

Original Article

Evaluation of Accuracy on Waist to Height Ratio as A Screening Tool for Obesity in Children Aged 5-12 Years

Kotana Siva Prasad¹, A Thumjaa², M Mathivanan³

Abstract

Background : Obesity and its related disorders have turned out to be a Global health issue and it is the fifth most common cause of death Worldwide. Waist to Height Ratio (WHtR) is a better screening tool than BMI to identify central obesity. WHtR is superior than BMI and it is more accurate in identifying co-morbidities like cardiovascular risks in children with obesity. Hence, this study was done to screen WHtR in determining obesity in children aged from 5-12 years.

Materials and Methods : A cross-sectional observational study was done in 940 children aged 5 to 12 years who came to OPD. Demographic data and anthropometric measurements like Weight, Height and Waist circumference and BMI were recorded. Data was analysed by SPSS.V.28.

Result : Among 940 children, 509(54.1%) were Boys and 431(45.8%) were Girls, in which 118 children were Obese, out of which 62(52.5%) were boys and 56 (47.5%) were girls. Mean WHtR was 0.44 ± 0.08 . There was significant correlation between WHtR and BMI (p value<0.00001). Our study showed higher AUC range of 0.089 and 0.090 with higher specificity levels which shows that WHtR can be used to determine obesity in children.

Conclusion : WHtR is a simple, easy, inexpensive, less age dependent and accurate index for identifying overweight and obesity in children.

Key words : Obesity, Waist to Height Ratio, BMI.

Obesity and its related disorders have turned out to be a Global health issue and it is the fifth most common cause of death Worldwide. WHO further clarifies that the fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended¹. During the past years, there is seen to be increased consumption of high calorie foods, less physical activity leading to increased prevalence of obesity and its risks such as Type 2 DM, cardiovascular diseases and metabolic syndromes in children². According to WHO, the prevalence of childhood obesity was 8.4% and overweight was 12.4%. In the year 2022, over 390 million children and adolescents were overweight and 160 million were living with obesity, In which 19% of girls and 21% of boys were overweight. If this trend persist, India will contribute approximately 11% of the Global burden of childhood obesity by 2030³. According to World Obesity Federation (WOF) 2024, over 30 million Indian children and adolescents of age 5-19 years were Obese, with a prevalence of 9%. If similar trends persist, over 80 million children will be Obese, with a prevalence rate of 24% by the year 2035⁴. WHtR is an anthropometric parameter used as an efficient and easy tool for quick, mass screening and to detect obesity in early childhood⁵. WHtR

Editor's Comment :

- This cross-sectional observational study evaluated the accuracy of Waist-to-height Ratio (WHtR) as a screening tool for obesity in 940 children aged 5-12 years.
- WHtR showed a significant correlation with BMI (p<0.00001) and demonstrated high specificity in identifying overweight and Obese children.
- The study concludes that WHtR is a simple, cost-effective, age-independent, and reliable tool for screening childhood obesity.

does not need age and gender-specific charts for interpretation. WHtR is better screening tool than BMI to identify central obesity⁶. Hence, the study was done to screen WHtR in determining obesity in children aged from 5-12 years.

MATERIALS AND METHODS

A cross sectional observational study was conducted in Children aged 5 to 12 years attending OPD, Department of Paediatrics, Aarupadai Veedu Medical College and Hospital. All children aged 5-12 years attending Paediatric OPD were included in this study where as children with congenital anomalies and chronic systemic illness were excluded. Informed consent was obtained from all the patients by giving a detailed explanation of the study protocol. Demographic information such as name, gender, age, and anthropometric measurements like Weight, Height, Waist, circumference and Body Mass Index (BMI) was recorded. Height was measured by standing upright and recorded to the nearest 0.1cm by using a stadiometer, and Waist circumference was measured by a nonelastic tape midway between the lower border of the rib cage

Department of Paediatrics, Aarupadai Veedu Medical College & Hospital (AVMC), Puducherry 607402

¹MD, Postgraduate Trainee and Corresponding Author

²MD, Professor

³MD, DCH, Professor

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and the upper iliac crest to the nearest 0.1 cm. Weight was measured to the nearest 0.1 kg using a calibrated weighing mission. Weight to Height Ratio was determined using the formula Waist circumference (cm) divided by Height (cm) and Body Mass Index was determined using the formula, Weight(Kg)/Height(m²). Data was collected and compared by Pearson’s correlation co-efficient to correlate WHtR and BMI. Area under curve was used to determine the best cut off value of WHtR to predict obesity.

RESULTS

In our study 940 children were enrolled in the age group of 5-12 years, 509(54.1%) children were Boys and 431(45.8%) children were Girls. The mean WHtR in Boys and Girls were 0.445±0.07 and 0.442±0.09 respectively and overall mean WHtR was 0.44±0.08.

In this study, WHtR were calculated for 940 children, out of which 633(67.3%) children were normal where as 189(20.1%) and 118(12.5%) children were over weight and Obese respectively. p value is 0.404 (p>0.05) which suggests that there is no significant difference between boys and girls in WHtR as shown in Table 1.

Based on the BMI, 214(22.7%) were Underweight, 513(54.5%) were Normal, 142(15.1%) were Overweight and 71(7.5%) were Obese respectively. p value is 0.0039 (p<0.05) which suggests that there is a significant difference between Boys and Girls in BMI as shown in Table 2.

Pearson correlation was performed to find the correlation between WHtR and BMI in the study population. The results show statistically significant correlation (p value<0.05) between WHtR and BMI in detecting overweight and obesity among children belong to the age groups of 5 to 12 years as shown in Table 3.

Table 1 — Distribution of children based on WHtR

	Normal		Overweight		Obesity		p value
	N	%	N	%	N	%	
Boys	352	55.6	95	50.2	62	52.5	0.404
Girls	281	44.4	94	49.8	56	47.5	
Total	633	100	189	100	118	100	

Table 2 — Distribution of children based on BMI

	Underweight		Normal		Overweight		Obesity		P Value
	N	%	N	%	N	%	N	%	
Boys	129	60.2	253	49.3	79	55.6	48	67.6	0.0039
Girls	85	39.7	260	50.6	63	44.3	23	32.3	
Total	214	100	513	100	142	100	71	100	

Table 3 — Correlation between Waist Height ratio and BMI

	Waist-to-height Ratio		BMI		r value	p value
	N	%	N	%		
Overweight	189	20.1	142	15.1	0.63	<0.00001
Obesity	118	12.5	71	9.5		

The best cut off value of WHtR by ROC to identify Over weight in boys was >0.445 (AUC-0.086) with sensitivity of 74% and specificity of 95%. Where as the cut off value to identify obesity in Boys was >0.485 (AUC-0.089) with sensitivity of 76% and specificity of 98%. In Girls, the best cut off value of WHtR by ROC to identify Over weight was >0.445 (AUC-0.086) with sensitivity of 75% and specificity of 97%. To identify obesity in Girls, best cut off value of WHtR by ROC was >0.475 (AUC-0.090) with sensitivity of 80% and specificity of 99% as shown in Table 4, which concludes that WHtR can be used as a screening tool in predicting obesity in children.

DISCUSSION

Obesity is excessive accumulation of body fat, which can lead to chronic diseases like Hypertension, Diabetes and Cardiovascular disorders. Obesity is commonly measured using Body Mass Index (BMI), but this metric alone does not capture the full scope of adiposity or its distribution. Although Body Mass Index (BMI) is widely used for assessing obesity, studies have highlighted its limitations in preventive practice, particularly its lack of precision in evaluating cardiovascular risk and body fat distribution⁷⁻⁹.

In this study, 940 children were enrolled, out of which 509(54.1%) were Boys and 431(45.8%) were Girls. The mean WHtR was 0.44±0.08, which was similar to the study done by Gabriela Ricardo, *et al*¹⁰ with 4964 children aged 6-10 years in Brazil with the mean WHtR of 0.44±0.04. In a population based study done in India by Avina Sarna, *et al*¹¹, the WHtR obtained in children aged 5-19 years showed a mean value of 0.43±0.04 which is more comparable due to similar ethnicity and cultural backgrounds. The mean BMI was 15.8±2.5, whereas the mean BMI from the study done by Avina Sarna, *et al*¹¹ was 16.2±3.1 which shows a slight increase in mean BMI which was contradictory to our study.

In our study, overweight and Obese using WHtR was 20.1%(189) and 12.5%(118) respectively. The optimal cut off values of WHtR >0.445 in both Boys and Girls were taken to predict overweight and WHtR>0.485 and >0.475 in Boys and Girls were taken respectively to predict obesity and proved that these cut off values were appropriate and effective in predicting overweight and obesity which was similar to a study done by Weili Yan, *et al*¹² in 2055 school going children in China aged 8-18 years in which WHtR was used for diagnosing overweight and obesity and the cut off values of WHtR for overweight in both Boys and

Table 4 — AUC including the optimal Waist-to-height Ratio cut-off

	Waist to Height ratio	Cut-off	AUC	Sensitivity	Specificity
Boys	Overweight	0.445	0.086	74	95
	Obesity	0.485	0.089	76	98
Girls	Overweight	0.445	0.086	75	97
	Obesity	0.475	0.090	80	99

girls was >0.445 and cut off values for obesity in Boys and Girls were >0.485 and >0.475 respectively. These WHtR cut off values were statistically significant and can be used to evaluate obesity in children. The proportion of the children who were overweight and Obese in the quoted study was 18% and 7.3% respectively. But Marrodan, *et al*¹³ conducted a study in 2319 children aged 6-14 years, in which WHtR >0.47 and >0.48 in Boys and Girls to diagnose overweight and >0.51 and >0.5 in boys and girls to diagnose obesity were taken as the cut off and proved that these cut off values were effective in predicting overweight and obesity which was contradictory to our study.

The correlation between WHtR and BMI in detecting overweight and obesity showed statistically significant correlation (p value <0.00001) between WHtR and BMI. Similar results showing significant correlation between WHtR and BMI in detecting overweight and obesity were obtained by the study done by Valesca Mansur Kuba, *et al*,¹⁴ in which 175 school going children aged 6-10 years from Brazil were enrolled. Another study done by Gabriela ricardo, *et al*¹⁰ in 4964 children aged 6-10 years in Brazil also showed results similar to our study.

In our study, the AUC was 0.086 in both Boys and Girls to predict overweight using a WHtR cut off >0.445 and AUC-0.089 in Boys and 0.090 in Girls to predict obesity which showed higher specificity values proving that these WHtR can be used as a screening tool in predicting obesity in children which was similar to a study conducted by Yalan Dou, *et al*¹⁵ on 8130 children and adolescents aged 7-18 years which showed higher AUC range of 0.84 and satisfactory sensitivity and specificity levels with an optimal WHtR cut off value of 0.487 in Boys and 0.456 in Girls.

In our study, WHtR is significantly useful in predicting overweight and obesity in children.

Recommendation : Additional large-scale prospective studies are needed to confirm the usefulness of WHtR for predicting comorbidities of obesity in children and adolescents.

CONCLUSION

WHtR is a simple, easy, inexpensive, less age dependent and accurate index for identifying overweight and obesity in children and adolescents. The cut-off points of WHtR >0.445 for both boys and girls were used to detect overweight and >0.485 for Boys and >0.475 for Girls were used to predict obesity.

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