Prevalence of Metabolic Syndrome among Obese Egyptian College Students

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Abstract

Background: The frequency of the metabolic syndrome is increasing throughout the world. The etiology of the metabolic syndrome is dependent on different factors.

Aim: This survey study aimed to evaluate the metabolic syndrome among obese Egyptian college students.

Methods: The study conducted on eight hundred female students, and their age (18-24 years). The obese students were collected from Cairo, October 6th and Misr university for science and technology (MUST) universities. Metabolic syndrome was diagnosed using Adult Treatment Panel-III (ATP-III) guidelines. The anthropometric measurements (body weight, height, body mass index, waist circumference, and waist-hip ratio) were measured. Also, blood pressure was measured and laboratory investigations (FBS, TG, HDL-c and LDL-c) were analyzed.

Results: The mean body weight, mean body mass index, waist circumference, systolic blood pressure, diastolic blood pressure, fasting blood glucose and TG levels were significantly higher in the students with metabolic syndrome. The frequency of metabolic syndrome was 24.37% among obese students. The prevalence of high blood glucose level, low HDL-c level; high TG level and high blood pressure were 18.5%, 33.5%, 28.4% and 26.25% respectively. Low HDL-c level (33.5%) and high triglyceride level (28.4%) are the most frequent characteristics in comparison to other metabolic components.

Conclusion: These findings indicate the need for study of the components of metabolic syndrome and detailed analysis of the risk factors for metabolic syndrome among college students in Egypt (especially central obesity). National health policies designed to prevent the Metabolic Syndrome, its individual abnormalities and its complications using population-based characteristics of our nation will generate improved outcomes.

Key Words: Metabolic syndrome – Egypt – Obesity.

Introduction

OBESITY is a corner stone of the metabolic syndrome (MS) as an etiology or sequel. It constitutes one of the elements of MS diagnosis [1]. Among different countries in the Middle East region there is significant heterogeneity in obesity (BMI >30Kg/m2) prevalence. Arab countries including Oman show prevalence of 30.8%, Qatar (40.8%), and Gaza and West Bank (41.5%) which is an extremely high prevalence of obesity. A community based cross-sectional survey representing all parts of Oman was designed in the year 2000. The crude prevalence of overweight and obesity (body mass index >25Kg/m2) was 47.9 for the whole sample, and 46.2% for males, 49.5% for females[2].

The overall prevalence of obesity in Middle East region was considerably higher among women compared with men. Although the exact explanation of such gender variations is not entirely clear, it has been reported that women are less active compared with men in certain areas. Physical and cultural barriers to physical activity have been reported among women in Egypt and Saudi Arabia [3]. These include climatic conditions of extreme heat in the summer, limited exercise facilities devoted solely for women, lack of physical education or an emphasis on its importance in schools, and absence of women’s participation in organized sports. Physical inactivity and sedentary lifestyle are major risk factors for the development of obesity and cardiovascular disorders (CVD) [4].

New Egyptian waist circumference (WC) cutoff points for abdominal obesity were developed based upon data from the Egyptian National Hypertension Project (ENHP) [5]. These are 97.5cm for men and
92.3 cm for women. The prevalence of abdominal obesity in Egyptians based upon the European cut-off points was 30.2% for men and 70.9% for women while based on new Egyptian criteria, the prevalence of abdominal obesity in men was 37.1 and in women 50.8% [6,7]. The metabolic syndrome (MS) is characterized by abdominal obesity, insulin resistance, hyperglycemia, hypertension, and dyslipidemia, and is a major risk factor for cardiovascular disease (CVD) and type 2 diabetes [8].

The metabolic syndrome is described by the clustering of several risk factors for cardiovascular disease (CVD) such as central obesity, glucose intolerance, and low level of high-density lipoproteins (HDL), high triglyceride (TG) level, and hypertension [9]. This syndrome has been recognized as a serious health problem principally in Western countries during the decade since Reaven [10] coined the term Syndrome X in 1988 to describe the clustering of those risk factors. However MS has become common in Asian countries as well [11]. Numerous articles have reported the prevalence of the MS [12-14] in individual nations although few cross-sectional comparisons have been made, especially between Western and Arab countries.

There are ethnic differences in the prevalence of metabolic syndrome. Differences in genetic background, diet, levels of physical activity, age, and sex structure all influence the prevalence of metabolic syndrome and its components [15]. The prevalence of metabolic syndrome in adult population worldwide varies from 8 to 24.4% in males [16,17] and from 7 to 46.5% in females [18,19]. Thus understanding the prevalence of MS in young adults is essential to the formulation of strategies to prevent and treat the MS. The prevalence of metabolic syndrome in Europe and among Americans of European ethnic groups change approximately between 20 to 30% in both gender [15-25].

Prevention, early screening and early intervention of the MS are recognized to be important in decreasing the morbidity and mortality associated with CVD, diabetes and their complications [20]. Young adults with the MS are especially at increased risk for the CVD and type 2 diabetes. Behavioral risk factors for the MS and CVD, such as tobacco use, alcohol consumption and low levels of physical activity, often start during early adulthood under the influence of social and cultural pressures. Such behaviors can contribute to the risk of the MS and CVD and may continue through late adulthood [21].

The importance of the metabolic syndrome in general population as a predictor of vascular disease has been confirmed by a number of large prospective epidemiologic studies [22-24]. In the USA, the metabolic syndrome has become common. The metabolic syndrome is an important public health problem in both developed and developing countries [25].

In our area, we do not have enough data on prevalence of the metabolic syndrome in obese Egyptian college students. Therefore, it is very important to set up a study on those obese college students with a risk of metabolic syndrome.

The present study aimed to estimate prevalence of the metabolic syndrome among obese Egyptian college students.

**Material and Methods**

This study conducted from April 2011 to April 2013, eight hundred obese (BMI >30Kg/m²) college student aged from 18 to 24 years old. Students were collected from Cairo, October 6th and Misr university for science and technology (MUST) universities. Metabolic syndrome was diagnosed using Adult universities. All students did not participate in diet reduction program within the last 6 months, and completed a personal health and medical history questionnaire.

**Inclusion criteria:**
- College students.
- Females.
- Age (18-24 years old).
- Obese (BMI >30Kg/m²).
- Egyptians (the students were from Great Cairo, Delta, and Upper Egypt).

**Exclusion criteria:**
- BMI less than 30Kg/m².
- Thyroid disease (hypo or hyperthyroidism).
- Hormonal or anti-lipidemic drugs.
- Smokers.

**Procedures:** All participants signed a written informed consent and were subjected to all of the following evaluation protocol:

1- Detailed medical history and physical examinations including vital signs.
2- Anthropometric measurements: Weight, height, BMI, waist, and waist hip ratio.
3- Laboratory investigations:
   - Fasting blood glucose (FBG).
   - Lipid profile:
     - Serum total cholesterol.
     - Serum Triglycerides level (TG).
     - Serum high density lipoprotein (HDL).
     - Serum low density lipoprotein (LDL).
Baseline blood samples, obtained after overnight fasting for at least 12 hours, were taken and analyzed in the laboratories of October 6 University hospital by biochemical kit using spectrophotometer techniques.

- All anthropometric measurements and laboratory investigations were done once at the beginning of the study.
- All the participants were classified into two groups, subjects with metabolic syndrome and other group without metabolic syndrome.

Students considered have metabolic syndrome if they had any three or more of the following, according to the ATP III Criteria (9):

- Abdominal obesity: Waist Circumference >88cm.
- Hypertriglycridemia: Serum TG level >150mg/dl.
- Low HDL-cholesterol: <50mg/dl.
- High blood pressure: SBP >130mm Hg and/or DBP >85mm Hg or on treatment for hypertension.
- High fasting blood glucose: serum glucose level >110mg/dl or on treatment for diabetes.

Weight was then measured, where subjects were minimally clothed without shoes using digital scales. Height was measured in standing position using tape meter while the shoulder was in a normal position.

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Those with a BMI >30kg/m² were classified as obese [26].

Waist circumference was measured at the point halfway between the lower border of ribs and the iliac crest in a horizontal plane [27].

Systolic and diastolic blood pressure was measured in sitting position from the right hand.

Statistical Analysis:

The results were reported as percentage and mean±SD. The Statistical Analysis was done with SPSS-16 version software. The results were evaluated by using Chi square tests. Statistical significant was considered at \( p<0.05 \).

Results

Results of Anthropometric Measurements:

The baseline data of the students with and without the metabolic syndrome are shown in Table (1). The mean body weight, body mass index, waist circumference, systolic blood pressure, diastolic blood pressure, fasting blood glucose and TG levels were significantly higher in the females with metabolic syndrome. There was no significant difference in the other parameters in females with or without metabolic syndrome.

### Table (1): Baseline data of obese students (total subjects, subjects with and without metabolic syndrome).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Total numbers of subjects</th>
<th>Subjects with MS</th>
<th>Subjects Without MS</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All females, No. (%)</td>
<td>800 (100%)</td>
<td>195 (24.37%)</td>
<td>605 (75.63%)</td>
<td>–</td>
</tr>
<tr>
<td>Age (years)</td>
<td>20.4±2.7</td>
<td>22.3±1.3</td>
<td>19.9±2.4</td>
<td>0.065</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>99.4±8.52</td>
<td>105.2±6.38</td>
<td>96.83±5.27</td>
<td>0.003 *</td>
</tr>
<tr>
<td>BMI Kg/m²</td>
<td>36.4±3.34</td>
<td>39.32±4.64</td>
<td>35.45±3.43</td>
<td>0.003 *</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>99.4±10.24</td>
<td>105.6±12.75</td>
<td>95.5±7.82</td>
<td>0.001 *</td>
</tr>
<tr>
<td>WHR</td>
<td>1.08±0.15</td>
<td>1.12±0.1</td>
<td>0.99±0.07</td>
<td>0.074</td>
</tr>
<tr>
<td>SBP (mm Hg)</td>
<td>128.3±15.75</td>
<td>138.72±22.23</td>
<td>121.6±13.83</td>
<td>0.001 *</td>
</tr>
<tr>
<td>DBP (mm Hg)</td>
<td>81.32±12.44</td>
<td>84.94±16.37</td>
<td>77.63±12.68</td>
<td>0.001 *</td>
</tr>
<tr>
<td>FBS (mg/dl)</td>
<td>102.30±22.4</td>
<td>119.54±32.38</td>
<td>87±17.59</td>
<td>0.001 *</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>135.27±65.28</td>
<td>178.59±85.42</td>
<td>105.66±51.47</td>
<td>0.001 *</td>
</tr>
<tr>
<td>T chol (mg/dl)</td>
<td>194.39±58.89</td>
<td>215.64±77.65</td>
<td>178.93±44.56</td>
<td>0.03 *</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>42.65±5.48</td>
<td>40.49±6.77</td>
<td>44.6±8.45</td>
<td>0.01 *</td>
</tr>
<tr>
<td>LDL (mg/dl)</td>
<td>145.33±48.56</td>
<td>159.87±76.48</td>
<td>134.33±39.42</td>
<td>0.01 *</td>
</tr>
</tbody>
</table>

BMI : Body mass index.
WC : Waist circumference.
WHR : Waist hip ratio.
SBP : Systolic blood pressure.
DBP : Diastolic blood pressure.
FBS : Fasting blood sugar.
TG : Triglyceride.
T-chol : Total cholesterol.
HDL-c : High density lipoprotein cholesterol.
LDL-c : Low density lipoprotein cholesterol.

* \( p \)-value less than 0.05 was considered significant.
Prevalence of metabolic syndrome and its components in obese Egyptian college students are shown in Table (2). The frequency of metabolic syndrome is shown 24.37%. The prevalence of high blood glucose level, low HDL-c level; high TG.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic syndrome</td>
<td>195</td>
<td>24.37</td>
</tr>
<tr>
<td>Central obesity (waist circumference &gt;88cm)</td>
<td>668</td>
<td>83.5</td>
</tr>
<tr>
<td>Fasting Blood Sugar &gt;110mg/dl</td>
<td>148</td>
<td>18.5</td>
</tr>
<tr>
<td>High density lipoprotein cholesterol &lt;50mg/dl</td>
<td>268</td>
<td>33.5</td>
</tr>
<tr>
<td>Triglyceride &gt;150mg/dl</td>
<td>227</td>
<td>28.4</td>
</tr>
<tr>
<td>Hypertension (Systolic blood pressure &gt;130mm Hg and Diastolic blood pressure &gt;85mm Hg)</td>
<td>210</td>
<td>26.25</td>
</tr>
</tbody>
</table>

Obese students with metabolic syndrome (195 out of 800) have 78.97%, 16.41% and 4.61% had three, four and five criteria for metabolic syndrome respectively.

Table (3): Number of Obese Students accomplishing the criteria of Metabolic Syndrome.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Subjects with MS (n=195)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 criteria</td>
<td>154 (78.97%)</td>
</tr>
<tr>
<td>4 criteria</td>
<td>32 (16.41%)</td>
</tr>
<tr>
<td>5 criteria</td>
<td>9 (4.61%)</td>
</tr>
<tr>
<td>Total criteria</td>
<td>195 (100%)</td>
</tr>
</tbody>
</table>

Discussion

The frequency of metabolic syndrome is increasing throughout the world. The etiology of the metabolic syndrome is dependent on different factors such as high prevalence of central obesity, high triglyceride, insulin resistance, sociological and environmental, genetic factors and lifestyle.

The results of our study in Egyptian college students showed these risk factors and its high frequency might start at a young age. The epidemic metabolic syndrome is worldwide health problem. Study in Italy showed that a prevalence of metabolic syndrome was 3-3.5% (on the basis of the presence of all five criteria) [28]. Studies among Korean and Chinese populations showed that prevalence of metabolic syndrome were 13.8% [29] and 17.8% for females respectively [30]. In Iran, Eshghi et al., (2010) showed that prevalence of metabolic syndrome was 18.3% [31].

In this study, the prevalence of metabolic syndrome among obese Egyptian college students was (24.37%) and was higher than some other studies were done in Italy, Korea, China and Iran [28-31]. This is due to the selection of the sample as the entire sample is centrally obese. Obesity is a cornerstone of the metabolic syndrome as an etiology or sequel (1). Our study is in agreement with some studies which have reported that waist circumference is positively associated with the risk of cardiovascular occurrences [23,33]. Depres et al., (2001) showed that extra fat mass rather than excess body weight was highly correlated with abnormal metabolism [34]. This study is in agreement with Ainy (33%) [35] and Heidari (24.9%) [36]. The study is also in agreement with a study in Tunisia, MS prevalence was 35.5% with significantly higher prevalence in women than men [37].

Study on the components of metabolic syndrome showed that the most frequent changes of components of metabolic syndrome was low high-density lipoprotein cholesterol (52%), which is in agreement with the findings in USA [38], Turkey [39], Italy [40], Canada [41], UK [42] and Iranian population [43] the most common found was high prevalence of low HDL-cholesterol.

Our study also showed that there is an increase in serum TG (28.4%). This is in agreement with
Incident is up to five times higher in individuals with type 2 DM in 75 to 85% of patients with insulinemia, and obesity precede the progression to type 2 DM. Although type 2 DM is heterogeneous disease, most patients with type 2 DM have insulin resistance and MS before of onset of type 2 DM. This in part relates to the transfer of cholesterol ester from the core of triglyceride-rich lipoproteins to HDL-c, a process catalyzed by cholesterol ester transfer protein CETP.

Our study showed that students with metabolic syndrome had high blood glucose levels >110mg/dl (18.5%). This result agrees with many experts who reported that, the worldwide increase in the prevalence of obesity in the recent decades is starting, and is likely a cause of the rising incidence of insulin resistance and the MS as well as CVD and type 2 DM. Although not all overweight or obese individuals are metabolically unhealthy, the majority are insulin resistant. The combination of obesity, physical inactivity, and consumption of an atherogenic diet is believed to insulin resistant. The prevalence of type 2 DM has tripled in the last 30 years. Currently, diabetes afflicts more than 20 million in USA. Type 2 DM is a complex disease caused by both environmental and genetic factors. It is marked by chronically elevated blood glucose concentrations, which result from defects in insulin production, insulin action, or a combination of both.

Although insulin resistance is considered the hallmark of prediabetes, defects in insulin secretion are regarded as the key pathophysiological characteristic of type 2 DM. Although type 2 DM is heterogeneous disease, most patients with type 2 DM have insulin resistance and MS before of onset of type 2 DM. In fact, insulin resistance, hyperinsulinemia, and obesity precede the progression to type 2 DM in 75 to 85% of patients. The presence of the MS increases the risk and is highly predictive of new-onset type 2 diabetes mellitus. The risk of incident is up to five times higher in individuals with the MS compared with those without the syndrome.

Conclusions:
- To delay the appearance of the syndrome or its manifestations, insulin sensitivity could be targeted by lifestyle modifications such as: Loss of weight, increase in physical activity, and a healthy diet or by pharmacological intervention.
- To treat the abnormalities of the MS, the first step is lifestyle modification, and even modest weight loss may be effective.
- Drug treatment should be used for the specific abnormalities according to current guidelines, and a more aggressive approach may be appropriate when more than one abnormality is present.
- The present study has highlighted the high prevalence of MS in young obese females (college students) in Egypt. This epidemic has great negative public health potential, which is not limited to any single country, age group or gender.
- National health authorities in Egypt, as well as across the globe, need to take immediate and urgent action to arrest the MS epidemic. Raising awareness about this lurking syndrome is the first step in ensuring affirmative and aggressive action in tackling MS in Egypt especially in young age.

References

Prevalence of Metabolic Syndrome among Obese Egyptian


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