Correlation of obesity indices and blood pressure among overweight and obese females

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ABSTRACT

Background: Overweight and obesity is defined as abnormal excessive accumulation of body fat that impairs health and normal functions of body. The worldwide obesity is increasing at an extremely alarming rate. The growing epidemic of obesity is responsible for parallel increase in prevalence of obesity-related hypertension. Hypertension is considered to be underlying risk factors in development of cardiovascular disease.

Aims & Objective: Aim of this study is to find out relationship of obesity indices namely BMI, WC and WHR with blood pressure and to find out which obesity measure is associated with greater risk of hypertension.

Materials and Methods: The cross-sectional study was conducted on three hundred and forty nine overweight and obese females at PNS Shifa Hospital, Karachi. Female between the ages 20-60 years were selected using simple random sampling. All females having BMI ≥23 kg/m² were selected after making necessary exclusion. Anthropometric data was taken from every individual according to standardized protocol. Descriptive statistics were used to calculate mean and standard deviation for weight, height, BMI, waist and hip circumference. Spearman correlation was used to find the correlation and odds ratio and 95% confidence interval was calculated for all obesity indices. P value less than 0.05 was taken as significant.
**Results:** Basic descriptive statistics for subject data were expressed as means ± standard deviations. The age of subjects ranged between 20 – 60 years with a mean 38.70 ± 5.44 years. The odds ratio of developing hypertension with increase in obesity indices. The results demonstrated that all obesity measures expect hip circumference showed significant association with systolic Blood pressure (p< 0.05). Waist Circumference showed strong correlation with systolic BP is stronger as compared to other obesity indices (p<0.001). However, with regard to diastolic BP, BMI showed strongest association while all other obesity measures showed almost equal correlation.

**Conclusion:** The study indicates a positive association of Waist circumference with hypertension. Measurement of waist circumference can serve as effective tool to identify individual at high risk of developing cardio metabolic disorder.

**Keywords:** Body Mass Index, Overweight, Obesity, Obesity indices
INTRODUCTION

Overweight and obesity is defined as abnormal excessive accumulation of body fat that impairs health and normal functions of body. The world wide obesity is increasing at an extremely alarming rate with prevalence almost doubled since 1980.According to recent report of WHO, 1.9 billion adults aged 18 years and older were overweight and more than 600 million were reported to be obese in year 2014.\(^1\)

The overweight and obesity has been labeled as major modifiable cardiovascular disease (CVD) risk factor by American Heart Association.\(^2\) The growing epidemic of obesity is responsible for parallel increase in prevalence of obesity related hypertension. Hypertension is considered to be underlying risk factors in development of cardiovascular disease.\(^3\)

According to data of Global burden of disease 2010, CVD is leading cause of age-standardized deaths in Pakistan and it has been projected that from 2010 to 2025 CVD will be the major cause of population level mortality among all causes of death.\(^4\) It is now considered as growing public health issues and associated with increase morbidity and mortality as well as increased socioeconomic cost.\(^5\)

Various methods are available for assessment of and overweight and obesity but mostly these methods are difficult to use in research settings. Simple anthropometric measurements are most practical and easy to use in clinical and epidemiological settings.\(^6,7\)

Body mass index (BMI) is a simple index use for assessment of overweight and obesity.\(^8\) BMI asses the overweight and obesity in terms of height and weight .It is simple anthropometric tool and has been widely used as surrogate measurements of assessment of obesity.\(^9\) However, it does not take into account difference in distribution of total body fat from abdominal fat and corresponding risk of chronic diseases which differs in different populations and ethnic groups. Moreover, it does not differentiate whether excessive body weight is due to increased body fat or muscle mass and may lead to misclassification of level of obesity.\(^10\) This is
the reason that WHO and International Task Force of obesity have purposed lowered BMI cut off values for assessment of overweight and obesity in Asians. BMI Cut offs for overweight and obesity is taken as of 23 kg/m$^2$ and 25 kg/m$^2$ respectively.\textsuperscript{11-13}

In addition to general level of obesity assessed by BMI, abdominal obesity represented by waist circumference and waist-hip ratio is independently associated with cardio metabolic risk factor. Correlation between abdominal obesity and CVD is evident by various researches and it has been proved that abdominal obesity correlate more strongly with obesity related health risk factors than overall obesity.\textsuperscript{14}

Several studies have been carried out in this regard in various populations but there is dearth of literature on this study in our part of the world. Aim of this study is to compare the relationship of obesity indices namely body mass index (BMI), waist circumference (WC) and waist hip ratio (WHR) with blood pressure and to find out which obesity measure is associated with greater risk of hypertension.

**METHODOLOGY**

Cross sectional study conducted on overweight and obese women of 15-60 years of age reporting at Dietitiant OPD, family OPD and during BMI Camp arranged by registered dietitian through official written invitation to lady wives and daughters of Residents of Shifa hospital (Doctor’s Complex).

Inclusion criteria for study participants include disease free healthy overweight and obese females of age group 20-60 years, with BMI more than 23 kg/m$^2$ and with no underlying co morbid associated with obesity. Exclusion criteria include females with syndromal obesity, polycystic ovaries and those on pharmacotherapy for obesity.

Total three seventy three females full filled the eligibility criteria, out of these, twenty four don’t full fill the inclusion criteria were excluded and rest of three forty nine females were enrolled after taking the informed consent. All selected females underwent physical examination in order to obtain anthropometric data.

Weight was measured in minimum clothing to the nearest 0.1 kg using a weight scale with calibration done after every 25
readings. Height was recorded in the erect position, back and hips touching the wall without shoes to the nearest 0.1 cm using wall mounted stadiometers. Waist circumference was measured according to standardized protocol given in WHO STEPS. As per this protocol waist circumference is measured by placing measuring tape approximately at mid of upper border of iliac crest and lower margin of last palpable rib. According to WHO STEPS protocol hip circumference should be recorded at the widest portion of the buttocks. Precise measurement of waist hip ratio depends on accurate measurement of waist and hip circumference which depends on correct positioning and tightness of measuring tape. Position should be parallel to the level of floor from which measurement is taken and it should not pull tightly in order to avoid constriction. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements were taken following standard procedure. Hypertension was defined according to the Seventh Report of the Joint National Committee (JNC-7) recommendation (SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg). BMI is categorized as per Asian cut off for classifying overweight and obesity. Normal weight BMI > 18.5 - 23 kg/m. Overweight BMI 23 - 25 kg/m² and BMI > 25 kg/m² is taken for Obese.

Waist circumference as per Asian cut off for females < 80cm and hip circumference < 90 cm is taken as normal. STATISTICAL ANALYSIS

Data was analyzed using statistical package for social sciences (SPSS) version 20.0. Descriptive statistics were used to calculate mean and standard deviation for weight, height, BMI, waist and hip circumference. Spearman correlation was used to find the correlation and odds ratio and 95% confidence interval was calculated for all obesity indices. P value less than 0.05 was taken as significant.

RESULTS

Basic descriptive statistics for subject data were expressed as means ± standard deviations. The age of subjects ranged between 20 – 60 years with a mean 38.70 ± 5.44 years. BMI was 26.34 ± 5.12 kg/m2, with mean systolic blood pressure 125.75 ± 8.18 mmHg and Diastolic Blood Pressure...
80.15 ± 9.54 mmHg. The odds ratio of developing hypertension with increase in obesity indices is shown in Table 2. The results (Table 3) has demonstrated that all obesity measures except hip circumference showed significant association with systolic Blood pressure (p<0.05). The results also demonstrated that association of Waist Circumference with systolic BP is stronger as compared to other obesity indices (p<0.001). However, with regard to diastolic BP, BMI showed strongest association while all other obesity measures showed almost equal correlation. In contrast to SBP, Hip circumference also showed correlation with DBP (p< 0.05)

**Table 1: Baseline characteristics of the study population**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>38.70</td>
<td>5.44</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>161.12</td>
<td>4.14</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65.30</td>
<td>6.11</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>26.34</td>
<td>5.12</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>80.56</td>
<td>7.13</td>
</tr>
<tr>
<td>Hip Circumference (cm)</td>
<td>89.17</td>
<td>6.17</td>
</tr>
<tr>
<td>Waist Hip ratio</td>
<td>0.90</td>
<td>2.13</td>
</tr>
<tr>
<td>Systolic Blood Pressure (mm/Hg)</td>
<td>125.75</td>
<td>8.18</td>
</tr>
<tr>
<td>Diastolic Blood Pressure (mm/Hg)</td>
<td>80.15</td>
<td>9.54</td>
</tr>
</tbody>
</table>
Table II: Odds-ratios for developing hyper tension with increasing obesity measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist Circumference(cm)</td>
<td>1.18</td>
<td>1.11-1.21</td>
<td>0.001</td>
</tr>
<tr>
<td>Hip Circumference (cm)</td>
<td>1.05</td>
<td>1.02-1.11</td>
<td>0.02</td>
</tr>
<tr>
<td>Waist Hip ratio</td>
<td>1.02</td>
<td>1.0-1.12</td>
<td>0.01</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>1.09</td>
<td>1.05-1.21</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 111: Correlation between obesity indices and development of Hypertension

<table>
<thead>
<tr>
<th>Variables</th>
<th>Systolic Blood Pressure(mm/Hg)</th>
<th>Diastolic Blood Pressure(mm/Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation</td>
<td>P value</td>
</tr>
<tr>
<td>Waist Circumference(cm)</td>
<td>0.840</td>
<td>0.001</td>
</tr>
<tr>
<td>Hip Circumference(cm)</td>
<td>0.213</td>
<td>0.09</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>0.512</td>
<td>0.049</td>
</tr>
<tr>
<td>Waist Hip ratio</td>
<td>0.622</td>
<td>0.01</td>
</tr>
</tbody>
</table>
DISCUSSION

Pakistan is the sixth most populous country in world and undergoing demographic and epidemiological transition. Average life expectancy of Pakistani population has been increased with overall life expectancy is more in females as compared to males. This increase in life expectancy has also increased the average time span for exposure of Non Communicable Diseases (NCD).\textsuperscript{17}

Pakistan is facing double burden of disease while they continue to have burden of infectious diseases along rapid upsurge in Non Communicable diseases including Diabetes, hypertension, CVD, dyslipidemia, cancers.\textsuperscript{18} Hypertension is an emerging public health issue of great concern. According to National Health Survey report, every third person, over the age of 45 years has hypertension in our country\textsuperscript{19}.

The purpose of this study was to compare the relationship of obesity indices with blood pressure and to find out the measure associated with strong risk of developing hypertension.

Among all obesity indices, WC and BMI were found to be significantly correlated with SBP and DBP respectively. This finding supported the evidence on appropriateness of measuring WC along with BMI in assessment of health risk factors associated with obesity.\textsuperscript{20}

Evidence has proved that BMI and WC when used in conjunction gives better estimation of abdominal obesity and associated health risk as compared BMI alone.\textsuperscript{21}

Singhal et al while discussing the different measures of assessment of obesity among Asian women \textsuperscript{22} stated that use of BMI alone is not effective in classifying the level of obesity as it may tend to underestimate the level of obesity and may categorize them as normal and added that BMI along with waist circumference is better method of assessment as it take into consideration the assessment of central obesity which is considered as a underlying risk factor for many chronic health problems associated with obesity.\textsuperscript{23}

The results of the present study also revealed that the odds ratio of developing
hypertension was comparatively greater with increasing WC than other obesity measures (WC, WHR and BMI). The OR associated with 1.0 cm increase in WC was 1.18. Comparing values for a 1 kg/m² increase in BMI was 1.09. A similar increase in WHR was associated with an odds ratio of 1.02.

Result of our study is also in accordance with the evidence that Asians have increased abdominal fat and adipose tissue that predisposes them to increased risk of chronic health problems and supported the fact that in addition to BMI (assess over all obesity), WC should be measured in order to categorize the individual according to health risk.\(^\text{24, 25}\)

Recent researches have supported fact that WC is strong marker of health risk as compared to BMI Qibin, et al reported WC is strong determinant of health risk as compared to BMI\(^\text{26}\). Result of most recent study have proved that WC is strong predictor of cardio metabolic risk factor while other obesity indices and BMI and WHR have no value in this regard.\(^\text{27}\) However, some studies in south Asians did not support this finding For instance study conducted on Indian adult population showed that OR of developing Hypertension is greater with Increasing BMI as compared to WC and WHR.\(^\text{28}\)

Study conducted in Hong Kong\(^\text{29}\) and Singaporean\(^\text{30}\) women found waist to stature ratio as best anthropometric index that is strongly associated with Cardio vascular risk factors. Since present study was cross sectional, similar studies should be replicated with large sample size with better study design to enhance generalizibility. The study was conducted only on females, further investigation involving all obesity indices and multiethnic population are necessary for effective control and management of hypertension.

**CONCLUSION**

The study indicates a positive association of Waist circumference with hypertension. Measurement of waist circumference can serve as effective tool to identify individual at high risk of developing cardio metabolic disorder. This study also suggests that abdominal fat more strongly associated with disease risk factor. This analysis
highlights the need of community based educational program to create health awareness for necessary for effective prevention and management of hypertension.

REFERENCES

1. Obesity and overweight Fact sheet N°311 Updated August 2015.


17. World Development Indicators. World Bank, Washington DC; 2009.


