Original Article

A Study on Waist Circumference as a Screening Tool for Obesity and its Effectiveness in Comparison with BMI among 5-15 Years Urban School going Children at Karimnagar

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Abstract

Introduction: World-wide obesity trends are causing serious public health concern and in many countries threatening the viability of basic health care delivery. Waist circumference as a screening measure of central obesity in children where obesity is a global phenomenon affecting all socio-economic groups, irrespective of age, sex or ethnicity.

Aims and Objectives: Waist circumference Reference values are in percentiles for children with 5-15 years of age in Karimnagar city. To screen over weight and obese children using waist circumference and in comparison with that of BMI (reference values)

Material and Methods: The study was prospective case control observational study included for 5-15 years of 1000 school going children in Karimnagar city from January 2021 to October 2022 For each group children – Height, weight, waist circumference and BP were recorded and BMI was calculated according to their (formula) wt/(ht)2.

Results: There was good correlation with waist circumference and BMI in each age group.

1. The reference values for each age group were constructed for WC, BMI, SBP and DBP.

2. The study population was observed over weight (OW) and obesity with their reference values i.e. OW between 85th and 95th percentile and obese over 95th percentile for both WC and BMI. There was good correlation between BMI and waist circumference for age groups and both the sexes and screening results of OW and obese raising WC and BMI were almost similar. This indirect WC alone can be used to screen over weight and obesity.

Conclusion: Reference values for both waist circumference and BMI, age wise and gender wise were constructed. Reference values for BMI and Waist Circumference with cutoff points of 75th, 85th and 95th percentiles were constructed. The reference values were developed both in percentiles and mean with standard deviation. Using these reference values, children were screened for overweight, obesity using both BMI and WC. Children at risk ("action point" >75th percentile of WC) for metabolic syndrome were identified. There is good correlation between BMI and Waist Circumference. WC measurement alone on regular basis during school health checkup can help to screen, intervene and monitor Overweight and obese children.

Key words: Body Mass Index; Basal Metabolic Rate; Diabetes mellitus; Magnetic Resonance Imaging; Obstructive Sleep Apnea

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Introduction

World-wide childhood obesity trends are causing serious public health concern and in many countries threatening the viability of basic health care delivery. Waist circumference as a screening measure of central obesity in children where obesity is a global phenomenon affecting all socio-economic groups, irrespective of age, sex or ethnicity[1]. Etiopathogenesis of childhood obesity is multifactorial and includes genetic, neuroendocrine, metabolic, Psychological, environmental and social- cultural factors. The treatment of overweight and obesity in children and adolescents requires a multi-disciplinary, multiphase approach, which includes dietary management, physical activity enhancement, and reduction of sedentary behaviour, pharmacotherapy and bariatric surgery[2]. In children and adolescents, overweight and obesity are defined using age and sex specific monograms for BMI. Children with BMI equal to or exceeding the age, gender specific 95th percentile are defined obese. Those with BMI equal to or exceeding 85th but are below 95th percentile are defined overweight and are at risk for obesity related co-morbidities[3]. Obesity index that predicts metabolic syndrome Includes BMI, Waist circumference, waist hip ratio, and waist height ratio and so on[4]. The true measure of obesity/overweight is a total body fat content but can be measured as on today using dual energy X-ray absorptiometer (DEXA). This method is available in a few research centres and not accessible and not affordable to many[4]. Many studies have been conducted using indices like BMI, waist circumference, hip ratio, waist height ratio alone or in combination for screening and evaluating children with obesity and overweight[6]. There are very few studies which have used waist circumference alone to identify obesity and overweight and also they have formulated waist circumference percentiles for their children and they have found this tool useful not only to identify obesity and overweight but also central obesity better predictor of metabolic syndrome[7]. Waist circumference is found to be more useful than BMI in screening for obesity and overweight[8]. In this context, a clinical study to have waist circumference as percentiles was taken up to screen obesity and overweight in school going children age 5-15 years of Karimnagar city and thereby using percentile chart and also to compare its usefulness with that of BMI.

Material and Methods

Study Design: Prospective cross sectional study

Study Place: Schools in Karimnagar city after obtaining the ethical clearance. Pre tested questionnaire method of primary source of information technique was used on school children in the age group of 5-15 years in Karimnagar.

Period of study: January 2021 to October 2022

Sample size: 1000 healthy school going children using the purposive sampling technique who met the predefined criteria.

Inclusion Criteria:

School going healthy children between age group of 5-15 years

Exclusion Criteria:

1. Children suffering from chronic illness
2. Children on long term medications
3. Children with congenital anomalies

Methodology and Sampling

In this study data regarding the list of schools in Karimnagar city was collected from Deputy Director of public instruction office and the schools were selected by purposive samplings.

1. The following information was collected
   - Age
   - Sex
   - Height
   - Weight
   - BMI
   - Waist circumference
   - Blood pressure
2. Waist circumference was measured in centimetres without compression of soft tissue at mid way level between lower rib margin and iliac crest using non stretchable measuring tape.
3. All measurements were taken while subject was standing with feet together, arms at the side, body weight evenly distributed and wearing little clothing.

4. Regarding comparison to Body mass index, height and weight will be measured by using stadiometer with child bare foot upright on ground with heels buttock touching well and hand in Frankfurt plane.
5. A calibrated and standardized mechanical scale was used to measure weight; body mass index was calculated (weight in kgs and height in meters).
6. Childhood central obesity was a serious public health problem where 90th and 95th percentile of body mass index were taken as a reference.
7. The data that was collected was transferred to a excel sheet as the master chart and was analysed.

Statistical Analysis:

Data analysis was done with the help of computer using the SPSS 25Version software range, frequencies, percentages, means, standard deviations chi-square, regression analysis, correlation, ANOVA and 'p' values were calculated. Chi-square test was used to test the significance of difference between quantitative variables and Fischer exact test for qualitative variables. A 'p' value less than 0.05 and 0.01 taken to denote significant relationship.

Results

A total of 1000 subjects were employed in the present study, of which 408 were males and 592 were female subjects. The age group wise distribution from 5 to 15 years indicated that there were 28,117 ,92,75,81,78,117,101,116,112, and 83 subjects in the age group of 5 to 15 respectively. Further, Cramer's V revealed a significant association between age and gender (CV=.201; p=<.0001), where we find that more male subjects in 7 and 8 years age groups and both males and females equal in 5 year age group and in remaining age groups we find more of female subjects.

Table -1: ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
Waist Circumference	Between Groups	15145.287	10	1514.529	28.629	0.0001**
	Within Groups	52320.635	989	52.903		
	Total	67465.922	999			
BMI	Between Groups	876.531	10	87.653	7.326	0.0001**
	Within Groups	11832.798	989	11.964		
	Total	12709.329	999			

In BMI, we find a significant mean difference across different age groups, as one way revealed significant difference between mean BMI scores of subjects in the age groups of 5 to 15 years. F value of 7.326 with 8 and 989 degrees of freedoms found to be significant at .0001 level. Two seventy four (274) out of 1000 children had WC above 75th percentile representing those at "Action Point", who needed intervention to prevent from becoming obese and at risk for metabolic syndrome. Taking into consideration between 85th and 95th percentile of WC as overweight 14.02% (83/592) female children and 9.06% (37/408) male children and overall 12% (120/1000) children in study group were overweight. Taking into consideration between 85th and 95th percentile as BMI 10.7% (44/408) males and 10.9% (65/592) females and overall 10.9% (109/1000) of study population showing overweight.

Table 2: Distribution of Children with >95th Percentile of WC, BMI, SBP and DBP

Age	SBP			DBP			WC			BMI		
	M	F	T	M	F	T	M	F	T	M	F	T
5-7	4	2	6	3	2	5	0	0	0	2	0	2
8-10	12	16	28	9	12	21	2	2	4	7	8	15
11-13	25	48	73	15	37	52	14	13	27	9	13	22
14-15	15	33	48	4	19	23	3	14	17	2	8	10
Total	56	99	155	31	70	101	19	29	48	20	29	49
Percent	13.73	16.72	15.5	7.6	11.82	10.1	4.7	4.9	4.8	4.90	4.90	4.9

This table shows WC, BMI, SBP and DBP 4.7% (19/408) males, 4.9% (29/592) females and an overall 4.8% (48/1000) of children in the study group were obese taking into consideration of >95th percentile of WC. 4.9% (20/408) of male children and 4.9% (29/592) female children and an overall of 4.9% (49/1000) children in the study group were obese taking into consideration >95th percentile of BMI.

Table-3: Comparison between WC and BMI in identifying overweight and obese children

	WC			BMI		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Overweight (>85th and <95th Percentile)	37	83	120	44	65	109
	9.06%	14.02%	12.00%	10.7%	10.9%	10.9%
Obese (>95th percentile)	19	29	48	20	29	49
	4.6%	4.9%	4.8%	4.9%	4.9%	4.9%
Total	408	592	1000	408	592	1000

This observation indicates WC is as good as BMI in identifying overweight and obesity.

Discussion

Waist circumference provides a simple yet effective measure of truncal adiposity in children and adolescents. WC is recommended as an index for central fat distribution, but there is no global standard for it. 53.2% of children who were obese using WC were either OW or Normal using BMI. The relationship between an increasing WC in obese children 12 to 14 years old with an adverse lipid profile has been observed[1]. Bogulosa heart study showed that an abdominal fat distribution indicated by WC in children between 5 and 17years. Old children were associated with adverse concentration of tri-glycerol LDL, cholesterol, HDL, cholesterol and Insulin. WC as it correlates well with BMI and metabolic abnormalities and is a straight forward methodology for predicting risk for cardiovascular disease and could be adopted as an alternative or additional measurement to BMI in children. Various international organizations and expert groups such as WHO, have attempted to define metabolic syndrome[3]. Out of all definitions, modified NCEPATPIII (2003) AND IDF definitions (2007) have a universal appeal and can be easily adopted in developing countries like ours.

Table 4: IDF and NCEP definition of metabolic syndrome for children and adolescents

CVD risk factors	**International Diabetic Federation(IDF)**	**NCEP ATP III modified as per age**
Waist Circumference	≥90th	>90th percentile
Blood Pressure	SBP≥130 OR DBP ≥85MM Hg or taking Antihypertensive drug	>90th percentile
HDL-C(mg/dl)	≤40	≤40
Triglyceride(mg/dl)	≥150	≥110
Glucose	≥100	≥110
Diagnosis	Central obesity +2 or more criteria	3 or more among 5 criteria

NCEP ATP III: National Cholesterol Education Program Adult Treatment Panel III; HDL-C High Density Lipoprotein Cholesterol; CVD: Cardio Vascular Disease

In our study screening for overweight and obese using waist circumference alone, using 75th percentile as cut off value for action point to identify those at risk, 274/1000 were at risk 24.51% being boys

and 29.39% being girls[4]. This 75th percentile as cut off value was as per recommendation of **Hirrschler et al**. who conducted a study with 5103 children aged 4 to 13 years and findings were summarized as WC value could be the right and practical tool to identify young children at risk for future type-2 diabetes and cardiovascular disease.**Anuradha Khadilkar et al** developed age and sex specific waist circumference percentiles in age 2 to 18 years old children. WC values increased with the age in both boys and girls. The median waist circumference at age >15 years was greater in boys than in girls. ROC (Receiver Operating Characteristic) analysis suggested that the 70th percentile as a cut off for metabolic risk[8]. Metabolic syndrome is no more an adult problem. Recent estimation for economic impact of Non-Communicable Disease (NCD) on India for the year 2012-13 has shown total losses associated with five NCD (Diabetes, CVS, Respiratory Diseases, Cancer and Mental Health) was USD 2.6 trillion, cardiovascular diseases alone estimated to maximum loss that is USD 1.21 trillion. Thus the need to identify the risk factor for metabolic syndrome early in life. Waist circumference in screening protocol to estimate the prevalence of central adiposity in school age children should be a prime priority and provides an indicator of the future health of children and aids in instituting appropriate remedial strategies for those at risk factors of central obesity[9]. Percentiles between 85 and 95 and/or above 95th percentile are significantly higher metabolic risk parameters as compared with those with less than 85th percentile for both WC and BMI. A study of central fatness using waist to height ratio in UK children and adolescence over two decades supports the simple message **"Keep your waist circumference to less than half of your height"**.

Conclusion

Childhood obesity is one of the serious problems encountered nowadays.

1. Reference values for both waist circumference and BMI, age wise and gender wise were constructed.
2. Reference values for BMI and Waist Circumference with cut off points of 75th, 85th and 95th percentiles were constructed.
3. The reference values were developed both in percentiles and mean with standard deviation.
4. Using these reference values, children were screened for overweight, obesity using both BMI and WC.
5. Children at risk ("action point" >75th percentile of WC) for metabolic syndrome were identified.
6. There is good correlation between BMI and Waist Circumference.
7. WC measurement alone on regular basis during school health checkup can help to screen, intervene and monitor overweight and obese children.

What this Study Adds?

WC shows good correlation with BMI. WC alone can be used to screen OW and obese children. Recording WC alone or along with other anthropometric measurements during routine school health checkup is of great help in screening for and monitoring early intervention in case of overweight and obese children. It also helps to identify the secular trends in WC.

Conflict of Interest: NIL

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