

Article

Symposium 2008:
Data Collection: Challenges, Achievements and New Directions

Methodological Issues in Anthropometry: Self-reported versus Measured Height and Weight



by Margot Shields, Sarah Connor Gorber, Mark S. Tremblay

2009

Methodological Issues in Anthropometry: Self-reported versus Measured Height and Weight ¹

Margot Shields², Sarah Connor Gorber^{2,3}, Mark S. Tremblay³

Abstract

Based on a representative sample of the Canadian population, this article quantifies the bias resulting from the use of self-reported rather than directly measured height, weight and body mass index (BMI). Associations between BMI categories and selected health conditions are compared to see if the misclassification resulting from the use of self-reported data alters associations between obesity and obesity-related health conditions. The analysis is based on 4,567 respondents to the 2005 Canadian Community Health Survey (CCHS) who, during a face-to-face interview, provided self-reported values for height and weight and were then measured by trained interviewers. Based on self-reported data, a substantial proportion of individuals with excess body weight were erroneously placed in lower BMI categories. This misclassification resulted in elevated associations between overweight/obesity and morbidity.

Key Words: Body mass index, Self-report, Direct measure, Measurement error, Bias, Validity.

1. Introduction

Population health surveys often base estimates of the prevalence of obesity on calculations of body mass index (BMI), which is a measure of weight in relation to height. Since the mid-1990s, Statistics Canada's two major health surveys, the Canadian Community Health Survey (CCHS) and the National Population Health Survey (NPHS), have asked respondents to report their weight and height, and then used these data to estimate BMI.

A recent systematic review of the literature substantiated the existence of a bias associated with self-reported weight and height data (Connor Gorber et al., 2007). Most studies have found that self-reports underestimate weight and overestimate height. Therefore, estimates of the prevalence of obesity based on self-reports tend to be lower than those based on measured data. As well, some evidence indicates that associations between obesity and morbidity differ depending on whether BMI is calculated with self-reported or measured data (Santillan and Camargo, 2003; Yannakoulia et al., 2006).

In 2005, the CCHS collected both self-reported and measured height and weight from a subsample of respondents. Using these data, this study documents the magnitude of the bias that exists for the Canadian population when height, weight and BMI are based on self-reports rather than on physical measures. A second objective was to compare associations between BMI categories and selected health conditions to see if the misclassification resulting from the use of self-reported data alters our understanding of associations between obesity and morbidity.

¹ This is a summary of two more detailed manuscripts: Shields, M., Connor Gorber, S., and M.S. Tremblay (2008), "Effects of obesity based on self-report versus direct measures", *Health Reports*, 19(2), pp. 61-76 and Shields, M., Connor Gorber, S., and M.S. Tremblay (2008), "Effects of measurement on obesity and morbidity", *Health Reports*, 19(2), pp. 77-84.

² Margot Shields and Sarah Connor Gorber. Health Information and Research Division, Statistics Canada, 24th Floor R.H. Coats Building, 100 Tunney's Pasture Driveway, Ottawa, ON, Canada, K1A 0T6; ³ Mark Tremblay, Children's Hospital of Eastern Ontario Research Institute

2. Methods

Data for this study are from a sub-sample of respondents aged 12 years or older to the 2005 CCHS who were asked to self-report their height and weight, and later, were directly measured by Statistics Canada interviewers. This study is based on 4,567 CCHS respondents for whom both self-reported and measured values of height and weight were collected. Pregnant women were excluded from the study.

The bias associated with using self-reported data was estimated by calculating the difference between measured and self-reported weight, height and BMI (measured minus self-reported). A positive difference indicates under-reporting, and a negative difference, over-reporting.

To identify factors associated with reporting bias, differences between measured and self-reported values were examined in relation to: age, household income, immigrant status, leisure-time physical activity level, and measured weight, height and BMI. Multiple linear regression models were used to determine which factors were independently associated with the bias. Only the results for the factors most strongly associated with the bias are presented in this paper. Results for the other variables, as well as the regression models, are available in a published report (Shields et al., 2008a).

Respondents were categorized into BMI categories according to the World Health Organization (World Health Organization, 1995) and Canadian classification guidelines (Health Canada, 2003), which characterize individuals as underweight (BMI less than 18.5 kg/m²), normal weight (BMI 18.5 to 24.9 kg/m²), overweight (BMI 25.0 to 29.9 kg/m²), obese class I (BMI 30.0 to 34.9 kg/m²), obese class II (BMI 35.0 to 39.9 kg/m²) or obese class III (BMI 40.0 kg/m² or more).

To study the impact that misclassification of BMI categories has on the association between obesity and selected health conditions, two sets of logistic regression models were fitted. In the first set, BMI categories were based on self-reported height and weight, and in the second set, on measured height and weight. In both sets, age and sex were entered as control variables. The purpose was to see if associations between BMI categories and health conditions differed, depending on whether they were based on self-reported or measured values. Both sets of models used data from the same respondents. Six health conditions were considered, but only three are presented in this paper. See (Shields et al., 2008b) for the results for the other conditions and more detailed information about this study.

All estimates were weighted to represent the household population aged 12 years or older in 2005. To account for the survey design effect of the CCHS, standard errors, coefficients of variation, and 95% confidence intervals were estimated using the bootstrap technique (Rao et al., 1992; Rust and Rao, 1996). Differences between estimates were tested for statistical significance, which was established at the 0.05 level.

3. Results

3.1 Height

On average, self-reported height was 0.7 cm more than measured height (Table 3.1-1). Males over-reported their height by an average of 1 cm, compared with 0.5 cm for females.

The tendency to over-report height increased with age, particularly among seniors (Table 3.1-2). Men and women aged 65 to 79 years over-reported by 2.3 and 1.6 cm, respectively, and those aged 80 years or older, by 2.6 and 3.3 cm.

Table 3.1-1
Mean height, weight and body mass index (BMI), by collection method and sex,
household population aged 12 years or older, Canada excluding territories, 2005

	Collection method		Difference	
	Measured	Self-reported	Measured minus self-reported	95% confidence interval
Mean height (cm)				
Both sexes	168.3	169.0 *	-0.7	-0.9 to -0.6
Males	174.8	175.8 *	-1.0	-1.2 to -0.8
Females	161.8	162.3 *	-0.5 †	-0.7 to -0.3
Mean weight (kg)				
Total	74.9	72.8 *	2.1	2.0 to 2.3
Males	81.9	80.1 *	1.8	1.6 to 2.0
Females	67.9	65.4 *	2.5 †	2.2 to 2.7
Mean BMI (kg/m²)				
Both sexes	26.4	25.3 *	1.1	1.0 to 1.1
Males	26.8	25.8 *	0.9	0.8 to 1.0
Females	26.0	24.8 *	1.2 †	1.1 to 1.3

* significantly different from estimate for measured (p < 0.05)

† significantly different from estimate for males (p < 0.05)

Table 3.1-2
Mean height (cm) and mean difference between measured and self-reported height (cm), by selected characteristics, household population aged 12 years or older, Canada excluding territories, 2005

	Males				Females			
	Mean height		Mean difference		Mean height		Mean difference	
	Measured	Self-reported	Measured minus self-reported	95% confidence interval	Measured	Self-reported	Measured minus self-reported	95% confidence interval
Total	174.8	175.8 *	-1.0	-1.2 to -0.8	161.8	162.3 *	-0.5	-0.7 to -0.3
Age group								
12 to 24 years	174.0	174.4	-0.3 ‡	-0.7 to 0.1	162.8	162.6	0.3 ‡	-0.2 to 0.7
25 to 44 years	176.0	176.8 *	-0.7	-1.1 to -0.4	163.3	163.5	-0.2	-0.5 to 0.0
45 to 64 years †	174.9	176.0 *	-1.1	-1.5 to -0.7	161.9	162.3 *	-0.4	-0.8 to 0.0
65 to 79 years	172.6	174.9 *	-2.3 ‡	-2.9 to -1.7	158.0	159.6 *	-1.6 ‡	-2.0 to -1.1
80 years or older	171.2	173.9 *	-2.6 ‡	-3.7 to -1.5	154.7	157.9 *	-3.3 ‡	-4.2 to -2.4
Measured height quartile for age 18 or older (cm)								
1 Lowest	166.0	168.3 *	-2.3 ‡	-2.8 to -1.9	153.0	154.9 *	-1.9 ‡	-2.3 to -1.5
2 †	172.9	174.2 *	-1.3	-1.6 to -0.9	159.7	160.1 *	-0.5	-0.8 to -0.1
3	177.8	178.7 *	-0.9	-1.3 to -0.6	164.4	164.6	-0.2	-0.5 to 0.1
4 Highest	184.9	184.5	0.4 ‡	-0.1 to 1.0	171.6	171.2	0.4 ‡	-0.1 to 0.9
Measured BMI category (range kg/m²)								
Underweight (less than 18.5)	175.6	173.9	1.7	-1.0 to 4.4	162.4	162.9	-0.5	-1.4 to 0.5
Normal weight (18.5 to 24.9) †	174.9	175.0	-0.1	-0.4 to 0.2	162.7	162.7	0.0	-0.3 to 0.2
Overweight (25.0 to 29.9)	174.9	176.2 *	-1.3 ‡	-1.6 to -1.0	161.1	161.9 *	-0.8 ‡	-1.2 to -0.4
Obese Class I (30.0 to 34.9)	174.4	176.2 *	-1.8 ‡	-2.4 to -1.3	160.8	161.7 *	-0.8 ‡	-1.3 to -0.4
Obese Class II (35.0 to 39.9)	175.2	176.9 *	-1.7 ‡	-3.0 to -0.4	159.7	161.1 *	-1.4 ‡	-2.3 to -0.5
Obese Class III (40.0 or more)	173.3	175.4 *	-2.1 ‡	-3.9 to -0.3	159.5	162.3 *	-2.8 ‡	-4.7 to -0.9

* significantly different from estimate for measured (p < 0.05)

† reference category

‡ significantly different from estimate for reference category (p < 0.05)

The shortest people (those whose measured height placed them in the lowest quartile of the distribution) were the least accurate: males in this group over-reported their height by an average of 2.3 cm, and females, by 1.9 cm. There was no significant difference between measured and self-reported height for males in the highest quartile (tallest), and for females in the two highest quartiles.

Over-reporting of height varied by measured BMI. For people in the normal weight category, self-reported and measured height did not differ, but those who were overweight or obese tended to over-report. Discrepancies were pronounced among people in obese class III, with males overreporting their height by an average of 2.1 cm, and females, by 2.8 cm.

3.2 Weight

Self-reported weight was, on average, 2.1 kg less than measured weight. The bias was greater among females, who under-reported by an average of 2.5 kg, compared with 1.8 kg for males. Females in all four measured weight quartiles under-reported their weight, with the difference rising from an average of 0.6 kg for those in the lowest quartile to 5.1 kg for those in the highest (Table 3.2-1). The self-reported and measured weight of males in the lowest measured weight quartile did not differ. Males in the other quartiles under-reported, with the difference rising from 1.1 kg for those in the second to 4.1 kg for those in the highest.

Table 3.2-1
Mean weight (kg) and mean difference between measured and self-reported weight (kg), by selected characteristics, household population aged 12 years or older, Canada excluding territories, 2005

	Males				Females			
	Mean weight		Mean difference		Mean weight		Mean difference	
	Measured	Self-reported	Measured minus self-reported	95% confidence interval	Measured	Self-reported	Measured minus self-reported	95% confidence interval
Total	81.9	80.1 *	1.8	1.6 to 2.0	67.9	65.4 *	2.5	2.2 to 2.7
Age group								
12 to 24 years	70.6	69.4 *	1.2 ‡	0.8 to 1.6	60.4	58.6 *	1.7 ‡	1.4 to 2.1
25 to 44 years	83.5	81.9 *	1.5 ‡	1.1 to 1.9	67.9	65.6 *	2.3 ‡	1.9 to 2.6
45 to 64 years †	87.2	84.8 *	2.4	1.8 to 2.9	72.6	69.5 *	3.1	2.6 to 3.6
65 to 79 years	84.3	81.8 *	2.5	2.0 to 3.0	68.9	66.2 *	2.7	1.8 to 3.6
80 years or older	75.0	74.0 *	1.0 ‡	0.0 to 1.9	62.9	61.0 *	1.8 ‡	1.1 to 2.6
Measured weight quartile for age 18 or older (kg)								
1 Lowest	66.5	66.5	0.0 ‡	-0.5 to 0.5	52.5	51.9 *	0.6 ‡	0.4 to 0.9
2 †	77.8	76.7 *	1.1	0.6 to 1.6	61.6	59.9 *	1.7	1.4 to 2.0
3	86.8	84.8 *	2.0 ‡	1.7 to 2.4	71.1	68.4 *	2.7 ‡	2.4 to 3.1
4 Highest	103.5	99.4 *	4.1 ‡	3.6 to 4.7	90.8	85.7 *	5.1 ‡	4.4 to 5.8
Measured BMI category (range kg/m²)								
Underweight (less than 18.5)	52.2	59.1 *	-6.9 ‡	-12.8 to -1.0	46.7	47.5	-0.7 ‡	-2.0 to 0.5
Normal weight (18.5 to 24.9) †	68.5	68.2	0.3	0.0 to 0.6	57.8	56.5 *	1.3	1.1 to 1.5
Overweight (25.0 to 29.9)	83.3	81.4 *	1.9 ‡	1.6 to 2.2	70.5	67.6 *	2.9 ‡	2.5 to 3.3
Obese Class I (30.0 to 34.9)	97.2	93.5 *	3.8 ‡	3.2 to 4.3	83.0	79.1 *	3.9 ‡	3.2 to 4.6
Obese Class II (35.0 to 39.9)	112.6	106.5 *	6.2 ‡	4.9 to 7.5	94.4	88.5 *	5.9 ‡	4.1 to 7.7
Obese Class III (40.0 or more)	118.5	113.5 *	5.0 ‡	2.7 to 7.4	118.2	109.6 *	8.6 ‡	6.0 to 11.1

* significantly different from estimate for measured ($p < 0.05$)

† reference category

‡ significantly different from estimate for reference category ($p < 0.05$)

Differences between self-reported and measured weight were strongly associated with measured BMI. Underweight males over-reported their weight by an average of 6.9 kg. Self-reported and measured weight did not differ

significantly for males in the normal weight range, but those who were overweight or obese tended to under-report, with the greatest difference among the obese. For underweight females, self-reported and measured weight were not significantly different. Females in the normal, overweight and obese categories all under-reported, with discrepancies increasing in successively heavier BMI categories.

3.3 Body mass index

BMI based on self-reported height and weight was, on average, 1.1 kg/m² less than BMI based on measured values. Underestimation occurred among both sexes, but was slightly greater among females (1.2 kg/m²) than among males (0.9 kg/m²). The extent of the difference between BMI based on self-reported rather than on measured height and weight was strongly associated with measured BMI (Table 3.3-1). For underweight males, BMI based on self-reported values was overestimated, and for underweight females, BMI based on self-reported and measured values did not differ significantly. For all other BMI categories, self-reported BMI underestimated measured BMI, with the degree of underestimation increasing with successively higher BMIs. For obese class III, underestimation amounted to, on average, 4.0 kg/m² among males, and 5.0 kg/m² among females.

Table 3.3-1
Mean body mass index (BMI kg/m²) and mean difference between measured and self-reported BMI, by selected characteristics, household population aged 12 years or older, Canada excluding territories, 2005

	Males				Females			
	Mean BMI		Mean difference		Mean BMI		Mean difference	
	Measured	Self-reported	Measured minus self-reported	95% confidence interval	Measured	Self-reported	Measured minus self-reported	95% confidence interval
Total	26.8	25.8 *	0.9	0.8 to 1.0	26.0	24.8 *	1.2	1.1 to 1.3
Age group								
12 to 24 years	23.2	22.6 *	0.6 ‡	0.4 to 0.8	22.8	22.0 *	0.8 ‡	0.5 to 1.1
25 to 44 years	26.9	26.2 *	0.8 ‡	0.6 to 0.9	25.5	24.6 *	0.9 ‡	0.8 to 1.1
45 to 64 years †	28.5	27.3 *	1.1	0.9 to 1.4	27.8	26.4 *	1.4	1.1 to 1.7
65 to 79 years	28.3	26.7 *	1.6 ‡	1.3 to 1.9	27.6	26.0 *	1.6	1.3 to 2.0
80 years or older	25.5	24.4 *	1.1	0.7 to 1.4	26.3	24.5 *	1.9	1.4 to 2.4
Measured BMI category (range kg/m²)								
Underweight (less than 18.5)	16.9	19.5 *	-2.6 ‡	-4.9 to -0.4	17.6	17.8	-0.2 ‡	-0.6 to 0.2
Normal weight (18.5 to 24.9) †	22.3	22.1 *	0.1	0.0 to 0.3	21.8	21.3 *	0.5	0.4 to 0.6
Overweight (25.0 to 29.9)	27.2	26.2 *	1.0 ‡	0.9 to 1.2	27.1	25.7 *	1.4 ‡	1.2 to 1.6
Obese Class I (30.0 to 34.9)	31.9	30.0 *	1.9 ‡	1.6 to 2.2	32.1	30.1 *	2.1 ‡	1.7 to 2.5
Obese Class II (35.0 to 39.9)	36.7	34.0 *	2.7 ‡	2.2 to 3.3	37.1	34.1 *	3.0 ‡	2.1 to 3.8
Obese Class III (40.0 or more)	41.6	37.6 *	4.0 ‡	2.7 to 5.3	47.3	42.4 *	5.0 ‡	3.0 to 6.9

* significantly different from estimate for measured (p < 0.05)

† reference category

‡ significantly different from estimate for reference category (p < 0.05)

3.4 Misclassification of BMI categories

The degree of misclassification that results when BMI categories are based on self-reported height and weight was assessed by calculating sensitivity and specificity (Table 3.4-1). Sensitivity is the percent of true positives, and specificity, the percent of true negatives. Sensitivity was high for those who, according to measured height and weight, were in the normal weight category. That is, 95% of males and 93% for females whose measured height and weight put them in the normal weight BMI category were correctly placed in this category based on their self-reported height and weight. For people who were overweight, sensitivity fell to 70% among males and to 63% among females. Sensitivity was low for males and females who were obese: 51% and 54% for those in obese class I, and 45% and 57% for those in obese class II/III. Among people who were underweight, sensitivity was particularly low for males at 40%, but higher for females at 78%.

Specificity was very high (more than 95%) for the obese categories, indicating that very few respondents reported height and weight that put them in the obese category unless they really were obese.

Table 3.4-1
Sensitivity and specificity values by BMI category and sex, household population aged 12 years or older, Canada excluding territories, 2005

	Measured BMI category (range kg/m ²)									
	Underweight (less than 18.5)		Normal weight (18.5 to 24.9)		Overweight (25.0 to 29.9)		Obese Class I (30.0 to 34.9)		Obese Class II/ III (35 or more)	
	95% confidence interval		95% confidence interval		95% confidence interval		95% confidence interval		95% confidence interval	
	%	interval	%	interval	%	interval	%	interval	%	interval
Sensitivity (% true positives)										
Both sexes	67	53 to 82	94	92 to 95	67	63 to 71	52	46 to 58	53	44 to 62
Males	40	8 to 71	95	93 to 97	70	65 to 75	51	43 to 59	45	32 to 59
Women	78	63 to 92	93	90 to 95	63	57 to 68	54	46 to 63	57	45 to 68
Specificity (% true negatives)										
Both sexes	99	98 to 99	81	78 to 83	86	84 to 88	96	95 to 97	100	100 to 100
Males	100	99 to 100	82	79 to 85	81	78 to 84	96	95 to 98	100	100 to 100
Women	98	97 to 99	79	75 to 82	90	88 to 92	96	95 to 97	100	100 to 100

3.5 Prevalence of obesity

Prevalence estimates of BMI categories differed substantially when calculated with measured rather than self-reported height and weight (Table 3.5-1). The prevalence of obesity based on measured data was 7 percentage points higher than the estimate based on self-reported data (22.6% versus 15.2%). Among males, the prevalence was 9 percentage points higher, and among females, 6 percentage points higher.

Table 3.5-1
Body mass index (BMI) prevalence distribution, by collection method and sex, household population aged 12 years or older, Canada excluding territories, 2005

BMI category (range kg/m ²)	Both sexes			Males			Females		
	Measured	Self-reported	Measured minus self-reported	Measured	Self-reported	Measured minus self-reported	Measured	Self-reported	Measured minus self-reported
Obese (30.0 or more)	22.6	15.2 *	7.4	24.2	15.4 *	8.8	21.0	15.0 *	6.0
Overweight/Obese (25.0 or more)	56.5	47.2 *	9.3	63.6	54.2 *	9.4	49.2	40.1 *	9.1
Underweight (less than 18.5)	1.6	2.3 *	-0.7	0.8 ^E	0.7 ^E	0.1	2.3 ^E	3.8 *	-1.6
Normal weight (18.5 to 24.9)	42.0	50.5 *	-8.5	35.5	45.1 *	-9.6	48.6	56.1 *	-7.5
Overweight (25.0 to 29.9)	33.8	32.0	1.9	39.4	38.8	0.6	28.2	25.0 *	3.1
Obese Class I (30.0 to 34.9)	16.6	12.0 *	4.6	19.9	13.3 *	6.6	13.2	10.6 *	2.6
Obese Class II/III (35.0 or more)	6.0	3.3 *	2.8	4.3	2.1 ^{E*}	2.2	7.8	4.4 *	3.4

* significantly different from estimate for measured (p < 0.05)

^E use with caution (coefficient of variation 16.6% and 33.3%)

3.6 Associations with morbidity

Given the substantial degree of misclassification that occurs when BMI is derived from self-reported height and weight, it is important to determine if associations between BMI categories and various health conditions are different when BMI is derived from self-reported rather than measured data.

Results of the regression analyses comparing associations between BMI categories and health conditions reveal that the odds ratios for the overweight and obese categories were generally higher for models based on self-reported values than the odds ratios for models based on measured values (Table 3.6-1). (Since the conditions considered are most prevalent among older adults, the population for this analysis was restricted to those aged 40 or older). In

several cases, the differences were substantial. For example, the odds ratios for diabetes for the overweight, obese I, and obese II/III categories, were 2.6, 3.2, and 11.8, respectively, in the model based on self-reported data; the corresponding odds ratios in the model based on measured values were 1.4, 2.2 and 7.0.

Table 3.6-1
Adjusted odds ratios relating measured and self-reported body mass index (BMI) to selected health conditions, household population aged 40 years or older, Canada excluding territories, 2005

BMI category (range kg/m ²)	Based on measured BMI		Based on self-reported BMI	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Diabetes				
Normal weight (18.5 to 24.9)	1.0	...	1.0	...
Overweight (25.0 to 29.9)	1.4	0.7 to 2.9	2.6 *	1.6 to 4.3
Obese Class I (30.0 to 34.9)	2.2 *	1.0 to 4.5	3.2 *	1.8 to 5.6
Obese Class II/III (35.0 or more)	7.0 *	2.9 to 16.5	11.8 *	5.5 to 25.3
High blood pressure				
Normal weight (18.5 to 24.9)	1.0	...	1.0	...
Overweight (25.0 to 29.9)	2.1 *	1.5 to 3.0	2.7 *	1.9 to 3.8
Obese Class I (30.0 to 34.9)	3.4 *	2.3 to 5.1	4.3 *	2.9 to 6.3
Obese Class II/III (35.0 or more)	5.5 *	3.1 to 9.8	7.8 *	3.7 to 16.6
Arthritis				
Normal weight (18.5 to 24.9)	1.0	...	1.0	...
Overweight (25.0 to 29.9)	1.2	0.8 to 1.7	1.2	0.8 to 1.7
Obese Class I (30.0 to 34.9)	1.2	0.8 to 1.8	2.0 *	1.3 to 3.0
Obese Class II/III (35.0 or more)	2.9 *	1.7 to 4.8	3.5 *	1.7 to 7.1

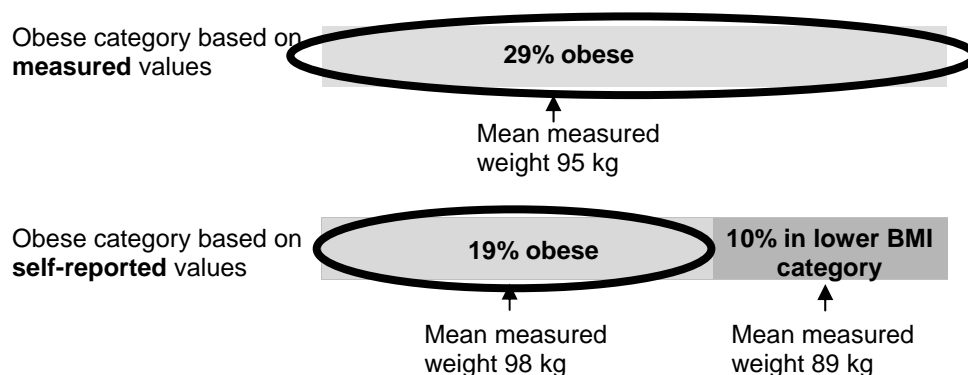
* significantly different from estimate for normal weight category (p < 0.05)

... not applicable

Note: Models control for age (continuous) and sex. Odds ratios for underweight group not reported due to small sample sizes.

The explanation for these differences becomes clear when average weights in BMI categories based on measured values are compared with those based on self-reported values. Figure 3.6-1 illustrates what happens in the overall obese category.

Figure 3.6-1
Percentage obese and average measured weights based on categories derived from measured vs. self-reported values, household population aged 40 years or older, Canada excluding territories, 2005



When the BMI categories are based on measured values, 29% of respondents are classified as obese. The average measured weight of these respondents is 95kg. When the BMI categories are based on self-reported values for these same respondents, 19% are correctly classified as obese. The remaining 10% reported height and weight that erroneously placed them in a lower BMI category – for most of them, overweight.

The regression coefficients associated with morbidity depend more on what people actually weigh than what they report they weigh. For the 19% who were properly classified as obese, the average measured weight was 98kg. For the 10% who reported values that erroneously placed them in a lower BMI category, the average measured weight was 89kg. In other words, heavier people were more likely to be properly classified, and somewhat lighter people more likely to be erroneously classified into a lower BMI category.

When the odds ratios in relation to morbidity are examined for the obese category based on measured values, we are considering people who on average weigh 95 kg. When the obese category is derived based on self-reported values, we are considering people whose average weight is 3 kg heavier; hence, the odds are elevated resulting from the misclassification bias.

4. Conclusion

For fiscal and logistical reasons, large-scale health surveys conducted by Statistics Canada will continue to collect self-reported height and weight data. As this study reveals, this practice yields biased values for height and weight, which result in substantial misclassification of the population by BMI category. The prevalence of obesity based on measured data was 7 percentage points higher than the estimate based on self-reported data (22.6% versus 15.2%). Furthermore, the misclassification of BMI categories that results from self-reported data exaggerates associations between overweight/obesity and morbidity.

To correct the bias, researchers may wish to consider adjusting self-reported values or lowering BMI cut-points for the overweight and obese categories. The feasibility of producing correction equations to adjust self-reported estimates using CCHS data and to assess whether they improve the estimation of obesity has been examined recently with promising results (Connor Gorber et al., 2008).

References

- Connor Gorber, S., Tremblay, M., Moher, D., and Gorber, B. (2007). A Comparison of Direct vs. Self-Report Measures for Assessing Height, Weight and Body Mass Index: A Systematic Review, *Obesity Reviews*, 8(4), 307-326.
- Connor Gorber, S., Shields, M., Tremblay, M.S., and McDowell, I. (2008). The Feasibility of Establishing Correction Factors to Adjust Self-Reported Estimates of Obesity in The Canadian Community Health Survey, *Health Reports*, 19(3), 71-82.
- Health Canada (2003), Canadian Guidelines for Body Weight Classification in Adults, Ottawa: Health Canada.
- Rao, J.N.K., Wu, C.F.J., and Yue, K. (1992), Some Recent Work on Resampling Methods for Complex Surveys, *Survey Methodology*, 18, 209-217.
- Rust, K.F., and Rao, J.N.K. (1996), Variance Estimation for Complex Surveys Using Replication Techniques, *Statistical Methods in Medical Research*, 5, 281-310.
- Santillan A.A., and Camargo, C.A. (2003) Body Mass Index and Asthma Among Mexican Adults: The Effect of Using Self-Reported vs. Measured Weight and Height, *International Journal of Obesity and Related Metabolic Disorders*, 27(11), 1430-1433.

Shields, M., Connor Gorber, S., and Tremblay, M.S. (2008a), Effects of Obesity Based on Self-Report versus Direct Measures, *Health Reports*, 19(2), 61-76.

Shields, M., Connor Gorber, S., and Tremblay, M.S. (2008b), Effects of Measurement on Obesity and Morbidity, *Health Reports*, 19(2), 77-84.

World Health Organization. (1995), Physical Status: The Use of and Interpretation of Anthropometry, Report of the WHO Expert Committee (WHO Technical Report Series, No. 854), Geneva: World Health Organization.

Yannakoulia, M., Panagiotakos, D.B., Pitsavos, C., and Stefanadis, C. (2006), Correlates of BMI Misreporting among Apparently Healthy Individuals: The ATTICA Study, *Obesity*; 14(5), 894-901.