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Accuracy of Self-Reported Height, Weight, and BMI Over Time in Emerging Adults

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Abstract

Introduction: Self-reported height and weight may lead to inaccurate estimates of associations between BMI and health indicators. The purpose of this study is to assess anthropometric misreporting in emerging adults, compare weight classification by self-reported and direct measures, and examine associations of self-reported and direct measures with cardiometabolic biomarkers.

Methods: Self-reported and directly measured height and weight were obtained in five waves of a nationally representative cohort study of US tenth graders (n=2,785) conducted 2010–2016; data were analyzed in 2018. Cardiometabolic biomarkers were assessed in three waves in a systematically recruited subsample (n=567). Pearson correlations (r) and Lin's concordance correlations (ρ_c) evaluated misreporting. Gwet agreement coefficient-1 evaluated weight classification agreement by self-reported and direct measures. Generalized estimating equations examined associations of cardiometabolic biomarkers with self-reported and direct measures.

Results: Participants overreported height by 1.0–1.7 cm and underestimated weight by 0.6–1.7 kg. Self-reported BMI was 0.6–1.0 kg/m^2 lower than measured. Self-reported and measured height, weight, and BMI were strongly correlated (r =0.88–0.97, 0.86–0.98, and 0.65–0.96, respectively) and concordant (ρ_c=0.82–0.96, 0.94–0.97, and 0.65–0.95, respectively). Agreement of weight classification by self-reported and direct measures ranged from Gwet agreement

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coefficient-1=0.79–0.94. Associations of ten cardiometabolic biomarkers with self-reported BMI, measured BMI, and waist circumference were similar in magnitude, direction, and precision.

Conclusions: Self-reported and measured BMI were strongly correlated and concordant, providing substantial to near-perfect agreement in weight classification. Findings suggest self-reported BMI in U.S. emerging adults provides nearly identical estimates of associations with cardiometabolic biomarkers.

INTRODUCTION

The transition from adolescence to young adulthood (emerging adulthood) is a critical period in the development of excess body weight.[1,2] Overweight/obesity prevalence in adults aged 20–39 years (70%) is roughly double that in adolescents (30%).[3] Weight gain from ages 18 to 55 years commonly exceeds 20 kg and is positively associated with risk of multiple adverse health outcomes.[4] BMI from self-reported values are widely used in large population studies, which have important strengths for investigating determinants and consequences of excess body weight in emerging adults. However, questions remain concerning whether BMI misreporting biases estimates of associations with predictors and health outcomes.[5]

In adolescents[5–9] and adults,[10] self-reported BMI underestimates measured BMI because of overreported height and underreported weight, with more underreporting of BMI in those with higher measured BMI.[6,8,9,11–14] Although some studies have reported differences in misreporting by sex and race/ethnicity, findings are variable.[12,13,15–21] Additionally, only four studies have examined misreporting in emerging adults,[22–25] and these have limited generalizability to the current population given the use of non-contemporaneous data,[23,25] or inclusion of only college[22] or female samples.[24] Furthermore, to the authors' knowledge, no studies have obtained repeated self-reported and measured values in youths or young adults.[11]

Another critical knowledge gap concerns whether BMI misreporting yields inaccurate estimates of associations with health indicators. Three studies found similar associations of diabetes diagnosis and cardiometabolic biomarkers with self-reported and measured BMI in older adults,[14,21,26] but these relationships have not been evaluated in younger samples. In addition, it is unknown whether associations of cardiometabolic biomarkers with self-reported BMI in this population differ from associations with alternative objective adiposity measures, such as waist circumference (WC), which is considered a more direct measure of central adiposity.[27,28]

The objectives of this study are to investigate in U.S. emerging adults: (1) the extent of height, weight, and BMI misreporting; (2) the stability of misreporting over time; (3) comparisons of weight classification by self-reported BMI, measured BMI, and measured WC; and (4) comparisons of associations of cardiometabolic biomarkers with self-reported BMI, measured BMI, and measured WC.

METHODS

Study Sample

Data come from the NEXT Generation Health Study,[29,30] a prospective study of a nationally representative cohort of U.S. emerging adults assessed at seven annual waves from 2010 to 2016 (83% retention in Wave 7). Prespecified endpoints included health behaviors (e.g., eating behaviors, physical activity, sedentary behavior, substance use, driving behavior) and health status indicators (e.g., BMI, WC, serum cardiometabolic biomarkers). Sampling and recruitment have been described elsewhere.[29,31] Briefly, a total of 2,785 tenth graders were enrolled using a three-stage stratified sampling method. A national subsample (NEXT Plus, *n*=567) of an approximately equal number of normal weight (fifth grade or more, <85th BMI percentile, *n*=286) and overweight participants (≥85th BMI percentile, *n*=281) was enrolled to contribute additional assessments beginning in Wave 1. The participant assessment timeline is provided in Appendix Table 1. Parental informed consent and youth assent were obtained at baseline, and youth provided informed consent upon reaching age 18 years. The IRB at the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development approved the study.

Participants completed an annual survey that queried height (in feet and inches) and weight (in pounds). Participants were asked: *How tall are you without shoes?* and *How much do you weigh without clothes?* Questions were validated in adolescents in the Youth Risk Behavior Survey.[13] Responses in inches and pounds were converted to centimeters (cm) and kilograms (kg) for analyses. Participants reported sociodemographic characteristics (age, race/ethnicity, SES) at baseline, and annually reported past-month alcohol use and smoking. Parent education was ascertained during the consent process.

Measures

Trained and certified health researchers measured height, weight, and WC of all participants at baseline and Wave 3, and for all participants attending NEXT Plus schools (both main study and NEXT Plus participants) in Wave 2. Anthropometrics of NEXT Plus participants were additionally obtained in Wave 4 and Wave 7. Anthropometrics were obtained for most participants (99%) after survey completion. After removing shoes and bulky layers of clothing, height was measured to the nearest 0.1 cm, and weight to the nearest 0.1 kg. WC was measured at the iliac crest with the waist fully exposed. Anthropometrics were obtained in duplicate; a third measurement was taken if the first two measures exceeded prespecified differences (1.0 cm for height and WC, 0.2 kg for weight). The mean of the two closest measures was used for analyses.

Home visits were conducted in NEXT Plus participants during Wave 1, Wave 4, and Wave 7 to measure blood pressure and collect blood samples that were analyzed in a central lab. Fasting blood glucose (mmol/L), HbA1c (mmol/mol), serum C-reactive protein (nmol/L), triglycerides (mmol/L), total cholesterol (mmol/L), high-density lipoprotein cholesterol (mmol/L), low-density lipoprotein cholesterol (mmol/L), and uric acid (μmol/L) were measured in Wave 1, Wave 4, and Wave 7.

Weight status was determined by measured and self-reported BMI. Until participants reached age 20 years, weight status was determined using sex- and age-specific percentile cut offs.[32] From age 20 years, weight status was determined according to adult BMI cut offs.[27] National Heart, Lung, and Blood Institute cut offs for WC (>102 cm for males; >88 cm for females) were used to classify central adiposity.[27]

Statistical Analysis

Analyses described below were performed in 2018 using Stata/SE, version 14.2. Analyses of the full sample accounted for the complex sampling design.

Misreporting was determined by subtracting measured from self-reported values. Analyses were conducted both including and excluding biologically implausible values (BIV), determined using published cut offs for youths aged ≤20 years[33] and adults.[34] Misreporting was summarized (mean and 95% CI) for each wave. To enable comparisons with previous research, Pearson's correlation coefficients between self-reported and measured values were calculated.[35] However, because the Pearson method is an inadequate indicator of reliability,[36] concordance was evaluated using Lin's concordance coefficient, a reliability measure that indicates how closely the line of correlation passes through the line of concordance (slope of 1),[37,38] and Bland and Altman's limits-of-agreement, which gives the mean and 95% prediction interval of the difference between objective measurements and self-reported values.[39] In the Next Plus subsample, generalized estimating equations examined differences in misreporting across all waves, and longitudinal relationships of misreporting with participant characteristics.

The authors compared classification of participants into categories of weight status (using measured and self-reported BMI) and central adiposity (using measured WC). Agreement of (1) self-reported with measured weight status, (2) self-reported obesity with central adiposity, and (3) measured obesity with central adiposity was estimated using Gwet's agreement coefficient (Gwet AC1),[40] a weighted agreement coefficient that is resistant to the paradoxes of κ and accommodates individuals rated by only one rater. The method calculates the probability for the agreement coefficient of falling into benchmark levels defined by Landis and Koch[41]; values of 0–0.20, 0.21–0.40, 0.41–0.60, 0.61–0.80 and >0.80 are interpreted as slight, fair, moderate, substantial, and near-perfect agreement, respectively.

Outcomes with skewed distributions were ln-transformed. Linear regression analyses examined cross-sectional relationships of cardiometabolic biomarkers with self-reported BMI, measured BMI, and measured WC to provide findings comparable with previous studies. Additionally, to improve statistical efficiency and power, generalized estimating equation models estimated longitudinal associations of cardiometabolic biomarkers with self-reported BMI, measured BMI, and measured WC using data from all assessments in the NEXT Plus subsample. Models adjusted for height, sex, concurrent age, race/ethnicity, smoking, and alcohol use.

RESULTS

The sample was aged ≅16 years at baseline, and 54% female (Appendix Table 2). Approximately half the participants were non-Hispanic white, and 40% of the full sample (49% of the NEXT Plus subsample) were overweight or obese.

In each wave, between 1.0% and 1.4% of self-reported heights and 0.2% and 0.8% of self-reported weights were biologically implausible. In the full sample, height was overreported by 1.4–1.5 cm and weight underreported by 0.92–1.8 kg, leading to underreporting of BMI by up to 1 kg/m^2 (Table 1). NEXT Plus participants overreported height by 1.00–1.56 cm and underreported weight by 0.63–1.36 kg, leading to BMI underreporting of 0.53–0.86 kg/m^2.

Measured and self-reported height, weight, and BMI in each wave were strongly correlated. As shown in Appendix Table 3, Pearson's correlations were $r \geq 0.94$ for self-reported and measured height, ≥0.96 for weight, and ≥0.93 for BMI (excluding BIV). Lin's concordance correlations were $\rho_c \geq 0.93$ for height (except for Wave 1 in the NEXT Plus subsample, $\rho_c = 0.83$), ≥0.95 for weight, and ≥0.92 for BMI. Including BIV had minimal effect on estimates of correlation or concordance, except for Wave 1 height (full sample and NEXT Plus subsample) and BMI (full sample) because of the sensitivity of correlation and concordance measures to outliers. Limits- of-agreement were within 3–4 kg/m^2 for BMI and were smaller in analyses excluding BIV.

Models examining longitudinal associations of participant characteristics with misreporting (Table 2) indicate that height overreporting was stable over time; the positive coefficients of wave in models estimating weight and BMI misreporting reflect less underreporting over time. Baseline age was not associated with height misreporting, but older age was associated with greater weight and BMI underreporting.

Mean misreporting for each covariate group was calculated from the regression coefficients, holding other covariates fixed at the referent values. Normal weight participants overreported height by an average of 1.01 (SE=0.11 cm), accurately reported their weight (misreporting= 0.007 [SE=0.15 kg]), and underreported their BMI by 0.25 (SE=0.06 kg/m^2). Relative to normal weight participants, overweight and obese participants, respectively, had greater height overreporting (by 1.69 [SE=0.14] and 1.51 [SE=0.15 cm]), weight underreporting (by −1.10[SE=0.21] and −3.10 [SE=0.21 kg]), and BMI underreporting (by −0.90 [SE=0.08] and –1.65 [SE=0.08 kg/m^2]). Males had greater height overreporting (1.85 [SE=0.12 cm]) than females (0.87 [SE=0.11 cm]), and less weight underreporting (−0.80 [SE=0.16 kg]) than females (−1.13 [SE=0.15 kg]); BMI underreporting was similar across sexes (−0.77 [SE=0.06 kg/m^2] for males and −0.69 [SE=0.06 kg/m^2] for females). Misreporting was not associated with race/ethnicity (Table 2), except that BMI underreporting was lower (more accurate) in black relative to white participants.

From measured BMI, the prevalence of normal weight was slightly lower, and obesity slightly higher, than estimates from self-reported BMI (Table 3). The estimated prevalence of overweight was similar according to measured and self-reported BMI.

Agreement between self-reported and measured weight status in each wave was ≥94%, with Gwet AC1 ≥0.90 (Appendix Table 4). Agreement between measured central adiposity versus self-reported and measured overweight/obesity was ≥83%, with Gwet AC1 ranging from 0.72 to 0.96. Probabilistic benchmarks were between 0.80 and 1.00, indicating near-perfect agreement for all comparisons other than the agreement of central adiposity with measured and self-reported obesity in Wave 4 and Wave 7 (which were between 0.60 and 0.80, indicating substantial agreement). In Wave 2 and Wave 3, Gwet AC1 of central adiposity with self-reported obesity was equivalent to that with measured obesity; Gwet AC1 of central adiposity with self-reported obesity was greater than that with measured obesity in Wave 1, Wave 4, and Wave 7.

Longitudinal model estimates (Table 4) indicated similar associations of cardiometabolic biomarkers with measured and self-reported BMI. Two noticeable differences include: (1) the positive association of fasting glucose with measured BMI was larger than the association with self-reported BMI; (2) systolic blood pressure was positively associated with both measured and self-reported BMI, but the association was stronger for measured BMI. Furthermore, associations of cardiometabolic biomarkers with measured and self-reported BMI were similar to those with measured WC. Fasting glucose was also not associated with measured WC. Estimates were similar in the unadjusted and adjusted models.

In cross-sectional analyses (Appendix Table 5), comparison of nearly 30 wave-specific associations of measured and self-reported BMI with cardiometabolic biomarkers yielded only two noticeable differences: (1) Wave 1 HbA1c was positively associated with both measured and self-reported BMI, but the association with self-reported BMI was smaller and had a larger SE; (2) the positive association in Wave 7 of fasting blood glucose with self-reported BMI had a larger SE than with measured BMI. Estimates give similar interpretations of the direction, magnitude, and precision for the relationships of cardiometabolic biomarkers with BMI regardless of whether BMI was measured or self-reported. Associations of cardiometabolic biomarkers with measured WC were similar in direction, magnitude, and precision to those of self-reported and measured BMI.

DISCUSSION

In this cohort of U.S. emerging adults, findings demonstrate modest weight underreporting and height overreporting leading to BMI underestimation by 0.5–1 kg/m^2, consistent with previous studies.[10] Self-reported and measured values were strongly correlated and had high concordance. There was near-perfect agreement in weight classification by measured and self-reported BMI, and overweight/obesity classification from both measures had substantial or near-perfect agreement with central adiposity calculated from measured WC. Few differences were observed between associations of measured and self-reported BMI with ten cardiometabolic biomarkers assessed at three time points, and estimates were similar to associations with measured WC.

Several measures of correlation, concordance, and agreement reflect strong similarities between self-reported and measured height, weight, and BMI, supporting findings of previous investigations. Pearson correlations in adults generally exceed r=0.73, whereas those in youth exceed r=0.90.[5,22,42–45] Although underestimation of overweight prevalence is typical, evidence consistently shows strong agreement of weight classification according to self-reported and measured BMI.[22,45] Furthermore, findings from this study indicate substantial or near-perfect agreement (Gwet AC1 ≥0.73) of central adiposity calculated from measured WC with obesity classification based on measured and self-reported BMI, consistent with findings from one previous study examining agreement of central adiposity with self-reported BMI (κ=0.79).[26] The totality of the evidence thus indicates that, on a population level, self-reported BMI is a reliable and valid indicator of measured BMI and weight status in adolescents and young adults.

Height misreporting did not change from ages 16 to 23 years, although self-reported weight and BMI became more accurate over time. Age was unassociated with height misreporting, but older baseline age was associated with greater weight and BMI underreporting. This is the first study to examine misreporting longitudinally in this age group and is somewhat contrasting to cross-sectional studies showing greater misreporting of height and BMI in older versus younger adolescents,[8,12,13,42] although findings are mixed.[46–48] Cross-sectional studies of older adults indicated positive associations of age with greater height overreporting.[15,17,18,49] In the present study, the association of older baseline age with greater weight and BMI underreporting replicate previous findings, whereas reduced misreporting over time is a novel finding that may reflect a practice effect wherein the repeated experience may have improved self-reporting accuracy.

Misreporting differed by measured weight status and sex in multivariable longitudinal models. Greater height overreporting, weight underreporting, and BMI underreporting in those with measured overweight and obesity is consistent with the literature.[6,17,18,50–52] The mean difference in BMI underreporting between obese versus normal weight participants was less than 1.5 kg/m^2, comparable with previous estimates.[10,11] Additionally, although there was more height overreporting in males and weight underreporting in females, BMI misreporting was similar between sexes. Several studies have reported greater weight underreporting in females relative to males[11] leading to greater BMI underreporting,[44] although greater BMI reporting accuracy in females has also been observed.[7] Findings are mixed regarding racial/ethnic differences in misreporting.[9,13,19] In this study, BMI was more accurately reported in black versus white participants. Discrepancies with previous studies may relate to different sample characteristics (e.g., racial/ethnic representation) and analytic methods (e.g., bivariate versus multivariable models). This is also the first study to present findings from longitudinal models. Taken together, available evidence does not indicate a consistent association of BMI misreporting with sociodemographic characteristics.

Associations of cardiometabolic biomarkers with measured and self-reported BMI were similar in magnitude, direction, and precision. Both BMI measures were associated with worse cardiometabolic biomarkers, comparable with cross-sectional associations in adults.[14,26] Additionally, the comparable associations of cardiometabolic biomarkers with self-reported BMI and WC support previous findings in adults showing similar associations with percentage body fat assessed by bioelectrical impedance analysis.[14] The present study extends previous work to adolescents and young adults and demonstrates consistent findings across multiple cross-sectional analyses and longitudinal repeated measures models. Findings thus indicate that measured BMI, self-reported BMI, and measured WC lead reliably to similar conclusions regarding associations with multiple cardiometabolic biomarkers.

Study strengths include the large, diverse, national sample, the repeated assessment of self-reported and objective measures over five assessment waves spanning 7 years and the 83% retention rate. Self-reported values were predominantly obtained prior to technician-obtained anthropometrics, and the proximity of the measures was uncorrelated with the degree of misreporting. The repeated measures of WC and multiple cardiometabolic biomarkers in the subsample enabled an in-depth investigation of the validity of self-reported BMI with respect to these known risk factors that has not been undertaken previously.

Limitations

Although availability of measured values at all waves in the full sample rather than the subsample would strengthen this study, missingness by design can be regarded as missing-at-random, such that analyses based on the subsample provided valid estimates. One limitation is that because participants were required to report whole units, this likely biased (increased) misreporting estimates, maximally for participants with true values at the half measure. Future research may improve reporting accuracy by providing the option to report unit fractions. Another consideration is that self-reported values were not cleaned other than identifying BIV to conduct sensitivity analyses; studies that assess height and weight in multiple ways (e.g., self-report and measured) and repeatedly over time, may employ additional data cleaning steps to further reduce error introduced by self-reported values.

CONCLUSIONS

Even though it will be important to replicate these findings in other studies, these findings suggest that self-reported BMI provides reliable and valid estimates of measured BMI in U.S. adolescents and young adults, and produced similar estimates of associations with cardiometabolic biomarkers that were comparable with associations with measured WC. Although self-reported obesity prevalence was modestly underestimated versus measured values, there was strong concordance between self-reported and measured height, weight, and BMI, and strong to near-perfect agreement in classification of self-reported weight status and measured central adiposity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Mean (95% CI) Misreporting[a] Over Time in U.S. Emerging Adults

	Full sample[b]			Subsample[c]		
Wave	**Height, cm**	**Weight, kg**	**BMI (kg/m^2)**	**Height, cm**	**Weight, kg**	**BMI (kg/m^2)**
1	1.39 (1.07, 1.7)	−1.77 (−2.4, −1.2)	−1.04 (−1.3, −0.7)	1.24 (0.9, 1.6)	−1.36 (−1.7, −1.0)	−0.86 (−1.0, 0.7)
2	1.45 (1.2, 1.7)	−0.92 (−1.2, −0.6)	−0.73 (−0.8, −0.6)	1.30 (1.1, 1.5)	−1.09 (−1.5, −0.7)	−0.80 (−1.0, −0.6)
3	1.48 (1.3, 1.7)	−0.97 (−1.3, −0.7)	−0.77 (−0.9, −0.6)	1.56 (1.3, 1.8)	−0.76 (−1.1, −0.4)	−0.74 (−0.9, −0.6)
4	–	–	–	1.25 (1.0, 1.5)	−0.63 (−1.1, −0.2)	−0.53 (−0.7, −0.4)
7	–	–	–	1.00 (0.7, 1.3)	−0.93 (−1.4, −0.4)	−0.64 (−0.8, −0.4)

[a]Measured subtracted from self-reported values; estimates exclude biologically implausible values for self-reported height or weight.

[b]n=2,784, mean ± SD wave 1 age = 16.3 ± 0.5 years.

[c]n=567.

Table 2.

Misreporting[a] Over Time, and Associations With Participant Characteristics in the NEXT Plus Subsample

	Height, cm		Weight, kg		BMI, kg/m^2	
Independent variables	**β (SE)**	***p*-value**	**β (SE)**	***p*-value**	**β (SE)**	***p*-value**
Wave	−0.04 (0.04)	0.29	0.20 (0.06)	**0.002**	0.10 (0.03)	**<0.001**
Baseline age, years	0.22 (0.16)	0.16	−0.77 (0.21)	**<0.001**	−0.26 (0.08)	**0.002**
Measured weight status[b]						
Underweight	0.75 (0.55)	0.18	1.13 (0.81)	0.16	0.64 (0.33)	0.06
Normal weight (ref)						
Overweight	0.61 (0.16)	**<0.001**	−1.11 (0.24)	**<0.001**	−0.65 (0.10)	**<0.001**
Obese	0.42 (0.18)	**0.02**	−3.10 (0.25)	**<0.001**	−1.40 (0.10)	**<0.001**
Sex						
Male (ref)						
Female	−0.98 (0.17)	**<0.001**	−0.33 (0.22)	0.13	0.08 (0.09)	0.35
Race/ethnicity						
Non-Hispanic white (ref)						
Non-Hispanic black	−0.46 (0.24)	0.05	0.14 (0.31)	0.64	0.27 (0.12)	**0.03**
Hispanic	−0.04 (0.19)	0.83	−0.22 (0.25)	0.36	−0.06 (0.10)	0.52
Other	−0.13 (0.40)	0.74	−0.37 (0.52)	0.48	−0.19 (0.20)	0.37

Note: Boldface indicates statistical significance ($p<0.05$).

[a]Estimates from longitudinal generalized estimating equations excluding biologically implausible self-reported values.

[b]Weight classification according to Centers for Disease Control and Prevention age- and sex-specific BMI percentile cut-offs until age 20 years (underweight= <5; normal weight= ≥5, <85; overweight= ≥85, <95; obese= ≥95). From age ≥20 years, underweight=BMI <18.5; normal weight=BMI ≥18.5, <25; overweight=BMI ≥25, <30; obese=BMI ≥30.

Table 3.

Weight Classification (Prevalence [%] and 95% CI) Based on Measured and Self-Reported BMI (kg/m^2)

Wave/Weight classification	Full sample[a]		NEXT Plus subsample	
	Measured BMI	Self-reported BMI[b]	Measured BMI	Self-reported BMI
1				
Underweight[c]	1.4 (0.8, 2.6)	1.7 (0.9, 3.2)	0	1.6 (0.8, 3.3)
Normal weight	59.5 (55.9, 63.0)	68.2 (64.2, 71.9)	51.0 (46.8, 55.1)	61.0 (56.3, 65.5)
Overweight	18.5 (16.5, 20.7)	16.9 (14.4, 19.7)	22.8 (19.5, 26.4)	19.0 (15.6, 23.0)
Obese	20.6 (17.9,23.5)	13.2 (10.9, 15.9)	26.3 (22.8, 30.1)	18.3 (15.0, 22.3)
2				
Underweight	1.9 (1.1, 3.3)	2.9 (1.7, 4.9)	1.2 (0.5, 0.03)	1.5 (0.7, 3.2)
Normal weight	63.6 (59.9, 67.2)	67.7 (63.4, 71.8)	55.7 (51.4, 59.9)	62.8 (58.3, 67.1)
Overweight	16.0 (13.3, 19.0)	16.5 (13.5, 19.9)	20.0 (16.7, 23.6)	16.8 (13.7, 20.6)
Obese	18.5 (15.6, 21.8)	12.9 (11.2, 15.0)	23.2 (19.8, 27.1)	18.8 (15.5, 22.7)
3				
Underweight	2.2 (1.4, 3.6)	3.3 (2.2, 5.0)	1.0 (0.4, 2.4)	1.5 (0.6, 3.7)
Normal weight	61.9 (57.6, 65.9)	66.0 (60.5, 71.2)	55.7 (51.3, 60.0)	62.2 (56.8, 67.4)
Overweight	15.4 (12.6, 18.5)	16.3 (13.0, 20.2)	19.9 (16.6, 23.7)	19.8 (15.8, 24.5)
Obese	20.6 (17.1, 24.5)	14.4 (11.6, 17.7)	23.3 (19.8, 27.3)	16.4 (12.7, 20.9)
4				
Underweight			2.3 (1.3, 4.3)	2.4 (1.3, 4.6)
Normal weight			52.9 (48.2, 57.6)	56.5 (51.4, 61.5)
Overweight			21.3 (17.7, 25.5)	22.6 (18.6, 27.1)
Obese			23.4 (19.6, 27.7)	18.5 (14.8, 22.8)
7				
Underweight			2.5 (1.1, 4.5)	2.3 (1.1, 4.5)
Normal weight			31.4 (27.1, 36.1)	36.4 (31.5, 41.5)
Overweight			31.7 (27.3, 36.4)	33.0 (28.2, 38.1)
Obese			34.4 (29.9, 39.2)	28.4 (23.9, 33.4)

[a]Weighted estimates are presented for the full sample.

[b]Biologically implausible self-reported values excluded from analyses.

[c]Weight classification according to Centers for Disease Control and Prevention age- and sex-specific BMI percentile cut-offs until age 20 years (underweight= <5; normal weight= ≥5, <85; overweight= ≥85, <95; obese= ≥95). From age ≥20 years, underweight=BMI <18.5; normal weight=BMI ≥18.5, <25; overweight=BMI ≥25, <30; obese=BMI ≥30.

Table 4.

Associations of Self-Reported and Measured BMI (kg/m^2) With Cardiometabolic Biomarkers[a]

	Measured BMI, kg/m^2		Self-reported BMI, kg/m^2		Waist circumference, cm	
Dependent variables	**β (SE)**	***p*-value**	**β (SE)**	***p*-value**	**β (SE)**	***p*-value**
CRP, nmol/L[b]						
Unadjusted	0.13 (0.007)	**<0.001**	0.12 (0.008)	**<0.001**	0.05 (0.003)	**<0.001**
Adjusted	0.13 (0.007)	**<0.001**	0.13 (0.008)	**<0.001**	0.05 (0.003)	**<0.001**
Triglycerides, mmol/L[b]						
Unadjusted	0.02 (0.002)	**<0.001**	0.02 (0.003)	**<0.001**	0.01 (0.0009)	**<0.001**
Adjusted	0.02 (0.002)	**<0.001**	0.02 (0.003)	**<0.001**	0.01 (0.0009)	**<0.001**
HbA1c, mmol/mol[b]						
Unadjusted	0.003 (0.0006)	**<0.001**	0.003 (0.0007)	**<0.001**	0.001 (0.0003)	**<0.001**
Adjusted	0.003 (0.0006)	**<0.001**	0.003 (0.0007)	**<0.001**	0.001 (0.0003)	**<0.001**
Fasting glucose, mmol/L[b]						
Unadjusted	0.002 (0.0006)	**0.005**	0.001 (0.0007)	0.07	0.0004 (0.0002)	0.07
Adjusted	0.002 (0.006)	**0.007**	0.001 (0.0007)	0.07	0.0004 (0.0002)	0.11
Total cholesterol, mmol/L						
Unadjusted	0.03 (0.003)	**<0.001**	0.03 (0.005)	**<0.001**	0.01 (0.002)	**<0.001**
Adjusted	0.03 (0.004)	**<0.001**	0.03 (0.005)	**<0.001**	0.01 (0.002)	**<0.001**
HDL-C, mmol/L						
Unadjusted	−0.02 (0.002)	**<0.001**	−0.02 (0.002)	**<0.001**	−0.008 (0.0006)	**<0.001**
Adjusted	−0.02 (0.002)	**<0.001**	−0.02 (0.002)	**<0.001**	−0.007 (0.0006)	**<0.001**
LDL-C, mmol/L						
Unadjusted	0.03 (0.003)	**<0.001**	0.03 (0.004)	**<0.001**	0.01 (0.001)	**<0.001**
Adjusted	0.03 (0.003)	**<0.001**	0.03 (0.004)	**<0.001**	0.01 (0.001)	**<0.001**
Uric acid, umol/L						
Unadjusted	3.90 (0.37)	**<0.001**	3.90 (0.41)	**<0.001**	1.78 (0.15)	**<0.001**
Adjusted	3.73 (0.31)	**<0.001**	3.78 (0.35)	**<0.001**	1.65 (0.13)	**<0.001**
Systolic BP, mmHg						
Unadjusted	0.16 (0.06)	**0.005**	0.13 (0.06)	**0.04**	0.08 (0.02)	**<0.001**
Adjusted	0.11 (0.05)	**0.03**	0.09 (0.06)	0.09	0.05 (0.02)	**0.02**
Diastolic BP, mmHg						
Unadjusted	0.41 (0.04)	**<0.001**	0.36 (0.05)	**<0.001**	0.17 (0.02)	**<0.001**
Adjusted	0.40 (0.04)	**<0.001**	0.35 (0.05)	**<0.001**	0.17 (0.02)	**<0.001**

Note: Boldface indicates statistical significance (p<0.05).

[a]Estimates from generalized estimating equation models examining longitudinal associations. Analyses include data from three assessment waves, and exclude biologically implausible self-reported BMI values. Models were adjusted for adjusted for time, baseline age, sex, race/ethnicity, and time-varying height, past-month alcohol consumption and smoking.

[b]Indicates continuous outcomes were transformed using the natural logarithmic function.

BP, blood pressure; CRP, c-reactive protein; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol.