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Validity of self-reported body mass and height: relation with sex, age, physical activity, and cardiometabolic risk factors

Validade da massa corporal e da estatura autorreferidas: relações com sexo, idade, atividade física e fatores de risco cardiometabólicos

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ABSTRACT: ***Objective:*** To evaluate the validity of self-reported body mass and height measurements in adolescents, adults and older adults according to sex, age, leisure-time physical activity level, nutritional status, and cardiometabolic risk factors. ***Methods:*** The study included 856 subjects, aged 12 years or older, who participated in the São Paulo Health Survey (ISA-2015) and who had their body mass and height measured and self-reported. Based on the Body Mass Index (BMI), a classification of nutritional status was made according to standardized criteria for each phase of life. The validation of self-reported data was examined by the Intraclass Correlation Coefficient, Bland-Altman and paired T-Test. Linear regression models were used to estimate the calibration coefficients, and sensitivity and specificity tests were performed. ***Results:*** Self-reported body mass and height values tend to be very similar to measured values, with a few exceptions. For the adolescents, an underestimation of height was noted, while for the older adults, an overestimation. There was a consistent underestimation of self-reported body mass among women, and an overestimation of BMI among men who practiced less than 150 minutes of physical activity per week during leisure time. The calibration process of self-reported measures made them more consistent with the values measured, increasing the sensitivity in the classification of nutritional status among women and the specificity among men. ***Conclusions:*** Self-reported measures of height, body mass and BMI provided valid and reliable measures, presenting a substantial improvement after calibration.

Keywords: Validation study. Health surveys. Body weight. Body height. Body mass index. Sensitivity and specificity.

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RESUMO: ***Objetivo*****:** Avaliar a validade da massa corporal e da estatura autorreferidas em adolescentes, adultos e idosos segundo sexo, idade, nível de atividade física no lazer, estado nutricional e fatores de risco cardiometabólicos. ***Métodos*****:** Participaram do estudo 856 sujeitos, com 12 anos ou mais, que responderam ao Inquérito de Saúde de São Paulo (ISA-2015) e que possuíam a massa corporal e a estatura autorreferidas e aferidas. Com base no índice de massa corporal, realizou-se uma classificação do estado nutricional de acordo com critérios padronizados para cada fase da vida. A validade das medidas autorreferidas foi examinada usando o coeficiente de correlação intraclasse, Bland-Altman e o teste *t* pareado. Utilizaram-se regressões lineares para elaborar os coeficientes de calibração, e realizaram-se testes de sensibilidade e especificidade. ***Resultados*****:** Os principais resultados apontam que os valores de massa corporal e estatura autorreferidas tendem a ser bem similares aos aferidos, apesar de algumas exceções. Para os adolescentes, notou-se uma subestimação da estatura, ao passo que, para os idosos, houve superestimação. Com relação à massa corporal, houve consistente subestimação da medida autorreferida entre as mulheres. Entre os homens que praticavam menos de 150 minutos semanais de atividade física no lazer, notou-se superestimação do índice de massa corporal. O processo de calibração das medidas autorreferidas tornou-as mais concordantes com as medidas aferidas, aumentando a sensibilidade na classificação do estado nutricional entre as mulheres e a especificidade entre os homens. ***Conclusões*****:** As medidas autorreferidas de estatura, massa corporal e índice de massa corporal forneceram medidas válidas e confiáveis, apresentando melhoras substanciais após a calibração.

Palavras-chave**:** Estudo de validação. Inquéritos epidemiológicos. Peso corporal. Estatura. Índice de massa corporal. Sensibilidade e especificidade.

INTRODUCTION

Self-reported body mass (BM) and height are often used to calculate the body mass index (BMI) in order to quantify excess weight and obesity in epidemiological studies[1], because of the ease of data collection and logistics, as well as low cost and time required — with questionnaires or interviews —, when compared to anthropometric measurements[2].

However, self-reported values are susceptible to important limitations such as social desirability bias[3], memory difficulties and body image perception[4]. Thus, it is essential to assess the extent of error present in the calculation of BMI based on self-reported measures before applying them in epidemiological studies. Otherwise, incorrect information for BMI calculation can produce inaccurate results from associations with other health indicators.

Review studies indicate that, in general, people tend to overestimate their height and underestimate their BM[5-7], leading to a potential bias in the estimates of BMI[7,8]. Other studies have identified several factors that are associated with inaccurate reporting of height and/or BM, including gender, height and actual BM measured, nutritional status, recent medical appointments, health history[9-17], and nutritional status[18-20]. Especially regarding age, the literature does not bring clear evidence. While studies show that differences between actual and self-reported BM tend to increase with age[10,21], others point to a U-shaped relationship, with younger and older people underestimating it[18], or even with age not influencing the precision of the self-reported measure[22,23].

Although there is a substantial body of evidence regarding the behavior of self-reported measures between genders and nutritional status, there is little evidence of how these measures behave as a function of cardiometabolic risk factors, such as physical inactivity, hypertension, dyslipidemia, diabetes[24-26], yet these self-reported measures are frequently used in epidemiological studies[27]. It is justifiable to explore the accuracy of these measures, specifically in these subgroups, as the presence of such conditions can change the precision with which individuals report their information. There could be, for example, greater knowledge due to more frequent medical follow-ups or even greater underreporting of BM due to the stigma associated with these conditions[28,29].

Another gap to be explored involves the calibration process, in which imprecise statements of BM and height are made more accurate through statistical adjustments. Although studies in Brazil[30,31] and in other countries around the world[32-35] have addressed this type of strategy, the magnitude of this possible improvement is still little explored.

Thus, the objectives of this study were:

- to analyze the relations and validity of self-reported BM and height per biological sex, age, leisure-time physical activity, nutritional status and cardiometabolic risk factors;
- to perform calibration coefficients to adjust BM, height and BMI measurements for each of the mentioned subgroups.

METHODS

This study is part of the São Paulo Health Survey, a cross-sectional population-based study conducted in 2014/15 in the city of São Paulo, Brazil (ISA-2015)[36]. This dataset is also part of the baseline of the longitudinal study entitled "ISA: Physical Activity and Environment"[37], whose objective was to verify the relations between the built environment where people live and work and the practices of physical activity in the period of leisure, while commuting between environments and nutritional status. The city of São Paulo has 12,325,232 million inhabitants, with a population density of 7,398.26 inhabitants per km^2 [38].

A subsample of the ISA-2015 was used in a study called ISA-Nutrition[39], which, in addition to being added to the baseline of the survey (n = 4,043), was used in two other subsequent steps: application of dietary recall (n = 1,737) and blood sample collection, blood pressure measurement and anthropometric assessment (n = 901)[39]. In short, the baseline sampling was carried out by clusters and stratified into two stages (urban census sectors and households), and all residents aged 12 years and over were invited to participate in the study[40].

Of the 901 subjects who participated in the ISA-Nutrition, 856 had their BM and height self-reported and measured. Self-reported measurements were obtained by the questions: "What is your weight?" and "How tall are you?".

The BM and height of the participants were measured in duplicate, and in the face of a ≥5% difference, an additional measurement would be collected and the discrepant measurement, discarded.

Data collection was conducted by four trained nursing technicians with previous experience in anthropometric measurements. The training was based on a manual produced for this purpose[41] and on the recommendations by the Ministry of Health[42].

After the first week of data collection, a new training was carried out to standardize the procedures and solve possible queries. Additionally, there were daily meetings between the anthropometrists and the team of coordinators to verify the data collected, discuss difficulties and clarify queries.

During data collection, participants remained barefoot, wearing light clothing and no adornments that could interfere with the measurement[39]. To measure the BM, a digital scale (Tanita®, model HD-313, accurate to 100 g) was used, calibrated and checked daily, supported on a flat, firm, smooth surface, away from the wall. The individuals were positioned in the center of the scale, in orthostatic position, with feet parallel and together, and arms positioned along the body. To measure height, a portable stadiometer (Seca®, model 208, with 0.1 cm precision) was used, fixed to a smooth wall and without a baseboard, with the subjects' heads positioned in the Frankfürt plane, with heels, calves, buttocks, shoulders and back of the head touching the wall and the upper part of the head against the stadiometer shaft.

The average time elapsed between the reporting of measurements and actual measurement was 131.9 standard deviations = 118.5 days. The mean values of BM and height of each participant were used to calculate BMI, which was used to classify the nutritional status of the participants into three categories. Adolescents (12 to 17 years old) were classified as not overweight when BMI ≤ +1 standard deviation (SD) of the *Z*-score for BMI/age, overweight when +1 SD < BMI ≤ +2 SD, and obese when BMI > +2 DP[43]. For adults and the elderly (18 years or older), the following cutoff points were adopted: BMI < 25 kg/m^2 = not overweight, 25 kg/m^2 ≤ BMI < 30 kg/m^2 = overweight, and BMI ≥ 30 kg /m^2 = obese[44].

Participants were considered physically active during leisure time when they performed at least 150 weekly minutes of moderate-intensity physical activity, 75 weekly minutes of vigorous activity or the equivalent combination of moderate and vigorous physical activity. Information about leisure-time physical activities was evaluated using the International Physical Activity Questionnaire, long version[45].

Participants were categorized into two cardiometabolic risk groups, having three or more of the following conditions as cutoff:

- obesity (BMI ≥ 30 kg/m^2 for adults[46] and BMI > +2 SD for adolescents);
- diabetes (fasting plasma glucose ≥ 126 mg/dL or drug treatment for diabetes) or insulin resistance (HOMA-IR ≥ 2.71)[47];

- hypertension (use of antihypertensive drugs or systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg for adults, or SBP or DBP > 95th percentile of sex, age and height for adolescents aged 12 and 13 years, or SBP ≥ 130 or DBP ≥ 80 for adolescents aged 14 to 19 years)[48];
- dyslipidemia (drug treatment for dyslipidemia or low-density lipoprotein cholesterol (LDL-C) ≥ 160 mg/dL for adults or LDL-C ≥ 130 mg/dL for adolescents, or high-density lipoprotein cholesterol (HDL-C) ≤ 40 mg/dL for men, ≤ 50 mg/dL for women, HDL-C < 45 for adolescents, or triglycerides ≥ 150 mg/dL for adults or ≥ 130 mg/dL for adolescents)[48].

After verifying the distribution of adherence to the normality curve, through the analysis of asymmetry and kurtosis, the descriptive parameters were presented as means and 95% confidence intervals.

The validity of self-reported measurements compared to measured BM and height was examined with the intraclass correlation coefficient (ICC), the Bland-Altman analysis and the paired t-test. For ICC classification, values lower than 0.4 were classified as poor agreement, 0.4 ≤ ICC < 0.6 reasonable agreement, 0.6 ≤ ICC < 0.75 good agreement, and e ≥0.75 excellent agreement[49].

Additionally, linear regression models were used to elaborate the calibration coefficients using the equation $y = B_0 + B_1x$, with y being the measured measure, x the reported measure, B_0 the linear coefficient and B_1 the angular coefficient. All analyses were stratified by sex, age group, nutritional status, level of leisure-time physical activity, and cardiometabolic risk.

Sensitivity and specificity stratified by sex, overweight and obesity were calculated for both the BMI based on the self-reported measurements and the calibrated BMI, using the measured value as reference. In addition, the proportions of overweight individuals were calculated based on the above-mentioned measures, and a proportion test was performed to verify the difference between groups, adopting a statistical significance level of $p < 0.05$.

This research was approved by the Research Ethics Committee of the Faculty of Public Health of Universidade de São Paulo (FSP-USP) (processes no. 32344014.3.3001.0086 and 30848914.7.0000.5421) and by the School of Arts, Sciences and Humanities of USP (EACH) (process No. 10396919.0.0000.5390). A written informed consent was obtained from all participants and, in the case of adolescents, from their guardians.

RESULTS

The final sample of the study had 856 individuals, with a mean age of 42.7 years (SD = 23.3 years, minimum = 12, maximum = 93), with 50.2% women. Of 856 participants, 24.6% performed at least 150 minutes/week of physical activity, 22.3% were considered obese, 16.9% for men and 27.7% for women (Table 1).

Table 1. Mean and standard deviations of measured and self-reported body mass, height and body mass index and sample distribution according to age, physical activity, nutritional status and cardiometabolic risk factors. São Paulo, Brazil, 2015.

	Males (n = 426)		Females (n = 430)		Total (n = 856)	
	n	%	n	%	n	%
Age (years)						
12–17	107	25.12	110	25.58	217	25.35
18–39	86	20.19	90	20.93	176	20.56
40–59	88	20.66	83	19.30	171	19.98
60+	145	34.04	147	34.19	292	34.11
Leisure physical activity (min/week)						
< 150	293	68.78	352	81.86	645	75.35
≥ 150	133	31.22	78	18.14	211	24.65
Nutritional status						
No overweight	227	53.29	184	42.79	411	48.01
Overweight	127	29.81	127	29.53	254	29.67
Obesity	72	16.90	119	27.67	191	22.31
Cardiometabolic risk						
less than 3 factors	301	70.66	276	64.19	577	67.41
3 or more factors	125	29.34	154	35.81	279	32.59

Table 2 shows the mean BM, height and measured and self-reported BMI according to age, physical activity level, nutritional status and cardiometabolic risk factors, stratified by sex. Significantly lower self-reported BM values were observed for adolescents and individuals with obesity.

Among men, there was an overestimation of BM by individuals aged 18 to 39 years and 60 years or more, among those who practiced less than 150 minutes/week of physical activity, without excess weight and with less than three cardiometabolic risk factors. In general, BMI showed a similar behavior to the BM, except among male adolescents, who showed an underestimation of BM and an overestimation of BMI. For women, in all situations in which there was a significant difference between measured and self-reported BM, such difference pointed to an underestimation of self-reported BM. In both sexes, there was an overestimation of BMI measures reported among those classified as not overweight and underestimation among those with obesity. Regarding height, adolescents reported lower values than the measured, while the elderly reported higher values, in both sexes.

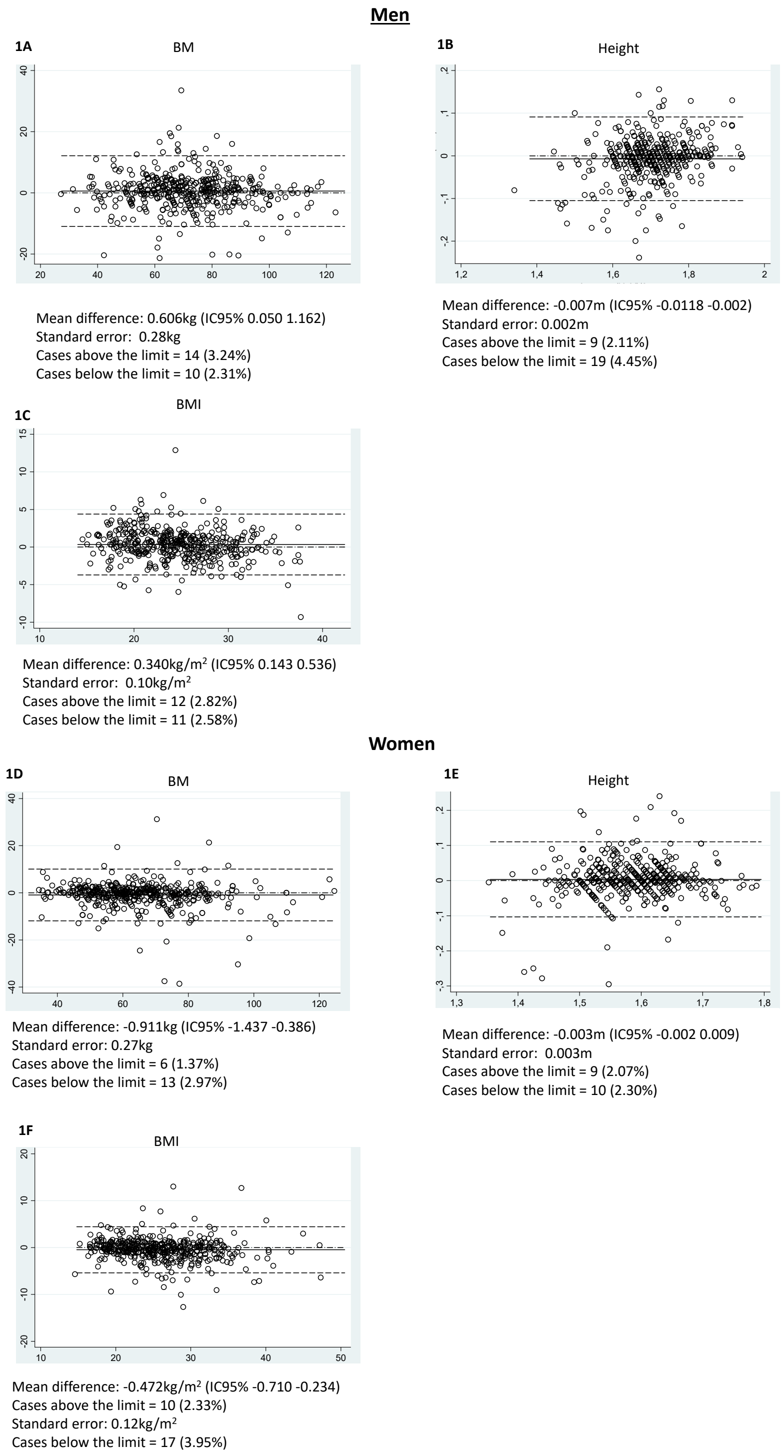
Men with less than three cardiometabolic risk factors overestimated BM and BMI and underestimated height, while women with three or more risk factors had the opposite behavior.

The Bland-Altman analyzes show excellent agreement rates between all reported and measured measures, for both sexes, with mean differences very close to zero and few cases outside the 95% agreement limits (Figure 1).

Table 2. Means of measured and reported body mass, height and body mass index according to age, physical activity, nutritional status and cardiometabolic risk factors, stratified by sex. São Paulo, Brazil, 2015 (n = 856).

			Males			Females		
			Measured mean	Reported mean	p	Measured mean	Reported mean	p
Age (years)	12–17	BM	57.22	55.85	**0.0318**	58.02	56.15	**0.0005**
		Height	1.68	1.64	**< 0.0001**	1.60	1.58	**0.0002**
		BMI	20.16	20.73	**0.0179**	22.53	22.46	0.6875
	18–39	BM	71.77	74.02	**0.0016**	65.89	63.98	**0.0079**
		Height	1.76	1.75	0.5923	1.62	1.61	0.0829
		BMI	23.23	24.01	**0.0028**	25.13	24.84	0.1884
	40–59	BM	80.14	80.74	0.3345	69.74	68.21	**0.0150**
		Height	1.73	1.73	0.2691	1.58	1.59	**0.0013**
		BMI	26.82	26.98	0.9455	27.96	26.77	**< 0.0001**
	60 +	BM	76.28	77.54	**0.0063**	68.68	69.30	0.0941
		Height	1.69	1.70	**0.0143**	1.55	1.58	**< 0.0001**
		BMI	26.71	26.85	0.3333	28.51	27.98	**0.0251**
Leisure physical activity (min/week)	< 150	BM	73.31	74.39	**0.0036**	65.71	64.81	**0.0078**
		Height	1.71	1.71	0.3296	1.58	1.59	0.3589
		BMI	25.05	25.48	**0.0056**	26.24	25.80	**0.0016**
	≥ 150	BM	66.73	66.66	0.7551	64.78	63.55	**0.0059**
		Height	1.70	1.69	**0.0006**	1.58	1.59	0.1915
		BMI	22.84	23.23	0.0560	25.73	25.10	**0.0125**
Nutritional Status	No overweight	BM	60.26	62.35	**< 0.0001**	52.96	53.12	0.4715
		Height	1.70	1.69	**0.0001**	1.59	1.58	**0.003**
		BMI	20.68	21.71	**< 0.0001**	20.86	21.31	**0.0035**
	Overweight	BM	77.75	77.46	0.4140	67.09	65.86	**0.0097**
		Height	1.70	1.71	0.3333	1.58	1.59	**0.0009**
		BMI	26.68	26.45	0.0651	26.95	25.98	**< 0.0001**
	Obese	BM	94.01	90.59	**0.0018**	82.96	79.95	**0.0017**
		Height	1.73	1.71	0.1812	1.57	1.59	**0.0444**
		BMI	32.00	30.88	**0.0083**	33.48	31.88	**< 0.0001**
Cardiometabolic risk	Less than 3 factors	BM	65.93	66.94	**0.0046**	59.45	58.80	**0.0075**
		Height	1.71	1.70	**0.0030**	1.58	1.58	0.5210
		BMI	22.56	23.09	**0.0001**	23.63	23.51	0.1781
	3 or more factors	BM	84.61	84.12	0.2964	76.25	74.92	**0.0250**
		Height	1.71	1.71	0.4850	1.58	1.59	**0.0007**
		BMI	28.71	28.76	0.6735	30.64	29.61	**< 0.0001**

BM: body mass; BMI: body mass index.



BM: body mass; BMI: body mass index.

Figure 1. Bland-Altman analysis for the agreement of measured and reported body mass, height and body mass index between men and women. São Paulo, Brazil, 2015.

When evaluating the intraclass correlation, among men, all categories evaluated had excellent ICC values (≥ 0.75) (Supplemental Material 1). As for women, the ICC values (≥ 0.6) for height were considered good among elderly women, among women who practiced less than 150 min/week of leisure-time physical activity, and among overweight women. In contrast, the ICC value of 0.587 for overweight women is considered reasonable (0.4 ≤ ICC < 0.6) (Supplemental Material 1).

As for the calibration coefficients stratified by sex and by other variables of interest in the study, most of the angular coefficients (B1) are close to 1 (Supplementary Material 1), indicating good equivalence with the measured values[50]. Similar values were also found for samples stratified only by sex, being for men B_0 = -0.17961 and B_1 = 0.9935 and for women B_0 = 1.5614 and B_1 = 0.9576. After applying these last two equations, individuals were classified using two independent cutoff points: the first referring to people with excess weight (overweight + obesity) and the second referring to people with obesity.

After calibrating the measurements, the mean BMI of the measured and calibrated values remained statistically similar to each other for all subgroups evaluated (Supplementary Material 2). Without the calibrations, several differences were found in the means of BMI for most of the groups evaluated.

Based on the BMI data, according to each of the three methods (measured, self-reported and calibrated BMI), the proportions of overweight and obesity were evaluated, as well as the sensitivity and specificity of each measure (Table 3). There was no significant difference between the proportions obtained based by self-report and calibrated values when compared to the ratings based on actual measured values. However, for

Table 3. Proportion of overweight and obese individuals, based on measured, self-reported and calibrated measurements, plus sensitivity and specificity analyses of body mass index stratified by sex. São Paulo, Brazil, 2015 (n = 856).

		Overweight (overweight+obesity) (%)		Obesity (%)	
Females	Measured	57.72		28.22	
	Reported	53.24		25.06	
	Calibrated	57.05		26.40	
Males	Measured	47.62		16.67	
	Reported	50.11		18.37	
	Calibrated	46.70		16.33	
		Sensitivity	Specificity	Sensitivity	Specificity
Females	Reported	0.841	0.888	0.760	0.950
	Calibrated	0.881	0.846	0.784	0.940
Males	Reported	0.876	0.840	0.819	0.947
	Calibrated	0.837	0.870	0.736	0.955

all cases presented, the proportions found using the calibrated measures tended to be closer to the measured value compared to the prevalence based on the reported values.

After calibrating the above-mentioned measures, there was an increase in the sensitivity in the classification of women for overweight (from 0.84 to 0.88) and for obesity (from 0.76 to 0.78) (Table 3). These results indicate that a greater number of women were correctly classified in these two categories (true positive). In contrast, specificity values decreased after calibration (from 0.89 to 0.85 and from 0.95 to 0.94, respectively) (true negative). Conversely, for men, the calibrated values decreased sensitivity and increased specificity.

DISCUSSION

The main results of this study show that self-reported BM and height values tend to be similar to the measured values, however the calibration process makes them even more consistent. Furthermore, by using the BMI results categorically, the calibration process increased the sensitivity of nutritional status classification among women and increased specificity among men.

Specifically for height, regardless of gender, an underestimation was observed among adolescents, which corroborates other studies involving boys[51-53], but contradicts studies carried out with girls[54,55]. Among the main reasons for these inconsistencies among adolescents, Enes et al. highlight that adolescents may not be aware of their current measurements, as they tend to measure themselves infrequently and may only remember outdated values[55] or be affected by the rapid morphological and psychosocial changes of this stage of life[56]. Finally, the social desirability bias in this group may fluctuate, since body image dissatisfaction can vary according to nutritional status among adolescents[57].

Among the elderly, both men and women overestimated their height in accordance with other studies involving the elderly[58,59]. Probable reasons for this finding would be the lack of knowledge of a possible natural reduction in height with aging[60,61] and the tendency of the elderly to report heights measured during their adult/youth life[12]. Furthermore, the higher values reported by older women, when compared to older men, may also be related to a possible osteoporosis, which tends to affect women more than men[62].

Regarding BM, for women, in all situations where there was a significant difference between measured and self-reported MC, there was an underestimation in self-reported BM. This consistent underestimation of BM was also pointed out by a systematic review study[8] that evaluated 60 studies and, in 51 of them, women underestimated BM, with mean differences ranging between 0.1 and 3.4 kg. Among men, 39 studies reported underestimation of BM, with mean differences ranging from 0.1 to 2.2 kg. Part of this phenomenon can be explained by social desirability, when subjects report a BM (or height) value that complies with a social norm, even if the reported value is imprecise[3,63].

From the perspective of BMI, there was an overestimation of the BMI measures reported in both sexes among those classified as not overweight and underestimation among those with obesity. This underestimation is supported by several other studies in different populations[7,8,64]. However, it is noteworthy that these gross differences in BMI based on self-reported and measured values remained small for both sexes (1.6 kg/m^2 for women and 1.12 kg/m^2 for men).

In a study involving 1,061 university students, those who reported BM more accurately also had a significantly higher metabolic equivalent (MET)-minute/week of physical activity, when compared to those who overestimated it[26]. When stratified by sex, men who overestimated BM had lower levels of vigorous activity and MET-minute/week, and among women, those who overestimated BM had lower levels of moderate activity and MET-minute/week. This study also identified that, based on the prediction of participants' cardiorespiratory fitness, there is a tendency to underestimate the BM and overestimate self-reported levels of physical activity. On the other hand, in this study, men who practiced less than 150 minutes of leisure-time physical activity per week overestimated their BMI, while women, regardless of the level of physical activity, underestimated it.

As for the differences according to cardiometabolic risk factors, there was greater precision in the information provided by men with three or more risk factors compared to men with less than three. This data may be a consequence of greater monitoring of health by those at higher cardiometabolic risk (consequently, greater awareness of their BM and height), since it is common that men have low demand for health services in Brazil[65,66]. Among women, the result was the opposite: all underestimated their BM, but those with three or more cardiometabolic risk factors did it to a greater extent, in addition to overestimating height, which resulted in an underestimation of BMI in this group. This may have been a consequence, among other factors, of a report influenced by greater social and health professional pressure for women to have a lower BMI[67].

Although no significant differences were found in the proportions of individuals classified as overweight or obese, the proportions found after measures were calibrated tended to be closer to the measured value, in comparison with the prevalence based on reported results. In this sense, it is important to highlight that, in epidemiological studies involving large samples, a small difference in proportions can have great impact.

After calibrating the above measures, there was an increase in sensitivity in the classification of women, both for overweight and obesity, and a reduction in specificity. For men, the calibrated values decreased sensitivity and increased specificity. The implications of these results must take into account the reasons and motivations for using the BMI variable. For example, if BMI is used as an outcome and the main objective of the study is to investigate factors associated with overweight or obesity, measures with greater sensitivity should be chosen. However, if the objective is to assess positive health habits to maintain adequate nutritional status, measures with greater specificity should be preferred.

Finally, this study has some limitations that are worth mentioning. The first is related to the time elapsed between reported measures and actual measurements (131.9 SD = 118.5 days), as there could have been changes between the two moments. However, intervals longer than 30 days between measurements did not result in greater differences in BMI (-0.03 95%CI -1.13 – 0.66 vs 0.10 95%CI -0.26 – 0.47). Similar results were also found among adolescents, who would be the most susceptible to this type of bias. Another limitation of the study is the assessment of physical activity through questionnaires, which are susceptible to response bias, which may even vary according to the respondent's nutritional status[68]. However, to mitigate this issue, the analyses were performed in a stratified manner according to nutritional status and time of physical activity analyzed in a dichotomous way.

Based on these facts, it is possible to conclude that the self-reported measurements of height and BM and, consequently, the BMI are valid and reliable measurements, showing substantial improvements after calibration.

The results of this study also suggest that the calibration equations for self-reported values tend to approximate the proportions of people classified as overweight and obese to the proportions based on the measured values. Finally, the calibrated measures increased the sensitivity for nutritional status classification among women and specificity among men living in the city of São Paulo. Thus, given the easy logistics, cost and time reduction for data collection, the use of self-reported height and BM measurements is recommended for epidemiological studies; there is also indication for application of calibration coefficients for each specific group to improve the accuracy of measures.

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