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Inaccuracy of Self-Reported Weights and Heights among American Indian Adolescents

FERN R. HAUCK, MD, MS, LINDA WHITE, RD, GUICHAN CAO, MS, NONIE WOOLF, MPH, RD, AND KAREN STRAUSS, MS, RD

ABSTRACT

To determine the accuracy of self-reported weights and heights and of relative weight status in a sample of American Indian adolescents, a survey was conducted in middle and high schools on or near three Indian reservations—Navajo, Choctaw, and Blackfeet. Self-reported weights and heights were compared with measured weights and heights. Participants were 12 through 19 years old (N = 806, 47.4% male). Overall, both boys and girls underreported weight (mean difference = self-reported − measured mean values) (−3.4 ± 13.1 and −4.6 ± 13.0 lb, respectively) and overreported height (0.6 ± 2.1 and 0.2 ± 2.6 in, respectively). However, underweight boys and girls overreported weight (4.1 ± 13.8 and 1.6 ± 6.4 lb, respectively) while normal-weight and overweight respondents underreported weight (normal: −1.6 ± 7.9 and −1.4 ± 6.3; overweight: −7.5 ± 17.9 and −11.6 ± 19.0 lb, respectively). Although correlations between measured and reported weight, height, and body mass index (BMI) were high, the sensitivity of relative weight categories based on BMI using self-reported weight and height compared with measured weight and height was poor: 66.7% for underweight (BMI < 15th percentile, based on a national reference population), 88.9% for normal weight, and 73.6% for overweight (> 85th percentile). These results call into question the accuracy of self-reported weight and height measurements among American Indian youth and are similar to findings among non-American Indian adolescents. Therefore, their use in prevalence studies should be avoided, and they should be used cautiously in other types of epidemiologic studies. Ann Epidemiol 1995; 5:386–392.

KEY WORDS: Adolescence; Indians, North American; obesity; body weight; body height.

INTRODUCTION

Because obesity is a major risk factor for many chronic diseases that afflict Native Americans, accurate data concerning the prevalence of obesity are necessary (1–4). Determination of obesity is generally based on measured weights and heights. However, performing measurements on large numbers of individuals is not always feasible owing to financial or logistical limitations. For these practical reasons, self-reported weights and heights are increasingly replacing measured weights and heights in many surveys of both adults and adolescents.

Numerous authors have studied the accuracy and reliability of self-reported weights and heights (5–14). However, a limited number of studies have been conducted in adolescent populations (15–18), and only one study that examined this issue among American Indian adolescents has been published, to our knowledge (19). This article describes a study in which we evaluated the accuracy of self-reported weights and heights and relative weight status among American Indian teenagers representing three tribes in three different regions of the United States.

MATERIALS AND METHODS

Sample

Students attending grades 7 through 12 in middle and high schools in three Indian Health Service (IHS) areas were eligible to participate. Three tribes were represented—the Navajo in Arizona and New Mexico, the Blackfeet in Montana, and the Choctaw in Mississippi. The sampling methodology varied according to site, but overall was primarily a convenience sample. For the Navajo, five of the eight service units (local administrative units of the IHS) participated (one service unit chose not to participate, one had no nutritionist available to perform the measurements, and the third was unable to participate because of delays at the

From the Departments of Family Medicine (F.R.H.) and Preventive Medicine and Epidemiology, Loyola University Chicago Stritch School of Medicine, Maywood, IL (F.R.H., G.C.); Nutrition and Dietetics Branch, Navajo Area Indian Health Service, Window Rock, AZ (L.W.); Blackfeet Diabetes Program, Billings Area Indian Health Service, Browning, MT (N.W.); and Nutrition Services Department, Nashville Area Indian Health Service, Nashville, TN (K.S.).

Address correspondence to: Fern R. Hauck, MD, MS, Department of Family Medicine, Loyola University Chicago Stritch School of Medicine, 2160 South First Avenue, Maywood, IL 60153.

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end of the school year). Among the participating service units, a random sample of schools was selected and requested to participate. Substitutions were made when selected schools declined to participate. In general, one class per grade from each school was surveyed (12 schools total). For the six schools from which enrollment data were available, 37% of students responded to the survey and 36% were surveyed and measured.

For the Blackfeet, two health classes from each grade of the middle school participated, and three health classes, one home economics class, and one young-mothers class participated in the high school, representing all grades. Twenty percent of the enrollees were surveyed, and 17% were surveyed and measured.

All schools ($N = 6$) and classes were surveyed for the Choctaw sample. Seventy-nine percent of enrollees were surveyed and 74% were surveyed and measured. For all sites, selected classes were visited only once, so that students absent on the day of survey administration were not included.

IHS and Tribal Council approval was obtained at each site, and consent for participation of their children was obtained from parents. The participants were not told that they would be measured, to avoid biasing their responses.

Questionnaire

A standardized protocol was followed for administration of the questionnaire and measurement of weights and heights. A 17-item questionnaire was developed, asking the students their current weight and height and certainty of their responses, perceptions of weight status, desired weight status, satisfaction with body shape, and estimation of their body size and that of their parents by selecting silhouettes drawn by an American Indian artist. Although the questionnaire was self-administered, study personnel explained each question verbally using transparencies and they were available for questions. Within 1 to 7 days, the IHS nutritionists returned to weigh and measure participating students. Measurements were made with the students wearing street clothing, but without shoes. Weights were measured to the nearest quarter pound and heights to the nearest quarter inch.

Data Analysis

Body mass index (BMI)—weight (kg) divided by height squared (m^2)—was calculated for each respondent based on the self-reported values and on the measured values. Underweight was defined as a BMI under the 15th percentile and overweight as a BMI over the 85th percentile, using normalized standards based on age- and sex-specific data from the first and second National Health and Nutrition Examination Surveys (20). Three categories of height status were based on height for age (HA), using the same reference: (a) short (HA under the 15th percentile); (b) average (HA between the 15th and 85th percentile); and (c) tall (HA over the 85th percentile).

Means and standard deviations (SDs) were calculated for weights and heights according to weight category (underweight, normal weight, and overweight). The prevalence of each weight category was calculated for the entire sample, by sex and age, and by tribe. Mean differences between measured and self-reported weights and heights were compared by using the two-tailed paired t test. Differences in proportions were examined by χ^2 analysis. Correlations were measured using Pearson correlation coefficients. Sensitivity and positive predictive values are expressed as percentages. We use the term "sensitivity" to denote how completely self-reported overweight status (based on self-reported weight and height) identifies overweight, using measured weights and heights as the gold standard (21). "Positive predictive value" denotes the accuracy of self-reported overweight status, that is, the percent of adolescents identifying themselves as overweight based on self-reported values who are overweight by measurement (21). Errors in self-reported weights or heights or both can lead to errors in the calculated BMI. For example, a height overreported by 1 in in a youth 60 in tall would result in a 3% error in BMI, assuming the weight is correctly reported. Conversely, if errors in reported weights and heights vary in the same direction, the error in calculated BMI may be reduced.

RESULTS

For analysis, of the 1,058 respondents, we eliminated girls who were pregnant and respondents who were missing information regarding age or sex, who were under 12 or over 19 years old, and who reported their race as other than American Indian. There were 806 surveyed individuals remaining who also had measured weights and heights, of whom 105 were Blackfeet, 289 were Choctaw, 384 were Navajo, and 28 represented other tribes, of whom 82% were from the Navajo sample site.

The resulting sample was evenly divided between males and females (47.4% males). The mean age was 14.6 years (SD 1.8); 53% were 12 through 14 years old, 31% were 15 through 16 years old, and 16% were 17 through 19 years old. The distribution of grades was similar. The age and grade distributions were similar for males and females.

When asked how much they weighed now, 140 (17%) of the 806 adolescents responded that they did not know, 1 reported a value that was not feasible (14 lb), and values for 87 were missing. Of the 578 who reported a feasible weight, half were not certain of their weight (Table 1). Of the 289 students who were very certain, 73% reported recently being weighed either by someone else or themselves. The most common reasons cited for being uncertain of or not knowing their weight were not being weighed in a long

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TABLE 1. Certainty of reported weights[a]

	Very certain		Not certain	Don't know weight
Reasons	(n = 289)		(n = 289)	(n = 140)
Recently weighed (other)	36%	Recently lost weight	16%	6%
Recently weighed (self)	37%	Recently gained weight	20%	8%
Weigh self often	25%	Not weighed in long time	45%	61%
Concerned about weight	19%	Don't pay attention	32%	21%
Other	2%	Other	2%	5%
Last weighed	(n = 170)		(n = 186)	(n = 138)
Within past week	46%		21%	7%
Within past month	15%		37%	28%
> 1 mo–1 y	27%		16%	20%
More than 1 y	9%		10%	9%
Don't know	4%		16%	37%

[a] Totals do not equal 100% because multiple responses were permitted.

time and not paying attention to their weight. Students who reported that they were very certain of their weight were more likely to have been weighed within the past week.

A similar proportion (16%) of adolescents did not know their height. Eight students gave values that were not feasible (e.g., 4 ft 14 in) and values for 83 were missing. The most common reason cited by those who were very certain ($N = 277$) was "I was recently measured" (53%). Those who were not certain ($N = 309$) or did not know their height ($N = 129$) most frequently chose "I haven't been measured in a long time" as the reason (61 and 55%, respectively). Of those who were certain of their height, 53% reported being last measured within the past month, compared with 46% of those who were not so certain and 26% of those who did not know.

There were no differences in the distribution of reasons cited for being certain, uncertain, or not knowing their weight or height according to weight category, except for the following: (a) Among those certain of their reported weight, "I am concerned about my weight" was more commonly chosen as a reason among the overweight boys and girls (33%) than among the underweight (7%) or normal-weight youth (14%, $P < 0.001$); and (b) among boys not certain of their reported weight, a larger proportion of overweight boys selected "I recently lost weight" as the reason (30%) compared with underweight (0) or normal-weight (7%) males ($P < 0.01$).

Overall, both boys and girls underrepported weight, with a mean difference (mean self-reported weight − mean measured weight) of −3.4 lb (SD 13.1 lb) for boys and −4.6 lb (SD 13.0 lb) for girls (Table 2). However, there were differences according to measured weight status: underweight youth overreported weight, while normal-weight and underweight individuals underreported weight (Table 2, Figure 1). The mean difference for overweight males was −7.5 lb (SD 17.9 lb) and for females, −11.6 lb (SD 19.0 lb). There were no differences in the amount of underreporting of weight by boys or girls comparing respondents who were certain with those who were uncertain about their reported weight. Similarly, there were no differences in underre-

TABLE 2. Comparison of students' self-reported versus measured weights by weight category[a]

		Self-reported		Measured		Difference[b]		P^c
	n	Mean	SD	Mean	SD	Mean	SD	value
Boys' weight (lb)								
Underweight	16	111.2	24.8	107.1	21.4	4.1	13.8	NS
Normal weight	185	129.9	20.7	131.6	21.1	−1.6	7.9	0.006
Overweight	112	178.4	40.5	185.9	41.8	−7.5	17.9	0.000
Total	313	146.3	38.2	149.8	40.8	−3.4	13.1	0.000
Girls' weight (lb)								
Underweight	12	95.8	13.0	94.2	11.4	1.6	6.4	NS
Normal weight	193	118.5	14.9	119.9	15.2	−1.4	6.3	0.003
Overweight	101	151.7	25.9	163.3	29.4	−11.6	19.0	0.000
Total	306	128.5	25.5	133.2	30.1	−4.6	13.0	0.000

SD, standard deviation; NS, not significant; BMI, body mass index.
[a] Underweight: BMI <15th percentile; normal weight: BMI 15th–85th percentile; overweight: BMI >85th percentile.
[b] Difference = self-reported value − measured value.
[c] Paired t test.

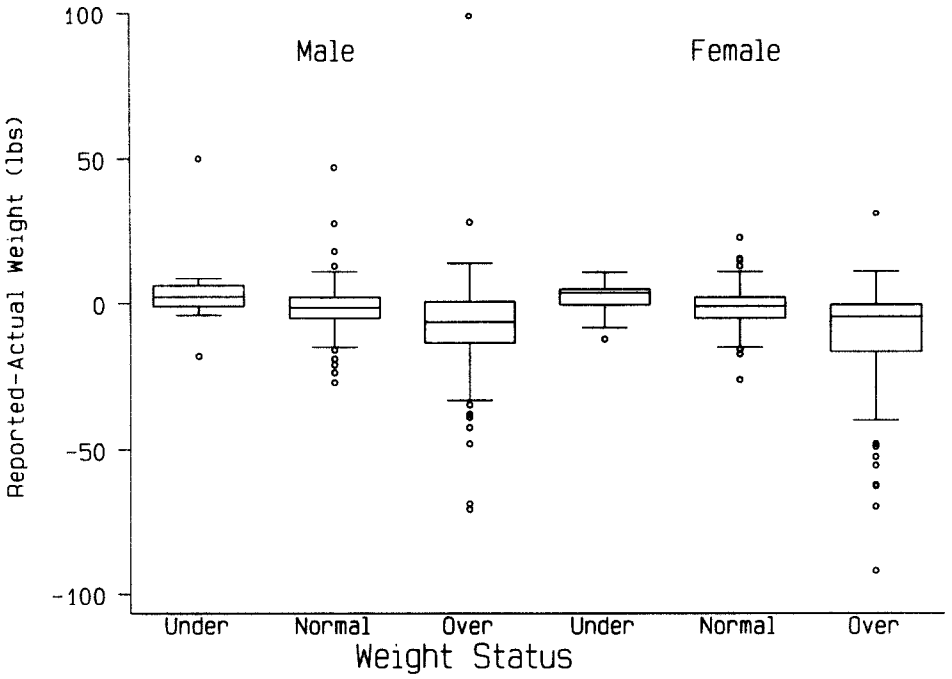

FIGURE 1. Box graph of the distribution of reporting error for weight according to measured weight category for American Indian adolescents.

porting comparing students who were weighed within the past month versus those who were weighed more than 1 month ago.

For all weight categories combined, both boys and girls overreported height (Table 3). There were no differences in overreporting between students who were measured within the past month versus those measured over 1 month ago. The mean difference between measured and reported heights was greatest for overweight adolescents, who overreported heights (Figure 2).

Males in the short-height category overreported height by 1 in ($P < 0.05$) and in the average category by 0.6 in ($P < 0.001$). There was no difference between reported and measured heights in the tall males. Females in the short-height category overreported height by 1.2 in ($P = 0.05$). There were no differences in the average and tall categories.

Correlations between measured and self-reported weight, height, and BMI were high for males (0.95, 0.83, and 0.88, respectively). For females, the correlation between measured and reported weight was high (0.90) but for height the correlation was low (0.62), resulting in an intermediate correlation for BMI (0.79).

The prevalences of underweight, normal weight, and overweight (using measured weights and heights) within each tribe were age-adjusted by direct standardization to the age distribution (three age categories) of the total sample.

TABLE 3. Comparison of students' self-reported versus measured heights by weight category[a]

		Self-reported		Measured		Difference[b]		P^c
	n	Mean	SD	Mean	SD	Mean	SD	value
Boys' height (in)								
Underweight	16	66.4	4.2	66.7	3.9	−0.4	1.9	NS
Normal weight	184	66.6	3.7	66.1	3.4	0.5	2.0	.001
Overweight	109	67.5	3.4	66.7	3.3	0.8	2.2	.000
Total	309	67.0	3.7	66.4	3.4	0.6	2.1	.000
Girls' height (in)								
Underweight	9	62.1	3.0	62.7	3.0	−0.6	2.6	NS
Normal weight	181	63.0	3.3	63.0	2.2	−0.02	2.4	NS
Overweight	113	63.9	3.4	63.2	2.6	0.7	3.0	.011
Total	303	63.3	3.4	63.1	2.4	0.2	2.6	.113

SD, standard deviation; NS, not significant; BMI, body mass index.
[a] Underweight: BMI < 15th percentile; normal weight: BMI 15th–85th percentile; overweight: BMI > 85th percentile.
[b] Difference = self-reported value − measured value.
[c] Paired *t* test.

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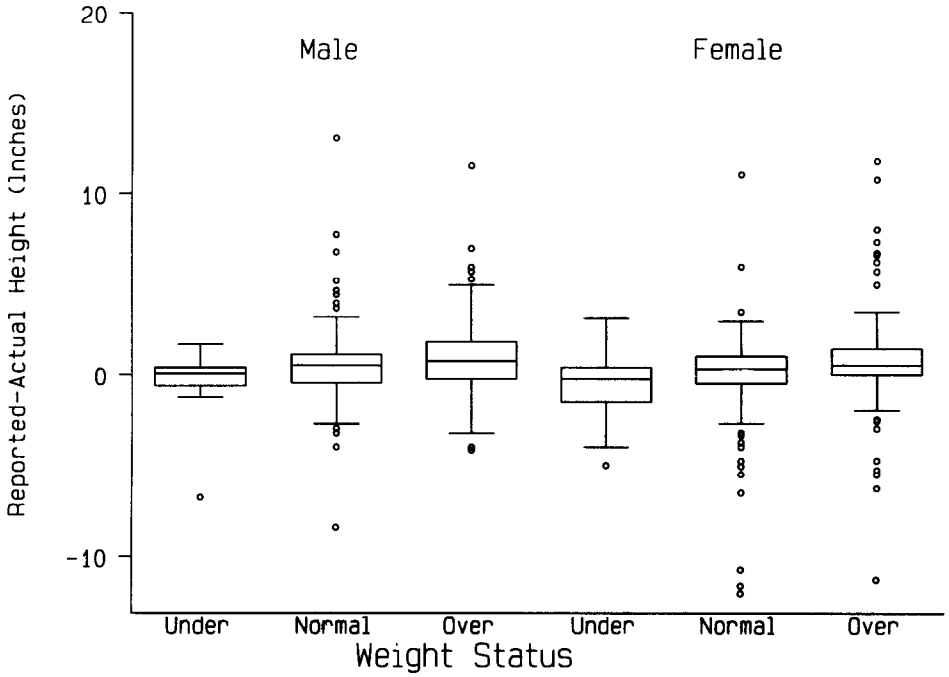

FIGURE 2. Box graph of the distribution of reporting error for height according to measured weight category for American Indian adolescents.

The prevalence of overweight was high among adolescents in each of the tribes participating in the study (Table 4). However, the Choctaw had the highest prevalence of overweight (44%) and the lowest of underweight (2%). The distribution of weight status was similar across gender and age groups, with the prevalence of overweight ranging from 33 to 39%.

We then conducted sensitivity analyses to examine how well self-reported overweight approximates measured or true overweight. For the entire sample, 182 individuals were overweight by measurement, 152 by self-report, of which 134 were correctly identified, resulting in a positive predictive value of 88% (Table 5). The actual prevalence of overweight was 34%, and that by self-report 28%, for an underreporting of 6 percentage points. The sensitivity of self-reporting was 74%; that is, 26% of the true overweight was missed by self-reporting alone. Separate analyses by sex (males and females) and age (12 to 14 and 15 to 19 years) show that sensitivity and positive predictive value are further reduced for girls. The sensitivities of self-reported values in underweight and normal-weight respondents were 67 and 89%, respectively.

TABLE 4. Prevalence of underweight, normal weight, and overweight by tribe[a]

	Underweight (%)	Normal Weight (%)	Overweight (%)
Blackfeet (n = 105)	9.4	55.8	34.8
Choctaw (n = 289)	1.8	54.5	43.8
Navajo (n = 384)	7.4	58.9	33.7
Males, total	7.1	58.1	34.8
Age (y)			
12–14	6.5	56.2	37.3
15–19	7.6	59.9	32.5
Females, total	3.8	57.5	38.7
Age (y)			
12–14	4.9	55.9	39.2
15–19	2.2	59.8	38.0

[a] Age-adjusted.

DISCUSSION

These findings call into question the accuracy of self-reported weights and heights among American Indian adolescents. A large proportion of the respondents did not know their weights or heights, and about half of those who responded with a value were uncertain. Underreporting of weight, particularly among overweight youth, along with overreporting of height leads to misclassification bias, with the self-reported prevalence of overweight underrepresenting the true prevalence.

Our findings are consistent with those of other studies conducted with children and adolescents. Himes and Story (19) found that American Indian youth in northern Minnesota underestimated their weight by about 6 lb; boys overestimated their height by a mean of 0.33 in (19). The degree of underreporting of weight increased with increasing BMI.

Pamuk (Centers for Disease Control and Prevention, personal communication, 1989) analyzed data from the second National Health and Nutrition Examination Survey (NHANES) and found even lower sensitivities than we did

TABLE 5. Self-reported overweight as a test for true overweight by sex and age

	Sample size	Self-reported prevalence − actual prevalence (%)	Sensitivity (%)	Positive predictive value (%)
Total	536	5.6	73.6	88.2
Male	283	−6.7	76.2	93.9
Age (y)				
12–14	123	−8.9	71.4	92.1
15–19	160	−5.0	80.8	95.5
Female	253	−4.3	70.4	81.4
Age (y)				
12–14	129	0.0	73.2	73.2
15–19	124	−8.9	67.5	93.1

for self-reported overweight (16% prevalence) among respondents 14 through 18 years old. The sensitivities and positive predictive values were higher in our sample because of the higher prevalence of overweight and of very high weights; that is, because many of the respondents were so overweight, even though they underreported weight, they remained in the overweight category.

Likewise, studies in other adolescent populations found that a large proportion did not know their weight, and underreporting of weight was common among both boys and girls and most pronounced for the tallest, heaviest children and for girls (17, 18). Brooks-Gunn and coauthors (18) recommended that self-reported measurements not be substituted for actual measurements in the estimation of population statistics.

Although many studies have found underestimation of weight and BMI among adults—particularly among the heaviest and among women—and/or overestimation of height, recommendations about use of self-reported values have varied (5–14). Some authors recommended the use of self-reported weights and heights based on high correlations between them and measured values (11). However, correlations can remain high even with significant underestimation or overestimation of values. For example, if all respondents underreported weight by 5 lb, the correlation would be 1.0. As other authors noted, it is justifiable to use self-reported values in certain types of analyses, such as in multivariate analysis with weight, height, or BMI as a continuous variable, based on these high correlations (10, 14). Nonetheless, since measurement error tends to bias regression coefficients to the mean, self-reported values should be used cautiously in regression and correlational analyses.

Use of self-reported weights and heights as relative weight results in a large degree of misclassification. In analyses using categorial weight status, the relative risk estimates should be adjusted based on the degree of bias found in the individual sample (7, 9). That is, any study in which self-reported weights and heights are used should have, at least, a subset of measured weights and heights for determination of the degree of bias. Because the effects of misclassification are complex and not easily generalized, as suggested by Flegal and associates (22), each study needs to evaluate the degree of bias and correct for misclassification (9).

Questionnaire surveys may be useful in getting an initial estimate of a problem, particularly when resources are limited. However, when accurate estimates of overweight prevalence are needed to plan public health programs or resource allocation, then, based on our findings, measured weights and heights would be necessary for American Indian youth.

Because our sample was chosen primarily on a convenience basis, prevalence levels of overweight for the sample may not be representative of the three adolescent Indian groups included; however, there is no reason to suspect that reporting bias—both systematic and nonsystematic—differs within the relative weight categories. Thus, although our prevalence estimates of overweight may differ from those in more representative studies, the findings with regard to reporting bias and variability are consistent with those reported in other studies.

The explanation for the findings is not entirely clear; that is, is underreporting of weight and overreporting of height intentional ("wishful thinking") or accidental? Dissatisfaction with body size and overconcern with being overweight, which have been found among white adolescents, particularly girls (23–27), have also been shown to be prevalent among Native American adolescents surveyed in the IHS Adolescent Health Survey (28). Furthermore, eating disturbances and pathologic weight loss practices are beginning to emerge among Native American youth (29, 30). This would support the view that weights are intentionally underreported or heights overreported to result in a more ideal body size. The greater degree of underestimation of weight among the overweight participants further supports this. On the other hand, a large proportion of respondents were uncertain of or did not know their weight and height because they had not been weighed or measured in a long time, supporting the view that the errors were not intentional. Adolescence is characterized by periodic growth spurts (31, 32); respondents undergoing these rapid changes in weight and height who have not been weighed and measured regularly are less likely to know their weights and heights. Therefore, these or other factors are probably operating simultaneously, with different explanations applicable to different subgroups.

In conclusion, we recommend that self-reported weights and heights should not be asked in surveys of American Indian adolescents when the purpose of the survey is to obtain accurate estimates of the prevalence of overweight and other weight categories. This requires measurement of weights and heights by trained personnel. Self-reported

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weights and heights may be used cautiously for other analytic purposes.

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