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Self-reported and measured weight, height and body mass index (BMI) in Italy, the Netherlands and North America

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Background: Self-reported values of height and weight are used increasingly despite warnings that these data—and derived body mass index (BMI) values—might be biased. The present study investigates whether differences between self-reported and measured values are the same for populations from different regions, and the influences of gender and age. **Methods:** Differences between self-reported and measured weights, heights and resulting BMIs are compared for representative samples of the adult population of Italy, the Netherlands and North America. **Results:** We observed that weight is under-reported (1.1 ± 2.6 kg for females and 0.4 ± 3.1 kg for males) and height over-reported (1.1 ± 2.2 cm for females and 1.7 ± 2.1 cm for males), in accordance with the literature. This leads to an overall underestimation of BMI values (0.7 ± 1.2 kg/m^2 or 2.8% for females and 0.6 ± 1.1 kg/m^2 or 2.3% for males). When BMI values are assigned to four categories (from 'underweight' to 'obesity'), 11.2% of the females and 12.0% of the males are categorized too low when self-reported weights and heights are used, with an extreme of 17.2% for Italian females. Older people tend to relatively over-report height and under-report weight, but the magnitude differs between countries and gender. **Conclusion:** We conclude that, apart from a general overestimation of height and underestimation of weight resulting in an underestimation of BMI, substantial differences are observed between countries, between females and males and between age groups.

Keywords: anthropometry, BMI, height, self-report, weight

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Introduction

Self-reported data on weight and height are much easier, simpler and inexpensive to obtain than measured values. Therefore, in many cases, self-reported data are used, but their validity may be questioned. Recent reviews[1,2] report a general trend to overestimate one's height and also to underestimate one's weight, especially by overweight or obese persons. Body mass index (BMI) values that are computed from weight and height are therefore also underestimated. These observations are confirmed for adolescents.[3] The self-reported data can substitute for measured data for most purposes, especially if only means are used, since the correlations between self-reported and measured heights and weights are high.[4–7] However, for other applications, such as health surveys (e.g. prevalence of obesity), clothing sizes., or input for ergonomic design, it is important to know how trustworthy the reported values are.

Many articles describe overall effects: over-reporting of height and under-reporting of weight. More specifically, a tendency toward the mean or 'flat slope syndrome',[8,9] meaning overestimation of lower values and underestimation of higher values, is also reported frequently (see, for instance, refs. 4, 6, 7 and 10). Factors that are related to the accuracy of the self-reported data are gender, age[7,10] and weight status (underweighted–obese).[4,5]

The present study investigates whether also regional differences exist with respect to the errors in reporting weight and height. Our specific aims are (i) to explore the effect of regional information in relation with gender, age and height or weight or obesity status on systematic errors in reporting weight and height, and (ii) to examine the same effects on the resulting calculation of BMI. The data used have been assembled by identical procedures in three countries (Italy, the Netherlands and North America).

Methods

Subjects

The data set contains data from the CAESAR project, an international co-operation to obtain anthropometric data from the populations of Europe and North America.[11] It consists of representative samples of the population of Italy, the Netherlands and North America. All participants were measured in 1999 or 2000 when they came to one of the measurement sites. Procedures were the same at each of the sites. Data were collected in three ways. Participants first filled out a demographic questionnaire. In the questionnaire, participants filled in gender, age, stature and weight. Thereafter, they dressed in a special scanning garment over their underwear. The scanning garment for males was a short that covers from the waist to mid-thigh. Female's scanning garments consisted of a short supplemented with a sport bra top. Participants were then measured manually by trained specialists. Weight was determined using a calibrated weighing scale. Stature was determined while participants were standing with their feet ∼10cm apart at the heels.

Overall, 4459 participants were measured in the CAESAR project: 801 in Italy, 1266 in the Netherlands and 2391 in North America. Eight subjects were removed from the data because they were either below 18 or above 65 years old, 20 participants had missing data on age, height and/or weight, five persons were excluded from the data set because they were extreme outliers with respect to stature or weight and

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23 participants were removed because they had extreme differences between reported and measured height (>20 cm) or weight (>25 kg). After excluding the outliers, total available data were 4403 participants, including 2327 females and 2076 males. This study sample consisted of 408 males and 384 females in Italy (stature 173.6 ± 6.7 cm and 161.1 ± 6.2 cm respectively, weight 72.6 ± 10.4 kg and 57.5 ± 9.1 kg), 562 males and 695 females in the Netherlands (stature 181.4 ± 8.6 cm and 168.0 ± 7.6 cm, weight 83.8 ± 16.1 kg and 72.9 ± 15.5 kg) and 1106 males and 1248 females in North America (stature 177.8 ± 7.9 cm and 164.0 ± 7.2 cm, weight 85.8 ± 17.4 kg and 68.8 ± 17.5 kg).

Variables and analysis

Gender, age, region (country) and self-reported height and weight from the questionnaire, and the manually measured stature and weight were included for further analysis. If necessary, reported values were converted to metric values. There were four derived variables, including BMI and three difference scores. Difference scores were produced for height, weight and BMI. Differences between measured and self-reported values are always presented as (reported − measured), thus giving over-reported values a positive and under-reported values a negative sign. BMI scores were calculated [weight (kg)/height (m)^2] for the measured data (measured BMI) as well as for the self-reported values (reported BMI) of each participant. Because of the possible effect of age, the data were divided in three age groups: 18–30, 31–45 and 46–65 years. Weight, height and BMI deciles (10% parts of the ordered distributions of measured values) were also assigned to each of the participants for further analysis.

To investigate whether the regional differences existed with respect to the errors in reporting weight and height, in relation with gender, age and height or weight or BMI deciles, data analyses were done as follows: First, paired samples *t*-tests were performed to confirm the general trend of over or underestimate of reported values on each cell categorized by gender, age group and country. Second, separate analysis of variances (ANOVA)s were carried out with difference scores on weight, height or BMI as dependent variables with country, gender, age, height, weight and BMI deciles as factors. This step examined the main effects of all six factors with interaction effects between country and all the other effects on difference scores. Because there were six main effects, the number of interaction terms in the full model became too high for practical application. Therefore, the model was reduced with all six main effects with two-way interaction terms associated with the country factor. When there were significant results that needed further analysis (*post hoc*) Tukey Honestly Significant Difference (HSD) tests were done. Third, standard categories of BMI were used to characterize participants as underweight (BMI under 18.5 kg/m^2), normal (BMI between 18.5 and 24.9 kg/m^2), overweight (25-29.9 kg/m^2) and obese (above 30 kg/m^2). Then, both BMIs (reported BMI and measured BMI) were cross-tabled by country to assess the extent of misclassification of BMI that would be the result from the use of self-reported values, and to compare the differences among the three countries.

All statistical analyses were carried out with STATISTICA.[12] Since the ANOVAs performed in this investigation were of unbalanced design, and had six factors with reduced interaction terms, the General Linear Model (GLM) procedure was used. Statistical significance was accepted for $P < 0.05$.

Results

Differences between reported and measured weight

Weight was underestimated significantly in almost all cases. Paired samples *t*-tests on each cell categorized by gender, age and country showed that reported weight was statistically smaller than measured weight in every case, except for young and medium-aged males from Italy and young males from the Netherlands. In other words, only younger males in the Netherlands and, especially, in Italy reported their weights more or less correctly.

The ANOVA's on weight difference showed a significant main effect for country ($F_{2,4310} = 8.35$, $P < 0.001$), with all three countries being significantly different from each other. The Dutch underestimated their weight by 1.1 ± 3.2 kg, the North Americans by 0.7 ± 2.9 kg and the Italians by 0.4 ± 2.4 kg. The main effects of weight deciles ($F_{9,4310} = 1.68$, $P = 0.089$) and BMI deciles ($F_{9,4310} = 4.82$, $P < 0.001$) were approaching significant and significant, respectively; *post hoc* Tukey HSD tests between BMI deciles revealed a gradual increase of the obesity difference from overestimation in the lowest decile to large underestimation in the higher deciles. No differences were found in height deciles ($F_{9,4310} = 1.29$, $P = 0.23$), meaning that smaller and taller people underestimate their weights equally.

There was also a significant main effect for gender ($F_{1,4310} = 60.23$, $P < 0.001$), females (mean (M) $= -1.05$ kg) underestimated their weight more than males ($M = -0.41$ kg), in general. Age was also an important factor ($F_{2,4310} = 7.37$, $P < 0.001$). Out of three age groups, the youngest group (age 18–30, $M = -0.51$ kg) underestimated their weight less than the other two age groups. There were two significant interaction effects associated with the country factor: country and gender ($F_{2,4310} = 3.10$, $P = 0.045$), and country and age groups ($F_{2,4310} = 2.92$, $P = 0.019$). Netherlands females ($M = -1.44$ kg) underestimated their weight the most, while Italian males ($M = 0.59$ kg) did not underestimate, but reported more or less correctly. Depending on the country, reported weights of each age group were underestimated differently. The Americans (18–30 years $M = -0.66$ kg, 31–45 years $M = -0.77$ kg, 46–65 years $M = -0.69$ kg) underestimated their weight about the same across all age groups. However, in both Italy and Netherlands, reported weight was underestimated more as people got older (Italy: 18–30 years $M = -0.62$ kg, 31–45 years $M = -0.41$ kg, 46–65 years $M = -0.79$ kg, Netherlands: 18–30 years $M = -0.62$ kg, 31–45 years $M = -1.131$ kg, 46–65 years $M = -1.44$ kg).

Differences between reported and measured height

Paired sample *t*-tests showed that reported height was statistically greater than measured height in every case. In other words, on the average, reported height data are always overestimated.

Height was overestimated in all cases, but there were marked differences. The ANOVAs on height difference showed four significant main effects by country, gender, age groups and height deciles. Regional difference affected the height difference values ($F_{2,4310} = 109.23$, $P < 0.001$). Tukey HSD tests showed a further distinction among the three countries with the largest overestimations made in Italy ($M = 2.6$ cm, SD = 1.9 cm), next North America ($M = 1.2$ cm, SD = 2.1 cm) and the smallest in the Netherlands ($M = 1.0$ cm, SD = 2.2 cm). For gender effects ($F_{1,4310} = 11.30$, $P < 0.001$) in

Table 1 Descriptive statistics for BMI

BMI (kg/m²)	Italy			Netherlands			North America		
Gender Age	Measured	Reported	Difference	Measured	Reported	Difference	Measured	Reported	Difference
Female 18–30	21.23 ± 2.41	20.23 ± 2.12	−1.00* ± 1.02	23.40 ± 4.25	22.83 ± 4.11	−0.57* ± 1.02	23.95 ± 4.96	23.31 ± 4.70	−0.63* ± 1.10
31–45	23.02 ± 4.01	21.95 ± 3.82	−1.07* ± 0.93	25.64 ± 4.79	24.98 ± 4.65	−0.66* ± 1.03	25.58 ± 6.16	25.08 ± 5.88	−0.49* ± 1.37
46–65	25.58 ± 4.60	24.25 ± 3.35	−1.33* ± 1.12	28.65 ± 5.80	27.56 ± 5.53	−1.09* ± 1.21	26.74 ± 6.67	26.12 ± 6.62	−0.62* ± 1.22
Total	22.16 ± 3.35	21.10 ± 3.04	−1.06* ± 1.03	25.88 ± 5.41	25.11 ± 5.15	−0.77* ± 1.11	25.53 ± 6.14	24.96 ± 5.96	−0.57* ± 1.25
Male 18–30	23.05 ± 2.83	22.55 ± 2.58	−0.50* ± 0.93	22.96 ± 2.88	22.62 ± 2.91	−0.35* ± 1.17	25.91 ± 4.59	25.30 ± 4.29	−0.61* ± 1.19
31–45	25.47 ± 3.14	24.80 ± 2.90	−0.67* ± 0.79	25.92 ± 4.41	25.48 ± 4.07	−0.44* ± 1.31	27.03 ± 4.40	26.39 ± 4.14	−0.64* ± 1.14
46–65	26.90 ± 2.81	25.88 ± 2.67	−1.01* ± 0.97	27.44 ± 4.60	26.68 ± 4.33	−0.76* ± 1.30	28.17 ± 4.93	27.45 ± 4.80	−0.73* ± 1.13
Total	24.10 ± 3.24	23.50 ± 2.96	−0.61* ± 0.92	25.45 ± 4.45	24.93 ± 4.18	−0.52* ± 1.27	27.08 ± 4.70	26.42 ± 4.47	−0.66* ± 1.15

*Indicates a significant difference.

general, males ($M = 1.7$ cm, SD = 2.1 cm) over-reported their heights more than females ($M = 1.2$ cm, SD = 2.2 cm). The height difference values were also affected by age ($F_{2,4310} = 9.82$, $P < 0.001$). The three age groups were significantly different from one another based on Tukey HSD. This indicated that the youngest group (18–30 years, $M = 1.7$ cm, SD = 2.1 cm) overestimated the most, followed by the oldest group (46–65 years, $M = 1.4$ cm, SD = 2.2 cm) and, finally, the middle-aged group overestimated the least (31–45 years, $M = 1.1$ cm, SD = 2.2 cm). The significant main effect of height deciles ($F_{9,4310} = 2.00$, $P = 0.035$) confirmed the general trend that the shorter people overestimate their height more. Tukey HSD test showed that people in the 10th percentile group overestimated more than other people, especially those who are taller than the 30th percentile. There was no other significant difference found in the height deciles groups, which means that an underestimation of height by the tall group (above 90th percentile) was not found. Weight deciles or obesity status did not statistically affect the overestimation of height.

There were also two interaction effects associated with the country factor. One was the interaction between gender and country ($F_{2,4310} = 39.81$, $P < 0.001$). Depending on the country, male and females overestimated their height differently. In general, males overestimated their heights, but for Italy, the opposite was true: Italian females overestimate their heights more than males. The other significant interaction was between country and weight deciles ($F_{2,4310} = 39.81$, $P < 0.001$). Italians overestimated their height more than the other two countries in all decile groups, but this effect was less distinct for the lowest two deciles (10th and 20th percentiles).

Differences between BMI from reported and from measured weights and heights

For BMI-scores the same characteristics as for weight and height were computed, both for BMI based on measured values (measured BMI) and for BMI computed from reported weights and heights (reported BMI). The results are in Table 1. Paired samples *t*-tests on each cell categorized by gender, age and country showed that the reported BMI was statistically smaller than measured BMI in every case.

Weight underestimation and height overestimation resulted in an underestimation of BMI values for both women and men in all countries and in all age groups, ranging from a minimum average of −0.35 kg/m² for young Dutch males to a maximum average of −1.33 kg/m² for older Italian females.

ANOVAs on BMI difference showed a total of five significant main effects that included country, gender, age groups, both weight and BMI deciles and two interaction effects between country and age groups or gender. The main effect of gender ($F_{1,4310} = 32.07$, $P < 0.001$) showed that

females' reported BMI ($M = -0.71$ kg/m², SD = 1.19 kg/m²) was underestimated more than males' reported BMI ($M = -0.61$ kg/m², SD = 1.15 kg/m²). The effect of age was again significant ($F_{2,4310} = 19.06$, $P < 0.001$). The older group (46–65 years, $M = -0.79$ kg/m², SD = 1.21 kg/m²) differed from both the young (18–30 years, $M = -0.62$ kg/m², SD = 1.09 kg/m²) and the middle-aged group (31–45 years, $M = -0.59$ kg/m², SD = 1.20 kg/m²). The main effect of country ($F_{2,4310} = 17.05$, $P < 0.001$) presented that reported BMI for Italy ($M = -0.80$ kg/m², SD = 0.97 kg/m²) was underestimated more than for the other two countries, the Netherlands ($M = -0.64$ kg/m², SD = 1.17 kg/m²) and North America ($M = -0.61$ kg/m², SD = 1.21 kg/m²).

The interaction effects between gender and country ($F_{2,4310} = 39.81$, $P < 0.001$) showed that males' and females' reported BMI were underestimated differently depending on the country. In Italy and The Netherlands, females' reported BMI were underestimated more than males', but North American data showed the opposite results in that males' difference scores between reported and measured BMI ($M = -0.66$ kg/m², SD = 1.15 kg/m²) were underestimated more than females'($M = -0.57$ kg/m², SD = 1.25 kg/m²), as shown in Table 1.

The other significant interaction was between country and age groups ($F_{2,4310} = 5.97$, $P < 0.001$). While the reported BMI of the older groups in both the Italian and Netherlands data (Italy: 18–30 years $M = -0.75$ kg/m², 31–45 years $M = -0.83$ kg/m², 46–65 years $M = -1.19$ kg/m², Netherlands: 18–30 years $M = -0.47$ kg/m², 31–45 years $M = -0.57$ kg/m², 46–65 years $M = -0.94$ kg/m²) underestimated more than the younger groups, North American data did not show any difference for the difference scores among their age groups (18–30 years $M = -0.62$ kg/m², 31–45 years $M = -0.56$ kg/m², 46–65 years $M = -0.67$ kg/m²).

The relative contribution of weight, height and BMI deciles to the observed BMI differences is calculated. Height apparently had no influence on the BMI differences, but weight deciles and obesity status (BMI value) did have an influence. There were significant main effects from both weight deciles ($F_{9,4310} = 1.94$, $P = 0.04$) and BMI deciles ($F_{9,4310} = 3.99$, $P < 0.001$). Both main effects showed a gradual increase of the observed BMI difference with higher deciles. Figure 1 shows the relation between BMI percentiles and observed BMI reporting errors.

BMI categories

BMI scores were classified into four categories (<18.5 is underweight, 18.5–24.9 is normal, 25–29.9 is overweight and >30 is obesity). The results are shown in Table 2.

The percentage of correctly classified persons ('correctly' defined as identical BMI categories from reported and
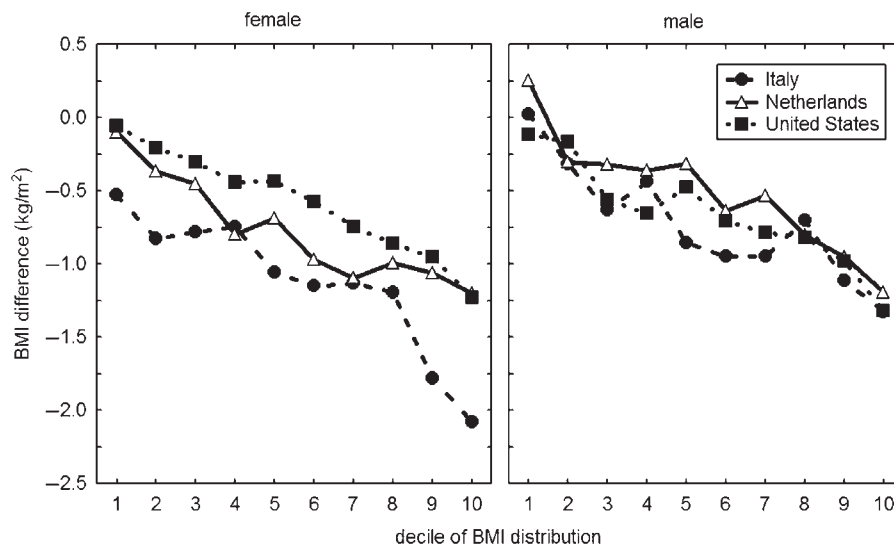
Figure 1 Differences between self-reported and measured BMI-values related to the deciles of the BMI for males and females of three selected regions in the world

Table 2 BMI categories from self-reported and measured height and weight data

	BMI category from measured values	BMI category from reported values							
		Underweight		Normal		Overweight		Obese	
Females									
Italy	Underweight	20	5.2%	0	0.0%	0	0.0%	0	0.0%
	Normal	35	9.1%	273	71.1%	0	0.0%	0	0.0%
	Overweight	0	0.0%	22	5.7%	19	4.9%	0	0.0%
	Obese	0	0.0%	1	0.3%	8	2.1%	6	1.6%
Netherlands	Underweight	12	1.7%	2	0.3%	0	0.0%	0	0.0%
	Normal	11	1.6%	339	48.8%	9	1.3%	0	0.0%
	Overweight	0	0.0%	47	6.8%	129	18.6%	6	0.9%
	Obese	0	0.0%	0	0.0%	25	3.6%	115	16.5%
North America	Underweight	27	2.2%	6	0.5%	0	0.0%	0	0.0%
	Normal	12	1.0%	691	55.4%	20	1.6%	0	0.0%
	Overweight	0	0.0%	75	6.0%	203	16.3%	5	0.4%
	Obese	0	0.0%	0	0.0%	24	1.9%	185	14.8%
Total	Underweight	59	2.5%	8	0.3%	0	0.0%	0	0.0%
	Normal	58	2.5%	1303	56.0%	29	1.2%	0	0.0%
	Overweight	0	0.0%	144	6.2%	351	15.1%	11	0.5%
	Obese	0	0.0%	1	0.0%	57	2.4%	306	13.1%
Males									
Italy	Underweight	5	1.2%	2	0.5%	0	0.0%	0	0.0%
	Normal	2	0.5%	250	61.3%	2	0.5%	0	0.0%
	Overweight	0	0.0%	40	9.8%	86	21.1%	0	0.0%
	Obese	0	0.0%	0	0.0%	9	2.2%	12	2.9%
Netherlands	Underweight	2	0.4%	7	1.2%	0	0.0%	0	0.0%
	Normal	5	0.9%	267	47.5%	12	2.1%	0	0.0%
	Overweight	0	0.0%	46	8.2%	138	24.6%	4	0.7%
	Obese	0	0.0%	0	0.0%	19	3.4%	62	11.0%
North America	Underweight	6	0.5%	0	0.0%	0	0.0%	0	0.0%
	Normal	6	0.5%	369	33.4%	17	1.5%	0	0.0%
	Overweight	0	0.0%	74	6.7%	390	35.3%	8	0.7%
	Obese	0	0.0%	0	0.0%	49	4.4%	187	16.9%
Total	Underweight	13	0.6%	9	0.4%	0	0.0%	0	0.0%
	Normal	13	0.6%	886	42.7%	31	1.5%	0	0.0%
	Overweight	0	0.0%	160	7.7%	614	29.6%	12	0.6%
	Obese	0	0.0%	0	0.0%	77	3.7%	261	12.6%

measured values of weight and height) was 86.8% for females and 85.5% for males (the diagonals of the rows for 'Total'), or, more specifically, 82.8 and 86.5% for women and men in Italy, 85.6 and 83.5% in the Netherlands and 88.6 and 86.1% in the North America.

A substantial number of participants were classified in one or two levels lower category (less obese) when reported values were used in comparison with the categorization by measured BMI (11.2% for females, 12.0% for males). Particularly, categorization by reported BMI of Italian females resulted in 17.2% of misclassification. They were always categorized one or two levels lower than their actual obesity status.

When age groups were compared, the oldest group had the largest underestimation of BMI category, which was consistent across countries. In the oldest group, 14.6% of the females and

15.5% of the males were categorized too low when self-reported weight and height values are used. The category underestimation ranges from minimum of 5.2% for middle-aged American females to maximum of 25.0% for older Italian males.

Discussion

In the analysis, we used both weight deciles and BMI deciles as independent variables. We found that this caused a moderate level of multicollinearity. Multicollinearity is known to produce large standard errors in the related independent variables, but does not bias the whole model. There are several remedies for the multicollinearity that include dropping the variable(s), collecting more data or leaving the model as it is, although some of these remedies are still controversial. In our study, it would be possible to consider 'the dropping the variable' as an option. However, when we dropped either the weight deciles or BMI deciles, the results were more inferior to when we kept both in the model. For example, when the height difference was the dependent variable, we lost one of the significant interaction effects between country and weight deciles by dropping BMI deciles. Moreover, main effects of BMI deciles and weight deciles were both significant when the BMI difference was the dependent variable. Thus, we decided to leave the model as it is, because the presence of multicollinearity would not be problematic in this case and the sample size is already large enough to reduce the standard error.

The expected average over-reporting of height and under-reporting of weight is present in our data, resulting in an average underestimation of BMI values. The underestimation was observed for men and women, for all three countries, and for all age groups. However, there are clear differences when the data are inspected more closely.

Weight was underestimated more by females ($M = 1.1$ kg) than by males ($M = 0.4$ kg), more by the Dutch ($M = -1.06$ kg) than by the Italians ($M = -0.35$ kg) and North Americans ($M = -0.71$ kg), more by middle-aged ($M = -0.83$ kg) and older persons ($M = -0.94$ kg) than by young ones ($M = -0.51$ kg) and more by heavier people than by persons with low weights. Probably, the effect of the so-called 'socially desirable ideal weight' plays an important role here.[13]

Height was overestimated more by males ($M = 1.7$ cm) than by females ($M = 1.5$ cm) and much more by Italians ($M = 2.6$ cm) than by participants from the Netherlands ($M = 1.0$ cm) and North America ($M = 1.2$ cm). Smaller persons overestimated their height more than taller ones (the so-called 'flat slope syndrome'),[8,9] possibly because of 'wishful thinking'.[13] The effect of age was significant but difficult to explain since both the younger (18–30 years) and the older group (46–65 years) showed a larger overestimation of height than the intermediate group (31–45 years). For the oldest group, a probable explanation is the seemingly unawareness of the well-documented phenomenon that people shrink with age.[10,14]

BMI values were underestimated, in general (0.8 kg/m^2 by females, 0.6 kg/m^2 by males), because of the over-reporting of height and under-reporting of weight, as expected. The difference was smaller for females than for males in North American data. For Italy, with a low overweight prevalence, the under-reporting was larger than for both other countries. Underestimation of BMI hardly occurred for persons with low weights, while a substantial underestimation happened with heavy people. As with weight, there was a distinct age effect that partly might be traced back to underestimation (or denial) of the effect of height loss with age: older persons

underestimated their BMI much more than younger ones, but this was only the case for Italy and the Netherlands.

When BMI categories were used, considerable differences were observed between classifications using reported BMI and measured BMI. Specifically, the use of self-reported values leads to underestimation of obesity status. Therefore, although reported BMI values are much easier to collect than those from measurements, great care should be taken when using them, for instance, in health surveys, because of the considerable category-dependent deviations.

We have found considerable differences between countries, but region might not be the only explanation. It is feasible that cultural or ethnic differences[15] also play a role, e.g. because quite different attitudes exist toward preferred values for height and weight. Fairly large differences, for instance, are reported in under- or overestimation of height and weight between children from different ethnic backgrounds within the Netherlands.[3]

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Conflicts of interest: None declared.

Key points

- This study compares self-reported and measured values of weight and height in three countries.
- In all three countries, weight is generally under-reported and height over-reported, causing underestimation of BMI. Weight is underestimated most by females, whereas height is overestimated most by males.
- Distinct differences between countries exist with respect to estimation of height and weight; underestimation of BMI is highest for Italians. Therefore, great care should be taken when combining self-reported data from studies in different countries, since regional differences may influence the results.

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