Validity of Self-Reported Anthropometric Values Used to Assess Body Mass Index and Estimate Obesity in Greek School Children


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Αξιοπιστία των αυτο-αναφερόμενων ανθρωπομετρικών τιμών που χρησιμοποιούνται για την αξιολόγηση του δείκτη σωματικής μάζας και τον προσδιορισμό της παχυσαρκίας σε Έλληνες μαθητές

Περίληψη

Σκοπός: Να εξετασθεί η αξιοπιστία των αυτο-αναφερόμενων τιμών σωματικού ύψους και βάρους που χρησιμοποιούνται για τον προσδιορισμό του δείκτη σωματικής μάζας (BMI), ως διαγνωστική μέθοδος για την εκτίμηση των υπέρβαρων και παχύσαρκων Ελλήνων μαθητών.
Obesity has become a worldwide epidemic in all segments of the population in recent years [1,2]. The prevalence and severity of overweight and obesity is also increasing in children and adolescents [3]. Obesity in early life is of particular importance due to its short- and long-term association with morbid outcomes and its influence on young people’s psychosocial development [4,5]. In most cases, childhood overweight and obesity track into adult life [6], implying a substantial increase in life style diseases such as type II diabetes, hypertension, and cardiovascular disease [7,8]. Therefore, the identification and monitoring of overweight or obese children and adolescents are major concerns in public health.

The most commonly used measurement of body composition is the body mass index (BMI), defined as body weight divided by height squared (kg.m\(^{-2}\)). Given its strong association (r = .83 – .98) with adiposity measurements derived from dual energy x-ray absorptiometry in children [9], BMI appears to be an appropriate measurement for the indirect assessment of adiposity in childhood and adolescence [10,11].
Alternatively to actual anthropometric measures, large scale studies like the Health Behaviour in School-Aged Children [12,13], frequently use self-reported height and weight for practical and financial reasons. The BMI derived from these reports is subsequently used to screen weight problems. However, most of the studies that have examined the accuracy of self-reported height and weight have shown inconsistent outcomes. Some studies suggest that adolescent self-reports of height and weight, are valid [14], while others have raised concern about the accuracy of self-reported anthropometric values in adolescence [15–18]. Furthermore, the validity of self-reported height and weight has not been adequately evaluated in diverse samples of youth, especially in different cultural contexts. Because BMI values may vary among different ethnic groups [19], these differences might result in greater inaccuracy for ethnic populations with higher BMI values [20–22].

Evidence of existing research using actual anthropometric measures indicates that childhood obesity has increased alarmingly throughout Greece in the last decades, and the current prevalence of overweight and obesity among Greek children and adolescents is one of the highest in Europe [23–26]. Contrary to these reports, and based on self-reported data obtained from a nationwide sample of Greek school-aged children, Karayiannis et al [27] concluded that the prevalence of childhood obesity is lower in Greece, compared to most other western countries. It is worth mentioning that only one study has investigated the accuracy of self-reported height and weight in Greek adolescents [28], while no validity study exists for primary school children. Thus, the patterns of height and weight validity of Greek children and adolescents have yet to be further evaluated. The purpose of the present study was to examine the validity of self-reported body measures as a diagnostic method for the evaluation of overweight and obesity in Greek children and adolescents.

Methods

Participants

Three secondary schools located in the metropolitan area of Athens and 15 elementary schools in the province of North Attica, Greece, were randomly selected. Prior to the commencement of the study, permission from the school principal was obtained and parental consent was secured. All students of the above schools were asked to participate into the study. A total number of 378 healthy elementary school pupils (197 girls, 181 boys, mean age 11.4 ± .4 years, participation rate 96.2%) and 298 high school students (152 girls, 146 boys, mean age 12.5 ± .3 years, participation rate 97.3%) obtained written parental consent, after full explanation of the testing procedures. The research ethics committee of Democritus University of Thrace approved the investigation. All measurements were conducted during
morning school visits by experienced investigators using identical protocols. The demographic
data of the study populations are shown in Table 1. The participants represented ethnic
groups as they occur in the Greek population (92.3% Greek origins vs. 7.7% non-Greek
origins), whereby most of the foreign students come from immigrant families, primarily from
Albania and East Europe [29].

**Procedure**
Assessments took place on two different days in classroom settings. During the first session,
students were asked to report their demographic information (date of birth, ethnicity, parental
education, height, and weight). Participants were not told that their actual height and weight
values would be subsequently verified. Age was derived from the date of interview minus the
date of birth. On the second session, trained staff measured all students who attended the
school classes according to the measurement protocol. Students were weighed on an
electronic scale to the nearest .5 kg, lightly dressed and barefooted. Standing height was
measured to the nearest .5 cm with shoes off, feet together, and head in the Frankfort
horizontal plane. BMI was calculated on both self-reported and measured height and weight.
Overweight and obesity were identified using age- and gender-specific international cut-off
points [30], based on average centiles estimated to pass through BMI values of 25 and 30
kg.m⁻² respectively, at the age of 18. These cut-off points have been widely used in studies
with children and adolescents [31].

**Statistical Analysis**
SPSS version 11.0 for Windows (Chicago, IL) was used for data management and statistical
calculations. Descriptive means and frequencies were generated. Pearson correlation
coefficients analyses were performed, while the student paired *t*-tests were used to determine
group differences for continuous variables (differences in self-reported vs. measured height,
weight, and BMI). Comparisons between continuous and categorical variables were performed
by unpaired *t*-tests and analysis of variance (ANOVA), to examine if the assessed differences
were influenced by gender, age, or BMI status. χ² tests were used to determine significant
differences in the estimating rates of overweight and obesity determined by self-reported
versus measured BMI. All reported *p*-values were compared to a significance level of 5%.

*Table 2*
Comparisons between self-reported height and weight measured and used to assess BMI
adjusted by gender and age group
Results

High correlations were found between self-reported and measured anthropometric indices: $r = .91$ (height), $r = .96$ (weight), and $r = .90$ (BMI), $p < .001$. However, paired $t$-test analysis revealed significant differences between the self-reported and actual measurements in all subgroups, except for height in elementary school girls (Table 2). Independent $t$-test analysis revealed that the degree of self-report bias did not differ between boys and girls for height ($t(644) = -.26, p < .797$), weight ($t(652) = -.69, p < .488$) or BMI ($t(638) = -.43, p < .665$).

Significant differences were found between age groups. High school students tended to overestimate their height and under-report their weight to a greater degree than elementary school pupils. As a result, the understating of BMI was greater for high school students compared to elementary school pupils (mean difference in measured vs. reported BMI = 1.61 ± 1.4 kg.m$^{-2}$ versus .79 ± 1.8 kg.m$^{-2}$; $p < .001$).

As shown in Figure 1, the ANOVA results revealed a significant effect of BMI status in the accuracy of self-reported parameters, with a higher BMI resulting in trivial discrepancies of height ($F(2, 644) = 5.39, p < .005$), and in considerable biases of weight ($F(2, 644) = 71.10, p < .001$) and BMI ($F(2, 644) = 74.91, p < .001$). The same pattern was observed when differences were computed for elementary pupils and high school students separately (Figure 1).
Figure 1. Differences between self-reported and measured values of height, weight, and BMI across BMI categories. Values significantly different: † vs. overweight (p-values between .004 and .001); ‡ vs. obese (p-values between .02 and .001).
Based on self-reports, prevalence estimates were 23.1% for overweight and 4.3% for obesity, but according to measured data, the corresponding rates were 28.8% and 9.5%, respectively ($\chi^2 = 541.49, p = .001$). Self-reports led to the underestimation of overweight by 5.7% and obesity by 5.2%, whereby the magnitude of the underestimation varied between elementary pupils and high school students (Figure 2).

**Discussion**

In health surveys, actual measurements are frequently replaced by self-reported height and weight, which are subsequently used to provide a categorical measure of overweight and obesity by applying cut-off points in BMI. The present study was undertaken to evaluate the validity of these data as an indicator of overweight and obesity in Greek children. Our results revealed significant differences between self-reported and actual measures in both genders and age groups. Discrepancies in self-reported height by students in Greece were either trivial (-.6 cm for primary school) or significant (-.3 cm for high school). On the other hand, biases in weight were significant and of considerable size for the total sample (Table 2). These findings are in accordance with previous studies reporting that children and adolescents tend to overestimate their height and underestimate their weight [21, 28, 32]. The overall mean difference of weight (2.0 kg) in the present study is lower than that reported for American adolescents [21], higher compared to Welsh adolescents [35], and similar to that observed by other studies among Australian [33], Italian [34], and Greek teenagers [28].
In line with previous reports [16, 17, 33], we found that the patterns of accuracy in self-reported anthropometric measures are not influenced by gender, although not all surveys have agreed with these findings [21]. On the contrary, our data indicate that the accuracy of self-reports varied significantly by age, whereby high school students over-reported their height and understated their weight more than their younger counterparts. We further found that the magnitude of the discrepancy between self-reported and actual anthropometric measures was affected by the actual body size, with heavier students understating their weight more than thinner students. The latter is a notable consistent finding in the literature [16, 28, 33, 36, 37]. Although it is clearly an objective, measurable phenomenon (i.e., BMI), obesity is also a subjective, emotional experience of one’s body and body image, and has been significantly associated with internal states, such as low self esteem [38, 39]. Because a lower self esteem is associated with greater bias in self-reported weight [35], discrepancies in self-reports of weight problems at pre-pubescent and first puberty phase possibly reflect discrepant perceptions of body image among individuals, implying one’s unwillingness or inability to acknowledge his/her obesity because of denial and/or social stigma [40].

Regardless of significant or non-significant differences, self-reports and actual measures were highly correlated, implying that the correlation coefficient does not secure validity. Thus, making inferences about the validity of self-reported data by relying solely on the correlation coefficient might be misleading [28]. Although this coefficient does not seem to provide valuable information about the discrepancy between self-reported and actual measures, some studies based only on high correlation coefficients suggest that self-reported height and weight are valid proxy measures for actual measures, especially in analyses that use these values as continuous variables [14, 21].

However, when BMI values are used for classification into BMI categories (normal weight, overweight, and obese), basing BMI on self-reports clearly leads to underestimates of the prevalence of weight problems. For example, in the study of Brener et al [21], the self-report screen for obesity showed just 54.9% sensitivity, failing to detect a substantial proportion of morbid cases. In our study, the self-report screen missed 41.5% of overweight and 57.8% of obesity cases, leading to an underestimation of overweight and obesity by 3.7% and 5.8%, respectively, for elementary school, and 8.4% and 4.4%, respectively, for high school students. The magnitude of underestimation for the total sample is compared with that reported for overweight (4.8%) and higher than that reported for obesity (1.6%) in Welsh adolescents [35]. These differences imply that self-reported data derived from children and adolescents might not be as valid as the data obtained from actual measurements, calling into question the use of self-reports in these age groups as a screen for overweight and obesity. For instance, using self-reported data derived from a nationwide sample of Greek school-aged
children [27], the estimating rates for adiposity problems were 15.3% for overweight and 1.8% for obesity, contradicting the corresponding prevalence estimates for overweight (21.6–30.3%) and obesity (5.6–9.5%) reported by previous studies based on actual measures from children and adolescents from several Greek regions [23–25] (Figure 3).

![Prevalence rates of overweight and obesity in several districts of Greece, according to published data [23–25,27]. Note: Prevalence rates of nationwide sample (Karayiannis et al. 2003) are based on self-reported anthropometric data.](image)

To overcome this shortcoming, it has been suggested that future large-scale studies should take measured data from at least a random sub-sample to examine the size and direction of bias [35] as well as to identify the sources of this bias. Identified sources of bias can be entered into adequate models as explanatory variables along with reported values and the derived function can then be applied to minimize the bias [28].

Our study has some limitations: a strictly random sampling of all eligible students was virtually impossible; the study was dependent on the principals’ disposal and the process of informed consent, which was based on the willingness of individual children and their parents to participate. The prevalence of overweight and obesity, however, was similar to that reported for school-aged children from other districts of Greece [23–25]. Furthermore, the sample size and the age range of our sample, limit the generalization of our findings.

Despite the above limitations, the high prevalence rates of overweight and obesity observed in our sample offer some support on the growing obesity prevalence in Greek children and adolescents, underlining the need for continuous and accurate monitoring of excess adiposity problems in youth. The present findings indicate that there is a considerable discrepancy between self-reported and measured anthropometric data in Greek children and adolescents,
which might have significant consequences in the accuracy of a self-report screen and could lead to erroneous estimating rates of overweight and obesity. Identifying sources of bias and using accuracy checks of self-reported data may improve health surveys of overweight problems in youth. Future research should involve a wider age range, a larger sample population, and explore predictors of inaccuracy, to elucidate trends in biases from self-reported anthropometric indices.

References


