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Self-Reported Versus Measured Height and Weight in Hispanic and Non-Hispanic Menopausal Women

Marcio L. Griebeler, M.D.,[1] Silvina Levis, M.D.,[1,2] Laura Muñoz Beringer, M.D.,[2]
Walid Chacra, M.D.,[1] and Orlando Gómez-Marín, Ph.D.[1,3]

Abstract

Background: Height and weight information is commonly used in clinical trials and in making therapeutic decisions in medical practice. In both settings, the data are often obtained by self-report. If erroneous, this practice could lead to inaccuracies in estimating renal function and medication doses or to inaccurate outcomes of research studies. Previous publications have reported lack of reliability of self-reported weight and height in the general population but have not addressed age-specific and ethnicity-specific subgroups in the U.S. population. The inaccuracy of self-reported weight and height could be particularly significant in times of considerable changes in body weight, such as at menopause, which is often associated with weight gain.
Methods: We assessed the validity of self-reported height and weight in 428 women within the first 5 years of menopause, 70.6% of whom were Hispanic.
Results: Participants overestimated their height by 2.2 ± 3.5 cm (mean ± standard deviation [SD]) and underestimated their weight by 1.5 ± 2.9 kg. As a group, based on self-reported measures, 33.3% were misclassified with respect to body mass index (BMI) category, and the difference between measured BMI and self-reported BMI was similar between Hispanic white and non-Hispanic white women, positively related to measured weight, and inversely related to measured height, years from menopause, and multiple parity.
Conclusions: From the public health perspective, inaccurate self-report could lead to a considerable underestimation of the current obesity prevalence rates. In our study population, the prevalence of obesity (BMI $\geq 30\,kg/m^2$) was 6.3% based on self-reported values and 18% based on measured height and weight, representing a 3-fold underestimation.

Introduction

Anthropometric measures, such as height, weight, and body mass index (BMI) are vital in daily clinical practice. They are used to make important clinical decisions such as adjustments of medication doses, calculation of kidney function, and estimation of water deficits in hyperosmolar states. In both outpatient and inpatient settings, self-reported values are often used instead of measured weight and height. Because of the possible inaccuracy of self-reported measures, this practice could cause erroneous calculations, incorrect medical decisions, and adverse consequences for patients.

Many clinical and epidemiological studies report height, weight, and BMI among the characteristics of the participants and use these variables in the analyses. Instead of measuring height and weight, some studies rely on self-reported height and weight and do not verify the accuracy of these self-reported measures.[1–5] Although this approach has the advantage of practicality and low cost, as the information can be taken during screening surveys, face-to-face or telephone interviews, or through self-administered questionnaires, it could lead to erroneous conclusions for the population or intervention being studied.[6–9] Thus, the accuracy and validity of self-reported anthropometric measures in clinical practice and in research studies are currently being questioned.[1–3]

Weight gain is one of the many changes women experience in the first years of menopause.[10,11] The inaccuracy of self-reported weight could be particularly significant in times of considerable changes in body weight, such as menopause. In addition to inaccuracy, self-reported data are subject to bias, which might be associated with a multitude of participants' characteristics, such as age, degree of obesity, and social and cultural values.[5–10] For example, there is a tendency to try to attain a socially valued appearance of the body, which may vary according to the

[1]Department of Medicine, University of Miami Miller School of Medicine, Miami, Florida.
[2]Geriatric Research, Education and Clinical Center, Miami Veterans Affairs Healthcare System, Miami, Florida.
[3]Departments of Epidemiology & Public Health and of Pediatrics, University of Miami Miller School of Medicine, Miami, Florida.

cultural or social expectations of a particular group.[12–14] The goal of the present study was to assess the validity and accuracy of self-reported height and weight in a multiethnic group of postmenopausal women living in South Florida.

Materials and Methods

This is a retrospective analysis of data collected during the telephone interview and the first clinic visit of menopausal women living in Miami-Dade County, Florida, who volunteered to participate in the study of Soy Phytoestrogens As Replacement Estrogen (the SPARE study), a clinical trial testing the effectiveness of soy isoflavones in preventing bone loss during the first 5 years of menopause or after discontinuing estrogen therapy.[15] From July 2004 to March 2007, approximately 4200 women who responded to advertisements and mailings promoting the SPARE study were screened by telephone. During the telephone interview, study staff explained the purpose of the study and collected information on medical history, demographic characteristics, and self-reported weight and height. Weight and height were reported in the responder's unit of choice, either metric or U.S. standard. The 956 women who satisfied the study's initial eligibility criteria and indicated interest in participating in the study were invited to the first clinic visit. A total of 524 women attended this visit during which trained health technicians obtained vital signs and measured height and weight. Height was measured using a standard stadiometer with the participant wearing no shoes, and it was recorded to the nearest centimeter. Weight was measured using an electronic scale that was calibrated periodically, and it was recorded to the nearest 100 g. During weighing, the participants wore light clothes and no shoes; no adjustments in weight were done for clothing. Included in this report are results from the 428 women with complete information from both the telephone interview and the initial screening clinic visit.

Statistical analysis

Reported herein are descriptive statistics of participants' characteristics such as age, primary language, marital status, race, ethnicity, smoking history, alcohol consumption history, parity, and comorbid conditions of interest (cardiovascular disease [CVD], diabetes, hypertension, hyperlipidemia, and thyroid disease/disorder). Data are reported and analyzed for the entire group and also for age-specific and race-specific subgroups, with emphasis on the comparisons of Hispanics vs. non-Hispanics. Chi-square tests were used to assess association between discrete variables; paired sample *t* tests were used to assess differences between self-reported and measured continuous variables, such as height, weight, and BMI, and independent samples *t* tests were used to compare means of continuous variables with normal or approximately normal distributions. Pearson correlation analyses were used to assess and measure the strength of the association between self-reported and measured variables.

Error was defined as:

$$\text{Height error} = [\text{measured height (m)} - \text{self-reported height (m)}]$$

$$\text{Weight error} = [\text{measured weight (kg)} - \text{self-reported weight (kg)}]$$

Separate simple linear regression models were used, with Error as the dependent variable and independent variables such as reported weight, reported height, age at time of visit, parity, years of menopause, race, CVD, diabetes, and hypertension. The next step in the analyses involved consideration of multivariate linear regression models, with Error as the dependent variable and the same group of independent variables. Finally, a stepwise linear regression approach was used, and the results confirmed the findings of the multivariable linear models. Statistical analyses were performed using the professional version of Statistix 9.2 (Tallahassee, FL) and SAS (Cary, NC). All analyses were carried out using two-sided tests at the 5% significance level.

Results

Characteristics of participants

The age of the participants ranged from 45 to 60 years, with a mean ± standard deviation (SD) of 52.13 ± 3.36 years; 53.0% were between the ages of 50 and 54, and 70.6% were Hispanic white. Ethnic-specific frequency distributions of baseline characteristics are shown in Table 1. Hispanic whites and non-Hispanic whites had similar baseline characteristics except for

Table 1. Ethnic-Specific Frequency Distribution of Characteristics Among Soy Phytoestrogens As Replacement Estrogen Study Participants

	Ethnicity		
Characteristic	*Hispanic* (n = *302*) n (%)	*Non-Hispanic* (n = *126*) n (%)	p *value*[a]
Age group at visit			0.137
45–49	70 (23.2)	26 (20.6)	
50–54	166 (55.0)	61 (48.4)	
55–60	66 (21.9)	39 (31.0)	
Primary language			< 0.001
English	34 (11.3)	109 (86.5)	
Spanish	266 (88.1)	1 (0.8)	
Other	2 (0.7)	16 (12.7)	
Marital status			0.416
Divorced or separated	80 (26.5)	36 (28.6)	
Married	168 (55.6)	74 (58.7)	
Other	54 (17.9)	16 (12.7)	
Race			< 0.001
White	297 (98.3)	89 (70.6)	
Black	4 (1.3)	30 (23.8)	
Asian	0 (0.0)	7 (5.6)	
Other	1 (0.3)	0 (0.0)	
Smoking history			0.571
Never	196 (64.9)	81 (64.3)	
Current	45 (14.9)	15 (11.9)	
Previous	61 (20.2)	30 (23.8)	
Alcohol use			< 0.001
Never	218 (72.2)	69 (54.8)	
1–2 drinks/day	84 (27.8)	57 (45.2)	
Parity			0.240
Nulliparius	27 (8.9)	18 (14.3)	
Parity 1–2	116 (38.4)	48 (38.1)	
Parity ≥ 3	159 (52.6)	60 (47.6)	

[a]Chi-square test of association.

Table 2a. Measured and Self-Reported Anthropometric Characteristics of Study Participants ($n=428$)

	Hispanic (n=302) Measurement[a]			Non-Hispanic (n=126) Measurement[a]		
Characteristic	*Measured*	*Self-reported*	*Difference (95% CI)*	*Measured*	*Self-reported*	*Difference (95% CI)*
Weight (lbs)	146.34 ± 20.68	143.24 ± 20.09	3.10 ± 5.89 (2.44-3.77)	148.09 ± 23.59	145.08 ± 22.22	3.01 ± 7.76 (1.65-4.38)
Height (in)	62.16 ± 2.30	63.14 ± 2.40	− 0.98 ± 1.37 (− 1.13-− 0.82)	64.26 ± 2.50	64.89 ± 2.73	− 0.64 ± 1.33 (− 0.87-− 0.40)
Weight (kg)	66.44 ± 9.39	64.89 ± 9.10	1.55 ± 2.67 (1.25-1.85)	67.23 ± 10.71	65.72 ± 10.07	1.51 ± 3.52 (0.89-2.13)
Height (cm)	157.89 ± 5.84	160.37 ± 6.11	− 2.48 ± 3.47 (− 2.87-− 2.09)	163.22 ± 6.34	164.83 ± 6.92	− 1.62 ± 3.37 (− 2.21-− 1.02)
BMI (kg/m^2)	26.63 ± 3.29	25.22 ± 3.13	1.41 ± 1.51 (1.24-1.58)	25.25 ± 3.85	24.21 ± 3.51	1.05 ± 1.64 (0.76-1.33)

[a]Mean ± standard deviation (SD).
BMI, body mass index; CI, confidence interval.

Table 2b. Mean Body Mass Index Error (Measured− Self-Reported BMI) and 95% Confidence Interval, by Measured Body Mass Index Category and Age Group

Category	n	*Total* (n=428)	n	*Hispanic* (n=302)	n	*Non-Hispanic* (n=126)
Measured BMI, kg/m^2						
< 20	10	0.18 ± 0.75 (− 0.36-0.71)	2	0.41 ± 0.86[a]	8	0.12 ± 0.78 (− 0.53-0.77)
20–25	154	0.80 ± 1.38 (0.58-1.02)	96	0.90 ± 1.18 (0.66-1.14)	58	0.62 ± 1.66 (0.18-1.06)
25–30	189	1.36 ± 1.50 (1.14-1.57)	148	1.38 ± 1.49 (1.14-1.63)	41	1.27 ± 1.54 (0.79-1.76)
> 30	75	2.36 ± 1.56 (2.01-2.72)	56	2.40 ± 1.62 (1.97-2.84)	19	2.24 ± 1.38 (1.58-2.91)
Age, years						
45–49	96	1.21 ± 1.41 (0.92-1.49)	70	1.33 ± 1.37 (1.00-1.65)	26	0.87 ± 1.50 (0.27-1.48)
50–54	227	1.29 ± 1.60 (1.08-1.50)	166	1.37 ± 1.60 (1.12-1.61)	61	1.08 ± 1.59 (0.68-1.49)
≥ 55	105	1.43 ± 1.60 (1.12-1.74)	66	1.62 ± 1.43 (1.27-1.97)	39	1.10 ± 1.84 (0.50-1.69)

[a]CI not calculated because of very small sample size, $n=2$.

race, primary language, and alcohol use. For analysis purposes, the small number of women with ≥ 8 years of menopause ($n=13$, or 3%) were coded as 8 years of menopause. There was no statistically significant difference in the average of years of menopause between Hispanics (2.3 ± 1.7) and non-Hispanics (2.5 ± 2.1, $p=0.231$). The proportion of women with self-reported history of comorbid conditions (data not shown) was very low and not significantly different between groups, except for CVD (Hispanics 0.7% vs. non-Hispanics 4.0%, $p=0.014$).

Weight, height, and BMI Error

On average, weight was underestimated by 3.1 ± 6.5 lbs (1.5 ± 2.9 kg), and height was overestimated by 0.88 ± 11.4 in (2.2 ± 3.5 cm). This translated into an underestimation of BMI by 1.3 ± 1.6 kg/m^2. Ethnic-specific means for measured and self-reported values, and their difference (Error), are shown in Table 2a. There were no statistically significant differences with respect to these variables between Hispanics and non-Hispanics. Table 2b shows the mean differences in BMI calculated from self-reported and measured values, categorized by BMI from measured values (< 20, 20–24.9, 25–29.9, ≥ 30 kg/m^2) and by age (45–49, 50–54, > 55 years). As BMI calculated from measured height and weight increased, the BMI Error (difference between measured and self-reported BMI) increased, although not significantly, independently of ethnicity. Similarly, the BMI Error also increased with increasing age, but the rate of change was not statistically significant either before or after adjusting for measured BMI.

Self-reported vs. measured BMI

Table 3 shows a cross-tabulation of standard categories of self-reported and measured BMI, revealing the degree of misclassification that can occur from using self-reported measures. Overall, 66.6% of the women were accurately classified into their respective BMI categories, as shown in the highlighted areas. The numbers above the main diagonal (the diagonal from the upper left corner to the lower right corner of the table) represent the number and corresponding percentage of women who were classified as having a BMI greater than the true value, and the numbers below the main diagonal represent those women who were classified as having a BMI smaller than the true value. As a result of underestimating their weight and overestimating their height, if using self-reported measures, approximately 31.5% ($n=135$) of the women would be classified into a lower BMI category. The prevalence of obesity (BMI ≥ 30 kg/m^2) based on self-reported values was 5.6%, whereas based on measured values, it was 17.5%.

Predictors of Error

Linear regression models to assess predictors of Error included independent variables, such as comorbidities (CVD, diabetes, hypertension, hyperlipidimia), and participants' characteristics (measured and reported weight; measured and reported height; age groups: 45–49 years used as reference category, 50–54 years and 55 years or older; race; parity groups: nulliparous used as reference category, 1–2 pregnancies, and ≥ 3 pregnancies; years of menopause; smoking; alcohol use). Of interest, none of the comorbid conditions attained statistical significance in any of the univariate or multivariate models

Table 3. Cross-Tabulation of Measured and Self-Reported Categories of Body Mass Index

	Reported BMI[a]				
Actual BMI	*<20*	*20–24.9*	*25–29.9*	*≥30*	*Total*
<20	9 (90.0)	1 (10.0)	0 (0.0)	0 (0.0)	10
20–24.9	15 (9.7)	137 (89.0)	2 (1.3)	0 (0.0)	154
25–29.9	0 (0.0)	64 (33.9)	120 (63.5)	5 (2.6)	189
≥30–35	0 (0.0)	0 (0.0)	56 (74.7)	19 (25.3)	75
Total	24	202	178	24	428

[a]*n* (row %).

considered. This was most probably due to the low proportion of women with comorbidities in this study.

As shown in Table 4, using multiple linear regression models, after adjusting for the remaining variables in the model, significant predictors of Error Weight included measured weight ($p<0.001$), years of menopause ($p=0.013$), and parity (compared with nulliparous women, those with 1–2 pregnancies ($p=0.034$) and those with ≥3 pregnancies $p=0.018$). In this model, measured height was marginally significant, with a p value of 0.062. As also shown in Table 4, significant predictors of Error Height were measured weight ($p=0.016$) and measured height ($p<0.001$).

Discussion

This is the first study to report the accuracy of BMI from self-reported weight and height in the South Florida female population, comparing the differences between Hispanics and non-Hispanics. Previous studies evaluating BMI misclassification have reported their findings from the general population, all ethnic groups combined. Worldwide, the validity of self-reported height and weight is inconsistent. Although studies from some countries estimate that self-report is a valid and accurate method,[10,16,17] others consider it unreliable.[1,3,18,19] An assessment of the U.S. population in the National Health and Nutrition Examination Survey (NHANES) II determined that self-reported BMI in Mexican Americans significantly underestimated the true prevalence of overweight and obesity independently of other variables.[4] Our results in South Florida menopausal women show an underestimation of weight and overestimation of height, with no significant differences between Hispanic and non-Hispanic women.

Our study shows that measured and reported height and weight are highly correlated, as previously cited in the literature.[1,5,21] Also in accordance with previous reports, our data show a tendency to overestimate height and underestimate weight, which, taken together, translates into an underestimation of BMI. A literature review of 64 citations of both observational and experimental studies in an adult population over the age of 18 years found an overall trend of underestimating weight and BMI and overestimating height.[2]

For our study population, the prevalence of overweight (BMI 25–29.9 kg/m^2) and obesity (BMI ≥30 kg/m^2) was underestimated in 34% and 75% of the cases, respectively. To further understand some of the dynamics involved in the differences observed, we found that as true BMI or age increased, so did the differences between measured and reported values. This finding is in agreement with previous reports showing that weight and height affect self-reporting of the corresponding values and that overweight status (based on measured BMI) affects the self-reporting of both values.[1] Possible explanations for underestimating weight and overestimating height may include recall bias and inaccurate information, as stature declines with age in older persons.[4] Although a group of U.S. women of reproductive age accurately reported their height and weight,[20] the increasing error of reported measures in older adults is not a unique finding and has been consistently reported in other studies.[5,22–24]

There are some limitations to our study. First, this report represents a small and selective group in the South Florida population, that is, menopausal women who volunteered for a clinical trial. Although the participants reflect the general

Table 4. Multivariate Linear Regression Models of Error Weight and Error Height on Various Independent Variables

	Error Weight (kg)[a]			*Error Height (m)*[b]		
Variable	β ± *SE*(β)	*95% CI* (β)	p *value*	β ± *SE*(β)	*95% CI* (β)	p *value*
Constant	3.68 ± 3.82	(−381-11.17)	0.336	−0.2031 ± 0.0458	(−0.2829-−0.1133)	<0.001
Measured weight (kg)	0.10 ± 0.02	(0.06-0.14)	<0.001	−0.0004 ± 0.0002	(0.0000-0.0008)	0.016
Measured height (m)	−4.67 ± 2.51	(−9.59-0.25)	0.062	0.1315 ± 0.0300	(0.0727-0.1903)	<0.001
Age at first visit						
Gp0 (45–49)	Reference category			Reference category		
Gp1 (50–54)	0.44 ± 0.34	(−0.23-1.11)	0.199	0.0038 ± 0.0041	(−0.0118-0.0042)	0.355
Gp2 (≥55)	0.15 ± 0.42	(−0.67-0.97)	0.714	−0.0085 ± 0.0050	(−0.0183-0.0013)	0.089
Parity						
Gp0 (nulliparous)	Reference category			Reference category		
Gp1 (1–2 pregnancies)	−1.01 ± 0.47	(−1.93-−0.09)	0.034	−0.0005 ± 0.0057	(−0.0107-0.0117)	0.931
Gp2 (≥3 pregnancies)	−1.10 ± 0.46	(−2.00-−0.20)	0.018	0.0037 ± 0.0056	(−0.0073-0.0147)	0.509
Years of menopause[c]	−0.19 ± 0.08	(−0.35-−0.03)	0.013	0.0006 ± 0.0009	(−0.0011-0.0024)	0.498
Ethnicity[d]	−0.13 ± 0.33	(−0.78-0.52)	0.680	−0.0031 ± 0.0039	(−0.0045-0.0107)	0.435

[a]Error Weight (kg) = measured weight (kg) − reported weight (kg).
[b]Error Height = measured height (m) − reported height (m).
[c]Years of menopause, actual number of years if ≤7; 8 if ≥8.
[d]Ethnicity, 1 = Hispanic, 0 = non-Hispanic.

female South Florida population in this age group, these results may not be applicable to other populations, such as men and premenopausal women. Additionally, some of the participants were recent immigrants from Central and South America where the metric system is commonly used, compared to the U.S. Standard used in the United States. This might have caused an error in their conversion and, thus, a reporting error. Other factors that may have introduced a source of error are the time elapsed between the self-report during the telephone interview and the clinic visit when the measurements were taken, which varied from 2 weeks to up to 3 months, and the possibility that participants estimated their weight without their clothes, whereas at the clinic visit, their weight was taken without shoes but with light clothes on.

Conclusions

Among South Florida menopausal women, self-reported weight and height could be a quick and practical method to estimate BMI. In this group, however, the accuracy of self-reported BMI was only 66%. The difference between measured BMI and self-reported BMI was similar between Hispanic white and non-Hispanic white women, positively related to measured weight, and inversely related to measured height, years from menopause, and multiple parity. From the public health perspective, inaccurate self-report could lead to a considerable underestimation of the current obesity prevalence rates.[2,7,25,26] In our study population, the prevalence of obesity based on self-reported values was 6.3% and based on measured height and weight was 18%, representing a 3-fold underestimation.

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Disclosure Statement

The authors report no competing financial interests.

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Address correspondence to:
Silvina Levis, M.D.
University of Miami Miller School of Medicine
PO Box 016960 (D-503)
Miami, FL 33101

E-mail: slevis@med.miami.edu