Study of Relationship among Hypertension, Overweight and Obesity in Individuals of Different Age Groups

Tirthankar Guha Thakurta[1], Pulak Panda[2]

ABSTRACT

Introduction: Hypertension is a leading cause of morbidity and mortality throughout the world. The age and sex specific cut-offs for diagnosis of hypertension vary in different parts of the world. The diagnosis of childhood hypertension is further complicated by absence of overt symptoms, target organ changes, difficulties in recording blood pressure and absence of a definite cut-off value. Anthropometric parameters correlate well with blood pressure and can provide an indirect measure of cardiovascular risk, including risk of hypertension.

Material and methods: In all 1000 participants, the height, weight, systolic blood pressure, diastolic blood pressure, waist circumference, hip circumference, mid-arm circumference and mid-thigh circumference were measured. Body mass index and waist:hip ratio were calculated. History of hypertension among their parents was recorded.

Result: Among 1000 participants, prevalence of hypertension in children between 5-18 years of age was found to be 6.9%. In subjects between 18-40 years of age, the prevalence of hypertension was 23.8%. For individuals between 40-60 years of age, the prevalence was 37.8%. The risk of hypertension was 2.7 times more in overweight and obese individuals, compared to normal weight or underweight individuals as calculated by Odd's ratio.

Conclusion: Since the root of adult hypertension lie in younger age, screening of younger adults for elevated blood pressure can help in early diagnosis of hypertension in children, adolescents and young adults. This may help in early lifestyle modification or medical interventions and may reduce the burden of cardiovascular morbidity and mortality in adult life.

Keywords: Hypertension, Obesity, Overweight, Anthropometry

INTRODUCTION

Hypertension is defined conventionally as a sustained increase in blood pressure over 140/90 mm Hg, a criterion that characterizes a group of patients whose risk of hypertension-related cardiovascular disease is high enough to merit medical attention.[1] The risk of both fatal and nonfatal cardiovascular disease in adults is lowest with systolic blood pressures of <120 mm Hg and diastolic BP <80 mm Hg.[1,2]

Hypertension can be essential and secondary. In adults, essential hypertension accounts for 80-95% cases of high blood pressure.[3] In contrast, in pediatric population, hypertension is more commonly secondary.[4] It is estimated that about 1-3% of the pediatric population may be hypertensive, and >3% of the pediatric population may be pre-hypertensive.[3,4]

There is a well-documented association between obesity (body mass index ≥ 30 kg/m^2) and hypertension.[4,5] Various studies indicate a direct linear relationship between body weight (or body mass index) and blood pressure.[6] Centrally located body fat is predicted to be a more important determinant of blood pressure elevation than is peripheral body fat.[6,7] In longitudinal studies, a direct correlation has been established by many workers between change in weight and change in blood pressure over time.[6–8] It has been established that 60–70% of hypertension in adults may be directly attributable to obesity.[7-10]

Global obesity rates have increased steadily in both developed and developing countries over the past several decades.[11] This poses a huge medical and economic burden to the society.[11] The definition of hypertension in adults is based on the relationship between blood pressure levels and incidence of adverse cardiovascular events like stroke, myocardial infarction, hypertensive nephropathy and hypertensive retinopathy.[5] Similar data to define hypertension in childhood that are based on risk for events in adult years are not available.[5] A major difficulty in diagnosis of hypertension in children and young adults is that, they do not develop the target organ damages to such an extent to warrant clinical manifestations.[4,5]

In children, hypertension is defined as SBP and/or DBP above 95th percentile for age, sex and height.[4,5,12-14] This involves comparison of the normative data of height and blood pressure percentiles with respect to age and sex of a child, and determination of the location of his/her blood pressure in the percentile curve.[12-14] In routine clinical practice, such elaborate procedures are difficult. Anthropometric indices like body mass index, waist-hip ratio, mid arm circumference, waist circumference are known predictors of overweight and obesity.[15] As obesity is often linked to hypertension in many studies[11,16-19], it may be expected that anthropometric parameters will also correlate with the risk for hypertension so study was done with this aim to know tha association between anthropometric parameters and the risk for hypertension.

MATERIAL AND METHODS

The subjects were selected from the students studying in government schools in Kolkata city and the suburban areas, and the students and staffs of our Institution. The study was approved by the Institutional Ethical Committee of KPC Medical College and Hospital, Jadavpur, Kolkata.

We selected 1000 individuals randomly from the study population. The students were included after informed consent of the school or college authorities and/or parents and assent from participants. The adult subjects were included after informed consent.

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The height, weight, systolic blood pressure (SBP), diastolic blood pressure (DBP), waist circumference (WC), hip circumference (HC), mid-arm circumference (MAC) and mid-thigh circumference (MTC) of the participants were measured.[20] Body mass index (BMI) and Waist:Hip ratio (W/H) were calculated. History of hypertension among their parents was recorded. Height was measured in standing position using a stadiometer. Weight was measured using a weighing-scale (manufactured by Doctor Beli Ram and Sons). Blood pressure was measured from the left upper arm in sitting position using an aneroid sphygmomanometer after a period of rest for at least 10 minutes. The mean of two separate readings was recorded.

For this study, the blood pressure (SBP/DBP) range for hypertension in subjects >18 years of age was defined in accordance with JNC-7 criteria.[1] For children younger than 18 years of age, SBP and/or DBP greater than 95th percentile for the given age, sex and height was defined as hypertension.[4,5] BMI within 25 - 29.9 kg/m^2 was considered overweight and BMI ≥ 30 kg/m^2 was categorised as obesity, in accordance with international standards.[21]

STATISTICAL ANALYSIS

The mean and standard deviation were calculated for each parameter. The prevalence of hypertension, overweight and obesity were calculated. The blood pressures of overweight/obese individuals were compared with that of the normal-weight individuals by Student's T-test. Calculations were performed using the software IBM-SPSS-20.

RESULTS

The 1000 participants were distributed in three groups (A-C) according to their age. Group A consisted of 347 individuals between 5 to 18 years of age, out of which 182 were male and 165 were female. Group B consisted of 378 individuals between 18 to 40 years of age, out of which 197 were male and 181 were female. Group C consisted of 275 individuals between 40 to 60 years of age, out of which 131 were male and 144 were female. Altogether, there were 510 male and 490 female participants.

For each group, the Mean ± SD of different parameters like age, systolic blood pressure (SBP), diastolic blood pressure (DBP), height, weight, body mass index (BMI), mid-arm circumference (MAC), chest circumference (Chest), Hip circumference (Hip) and mid-thigh circumference (MTC) were calculated. They are represented in Table 1.

The prevalence of hypertension in children between 10-18 years of age was found to be 6.9%. In subjects between 18-40 years of age, the prevalence of hypertension was 23.8%. For individuals between 40-60 years of age, the prevalence was 37.8%. The risk of hypertension was 2.7 times more in overweight and obese individuals, compared to normal weight or underweight individuals as calculated by Odd's ratio. The mean systolic and diastolic blood pressures of male subjects were higher than that of female subjects in each age group.

The blood pressures, both systolic and diastolic, showed a steady rise with age. This is evident from Figure 1, where the mean SBP and mean DBP of different age groups are plotted as a bar diagram.

Figure 1 demonstrates a steady rise in both systolic and diastolic blood pressures in the subjects with increase in age.

Figure 2 compares the prevalence of obesity, overweight and underweight in different age groups. The prevalence of obesity and overweight steadily increases from 5 to 60 years of age. The prevalence of underweight shows a decline with increase in age.

The blood pressures of the normal weight persons were compared with overweight and

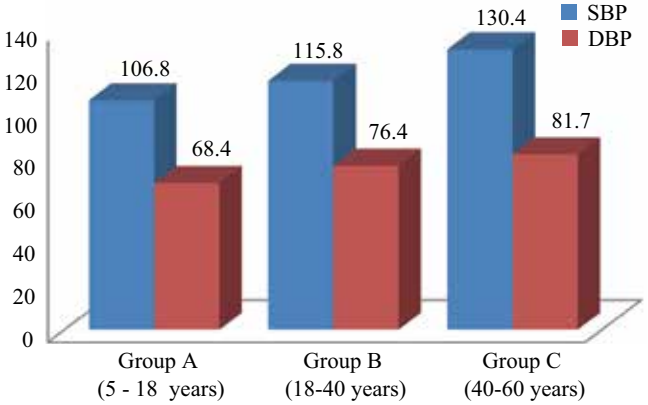

Figure-1: Bar diagram showing mean systolic blood pressures (SBP) and diastolic blood pressures (DBP) of the subjects in different age groups (in mm of Hg).

Group		Age (years)	SBP (mm Hg)	DBP (mm Hg)	Weight (kg)	Height (cm)	Waist (cm)	Hip (cm)	MAC (cm)	MTC (cm)	Chest (cm)	BMI (kg/m^2)
A (5 – 18 years)	Mean	10.6	102.1	65.4	48.0	146.1	59.1	68.9	18.5	32.0	71.2	17.0
	SD	±3.4	±15.1	±10.7	±9.6	±19.5	±9.9	±11.4	±3.1	±4.3	±9.9	±5.2
B (18 – 40 years)	Mean	29.4	113.8	74.4	56.0	156.2	76.1	85.5	25.1	46.0	78.2	22.7
	SD	±4.5	±10.3	±3.6	±5.8	±16.2	±7.8	±12.7	±2.3	±5.4	±8.2	±4.9
C (40 – 60 years)	Mean	51.7	130.4	81.7	59.0	158.1	80.1	91.5	24.5	44.0	83.8	23.5
	SD	±4.7	±12.6	±9.5	±7.8	±14.7	±8.3	±10.5	±4.2	±7.1	±6.5	±6.1

Table 1: Mean ± SD of different study parameters in individuals of different age groups.

	Parameter	Mean ± SD of the parameter in persons with BMI < 25 kg/m^2 [in mm of Hg]	Mean ± SD of the parameter in persons with BMI ≥ 25 kg/m^2 [in mm of Hg]	P-value
Comparison of blood pressures of individuals with normal BMI with individuals with high BMI †	SBP	121.2 ± 13.6	132 ± 9.2	< 0.01
	DBP	79.3 ± 10.4	87.1 ± 10.1	< 0.01
	Parameter	Mean ± SD of the parameter in persons with normal W/H [in mm of Hg]	Mean ± SD of the parameter in persons with increased W/H [in mm of Hg]	P-value
Comparison of blood pressures of individuals with normal W/H ratio with individuals with high W/H ratio ‡	SBP	118.7 ± 11.5	134 ± 7.1	< 0.01
	DBP	78.8 ± 7.8	89.1 ± 8.9	< 0.001
† Individuals with BMI < 25 kg/m^2 are considered normal-weight, and individuals with BMI ≥ 25 kg/m^2 are considered overweight/obese. ‡ Central obesity is defined as a waist–hip ratio (W/H) above 0.90 for males and above 0.80 for females, as proposed by WHO.				

Table-2: Comparison of blood pressures in normal-weight and overweight/obese individuals by using Student's T test.

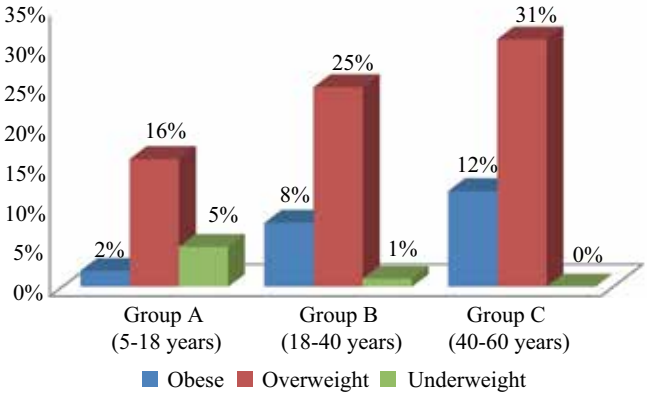

Figure-2: Comparison of prevalence of obesity, overweight and underweight in different age groups.

obese individuals. We also compared the blood pressures of individuals with normal waist:hip ratio (W/H) to that of individuals with increased W/H. In all cases, the blood pressures of the overweight or obese individuals were significantly higher ($p < 0.01$) than the normal individuals. The findings are presented in Table 2.

Both systolic and diastolic blood pressures were significantly greater in individuals with higher BMI or W/H ratio. The diastolic blood pressure varied more significantly with the increase in waist:hip ratio.

DISCUSSION

Overweight and obesity are considered to be an escalating epidemic in both developed and developing countries.[22] The onset of obesity and cardiovascular disease is rooted in childhood and this calls for targeted interventions and health promotions in youth population.[22]

Body Mass Index (B.M.I) is the most widely used anthropometric tool for the clinical assessment of obesity. It is defined as weight in kilogram divided by the square of the height in meters (W/H^2).[21] In this study, BMI < 18.5 kg/m^2 was considered underweight, BMI within 18.5 - 24.9 kg/m^2 was considered healthy weight, BMI within 25 - 29.9 kg/m^2 was considered overweight and BMI ≥ 30 kg/m^2 was categorised as obesity.[21] However, for Asian countries, lower cut-off values have been suggested by a WHO expert consultation for the purpose of public health action. The proposed values were 23 kg/m^2 for overweight and 27.5 kg/m^2 for obese.[23]

In our study we found a significant difference between the blood pressures in individuals with normal BMI, compared to individuals with high BMI. The risk of hypertension was 2.7 times more in overweight and obese individuals, compared to normal weight or underweight individuals as calculated by Odd's ratio.

Obesity has been linked to several cardiovascular diseases including hypertension. However, the exact relationship between body mass index and hypertension varies with the age, sex and race of the individuals.[24] Anthropometric parameters can be used to detect the presence of overweight or obesity, and can serve as indirect predictors of high blood pressure in children and adults.

CONCLUSION

Hypertension is a leading cause of cardiovascular morbidity and mortality worldwide. With the rise in the prevalence of overweight and obesity in the younger generation, the prevalence of hypertension has also been reported to have increased significantly.

Since the root of hypertension may lie at younger ages, screening of younger adults for elevated blood pressure can help in early diagnosis of hypertension in children and adolescents. This may help in early lifestyle modification or medical interventions and may reduce the burden of cardiovascular morbidity and mortality in adult life.

Although there are several international data on normal values of blood pressure, height and weight in different age groups, national data pertaining to West Bengal is not abundant. As India is a country that exhibits immense socio-cultural, anthropological and racial diversity, regional data for evaluation of normative values may be more accurate.

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