Comparison Between Self-reported and Measured Height, Weight and BMI in Spanish University Students: Relationships With Body and Trunk Fat Mass

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Abstract

Objective: Validity of self-reported height and weight has not been adequately evaluated in diverse young populations. This study aims to examine the accuracy of self-reported weight, height, and BMI values in Spanish university students, as well as related factors that may determine the BMI in such population.

Methods: Weight and height were self reported and measured in 68 university students between 18-24 years from the area of Extremadura, Spain. BMI was calculated from both, reported and measured values. Additionally, percentage body/trunk fat was measured using bioelectrical impedance analysis (BIA). Finally, hip and waist circumference were obtained using standard procedures.

Results: There were no differences between self-reported and measured BMI (p > 0.05). In the multiple regression analysis (stepwise) weight (p < 0.0001) and height (p < 0.01) were the main determinants of self-reported BMI.

Conclusion: Self-reported BMI correctly estimates the real BMI in Spanish university students.

Introduction

Elevated Body Mass Index (BMI) (weight (kg)/height2 (m)), has been associated with several highly prevalent diseases such type 2 diabetes mellitus, cardiovascular diseases and cancer (1). Currently, in Spain, 13.2% of men and 17.5% of women are obese. In industrialized countries, the prevalence of obesity has been increased in the recent years. Self-reported height and weight are widely used for calculating BMI to establish the prevalence of obesity in many countries and regions around the world (2). The reliance on self-reported BMI is a cost-effective alternative (3) to directly measuring the heights and weights of all participants in epidemiological studies and reduces participant burden by avoiding the need for clinical attendance. Previous validation studies have shown inconsistent outcomes. Some studies suggested that self-reports of height and weight were valid (3, 4), while others raised concern about the accuracy of self-reported anthropometric values (2, 5-7), the height tends to be overestimated and weight underestimated in young and adult population (8). Thus, self-reported BMI is most often lower than measured BMI; as a result, some obese individuals are classified as non-obese, leading to underestimation of obesity prevalence. These studies also found that with the increasing of age and weight of the subjects, the error of the self-reporting increases too. Some experts have reported no change with gender. However, other authors found differences in the accuracy of self-reported depending on age, sex, socioeconomic status, actual weight, ethnicity, and perceived body image (7, 9, 10). Circumferences ranges, mainly of the waist and hip, are also increasingly being used as measures of body size, shape, adiposity, and health risk (3). International organizations are increasingly reporting circumferences normative range as a component of metabolic syndrome diagnosis, and many studies are now reporting associations between circumference ratios and health outcomes (11, 12). Waist circumference (WC) is gaining popularity as an anthropometric marker of overall and abdominal obesity (13), the WC cut-off point for central obesity was defined as ? 94 cm and ? 80 cm in white men and women. BMI is a measure of weight adjusted for height that do not measure body composition directly, is an imperfect measure of body fatness, as it does not directly measure fat mass (14). Associated to BMI it has been proposed that the study of fat distribution (total and local distributed) represents a better predictor of the variation in health risk (15). The purpose of the present study was to evaluate the validity of BMI derived from self-reported height and weight, and to identify potential predictors of BMI within a sample of 18 to 24 year-old young Spanish university students.

Methods/Design
Subjects and design: This cross-sectional study was conducted from April to May 2012. A total of 72 healthy university students were enrolled. Participation was voluntary. Participants with missing values, women who were pregnant at the time of evaluation, those who had more than 24 years or metal implants (such as pacemakers, Stents and hip replacements that can affect the accuracy of the results) were excluded from the analysis. Measured data was missing or not able to perform tests in 4 students. A final sample of 68 students (21 men and 47 women) formed the cohort. Participants gave their written informed consent prior to the interview and examination. Self-reports of height and weight were collected face-to-face respectively in the first half of the survey.

Anthropometric measurements: Anthropometric measurements were taken at a subsequent clinic visit by one research assistant on each occasion using standardized methods. Body weight and percentage body fat was measured by bioimpedance (BIA) (Body Composition Analyzer BC418NA, Tanita, Tokio, Japan) and recorded the analysis. For WC, the examiner explored the subject’s hip area for the right iliac crest and then at its high point marked a horizontal line while the subject was standing using an inelastic measuring tape. The hip circumference (cm) was measured at the level of the widest circumference over greater trochanters. WH ratio was computed as waist circumference divided by hip circumference. Next, one research measured height of the subjects using a stadiometer, who stood erect with their shoulders level, hands at their sides, thighs together, heels comfortably together and their head aligned during the height measurement.

Statistical analysis: We have expressed all values as the mean + SD. We confirmed the normal distribution of the data by calculating skewness and kurtosis before applying standard tests. We compared the values studied (continuous variables) in each group (nominal variables) using the t test. We defined statistical significance as a p value of < 0.05. We also used simple and multiple-stepwise regression, and partial correlations (adjusted for age) to examine the relationships between continuous variables. We conducted all statistical analyses using the StatView 5.01 statistical package (SAS Institute Inc. Cary, NC, USA)

Results

Sample characteristics are presented in Table 1. There were no significant differences (p>0.05) in the age distribution between genders. Self-reported BMI did not statistically differ from measured BMI (Table 1). Self-reported BMI and measured BMI distribution in the total group and by gender is showed in figure 1. However, height was overestimated in the female group (p=0.0192) and in the total group (p=0.0059). Between genders, there were significant differences (p<0.01) in WH, WC, percentage body fat (PBF) and percentage trunk fat (PTF). To evaluate the relationship between the BMI and some commonly measured variables, we developed a simple regression analysis. Self reported BMI in the total group positively correlates with self reported weight (r=0.209; p<0.0001), measured weight (r=0.194; p<0.0001), HC (r=0.181; p<0.0001) and WC (r=0.214; p<0.0001). Measured BMI positively correlated with PBF (r=0.294; p<0.0001), PTF (r=0.318; p<0.0001), waist circumference (r=0.299; p<0.0001) and HC (r=0.212; p<0.0001). Linear regression between measured BMI and body composition factors as well as the yielded equations are showed in figure 2. Multiple regression analysis (stepwise) showed that self-reported weight (?=0.359;F=7064.160) was a positive determinant of self-reported BMI in the total group while height (?=27.439;F=2895.834) was a negative determinant. In the male group self-reported weight remained as a positive determinant (?=0.323;F=10046.307) as well as self-reported height (?=25.796;F=3187.097) remained negative. In the female group self-reported weight (?=0.360;F=4666.117), WC (?=0.016;F=6.566) and measured BMI (?=0.023;F=4.929) were positive determinants of self-reported BMI while self-reported height remained as a negative determinant (?=-28.544;F=1904.175).

Discussion

This study examined the accuracy of self-reported weight, height and resultant BMI in Spanish university students. The results obtained in our study show no differences between self-reported and measured BMI, according to some previous studies (6, 16). However, other studies have observed differences between self-reported and measured values for weight, height and resultant BMI (2, 8, 17). Age was not associated with differences between self-reported and measured values in our study, probably because it was a controlled in our sample, but others authors showed a greater difference between self-reported and measured BMI with increasing age (18), and between genders (9). It has been previously described that women are more likely to underestimate their body.
weight, to a larger extent compared with men, and men are more likely to overestimate their height than women (19). This might be because the ideal in Western cultures is to be leaner, and the social pressure may lead to the negative attitudes toward big body sizes (20). In our case, we have observed only an overestimation of height in women and hence in total group, but not in men and either in weight. We consider that this effect in the total group might be due to the significant higher number of females in the sample. As expected the main predictors for self-report BMI in the studied subjects were weight and height. These factors remained as best predictors in the male group while in the female group WC was also a positive determinant. It has been previously described that WC predicts BMI in both males and females with high sensitivity (21), and it has been positively associated with the self-reported BMI in adults with independence of race and gender (13). We think that the differences observed between genders might be due to the differences in the sample distribution. There are both strengths and limitations to this study. A major limitation is the sample size (n = 68). However, individual data and the anthropometric measurements were measured by trained staff, and potential sources of bias and confounding factors including illness-related weight losses were sought eliminated with the exclusion of subjects with BMI under 18.5 kg/m2 or with chronic diseases.

Conclusion

Our study suggests that self-reported weights and heights can be used successfully to determine the BMI in university students. BMI and WC have been proposed as instruments for identifying individuals with health risk. Therefore, the combination of the two measures will represent a valuable predictor of the variation in health risk.

Footnotes:

Figure 1: Self-reported BMI and measured BMI in the total (A), women (B) and men (C) group.

Figure 2: measured BMI related to percentage body fat mass (A) and percentage trunk fat mass in Spanish university students. Regression line and equation are given.

References


Illustrations

Illustration 1

Self-reported BMI and measured BMI in the total (A), women (B) and men (C) group.

Illustration 2

Measured BMI related to percentage body fat mass (A) and percentage trunk fat mass in Spanish university students. Regression line and equation are given.
Table 1. Characteristics of study sample

<table>
<thead>
<tr>
<th></th>
<th>Women (n=47)</th>
<th>Men (n=21)</th>
<th>Total (n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) (mean±SD)</td>
<td>20.29 ± 1.55</td>
<td>19.95 ± 1.71</td>
<td>20.19 ± 1.60</td>
</tr>
<tr>
<td>Weight measured (kg)</td>
<td>59.24 ± 10.89</td>
<td>68.65 ± 7.72</td>
<td>62.14 ± 10.88</td>
</tr>
<tr>
<td>Weight self-reported (kg)</td>
<td>59.32 ± 9.72</td>
<td>69.9 ± 6.76</td>
<td>62.59 ± 10.14</td>
</tr>
<tr>
<td>Height measured (m)</td>
<td>1.61 ± 0.07</td>
<td>1.74 ± 0.04</td>
<td>1.65 ± 0.09</td>
</tr>
<tr>
<td>Height self-reported (m)</td>
<td>1.62 ± 0.06c</td>
<td>1.75 ± 0.04d</td>
<td>1.66 ± 0.08e</td>
</tr>
<tr>
<td>BMI measured (kg/m²)</td>
<td>22.77 ± 3.73</td>
<td>22.43 ± 2.23</td>
<td>22.66 ± 3.33</td>
</tr>
<tr>
<td>BMI self-reported (kg/m²)</td>
<td>22.35 ± 2.99f</td>
<td>22.68 ± 2.05f</td>
<td>22.45 ± 2.72f</td>
</tr>
<tr>
<td>Waist-hip ratio (cm)</td>
<td>0.72 ± 0.06</td>
<td>0.78 ± 0.04</td>
<td>0.74 ± 0.06</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>100.95 ± 7.29</td>
<td>97.95 ± 5.29</td>
<td>100.02 ± 6.84</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>73.59 ± 9.66</td>
<td>76.76 ± 4.97</td>
<td>74.57 ± 8.58</td>
</tr>
<tr>
<td>Percentage body fat (%)</td>
<td>23.71 ± 7.09</td>
<td>19.79 ± 9.56</td>
<td>22.5 ± 8.07</td>
</tr>
<tr>
<td>Percentage trunk fat (%)</td>
<td>20.13 ± 7.79</td>
<td>19.08 ± 9.88</td>
<td>19.81 ± 8.43</td>
</tr>
</tbody>
</table>

\(a\) vs women group (p<0.01); \(b\) vs measured weight (p>0.05); \(c\) vs women measured height (p=0.0192); \(d\) vs men measured height (p<0.05); \(e\) vs total measured height (p=0.0059); \(f\) vs measured height (p>0.05)
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