# Validity of Self-report Screening for Overweight and Obesity

## Evidence from the Canadian Community Health Survey

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## ABSTRACT

**Objective:** Community health surveys often collect self-report data on body height and weight for the purposes of calculating the Body Mass Index (BMI) and identifying cases of overweight and obesity. The aim of the study was to test the validity of this method and to describe age and gender trends in self-report bias in height, weight, and BMI.

**Methods:** This population survey included 4,615 adolescents and adults from across Canada who were interviewed and then measured in their homes. Overweight and obesity were identified using self-reports and cut points in BMI.

**Results:** Self-reports correlated highly with body measurements but on average, self-reported height was 0.88 cm greater than measured height, self-reported weight was 2.33 kg less than measured weight, and BMI derived from self-reports was 1.16 lower than BMI derived from measurements. Consequently, self-reports yielded lower rates of overweight (31.87%) and obesity (15.32%) than measurements (33.67% and 22.92%, respectively). The magnitude and variability of self-report bias in BMI were related to female gender, older age, and the presence of overweight or obesity.

**Discussion:** Comparison of self-reported and measured height and weight indicated that most survey respondents under-reported weight and over-reported height. Intentional or not, these biases were compounded in the BMI formula and affected the accuracy of self-reports as a tool for identifying weight problems. Self-reports may be easier to collect than body measurements but should not be used exclusively as an obesity surveillance tool.

**Key words:** Body mass index; obesity; overweight; self-report bias; validity

*La traduction du résumé se trouve à la fin de l'article.*

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The prevalence of obesity rose dramatically in the past 25 years. In Canada, as for many other developed nations, the prevalence of obesity increased from 9% to 21% in adults and from 3% to 9% in adolescents (based on body measurements).[1,2] Obesity is a major contributor to disease including type 2 diabetes, hypertension, cardiovascular disease, osteoarthritis, gallbladder disease, and some cancers,[3,4] thereby affecting people's quality of life, shortening life expectancy, and costing billions of dollars in health care expenditures each year.[5] Therefore, the accurate surveillance of overweight and obesity in the population are essential to effective public health policy.[6]

Overweight and obesity are typically identified using cut points in Body Mass Index (BMI; kg/m$^2$). In adults, a BMI between 25 and 30 indicates overweight and a BMI greater than 30 indicates obesity.[7] In children, normative age- and gender-appropriate cut points that pass through BMI values of 25 and 30 respectively at age 18 are used.[8,9] Oftentimes, for reasons of convenience or cost or to minimize assessment burden, surveys of these weight classifications rely on self-reported height and weight when calculating BMI. These data tend to correlate highly with body measurements, but too often researchers have interpreted such correlations as evidence of accurate self-reporting. The problem is that a correlation conceals bias that may be caused by social desirability and is an inappropriate statistic to test the validity of a self-report screen.[10] Even small biases in under-reporting weight and over-reporting height are compounded in the BMI formula and could have large effects on the accuracy of the measured prevalence of obesity and overweight.

Studies have shown how systematic under-reporting of body weight leads to erroneously low prevalence rates of overweight and obesity in children[11-16] and adults.[17-24] An example is a study of 1,995 adults in Prince Edward Island, Canada, that found that nearly one third of the sample was obese according to measured height and weight, double what was reported in the National Population Health Survey using self-reported height and weight.[20] In a similar study of 418 adolescents in Wales, 18.7% of the sample was identified as overweight and 4.4% was identified as obese using body measurements while self-reports produced rates of 13.9% and 2.8%, respectively.[12]

Despite evidence of inaccurate self-report screening for overweight and obesity, the technique is still commonly used to estimate the prevalence of these conditions,[25-27] to compare populations,[28-30] and to study behavioural and environmental factors that are associated with obesity.[31-36] Given its continued application in clinical and epidemiological research, self-report screening for obesity and overweight was subjected to validity testing using data from the Canadian Community Health Survey (CCHS), Cycle 3.1.[37] Previous studies compared body measurements to self-reports in relatively small samples. The CCHS collected measurements and self-reports on a national sample that was sufficiently large to permit estimation of the direction and magnitude of self-report biases across age groups. The aim of the study was to describe age and gender differences in the level of agreement between measured and self-reported height, weight and BMI.

**TABLE I**

**Mean (95% CI) Weight, Height and BMI Based on Body Measurements and Self-reports and Differences Between Measurements and Self-reports**

| | Males (n = 2120) | Females (n = 2495) | Total (n = 4615) |
|---|---|---|---|
| Measured Data | | | |
| Weight (kg) | 81.92 (80.93 – 82.92) | 68.18 (67.10 – 69.27) | 75.08 (74.28 – 75.88) |
| Height (cm) | 174.62 (174.07 – 174.18) | 161.63 (161.17 – 162.10) | 168.16 (167.69 – 168.62) |
| $BMI_M$ | 26.85 (26.51 – 27.18) | 26.14 (25.72 – 26.56) | 26.49 (26.23 – 26.76) |
| Self-reported Data | | | |
| Weight (kg) | 80.03 (79.11 – 80.96) | 65.39 (64.43 – 66.36) | 72.75 (72.00 – 73.50) |
| Height (cm) | 175.73 (175.24 – 176.21) | 162.28 (161.84 – 162.71) | 169.03 (168.59 – 169.48) |
| $BMI_{SR}$ | 25.83 (25.57 – 26.10) | 24.83 (24.47 – 25.18) | 25.33 (25.11 – 25.56) |
| Differences between Measurements and Self-reports | | | |
| Weight (kg) | 1.89 (1.62 – 2.15) | 2.79 (2.43 – 3.14) | 2.33 (2.11 – 2.56) |
| Height (cm) | -1.11 (-1.40 – -0.81) | -0.64 (-0.85 – -0.43) | -0.88 (-1.06 – -0.69) |
| BMI | 1.01 (0.84 – 1.18) | 1.31 (1.15 – 1.48) | 1.16 (1.04 – 1.28) |

**TABLE II**

**Percentage (95% CI) of Overweight and Obese Cases Based on Body Measurements and Self-reports**

| | Males (n = 2120) | Females (n = 2495) | Total (n = 4615) |
|---|---|---|---|
| Measured Data | | | |
| Obese | 24.38 (21.41 – 27.36) | 21.43 (18.90 – 23.97) | 22.92 (20.95 – 24.88) |
| Overweight | 39.31 (36.18 – 42.44) | 27.97 (25.25 – 30.69) | 33.67 (31.59 – 35.75) |
| Normal or underweight | 36.31 (33.17 – 39.44) | 50.59 (47.53 – 53.66) | 43.19 (41.20 – 45.64) |
| Self-report Data | | | |
| Obese | 15.56 (12.96 – 18.15) | 15.08 (12.82 – 17.35) | 15.32 (13.60 – 17.04) |
| Overweight | 38.71 (35.56 – 41.87) | 24.96 (22.31 – 27.60) | 31.87 (29.79 – 33.94) |
| Normal or underweight | 45.73 (42.49 – 48.97) | 59.96 (56.94 – 62.98) | 52.82 (50.57 – 55.05) |

## METHODS

### Sample and procedures

The CCHS gathered information on health determinants, health status, and health system utilization in Canada.[37] The sample was stratified to ensure representation of all health regions and socio-economic conditions in Canada. A multi-stage sampling procedure identified one individual (12 years or older) per household for a telephone or in-person interview between January and December 2005. Interviews included questions to record body height and weight, which were either reported in or later converted to metric units.

In Cycle 3.1, height and weight were also measured in a randomly selected subsample, which was representative of most regions and socio-economic conditions in Canada excluding residents of the three Territories, Indian reserves and some remote areas, and regular members of the Canadian Armed Forces. Response rates were 54% in men and 61% in women, resulting in a sample of 4,615 participants (2,120 males and 2,495 females). Reasons for not measuring height and weight were: refusal (13.6%); measuring equipment unavailable (9.0%); too tall for interviewer to measure (7.1%); interview conducted by telephone (4.5%); interview setting was a problem (3.5%); respondent's physical condition (1.8%); and other (3.0%). Interviewers measured respondents' height and weight in their homes following a standard protocol and using digital weight scale and measuring tape. Given the low response rate, Statistics Canada recalculated data weights specifically for this subsample to ensure accurate representation of the Canadian population.[1]

### Analysis

Data were analyzed using Stata 9.2 (Stata Corp., College Station, TX, USA) with bootstrap weights supplied by Statistics Canada. Three groups of weight conditions were created (normal/underweight, overweight, and obese) using cut points of 25 and 30 in adult BMI and age- and gender-adjusted cut points in child BMI.[9] Two-way analyses of variance (ANOVAs) were used to test effects of gender and age. Confidence intervals for proportions were calculated using the Newcombe's efficient-score method.[38] Bland-Altman plots were used to display agreement between BMI based on body measurements ($BMI_M$) and BMI based on self-reports ($BMI_{SR}$).[10] Brown-Forsythe's test of data heterogeneity was used to determine whether $BMI_{SR}$ was differentially variable across normal/underweight, overweight, and obese groups.[39]

## RESULTS

Self-reported height and weight and $BMI_{SR}$ were highly correlated with measured height, $r(4,614) = 0.92$, $p<0.001$, weight $r(4,614) = 0.94$, $p<0.001$, and $BMI_M$, $r(4,566) = 0.87$, $p<0.001$, respectively. However, comparison of self-reports to body measurements showed consistent under-reporting of body weight by both males and females. Table I

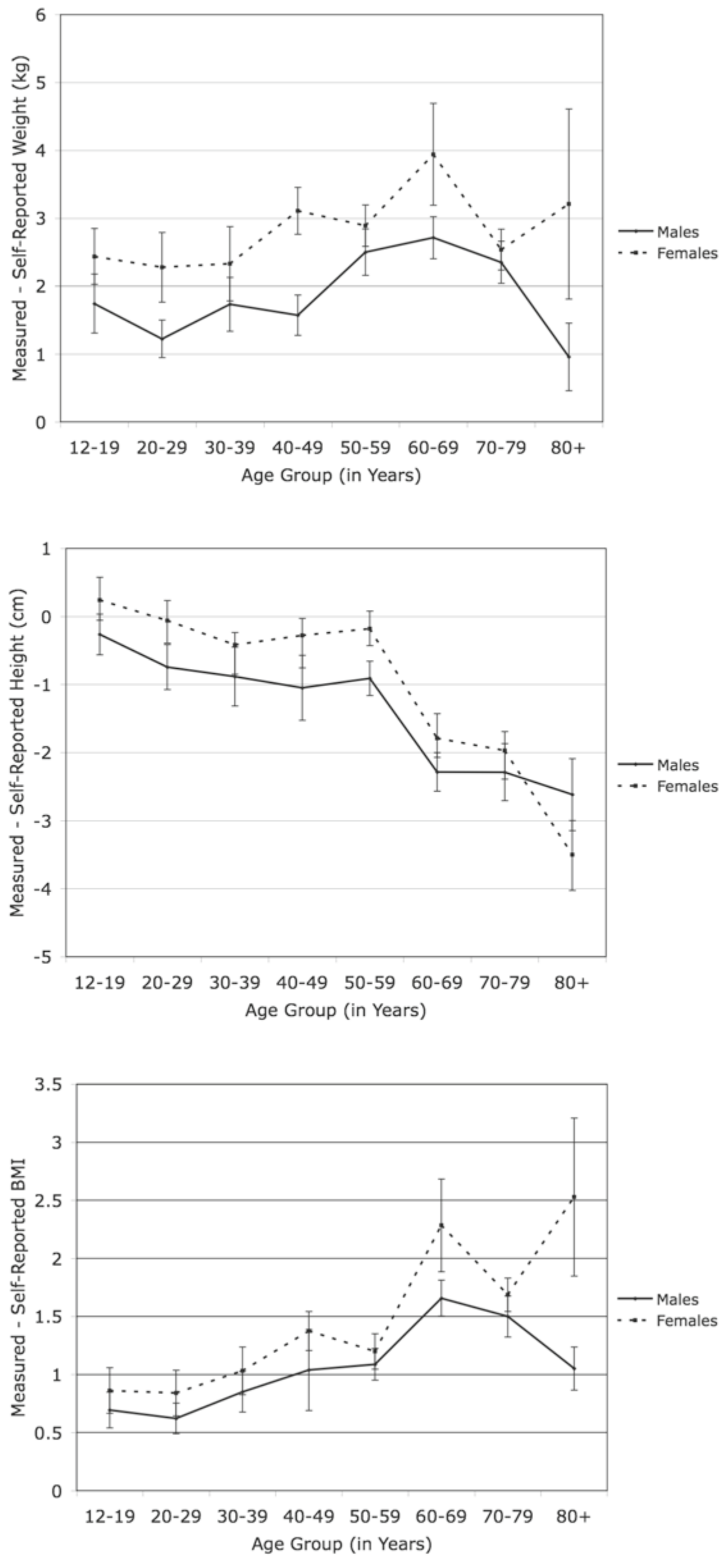


**Figure 1.** Mean bias in self-reported weight (top), height (middle), and BMI (bottom) by age and gender
Error bars show the 95% confidence interval.

shows the mean height, weight and BMI of the sample based on measured and self-reported data and the differences between measured and self-reported values. On average, measured weight was 2.33 (95% CI 2.11 to 2.56) kg greater than self-reported weight and, as shown in Figure 1, differences between measured weight and self-reported weight were greatest among women aged 60-69 years ($\bar{X}$ = 3.94, 95% CI 2.47 to 5.41 kg) and least among men aged 80 years and older ($\bar{X}$ = 0.96, 95% CI -0.02 to 1.93 kg). An ANOVA showed significant main effects of gender, $F(1, 4606) = 38.86$, $p<0.001$, and age, $F(7, 4606) = 164.46$, $p<0.001$, on the differences between measured and self-reported weight.

Self-reported height was generally accurate, within an average of 0.88 (95% CI 0.69 to 1.06) cm of measured height. There was a greater tendency to over-report height among men than women, $F(1, 4606) = 38.86$, $p<0.001$, and among older age groups than younger age groups, $F(7, 4606) = 4.39$, $p<0.001$ (Figure 1).

Tendencies to under-report weight and over-report height affected the accuracy of $BMI_{SR}$, particularly in older age groups. $BMI_M$ was, on average, greater than $BMI_{SR}$ by 1.16 (95% CI 1.04 to 1.28). Differences between $BMI_{SR}$ and $BMI_M$ were greatest among women 80 years and older ($\bar{X}$ = 2.53, 95% CI 1.19 to 3.86) and least among men in the 20-29 age group ($\bar{X}$ = 0.62, 95% CI 0.36 to 0.88). There were significant main effects of gender, $F(1, 4558) = 95.05$, $p<0.001$, and age, $F(7, 4558) = 100.15$, $p<0.001$, on the differences between $BMI_M$ and $BMI_{SR}$.

Figure 2 shows the effects of gender and weight classification on bias in $BMI_{SR}$. An interaction of gender and weight conditions was found whereby gender differences in $BMI_{SR}$ bias were most pronounced among obese individuals, $F(2, 4563) = 8.50$, $p<0.001$. This ANOVA showed main effects whereby bias in $BMI_{SR}$ was greater among women than men, $F(1, 4563) = 272.42$, $p<0.001$, and different among normal/underweight, overweight and obese groups, $F(2, 4563) = 2389.11$, $p<0.001$.

While differences between $BMI_M$ and $BMI_{SR}$ were affected by the actual weight conditions of the respondents, the level of agreement between $BMI_M$ and $BMI_{SR}$ was made clearer in a Bland-Altman analysis.[10] Figure 3 shows a moderate but significant positive correlation between discrepancies between $BMI_M$ and $BMI_{SR}$ and higher BMI values, $r(4528) = 0.32$, $p<0.001$. The cone-shaped array of data points in this plot suggests that the variability of self-report bias was different across normal/underweight, overweight, and obese groups. This observation was confirmed by a Browne-Forsythe test of data heterogeneity (i.e., an ANOVA of deviations around group medians), which indicated that bias in $BMI_{SR}$ was significantly less variable among under- or normal weight individuals ($\bar{X}$ = -0.13, 95% CI -0.35 to -0.22), as compared to overweight ($\bar{X}$ = 0.05, 95% CI -0.06 to 0.16) and obese ($\bar{X}$ = 0.76, 95% CI 0.33 to 1.19) individuals, $F(2, 4564) = 37.96$, $p<0.001$.

Cut points were applied to $BMI_{SR}$ and $BMI_{M}$ to compare prevalence estimates of overweight and obese conditions as estimated using self-report data versus measured data (Table II). According to $BMI_{SR}$, 31.87% (95% CI 29.79 to 33.94%) of the sample was overweight and 15.32% (95% CI 13.60 to 17.04%) was obese. However, $BMI_{M}$ indicated that the true prevalence of overweight was 33.67% (31.59 to 35.75%) and true prevalence of obesity was 22.92% (95% CI 20.95 to 24.88%).

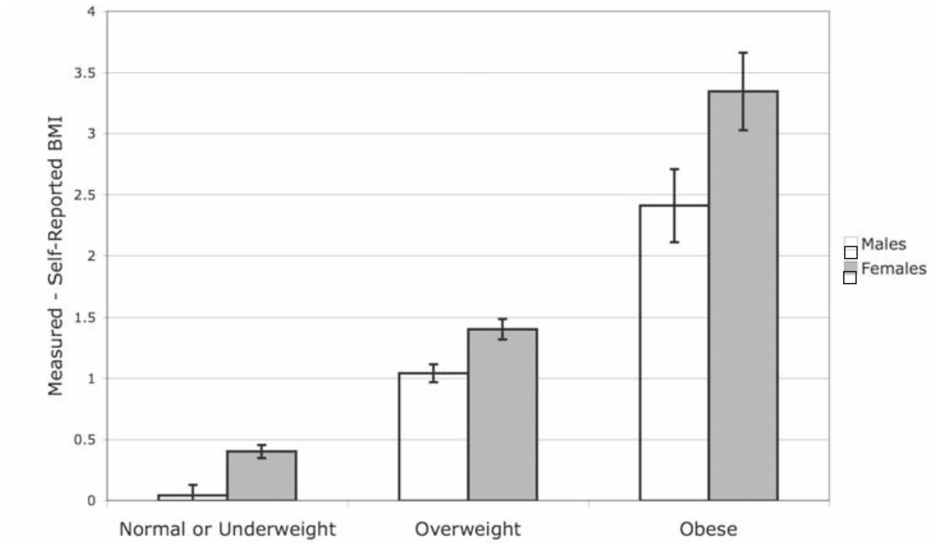


**Figure 2.** Mean bias in self-reported BMI by weight condition and gender
Error bars show the 95% confidence interval.

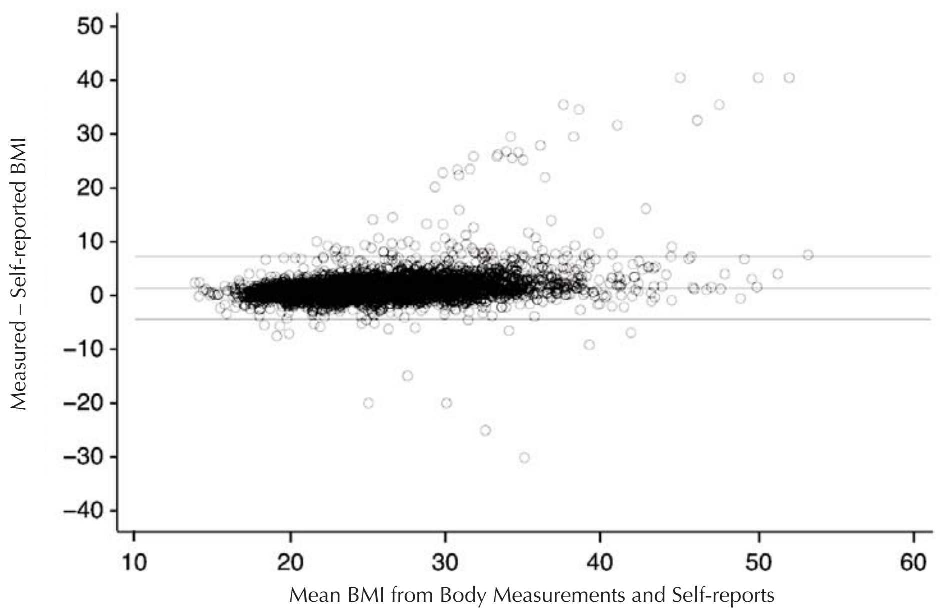


**Figure 3.** Bland-Altman plot of agreement between measured and self-reported BMI
Horizontal lines show the mean difference (1.22 $kg/m^2$) and 95% limits of agreement (-4.88 to 7.35 $kg/m^2$).

## DISCUSSION

Collecting self-report data on height and weight is a cost-efficient means of calculating BMI and determining the presence of overweight or obesity. The aim of this study was to test the accuracy of self-reported height, weight and $BMI_{SR}$ and the validity of screening for overweight and obesity using self-reports. Despite highly correlated self-reports and body measurements, self-report screening misidentified approximately one in three cases of obesity – similar to what has been reported in previous studies.[12-16] An analysis of agreement between measurements and self-reports showed how relatively small biases in weight and height together produced meaningful differences between $BMI_{SR}$ and $BMI_{M}$ and between point prevalence estimates of obesity.[1] A high correlation between a self-report screen and a valid diagnostic measure is insufficient to establish validity of the screen.[10]

A key finding of the study is that biases in self-reported height and weight were not randomly distributed and therefore cannot be easily corrected. The tendency to under-report weight was greater in women than in men, the tendency to over-report height was greater in older adults than in adolescents and younger adults, and bias in $BMI_{SR}$ changed in magnitude and variability with the presence of overweight or obese weight conditions. These trends in misreporting height and weight pose challenges in monitoring the prevalence of obesity in the population and in developing policies to combat weight problems, irrespective of whether such self-report bias is intentional or not. If it is not known who is most likely to be at risk, interventions and policies will not target the appropriate populations.

A limitation of the study was the low consent rate. Although this problem was managed with revised data weights supplied by Statistics Canada, it still might have reduced the accuracy of our estimates of self-report bias. An important strength of the study was the large size and age range of the sample, which enabled estimates of the direction and magnitude of self-report biases from adolescence to old age.

Public health researchers who study the social and behavioural determinants of obesity should be concerned with this measurement error. Accurate screening of weight problems is essential to epidemiological research and BMI criteria for measuring these problems will likely remain a key health surveillance tool.[6] Whenever possible, body measurements should be used instead of self-reports to calculate BMI. As well, caution is warranted when interpreting BMI and rates of overweight and obesity that are derived solely from self-reports. Not only do they produce erroneously low prevalence rates of weight problems but also they appear to be least accurate among individuals who are obese or at risk of becoming obese.

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## RÉSUMÉ


**Objectif :** Dans les enquêtes sur la santé dans les collectivités, on recueille souvent des données auto-évaluées sur la taille et le poids pour calculer l'indice de masse corporelle (IMC) et repérer les cas de surpoids et d'obésité. Nous avons voulu éprouver la validité de cette méthode et décrire les tendances d'âge et de sexe dans le biais d'auto-évaluation de la taille, du poids et de l'IMC.

**Méthode :** Enquête démographique auprès de 4 615 adolescents et adultes au Canada, interviewés puis mesurés à domicile. Le surpoids et l'obésité ont été repérés selon l'auto-évaluation des intéressés et les points limites de l'IMC.

**Résultats :** Les auto-évaluations affichaient une forte corrélation avec les mensurations, mais en moyenne, la taille déclarée par l'intéressé faisait 0,88 cm de plus que la taille mesurée, le poids déclaré par l'intéressé faisait 2,33 kg de moins que le poids mesuré, et l'IMC dérivée des auto-évaluations était inférieur de 1,16 à l'IMC dérivé des mensurations réelles. Par conséquent, les auto-évaluations ont donné des taux de surpoids et d'obésité inférieurs aux taux mesurés (31,87 % c. 33,67 % pour le surpoids, et 15,32 % c. 22,92 % pour l'obésité, respectivement). L'ampleur et la variabilité du biais d'auto-évaluation dans le calcul de l'IMC étaient liées au sexe féminin, à la vieillesse et à la présence de surpoids ou d'obésité.

**Discussion :** La comparaison de la taille et du poids déclarés par l'intéressé et mesurés montre que la plupart des répondants de l'enquête disent avoir un poids inférieur et une taille supérieure à leurs mensurations réelles. Qu'ils soient voulus ou non, ces biais sont aggravés lors du calcul de l'IMC et font en sorte que les auto-évaluations manquent de précision en tant qu'outils de repérage des problèmes de poids. Les auto-évaluations sont plus faciles à obtenir que la prise de mensurations, mais elles ne doivent pas être la seule mesure utilisée pour la surveillance de l'obésité.


**Mots clés :** indice de masse corporelle; obésité; surpoids; biais d'auto-évaluation; validité