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Self-Reported vs Measured Body Mass Indices in Migraineurs

Michael J. Katsnelson, MD, B. Lee Peterlin, DO, Andrea L. Rosso, MPH, Guillermo M. Alexander, PhD, and Kirsten L. Erwin, BS

Department of Neurology, Drexel University College of Medicine, Philadelphia, PA, USA (M.J. Katsnelson, B.L. Peterlin, G.M. Alexander, K.L. Erwin, and A.L. Rosso); Department of Pharmacology and Physiology, Drexel University College of Medicine, Philadelphia, PA, USA (B.L. Peterlin and G.M. Alexander)

Abstract

Objective—To compare and contrast body mass indices calculated based on self-reported height and weight as compared with measured height and weight in migraine patients.

Background—Obesity is a risk factor for multiple neurological disorders including stroke, dementia, and migraine chronification. In addition, several cytokines and adipocytokines associated with migraine are modulated by body mass. The body mass index (BMI) is a commonly used anthropometric measure to estimate total body fat and is often calculated based on patient's self-reported height and weight.

Methods—This was a retrospective study evaluating consecutive migraine patients presenting to a headache clinic. Demographic characteristics and self-reported height and weight were obtained from a standardized questionnaire that each new patient completes upon presentation to the clinic. In addition, as depression has been shown to be associated with both migraine and obesity, information in regards to major depression utilizing the Patient Healthcare Questionnaire-9 was extracted as well. Following completion of the questionnaire, body mass indices are routinely measured, with height measured to the nearest 0.5 inch utilizing a mounted stadiometer, and weight measured with a standard scale to the nearest 0.5 lb. After this information was extracted from the charts, BMI was then calculated for both self-reported and measured body mass indices. Using the measured body mass indices as a standard, this was then compared and contrasted to the patient's self-reported body mass indices.

Results—A total of 110 patients were included in the study. Patients were predominantly female (91%) with a mean age of 38.6 ± 11.6 years. Of the total patients included, no significant difference in self-reported height (mean 64.7 ± 3.1 inches) as compared with measured height (mean 64.5 ± 3.4 inches) was seen, $P = .463$. However, self-reported weight (169 ± 41.3) was underestimated as compared with the measured weight (173.5 ± 43.2), $P = .001$. And, the self-reported BMI (28.4 ± 6.8) was significantly less than the measured BMI (29.4 ± 7.5), $P < .001$.

Conclusions—In our study, the self-reported mean weight and BMI for migraineurs was significantly less than the measured mean weight and BMI, and was of greater magnitude in the obese migraineurs. This suggests that conclusions drawn from studies evaluating obesity utilizing self-reported BMI in migraineurs may undercall the effect of total body obesity.

Keywords

headache; migraine; chronic daily headache; adiponectin; obesity; body mass index

Migraine and obesity are both prevalent and potentially disabling disorders in the American population.¹⁻⁴ The number of adults who have reported increased weight and who are considered obese has grown steadily in the past several decades in the United States, with 1 in 3 considered overweight and an additional 1 in 4 considered obese.⁵ With almost two-thirds of adults in one of these 2 categories, the economic costs and the negative impact on the quality of life have sky rocketed in recent years.⁶⁻⁹ Various studies have linked obesity with a number of medical conditions (hypertension, diabetes, dyslipidemia), neurological disorders (migraine, dementia, narcolepsy), and chronic pain syndromes (back pain, neck pain, fibromyalgia).¹⁰⁻¹³

Specifically with regards to migraine, obesity has been shown to be associated with chronification.¹⁴ Recent studies have demonstrated a possible subcellular link between migraine and adipose tissue. Adipose tissue has been shown to secrete a variety of cytokines including interleukin (IL)-6 and tumor necrosis factor- α (TNF- α), as well as adipocytokines, such as adiponectin, which have been linked to migraine.¹⁵⁻¹⁷ Adipose tissue derived cytokines and adipocytokines may contribute to the neurogenic inflammatory state of migraine as well as the chronic low grade inflammation seen in obesity. And, IL-6, TNF- α , and adiponectin have all been shown to be modulated by body mass.¹⁵⁻¹⁷

The body mass index (BMI) is a commonly used anthropometric measure to estimate total body fat, and is calculated from a patient's weight and height. Given the increasing relevance of the BMI to overall health as well as in association to neurological disorders, these measurements are becoming increasingly important to gather and analyze. These data can be collected subjectively (relying on self-reporting of patients) or objectively (anthropometric measurements taken in the office). Self-reporting possesses the advantage of being quickly accomplished and easily administered with no special equipment or personnel needed. On the other hand, patients' recollections might be faulty, or the responses intentionally skewed in a socially desirable direction. Objectively measured height and weight data can help avoid these shortcomings. However, the process is more time-consuming, requires additional resources of staff and equipment, and some patients might object to being measured altogether. This study was designed to compare and contrast body mass indices as calculated based on self-reported height and weight as compared with measured height and weight in migraineurs evaluated in the outpatient clinic setting.

METHODS

This was a retrospective, chart review study. It was approved by the Drexel University College of Medicine institutional review board. Migraine patients between the ages of 18 and 65 years old who were evaluated during January 2007 to February 2008 at an outpatient headache center and who fulfilled criteria for migraine, chronic migraine (CM), or medication overuse headache (MOH) according to the Second Edition of the International Classification of Headache Disorders (ICHD-2), were included in the study.¹⁸ Demographic characteristics (including age, gender, race, marital status, education, and total household income), depression history (Patient Healthcare Questionnaire [PHQ-9]), and self-reported height and weight were obtained from a standardized questionnaire that each new patient completed upon presentation to the clinic. After completion of the questionnaire, vitals signs including height and weight were measured. Characteristics of the groups are presented in Table 1.

Based on their diagnoses, migraine participants were divided into the following groups: (1) men as compared with women; (2) chronic daily headache (CDH) sufferers with an ICHD-2 code of probable MOH or CM, as compared with episodic migraineurs with an ICHD-2 code of migraine with or without aura;¹⁸ (3) obese (BMI ≥ 30) migraineurs as compared with nonobese migraineurs (BMI < 30); and (4) depressed migraineurs (PHQ ≥ 15) as compared with nondepressed migraineurs (PHQ < 15).

Total Body Obesity Estimation Utilizing BMI

Height was measured to the nearest 0.5 inch with a mounted stadiometer. Weight was measured with a standard scale to the nearest 0.5 lb. BMI was then calculated using the formula: $BMI = \text{weight [lbs]} / \text{height}^2 \times 703$, and categorized on the basis of the World Health Organization categories: < 18.5 (underweight), 18.5–24.9 (normal weight), 25–29.9 (overweight), and $\geq 30 \text{ kg/m}^2$ (obese).¹⁹

Measurement of Depression (PHQ-9)

It is well described that migraine and obesity are associated with depression.^{20–22} Thus, all participants were evaluated for major depression using the PHQ-9. The PHQ-9 is a self-reported diagnostic measure for current depression that utilizes the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria. It was derived from the PHQ of the PRIME-MD (Pfizer Inc., New York, NY, USA) and has been shown to have superior validity criterion for the diagnosis of major depressive disorder as compared with other established depression scores.²³ A study has shown that a score of ≥ 15 on the PHQ-9 is associated with a 68% sensitivity and 95% specificity in diagnosing “major depressive disorder” using the DSM-IV criteria.²⁴ Thus, major depression was defined as a score ≥ 15 on the PHQ-9 in our study’s participants.

Statistical Analysis

Statistical analyses were carried out using SPSS, version 15 (SPSS Inc., Chicago, IL, USA). All data were presented as mean $\pm$ standard deviation (SD) where appropriate. For demographic and body mass indices, migraine groups were compared using chi-square tests for categorical variables and independent *t*-tests for continuous variables. Self-reported body mass indices were compared with measured indices by McNemar test for categorical variables and paired *t*-tests for continuous variables. Differences in self-reported and measured indices were compared for those with or without obesity or depression by independent *t*-tests.

RESULTS

A total of 110 patients were included in the study and were predominantly female (91%) with a mean age of 38.6 years (SD 11.6). There was no significant difference in demographic characteristics between groups with the exception of depression. A total of 29.5% of CDH as compared with 9.1% of episodic migraine (EM) patients fulfilled criteria for depression based on the PHQ-9, $P < .005$. Complete demographic characteristics are summarized in Table 1.

Of the total patients included in the study, no significant difference in regards to self-reported height (mean 64.7 inches $\pm$ 3.1) as compared with measured height (mean 64.5 inches $\pm$ 3.4) was seen, $P = .463$. However, self-reported weight (169.0 $\pm$ 41.3) was underestimated as compared with the measured weight (173.5 $\pm$ 43.2), $P = .001$. And, the self-reported BMI (28.4 $\pm$ 6.8) was significantly less than the measured BMI (29.4 $\pm$ 7.5), $P < .001$. Of the total patients, 36.3% (37/102) were identified as having a BMI ≥ 30 when BMI was calculated utilizing the self-reported height and weight, while 40.4% (41/102)

were identified as having a BMI ≥ 30 when utilizing the measured height and weight, $P = .39$ (see Table 2). Thus, the overall sensitivity of identifying those who were obese by self-report in this study was 80.5% and the overall specificity of identifying those who were not obese by self-report was 93.4%.

Of the men (10/110) included in the study, there was no significant differences in the self-reported vs measured height, weight, or BMI. Of the 100 women included, although there was no statistical difference between self-reported height (mean 64.3 inches $\pm$ 2.7), as compared with the measured height (mean 64.2 inches $\pm$ 2.9, $P = .415$), a significant difference was seen in regards to reported vs measured weight, with a mean self-reported weight of 168.6 lbs $\pm$ 42.1 as compared with a mean measured weight of 173.3 lbs $\pm$ 44.1, $P < .001$. In addition, the self-reported BMI for female participants (mean 28.7 $\pm$ 6.8) was significantly less as compared with the measured BMI (mean 29.6 $\pm$ 7.1), $P < .001$. However, no significant difference was seen in those women with a BMI ≥ 30 measure whether self-reported or measured, $P < .21$.

We obtained similar results comparing and contrasting self-reported vs measured body mass indices when the groups were divided as episodic migraineurs and chronic daily headache sufferers. Episodic migraineurs had an average self-reported height of 64.91 inches $\pm$ 3.33 as compared with 64.78 inches $\pm$ 3.55 when it was measured (not significant [NS]); and they had a self-reported weight on average of 172.37 lbs $\pm$ 42.38 as compared with a measured weight of 177.34 lbs, $P = .004$. Chronic daily migraineurs self-reported their height on average as 64.40 inches $\pm$ 2.72, as compared with 64.22 inches $\pm$ 3.15 when it was measured (NS); and they self-reported their weight on average as 164.54 lbs $\pm$ 39.60 while the actual measured weight was 167.66 pounds $\pm$ 41.97, $P = .001$. The self-reported average BMI for episodic migraineurs was 28.8 $\pm$ 6.8 while the measured BMI for episodic migraineurs was 29.8 $\pm$ 7.6, $P = .01$. The self-reported average BMI for CDH migraineurs was 27.8 $\pm$ 6.8 and the measured was 28.7 $\pm$ 7.3, $P = .05$. There were no significant differences between self-reported and measured body mass indices between these 2 groups (see Table 1).

Groups were also divided as obese and nonobese migraineurs. Neither group showed a significant difference in regards to self-reported and measured height. In the nonobese migraineurs, self-reported weight was significantly less than measured weight by a mean difference of 2.5 lbs $\pm$ 5.3, $P = .001$. In obese migraineurs, the mean difference between self-reported and measured weight was 6.4 lbs $\pm$ 12.9, $P = .003$. Although in nonobese migraineurs the self-reported as compared with measured BMI was not significantly different, with a mean difference of 0.3 $\pm$ 1.4, in obese migraineurs the mean difference between self-reported and measured BMI was 1.9 $\pm$ 4.0, $P = .003$. The mean differences between the obese as compared with nonobese migraineurs were not significant for height and weight, but were for BMI, $P = .014$.

Lastly, there were no significant differences between measured and reported body mass indices between those who had depression and those who did not.

DISCUSSION

Given the recent reports of possible links between obesity and headache pathogenesis and chronification, estimating total body fat in headache sufferers quickly and accurately has become increasingly important in both translational and epidemiological migraine research.^{15–17} BMI is a commonly used anthropometric measure often utilized to estimate obesity. Previous studies have analyzed the trends and accuracy of self-reporting of height and weight in different subgroups, with their results varying depending on which subpopulation was being studied.^{25–27} A meta-analysis by Gorber et al analyzed 64 studies

evaluating self-reported vs measured anthropometric measures in various populations, including general populations, college students, athletes, military recruits, and different ethnicities. Of the 14 studies that provided combined-sex comparisons, 12 of the 14 showed that participants underreported their weight as compared with the measured weight. The rest of the studies contrasted body mass indices based on gender, with 27 out of 34 male and 24 out of 27 female studies finding subjects to have underreported their weight. Similarly, the majority of studies also showed that participants overestimated height.²⁷ Finally, 9 of the 11 studies comparing self-reported with measured BMI calculations found that the self-reported BMI was an accurate or underestimated interpretation of the measured BMI.

Similarly, we found that BMI calculations based on self-reported body mass indices in migraineurs result in statistically significant underreporting of their BMI as compared with BMI calculations based on measured indices. And this difference is most significantly attributed to the underestimation of self-reported weight as compared with the measured weight, because no significant difference was found in self-reported vs measured height. These findings suggest that self-reported body mass indices tend to undercall total body fat in headache sufferers as estimated based on the BMI and that it is of greater magnitude in obese migraineurs as compared with nonobese migraineurs.

The main limitation of our study was a relatively small sample size of male migraineurs. In addition, as the participants of our study have access to regular health care, it is possible that clinic-based populations may be more accurate than headache sufferers in the general population in regards to self-reporting their height and weight. Thus, it is possible that population-based studies may find an even greater disparity between measured and reported body mass indices.

CONCLUSION

In our study, migraineurs underestimated their weight and total body fat as estimated by the BMI and this was most significant in obese migraineurs as compared with nonobese migraineurs. This suggests that studies utilizing self-reported height and weight to estimate total body fat, utilizing the BMI, may undercall the significance of their findings.

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Table 1

Demographic and Clinical Characteristics

	All (n = 110)	Episodic migraine (n = 66)	Chronic daily headache (n = 44)	P value
Mean age $\pm$ SD (years)	38.6 $\pm$ 11.6	39.5 $\pm$ 11.9	37.2 $\pm$ 10.9	.308
Race (n = 105)				.512
White (%)	66 (60.0)	39 (59.1)	27 (61.4.9)	
Black (%)	14 (12.7)	7 (10.6)	7 (2.3)	
Hispanic (%)	24 (21.8)	17 (25.8)	7 (2.3)	
Other (%)	2 (2.0)	3 (4.50)	0 (0)	
Gender				.498
Male (%)	10 (9.1)	5 (7.6)	5 (11.4)	
Female (%)	100 (90.9)	61 (92.4)	39 (88.6)	
Marital status (n = 107)				.392
Single (%)	43 (39.1)	24 (36.4)	19 (43.2)	
Married (%)	52 (47.3)	31 (47.0)	21 (47.7)	
Separated (%)	8 (7.3)	5 (7.6)	3 (6.8)	
Divorced/Widowed (%)	6 (5.5)	5 (7.6)	1 (2.3)	
PHQ-9 depression (%)	19 (17.3)	6 (9.1)	13 (29.5)	.005
Education (n = 108)				.295
<High school (%)	10 (9.2)	4 (6.1)	6 (14.0)	
High school (%)	45 (41.7)	25 (38.5)	20 (46.5)	
College (%)	37 (34.3)	26 (40.0)	11 (25.6)	
Post graduate (%)	16(14.8)	10 (15.4)	6 (13.9)	
Mean self-reported height $\pm$ SD (n = 107)	64.70 $\pm$ 3.10	64.91 $\pm$ 3.33	64.40 $\pm$ 2.72	.40
Mean office height $\pm$ SD (n = 109)	64.55 $\pm$ 3.39	64.78 $\pm$ 3.55	64.22 $\pm$ 3.15	.40
Mean self-reported weight $\pm$ SD (n = 102)	169.04 $\pm$ 41.33	172.37 $\pm$ 42.38	164.54 $\pm$ 39.60	.35
Mean office weight $\pm$ SD (n = 109)	173.52 $\pm$ 43.15	177.34 $\pm$ 43.80	167.66 $\pm$ 41.97	.25
Mean BMI (kg/m ²) $\pm$ SD (n = 109)	29.4 $\pm$ 7.5	29.8 $\pm$ 7.6	28.7 $\pm$ 7.3	.45
BMI 30%	40.4	42.4	37.2	.588
Mean self-reported BMI (kg/m ²) $\pm$ SD (n = 102)	28.4 $\pm$ 6.8	28.8 $\pm$ 6.8	27.8 $\pm$ 6.8	.48
Self-reported BMI 30% (n = 102)	36.3	38.7	32.5	.52

BMI, body mass index; SD, standard deviation.

Table 2

Analysis of Self-Reported vs Measured Body Mass Indices

	Self-reported	Measured	<i>P</i> value
Female			
Height $\pm$ SD (n = 96)	64.3 $\pm$ 2.7	64.2 $\pm$ 2.9	.415
Weight $\pm$ SD (n = 92)	168.6 $\pm$ 42.1	173.3 $\pm$ 44.1	<.001
BMI $\pm$ SD (n = 92)	28.7 $\pm$ 6.8	29.6 $\pm$ 7.1	<.001
BMI 30% (n = 92)	38.0 (n = 35)	42.4% (n = 39)	.344
Male			
Height $\pm$ SD (n = 10)	68.4 $\pm$ 4.1	68.1 $\pm$ 5.4	.855
Weight $\pm$ SD (n = 10)	172.8 $\pm$ 35.2	175.5 $\pm$ 34.7	.166
BMI $\pm$ SD (n = 10)	26.2 $\pm$ 10.4	27.6 $\pm$ 10.5	.487
BMI 30% (n = 10)	20.0 (n = 2)	20.0 (n = 2)	1.0
All			
Height $\pm$ SD (n = 106)	64.7 $\pm$ 3.1	64.5 $\pm$ 3.4	.463
Weight $\pm$ SD (n = 102)	169.0 $\pm$ 41.3	173.5 $\pm$ 43.2	.001
BMI $\pm$ SD (n = 102)	28.4 $\pm$ 6.8	29.4 $\pm$ 7.5	<.001
BMI 30% (n = 102)	36.3 (n = 37)	40.2 (n = 41)	.39

BMI, body mass index; SD, standard deviation.