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Correlation of Body Surface Area and Body Mass Index with Blood Pressure in Young Adults in a South Indian Medical College.

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KEYWORDS

Hypertension, Systolic Hypertension, Diastolic Hypertension, Body Surface Area, Body Mass Index

ABSTRACT:

Background: With hypertension becoming more and more common among young adults , it has become essential to screen for hypertension from a young age. But practical issues of training , BP equipment availability in rural areas in India, it is necessary that some surrogate anthropometric measurements which will help in early diagnosis of hypertension are used. In this study the Body Surface Area and Body Mass Index have been compared to be used as markers for diagnosis of Hypertension among medical students aged 19-22 years.

Materials and Methods:100 medical students (65 females, 35 males) were included in the study. Anthropometric measurements- Height, Weight, Waist Circumference(WC), Hip Circumference(HC) were measured using standard technique. Blood Pressure was measured. The BSA, BMI were correlated with the Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP). The ROC curve was analysed for the anthropometric measurements and best cut off points were analysed.

Results & Conclusion: A statistically significant difference was found between males and females with regards to mean±SD of SBP, WC and BSA. The prevalence of high Systolic Blood Pressure was found to be 7% and Diastolic hypertension was found to be 21 %. BSA was found to have a significant moderate correlation with SBP ($r=0.520, p<0.05$) compared to a weak significant correlation with BMI ($r=0.369, p<0.05$). No significant correlation was found between DBP and anthropometric measurements. The AUC was found to be larger and significant with regards to BSA (0.823) compared to BMI (0.801). The best cut off point was suggested as 1.26 m^2 for BSA and 14.9 kg/m^2 for BMI.

Hence BSA was found to be a better predictor for diagnosis of hypertension especially systolic hypertension among young adults and can be considered for use in large scale areas including rural areas for early diagnosis or prevention of same.

I. INTRODUCTION

The National health policy 2014 defines age group of 15-29 as youth. India has one of the largest youth population with 27.6 % of the population comprising this population according to 2011 Census[1]. With hypertension being one of the leading and most common risk factors for Coronary Artery Disease for both men and women, it becomes imperative to monitor the same frequently[2]. The prevalence of hypertension in India stands tall at 30% with the urban population having a higher prevalence of 34% and rural prevalence being 28%[3]. According to the global burden of disease report, Ischemic Heart disease which is majorly caused due to high systolic blood pressure is largest source of DALYs[4].

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It has been stated that Hypertension is becoming common among young adults with every 1 in 8 being affected by the same. With unhealthy lifestyle habits and lowering of hypertension diagnostic criteria to 130/80mm Hg it is expected that this number will increase by leaps and bounds. According to Coronary Artery Risk Development in Young Adults (CARDIA) study it was specified that before 40 years of age Hypertension in Stage 2 had a significantly higher risk for all cause mortality[5].

It has been identified by the European hypertension guidelines that South Asian population are at the highest category of risk and are considered most prone to Hypertension consequences. High Blood Pressure increases the risk of death prematurely and also brings down productivity at work which will affect a country like India in the long run wherein the youth are working day and night to convert India into a developed Nation[6].

Hence, it becomes imperative that blood pressure is monitored and kept under control by lifestyle modifications etc. The onus for this monitoring hence lies to a major part at school and college level where we have children and young adults in large numbers.

Monitoring young adults at the college level will require training staffs to measure and report blood pressure. This might not be possible in all settings bearing in mind the practical aspects of the same. Instead anthropometric measurements that can be fed into a central system which can recognize young adults with hypertension can be considered.

Various studies in the past have shown that anthropometric measurements like Body Mass Index (BMI) are positively correlated with Hypertension[7].

One of the most commonly used parameters for assessing obesity is BMI due to its worldwide acceptance and convenience. Although it is commonly used, BMI is not a dependable method to know the distribution and degree of adiposity. Body Surface area(BSA) , a measure for body size is a frequently used biometric measurement which adjusts mass and volume and can be used for physiological parameters associated with cardiovascular diseases[8].

In our study we examined the use of measures of obesity like Waist Circumference (WC), Hip Circumference (HC), Body Mass Index(BMI) along with Body surface area (BSA) to know which parameter correlated with blood pressure better. This can be used at the monitoring level to take preventive measures so that onset of Hypertension can be prevented or prolonged.

II. MATERIALS AND METHODS

This was a cross Sectional Study . It was conducted in PK Das Institute of medical Sciences in 2015. This study was started after getting acceptance from The Institutional Ethics Committee. In total 100 first year medical students were included in the study. None of the students had cardiovascular conditions. None of them were known hypertensives. Stage 1 Hypertension was defined as blood pressure≥130mm Hg and/or Diastolic Blood Pressure ≥80 mm Hg according to American Heart Association[9].

Informed consent was taken from the students and information regarding the study was given. They were assured regarding confidentiality and anonymity.

The data collected included age, gender, medication. Weight, height, BMI, WC and Blood Pressure. Anthropometric measurements were taken using standard procedures. WC was measured between the last rib lower lateral margin of last rib and superior region of iliac crest using a non distensible flexible measuring tape. HC was measured around the largest circumference around the buttocks. Blood pressure was measured using sphygmomanometer. At least two measurements were taken one minute apart, and average of two was considered.

BMI was calculated as weight/(Height)^2

BSA was calculated as Sq Rt (Ht cm*Wt kg/3600) – Mostellar formula(1987)[10]

*Statistical Analysis:*Data was first entered in to excel sheet. Then it was transferred to SPSS version 21 and analysed. Descriptive statistics was calculated for examining frequencies, means and standard deviations. This derived the prevalence. The prevalence was found for in total and both genders males and females. The correlation between Blood pressure and anthropometric measurements of Waist Circumference, Hip Circumference, BMI and BSA were tested using Pearson Correlation. The value of probability for statistical significance was set at p value of < 0.05. Area under

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the curve was studied using ROC curves and cut off point was examined for BSA with best sensitivity and specificity.

The reliability and validity were maintained by making sure that blood pressure measurements and anthropometric measurements were repeated throughout the study. If there was a difference of more that 5mm Hg for Blood pressure or more than 5 % for anthropometric measurements ,a third measurement was taken to check for accuracy. Average of closest measurement s were then taken.

III. RESULTS

This study had a total of 100 students out of which 65 were females and 35 were males. They were from the age Group of 19- 22 years with males having a mean age of 19.02 years and females having a mean age of 19.34 years.

TABLE I: Descriptive Statistics of study population aged 19-22 years.

	Females (n=65)	Males (n=35)
	Mean±SD	Mean±SD
SBP (mmHg)*	103.9±11.5	115.1±8.3
DBP(mmHg)	70.2±7.0	71.1±7.7
WC (cm)*	70.2±11.2	78.8±11.2
HC(cm)	90.7±6.9	95.1±8.8
BMI(kg/m2)	21.2±3.2	23.1±4.3
BSA(m^2)*	1.5±0.15	1.7±0.15

*p Value < 0.05 significant difference between males and females; SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, BMI- Body Mass Index, BSA- Body Surface Area

The prevalence of high Systolic Blood Pressure (SBP) was found to be 7% and high Diastolic Blood Pressure (DBP) was found to be 21 %. Amongst males high SBP was found amongst 11.8% of the participants and high DBP was found in 23.5% of the participants. Amongst females 4.5 % had Systolic Hypertension compared to 21.2 % who had Diastolic Hypertension.

In our study 20% of the participants were found to be overweight and 15% were found to be pre obese and 2 % were found to be Obese. In case of Males 25.7%,22.9%,2.9% males were found to be overweight, Pre obese and obese respectively. Amongst females 16.9% were found to be overweight,10.8% were found to be preobese and 1.5% were found to be obese.

In the study population significant weak correlation was found between BMI and SBP. ($r= 0.369, p<0.05$) and BMI and DBP ($r= 0.258, p<0.05$).A moderate significant correlation was found between BSA and SBP ($r= 0.520, p<0.05$). In case of males no correlation was found between BMI, BSA and SBP ($r= 0.320, p<0.05$). A moderate correlation was found between BMI and SBP ($r= 0.455, p<0.05$). In case of females both BSA ($r= 0.408, p<0.05$) and BMI ($r=0.380, p<0.05$) were found to have a significant correlation with SBP .No significant correlation found between DBP and anthropometric measurements.

The area under the curve was studied for its value in diagnosis of systolic and diastolic hypertension.WC and HC were not found to have statistically significant AUCs. It was found that BSA had the highest and significant area under the curve followed by BMI. The best cut off point for diagnosis of systolic hypertension was suggested as 1.54 m^2 (Sensitivity-100%, Specificity- 48%) for BSA and 20.6 kg/m^2 for BMI(Sensitivity-100%, Specificity- 48%) .No statistical significance was found between DBP and Anthropometric measurements.

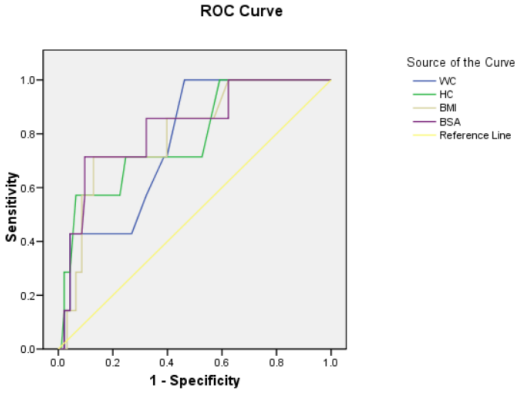

Fig. 1. ROC curves to analyse Area Under the Curves for WC, HC, BMI, BSA

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Table II: Area Under the Curve for whole study population

S No	Variable	Area
1	WC	0.769
2	HC	0.786
3	BMI	0.801*
4	BSA	0.823*

*P<0.05

IV. DISCUSSION

This was a cross sectional study done on 100 students to know the prevalence of hypertension on the whole as well as in males and females. Overall prevalence of systolic hypertension was found to be 7% and that of Diastolic hypertension was found to be 21%.Males were found to have higher prevalence of hypertension compared to females. This finding is parallel to the study which suggests that Men of the same age as pre menopausal women have been found to have higher blood pressure[11].

It has been documented in various studies in the past that testosterone in males tend to increase the blood pressure and estrogen in females tend to reduce blood pressure by affecting the Renin Angiotensin system.Estrogen has been found to reduce Angiotensin II and Angiotensin Receptor 1. Androgens have been found to directly exacerbate sodium reabsorption from the proximal Convoluted tubule[12]. Also, testosterone has been found to increase angiotensinogen synthesis[13]. In our study too a significant difference was found between males and females with regards to systolic hypertension with males having a higher mean compared to females[14]

For the whole study population a positive significant correlation of BMI was found with SBP and DBP. These findings are parallel to the findings by Thato Tshepo Raphadu et wherein similar results were obtained amongst adolescents of a local municipality of South Africa[15] .

Various other studies have found similar results wherein positive correlations have been found between BMI and Blood Pressure (SBP and DBP). This shows that there is a connection between increase in body weight and blood pressure. Activation of the sympathetic nervous system (SNS), the amount of intra-abdominal and intra-vascular fat, sodium retention leading to increase in renal reabsorption, and the renin-angiotensin system, are considered to have important functions in the pathogenesis of obesity-related hypertension[16].

Although BMI is a well known and widespread used parameter for obesity but it has some shortcomings. Even in the calculation of BMI many have questioned the use of height square as denominator. The differentiation between muscle mass and fata mss is not possible with the usage of BMI calculation.[17] In order to predict cardiovascular performance ,body size parametrs are used and various studies have been done in the past to determine the best one. In a study by Barak Zafrir et al, BSA correlated strongly with stroke volume(SV) in supine condition as well as well as with changes in SV upon standing .No correlation with BMI was found. Also Cardiac out put also showed correlation with BSA and not with BMI[8].

BSA is commonly used measure of body size which is usually used to index physiological parameters.It has been quoted that BSA correlates much better with physiological parameters than body weight. DuBois brothers in 1915 developed an equation including mass and height based on cadaver data. It was Mostellar who suggested a simplified equation in 1987.It was found by Verbraecken et al that Mostellar equation could not be used amongst people with normal weight but also in overweight and obese individuals[18].

In our study we found a stronger correlation between SBP and BSA. Also the area under the curve for predicting diagnostic value of BSA for Sytolic hypertension it was found that BSA had the highest area followed by BMI ($p<0.05$). Statistically significant values were not found for Diastolic Hypertension Diagnosis.Lowereingof Diastolic blood pressure to 80 mm Hg has inadvertently increased the prevalence of Diastolic Hypertension ,much more than Systolic hypertension. According to the article by Kartik Gupta et al the weighted prevalence of hypertension increased from 18.5% to 43 %[19].This jump in prevalence is like two sides of a coin. One side is that far more people diagnosed with hypertension will be able to prevent onset of CAD or even prolong the onset of the same by taking preventive or

secondary measures. The second side being that medical expenses at a household level will see an increase in the coming years.

V. CONCLUSIONS

This study showed that simple anthropometric measurements more importantly BSA than BMI had a statistically significant correlation with Blood Pressure. With the diagnostic criteria for hypertension being reduced to 130/80 mm Hg the population diagnosed with hypertension will increase to a great extent. It is hence imperative that from an earlier stage itself young adults are monitored either directly by checking their blood pressure or at a rural set up or where facilties and trained staff are not available to check the Blood pressure , indirectly by monitoring their physical parameters like BSA and BMI to predict onset of hypertension.Prevention is better than cure is still the best Mantra for a healthy long life. This prevention needs to start early as it will be useful in ht elong run for our country's growth and development.

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