Original Article

Lipid Profile Pattern and Dyslipidemia in Obese and Non Obese Libyan Type 2 Diabetic Patients in Benghazi City

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Introduction

Dyslipidaemias are common in type 2 diabetic patients, they make diabetic patients more susceptible to develop cardiovascular disease (CVD) and other complications of atherosclerosis which further increases and leading to excess CVD risk at an earlier age with obesity [1]. Dyslipidaemias represent a growing epidemiological problem worldwide and a great challenge to public health in several countries [2].

In Libya, obesity and diabetes became major causes of morbidity in the last decades [3]. The frequency of abnormality of lipids, lipoproteins and apolipoproteins varies in different populations [4, 5]. The most typical lipoprotein pattern in diabetes, also known as diabetic dyslipidaemia or atherogenic dyslipidaemia, consists of moderate raised in triglycerides, reduced high density lipoprotein (HDL) and excess of small, dense low density lipoprotein (LDL) particles. The lipid abnormalities are prevalent in diabetes mellitus because missing of insulin effects on liver apo protein production, regulation of lipoprotein lipase (LpL), actions of cholestereryl ester transfer protein, and peripheral actions of insulin on adipose and muscle [6, 7].

The lipid profile is an important predictor for metabolic disturbances and serious medical conditions, including dyslipidaemia, hypertension, diabetes and cardiovascular diseases [1].

The epidemiological evaluation of the lipid profile tool is an important for the promotion of health policies aimed at preventing and reducing cardiovascular risk factors in the general population [8-10].

Considering the major effects of diabetes and obesity on health, the objective of the present study was to determine the relationship of lipid profile in obese versus non-obese Libyan type 2 diabetic patients and to determine the frequency of dyslipidaemia in these two groups.
2. Subjects and Methods

2.1. Data Collection

The subjects for this hospital based case study were selected from the Benghazi Diabetes Centre and Benghazi Medical Centre, Benghazi – Libya. This study was approved with ethical clearance obtained from the local authority. A total of 500 type 2 diabetic patients attending the medical outpatient clinics were selected. After following the inclusion and exclusion criteria, 350 patients (152 women and 198 men) were found eligible for the study. The study targeted medically diagnosed type 2 diabetic patients. Those associated with concomitant disease or conditions affecting lipid levels such as thyroid disease, renal disease, chronic liver disease, familial hyperlipidaemia, on lipid lowering agents or other drugs known to affect lipid profile etc., and pregnant women were excluded. Then, diabetic patients were divided into two groups by presence of obesity, according to BMI: Group 1 consisted of 194 diabetic non obese subjects (61 women and 133 men) and Group 2 contained 156 participants with diabetes and obesity (91 women and 65 men). Obesity was defined using World Health Organization criteria (BMI > =30 kg/m2) WC >102 cm for male and WC >88 cm for female participants.

Venous blood samples for lipid profile were collected after an overnight fast of at least 14 h from both groups. Blood pressure was measured twice for each patient after 5 min interval, and the mean of the two was considered as the final record. In both the diabetic non obese and diabetic obese patients 5 ml venous blood samples were obtained in the morning after an overnight fast.

Samples were obtained from the antecubital forearm vein, after a 10 min rest in a sitting position, using evacuated tubes. The blood was collected into centrifuge tubes. It was allowed to clot and it was then centrifuged at 3000 rpm for 15 min at room temperature. The obtained serum which was pipetted into a clean blood sample bottle and analysed on the day of collection for serum lipid profile tests. Samples were assayed in the clinical chemistry laboratory of central lab of the Benghazi Diabetes Centre and Benghazi Medical Centre, Benghazi – Libya. The lipid profile assays were done using already and well established methodology. The serum concentrations of total cholesterol and triglycerides were determined by an enzymatic colorimetric method [11, 12], HDL-Cholesterol was estimated by a precipitant method [13] and LDL- cholesterol was calculated using the Friedewald formula, which can be used with serum TG values not exceeding 350 mg/dl [14]:

\[
LDL [mg/dl] = \text{total cholesterol} - \text{HDL-cholesterol} - \left(\frac{\text{TG}}{5}\right).
\]

All the parameters which were under investigation were determined in the serum of the subjects by using commercially available reagent kits.

2.2. Statistical Analysis

Results are expressed as mean ± S.D. Statistical analysis was performed using the SPSS statistical software version 16. The statistical significance of the difference between diabetic non obese and diabetic obese patients was evaluated by the Student’s t-test. The accepted level of significance was defined at \(p < 0.05\).

3. Results

3.1. Characteristics of the study population

The essential data of total and difference between non obese and obese diabetic patients are listed in Table 1.

A total of 350 diabetic patients attending the Benghazi Diabetes Centre and Benghazi Medical Centre were included in this study (56.6% men and 43.4% women). The non-obese group comprised of 38.6 % male and 17.7 % female and obese group comprised of 18 % male and 25.7 % female of the sample.

The obese diabetic patients were older when compared to non-obese diabetic subjects. As expected BMI and WC were significantly higher in obese diabetic group with the mean BMI and WC 35.2 and 98.4, respectively, as compared to non-obese diabetic group where the mean BMI was 26.1 kg/m2 and WC was 80.2 cm.

Table 1: Clinical characteristics of non-obese and obese type 2 diabetic females and males patients in Benghazi City.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Non-obese (n=194)</th>
<th>p-value</th>
<th>Obese (n=156)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>53 ± 14</td>
<td>0.001</td>
<td>53 ± 15</td>
<td>0.001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>77.12 ± 6.7</td>
<td>0.005</td>
<td>77.35 ± 5.95</td>
<td>0.001</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>173.01 ± 7.94</td>
<td>0.001</td>
<td>170.31 ± 9.97</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI (kg/m^2)</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25.76 ± 2.38</td>
<td>0.001</td>
<td>25.40 ± 1.47</td>
<td>0.001</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>83.14 ± 6.43</td>
<td>0.001</td>
<td>87.25 ± 7.25</td>
<td>0.001</td>
</tr>
<tr>
<td>Fasting plasma glucose (mg/dl)</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>167.11 ± 62.72</td>
<td>0.006</td>
<td>186.30 ± 60.52</td>
<td>0.001</td>
</tr>
<tr>
<td>HbA1c (% )</td>
<td>Men (n=133)</td>
<td></td>
<td>Female (n=61)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.29 ± 1.20</td>
<td>0.009</td>
<td>9.20 ± 1.36</td>
<td>0.009</td>
</tr>
</tbody>
</table>

3.2. Lipid levels in the study population

3.2.1. Total cholesterol

The total serum cholesterol levels were lower among non-obese diabetics than in the obese diabetic in both male and female patients ( \(P<0.05\) in both sexes) Among male patients, the serum total cholesterol levels were significantly lower in non-obese diabetic group than in the obese diabetic group (\(P<0.05\)). Also among female patients, the serum total cholesterol levels were significantly lower in non-obese diabetic group (\(P<0.05\)). The difference of serum total cholesterol levels between men (192.04 ± 44.48 and 198.02 ± 54.10 mg/dL) and women (183.68 ± 41.44 and 194.59 ± 43.20 mg/dL) (\(P<0.05\); table 2) were statistically significant within both non obese and obese diabetic groups respectively.

3.2.2. LDL-cholesterol

Among men, there was a higher significant difference in the serum LDL-C levels between non obese and obese (\(P<0.05\)), where serum LDL-C level was significantly lower in non-obese diabetic group (106.89 ± 32.10 mg/dL) than in those of obese diabetic group (114.30 ± 33.37 mg/dL). While among women, there was no significant difference in the serum LDL-C levels between groups. The difference of serum LDL-cholesterol levels between men (114.30 ± 33.37 mg/dL) and women (108.22 ± 31.72 mg/dL) in obese group was statistically significant (\(P<0.05\)). In contrast, there was no significant difference in the LDL-C levels among the men and women in non-obese diabetic group (\(P>0.05\)) (Table 2).

\[
LDL [mg/dl] = \text{total cholesterol} - \text{HDL-cholesterol} - \left(\frac{\text{TG}}{5}\right).
\]
3.2.3. HDL-cholesterol

As shown in Table 2, the serum HDL-C level was significantly lower in obese diabetic male patients than in the corresponding non-obese diabetic group (P>0.05). In contrast, there was no significant difference in the HDL-C level among the women in both obese and non-obese groups (P>0.05). The difference of serum HDL-cholesterol levels between men (37.68 ± 8.48 mg/dL) and women (43.96 ± 10.90 mg/dL) in obese group was statistically significant (P<0.05). While, there was no significant difference in the HDL-C levels among the men and women in non-obese diabetic group (P>0.05).

3.2.4. Triglycerides

As expected the difference of serum triglyceride levels between non-obese and obese diabetic groups was statistically significant. The difference of serum triglyceride levels between men (177.58 ± 86.14 and 169.49 ± 78.98 mg/dL) and women (167.17 ± 73.44 and 162.98 ± 57.88 mg/dL) (P<0.05; Table 2) was statistically significant within both obese and non-obese diabetic groups respectively.

Table 2: Biochemical characteristics of non-obese and obese type 2 diabetic females and males patients in Benghazi City.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-obese (n=154)</th>
<th>p-value</th>
<th>Obese (n=156)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total-Cholesterol (mg/dL)</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>LDL-Cholesterol (mg/dL)</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>HDL-Cholesterol (mg/dL)</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
</tbody>
</table>

3.3. Percentage and Pattern of Dyslipidemia

The National Cholesterol Education Programme (NCEP) and American Diabetes Association (ADA) have laid down the cut off values for the presence of dyslipidemia. These values are very important in classifying the patients and taking therapeutic decision. On analyzing the Coronary Heart Disease (CHD) risk based on the lipid profile, it was revealed that with LDL-C dyslipidemia 30% and 29% of obese diabetic and non-obese diabetic men and women respectively fell in higher risk of CHD (LDL > 130 mg/dL). For triglyceridemia 73% and 62% of obese diabetic and 54% and 60% of non-obese diabetic men and women respectively fell in higher risk of CHD (HDL < 40 mg/dL). For triacylglycerol dyslipidemia 73% and 62% of obese diabetic and 54% and 60% of non-obese diabetic men and women respectively fell in higher risk of CHD (HDL > 150 mg/dL) (Table 3).

Table 3: Percentage and pattern of dyslipidaemia in non-obese and obese type 2 diabetic females and males patients in Benghazi City.

<table>
<thead>
<tr>
<th>Dyslipidemia</th>
<th>Non-obese (n=156)</th>
<th>Obese (n=156)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High LDL (%)</td>
<td>Male (n=133)</td>
<td>Female (n=61)</td>
</tr>
<tr>
<td>Low LDL (%)</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>High HDL (%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low HDL (%)</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>High HDL = Low HDL (%)</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Low HDL + High HDL (%)</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>Nonlipidemia (%)</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

4. Discussion

Diabetes mellitus is the third leading cause of death in the world and it is responsible for many of the complications that affect various organs in the body [15]. Our study in Benghazi indicated that nearly 99% of Libyan diabetic patients’ sample (obese and non-obese) had dyslipidemia. These results appeared relatively high compared with reports from America and Finland, where they noted an overall prevalence of lipid abnormalities of and among diabetic patients [16, 17]. The above observations was not consistent with previous regional studies that somewhat similar to our study in Sudan and Kuwaiti studies which show an incidence of lipid disorders of around 50% among diabetic patients [18]. Lifestyle, environment, occupation and level of education may account for these differences [6].

Global epidemic exists regarding diabetes mellitus, mainly due to increased overweight and obesity rates. Overweight and obesity, which are characterized by excessive accumulation of adipose tissue in the body, represent a growing epidemiological problem throughout the world and a major challenge for public health in several countries [7]. Several studies have indicated a relationship between Excess body fat and the risk of diseases that increase morbidity and mortality, including cardiovascular diseases, which they are among the leading causes of death.
worldwide [9, 19-21]. Another consequence of excess weight is dyslipidaemia [21], which it is defined by the presence of at least one alteration lipid profile: increased serum levels of low density lipoprotein cholesterol (LDL-C) and triglyceride (TG) and/or decreased levels of cholesterol high-density lipoproteins (HDL-c). The increase in the number of these alterations is a positive correlation with the development of atherosclerosis, which it is a chronic inflammatory disease closely related to elevated serum levels of total cholesterol (TC) and leads to thickening of the layers of the media and intima of the arterial walls and reducing blood elasticity [22, 23].

This study highlights the importance of overweight and obesity in Libyan population with diabetes. BMI and WC were used as indicators of obesity and used as a screening tools for the risk assessment health problem related to obesity. On the basis of these data, the present study included two groups: obese diabetic versus non obese diabetic. Obese included those who have high BMI, as well as high WC values (according to NIH cut off values) [24] and non-obese group included those who have normal BMI and normal WC. This study provided us the opportunity to see the prevalence of dyslipidaemia in these two groups. Our results indicate the high prevalence of dyslipidaemia in obese as compared to non-obese and all the lipids profile was statistically significant, except that of LDL and HDL-cholesterol. Also this study shows alteration in lipids profile and dyslipidaemia in non-obese group.

An important observation was that males presented with high lipid compared to females, these results are concur with recently published data demonstrated that dyslipidaemia was higher in obese and non-obese men than that in women particularly among diabetic participants [25, 26]. This study performed inferred that diabetic obese patients are more prone to develop dyslipidaemia than the non-obese patients. Obese type 2 diabetes have significantly decreased insulin stimulated glucose disposal and insulin sensitivity index, confirming that insulin resistance is the major reason to the pathogenesis of hyperglycaemia and dyslipidaemia in obese subjects with type 2 diabetes, where as lean type 2 diabetes are characterized by a defect in insulin secretion [27, 28]. The present study showed that cholesterol was significantly higher in obese people compared with people with normal weight. These findings correlate well with the findings of Aljabri et al. and Ahmida et al.[26, 5].

From this study, we find that in obese diabetic people their lipid profile is characterized by hypertriglyceridemia, hypercholesterolemia, higher levels of LDL-C and low levels of HDL-C with compared with people with non-obese diabetics among both gender; these findings correlate well with the studies of Grundy and Barnett [29]. In our study, the TG levels were significantly higher among the obese group when compared with the non-obese group, and the findings are in par with the study performed by Wilson et al.[30].

With obesity, the low plasma HDL-C levels have been attributed to increased fractional clearance of HDL secondary to depletion of its cholesterol [31]. Many key enzymes involved in HDL metabolism are altered in obese people with insulin resistance. Some of these changes are further developed in type 2 diabetes where in addition to insulin resistance, relative or absolute insulin deficiency. The observation of higher level of HDL among females than males is found in our study and it is another evidence of the positive effect of estrogen, as previously documented by Vajo et al. [32].

5. Conclusion

In conclusion, the study has documented several lipid profile abnormalities and dyslipidaemia among obese and non-obese type 2 diabetic Patients. Since both dyslipidaemia and obesity are the risk factors for coronary artery diseases (CAD), these may be the marker for the future development of CAD. The study revealed that obesity and dyslipidaemia were high among diabetic patients and required special attention. This can be done through health education at the primary care level and the diabetic clinics.

References


