ABSTRACT • OBJECTIVE: The aim of this study is to investigate the relation between body mass index (BMI) and body fat (BF) among Lebanese female adolescents.

METHODS: 51 Lebanese females aged 12 to 18 years participated in this study. BMI was calculated as weight/height\(^2\). Adiposity was measured by dual energy X-ray absorptiometry (DEXA).

RESULTS: Correlation coefficient of percent body fat (%BF) with BMI is 0.82. Correlation coefficient of fat mass (BF) with BMI is 0.93. The two linear regression formulas are: %BF = 6.89 + (1.1 *BMI) and BF = – 0.425 + (1.29 *BMI).

CONCLUSION: Correlations of BMI with DEXA measurements were higher with BF than %BF. For a given BMI, Lebanese girls have a higher than expected %BF. Based on the current findings, there may be a need to develop new cutoff points. From a public health perspective, this may considerably increase the prevalence of obesity among Lebanese female adolescents.

INTRODUCTION

After being classified as a disease by the World Health Organization (WHO), obesity-related research has expanded widely. By definition, obesity is a pathological condition associated with excess adiposity [1-2]. The prevalence of overweight and obesity has increased in many parts of the world [3-4]. An even more shocking phenomenon is the global rise among children and adolescents [5]. The association of obesity with numerous health disorders has amplified the need for accurate assessment techniques of body fat (BF). However, these methods are usually complicated, expensive and time consuming, therefore making them inappropriate for population-based studies. This led to the development of indirect methods to estimate adiposity, among these, the most widely used is the body mass index (BMI), which is defined as weight (kg)/height squared (m\(^2\)) [6]. Even though it is a measure of excess weight rather than excess body fat, studies have shown a high correlation between BMI and body fat [7-9]. By using appropriate cutoff points, BMI may be used to assess overweight and obesity. Adults with a BMI 25-30 are classified as overweight, whereas those with BMI > 30 are classified as obese [9]. Other studies have also defined obesity based on BF. These studies suggest a body fat percent (%BF) of at least 25% of total body mass for men and 30-33% for women [10-11].
In children, age and sex specific BMI cutoff points have been developed and validated against direct measures of adiposity [12]. However, defining overweight and obesity in children is complicated by the fact that weight varies with height as children grow, this process is best described by Horlick in the title of his article, “Measuring a Moving Target” [13]. Moreover, several studies have suggested that the relationship between BMI and BF is affected by factors such as ethnicity and body build [14-18]. These limitations may become an important issue when assessing obesity in specific populations or when comparing ethnic groups with distinctively different body proportions. Indeed, these studies have suggested that universal cutoff points may not be used to accurately assess overweight and obesity in certain Asian populations and therefore they recommend the use of lower BMI cutoff points to define obesity [16-18].

In Lebanon and the Middle East, universal BMI cutoff points have been used to assess obesity [19]. However, the relation between BMI and BF has never been assessed. Thus the aim of this study is to determine the relation between BMI and BF among Lebanese female adolescents.

METHODS

Subjects
Fifty-one adolescent females aged 12 to 18 years were recruited from different schools to participate in this study. At the time of this study all subjects were at least twelve months ahead of their first menstruation.

Study design
Body weight was measured using an electronic scale (Taurus, Quasar) with a precision of 140 kg/100 g, height was measured to the nearest 0.5 cm using a stadiometer (Seca model 222). BF was measured by dual energy X-ray absorptiometry (DEXA Hologic QDR-4500W, Hologic Inc., Waltham, MA). The coefficient of variation was 0.54% for fat-free mass, and 1.13% for fat mass. Testing took place in a hospital setting under the direct administration of accredited technicians.

<p>| TABLE I |
| DESCRIPTIVE CHARACTERISTICS OF THE FEMALE ADOLESCENTS (N = 51) |</p>
<table>
<thead>
<tr>
<th><strong>Mean</strong></th>
<th><strong>SD</strong></th>
<th><strong>Range</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>15.06</td>
<td>1.67</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.18</td>
<td>5.5</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65.53</td>
<td>13.40</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.46</td>
<td>4.64</td>
</tr>
<tr>
<td>Fat-free mass (kg)</td>
<td>39.97</td>
<td>5.63</td>
</tr>
<tr>
<td>BF (kg)</td>
<td>23.58</td>
<td>7.98</td>
</tr>
<tr>
<td>%BF</td>
<td>34.93</td>
<td>6.21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SD : standard deviation</th>
<th>BMI : body mass index</th>
<th>BF : body fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Correlation of %BF by DEXA with BMI is 0.82. Correlation of BF by DEXA with BMI is 0.93, both values at $p < 0.0001$. Figure 1 shows a scatter diagram of the association between %BF by DEXA and BMI, including best fit lines for the regression of %BF on BMI. On the other hand, figure 2 shows a scatter diagram of the association between BF by DEXA and BMI.

As mentioned earlier, several studies have suggested that the relationship between BMI and %BF may differ between populations. Their findings recommend the development of population specific BMI cutoff points based on age, gender, and ethnicity [9-11].

This study shows that BMI is highly correlated with measures of body fat obtained by DEXA. This finding supports previous research which shows that although...
BMI has some flaws, it can be used for the initial screening of obesity [24-25].

The correlations of BMI with DEXA measurements in this study group were higher with FM (r = 0.93) than %BF (r = 0.82). These results were similar to that reported in a study conducted in Italian children adolescents [24].

From these results we conclude that even though BMI is used to assess obesity in epidemiological studies and initial screening, it provides only a limited insight to the degree of obesity based on the percent body fat. Because of this, results should be interpreted with caution since the cutoff points currently used cannot detect subjects who have a higher than expected %BF for a given BMI. Perhaps this may show that the low prevalence of obesity previously reported in adolescent girls [19] may be more due to methodological causes.

One of the limitations of this study is the fact that it is conducted only in adolescent girls. However, our interest was restricted to this group because previous epidemiological studies reported very low prevalence of obesity in this population [19].

Finally, based on the current findings, one can suggest that a BMI cutoff point of 23 may be a more suitable alternative for the assessment of obesity in adolescent girls. From a public health perspective, this finding may considerably increase the prevalence of obesity among Lebanese female adolescents.

ACKNOWLEDGEMENTS

This study was funded by a grant from the University of Balamand Research Committee and the “Projet Cèdre” Committee.

REFERENCES


