Prevalence of overweight and obesity among patients with type 2 diabetes mellitus in Kathmandu

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Obesity and type 2 diabetes constitute major public health issues in modern societies worldwide. These two forms frequently coexist, and statistics show that 60–90% of all patients with type 2 diabetes are or have been obese. Obesity is generally considered to be a strong risk factor for the development of type 2 diabetes mellitus in future. Thus, the main aim of this study is to evaluate the trend of overweight and obesity among patients with type 2 diabetes mellitus. It also attempts to determine the prevalence of abdominal adiposity in type 2 diabetic subjects. The present study comprised of a total of 160 type 2 diabetic subjects who were interviewed for different demographic factors, diabetes related information and personal habits. Anthropometric measurements were done, body mass index and waist-hip ratio were determined. Thus, obtained data were analyzed and the results were reported. This study revealed that nearly half i.e. 51.9% of the total patients have been suffering from overweight and obesity as per the BMI category. Similarly, obesity was found to be more prevalent in female subjects than their male counterparts, with 5.5% males and 25.7% females being obese.

Key words: Diabetes mellitus, body mass index, cardiovascular disease.

INTRODUCTION

Diabetes mellitus is one of the most common endocrine disorders in the world. The prevalence of diabetes has been increasing globally and the disease has become one of the major public health concerns. According to World Health Organization (WHO), diabetes affects more than 170 million people worldwide and the number will rise to 370 million by 2030. World health organization 2004. The recent update of WHO has updated that diabetes, hypertension, and obesity are one of the top five continuing risk factors for cardiovascular deaths in the world, (World Health Organization, 2009). In Nepal, diabetes is the fifth leading cause of death. The Nepal Diabetes Association reported that diabetes affects approximately 15% of people ≥ 20 years and 19% of people ≥ 40 years of age in urban areas (Bhattarai and Singh, 2007). Approximately 90% of all cases of diabetes have type 2 diabetes and the obesity is commonly associated with this type. Body mass index (BMI) is the commonest parameter used to define obesity in clinical practice (Bakari and Onyemelukwe, 2005). The prevalence of obesity has been increasing dramatically in the last few decades in the whole world, not only in industrialized countries but also in developing areas with changes in dietary habits and activity level, Keller U 2006. Moreover, obesity is a worldwide epidemic that contributes to many chronic diseases and early mortality (James et al., 2002; Must et al., 1999).

Adverse health consequences associated with obesity include increased incidence rate of type 2 diabetes mellitus, coronary artery disease, dyslipidemia, hypertension, osteoarthritis, various malignancies and the diseases of respiratory tract system, gallbladder diseases as well as psychosocial effects (Racette et al., 2003). Obesity is the most important modifiable risk factor in the pathogenesis of type 2 diabetes as reported in most cross-sectional studies (World Health Organization, 1995; Bakari and Onyemelukwe, 2005). Obesity is involved in

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Table 1. Baseline characteristics of the study population.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>36.00</td>
<td>85.00</td>
<td>57.41</td>
<td>10.51</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>134.50</td>
<td>178.00</td>
<td>159.55</td>
<td>10.01</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>40.00</td>
<td>99.00</td>
<td>65.04</td>
<td>11.16</td>
</tr>
<tr>
<td>BMI</td>
<td>17.09</td>
<td>34.17</td>
<td>25.55</td>
<td>3.74</td>
</tr>
<tr>
<td>WHR</td>
<td>0.75</td>
<td>1.18</td>
<td>0.95</td>
<td>0.08</td>
</tr>
<tr>
<td>Duration of diabetes (years)</td>
<td>1.00</td>
<td>40.00</td>
<td>7.14</td>
<td>6.55</td>
</tr>
<tr>
<td>Fasting serum glucose (mg/dl)</td>
<td>68.00</td>
<td>350.00</td>
<td>132.76</td>
<td>50.26</td>
</tr>
</tbody>
</table>

BMI: Body Mass Index, WHR: Waist to Hip Ratio.

Table 2. Prevalence rates of overweight and obesity.

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI (kg/m²)</th>
<th>No. of patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt; 18.50</td>
<td>5</td>
<td>3.1</td>
</tr>
<tr>
<td>Normal</td>
<td>18.50 - 24.99</td>
<td>72</td>
<td>45.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.00 - 29.99</td>
<td>60</td>
<td>37.5</td>
</tr>
<tr>
<td>Obese</td>
<td>≥ 30.00</td>
<td>23</td>
<td>14.4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>160</td>
<td>100.0</td>
</tr>
</tbody>
</table>

the pathologic process that culminates in the development of frank type 2 diabetes (Steppan et al., 2001; Ford et al., 1997) and is a severely aggravating factor in many cardiovascular diseases as well as premature death (Pi Sunyer, 2009). Recent estimates suggest that around 80% of patients with type 2 diabetes are overweight or obese (Norris et al., 2005; Kyrou and Kumar, 2000). This study was therefore undertaken to evaluate the trend of overweight and obesity among diabetic subjects. It also sought to determine the prevalence of abdominal obesity in diabetic subjects.

**METHODS**

A cross-sectional study was conducted at National Public Health Laboratory (NPHL), Teku Kathmandu, Nepal from December 2010 to March 2011. One hundred and sixty subjects (90 males and 70 females) who were already diagnosed with Type 2 diabetes mellitus participated in the study. The study populations were randomly selected among the patients visiting NPHL. All the information about the subjects was obtained through the questionnaires. Fasting blood samples were collected for serum glucose estimation. For the assessment of BMI, height was measured to the nearest centimeter using an anthropometric rod with the subject standing erect on the floor with the back against a vertical mounted ruler. Weight of the subjects was measured on a pre-standardized scale to the nearest 100 g. BMI of the study population was then calculated using the formula, weight in Kilogram (kg) divided by height in square of the meter square (m²). Similarly, the hip circumference (HC) was measured around the hips, and the waist circumference (WC) was measured at the waist to the hip ratio (WHR) was then calculated by dividing waist circumference with the hip circumference. Finally, the collected data were analyzed using “Statistical Packages for Social Sciences” (SPSS) 17.0 software. The results were reported as mean ± SD and were evaluated by using the Pearson’s correlation coefficient test. Statistical significance was considered at P values < 0.05.

**RESULTS**

Table 1 shows the baseline characteristics of the study population. According to this table, the mean age of the patient was 57.41 ± 10.51 years, the mean height was 159.55 ± 10.01 cm, and the mean weight was 65.04 ± 11.16 kg. Similarly the mean BMI was found to be 25.55 ± 3.74 kg/m² and the mean WHR of the patients was 0.95 ± 0.08. Also the mean duration of diabetes was 7.14 ± 6.55 years and the mean fasting serum glucose was 132.76 ± 50.26 mg/dl.

Table 2 shows the prevalence rates of overweight and obesity as per the BMI category. Out of the total 160 subjects, 60 (37.5%) were overweight, 23 (14.4%) were obese and the rest were underweight and normal.

Table 3 shows the comparison of ranges of BMI in male and female patients according to which obesity was found more prevalent in female subjects than their male counterparts. Out of 90 male diabetics 5 were obese (5.5%) while out of 70 female diabetics 18 were obese.
Table 3. Comparison of range of BMI in male and female patients.

<table>
<thead>
<tr>
<th>BMI category</th>
<th>Males N= 90 (%)</th>
<th>Females N= 70 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>2 (2.2)</td>
<td>3 (4.2)</td>
</tr>
<tr>
<td>Normal</td>
<td>52 (57.7)</td>
<td>20 (28.5)</td>
</tr>
<tr>
<td>Overweight</td>
<td>31 (34.4)</td>
<td>29 (41.0)</td>
</tr>
<tr>
<td>Obese</td>
<td>5 (5.5)</td>
<td>18 (25.7)</td>
</tr>
</tbody>
</table>

Figure 1. Prevalence of abdominal obesity in male diabetics according to WHR.

Figure 2. Prevalence of abdominal obesity in female diabetics according to WHR.

Table 4. Pearson correlation coefficients between anthropometric indices among the diabetic subjects.

<table>
<thead>
<tr>
<th></th>
<th>BMI</th>
<th>WHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC</td>
<td>0.632 (P&lt;0.01)</td>
<td>0.672 (P&lt;0.01)</td>
</tr>
<tr>
<td>HC</td>
<td>0.646 (P&lt;0.01)</td>
<td>-0.120</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.201 (P&lt;0.05)</td>
<td>-</td>
</tr>
</tbody>
</table>

WC: Waist Circumference, HC: Hip Circumference. P<0.01, Correlation is significant at the 0.01 level (2-tailed). P<0.05, Correlation is significant at the 0.05 level (2-tailed).

(25.7%). Figure 1 depicts that 51.1% of the male diabetics are obese (WHR > 0.95) and Figure 2 shows nearly all of the female diabetics i.e. 94.2% are obese (WHR>0.80) according to WHR.

There was a highly significant positive correlation between WC and BMI; WC and WHR; HC and BMI and BMI and WHR whereas there was a negative correlation between HC and WHR which is shown in Table 4.

DISCUSSION

The association between degree of obesity, body fat
distribution and weight gain with subsequent occurrence of type 2 diabetes has been examined in several prospective studies. Increased BMI is now a well-established independent risk factor for the development of type 2 diabetes (Astrup and Finer, 2000; Boden, 1997). In this study, 51.9% that is nearly half of the total patients have BMI ≥ 25 kg/m². The prevalence of overweight and obesity as indexed by BMI was 37.5% and 14.4% respectively. In consistent with this, a recent study by Pandeya et al. (2012) showed that 39.0% and 11.0% of the diabetics to be overweight and obese respectively, Pandeya et al. (2012). A study by Ahmed et al. (2007) showed that 67% of the patients with diabetes mellitus had BMI ≥ 25 kg/m². Similarly, Shera et al. (2004) showed that 61% of the diabetics had BMI ≥ 25 kg/m². However, slightly higher prevalence was reported by Joseph et al. (2004), the majority (83%) of the type 2 diabetic patients were either overweight or obese. These findings further support the fact that obesity or excess body fat accumulation is a strong risk factor for type 2 diabetes. The differences in percentage of overweight and obesity in type 2 diabetes in various studies might be due to different factors like geographical variations, lifestyle, occupational status, genetic factor or ethnic differences of the population.

A study by Bays et al. (2007) depicted an association between increased BMI and increased prevalence of diabetes which was highest among morbibly obese individuals. Obesity plays a central role in insulin resistance syndrome, which includes hyper-insulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus and an increased risk of atherosclerotic cardiovascular disease (Pinhas-Hamiel et al., 1996; Fagot-Campagna et al., 2000). These lipid abnormalities are the major risk factors for the development of cardiovascular risk in type 2 diabetes, Snideman et al., 2001. The study by Pandeya et al. (2012) showed the pattern of dyslipidemia in diabetics with the majority of individuals having low levels of high density lipoprotein cholesterol (HDL-C) and high triglyceride (TG) levels (Pandeya et al., 2012). Therefore, further research should be done in large population to see the type of lipid abnormalities in type 2 diabetes and also to evaluate the newer marker of dyslipidemia like non-high density lipoprotein cholesterol (non-HDL-C) which predicts cardiovascular risk in diabetics.

In accordance with the findings observed in other studies, Sharma and Jain 2009, this study also found higher prevalence of abdominal obesity as indexed by WHR in female subjects than their male counterparts. Nearly all the female diabetics (94.3%) had abdominal obesity while only 51.1% of the male diabetics had abdominal obesity. Besides abdominal obesity, the present study also found that generalized obesity is more prevalent in female diabetics than male diabetics. This fact is also in agreement with several other studies (Joseph et al., 2004; Shah et al., 2006). Hence, in this study, both obesity and central obesity were more prevalent among females than males and the difference was evidently more in central obesity where the rate for females was nearly double compared to males. The factors that affect these differences may include childbearing, hormonal status and the high female illiteracy rates, which lead to lower female awareness to the importance of their physique (Williamson, 1993; Riyami et al., 2003). This may further be due to cultural practices that tend to limit physical exertion by females with resultant sedentary habits, obesity and its attendant complications (Bakari and Onyemelukwe, 2005). In the present study, there was a highly significant positive correlation between WC and BMI and WC and WHR. These findings are in consistent with the outcome of other studies, (Adediran et al., 2007; Marjani, 2011).

Conclusion
Based on the findings of the present study, it can be concluded that overweight/obesity and abdominal obesity persist in diabetic patients. Furthermore, both obesity and central obesity were more prevalent among females than males and the difference was evidently more in central obesity where the rate for obesity in females was nearly double compared to that in males. Both the diseases are closely interlinked, obesity being central to the development of insulin resistance and hence is a strong risk factor for type 2 diabetes. Therefore an important implication from this study is that effective treatment of obesity with sustained weight loss and obesity prevention including lifestyle modifications are important interventions in an effort to reduce the risk for diabetes and other related complications.

Acknowledgements
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REFERENCES
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