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Original Research Paper

Anatomy

ANTHROPOMETRIC ANALYSIS OF SUBJECTS OF HYPERTENSION IN SUB-HIMALAYAN REGION

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ABSTRACT

INTRODUCTION: In India, Hypertension (HT) has emerged as a leading risk factor for mortality. The burden of hypertension in India is expected to almost double from 118 million in 2000 to 213.5 million by 2025.

OBJECTIVE: Anthropometric analysis of the Sub-Himalayan population suffering from HT with calculation of the cut-off point to predict HT.

METHODOLOGY: Cross sectional study was carried out on 63 healthy and 51 hypertensives.

RESULTS: The waist circumference (WC), waist to height ratio (WHtR) and body mass index (BMI) cut-off point to predict hypertension was found to be 93.5cm, 0.54 and 24.58kg/m^2 in men and 88.5cm, 0.59 and 25.3kg/m^2 in females respectively.

CONCLUSION: BMI is considered as the best indicator to predict HT in males with a cut-off point of 24.58kg/m^2 and in females, WHtR was found to be the best indicator to predict HT with a cut-off point of 0.59.

KEYWORDS : Body mass index, Hypertension, Waist Circumference, Waist to height ratio.

INTRODUCTION

The single largest risk factor for disease burden worldwide is Hypertension. In India, HT has emerged as a leading risk factor for mortality.[1] Kearney *et al* in their paper predicted that the burden of hypertension in India is expected to almost double from 118 million in 2000 to 213.5 million by 2025.[2] The seventh report of the Joint National Committee (JNC-7) of high Blood pressure defines Hypertension (HT) as BP ≥140/90 mm Hg.[3] The National Family Health Survey-4[4] indicates the mean prevalence of BP in India to be 22.4% for both men and women. Study by Roy et al[5] in National Capital Region (NCR) revealed the prevalence of HT increasing from 23.0% to 42.2% in urban and from 11.2% to 28.9% in rural areas of NCR.

The accumulation of fat in the body beyond a critical level is responsible for ill-health and disease. Many anthropometric indices are used for estimation of total fat deposit or abdominal fat to assess the risk of various diseases like diabetes, hypertension or other cardiovascular diseases. The most popular clinically is the BMI which associates with total body fat deposit .However; it does not differentiate the fatty mass from the muscle mass or between different fat locations in the body. It is an established fact that individuals with location of central fat are at a greater health risk than those with peripheral location of fat.[6] Individuals with a central type of fat location (android type) with deposition of fat around the abdomen are at more health risk than those whose fat is located away from the centre (gynoid type) in the buttocks and thighs. The health risks are more related to the site of location of the excess fat than by its total amount in the body. The unhealthy android type with apple shape is related with the characteristic location of fat in the internal, visceral fat depots. The healthy gynoid type with pear shape is characterised by location of fat externally in the subcutaneous compartment more in the buttocks, hips and thighs.[7] The body fat distribution for assessing the risk of various diseases can be assessed by body mass index(BMI),waist hip ratio(WHR),waist circumference (WC) and waist to height ratio(WHtR).The BMI only conveys the total fat in the body.[8] WHR is also not a reliable indicator for follow up as both waist and hip circumference decrease with weight reduction and practically the ratio remains the same.[6] Similarly, the WC also suffers from over and under estimation of the total abdominal fat in tall and short statured individuals with the same WC.[6] In recent times, WHtR which corrects the WC for height of the individual has come up which strongly correlates with unhealthy central abdominal fat.[9] The WHtR offers the benefit that it is possible that a single WHtR value is useful in different age, sex and ethnic groups.[10]

The present paper attempts to analyze the three indices namely BMI, WC and WHtR and finally conclude as to which indicator best correlates and predicts the occurrence of maintaining health and diseased states namely HT.

MATERIALS AND METHODS

The study was carried out in the Department of Anatomy and in the Department of Biochemistry, Dr. Rajendera Prasad Government Medical College, Kangra at Tanda, Himachal Pradesh after obtaining approval from Institutional Ethics Committee. Sampling population comprised of adult subjects in the age group of 30 to 80 yrs randomly selected after due informed consent who were attending the OPD at Dr. RPGMC Tanda and Civil Hospital, Kangra.

The sample size comprised of 63 healthy controls and 51 subjects on anti-hypertensive therapy. The BP of subjects was recorded by AG safe chek upper arm digital BP monitor (AG-1010) after rest for 15 minutes on the left arm sitting posture. BP was again recorded after a gap of 10 minutes and the final reading was taken as the mean of the two readings. Height was recorded against vertical wall with flexible measuring tape. Waist circumference was measured at level of umbilicus with flexible measuring tape. Weight was recorded with same standard digital weighing machine. BMI and body surface area (BSA) was calculated as per the formula obtained from the website www.medcalc.com.

Thorough history taking and clinical examination of the subjects along with confirmation of the diagnosis by checking the OPD papers was done. Further, the healthy controls and the group on anti-hypertensive medication were subjected to most of the routine biochemical investigations to rule out any other disease and confirm normal health in controls and only hypertension in the other group. Fasting venous blood sample of subject's approximately 6 ml was collected; 3 ml in ethylene diamine tetra acetic acid (EDTA) tube and 3 ml in plain tube. Whole blood sample

was used for HbA1c estimation using Nyco card (Alere Technologies AS, Oslo, Norway) reader. Serum obtained was analyzed for fasting blood sugar (FBS) by XL 300 (Erba, Mannheim, Germany) automated chemistry analyzer using commercially available kit (Trans-asia Bio-Medicals Ltd., Baddi, India).

MEASUREMENTS

We examined the likelihood of being healthy and the likelihood of being hypertensive beyond a critical cut-off point of fat accumulation in the body in the subjects hailing from Tehsil Kangra and adjoining areas. The various cut-off values of BMI, WC and WHtR to predict hypertension (HT) were examined by receiver operating characteristic curve (ROC) analysis.

STATISTICAL ANALYSIS

Data was presented as median (range), and in numbers. Quantitative variables between two groups were compared using Mann Whitney U test. Chi square test was used to compare descriptive variables between the healthy and hypertensive group. The optimal sensitivity and specificity of using various cut-off values of WC, WHtR and BMI to predict hypertension was examined by the receiver operating characteristic curve (ROC) analysis. ROC curves were plotted using measures of sensitivity and specificity based on various anthropometric cut-off values. P value <0.05 was considered significant. Statistical analyses were performed using Statistical package for social sciences (SPSS) version 16.

OBSERVATIONS AND RESULTS

Table 1. Subjects' characteristics

	Control (n=63)	Hypertension (n=51)	P Value
Age	52 (30-75)	57.0 (34-80)	0.005
Sex (M:F)	35:28	29:22	0.888
Waist Size	88 (71-113)	95 (78-120)	0.001
BSA	1.61 (1.33-2.13)	1.78 (1.26-2.21)	0.031
BMI	23.56 (18.8-33.8)	26.16 (17.78-35.0)	0.007
WHtR	0.55 (0.45-0.73)	0.59 (0.46-0.69)	0.001
FBG	91.0 (64-99)	98.6 (64-142)	<0.001
HbA1c	5.3 (4.7-6.2)	5.8 (4.9-6.6)	<0.001
Triglycrides	140 (50-96)	143 (64-451)	0.116

Data shown as median (range) and numbers.

Table2. Cut-off values of BMI, WC, and WHtR to predict HT based on ROC analysis

Index	Cut-off	Sensitivity	Specificity	AUC (95%CI)
Male				
WC(cm)	93.5	63.3%	63%	0.729 (0.609-0.829)
WHtR(ratio)	0.54	66.7%	60%	0.718 (0.593-0.843)
BMI(kg/m^2)	24.58	66.7%	65.7%	0.673 (0.539-0.807)
Female				
WC(cm)	88.5	77.3%	53.6%	0.632 (0.475-0.789)
WHtR(ratio)	0.59	72.7%	67.9%	0.717 (0.566-0.868)
BMI(kg/m^2)	25.3	68.2%	64.3%	0.619 (0.451-0.786)

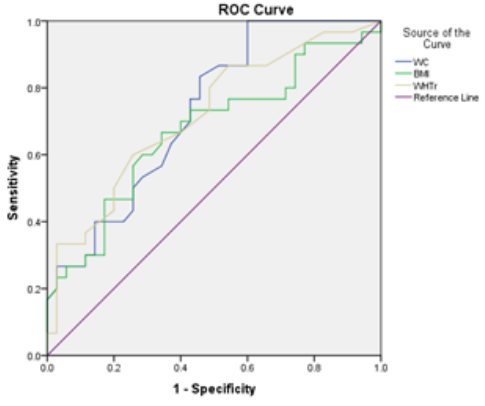

Fig 1. ROC Analysis in the study population: Males

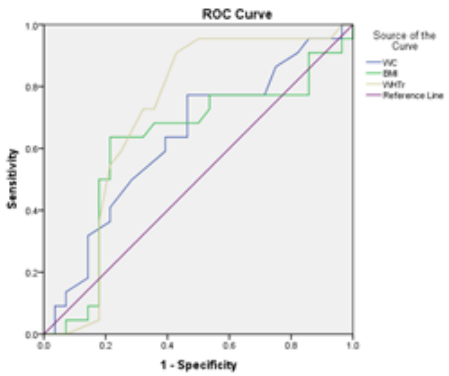

Fig 2. ROC Analysis in the study population: Females

RESULTS

The WC cut-off to predict hypertension in this Sub-Himalayan population was found to be 93.5cm in men with a sensitivity of 63.3% and specificity of 63%. The WC cut-off in females was found to be 88.5cm in women with a sensitivity of 77.3% and specificity of 53.6%. The WHtR cut-off to predict hypertension in men was found to be 0.54 with a sensitivity of 66.7% and specificity of 60% and in females it was found to be 0.59 with a sensitivity of 72.7% and specificity of 67.9%. The BMI cut-off to predict hypertension in males was calculated to be 24.58 kg/m^2 with a sensitivity of 66.7% and specificity of 65.7%.The BMI cut-off to predict HT in females was 25.3kg/m^2 with a sensitivity of 68.2% and specificity of 64.3%.

DISCUSSION

Study done by Zhan et al[11] in elderly Chinese population for prediction of multiple metabolic risk factors which included HT concluded that BMI, WC and WHtR were found to be the most accurate for predicting multiple metabolic risk factors which included HT. According to Rajput et al[12] the predictive value of WC and single value of WHtR are the best anthropometric measure for predicting metabolic syndrome in Urban and rural population of Haryana. Midha et al[13] in her study on Indian hypertensive population found BMI and WC both as good predictors of HT in both men and women. The cut-off of BMI in this study was found to be 24.5 kg/m^2 and 24.9 kg/m^2 in males and females and the cut-off of WC was 83 cm and 78 cm in men and women. The findings in the present study are very close to these earlier studies. BMI was found as the best Indicator to predict HT with cut-off of 24.58 kg/m^2 in males and WHtR was found as the best indicator to predict HT in females with cut-off of 0.59 in this Sub-Himalayan population.

CONCLUSION

The anthropometric analysis in this Sub-Himalayan population concludes that BMI is considered as the best indicator to predict HT in males with a cut-off of 24.58kg/m^2. In the case of females in this Sub-Himalayan region, WHtR was found to be the best anthropometric indicator to predict HT with a cut-off of 0.59.

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