of eight children were found to be obese (9.5%, 95% CI: 4.2 - 17.9%), while seven (8.3%, 95% CI: 3.4 – 16.4%) were overweight, the two categories constituting 17.8% (95% CI: 10.3 – 27.7%) of the sample. Seventeen of these children (20.2%, 95% CI: 12.3 -30.4%) were underweight, a total of 38% (95% CI: 27.7 – 49.3%) either over- or under-weight.

Mean Waist Circumference for the sample was 62.2 ± 9.7 cm with females having a higher value (63.4 ± 7.9 cm) compared to males (60.9 ± 11.1 cm), the difference statistically non-significant (P = 0.24). A total of 26 (30.6%; 95% CI: 20.6 – 40.6%) children from this sample had waist circumference above 75th percentile[40], half of which (95% CI: 30.0 – 70.0%) had normal BMI, i.e. between 5th and 85th percentiles for age and gender. The status of being obese showed a statistically significant association with increased triglyceride levels (P = .008), while being overweight did not show such association (P = .77).

LDL-c (P = 0.003), HDL-c (P = 0.005), triglycerides (P = 0.023) and systolic blood pressure (P = 0.005) were all significantly different between those with high and normal waist circumference in 10-12 years age group. Difference of HDL-c levels between the high and low waist circumference children, with a two tailed test, failed to achieve statistical significance (P=0.08), while for a one sided test, the difference did achieve borderline statistical significance (P = .040).

Triglycerides (p = .002), systolic blood pressure (P = .001), and diastolic blood pressure (P = .002) were significantly higher among those with WC above 75th percentile. Triglycerides to HDL-c ratio, a surrogate measure for Insulin Resistance[41], was also significantly higher among those with waist circumference in the highest quartile (P =.003). The odds of triglycerides to HDL-c ratio being 0.5 or more were 7.3 times higher among those with waist circumference in the fourth quartile. Correlation coefficient of waist circumference with the outcome variable triglycerides to HDL-c ratio (r = .436), was larger than that of weight (r = .408) or BMI (r = .375), although the difference was not statistically significant (P values = .83 and .64 respectively).

DISCUSSION

While 10% of the world's children have been reported to be either obese or overweight[1], by comparison we have found 18% of our study participants belonging to these two categories. Similarly, in a sharp contrast to the 17% of the boys and 12% of the girls reported to have waist to height ratio above 0.5[2], 24% of male and 30% of female children in our sample had waist to height ratio above 0.5.

Compared to the reported 12% of Pakistani children having BMI above 95th percentile[4], we have found more than 15% of these children with BMI values in this range. While Ahmed et al. found 15% of boys and 8% of girls to be obese, we have found 14% of the boys

being obese while 12% being overweight, hence a total of 26% either obese or overweight. For the girls these values are 5%, and 10% respectively.

In this study, we have found that waist circumference above 75th percentile is significantly associated with higher levels of triglycerides ($p = .002$), and also with lower levels of HDL-c ($p = 0.04$ for one tailed test). Higher values of Triglycerides together with lower HDL-c translate into higher values of triglycerides-to-HDL-c ratio, which is an established surrogate measure of Insulin Resistance[43].

On the other hand, waist-to-height ratio above 90th, or even 95th percentiles did not show any significant association with either of the two biochemical markers of increased cardiometabolic risk Compared to that, even overweight alone has showed a significant association with higher triglycerides.

The fact needs to be highlighted here that waist-to-height ratio as a measure of central adiposity has received much more attention in literature over the recent years, in sharp contrast to the simple measure of waist circumference alone[44-46].

We have shown that waist circumference alone can serve as a good indicator of central adiposity and possible risk of Insulin Resistance, which is a major component of the Metabolic Syndrome. Early detection of such dysmetabolic health status in clinical settings, using simple morphometric measures, can be of fundamental importance in primary prevention of diabetes and coronary heart disease.

With the pandemic of diabetes globally, and the ever-increasing costs of healthcare for diabetes and related disorders, early detection of cardiometabolic risk and lifestyle interventions aimed at reducing such risk should probably be considered among the most important goals and highest priorities of public health in our communities.

Routine examination and assessment of children in pediatric clinics in Pakistan does not include the measurement of waist circumference. With up to 16% of 6 to 12 years old Pakistani children carrying increased cardiometabolic risk[31], it is time that this simple measure should be introduced in routine assessments of children. Such change will require a concerted and collaborative multi-sectorial effort by Pediatricians, aimed at changing management guidelines by the various institutions involved in child care.

Association of triglycerides to HDL-c ratio with insulin resistance is well documented[43] and the association of this ratio with cardiovascular disease has been described as robust[47]. Although the cutoff point for this ratio as an indicator of insulin resistance has been reported to be 3, the ratio itself, being a continuous variable, can be perceived to accrue deleterious metabolic influences over time even at even lower levels.

It is also important to notice that 50% of the children with waist circumference in the highest quartile in this sample had normal-range BMI. These children, by any routine examination, will not be considered to be eligible for any further assessment or lifestyle intervention. Introduction of waist measurement in routine clinical pediatric assessment can ensure that such children receive attention at an early stage for lifestyle intervention and health education for the whole family. In addition, proper follow up needs to be provided for this population as an effort to avert the long term consequences of a dysmetabolic state and increased cardiometabolic risk.

With the increasing burden of chronic metabolic and coronary heart disease and in view of the staggering costs of healthcare provision for these disorders, the time is right to initiate preventive measures, aimed not only at the high risk groups but also the general population. Making a simple morphometric measure like waist circumference a part of routine pediatric examination, in an effort aimed at early detection and prevention of increased cardiometabolic risk, can prove to be of great practical importance in this respect.

CONCLUSION

Among the various measures of fatness, waist circumference above 75th percentile shows strongest associated with increased triglycerides and lower levels of HDL-c. This simple measure should be part of routine Pediatric assessment.

Limitations

The sample was taken from the author's private clinic clientele, consisting of relatively affluent families. As such the results may be generalizable to this particular stratum of the community.

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