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Letter to the Editor

Anthropometric correlates of blood pressure in normotensive Pakistani subjects


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Abstract

Obesity and hypertension are two major inter-related cardiovascular risk factors. Decrease in adiposity is one of the most effective preventive measures not only in decreasing the overall cardiovascular risk but also the blood pressure. This cross-sectional study measured the effect of various measures of adiposity on blood pressure in normal healthy subjects of Pakistani origin. 400 normotensive subjects (247 males and 153 females) were included in this study. Along with data on co-morbid conditions, two blood pressure readings and several anthropometric measurements were recorded. Age and gender specific analysis was done. Following the WHO cutoffs for Asians, about 52% of our sample population was found to be overweight or obese. Age was not associated with blood pressure indices in males; however it was strongly associated with all blood pressure indices in females. Greater Body Mass Index (BMI), Waist Circumference (WC) and Waist to Height Ratio (WHTR) were associated with higher Systolic and Diastolic Blood pressure. Increasing age was also associated with higher levels of BMI, WC and WHTR. Anthropometric variables however, were more strongly associated with blood pressure indices than age in this sample population. In conclusion, we found WC and WHTR to be strongly associated with blood pressure indices in normotensive Pakistani males.

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Keywords: Blood pressure; Waist–Hip ratio; Waist–Height ratio; BMI

1. Introduction

Obesity and hypertension have a central role in the pandemics of cardiovascular diseases that have become the bane of modern day health of populations. Various measures of obesity including Body Mass Index (BMI), Waist Circumference (WC), Waist–Hip ratio (WHR) and Waist–Height ratio (WHTR) have been employed to capture the obesity related cardiovascular risk. Obesity and hypertension are known to increase in parallel in both developed and developing populations [1]. Decrease in adiposity is one of the most effective preventive measures not only in decreasing the overall cardiovascular risk but also the blood pressure [2,3]. WHO has recommended increase in physical activity and modification of dietary habits as preventive measures to control the high and increasing incidence of cardiovascular diseases in developing countries [4]. South Asians emigrants including the Pakistanis have high prevalence and incidence of cardiovascular diseases...
in general and metabolic syndrome in particular [5]. We undertook this study to observe the effect of various measures of adiposity on blood pressure in normal healthy subjects of Pakistani origin.

2. Methods

We recruited a random sample of healthy adults of Pakistani origin from three provincial capitals of Pakistan. Data collection which included complete medical history and physical examination was conducted by trained medical personnel. All subjects were in a resting state at the time of examination. Two blood pressure readings, ten minutes apart were taken using standard mercury sphygmomanometers and appropriate cuff sizes. Mean of these two readings was used for data analysis. Height and weight were recorded using standard hospital equipment and values were rounded off to the nearest cm and 0.5 kg, respectively. Height was measured without shoes. During measurement of weight men wore minimum clothing however, this could not be enforced in case of females due to local social limitations. Hip circumference was measured at the level of greater trochanters of femur and waist circumference was measured at a point midway between the ribcage and the iliac crests. An individual was excluded from data analysis if he/she was a diagnosed hypertensive, or on an anti-hypertensive treatment or had even a single blood pressure reading of systolic (SBP) > 140 mmHg / diastolic (DBP) > 90 mmHg. The diagnosis of Diabetes Mellitus (DM) and other comorbidities was based on medical history. The data were analyzed using SPSS® version 10.0 for Windows. BMI was calculated as kg/m². Quartiles of BMI, WC and WHTR were created from the frequency tables. Males and females were analyzed separately. Continuous variables were expressed as mean±1 SD. Linear regression was used to see the effect of age, smoking, diabetes and the anthropometric factors on blood pressure indices. Multivariate models were created based on the results of univariate analysis. Statistical significance was considered at p<0.05 for all analysis.

3. Results

A total of 400 normotensive subjects (247 males, 153 females) were included in this study. The females were
relatively older (p<0.00), and had lower height (p<0.00) and weight (p<0.00) but greater BMI (p=0.02). Table 1, shows the relevant clinical characteristics of the study population. Invariably the males and females represented two characteristically different subgroups of the sample and hence were analyzed separately. Table 2A, shows the effects of the anthropometric variables on systolic blood pressure. Surprisingly, age was not associated with blood pressure indices in males; however it was strongly associated with all blood pressure indices in females. BMI, WC, WHR, WHTR, and DM showed strong association with SBP but in age adjusted multivariate analysis only WC remained associated (p<0.00). Age was the only factor significantly affecting SBP in females. A similar trend was seen in diastolic blood pressure (Table 2B), where multivariate analysis showed WC (p<0.00) and WHTR (p<0.00) to be associated with DBP in males. Univariate and multivariate analysis of DBP showed age to be the strongest factor in females. We also studied the effect of anthropometric measures on pulse pressure (data not shown). In this case, multivariate analysis showed WHTR to be strongly associated with PP in males (p<0.00), however age was the only factor affecting PP in females (p<0.00). Table 3 shows the distribution of age, SBP and DBP in the quartiles of BMI, WC and WHTR in males. It is clearly evident that greater BMI, WC or WHTR is associated with higher SBP and DBP. Increasing age is also associated with higher levels of BMI, WC and WHTR, but age is a universal non-modifiable variable and hence this effect is inevitable. Aging leads to stiffening of vessels and hence higher blood pressure levels. We have however, shown in both univariate and multivariate analysis in Table 2A and B, that anthropometric variables are more strongly associated with blood pressure indices than age in this sample population.

4. Discussion

The adverse effects of BMI and waist circumference on cardiovascular risk have been shown in a multitude of longitudinal studies including the Framingham Heart study [6]. The NIH (US) has indicated that there is a graded increase in health risk with increasing BMI and in each BMI category increasing WC is associated with higher risk [7]. Other measures of fat distribution including WC, WHR and WHTR have also been shown to correlate more closely with cardiovascular risk as compared to BMI.

South Asia is one of the high incidence areas for cardiovascular diseases in the world [5]. It has recently been shown that South Asian children have higher body mass adjusted blood pressure levels than white American–Caucasian children [8]. Furthermore, WHO has also lowered the cutoffs for overweight and obesity for the Asian population, which again points to the fact that Asian and especially south Asian population suffers from an overall higher obesity related cardiovascular risk. Most studies that report the relationship between adiposity and blood pressure include hypertensive populations however our sample consists of only normotensive people. We have tried to see the relationship between adiposity and blood pressure in the pre-hypertensive stages; the actual window where risk factor modification could actually prevent hypertension.

Our results are in accord with the previous reports. BMI, WC, WHR and WHTR were found to strongly influence systolic and diastolic blood pressure indices in males. WC

| Table 3 | Analysis of variance; distribution of age, SBP and DBP among quartiles of BMI, WC, WHTR in male subjects |
|-----------------|---------------------------------------------------------------|-----------------|
| BMI (kg/m²) quartiles (mean, range) | p value | WC (cm) quartiles (mean, range) | p value | WHTR quartiles (mean, range) | p value |
| I (18.9, 13.7–20.5) | II (21.7, 20.6–22.7) | III (23.9, 22.8–25.3) | IV (28.9, 25.4–40.6) | | I (67.7, 60–72) | II (76.8, 73–80) | III (85.3, 80.5–90) | IV (98.8, 90.6–120) | | I (0.41, 0.35–0.43) | II (0.46, 0.44–0.47) | III (0.50, 0.48–0.53) | IV (0.59, 0.54–0.75) |
| Age (years) | 31.9±14 | 32.3±12 | 32.3±9 | 37±12 | 0.04 | Age (years) | 29±11 | 32±11 | 36±12 | 38±12 | <0.00 | Age (years) | 29±11 | 31±11 | 35±11 | 39±12 | <0.00 |
| SBP (mmHg) | 107±12 | 111±14 | 114±12 | 118±14 | <0.00 | SBP (mmHg) | 105±12 | 108±12 | 117±12 | 121±11 | <0.00 | SBP (mmHg) | 105±12 | 109±12 | 116±12 | 120±12 | <0.00 |
| DBP (mmHg) | 71±8 | 73±10 | 76±9 | 77±9 | <0.00 | DBP (mmHg) | 70±8 | 75±10 | 77±9 | 76±9 | <0.00 |

Quartiles were generated from frequency tables. Values were rounded off to the nearest second decimal.

SBP — systolic blood pressure.

DBP — diastolic blood pressure.
was the only variable that was consistently associated with high blood pressure in males. The females in our study sample were older and had greater BMI. We found age to be the only factor, significantly associated with blood pressure indices in the females.

The mean BMI in our study population is lower than that found in the American population [9]. However, according to the WHO cutoffs for Asians, about 52% of our sample population was overweight or obese. The association of WC with blood pressure in males is consistent across several populations including American [9], Italian [10] and Japanese [11]. We did not find any anthropometric variable to be strongly associated with blood pressure in females. This could be due to a more complex interaction of female hormones with blood pressure. About 70% of our female sample population was pre-menopausal and strong effects of estrogen could account for our inability to detect the effect of anthropometric factors on blood pressure. Recently published results of the National Health Survey of Pakistan (1990–1994) showed a high prevalence (25%) of overweight and obesity in the Pakistani population. Female gender was independently associated with being overweight or obese [12]. The results also showed a higher prevalence of coexistence of cardiovascular risk factors in Pakistani females and increasing age and higher BMI were among the factors that were independently associated with the coexistence of risk factors [13]. Our results show a similar relationship between age and blood pressure in the females.

WHTR is a relatively new inclusion in the armamentarium of anthropometric variables. It has been proposed to augment the role of WC in risk prediction people who have central fat distribution [14]. We found WHTR to be associated with systolic, diastolic and pulse pressures in males. It is interesting to note that systolic blood pressure was most significantly affected by WC, however diastolic was affected by both WC and WHTR, and pulse pressure was affected by WHTR only in the multivariate analysis.

In conclusion, we found WC and WHTR to be strong predictor of blood pressure indices in normotensive Pakistani males. Age was found to be the strongest factor affecting blood pressure in females. Anthropometric measurements should be part of the national health surveys so that high risk non-diseased population groups can be identified to target preventive efforts.

References