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An evaluation of body mass index, waist-hip ratio and waist circumference as a predictor of hypertension across urban population of Bangladesh.

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Abstract:

In Bangladesh, especially in the urban areas, the prevalence of Cardiovascular Diseases is increasing at an alarming rate and hypertension is one of the most important risk factor for cardiovascular mortality and morbidity. So a cheap, available, understandable, user friendly and acceptable predictor should be evaluated and this study has tried to know the extent and magnitude among the body mass index, waist-hip ratio and waist circumference with hypertension in the urban areas of Bangladesh. This cross sectional study was conducted on some adult people in Dhaka City who were not suffering any kind of chronic disease and also females were non pregnant. All the anthropometric measurements were measured by following WHO recommended standard operating procedures, data was collected through a structured questionnaire and for the analysis chi-square was used and odds ratio and relative risk were measured. Total 300 participants were enrolled in the study where number of male and female participants were equal with the mean age of 42.63 ± 11.45 years. All the anthropometric measurements were significantly correlated with hypertension (p-value < 0.001). But for the male participants waist hip ratio was found more significant than others, for the female participants waist circumference was found more significant and body mass index showed a moderate level of significance for both groups. In considering the accuracy level during antropometric measurements, the possibility of community acceptance and the study result, body mass index should be regarded as an effective predictor of hypertension.

Keywords: body mass index, waist-hip ratio, waist circumference, hypertension.

Introduction:

Developing countries are increasingly faced with the double burden of Hypertension (HTN) and other cardiovascular diseases[1,2]. HTN places an excessive financial burden on populations and health systems[3-5]. However, excess body weight is the sixth most important risk factor contributing to the overall burden of disease worldwide[7]. Obesity has been consistently associated with HTN and increased CVD risk. Some studies have shown that, at least two-thirds of the prevalence of obesity can be directly attributed to HTN[8]. Body mass index (BMI) is positive and independently associated with morbidity and mortality from hypertension and cardiovascular disease[6]. Again, waist circumference (WC) and waist-hip ratio (WHR) is used to predict the risk of obesity related diseases[9-11]. As excess intra-abdominal fat is associated with greater risk of obesity-related morbidity like HTN than in overall adiposity[12,13] and for that reason measurements of WC and WHR have been viewed as alternatives to BMI. WC has been shown to be the best simple measure of both intra-abdominal fat mass and total fat[14,15]. So, the superiority of BMI, WHR and WC as a predictor of HTN is not established yet. Earlier Bangladeshi people are used to do more physical activities. But now due to industrialization and urbanization, they are entering to the more sedentary lifestyles. Thus the BMI, WHR and WC become high and the prevalence of the diseases that has links with higher BMI, WHR and WC increased. Moreover, the efficacy of BMI, WHR and WC as a predictor of HTN in undeveloped countries like

Bangladesh is not evaluated and these parameters should be evaluated in the Sub-continent region because of their unique lifestyle, stature and genetic variance. This study tries to remove these gaps.

Methods and Materials:

Study design, period and study setting: It was a cross sectional study of descriptive type which was conducted from April 2012 to September 2012 in two Mahallahs (Smallest unit of urban area of Bangladesh) of Dhaka city.

Sample size and sampling: Assuming the proportion of particular characteristics in the target population and a desired accuracy of 50% with a desired degree of accuracy 0.05 our calculated sample size was 284. However, we enrolled 300 participants; 150 male and 150 female participants and purposive type of sampling technique was adopted to conduct the study.

Sample selection criteria: Male or female participants more than 25 years of age were included in the study. People suffering from any kind of chronic diseases, pregnant women and non co-operative persons were excluded.

Study technique adopted: We selected two Mahallas of Dhaka City, one of North zone and one from South zone through a lottery, collected the holding numbers of those areas, randomly selected 200 holdings from each Mahalla and according to selection criteria we enrolled 300 participants; 150 male and 150 female for the study purpose. Then we collected socio-demographic data through a structured questionnaire, measured height, weight, waist circumference, hip circumference and blood pressure following Standard Operating Procedure of WHO and calculated BMI and WHR.

Statistical analysis: All data was computed and analyzed using the SPSS software (version 16.01) through descriptive and analytical method. We used chi-square to analyze data and also Odds Ratio (OR) and Relative Risk (RR) was measured. All the p-values were two tailed and a p-value of < 0.001 was considered as significant.

Ethical consideration: The study protocol was approved by the Ethical Review Committee (ERC) of the American International University Bangladesh (AIUB).

Results:

Table 1 shows that a total of 300 individuals in the age group of 25-65 years from Dhaka City of Bangladesh, participated in the study. The number of male and female participants was equal with the mean age of 42.63 ± 11.4 years for male participants it was 42.03 ± 11.77 years and for female participants it was 43.23 ± 11.14 years . In considering education, only 5.33% participants had no level of education and the rest were educated. Of them, 78% male was married and the rest were unmarried where as 60% female were married, 22% were widowed and the rest were unmarried and divorced. Again, the mean family income of the participants was 22809.33 ± 8419.879 Bangladesh Taka; currency used in Bangladesh (BDT) and for male participants this was 23858 ± 8510.603 BDT and for female participants it was 21760 ± 8222.967 BDT.

Table 1: Socio Demographic Characteristics of the Participants

Age	Male (n = 150)	Female (n = 150)	Total (n = 300)
25-34 yr	49 (32.67%)	40 (26.67%)	89 (29.67%)
35-44 yr	48 (32%)	53 (35.33%)	101 (33.67%)
45-54 yr	24 (16%)	30 (20%)	54 (18%)
55-64 yr	26 (17.33%)	25 (16.67%)	51 (17%)
65 & above yr	03 (2%)	02 (1.33%)	05 (1.67%)
Education			
No Education	07 (4.67%)	09 (6%)	16 (5.33%)
Primary Level	17 (11.33%)	49 (32.67%)	66 (22%)

Secondary Level	19 (12.67%)	17 (11.33%)	36 (12%)
SSC Level	30 (20%)	18 (12%)	48 (16%)
HSC Level	29 (19.33%)	18 (12%)	47 (15.67%)
Degree & Above Level	48 (32%)	39 (26%)	87 (29%)
Marital Status			
Unmarried	33 (22%)	21 (14%)	54 (18%)
Married	117 (78%)	90 (60%)	207 (69%)
Divorced	00 (0%)	06 (4%)	06 (2%)
Widow	00 (0%)	33 (22%)	33 (11%)
Family Income			
< 10,000 BDT	00 (0%)	04 (2.67%)	04 (1.33%)
10,000-19,999 BDT	53 (35.33%)	61 (40.67%)	114 (38%)
20,000-29,999 BDT	71 (47.33%)	68 (45.33%)	139 (46.33%)
30,000-39,999 BDT	16 (10.67%)	07 (4.67%)	23 (7.67%)
40,000 < BDT	10 (6.67%)	10 (6.67%)	20 (6.67%)

Table 2 shows the relationship of BMI, WHR and WC with HTN among the male participants. BMI shows a significant relationship with HTN (p value < 0.001) with Odds Ratio (OR) of 52.56 and Relative Risk (RR) of 19.33 which indicates BMI as a predictor for HTN. Total 60 participants were with a BMI of < 25 kg/m^2 and only 2 of them were suffering from HTN, 20 were at the Pre HTN stage and 38 were within the normal range. On the other hand, 63 participants were with a BMI ranging 25-29.9 kg/m^2 and more than half of them (36 participants) were with HTN, 22 participants were with Pre HTN and only 5 were within normal limit but the most interesting finding is that 27 participants were with a BMI > 30 kg/m^2 and surprisingly 22 of them with HTN, 3 were with Pre HTN and only 2 were normal. On the other hand, while considering WHR we found that it was also a very significant predictor HTN (p value < 0.001) with Odds Ratio (OR) of 118. Of them, 60 were with WHR ≤ 0.9 and only 1 was with HTN, 17 were with Pre HTN and the rest were normal where as 80 participants were with WHR > 0.9 and 59 were with HTN, 27 were with Pre HTN and only 3 were within normal limit. Again, regarding WC we found that 62 participants were with WC of ≤ 120 cm and only 3 were with HTN, 19 were in Pre HTN and rest of 40 were within normal range. On the other hand, 78 were with WC > 120 cm and 57 of them were in with HTN, 26 were with Pre HTN and only 5 were within normal limit. It was also appearing as a significant predictor of HTN (p value < 0.001) with Odds Ratio (OR) of 36.16.

Table 2: Relationship of Body Mass Index (BMI), Waist Hip Ratio (WHR) and Waist Circumference (WC) with Hypertension (HTN) Among Male Participants

BMI (kg/m^2)	No HTN (SBP < 120 mm of Hg and DBP < 80 mm of Hg)	Pre HTN (SBP 120-139 mm of Hg and DBP 80-89 mm of Hg)	HTN (SBP ≥ 140 mm of Hg and DBP ≥ 90 mm of Hg)	Statistical Result
< 18.5	03	00	00	X^2: 79.98; df: 6; p value: < 0.001 OR: 52.56.
18.5-24.9	35	20	02	
25-29.9	05	22	36	
≥ 30	02	03	22	

WHR				
≤ 0.9	42	17	01	X^2: 97.33; df: 2; p value: < 0.001 OR: 118.
>0.9	03	28	59	
WC (cm)				
≤ 120	40	19	03	X^2: 74.64; df: 2; p value: < 0.001 OR: 36.16.
>120	05	26	57	

*****Considering BMI ≤ 24.9 as one group and BMI ≥ 25 as another group and also no HTN and Pre HTN as one group and HTN as another group.

Table 3 shows the relationship of BMI, WHR and WC with HTN among the female participants. Here also BMI shows a significant relationship with HTN (p value < 0.001) with Odds Ratio (OR) of 19.87 and Relative Risk (RR) of 7.89 which indicates BMI as a predictor for HTN. Total 87 participants were with a BMI of < 25 kg/m^2 and only 7 of them were suffering from HTN, 23 were at the Pre HTN stage and 57 were within the normal range. On the other hand, 36 participants were with a BMI ranging 25-29.9 kg/m^2 and more than half of them (20 participants) were with HTN, 15 participants were with Pre HTN and only 1 was within normal limit but the most interesting finding is that 27 participants were with a BMI > 30 kg/m^2 and surprisingly 20 of them with HTN, 7 were with Pre HTN and no one was within normal limit. On the other hand, while considering WHR we found that it was also a very significant predictor HTN (p value < 0.001) with Odds Ratio (OR) of 17.81. Of them, 75 were with WHR ≤ 0.9 and only 5 were with HTN, 20 were with Pre HTN and the rest were normal where as 75 participants were with WHR > 0.9 and 42 were with HTN, 25 were with Pre HTN and only 8 were within normal limit. Again, regarding WC we found that 80 participants were with WC of ≤ 120 cm and only 3 were with HTN, 22 were in Pre HTN and rest of 55 were within normal range. On the other hand, 70 were with WC > 120 cm and 44 of them were in with HTN, 23 were with Pre HTN and only 3 were within normal limit. It was also appearing as a significant predictor of HTN (p value < 0.001) with Odds Ratio (OR) of 43.43.

Table 3: Relationship of Body Mass Index (BMI), Waist Hip Ratio (WHR) and Waist Circumference (WC) with Hypertension (HTN) Among Female Participants

BMI (kg/m^2)	No HTN (SBP < 120 mm of Hg and DBP < 80 mm of Hg)	Pre HTN (SBP 120-139 mm of Hg and DBP 80-89 mm of Hg)	HTN (SBP ≥ 140 mm of Hg and DBP ≥ 90 mm of Hg)	Statistical Result
< 18.5	17	03	00	X^2: 89.1005; df: 6; p value: < 0.001 OR: 19.87; RR: 7.89
18.5-24.9	40	20	07	
25-29.9	01	15	20	
≥ 30	00	07	20	
WHR				
≤ 0.9	50	20	05	X^2: 47.49; df: 2; p value: < 0.001 OR: 17.81; RR: 7.84
>0.9	08	25	42	
WC (cm)				
≤ 120	55	22	03	X^2: 82.09; df: 2; p value: < 0.001 OR: 43.43; RR: 16.76
>120	03	23	44	

*****Considering BMI ≤ 24.9 as one group and BMI ≥ 25 as another group and also no HTN and Pre HTN as one group and HTN as another group.

Discussion:

Recently BMI is used to define obesity and overweight and WHO also recommended it to use for the same purpose and a significant relationship with mortality and morbidity outcomes has been revealed[16]. As BMI shows the relationship of height and weight that is why it is now used in survey though it cannot show any relationship when increase of weight occurs due to increased muscle and distribution of excess body fat within the body. Obesity related illness mainly connected with the distribution of abdominal fat and BMI cannot serve this purpose even after individuals with a similar BMI can vary in their abdominal fat mass[17]. Previously WHR was used to identify the access fat accumulation and recently WC has been suggested to measure intra abdominal fat mass because some studies have found a closer relationship with the level of abdominal fat distribution than that of WHR[18-20]. Waist circumference correlates closely with both BMI and WHR and has found out the relationship of risk factors for CVD and other chronic diseases[21] but this association may vary between population groups. A study was conducted among the Hong Kong population and the result was differ between men and women, BMI and WC proved most effective for men and WC and WHR proved most effective for women[22]. So, this finding indicating WC may be used as a useful index. In this study, we have tried to investigate the relationship of three anthropometric measurements (BMI, WHR, WC) with hypertension as it is regarded one of the most important risk factor for CVD. So, this relationship will also help to find out the risk burden of CVD in the future.

Considering the p-Value, OR and RR in Table 2 and 3, it is clear that HTN is strongly associated with BMI, WHR and WC. But when we want to identify the superiority of the measurements the study shows that BMI and WHR is a better predictor of HTN among the male population while WC is a good predictor of HTN among the female population comparing the other two as because better parameters have higher x^2 Value, OR and RR. Again, when we want to find out the best predictor among male participants we identify that WHR has the highest OR and RR, then BMI and WC respectively. On the other hand, while considering female participants WC has the highest OR and RR, then BMI and WHR. So, for the male participants WHR and for the female participants WC is the best predictor for HTN. However, for the both groups BMI can be considered as a good one. Again, epidemiological study requires easy and accurate physical measurement. By the way, hip measurements in the severely obese are difficult and unreliable and for that reason, both WC and particularly WHR suffer from measurement error whereas BMI is both simple and routinely measured. However, the problems with measurement of WC and WHR are largely restricted to the extremely obese, for whom the assessment of HTN is likely to be routine in any case. Therefore, considering that measurement of BMI as a predictor of HTN is the best option because it can be used for both male and female population group and also can minimize measurement error.

In considering the accuracy level during antropometric measurements, the level of community acceptance and the study result body mass index should be regarded as an effective predictor of hypertension.

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