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Original Research Article

Body fat indices for identifying risk of hypertension in Indian children

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ABSTRACT

Background: Studies in India shown high body fat indices were strongly associated with hypertension in Indian children, but such studies mostly not done in southern states of India. So, authors include children in Tamilnadu measure body fat indices and blood pressure to find which body fat index correlates closely with hypertension.
Methods: Standing height was measured using stadiometer. Weight was measured using electronic scale. WC measured in standing position, by a stretch resistant. WC above 90th centile will be considered as Adipose. Waist to height ratio optimal cut-off value is 0.44 for children. TSFT recorded using Harpenden caliper, on the non-dominant upper arm. Wrist circumference measured using stretch resistant tape.
Results: In this study 2000 children were participated. More hypertensives are seen in 10 to 12 years(62) and 16 to 18 years(31).Increased weight correlated with hypertension. Study indicates waist circumference is significantly correlated with systolic BP $p<0.003$, diastolic BP $p<0.000$. This study shows significant correlation $p<0.003$ for systolic and $p<0.000$ for diastolic BP with triceps skin fold thickness estimation. In multivariate analysis with systolic blood pressure and diastolic blood pressure shows very strong correlation with waist circumference, waist to height ratio and triceps skin fold thickness.
Conclusions: In this study we investigate the correlation between body fat indices and blood pressure correlation was statistically analyzed which shows that waist circumference, waist to height ratio and triceps skin fold thickness were strongly correlated with systolic and diastolic BP.

Keywords: Body mass index, Hypertension, Triceps skin fold thickness, Waist circumference, Waist to height ratio

INTRODUCTION

Children are becoming obese in younger ages, both in high-income as well as middle and low-income populations.[1] Obesity is identified as the most important risk factor affecting blood pressure (BP) distribution in children.[2,3]

Normal range of BP in childhood varies with age and gender.[4] Considering the strong correlations of anthropometric parameters such as body mass index (BMI) and waist circumference (WC) with BP, an indirect assessment of high BP using these indices may be an efficient strategy in the community setup.[5] Various studies have shown significantly high body mass index (BMI), waist circumference (WC), waist to height ratio (WHTR), triceps skin fold thickness (TSFT) and wrist measurements were significantly associated with risk of hypertension in various multi-centric sample of Indian children and adolescents.[6] WC and WHtR are better predictors of central adiposity and obesity related metabolic risks. In Tamilnadu very few studies are done on risk factors for Hypertension in children and its outcome.

The aim of this study was to determine the efficacy and correlation of body fat indices and hypertension in urban school going children. There by useful in providing a cutoff value for these body fat indices in Tamilnadu School going children in future.

METHODS

It's a Cross sectional study in urban schools of Tamilnadu. Period of study is 6months. Sample size was 2000 children (Convenient sampling) Inclusion Criteria-Urban school going children aged 10 to 18 years. All apparently healthy children from 10 to 18 years of age from the selected urban schools were included after informed written consent from parents and assent from children. The exclusion criterion is children with pre-existing serious illnesses.

The study was approved by the ethics committee of the institute of child health and hospital for children. A single team led the data collection at each site and equipment's were calibrated daily. Height (Ht), Weight (Wt), Waist Circumference (WC), Triceps Skin fold Thickness (TSFT), Wrist circumference, Waist to height ratio (WHTR) and Blood Pressure measurements, were taken and differences between observers if statistically significant noted.

Anthropometric measurements

Standing height was measured using a portable stadiometer (Leicester Height Meter, Child Growth Foundation, and UK). Weight will be measured using electronic scales (Salter, India measuring up to 100 g. Height for age, weight for age and BMI for age z-scores were computed using Indian reference Data.[7]

WC was measured in standing position, by a stretch resistant tape which was applied horizontally just above the uppermost lateral border of the right ileum using NHANES protocol WC above 90th centile of available reference population was considered as Adipose.[8-10] Waist to height ratio (WHTR) was computed and optimal cut-off value of 0.44 WHTR for children and adolescents was used to classify children as normal or adipose.[11]

TSFT was recorded using Harpenden caliper, on the non - dominant upper arm as per standard protocol.[12] Children were classified as normal (< 85th centile), moderate (85th -95th) and excess fat (>95th centile) with respect to references in centiles. In the absence of Indian reference data for TSFT, Western Cut-Offs were used.[13] Similarly, Wrist circumference was measured using stretch resistant tape using NHANES protocol.

The most prominent aspect of the radial styloid process was located with the middle or index finger of the left hand. Firm pressure was applied, and the circumference was recorded to the nearest 0.1 cm. Average of two readings for all parameters was used for analysis.

Statistical analysis

SPSS version 20.0 (Chicago, 2011) was used for analysis. All results are expressed as mean (SD). Correlations were estimated (unadjusted and after age adjustment) separately for both genders to examine association of anthropometric measurements with BP. Level of significance was set at $P<0.05$. Two separate multiple logistic regression models adjusted for age and gender were used to examine relationship of hypertension with, TSFT classes and Wrist with WC categories in the first model, and with WHTR categories in the second model to avoid multi-co linearity. The Optimal cut-off points for each anthropometric indicator was determined.[14,15] The differences between area under for BMI, WC, WHTR, TSFT and WRC to determine the best predictor for hypertension were tested.

RESULTS

In this study 2000 children were included; body fat indices and blood pressure were measured. Age-and gender-wise anthropometric characteristics of children aged 10-18 years (total, 658 boys and 1352 girls) are taken for study. Overall prevalence of obesity was higher in girls (67.1%) than boys (32.9%) with higher percentage in the younger age groups than older age groups.

Table 1: Age wise prevalance of hypertension in study population.

Age	Normal BP		Pre-hypertension		Hypertension	
10-12 Years	904	952	54	28	42	20
12-14 Years	237	236	11	8	2	6
14-16 Years	213	243	17	2	19	4
16-18 Years	453	472	26	18	21	10

Table 1 shows prevalance of hypertension and prehypertension in each age group. The higher incidence of overweight and obesity is in younger age group of 10 to 12 years in the given study group. Prevalence of overweight/obese decreased with increasing age. In girls, Prevalence of hypertension amongst overweight/obese was higher. In 10 to 18 years most of the children come under 3rd to 97th percentile. Data Collected among 10 to 18 years age, 7.50% of significant BMI occurs in the age group 10-12 years. In observed data female children has increased incidence of overweight and obesity (67.1%) as compared with boys. Study indicates children with increased weight correlated with systolic Hypertension 4.2% which is not significant. It also indicates that in underweight children prehypertension5.6% and hypertension 4.3% exists but compare with overweight and obese children incidence of prehypertension,

hypertension is less established the outcome in the form of increased systolic and diastolic BP. In both genders, correlation coefficients for BMI and WC with SBP were around 0.5 (P<0.005) Multiple logistic regression model indicated that odds ratios (OR) for waist centile classes, TSFT centile classes, and Wrist circumference against high BP were tabulated. Overweight children showed double risk of hypertension and obese children 7 times higher risk than normal weight children.

Table 2 shows significant correlation (p<0.003) for systolic and (p<0.000) diastolic BP for TSFT >95th centile showed almost 3 times risk and between 85th-95th double risk than normal weight children.

Table 2: Correlation of triceps skin fold thickness with blood pressure.

TSFT	Systolic blood pressure				Diastolic blood pressure			
	Normal	Prehypertension	Hypertension	p value	Normal	Prehypertension	Hypertension	p value
<85th percentile	1682	84	54	0.000	1756	34	30	0.000
85th -95th percentile	122	24	10		132	18	6	
>95th percentile	4	0	20		16	4	4	

Table 3: Correlation of waist cirumference with blood pressure.

Waist circumference	Systolic blood pressure				Diastolic blood pressure			
	Normal	Prehypertension	Hypertension	p value	Normal	Prehypertension	Hypertension	p value
<90th percentile	1463	74	66	0.003	1549	32	22	0.000
>90th percentile	345	34	18		355	24	18	

Table 4: Correlation of waist to height ratio with blood pressure.

WTHR	Systolic blood pressure				Diastolic blood pressure			
	Normal	Prehypertension	Hypertension	p value	Normal	Prehypertension	Hypertension	p value
<0.44	1250	78	44	0.003	1324	24	24	0.000
>0.44	548	30	40		518	32	16	

Table 3 shows Higher WC (>90th centile) also exhibited 1.5 times risk and high Wrist circumference 1.26 times higher risk of hypertension. Study indicates waist circumference is significantly correlated with systolic BP p<0.003. And also correlated with diastolic BP p<0.000.

The age- and gender-specific optimal cut-off values and for each of the five anthropometric indices in detecting the risk of high BP. With growing age, all the body measurements showed increasing trend, which is reflected in higher cut offs for, WC, WHtR, TSFT and WrC in Older age groups in both genders. Table 4 shows significant correlation p<0.003 for systolic and p<0.000 for diastolic BP with waist to height ratio. Sensitivity and specificity of all the indices were similar ranging from 60 to 90%. The Area under curve was also significantly high, different from 0.5 for BMI, WC, WHtR, TSFT and Wrist for both genders indicating the ability of these anthropometric indices for detecting the risk of high BP. Overall comparison of the five indices in different age-gender groups suggests that, WC and TSFT, WHtR, WC are better indicators of risk of hypertension.

All five indices showed significant positive association with BP and indicated that obese children were seven times at risk of hypertension than normal-weight children. For boys, BMI, WC and TSFT showed similar predictive power while in girls all five indices performed equally well.

The prevalence of hypertension in this study was higher than that reported previously. Further, the prevalence of high blood pressure was more in girls than in boys. There is no difference of hypertension prevalence found in puberty prepubertal subjects.

DISCUSSION

Age-and gender-wise anthropometric characteristics of children aged 10-18 years (total 658 boys and 1352 girls) are taken for study. Overall prevalence of obesity was higher in girls (67.1%) than boys (32.9%) with higher percentage in the younger age groups than older age group. The higher incidence of overweight and obesity is in younger age group of 10 to 12 years in the given study group.

Prevalence of overweight/obese decreased with increasing age. In girls, Prevalence of hypertension amongst overweight/obese was higher. In 10 to 18 years most of the children come under 3rd to 97th percentile. children coming under 3rd percentile and above 97th percentile is minimum. Study indicates children with increased weight correlated with systolic Hypertension (4.2%) which is not significant. It also indicates that in underweight children prehypertension 5.6% and hypertension 4.3% exists but compare with overweight and obese children incidence of prehypertension, hypertension is less established the outcome in the form of increased systolic and diastolic BP. Gender wise correlations between SBP, DBP and anthropometric indices are presented here. In both genders, correlation coefficients for BMI and WC with SBP were around 0.5 ($P<0.005$).

Multiple logistic regression model indicated that odds ratios (OR) for, waist centile classes, TSFT centile classes, and Wrist circumference against high BP were tabulated. Overweight children showed double risk of hypertension and obese children 7 times higher risk than normal weight children. TSFT >95th centile showed almost 3 times risk and between 85th-95th double risk than normal weight children

Higher WC (>90th centile) also exhibited 1.5 times risk and high Wrist circumference 1.26 times higher risk of hypertension. The age- and gender-specific optimal cut-off values and for each of the five anthropometric indices in detecting the risk of high BP. With growing age, all the body measurements showed increasing trend, which is reflected in higher cut offs for, WC, WHtR, TSFT and WrC in older age groups in both genders.

Sensitivity and specificity of all the indices were similar ranging from 60 to 90%. The Area under curve was also significantly high, different from 0.5 for BMI, WC, WHtR, TSFT and Wrist for both genders indicating the ability of these anthropometric indices for detecting the risk of high BP. Overall comparison of the five indices in different age-gender groups suggests that WC and TSFT, WHtR, WC are better indicators of risk of hypertension.

All five indices showed significant positive association with BP and indicated that obese children were seven times at risk of hypertension than normal-weight children. For boys, WC and TSFT showed similar predictive power while in girls all five indices performed equally well the prevalence of hypertension in this study was higher than that reportedpreviously. Further, the prevalence of high blood pressure was more in girls than in boys. There is no difference of hypertension prevalence found puberty prepubertal subjects.

Abdulle A et al, to estimate the prevalence of high blood pressure (BP) and its relationship with obesity among children and adolescents. The prevalence of elevated BP, notably systolic was significantly high.[16] High BP was strongly related to body weight, and WC and in this study also authors have same correlation between overweight, obese and BP. Sorof et al, recently reported a 3 times greater prevalence of hypertension in obese compared with nonobese adolescents in a school-based hypertension and obesity screening study in this study similar results obtained. appears more strongly associated with BMI than WC.[17] A Chiolero et al, reported obesity is a major risk factor for elevated blood pressure in children.1, 2, 3, 4 For instance, in as School based study of 5207 children aged 10–12 years, the prevalence of hypertension, which is sustained elevated blood pressure over several visits, was 1.5%, 3.9% and 17.5% in normal weight, overweight and obese children, respectively.[18] In this studies prehypertension is 5% and 5.4% respectively with systolic BP in obese children and prehypertension 5% and 2.8%, with diastolic BP. The hypertension 5% and 10% in systolic BP with overweight and obese children.

All five measures of adiposity were significantly associated with risk of hypertension in a multi-centric sample of Indian children and adolescents. Age-gender Specific optimal cutoffs for, TSFT, WC, wrist circumference and WHtR Measurements presented in the study may be useful in screening for risk of Hypertension. In this study family history of hypertension not asked. If asked outcome of this study will be accurate. Study sample is a convenient sampling not matched with previous data. Hence, if it is compared with previous data's will be useful. In this study data was not collected from rural school going children if done and compared with urban school going children authors will get better out comes. Other limitation of the study was nonavailability of biochemical measurements, therefore utility of these indices for screening other cardio-metabolic risk factors was not possible. A limitation of the study is that children were classified in age groups on consideration of conventional pubertal development years. It was not possible to assess Tanner staging for each child in the present study due to logistic reasons.

CONCLUSION

In this study authors investigate the correlation between body fat indices and measured blood pressure correlation was statistically analysed. which shows that waist circumference, waist to height ratio, and triceps skin fold thickness were strongly correlated with systolic BP and

diastolic BP whereas BMI, height, weight are not significantly correlated.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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