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Do People Know Whether They Are Overweight? Concordance of Self-Reported, Interviewer-Observed, and Measured Body Size

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Abstract

PURPOSE—To evaluate associations among self-reported, interviewer-observed, and measured body size in a healthcare setting.

METHODS—543 adult men and women undergoing colonoscopy were enrolled into a cross-sectional study conducted from 2002 to 2008 at the Johns Hopkins Hospital Outpatient Center. Self-reported and interviewer-observed Stunkard body size figure numbers and measured body mass index (BMI) were collected and evaluated. The body size figures and BMI were categorized as normal weight, overweight, and obese.

RESULTS—Correlation between self-reported and interviewer-observed body size figure numbers ($r=0.62$) was lower than the correlation between self-reported ($r=0.72$) or interviewer-observed ($r=0.84$) body size figure number and BMI. Participants underestimated body size by about one figure compared with the interviewers (mean 0.92 ± 1.25). Agreement on normal weight, overweight, and obese between the interviewer-observed body size figures and BMI categories ($\kappa=0.40$) was higher than for the self-reported body size figures and BMI categories ($\kappa=0.23$). Among participants who judged themselves in the normal weight category by the figures, 38% and 13% were overweight and obese, respectively, as measured by BMI. Among participants who judged themselves overweight by the body size figures, 57% were obese as measured by BMI.

CONCLUSIONS—Although self-reported and measured body size were well correlated, participants underestimated their body size in comparison to interviewers. Many individuals misperceive themselves as normal weight when they are overweight or obese by BMI, which may hinder prevention and control efforts.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

Keywords

body size; body mass index; obesity; colon cancer

INTRODUCTION

Obesity is the largest avoidable non-smoking cause of cancer mortality, accounting for an estimated 4 to 20% of cancer deaths in the US [1]. For cancer incidence, one of obesity's strongest links is with colorectal cancer [2]. Epidemiologic studies support that obesity, measured as body mass index (BMI) or by waist circumference, is associated with a higher risk of colorectal cancer [3]. These data help to establish excess body fat as a major risk factor for colorectal neoplasia.

More than sixty percent of the adult population in the US is overweight (BMI 25–29.9 kg/m²) or obese (BMI ≥ 30 kg/m²) [4]. Guidelines recommend that Americans should maintain a healthy weight and engage in regular physical activity [5] in an effort to reduce and control the growing obesity epidemic. The US Preventive Services Task Force (USPSTF) recommends that all adults be screened for obesity and that health care providers should “offer or refer patients with a body mass index (BMI) of 30 kg/m² or higher to intensive, multicomponent behavioral interventions.”[6]. The USPSTF gave this recommendation a B grade, which under the Patient Protection and Affordable Care Act, means that such screening and intervention should be covered by health insurances without patient cost-sharing [7].

Perception of body size may be important in successfully implementing these recommendations for controlling obesity. Prior US studies have observed that a high proportion of individuals who perceived themselves to be of normal weight actually were overweight or obese [8–10]. In a US nationally representative study, 13.0% and 48.1% of obese and overweight men, respectively; and 5.1% and 23.4% of obese and overweight women, respectively, thought they were “the right weight” [11]. Inaccuracy in body size perception may differ by demographic characteristics [12,13]. For example, two studies investigating body image discrepancy, defined as the difference between current perceived body image and ideal body image, found a larger body image discrepancy among whites than among African-Americans, suggesting that African-Americans were more satisfied with their current body size [14,15]. Additionally, in the study by Fitzgibbon et al. [14], white women reported body image discrepancy at a BMI of 24.6 kg/m² (indicating that their ideal differed from their current perceived body image at a normal BMI) compared to African-American and Hispanic women at 29.2 kg/m² and 28.5 kg/m², respectively. The possible implication of these findings for health care providers and national healthcare policy makers is that individuals and populations – overall and as defined based on demographic characteristics (e.g., race and ethnicity) – may not be motivated to improve diet or physical activity, if they do not recognize that they are overweight or obese [16].

While these studies reported on the difference between perceived and ideal body size, to our knowledge, studies have not described the differences among self-reported, interviewer-observed, and measured body size in the context of cancer prevention. Thus, we evaluated

the associations among self-reported, observed, and measured body size in adult men and women undergoing colonoscopy. This study population was selected because its members are targets for messages about reducing individual-level risk of colorectal cancer and precursor adenomas by avoiding or reducing obesity through changes in diet and lifestyle.

MATERIALS AND METHODS

Study population and assessment of body size

This study was embedded in a case-control study on the etiology of adenomatous polyps. Starting in November 2002, we recruited patients undergoing colonoscopy in the Endoscopy Unit at the Johns Hopkins Outpatient Center in Baltimore, Maryland. All patients who were referred for colonoscopy, including those seeking screening, diagnostic work-up, and surveillance for inflammatory bowel disease, and who provided informed consent were eligible for the study. The Outpatient Center, a tertiary care facility, draws patients from Baltimore and from the larger geographic area.

As part of the adenoma case-control study, at the time of colonoscopy we interviewed participants about demographics, history of cancer, lifestyle, and anthropometrics and collected a blood sample. During the interview, one of two interviewers, long-time study coordinators (a nurse and a healthcare technician), who were both white females ages 45 to 55 years, measured the participant's weight, height, waist circumference, and hip circumference. Weight was measured using a standard upright mechanical bar balance while the participant was wearing a hospital gown. Height was measured using the sliding height rod on the balance. Waist and hip circumferences were measured at the narrowest point circa the umbilicus and the largest point circa the buttocks, respectively, and recorded to the nearest ¼ inch. In addition, surreptitiously, the interviewer assessed the participant's body size using the Stunkard scale (Figure 1) [17]; the body size figure numbers range from 1 to 9, with 1 being the thinnest figure.

Two weeks after colonoscopy, participants were mailed a more detailed exposure and medical history questionnaire and the 60-item Block food frequency questionnaire [18]. The former questionnaire collected information on family history of cancer, history of cigarette smoking and alcohol consumption, physical activity, and use of non-steroidal anti-inflammatory drugs. Participants also were asked to provide their weight at ages 18–22 years, maximum lifetime weight, and to choose the figure that best described their body size using the same Stunkard body size figures.

Over six years 1,225 participants enrolled in the case-control study. Included in the analysis are the 543 participants who completed the interview at the time of the colonoscopy, returned the mailed exposure and medical history questionnaire (N=659 excluded), and had complete information on measured BMI (N=4 excluded) and the self-reported (N=8 excluded) and interviewer-observed (N=11 excluded) Stunkard body size figures. Participants included in this analysis were similar in gender and BMI to those excluded, although they were more likely to be white (81% vs 67%; $p<0.0001$) and older (median: 52.6 vs 50.6 years old; $p<0.0001$). The Institutional Review Boards at the Johns Hopkins

School of Medicine and at the Johns Hopkins Bloomberg School of Public Health approved this study.

Statistical Analysis

BMI was calculated from measured weight and height. Cutoffs of <25, 25–29.9, 30 kg/m² were used to categorize the participants as normal weight, overweight, or obese.[19] Waist and hip measurements were combined to create waist-to-hip ratios. Waist circumference (inches) and waist-to-hip ratio were categorized by gender into normal (female waist: ≤35; male waist: ≤40; female waist-to-hip ratio: ≤0.8; male waist-to-hip ratio: ≤0.9) and central obesity (female waist: >35; male waist: >40; female waist-to-hip ratio: >0.8; male waist-to-hip ratio: >0.9). The body size figures were categorized into normal weight (figure numbers 1–5), overweight (6–7), and obese (8–9) [20,9].

Age-adjusted participant characteristics were calculated by measured BMI category separately for each gender. Age adjustment was performed using linear regression. Differences in characteristics by measured BMI category were assessed using the Wald test with BMI <25 kg/m² as the reference category. To evaluate the association of self-reported and interviewer-observed body size figure numbers with each other and with objective measures of body size (measured weight, BMI, waist circumference, waist-to-hip ratio), Spearman correlation coefficients were calculated. Mean differences between the figure number chosen by the participant and by the interviewer were calculated and these differences were tested using t-tests. Agreement between measured BMI categories and self-reported or interviewer-observed body size figure categories of normal weight, overweight, and obese was assessed using the Kappa statistic. Analyses were repeated stratifying by gender, age (<60, ≥60 years), race (white, African-American), BMI categories (normal weight, overweight, obese), waist circumference (normal, central obesity) and waist-to-hip ratio (normal, central obesity). We confirmed a similar correlation between the interviewer-observed body size figure number and measured BMI for the two interviewers (r=0.85 and r=0.84); thus, combined results are reported.

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RESULTS

The mean age of the study participants was 59.6±10.7 years, and 78% were white, 19% were black, and 3% were of other racial backgrounds. The majority of study participants were overweight (37%) or obese (28%) based on measured BMI. For men, the median (IQR) self-reported and interview-observed body size figure numbers were as follows: among those with normal weight based on measured BMI - 4 (3–5) and 5 (4–5); among those overweight based on measured BMI - 5 (5–6) and 5 (5–6); and among those obese based on measured BMI - 6 (6–7) and 7 (6–7), respectively. For women, the median (IQR) self-reported and

interviewer-observed body size figure numbers were as follows: among those with normal weight based on measured BMI - 3 (2–4) and 5 (4–5); among those overweight based on measured BMI - 5 (4–5) and 6 (6–6); and among those obese based on measured BMI - 6 (5–7) and 7 (7–8), respectively. The age-adjusted characteristics of the participants pertinent to obesity and to colorectal cancer risk are presented in Table 1. When asked the reason for colonoscopy, most male and female participants reported they were of screening age, had a previous colon or rectal polyp, or had a family history of colorectal cancer or polyps. The prevalence of diabetes was higher among both female and male participants who were obese; this result was statistically significant only for women. Approximately 10% of the participants were current cigarette smokers with little variation by BMI category. Fruit and vegetable consumption was lower in obese participants, especially among women.

The correlations between interviewer-observed body size figure number and measured weight, BMI, waist circumference, and waist-to-hip ratio varied; the strongest correlation was for measured BMI ($r=0.84$) and the weakest was for waist-to-hip ratio ($r=0.38$) (Table 2). A similar pattern and magnitude of correlation was observed for self-reported body size figure number and measured body size. The correlation between the self-reported and the interviewer-observed body size figure numbers ($r=0.62$) tended to be lower than the correlation between self-reported or interviewer-observed body size figure number and measured body size. Taking into account age, gender and race increased the correlations with interviewer-observed body size, but had little impact on the correlations with self-reported body size (Table 2). Regarding the difference between self-reported and the interviewer-observed body size figure numbers, on average, participants underestimated their body size by one figure (0.92; SD: 1.25; Table 3).

The correlations between interviewer-observed body size figure number and measured BMI, between self-reported body size figure number and measured BMI, and between self-reported and interviewer-observed body size figure numbers generally were similar within strata defined by gender, age, and race (Table 3). Within each stratum, the correlation with measured BMI was slightly lower for self-reported than for interviewer-observed body size figure number. The mean difference between self-reported and interviewer-observed body size figure number was statistically significantly different between strata of several of the variables (Table 3). The mean difference was significantly higher for women than men (1.38 vs. 0.54) and for African-Americans than whites (1.22 vs. 0.83). This indicated that women and African-Americans underestimated their body size in comparison to interviewers more than men and whites, respectively.

After dividing the interviewer-observed and self-reported body size figure numbers and measured BMI into categories of normal, overweight, and obese, agreement between the interviewer-observed and the BMI categories (weighted kappa=0.46) was higher than for the self-reported and the measured BMI categories (weighted kappa=0.27). Among participants who judged themselves to be in the normal weight category by the figures, 38% and 13% were overweight and obese, respectively, as measured by BMI. Among participants who judged themselves to be overweight by the body size figures, 57% were obese as measured by BMI (Table 4). Several differences by gender and race were found. African Americans were more likely to underestimate their body size than whites. 44% and 30% of African-

American participants who judged themselves to be in the normal weight category by the figures were overweight and obese by measured BMI compared to 37% and 10% among whites, respectively. 74% of African-American participants who judged themselves to be in the overweight category by figures were obese by measured BMI compared to 54% among whites. Men and women differed in judgment of body size. Women were more accurate in judgment at the lower range of body size: a higher proportion of women (57%) than men (40%) judged themselves to be in the normal weight category by the figures when they were of normal size based on measured BMI. However, women were more likely to drastically underestimate their body size: a higher proportion of women (18%) than men (9%) in the self-reported normal category were obese based on measured BMI. Women were also more likely to underestimate their body size at the higher range: a higher proportion of women (68%) than men (54%) who judged themselves to be overweight by the figures were obese by measured BMI.

DISCUSSION

In this study evaluating the agreement among self-reported, interviewer-observed and measured body size, we found a good correlation between self-reported and measured body size. However, participants, in particular females and African-Americans, tended to underestimate body size in comparison to interviewers.

Other studies have compared self-reported body size and measured BMI and found correlations ranging from 0.6 to 0.9 [15,21–25]. Our finding of a correlation of 0.72 for self-reported and 0.84 for interviewer-observed body size with measured BMI are consistent with these investigations. This strong correlation between self-reported body size and measured BMI is reassuring for investigators who use self-reported data. While participants may consistently under-report body size, in general, they are able to rank their size correctly, thus preserving the validity of observed associations between body size and health outcomes of interest.

However, the differences in agreement between self-reported and interviewer-observed body size and the lower perceived body size of participants are a concern for the public health community. Prevention efforts aimed at encouraging a healthier lifestyle and body size may be less effective if individuals do not perceive themselves as overweight or obese [16]. In this study, over half of participants who considered themselves as normal weight were overweight or obese by measured BMI. Similar results have been found in other studies in the US [8,11,9]. Inaccurate body size perceptions may have implications for future weight management. Indeed, a study among participants in the CARDIA cohort found that obese women who accurately perceived their body size lost weight, whereas obese women who inaccurately perceived themselves to be of normal weight gained weight over the long-term [15].

The racial differences found in this investigation are also compatible with previous literature; while other studies did not examine self-reported versus interviewer-observed body size, they found racial differences in body dissatisfaction and ideal size. African-American participants of both genders have less body dissatisfaction than white participants

[15,26–28,25], and have larger ideal body sizes [24,29,30,25]. African-American adults in the Bogalusa Heart Study perceived themselves as thinner than they actually were as measured by BMI [9]. Investigators have postulated that these observed racial differences may be due to a more flexible cultural standard of attractiveness, and specifically to a wider range of acceptable weights and body shapes [31]. Our finding that African-Americans underestimated body size as compared to an interviewer and measured BMI is consistent with the literature, although we were not able to examine reasons underlying these observed differences.

The gender differences found in this study are also consistent with the literature. Studies comparing self-reported and measured weight, height and BMI found that participants routinely overestimate height and underestimate weight, which leads to an underestimation of BMI and, consequently, the prevalence of obesity [32,33]. Women, however, are much more likely to self-report as taller and thinner, leading to greater discrepancies in self-reported and measured BMI and the prevalence of obesity than for men. In our study evaluating self-reported body size rather than height and weight, we found a high proportion of women who drastically underestimated their body size, and that women were more likely than men to underestimate their body size at the higher end of the spectrum. This may account for the larger observed discrepancies between the interviewer-observed and self-reported body size among women than men. While this gender difference in self-reported body size is important, prevention efforts will also need to consider perceptions about body size and weight status, which also differ by gender, and influence the desire for and success of weight management efforts [10,32].

This study was conducted among patients undergoing colonoscopy at a large tertiary hospital. Consequently, participants were generally older and may have been more motivated about health maintenance, thus potentially limiting the generalizability of the findings to the general population or populations in other settings. However, the majority of our study participants were either overweight or obese similar to estimates in the general US population [4]. Another limitation of the study was the absence of information on socioeconomic status (SES) and attained education.

Another possible shortcoming is the use of the Stunkard scale in assessing body size in a racially diverse population. The scale may not be culturally appropriate for the African-American population [34], as the morphology of the Stunkard scale figures more closely resembles that of whites [35]. However, in a comparison of figure rating scales, Patt et al. found that the Stunkard scale performed similarly to other scales developed specifically for African-American women [36].

Healthcare team members must be able to accurately judge a patient's body size to provide appropriate counseling regarding weight reduction. If BMI is the gold standard for body size, the correlation and agreement between interviewer-observed body size and BMI was high and better than the correlation and agreement between self-reported body size and BMI. This suggests that the interviewers, a nurse and a healthcare technician who were based in the endoscopy unit for this study, were more accurate judges of body size than the participants. The two interviewers in this study were female, white, and middle-aged and

may have some bearing on assessment of the participant's body size. It is unknown how the assessments would have differed if the interviewers had been male, younger or older, or other races.

With obesity's contribution to risk of many cancers and other health problems, there is an urgent need to address the growing obesity epidemic. Prevention messages and guidelines have been developed to promote a healthier diet and lifestyle; however effectiveness depends on the perceived relevance of these messages to an individual's obesity-associated health risks. A growing body of evidence, including the findings from this study, suggests that individuals underestimate body size and that this is due to a variety of factors, including race and gender. Overweight and obese individuals without an accurate perception of their body size may not be receptive to or motivated by prevention messages to manage weight and adopt a healthier lifestyle. For prevention efforts to be successful, individuals need education about healthy body sizes and how to accurately determine their status. In addition, clinicians involved in preventive medicine should understand how their patients perceive themselves, so that effective weight reduction and lifestyle strategies can be utilized.

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Figure 1.
The nine-figure body size scale of Stunkard et al. Source: Stunkard, A. J., T. Sorensen, et al. (1983). "Use of the Danish Adoption Register for the study of obesity and thinness." *Res Publ Assoc Res Nerv Ment Dis* 60: 115-20.

Table 1

Age-adjusted characteristics of participants undergoing colonoscopy at the Johns Hopkins Hospital Outpatient Center in Baltimore, MD according to gender and BMI category, 2002–2008

	Men (n=301)			Women (n=242)		
	BMI Category			BMI Category		
	<25 kg/m ²	25–29.9 kg/m ²	30 kg/m ²	<25 kg/m ²	25–29.9 kg/m ²	30 kg/m ²
N (%)	78 (25.9)	141 (46.8)	82 (27.2)	112 (46.3)	59 (24.4)	71 (29.3)
Measured						
Mean weight in pounds (SE)	160.7 (2.4)	185.1 (1.8) [†]	226.6 (2.3) [†]	130.6 (2.1)	157.5 (2.9) [†]	201.3 (2.7) [†]
Mean waist circumference in inches (SE)	34.2 (0.4)	38.0 (0.3) [†]	43.8 (0.4) [†]	29.6 (0.3)	34.0 (0.5) [†]	40.4 (0.4) [†]
% with central obesity by waist circumference *	1.4	22.8 [†]	92.3 [†]	12.3	41.6 [†]	91.2 [†]
% with central obesity by waist-to-hip ratio **	53.8	73.8 [†]	94.6 [†]	31.8	51.9 [†]	83.4 [†]
Self-reported						
Mean maximum weight in pounds (SE)	177.3 (3.2)	203.6 (2.4) [†]	243.6 (3.1) [†]	146.3 (2.6)	168.2 (3.5) [†]	216.9 (3.2) [†]
Mean weight in pounds at 18–22 years (SE)	151.4 (2.5)	159.8 (1.9) [†]	173.4 (2.5) [†]	119.2 (2.1)	117.7 (2.8)	139.5 (2.6) [†]
Reason for colonoscopy (%) ***						
Positive screening test	5.4	2.6	1.4	7.5	3.1	5.3
Family history of colorectal cancer/polyps	25.7	28.1	35.8	28.4	46.7 [†]	33.3
Screening due to age	55.8	52.1	50.1	44.5	38.3	50.7
Current symptoms	10.3	16.2	17.2	24.2	23.8	21.0
Past symptoms	6.3	11.8	6.7	22.2	15.9	10.9 [†]
Past colon cancer	0.0	0.7	1.4	0.0	3.7 [†]	1.8
Recent colon/rectal polyp	0.0	1.4	3.7	0.0	0.0	1.7
Past colon/rectal polyp	34.5	34.6	32.0	17.8	21.1	30.5 [†]
Diabetes (%)	9.0	5.7	17.2	3.0	15.6 [†]	20.7 [†]
Current smoker (%)	11.3	6.5	10.1	10.1	9.0	7.6
% consume alcohol > 1 time/week	47.9	48.7	48.2	44.4	17.5 [†]	19.6 [†]

	Men (n=301)			Women (n=242)		
	BMI Category			BMI Category		
	<25 kg/m ²	25–29.9 kg/m ²	30 kg/m ²	<25 kg/m ²	25–29.9 kg/m ²	30 kg/m ²
% consume fruit >1 time/day	31.7	39.2	29.9	52.7	35.6 [†]	35.1 [†]
% consume vegetables ≥1 time/day	33.9	34.3	27.6	52.5	46.7	26.3 [†]
% consume red/processed meat >1 time/week	64.2	63.8	67.7	49.5	53.5	49.2

[†] p<0.05 for comparison to reference group (BMI<25 kg/m²)

* Normal: female 35", male 40" central obesity: female >35", male >40".

** Normal: female <0.8, male <0.9; central obesity: female 0.8, male 0.9.

*** Categories not mutually exclusive

Table 2

Correlations between self-reported, interviewer-observed, and measured body size among participants undergoing colonoscopy in the Johns Hopkins Hospital Outpatient Center in Baltimore, MD 2002–2008

	Body size figure number	
	Self-reported	Interviewer-observed
Crude		
Self-reported body size figure number	---	0.62
Body mass index	0.72	0.84
Weight	0.70	0.64
Waist circumference	0.73	0.71
Waist-to-hip ratio	0.48	0.38
Partial[†]		
Self-reported body size figure number	---	0.65
Body mass index	0.72	0.84
Weight	0.67	0.75
Waist circumference	0.71	0.80
Waist-to-hip ratio	0.41	0.51

[†] Adjusting for age, race and gender

Table 3

Correlations between self-reported, interviewer-observed, and measured body size by strata of characteristics of participants undergoing colonoscopy at the Johns Hopkins Hospital Outpatient Center in Baltimore, MD 2002–2008

	Correlations			Mean difference between interviewer-observed and self-reported body size figure number (SD)
	Interviewer-observed body size figure number and BMI	Self-reported body size figure number and BMI	Interviewer-observed and self-reported body size figure number	
Overall	0.84	0.72	0.62	0.92 (1.25)
Gender				
Male	0.79	0.69	0.59	0.54 (1.17)
Female	0.91	0.77	0.73	1.38 (1.19) [†]
Age				
< 60 years	0.86	0.77	0.66	0.92 (1.17)
60 years	0.82	0.68	0.57	0.91 (1.33)
Race				
White	0.81	0.75	0.63	0.83 (1.22)
African-American	0.85	0.69	0.59	1.22 (1.32) [†]

[†] p<0.05

Table 4

Percentage of participants of normal weight, overweight and obese, as measured by BMI, by self-reported body size category, among participants undergoing colonoscopy in the Johns Hopkins Hospital Outpatient Center in Baltimore, MD 2002–2008

Self-reported body size category	Actual body size category as measured by BMI		
	Normal	Overweight	Obese
Normal	48.8	37.9	13.3
Overweight	4.6	38.2	57.2
Obese	0.0	0.0	100.0
By Gender:			
Women			
Normal	57.0	25.4	17.6
Overweight	5.3	26.3	68.4
Obese	0.0	0.0	100.0
Men			
Normal	40.1	51.1	8.8
Overweight	4.4	42.1	53.5
Obese	0.0	0.0	100.0
By age:			
< 60 years			
Normal	49.2	35.5	15.2
Overweight	4.2	38.9	56.9
Obese	0.0	0.0	100.0
60 years			
Normal	48.3	40.5	11.2
Overweight	5.0	37.5	57.5
Obese	0.0	0.0	100.0
By Race:			
African American			
Normal	25.8	43.9	30.3
Overweight	0.0	25.9	74.1
Obese	0.0	0.0	100.0
White			
Normal	53.7	36.8	9.5
Overweight	5.7	40.2	54.1
Obese	0.0	0.0	100.0