Validity of Self-Reported Height, Weight and Body Mass Index Among Cypriot Adolescents: Accuracy in Assessing Overweight Status and Weight Overestimation as Predictor of Disordered Eating Behaviour

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Abstract *Aim: the aim of the present study was to assess the validity of self-reported weight and height among Cypriot adolescents. Method: Adolescents' weight and height was measured during school. Students completed the questionnaires EAT-26 and EDI-3. Results: self-reported and measured weight and height are highly correlated. Boys underreport their weight by 0.28 kg and over report their height by 0.84 cm; girls underreport their weight by 0.91 kg and over report their height by 1.52 cm. 8% of overweight adolescents would have been neglected if self-report measures were relied upon. Overweight adolescents make greater self-report errors in BMI in comparison to their normal/ underweight counterparts. Adolescents who overestimated their weight by 5% had lower scores on Drive for thinness scales and Body dissatisfaction scales. Conclusion: relying on self-report estimates of height and weight can lead to erroneous conclusions of prevalence estimates of overweight and obesity among Cypriot adolescents and must be used with caution.*

Keywords: *anthropometric measures; body mass index; obesity; self-report; disordered eating behaviour*

1. Introduction

The measurement of weight and height are perhaps amongst the most widely used anthropometric measurements in clinical practice and research. From these two measurements body mass index (BMI) is constructed, which has been used to assess a wide array of factors including nutritional status, the presence or absence of eating disorders and body type to name a few. A higher BMI has been pinpointed as an important risk factor for conditions such as high blood pressure, high cholesterol, insulin resistance, type 2 diabetes and cardiovascular diseases (Brown et al., 2000; Grundy, 2004). Accurate measurement of weight

and height are therefore vital.

Often in research and practice professionals rely on self-reported height and weight measurements rather than actual measurements most likely because it is convenient, saves both time and money and is non-invasive, especially when dealing with larger numbers of participants (Elgar et al., 2005; Wada et al., 2005). Studies have shown that self-reports of height and weight are reliable and are highly correlated with actual measurements in both adults and adolescents (Elgar et al., 2005; Wada et al., 2005; Goodman, Hinden, & Khandelwal, 2000; Lim, Seubsman, & Sleigh, 2009; Larsen et al., 2008). Nevertheless, despite these high correlations systematic errors have been noted in self-reported data among the population (Sherry, Jefferds, & Grummer-Strawn, 2007). Generally, people tend to overestimate their height and underreport their weight resulting in failures to detect a portion of morbidly obese cases (Larsen et al., 2008), with sensitivity rates being specifically low among older adolescents (Elgar et al., 2005). Furthermore, studies have also found that there is a tendency among adolescents for girls to underreport their weight more so than boys (Brener et al., 2003), overweight and obese adolescents also tend to underreport their body weight in comparison to normal and underweight adolescents (Wang, Patterson, & Hills, 2002).

Research is accumulating to suggest that weight overestimation is linked to diagnosed eating disorders and has been suggested to play an important role in the maintenance of anorexia nervosa (Farrell, Lee, & Shafran, 2005). In addition this overestimation or underestimation of weight could be characteristic of someone at-risk for the development of an eating disorder rather than the actual presence of one (Heilburn, & Friedberg, 1990), as a result weight discrepancies could be used as a way of identifying those at-risk persons (Conley, & Boardman, 2007). In Cyprus no data exist on the association between weight overestimation and symptoms of disordered eating behaviours among the non-clinical adolescent population.

The vast majority of research on self-reported weight, height and BMI have been conducted mainly in Western, developed nations. Due to differences in body size and cultural norms the accuracy of self-reported data may differ among populations and sub-groups. For example one Japanese study found no statistically significant difference between self-reported and measured weight in adults (Wada, et al., 2005) but in another Asian country, Thailand, researchers found discrepancies in self-reported and measured data similar to those in developed countries (Lim, Seubsman, & Sleigh, 2009). Cyprus is an island located in the eastern Mediterranean Sea, over the past forty years a great cultural shift has been observed where the population has changed from a traditional rural one into a modern, developed, European one as far as way of life, nutritional and clothing habits, media, entertainment and role models are concerned. It is a question therefore, whether the accuracy of self-reported anthropometric measurements vary in ways similar to those of Western countries.

No literature exists on the precision and differences in self-reported and measured weight, height and BMI among the Cypriot adolescent population. The scope of this study was to examine the discrepancy between these two sets of data, discover the accuracy of using self-reported data to categorize adolescents into underweight, normal weight, overweight and obese, to determine whether a person's gender and weight status has an effect on their accuracy in reporting their weight and height and finally to assess whether weight overestimation is characteristic for the development of an eating disorder.

2. Research Methods

2.1 Participants

In 2010, a representative sample of school students was selected to participate in an epidemiological study on eating disorders. Students were requested to answer a self-administered questionnaire, either the Eating Attitudes Test-26 or the Eating Disorder Inventory-3. The questionnaires included asking a person to state his or her gender, age, height and weight. The handing out of questionnaires and anthropometric measurements of weight and height were collected on the same day. For the purpose of this study only those students were

used where complete data was collected. Complete data included date of birth, gender, self-reported weight and height and measured weight and height. This left a total of 579 adolescents used in this research, 392 females of mean age 15.4 (SD 1.7) and 187 males of mean age 15.0 (SD 1.7). Out of the 579 adolescents, 403 completed the EDI-3 and 176 the EAT-26. Participation in the study was voluntary and students were ensured the confidentiality of their answers.

2.2 Anthropometric Measurements

Height and weight were measured by the same trained professionals each time; the participants were dressed in light trousers and school t-shirt and were without shoes. Weight was measured using a portable scale, and height was measured to the nearest 0.1cm using a stadiometer. The students were asked to stand with their feet together and look forward.

Measured BMI was defined as the BMI calculated from measured weight and height, and self-reported BMI as the BMI calculated from self-reported weight and height. Adolescents were classified as underweight, normal, overweight and obese according to the percentile curves for BMI of children and adolescents in the unoccupied area of Cyprus described in 2001 (Savva et al., 2001).

2.3 Questionnaires

The Eating Attitudes Test (EAT-26) is a self-report questionnaire of 26 items assessing the range of symptoms of anorexia and bulimia nervosa. Each item is rated on a 6-point Likert scale ranging from “never” to “always”. Total EAT scores (the sum of all 26 items) were calculated for each participant. The clinical cut-off point for eating disturbances is a score of 20 or above, which is indicative of serious eating disturbances or weight concerns.

The EDI-3 is also a self-report questionnaire consisting of 91 items measuring psychological domains relevant to the understanding and treating of eating disorders (Garner, 2004). The EDI-3 presents items on a 6-point Likert scale using a 0-4 point scoring system (e.g. 001234) with null scores for the non-symptomatic answers. The 91 items of the questionnaire are organized into 12 primary scales: three eating-disorder specific scales and nine general psychological scales relevant but not specific to eating disorders. The three eating disorder specific scales are relevant to this research: (a) Drive for thinness (DT) which consists of 7 items measuring an individual’s preoccupation with dieting and fear of weight gain. (b) Bulimia (B) comprises of 8 items and assesses an individual’s tendency to think about and engage in periods of overeating. (c) Body Dissatisfaction (BD) scale consists of 10 items assessing the extent of people’s dissatisfaction with the overall shape and size of their body. Raw scores were calculated for each of these scales and using the EDI-3 interpretive guidelines cut-off points were created.

2.4 Statistical Analyses

SPSS version 18.0 was used for data management and all statistical analyses. As the validity of self-reported height and weight may differ among boys and girls, separate analyses were made for each gender. A p-value of less than 0.05 was considered statistically significant in all analyses.

Differences were calculated by subtracting measured values from self-reported values in height, weight and BMI. Paired sample t-tests were used to examine differences between self-reported and measured values. Pearson correlation coefficients were computed to determine the concordance between measured and self-reported values. So as to assess the agreement in detail Bland-Altman plots were conducted (Bland, & Altman, 1986).

Measured and self-reported BMI was divided into four categorical groups (underweight, normal, overweight and obese) using age- and gender appropriate cut-off points according to Cypriot percentile

curves. The Kappa statistics were performed to assess the degree of concordance. Independent sample t-tests were used to compare overweight/obese and underweight/normal weight participants.

In line with previous research (Conley, & Boardman, 2007) participants were divided into two categories: those who overestimated their weight by 5% or more of their actual weight and all others who estimated their weight to be below 5% of their measured weight. Chi-square tests were carried out to determine whether adolescents who overestimate their weight by 5% or more have more pathological scores on the EAT-26 and EDI-3 subscales than those who do not.

3. Results

Descriptive statistics on measured and self-reported weight, height and BMI are presented in Table 1. Self-reported weight was less than measured weight in girls, but not so for boys. Both boys and girls overestimate their height. As a result, BMI calculated from self-reported data significantly under-reported measured BMI by 0.3 kg/m^2 for boys and 0.74 kg/m^2 for girls. The degree of self-report bias in weight and height did not differ between genders but with regards to BMI there was a greater discrepancy between subjective and measured values for girls ($t(577) = 2.583$, $p < 0.01$) in comparison to boys. There were strong correlations between measured and self-reported values ranging from 0.85 to 0.95.

Table 1. Paired sample t-test comparing self-reported and measured anthropometric data; discrepancies and correlations (boys (n =187), girls (n = 392)

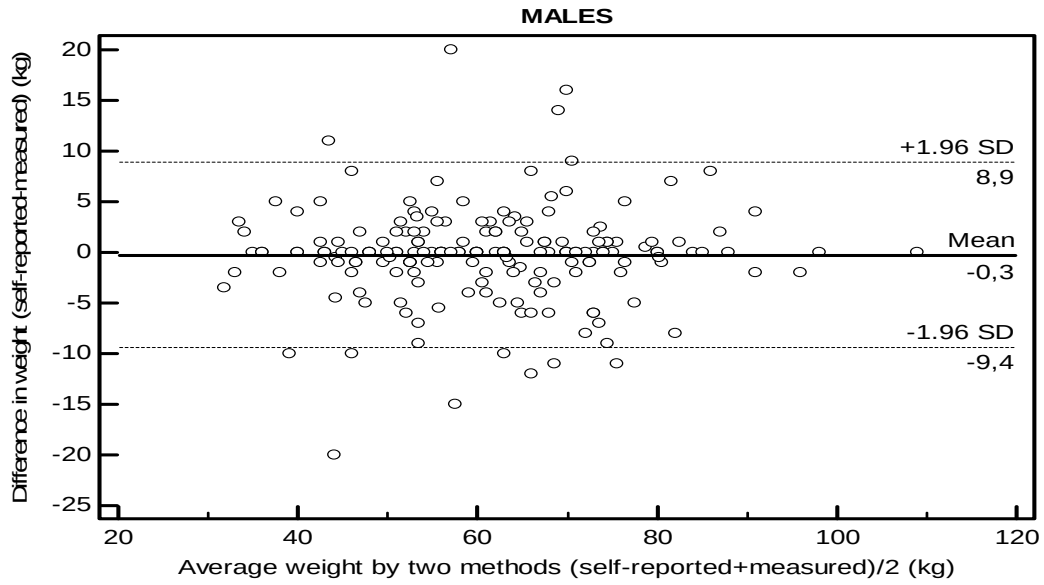
	Self-report Mean (SD)	Measured Mean(SD)	t	Discrepancy[a] (self-report-measured) Mean (SD)	Pearson correlation coefficient
Weight, kg					
Boys	60.95 (14.1)	61.23 (14.0)	0.807	-0.28 (4.7)	0.945**
Girls	54.11 (10.3)	55.02 (11.0)	4.762**	-0.92 (3.8)	0.939**
Height, cm					
Boys	167.72 (10.6)	166.88 (9.7)	-2.110*	0.85 (5.5)	0.858**
Girls	162.20 (6.9)	160.68 (6.9)	-8.352**	1.52 (3.6)	0.865**
BMI, kg/m^2					
Boys	21.48 (3.8)	21.78 (3.8)	1.977*	-0.30 (2.1)[†]	0.851**
Girls	20.51 (3.3)	21.25 (3.7)	9.405**	-0.74 (1.6)	0.907**

[a] A negative value reflects underestimating and a positive value reflects overestimating
* $p < 0.05$
** $p < 0.0001$
[†] Significant differences between males and females $p < 0.05$

The differences between measured and self-reported values were plotted against the mean of measured and self-reported values in height and weight for both males (Figure 1) and females (Figure 2). A range of agreement was defined as mean bias ± 1.96 SD. Concerning self-reported and measured weight, the 95% limits of agreement between the two methods ranged from -9.43 to 8.88 for males and -8.37 to 6.54 for females. The 95% limits of agreement between self-reported and measured height are -9.90 to 11.59 for males and -5.53 to 8.56 for females. The percentage of participants scoring outside the ± 1.96 SD range of

agreement for weight is 5.3% of boys and 4.6% of girls, for height the corresponding figures are 3.7% of boys and 4.3% of girls. Overall therefore, self-report and measured values do provide similar measures.

Figure 1. Bland-Altman plots of differences between measured and self-reported weight and height against the mean of these values for males



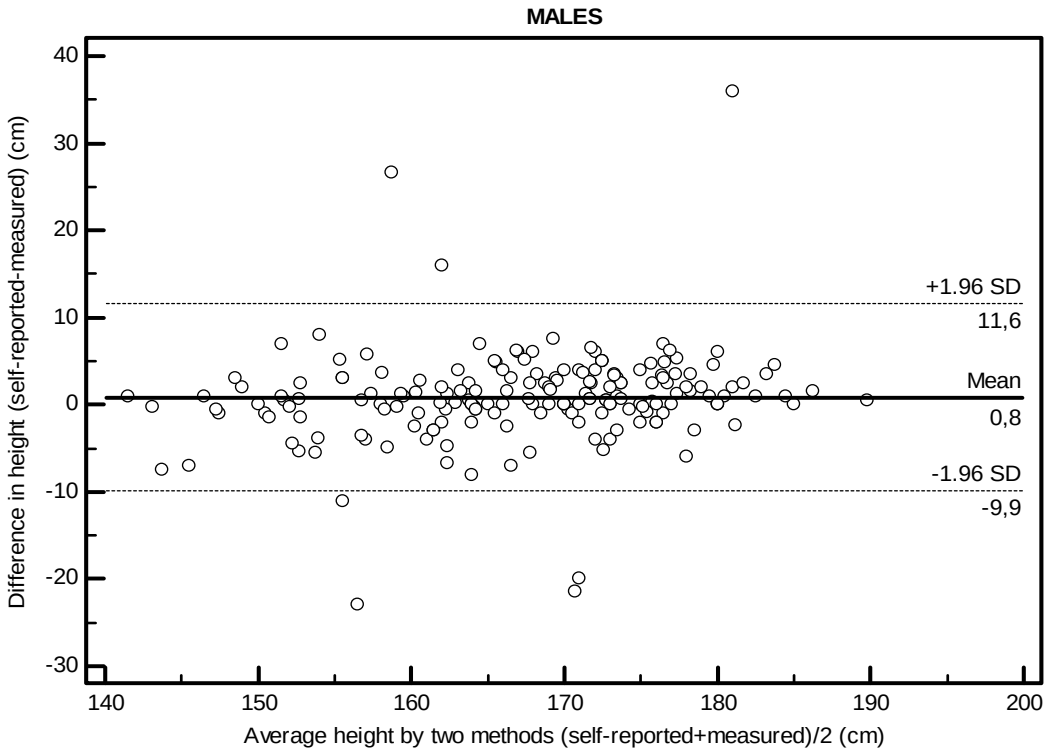


Figure 2. Bland-Altman plots of differences between measured and self-reported weight and height against the mean of these values for females

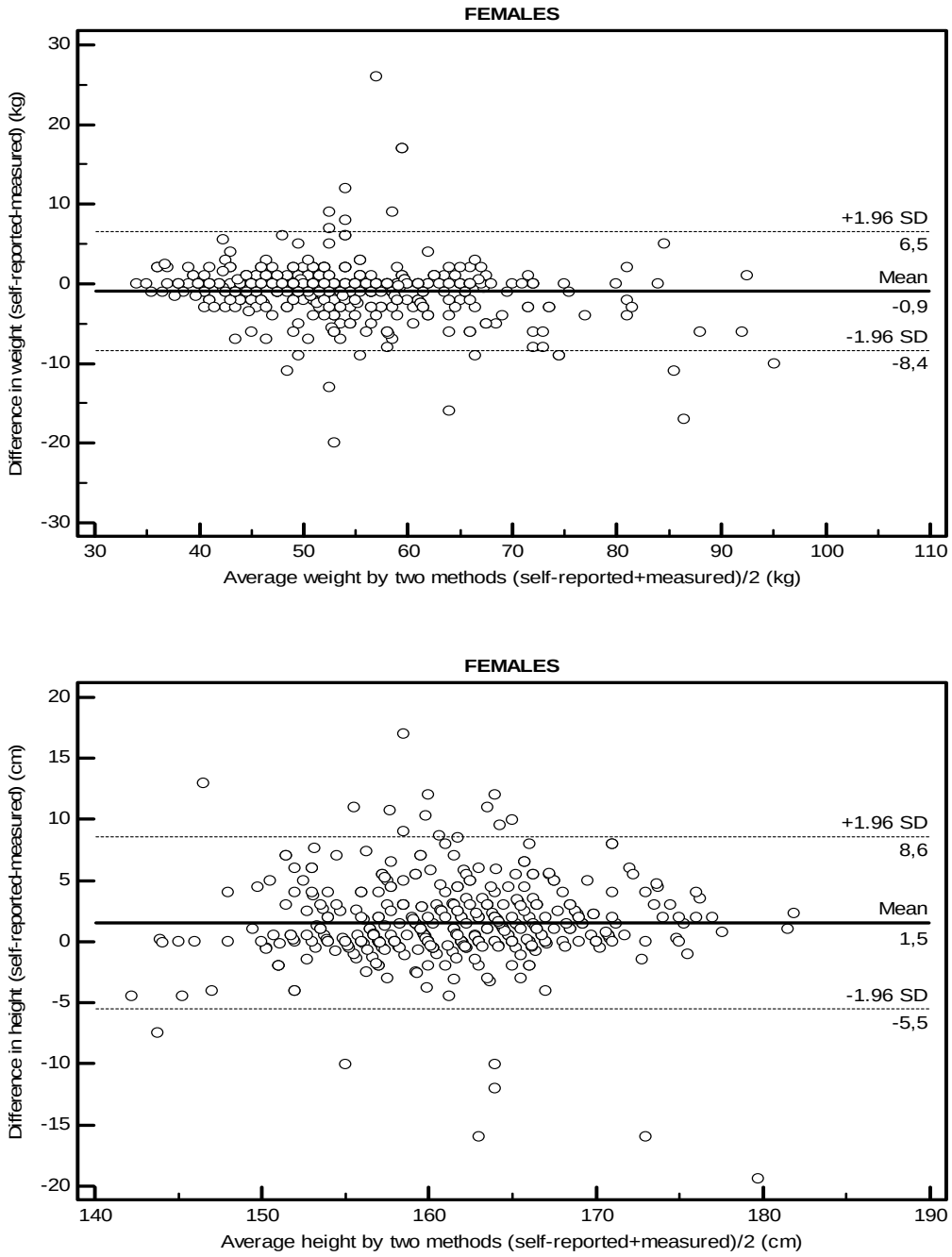


Table 2 shows the Kappa value when the four classes of self-reported BMI were compared to their measured BMI. Females have substantial agreement whereas males have only moderate agreement. Twenty-five cases of overweight/obese participants would have been overlooked if one relied solely on self-report measures. Overweight and obese females have greater discrepancies in weight, height and therefore BMI in comparison to under- and normal weight females (Table 3). There is no difference in height discrepancy for overweight/obese and underweight/normal males. The former however have greater discrepancies in weight and BMI in comparison to the latter.

Table 2. Classification of participants according to measured and self-reported BMI

	FEMALES N=392			MALES N=187		
	Measured N (%)	Self-report N (%)	Kappa	Measured N (%)	Self-report N (%)	Kappa
Underweight	47 (12)	59 (15.1)	0.662 (p <0.000)	9 (4.8)	11 (5.9)	0.562 (p <0.000)
Normal	272 (69.4)	279 (71.2)		122 (65.2)	126 (67.4)	
Overweight	62 (15.8)	48 (12.2)		46 (24.6)	41 (21.9)	
Obese	11 (2.8)	6 (1.5)		10 (5.3)	9 (4.8)	

Table 3. Independent sample t-test comparing overweight/obese participants and underweight/normal participants in discrepancies between weight, height and BMI

	FEMALES			MALES		
	Under/normal weight Mean (SD) N=319	Overweight/ obese Mean (SD) N=73	t	Under/normal weight Mean (SD) N=131	Overweight/ Obese Mean (SD) N=56	t
Weight discrepancy	-0.44 (3.6)	-2.99 (3.9)	5.065**	0.43 (4.7)	-1.93 (4.2)	3.246**
Height discrepancy	1.30 (3.6)	2.50 (3.4)	-2.622*	0.50 (5.5)	1.66 (5.4)	-1.327
BMI discrepancy	-0.47 (1.4)	-1.90 (1.8)	6.403**	0.06 (1.9)	-1.15 (2.1)	3.796**

* $p < 0.01$
** $p < 0.001$

Participants who overestimated their weight by at least 5% of their measured weight have lower scores on the DT scale ($t(389) = 3.533$, $p = 0.000$) and the BD scale ($t(389) = 2.599$, $p = 0.01$) of the EDI-3 in comparison to the other participants who completed the questionnaire. This can also be seen in Table 4, with the results of the Chi-square tests. There was no difference between the two groups on the EAT-26 and its subscales or the B subscale of the EDI-3.

Table 4. Weight overestimation and scores on the EAT-26 and EDI-3 subscales

	Weight estimation by under 5% N (%)	Weight over-estimated by 5% and above N (%)	$\div^2$
EAT-26 Normal score	107 (69.9)	46 (30.1)	0.08
Pathological score (>20)	12 (66.7)	6 (33.3)	
DT Normal score	266 (77.3)	47 (22.7)	4.65*
Pathological score ≥ 17	78 (90.4)	5 (9.6)	
B Normal score	228 (65.5)	120 (34.5)	1.74
Pathological score ≥ 5	41 (74.5)	14 (25.5)	
BD Normal score	272 (80.2)	67 (19.8)	3.09*
Pathological score ≥ 22	47 (90.4)	5 (9.6)	

* $p < 0.05$

4. Discussion

This study investigated the validity of self-reported weight and height in Cypriot male and female adolescents. Similar to the conclusions of other studies carried out in other countries (Elgar et al., 2005; Wada et al., 2005; Lim, Seubsman & Sleigh, 2009; Larsen et al., 2008; Brener et al., 2003; Wang, Patterson, & Hills, 2002; Sherry, Jefferds, & Grummer-Strawn, 2007) self-reported height and weight are highly correlated with measured height and weight for both boys and girls, with correlations for height being lower than for weight.

In spite of these high correlations between the objective and subjective measurements certain characteristic errors can be detected. Girls underreport their weight by an average of 0.91kg and over-report their height by 1.51cm thereby underreporting their BMI by 0.74kg/m^2. For adolescent boys on the other hand although there was no statistical significance they underestimated their weight by average 0.28kg. Statistically significant differences however were found for height which was overestimated by 0.84cm making BMI underestimated by 0.3kg/m^2. These findings are similar to those of other general population studies of European, developed nations such as France (Niedhammer et al., 2000), Scotland (Bolton-Smith et al., 2000), and the UK (Spencer et al., 2002). Review studies (Sherry, Jefferds, & Grummer-Strawn, 2007) find that females underestimate their weight and BMI more so than males. Although this study did find that girls underestimate their BMI more than boys, no differences were found between the two genders in their estimates of weight and height.

Of much more importance for researchers and practitioners is the use of self-reported height and weight to calculate BMI and provide categorical measures of overweight and obesity. In line with previous research (Sherry, Jefferds, & Grummer-Strawn, 2007) the prevalence of overweight is consistently underestimated by self-reported data, with the relative error ranging from-2.4 to -42.7% and sensitivity data reporting that 25% - 45% of those overweight would be ignored. Concerning Cypriot adolescents, 19 overweight and obese females (4.9%) and 6 overweight and obese males (3.2%) would have been overlooked and neglected by relying only on subjective measures of height and weight.

A further consistent bias concerning adolescents is the tendency for those overweight to underreport their weight and BMI more so than normal weight adolescents (Sherry, Jefferds, & Grummer-Strawn, 2007). Both overweight and obese female and male Cypriot adolescents have greater weight discrepancies in comparison to their normal/ underweight counterparts. Adolescent overweight and obese females tend to overestimate their height in addition to underestimating their weight, which is not the case for overweight and obese males.

One of the final aims of this research was to assess whether weight overestimation may be a sign of an adolescent at-risk for the development of an eating disorder. Body size overestimation has been found to be associated with eating disorders (Farrell, Lee, & Shafran, 2005). No differences however were found between adolescents with pathological scoring on the EAT-26 and the eating disorder specific scales of the EDI-3 when discrepancies in weight, height and BMI were seen. Conley and Boardman (2007), found that women who over reported their weight by at least 5% were significantly more likely than those who either under reported or accurately reported their weight to exhibit disordered eating behaviours. A different set of questionnaires were used in this research to assess disordered eating however the opposite results were found. Participants who overestimated their weight by at least 5% had lower scores on Drive for thinness scales and Body dissatisfaction scales. In conclusion therefore, weight overestimation among Cypriot adolescents cannot be taken as a sign of vulnerability for the development of eating disorders.

Overall, it can be concluded from the results of this research that the accurate measurement of weight and height must depend on objective measurement and not subjective self-report. The greatest errors in self-reporting derive from those overweight and obese individuals researchers and practitioners wish to detect. As rates of overweight and obesity continue to increase relying on self-reports are likely to become more and more unreliable.

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