# Validity of Self-Reported Height and Weight for Estimating Overweight and Obesity

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ABSTRACT

**Objectives:** To determine the validity of self-reported body mass index (BMI) in estimating the prevalence of overweight and obesity in the Canadian population.

**Method:** In this analysis the Canadian Community Health Survey, Cycle 2.2 dataset was used to estimate the prevalence of overweight and obesity and mean and standard deviation (SD) of BMI from self-reported and measured heights and weights according to gender, age group, and measured weight classification. Multiple regression technique was used to evaluate the relation between BMI underreporting and variables of age, gender, and measured height and weight.

**Results:** There were 18886 participants with self-reported or measured height and weight. Estimated mean (SD) for self-reported and measured BMI are 25.8 (4.8) and 25.4 (6.1) $kg/m^2$, respectively. On average BMI underreporting is 1.2 $kg/m^2$ (0.8 $kg/m^2$ for men and 1.5 $kg/m^2$ for women). Overall prevalence rates of overweight and obesity were 35.8% and 26.1%, respectively, for measured BMI, and 35.5% and 18.9% for self-reported BMI. Females and heavier respondents showed more BMI underreporting than others. Also, older and taller participants reported BMI more accurately.

**Conclusion:** To estimate overweight and obesity in etiological and disease relationship studies, use of measured BMI is highly recommended instead of self-reported BMI. Otherwise, the finding could be distorted and unreliable. In the population surveys, if there is no access to the measured height and

weight, then, one might expect a BMI underreporting of 1.2 and an underestimation of overweight and obesity rate by at least 4 -5% among men and 10% among women.

Key words: Body weight, obesity, overweight, body mass index

**Validity of Self-Reported Height and Weight for Estimating Overweight and Obesity**

## INTRODUCTION

Overweight and obesity have a significant impact on both physical and psychological health and are important risk factors for cardiovascular disease and diabetes (1), and certain types of cancer (2). Increasing obesity rates result in rising healthcare costs which could create a substantial economic burden (3). It is therefore important to monitor societal trends in overweight and obesity, from both a healthcare intervention and economic standpoint. Body mass index (BMI) which is calculated as weight-to-squared height ( $kg/m^2$ ) is used extensively to identify underweight, overweight, and obese individuals in large population-based studies because it is easy, reproducible, and inexpensive to use (4). Also, BMI predicts risk of morbidity and mortality globally (5).

In large epidemiological studies and national surveys, BMI is often obtained from self-reported heights and weights rather than measured values. The accuracy of BMI derived from self-reported height and weight (referred as self-reported BMI in this article) has been called into question because individuals tend to overestimate height and underestimate weight which can affect the estimation of BMI significantly (6). Although some studies suggested that self-reported BMI could be used in certain populations (7-9), many studies reported systematic errors in the self-reported BMI (6;10-12).

Underreporting of BMI is greater in certain groups. Overweight and obese individuals tend to underestimate BMI more than average weight populations and women tend to underestimate it more than men (especially overweight or obese women) (6). It appears that underreporting of weight and over-reporting of height increase with age, resulting in underestimated BMI in older populations (11). Mexican-Americans underestimate BMI more than European-Americans (13) which may be due to overestimation of height in the Mexican-American population. On the other hand, underweight individuals appear to overestimate BMI by overestimating weight (10). Some studies have found that individuals with eating disorders reported their weight and height more accurately than others (14;15).

Reasons for the systematic errors in self-reported BMI are unclear: underreporting of weight may be due to psychological factors or social norms for slimness (6), recall bias, lack of access to scale, and lack of information while no recent measurements taken at home or at clinics (13). Perceived weight and body size appears to contribute to underreporting of body weight in some populations (16).

The prevalence of overweight and obesity in Canada has continued to rise over the past several years (17;18), but these trends are based mostly on self reported height and weight. In the only study using measured height and weight among Canadians from Prince Edward Island, prevalence of obesity estimated from measured BMI was about twice of that found using self report (12). Therefore, self-estimated prevalence rates of overweight

and obesity in Canada may be underestimated. Recently, the Canadian Community Health Survey, Cycle 2.2 (CCHS-2.2) collected self-reported and measured BMI status for a sample of 18886 Canadians aged 18 and over. In this paper we compare prevalence of overweight and obesity based on the self-reported vs. measured BMI in CCHS-2.2 dataset and examine the validity of self-reported BMI.

**Objectives**

The purpose of this investigation is to examine the validity of self-reported BMI for measuring prevalence of overweight and obesity in Canada. To accomplish this, we compare mean of BMI and prevalence rates of overweight and obesity derived from measured versus self-reported heights and weights in the Canadian population using the CCHS-2.2 dataset.

**METHODS**

**Study population and sample size**

We used the CCHS-2.2 dataset provided by Statistics Canada for analysis (19). The CCHS-2.2 is a cross-sectional survey that contains information related to health status, health care utilization, and health determinants for the Canadian population. The survey was conducted between January 2004 and January 2005 in 10 Canadian provinces and includes over 35000 individuals of all ages living in private dwellings, with 98% coverage of the target population. It excluded persons living in the Territories or Crown Lands, institutional residents, full-time members of the Canadian Forces, and residents of certain remote regions. The CCHS-2.2 survey is based on a

complex design with stratification and multiple stages of selection and unequal probabilities of selection of respondents. Selection of respondents was designed to ensure adequate representation of young persons (15 to 24) and seniors (65 and over). One individual per household was randomly selected. These data include self-reported BMI for 7589 adult (18 years and over) individuals and measured BMI for 12428 adults with 1131 individuals who have both self-reported and measured BMI in the dataset.

We used the Canadian body weight classification system for adults to identify overweight and obese respondents (20). Using this system respondents are classified as *underweight* with BMI less than 18.5, *normal weight* with BMI of 18.5- 24.9, *overweight* with BMI of 25.0-29.9, and *obese* with BMI of 30 or more. Due to unreliability of BMI during pregnancy pregnant women are excluded from this analysis.

**Statistical Analysis**

The sample weights provided by Statistics Canada were used in all tabulations and estimations. First, the prevalence rates of overweight and obesity are reported based on both self-reported and measured BMI. Then, mean and standard deviation (SD) of self-reported and measured BMI are provided based on the gender, age group, and actual weight classification. For comparison purposes a cross-tabulation of discrepancies between self-reported and measured BMI is also provided. Multiple regression technique was used to evaluate the relationship between the difference of self-reported and measured BMI and variables of age, gender, actual height, and actual

weight. In this analysis measured BMI minus self-reported BMI is used as the outcome variable. The statistical packages of STATA/SE Version 8.0 and SPSS version 14.0 were used for analyses.

**RESULTS**

Age and gender distribution of the participants who were included in this analysis is shown in Table 1. The overall estimated mean (SD) of the self-reported and measured BMI are 25.8 (4.8) and 26.9 (5.0), respectively. These figures are 27.0 (4.7) and 27.2 (4.8) for males and 24.6 (4.7) and 27.0 (6.1) for females. In general, the mean of BMI underreporting is 1.2 (0.8 for men and 1.5 for women). The overall prevalence rates of overweight and obesity are 35.8% and 26.1% based on the measured BMI and 35.5% and 18.9% based on self-reported BMI. These rates vary between males and females (see Table 2) with the largest difference in the prevalence of obesity among female respondents which is 12.2% for self-reported BMI and 23.2% for measured BMI. Table 3 provides the estimated mean (SD) for self-reported and measured BMI based on gender, age group, and actual weight class. For most age groups and weight categories measured BMI is larger than self-reported BMI. Larger differences are noticed in women 41- 60 years old or overweight and obese women (Table 3).

Percentages of obesity based on age group and gender from self-reported and measured BMI are provided in Table 4. This percentage is always higher for measured BMI among women. Extensive differences are seen for

women aged 36-70; about 20% or more for age groups of 46 - 50 and 56 – 70 years old.

Figure 1 depicts the differences between self-reported BMI and measured BMI based on actual weight class, gender, and actual height. This graph indicates no specific pattern between BMI underreporting and height. However, it is apparent that female respondents showed more BMI underreporting than men. Also, heavier respondents showed more underreporting than others.

We also applied multiple regression analysis to evaluate the relationship between the BMI underreporting and variables of age, gender, actual height and actual weight. The results indicate a highly significant difference ($p < 0.001$) in underreporting of BMI between males and females. It also indicates that older and taller participants reported lesser differences between measured and self-reported BMI. On the other hand, heavier weight relates to more differences between self-reported and measured BMI (Table 5). A sub-analysis confirmed the same results for each gender.

## DISCUSSION

We found an obesity prevalence of 15.6% based on self-reported BMI and 23.1% based on measured BMI, indicating a difference of 7.5% that cannot be overlooked for its impact on public health and etiologic research. These results resemble findings from some other studies (11;13), however, the extent of the problem seems to be larger in this analysis.

Although estimating overweight and obesity using self-reported height and weight might be a common practice, this analysis shows that it involves a great deal of underestimating. Some studies have attempted methods to correct self-reported BMI, for example, John et al. (6) asked another member of the household to report the weight and height of the respondent which still resulted in underestimation of BMI. Thus, with the reported error in self-reported BMI from various populations, it is important to examine whether this method is sufficient for monitoring overweight and obesity.

This analysis confirms the finding by John et al. (6) that underreporting of BMI depends on height and weight of respondents: underreporting has direct relation with weight and inverse relation with height which means that shorter individuals over-report their heights and heavier individuals under-report their weights. Several studies from the US (11;21) and UK (22) showed an increased underreporting of BMI with age. However the results of this analysis do not support such findings. The reasons for this discrepancy are unclear. This may be due to characteristics of the Canadian population as studies have shown that self-reporting of BMI is influenced by factors such as socioeconomic status which varies internationally (21). This may also be because of different ethnicity distributions of population in Canada and US.

In addition, we found that underweight individuals tend to over-report their BMI by over-reporting their weights which is in accordance with literature (10).

The majority of studies have shown that obese participants are most likely to be misclassified and individuals with normal BMI are less likely to be incorrectly allocated to another category of BMI. Based on the CCHS-2.2 dataset, about 12% of respondents misclassified their weight classes. Most of the misclassification happened by the overweight and obese individuals; 25% of obese men and 37% of obese women misclassified themselves as overweight. Furthermore, about 20% of overweight men and 37% of overweight women misclassified themselves as having normal weight. Allocation of overweight and obese participants to a lower BMI category would underestimate the relative risks of diseases associated with increasing BMI. Hence, results of studies calculated based on self-reported weight and height should be interpreted with caution.

Spencer et al. (9) compared the self-reported and measured height and weight of 5140 participants of EPIC-Oxford study and found similar systematic error of over-estimation of height and under-estimation of weight among men and women.

Overweight and obesity have substantial effects on public health and public resources and underestimation of overweight and obesity could mislead policy makers to overlook the extent of the problem. Most importantly, this misclassification can distort the results from etiological studies about the

risk factors of overweight and obesity and underestimate the impact of the obesity related diseases.

A point worth mentioning in this analysis is that in the CCHS-2.2 survey respondents first reported their height and weight measurements and then were asked about their willingness to have their heights and weights being measured. This technique could minimize the bias of self-report measurements. Alternatively it could underestimate the problem if those persons who had knowingly misreported their heights and weights selectively refused to be measured.

In conclusion, to estimate overweight and obesity in etiological and disease relationship studies use of measured BMI is highly recommended instead of self-reported BMI. Otherwise, the finding could be distorted and unreliable. In population surveys if there is no access to the measured height and weight, then, one might expect a BMI underreporting of 1.2 and an underestimation of overweight and obesity prevalence by at least 4-5% among men and 10% among women.

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**Table 1: Age distribution and gender distribution, number (%), of the participants**

| Age group | Male | Female | Total |
|---|---|---|---|
| **18- 24** | 1289 (15.4) | 1360(12.9) | 2649 |
| **25- 30** | 766 (9.2) | 883 (8.4) | 1649 |
| **31- 35** | 474 (5.7) | 486 (4.6) | 960 |
| **36- 40** | 579 (6.9) | 565 (5.4) | 1144 |
| **41- 45** | 647 (7.8) | 687 (6.5) | 1334 |
| **46- 50** | 729 (8.7) | 840 (8.0) | 1569 |
| **51- 55** | 747 (9.0) | 894 (8.5) | 1641 |
| **56- 60** | 687 (8.2) | 834 (7.9) | 1521 |
| **61- 65** | 497 (6.0) | 749 (7.1) | 1246 |
| **66- 70** | 493 (5.9) | 651 (6.2) | 1144 |
| **≥ 71** | 1430 (17.2) | 2599 (24.6) | 4029 |
| **Total** | 8338 (100.0) | 10548 (100.0) | 18886 |

**Table 2: Prevalence (%) of overweight and obesity based on self-reported and measured BMI in men and women***

| Weight class | Self-reported | | Measured | |
|---|---|---|---|---|
| | Male | Female | Male | Female |
| Overweight | 42.1 | 31.4 | 42.0 | 30.2 |
| Obesity | 19.1 | 12.2 | 22.9 | 23.2 |
| Total | 61.2 | 43.5 | 64.9 | 53.4 |

**Table 3: Mean (SD) of self-reported and measured BMI based on gender, age, and actual weight class***

| | Gender | | | |
|---|---|---|---|---|
| | Male | | Female | |
| | SR | MD | SR | MD |
| **Age group (Year)** | | | | |
| 18-24 | 23.1 (3.0) | 24.6 (4.5) | 23.3 (3.7) | 24.2 (5.6) |
| **25- 30** | 28.1 (5.3) | 26.8 (4.9) | 25.1 (5.2) | 25.4 (6.2) |
| **31- 35** | 27.4 (3.3) | 28.6 (4.0) | 21.6 (3.7) | 26.3 (2.4) |
| **36- 40** | 27.9 (4.9) | 27.4 (5.1) | 26.1 (3.8) | 26.7 (6.3) |
| **41- 45** | 25.8 (3.1) | 27.7 (4.7) | 22.3 (4.2) | 26.4 (6.3) |
| **46- 50** | 27.5 (4.2) | 27.4 (4.2) | 25.4 (3.7) | 28.4 (6.9) |
| **51- 55** | 29.5 (5.4) | 28.7 (4.8) | 26.4 (5.8) | 27.9 (6.2) |
| **56- 60** | 27.3 (3.6) | 27.9 (4.7) | 24.4 (3.2) | 28.3 (6.1) |
| **61- 65** | 28.5 (4.0) | 28.2 (4.8) | 26.2 (3.7) | 27.3 (5.9) |
| **66- 70** | 25.5 (2.9) | 28.0 (4.5) | 26.2 (4.3) | 27.5 (5.3) |
| >= 71 | 27.2 (3.8) | 27.1 (4.4) | 26.0 (4.6) | 27.2 (5.2) |
| **Weight group** | | | | |
| Underweight | 18.8 (0.8) | 18.3 (0.5) | 18.6 (1.5) | 17.8 (0.4) |
| Normal weight | 23.0 (1.7) | 22.7 (1.7) | 21.4 (2.0) | 22.2 (1.8) |
| Overweight | 26.5 (1.7) | 27.4 (1.4) | 24.9 (3.0) | 27.2 (1.3) |
| Obese | 33.1 (4.0) | 33.9 (3.4) | 31.0 (4.4) | 35.5 (5.4) |

* SR= self-reported BMI, MD= measured BMI

**Table 4: Distribution (%) of obesity based on gender and age group**

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| **Age group (Year)** | SR | MD | (Diff) | SR | MD | Diff |
| **18- 24** | 3.1 | 10.7 | (7.6) | 4.9 | 12.1 | (7.2) |
| **25- 30** | 26.3 | 19.8 | (-6.5) | 14.3 | 17.4 | (3.1) |
| **31- 35** | 25.6 | 25.5 | (-0.1 ) | 7.2 | 15.4 | (7.2) |
| **36- 40** | 24.3 | 25.8 | (-1.5) | 6.0 | 22.7 | (16.7) |
| **41- 45** | 8.4 | 20.9 | (12.5) | 7.3 | 19.3 | (12.0) |
| **46- 50** | 10.2 | 21.7 | (11.5) | 9.7 | 31.6 | (21.9) |
| **51- 55** | 34.2 | 37.3 | (3.1) | 24.0 | 33.2 | (9.2) |
| **56- 60** | 24.0 | 26.2 | (2.2) | 8.8 | 29.7 | (20.9) |
| **61- 65** | 37.5 | 30.6 | (-6.9) | 8.1 | 28.1 | (20.0) |
| **66- 70** | 3.7 | 26.9 | (3.2) | 9.1 | 28.0 | (18.9) |
| **>= 71** | 21.5 | 20.5 | (-1.0) | 22.2 | 26.0 | (3.8) |

* SR= self-reported BMI, MD= measured BMI, Diff= MD-SR

**Table 5: Regression analysis of the relation between BMI underreporting and gender, age, measured weight, and measured height**

| Variable | Coefficient | SE | t-value | p-value |
|---|---|---|---|---|
| Constant | 10.9343 | 0.0347 | 315.20 | < 0.001 |
| Gender | 0.4911 | 0.0034 | 144.60 | < 0.001 |
| Age | -0.0828 | 0.0004 | -198.95 | < 0.001 |
| Measured weight | 0.0487 | 0.0001 | 516.84 | < 0.001 |
| Measured height | -7.9646 | 0.0190 | -418.69 | < 0.001 |

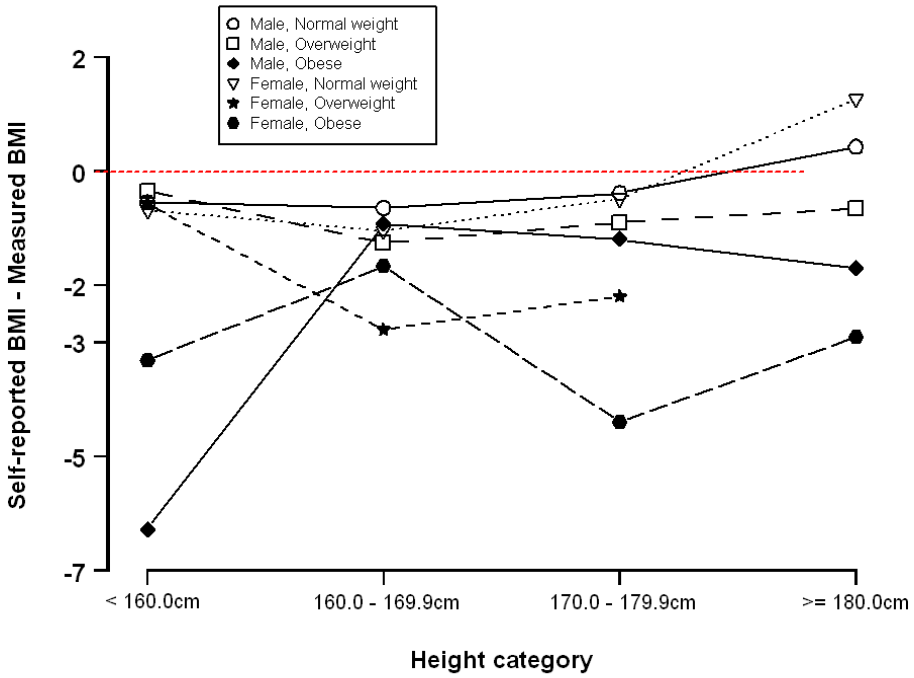


**Figure 1:** BMI difference based on gender, height, and weight class.