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Original Research Article

Age and sex-specific waist circumference percentiles among school children in Chennai

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ABSTRACT

Background: The aim was to develop age- and sex-specific waist circumference percentiles for school children aged 5 to 17 years in Chennai.
Methods: This was a cross-sectional study done among school children in Chennai. A total of 1124 children aged 5 to 17 years were included in the study, of which 540 were female and 584 were male. Anthropometric details, weight, height, waist circumference (WC), and body mass index (BMI) were measured. The percentiles for waist circumference according to age and gender was done using SPSS 28.0. Khadilkar et al suggested a cutoff of 70th centile screening for central obesity and risk for metabolic syndrome; similarly, we plotted 70th WC percentiles.
Results: Age- and sex-specific WC percentiles (5th, 10th, 15th, 25th, 50th, 75th, 85th, 90th, 95th) were provided. Our study revealed a higher prevalence of overweight or obesity (40.6%) in children (overweight: 21.08%, obesity: 19.50%) when compared to other school studies. BMI in children with WC >70th percentile revealed 87% of them were overweight or obese. A strong and significant statistical correlation was observed between waist circumference and overweight or obesity ($p<0.001$).
Conclusions: Age- and sex-specific reference curve percentiles for waist circumference and cut-off values greater than the 70th percentile for schoolchildren were provided. We strongly recommend utilising waist circumference as an anthropometrical tool to quantify central obesity in schoolchildren.

Keywords: Waist circumference, Body mass index, Obesity, Overweight, Metabolic syndrome

INTRODUCTION

In the present era, one of the critical public health challenges is childhood obesity, despite emerging as a concern several years ago. According to 2016 Global estimates, 40 million under the age of 5 years and 330 million between 5 to 19 years of age were either overweight or obese.[1]

Over the past forty years, there has been an eight-fold increase in the prevalence of childhood obesity in those aged 5 to 19 years and a doubling in children aged 2-4 years. India is currently ranked third in the world for the prevalence of paediatric obesity, behind China and the United States. The prevalence of overweight or obesity increased from 16.3% in 2001-2005 to 19.3% in studies conducted after 2010, according to a compilation of 52 Indian studies.[2]

Childhood obesity has significant short and long-term repercussions. These children experience short-term psychological comorbidities like depression, anxiety, and low self-esteem. Moreover, they have higher rates of metabolic and cardiovascular risk factors, including hypertension, dyslipidemia, type 2 diabetes, and other cardiovascular system abnormalities. Long-term risk factors for cardiovascular disease, diabetes, certain

malignancies, and musculoskeletal issues in adulthood include being overweight or obese as a child.[1]

Obesity is detected by various anthropometric measurements, and the most common tool used worldwide is the calculation of BMI using weight (kg) divided by height (metres) squared. In India, BMI for children aged 5 to 18 years is plotted on the Indian Academy of Paediatrics (IAP) 2015 charts. The IAP 2015 charts used the International Obesity Task Force (IOTF) technique for developing the BMI charts because Asians have a tendency for greater cardiometabolic risk with a lower BMI. For Asian Indians, the overweight and obesity cutoffs in IAP charts are the 23-adult equivalent (as overweight cutoff) and the 27-adult equivalent (as obesity cutoff).[3]

BMI is a more accurate indicator of overall adiposity and it assesses only excess body weight to length, which includes lean muscle mass. It does not differentiate between fat and fat-free mass, and it may not be able to effectively assess adiposity, especially central adiposity.[4] BMI calculation is time-consuming, and it gets easily skipped in daily paediatric OPD practice.

WC is an additional crucial anthropometric parameter that needs to be measured and plotted. WC is easy to measure at the office or at home and can be used for large-scale population studies.

WC is an important component of paediatric metabolic syndrome, and it can predict visceral adipose tissue, hypertension, and an abnormal lipid profile in adolescents.[5]

WC measurement is not only useful for evaluating children with obesity but also for finding those children who are not overweight or obese but have excessive visceral adiposity who are at risk for metabolic syndrome.[3]

For Indian children aged 2 to 18 years, age- and sex-specific WC percentiles are available, and a cutoff value of 70th percentile for WC is advised to screen Indian children for the risk of metabolic syndrome.[6] The 90th percentile has been proposed as the threshold for determining central adiposity by the National Health and Nutrition Examination Survey (NHANES).[7]

In this study, we aimed to measure waist circumference percentiles in healthy children of age 5 to 17 years studying in private schools in Chennai. Also, to plot 70th cutoff values for WC, and compare with BMI.

METHODS

This study was conducted for 4 days, from July 14 to July 17 2022. A cross-sectional study was carried out in a private urban Secondary School, Chennai with a fee structure of approximately 15 thousand per term, covering all socio-economic strata. This study was approved by institutional ethical review committee. Detailed written protocol was provided to all parents through school administration requesting them to give consent for their children to participate in the study. Date of births of all children was recorded from the school registers. 1124 healthy school children between the ages of 5 and 17 were included under study. Clinical history was collected, anthropometric details (weight, height, BMI, waist circumference) were measured, and a systemic examination was performed and children with significant systemic diseases were excluded from study. Utilizing standardized methods, weight was measured using portable electronic scale, standing height was measured using portable stadiometer. BMI was calculated using weight (kg) divided by height (meter) square. Children were categorized into either normal, overweight (BMI more than 23 adult equivalents) or obese (BMI more than 27 adult equivalents) by plotting BMI in IAP 2015 charts. The WC was measured with a non-stretchable tape in a standing position with arms at the sides and feet close together during end-tidal expiration at the midpoint of the lowest rib cage and the iliac crest, to the nearest 0.1 cm, while applying the same standard pressure on the tape. Centile charts of waist circumference by Khadilkar et al were taken as reference. The cutoff value for WC was considered to be above the 70th percentile, which was an indication of visceral adiposity and a risk factor for metabolic syndrome.

Descriptive statistics were presented with frequency (percentage) and mean (SD) for the categorical and continuous factors respectively. Percentile were calculated for WC according to age and gender. Smooth curve for waist circumference was performed according to the gender. The analysis was done by using SPSS 28.0.

RESULTS

1124 students in total took part in the study, of which 540 were female and 584 were male. The descriptive statistics of age and gender-specific waist circumference percentile tables for children aged 5 to 17 are given in Table 1. WC percentile curves (5th, 10th, 15th, 25th, 50th, 75th, 85th, 90th, 95th) for boys and girls are depicted in Figure 1. Table 2 presents WC percentiles above the 70th percentile cutoff values for boys and girls.

The prevalence of normal BMI in the study population was 59.3% (667), and the prevalence of overweight and obesity was 21.08% (237) and 19.5% (220), respectively. In the study group, the prevalence of central obesity was 29.71% (334), as determined by waist circumference measured above the 70th percentile. In the study population, 334 children were above the 70th percentile for waist circumference, of which 13% had normal body mass indices, 55.9% were overweight, and 31.1% were obese. Overweight and obesity together were observed in 87% of children with WC >70th percentile.

Table 1: Age and sex specific WC percentile values (cm) for school children 5 to 17 years of age.

Gender	Age in years	Waist circumference percentile								
		5th	10th	15th	25th	50th	75th	85th	90th	95th
Male	5+	48.3	50.0	50.0	52.0	54.0	56.6	58.5	62.0	66.0
	6+	49.0	49.5	52.0	52.5	56.0	60.5	65.0	68.0	72.5
	7+	50.7	52.4	53.5	55.0	57.8	67.8	71.5	75.6	80.1
	8+	52.0	53.0	54.0	56.0	60.8	67.1	71.7	72.7	75.6
	9+	51.3	55.2	56.8	58.5	65.0	74.5	77.7	79.0	84.6
	10+	54.2	55.6	56.5	61.0	67.0	73.0	78.0	81.3	86.0
	11+	55.1	56.3	59.5	64.8	73.3	79.3	85.7	88.4	97.8
	12+	58.4	60.8	63.4	67.0	74.0	83.0	89.4	90.0	92.0
	13+	61.6	63.2	67.3	71.8	79.5	89.0	93.4	94.0	98.0
	14+	64.4	67.2	69.6	72.0	80.0	89.0	93.2	96.8	101.2
	15+	62.5	64.0	64.5	68.8	79.0	86.5	92.0	99.5	102.5
	16+	60.7	62.9	64.4	69.5	76.1	88.5	91.4	94.9	109.0
	17+	66.5	68.6	73.2	73.6	79.0	97.5	105.1	111.9	
Female	5+	48.6	49.0	49.0	50.8	53.3	57.0	59.0	60.8	65.1
	6+	49.0	49.1	50.6	52.0	54.0	61.1	63.4	64.0	69.9
	7+	49.7	54.0	54.0	55.6	58.3	64.1	67.1	69.9	75.6
	8+	51.2	53.6	54.2	56.0	60.5	68.8	70.4	73.3	77.5
	9+	50.9	55.0	56.7	57.5	63.5	68.1	71.9	73.9	78.3
	10+	52.6	56.2	57.1	58.0	65.0	76.0	78.5	82.8	84.9
	11+	58.0	60.0	60.3	63.0	70.0	77.0	81.0	87.8	95.8
	12+	63.6	65.4	66.8	69.3	76.5	86.0	93.5	94.6	96.6
	13+	61.1	64.7	67.0	71.0	78.0	88.3	93.9	96.3	102.9
	14+	60.8	64.0	67.0	69.5	74.0	83.5	87.9	93.4	104.0
	15+	59.5	62.9	65.0	68.5	71.5	80.0	84.3	90.2	92.0
	16+	56.2	62.6	64.6	69.6	75.3	83.0	88.5	89.3	93.3
	17+	66.0	67.8	70.4	73.6	77.5	82.0	86.5	92.1	

Table 2: 70th percentile WC values for boys and girls.

Age in years	Gender	
	Male	Female
5+	56.0	56.0
6+	59.5	58.4
7+	63.6	62.6
8+	65.0	66.7
9+	71.0	66.6
10+	72.9	75.2
11+	77.2	74.3
12+	81.8	84.0
13+	85.7	85.7
14+	87.4	80.8
15+	85.0	79.1
16+	85.4	81.9
17+	88.4	81.8

Age-related increases in WC levels were seen in both boys and girls. At every percentile point, boys had a higher WC than girls' percentiles, except for between ages 11 and 13 years.

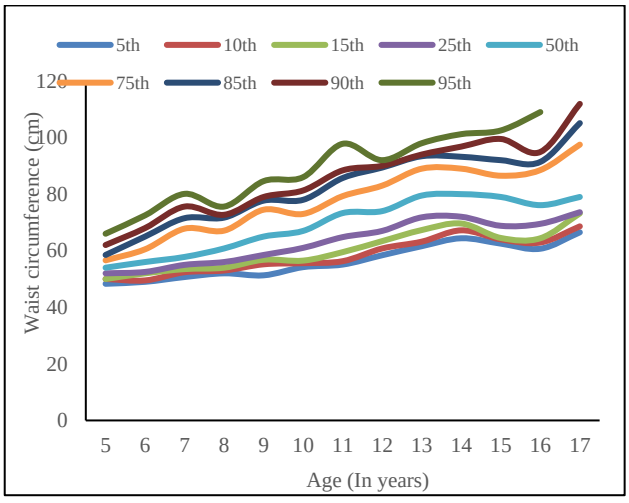

Figure 1: WC percentile curves for school children males aged 5 to 17 years.

WC showed a statistically significant correlation with overweight or obesity ($p<0.001$).

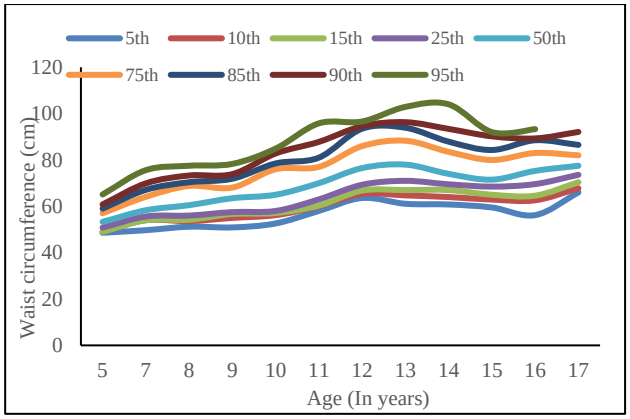

Figure 2: Waist circumference percentile curves for school children females aged 5 to 17 years.

DISCUSSION

In the past two decades, the prevalence of obesity has increased globally. Being overweight and obese leads to many health problems and is significantly associated with metabolic syndrome, coronary heart diseases, musculoskeletal problems, respiratory illness, mental health issues, and various gastrointestinal and hepatobiliary disorders.

In our study, primary objective was to find out age- and sex-specific waist circumference percentiles for schoolchildren aged 5 to 17 years. According to a meta-analysis of Indian studies, the prevalence of overweight and obesity in children older than five years ranges from 0.1 to 11.7% and 2.7 to 25.2%, respectively.[8] In the present study, prevalence of overweight or obesity was higher than that of many other school studies conducted in India, was 40.6% (overweight: 220 (21.08%), obesity: 237 (19.50%).[9]

Zimmet et al have proposed that children with WC over the 90th percentile are more likely to be at risk for MS, although other researchers have proposed an increased risk at lower percentiles (i.e., the 85th or 75th percentile).[10] According to Khadilkar et al the cutoff values for waist circumference to screen for metabolic syndrome were at the 70th percentile. We observed that the prevalence of overweight and obesity in children with an above-70th percentile waist circumference at ages 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, and 17 years was 51.8%, 86.1%, 92.3%, 83.7%, 92.3%, 100%, 88%, 96.1%, 89.6%, 96%, 85.7, 90.9%, and 75%, respectively. Overweight and obesity were observed in 87% (291) of children with WC >70th percentile.

The WC percentiles seen among schoolchildren showed a progressive increase in values in both boys and girls when compared to Khadilkar et al who carried out a study a decade ago. There had been an inherent tendency towards higher adiposity during the last decade, and unless aggressively addressed, there was a risk of morbid obesity in the next generation. The projection of a rapid rise in BMI due to a sedentary lifestyle, higher consumption of fast food, excessive gadget usage, automobile drop-and-pickup from school to home, and decreased extracurricular activities in order to meet the demands of academic curricular goals.

According to many studies, WC is being increasingly used for screening for visceral obesity and metabolic risk in children, but there still remains no consensus on age- and sex-specific appropriate cutoff values. The data from our study can be used to evaluate WC in Indian children based on their age and gender. And also, we compared 70th percentile waist circumference cut-off values with BMI and overweight/obesity. This study added and revalidated the diagnosis of obesity using WC as an anthropometrical tool in schoolchildren, as the prevalence of overweight and obesity was high above the 70th percentile WC cutoff values.

The WC values proposed in the present study may be used as an additional tool in addition to BMI in screening for central obesity in Indian children, considering the established correlations between WC and other cardiometabolic risk factors in children.

The WC percentiles will be helpful in detecting children who have central obesity and screening them for those who might benefit from early dietary and exercise intervention.

Limitation

The urban school may have a higher prevalence of overweight and obese students due to unhealthy dietary habits and sedentary lifestyles. The sample size was small for deriving percentiles, as the study was conducted at a single school.

CONCLUSION

Age- and sex-specific reference values and percentile curves for waist circumference and cut-off values greater than the 70th percentile for schoolchildren were provided. We strongly recommend utilizing waist circumference as an anthropometrical tool to quantify central obesity in schoolchildren because the prevalence of overweight and obesity is high above the 70th percentile WC cutoff values.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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