ABSTRACT
This study is aim at determining the correlations between the derived and basic anthropometric indices in hypertension among the people at Chitwan District of Nepal. A total 500 subjects above aged 20 were recruited for the study. This study was conducted from 7th November, 2011 to 15th November 2011. All historical information was obtained by interview and medical records. Height and weight were measured after the removal of shoes and with the patients wearing light clothing. Similarly, waist circumference was measured using a steel measuring tape, with measurements made halfway between the lower border of the ribs, and the iliac crest in a horizontal plane. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor. The result showed that the mean value of waist hip ratio (WHR) for male participants fell below the range for the overweight and obese, while the mean value of WHR for female participants fell within the range classified as obese. The mean body mass index (BMI) for all the participants fell within the healthy weight range. Furthermore, there was a significant relationship between the systolic blood pressure as well as the diastolic blood pressure, and the indices of adiposity of all the participants (p=0.0001). In conclusion, WHR is a strong independent indicator of hypertension, particularly in men aged 40-59 years and women aged 40-69 years. However, age disparity in relation to hypertension was not taken into consideration.

Key words: Waist hip ratio, body mass index, systolic blood pressure and diastolic blood pressure.

INTRODUCTION
Obesity has been particularly recognized as a major independent risk factor for cardiovascular diseases [1]. This is because increased body fat is accompanied by profound changes in the physiological and metabolic functions of the body, which are directly dependent on the degree of excess weight and on its distribution around the body. The prevalence of obesity is rising in developed and developing nations, and it is cited as an important risk factor for early mortality [2]. Obesity has a strong relationship with cardiovascular diseases like hypertension, coronary heart disease and diabetes [1, 3, 4]. A number of clinical measurements for obesity have been used to determine susceptibility to cardiovascular diseases [4]. These include anthropometric indices such as body mass index (BMI), waist-hip ratio (WHR) and waist circumference (WC) [5, 6].

Body mass index (BMI), which is defined as weight (kg)/ height (m²), is the accepted measure to assess obesity [2]. Obesity is defined by a BMI value ≥ 30 kg/m² [7]. BMI is an indicator of total body fat; however, it is not a good indicator of regional fat distribution [8, 9]. Waist-hip ratio (WHR) is an index of body fat distribution. As the WHR is difficult to interpret biologically and less sensitive to changes in total body fat and visceral fat [10], waist circumference (WC) has been proposed to be a better predictor of cardiovascular risk factors [7]. This study is aim at determining the correlations between the derived and basic anthropometric indices in hypertension among the people at Shivanagar VDC in Chitwan District of Nepal.

MATERIALS AND METHODS
This cross-sectional study was carried out at Shivanagar, Jagatpur and Sharadpur VDC of Chitwan District by organizing medical camps...
and a total 500 subjects above aged 20 were recruited for the study. Informed consent was obtained from each subject. This study was conducted from 7th November, 2011 to 15th November 2011. All historical information was obtained by interview and medical records.

Measurement of BMI
Height and weight were measured after the removal of shoes and with the patients wearing light clothing. BMI was calculated as weight (kg)/height (m^2). Those with a BMI of 25.0–29.9 kg m^2 were classified as overweight, whilst those with a BMI ≥ 30.0 kg m^2 were classified as obese.

Measurement of Hip and Waist Circumference
Waist circumference was measured using a steel measuring tape, with measurements made halfway between the lower border of the ribs, and the iliac crest in a horizontal plane. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor. For each of waist and hip circumference, two measurements to the nearest 0.5 cm were recorded. If the variation between the two closest measurements was greater than 2 cm, a third measurement was taken. The mean of the two measurements was calculated. Men with a waist circumference 94–101.9 cm (>102 cm) and women with a waist circumference ≥88.0 cm were classified as overweight, whilst those with a waist circumference ≥102.0 cm and women with a waist circumference ≥88.0 cm were classified as obese.

Blood pressure was measured in a seated position after the participant had rested for at least 5 min. After measurement of the circumference of the mid upper arm, a cuff of suitable size was applied to the participant’s exposed upper arm (the arm not used for blood collection), which was supported by the table at heart level. Blood pressure was measured twice with a standard mercury sphygmomanometer and the mean measurement was used. Participants were classified as hypertensive if they were on treatment for hypertension, had a mean systolic reading ≥140 mmHg or a mean diastolic reading ≥90 mmHg.

Statistical Analysis
The statistical software SPSS (version 15) was used for data analysis. The mean values of WC, HC, BMI, WHR and BP were determined. Correlations between the BMI vs BP, and WHR vs BP were examined using the Pearson correlation coefficients keep statistical significance at 95% confidence interval of mean (P=0.05, P<0.05).

RESULTS
Characteristics of Participants
The study population consisted of 500 individuals with ages ranging from 20-85 years. Their weights ranged between 22 and 90 kg and heights between 122 and 176 cm. (Table 1) shows the demographic characteristics and the indices of adiposity of the participants. From the table 1, it can be observed that male participants were significantly taller and heavier (P < 0.05), while no significant difference existed in age between the male and female participants (P= 0.057, P > 0.05). Furthermore, the mean value of WHR for male participants (0.891) fell below the range for the overweight and obese, while the mean value of WHR for female participants fell within the range (0.94) classified as obese.[11] The mean BMI for all the participants fell within the healthy weight range (18.5 to 25kg/m^2).

Relationship between Indices of Adiposity and Cardiovascular Variables of Participants
There was a significant relationship between the systolic blood pressure as well as the diastolic blood pressure, and the indices of adiposity of all the participants (P < 0.05) (Table 2).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>All Subject X±SD</th>
<th>Male X±SD</th>
<th>Female X±SD</th>
<th>Calculated t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50.95±16.71</td>
<td>56.45±16.41</td>
<td>52.07±16.03</td>
<td>1.910</td>
<td>0.057</td>
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<tr>
<td>Weight</td>
<td>56.98±13.18</td>
<td>66.86±14.63</td>
<td>52.12±9.96</td>
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<tr>
<td>Height</td>
<td>153.69±11.49</td>
<td>163.08±10.84</td>
<td>146.94±6.70</td>
<td>1.275</td>
<td>0.000</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>81.90±13.78</td>
<td>91.78±11.73</td>
<td>77.33±12.50</td>
<td>1.715</td>
<td>0.000</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>91.73±10.53</td>
<td>96.95±10.10</td>
<td>90.09±10.35</td>
<td>1.446</td>
<td>0.000</td>
</tr>
<tr>
<td>Waist-Hip Ratio</td>
<td>0.89±0.10</td>
<td>0.94±0.07</td>
<td>0.85±0.93</td>
<td>0.012</td>
<td>0.000</td>
</tr>
<tr>
<td>BMI</td>
<td>23.98±4.09</td>
<td>24.92±3.87</td>
<td>24.14±4.22</td>
<td>1.350</td>
<td>0.178</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters</th>
<th>WC</th>
<th>WHR</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>0.259</td>
<td>0.309</td>
<td>0.215</td>
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<tr>
<td>p-value</td>
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<td>0.001</td>
<td>0.031</td>
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<tr>
<td>DBP</td>
<td>0.386</td>
<td>0.291</td>
<td>0.313</td>
</tr>
<tr>
<td>p-value</td>
<td>0.000</td>
<td>0.003</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 1: Socio-demographic Characteristics

Table 2: Correlation between Indices of Adiposity and Cardiovascular Variables

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Comparison of Indices of Adiposity of Hypertensive and Normotensive Participants

The participants were further classified as normotensive (SBP <160; DBP <100) and hypertensive (SBP >160; DBP >100). A significant difference (P < 0.05) was observed between the WHR and BMI of hypertensive and normotensive participants. The hypertensive participants had a significantly higher WHR (> 0.9) as well as a significantly higher BMI (> 25kg/m²) compared to the normotensive participants (Table 3).

Table 3: Comparison of Indices of Adiposity of Hypertensive and Normotensive Participants

<table>
<thead>
<tr>
<th></th>
<th>Normotensive</th>
<th>Hypertensive</th>
<th>T value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHR X±SD</td>
<td>0.89±0.15</td>
<td>0.94±0.11</td>
<td>-0.05</td>
<td>0.0001</td>
</tr>
<tr>
<td>BMI X±SD</td>
<td>23.98±4.08</td>
<td>32.74±6.12</td>
<td>-8.76</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

DISCUSSION

In this study, the mean values of WHR for female participants (> 0.9) fall within the range classified as obese in women. This shows an increase in abdominal fat \(^\text{[12]}\) for this group of participants, even though the mean value for BMI falls within the healthy weight range. WHR may prove to be a more appropriate and universal indicator of risk for an ethnically-diverse population \(^\text{[12, 13]}\). It has also been suggested to be a better indicator of cardiovascular risk, as it is less dependent on body size and height and WHR ratio \(^\text{[14]}\). Furthermore, the measurements used for obesity assessment in this study – BMI and WHR, correlated significantly with systolic and diastolic blood pressures. This result is similar to that of Canoy et al., \(^\text{[15]}\), in which it was observed that waist and hip circumferences were positively related to systolic and diastolic blood pressures in male and female participants who were involved in a Norfolk cohort study. However, hip circumference was not independently correlated with blood pressure. In addition, the result of this study showed that an increase in BMI > 25kg/m² and WHR > 0.9 correlates with hypertension in both the male and female participants. This finding is in accordance with the study by Hartz et al., \(^\text{[16]}\), in which it was discovered that WHR is a strong independent indicator of hypertension, particularly in men aged 40-59 years and women aged 40-69 years. However, age disparity in relation to hypertension was not taken into consideration.

ACKNOWLEDGEMENT

The authors would like to thank Chitwan Medical College for providing research facilities and fund.

REFERENCES


