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Comparison of measured and self-reported anthropometric information among firefighters: implications and applications

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Abstract

This study evaluated the accuracy of self-reported body weight and height compared to measured values among firefighters and identified factors associated with reporting error. A total of 863 male and 88 female firefighters in four US regions participated in the study. The results showed that both men and women underestimated their body weight (−0.4 ± 4.1, −1.1 ± 3.6 kg) and overestimated their height (29 ± 18, 17 ± 16 mm). Women underestimated more than men on weight ($p = 0.022$) and men overestimated more than women on height ($p < 0.001$). Reporting errors on weight were increased with overweight status ($p < 0.001$) and were disproportionate among subgroups. About 27% men and 24% women had reporting errors on weight greater than ± 2.2 kg, and 59% men and 28% women had reporting errors on height greater than 25 mm.

Keywords

weight; height; self-reported; firefighter; anthropometry; obesity

1. Introduction

The National Fallen Firefighters Foundation reported a pressing need for a national firefighter anthropometry study to be used for fire apparatus and equipment design (i.e. cabs, seats, seatbelts and bunker gear) in the USA (Routley 2006) to mitigate firefighter fatalities and injuries associated with crash instances, rollover incidents and excessive thermal and chemical exposure among 1.1 million firefighters in the US (Karter and Stein 2011). In response to the call, the National Institute for Occupational Safety and Health conducted a

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national study during 2009–2012, along with several stakeholders, including professional associations, fire apparatus standards committees and apparatus manufacturers (Hsiao et al. 2014). The data provided the first available US national firefighter anthropometric information for fire apparatus designs and the results demonstrated that on average, male firefighters were 9.8 kg heavier and female firefighters were 29 mm taller than their counterparts in the US general population. Both male and female firefighters also showed larger upper-body builds (e.g. larger chest circumference, waist circumference and bideltoid breadth) than those of the US general population.

Literature has shown that the US population has gotten heavier over the recent past. For instance, male truck drivers were found to be heavier by 12 kg on average and larger in body width and girth, even though they were not taller, as compared to their counterparts of 25 to 30 years ago (Guan et al. 2012). Planning for future-generation fire apparatus specifications every decade or two is indispensable in responding to fire apparatus technology advancement and continuing anthropometric evolution (changes in body shape and ethnic composition) among firefighters. A national anthropometric survey in detail for firefighters, however, is costly. A cost advantageous method using prediction equations, self-reported weight and height and some demography data may offer an alternative solution for the next course of firefighter anthropometry survey if proven to be effective.

The error in self-reported weight and height compared with measured weight and height among the general population has been appraised in national nutrition surveys, such as the second National Health and Nutrition Examination Survey (NHANES) of 1976–1980 with a representative sample of 11,284 adults aged 20–74 years (Rowland 1990). Although weight and height were reported with small errors on average, self-reported weight and height were found undependable in critical population subgroups. As a professional group having annual physical examinations, certain capacity evaluation tests, and frequent equipment fit assessments, firefighters may be more attentive to their weight and height than the general population and thus may have more reliable self-reported potentials.

An accuracy assessment of self-reported body weight and height of firefighters, in particular the degree and direction of reporting error, will be valuable in planning and interpreting studies in which height and weight are reported rather than measured. It may, on the other hand, prove that reliability or accuracy of self-reported anthropometric information of physically active professionals is still undependable and thus substituting for professional measurements to lessen survey cost is not scientifically acceptable or practical.

2. Objectives

This study: (1) inspected factors associated with self-reporting errors on body weight and height within a firefighter population, (2) evaluated the magnitude and distribution of the errors and (3) assessed the feasibility of error-rectification equations for improving the accuracy of self-reported weight and height among firefighters.

3. Methods

3.1 Dependent variables

Difference between self-reported and measured weights (kg): firefighters' body weight measured by the research team was subtracted from their self-reported body weight as reported by the participants in a demography data sheet.

Difference between self-reported and measured heights (mm): firefighters' body height measured by the research team was subtracted from their self-reported body height as reported by the participants in a demography data sheet.

3.2 Independent variables

Body mass index (BMI): BMIs were computed from measured weight and height, defined as weight/height^2 (in kg/m^2). The values were categorised into four classes, based on the criteria recommended in the consensus statement of the 1985 National Institute of Health Development Conference on the Health Implications of Obesity (Consensus Development Panel 1985; Rowland 1989). For men, underweight was defined as ≤20.7, mid-weight 20.8–27.7, overweight 27.8–31.0 and severely overweight ≥31.1 kg/m^2. For females, underweight was defined as ≤19.1, mid-weight 19.2–27.2, overweight 27.3–32.2 and severely overweight ≥32.3 kg/m^2.

Gender: data were analysed by gender (men and women) for their different reporting distribution patterns and their different BMI classifications.

Age: three age groups were targeted in the study: 18–32, 33–44 and 45 + years. While continuous values in years were recorded in the study, divided values (young, mid-age and senior) were used in 'factor' evaluations and continuous values were used in regression analyses.

Ethnicity: three ethnicity categories were used in the analysis: white, black and other (e.g. Hispanics, Asians and Pacific Islanders).

Period of service: continuous values in period of service were recorded in the study. Divided values in four classes (defined as new: ≤60, mid-level: 61–120, senior: 121–240 and extended experiences: ≥241 months) were used in data analysis.

Job title: four titles were used in data analysis: officer, master firefighter, firefighter and other.

Geographic location: data were collected in four US regions centred at Fort Worth, TX; Rockville, MD; Philadelphia, PA; and Phoenix, AZ areas.

3.3 Participants and procedure

A stratified sample (3-age × 3-race/ethnicity × 2-gender combinations) of 863 male and 88 female firefighters from four geographic locations (Rockville, MD; Phoenix, AZ; Philadelphia, PA; and Fort Worth, TX) participated in the study (see Table 1) (Hsiao et al. 2014). As part of a national firefighter anthropometry survey, firefighters reported their

height and weight in a questionnaire. Their height and weight were then measured using an anthropometric tool (FARO digitiser) and a weight scale. FARO digitisers have been tested to be more time-efficient for vertical-height measurements than traditional anthropometric calipers within a 0.4-mm difference (Hsiao et al. 2014). Their demographic data (gender, age, ethnicity, BMI, period of service, job title and geographic location) were collected for evaluating and determining factors that were associated with the error of the self-reported height and weight.

The sampling plan of 951 participants was based on a statistical power estimation for between-gender and between-age assessments of the proposed dimensions representing the 1,136,650 firefighters from the US Fire Department Profile Through 2005 (Karter 2006), which was the best available and updated information at the study planning stage in 2007. Department of Labor Household Data Survey of years 2000–2004 indicated a distribution of 4.2% female firefighters and 95.8% male firefighters (US DOL 2006). An over-sampling (88 participants; 2.2 times of 4.2%) of female firefighters was necessary to address BMI classification and some fire apparatus design issues (such as seat height and backrest height) that are unique to females.

4. Data analyses

The weight and height raw data were used in the analyses without sample weighting, in that the raw data-set represented the demographic characteristics of the current firefighter population reasonably well (Hsiao et al. 2014). Case-wise deletion of missing data was employed, which excluded all cases that have missing data in at least one of the selected variables used in the analyses. Excluded in the initial analyses were 18 men and 4 women whose weight information was incomplete, as well as two men (of the 18 men who missed weight information) and one woman whose height data were lacking. A few cases with either missing periods of service or job titles were also excluded in the initial main effects analyses on ‘factors affecting the accuracy’ and ‘prediction models’ (i.e. study objectives #1 and #3) for statistical cell balance reasons. Furthermore, six men and one woman for whom the differences in reported weight and measured weight were greater than ± 13 kg (three times of standard deviation from the mean differences) were further excluded. In short, a total of 817 men and 81 women were included in the study to address study objective #1 on body weight and 820 men and 81 women on body height, in which gender, BMI, age, race/ethnicity, geographic location, period of service and job title were considered as a whole. Univariate and multivariate analyses of variance and regression analyses were used to identify factors that affected the accuracy of the self-reported weight and height.

On the follow-up analyses of interaction effect of independent variables, data were excluded for analyses only if they were missing and were directly associated with the specific independent variables included in the follow-up analyses. For instance, in the analysis of gender × BMI effect on error in self-reported weight, data of 838 men and 83 women were used instead of 817 men and 81 women, in that the cases with missing data on job title and/or period of service (but not gender and BMI-related measurements) can be included in the analysis.

On the aspect of distribution of self-reporting errors on body weight and height (i.e. study objective #2), all non-missing data on body weight were used for weight distribution analyses and all non-missing data on body height were used for height distribution analyses.

On assessing the feasibility of error-rectification equations derived from the second NHANES for improving the accuracy of self-reported weight and height among firefighters (study objective #3), case-wise deletion was employed to exclude missing data associated with age, weight, height and BMI which were used in the equations.

5. Results

5.1 Factors affecting the accuracy of self-reported body weight

Univariate least square means analyses on main effects showed that gender ($p = 0.022$) and BMI ($p < 0.0010$) significantly affected the accuracy of self-reported body weight (see Table 2). Female firefighters underreported their weight more than male firefighters. Severely overweight firefighters underestimated their weight more than the overweight group, and overweight firefighters underestimated their weight more than the mid-weight group. There were only three men and no women in the category of underweight based on their BMI. These three participants were rolled into the category of 'mid-weight'. Age, race/ethnicity, location, years of service and job title were not significant factors. Multivariate analyses (i.e. along with self-reported errors in body height) revealed the same results that gender ($p < 0.001$) and measured BMI ($p < 0.001$) significantly affected the accuracy of self-reported body weight.

Further univariate analyses on gender, BMI and gender × BMI interaction did not demonstrate a significant interaction effect of gender × measured BMI ($p = 0.12$) on the accuracy of self-reported body weight (see Table 3).

5.2 Distribution of errors on self-reported body weight

Table 4 summarises the self-reporting errors of body weight in the firefighter population by gender and BMI status, for all cases containing valid gender, weight and height (and thus BMI) information, including the outliers who were excluded in the ANOVA and MANOVA analyses in Tables 2 and 3. Although the gender × BMI interaction effect on errors of self-reported body weight was not significant ($p = 0.12$; see Table 3), it was necessary to report the BMI effect by gender in this distribution assessment in that the BMI values within each BMI category were different between the gender groups (see Section 3.2).

A total of 73% of male and 76% of female participants reported their weight within ±2.2- kg difference from their true weight (i.e. measured weight). About 15% of male and 21% of female participants underreported their weight from 2.3 to 49 kg. On average, both men and women firefighters underreported their weight by 0.4 kg for men and 1.1 kg for women. The variability (standard deviation) of the reporting errors was 4.1 kg for men and 3.6 kg for women. Underreporting in weight was most common in overweight and severely overweight firefighters. On average, overweight men underreported their weight by 0.5 kg, and severely overweight men underreported their weight by 1.6 kg. For women, on average, underreporting of their weight was 0.3 kg by mid-weight women, 1.7 kg in the overweight

group and 6.2 kg for the severely overweight cluster. On the other hand, over-reporting weight was observed by mid-weight and underweight men by an average of 0.8 and 2.0 kg, respectively.

5.3 Factors affecting the accuracy of self-reported body height

Univariate analysis results in Table 5 showed that gender ($p < 0.001$) and geographic location ($p = 0.007$) significantly affected the accuracy in self-reported body height. Male firefighters over-reported their height more than female firefighters. The Rockville, MD group had a smaller estimation error of 18 mm as compared to the Fort Worth, TX and Philadelphia, PA groups for 27 and 25 mm, respectively. Multivariate analysis (along with body weight) also showed that gender ($p < 0.001$) and the geographic location ($p < 0.001$) significantly affected the accuracy of self-reported body height, which are the same as those of the univariate analysis results reported in Table 5. Race/ethnicity, age, period of service, location, job title and BMI effects were not significant, so were the interactions among the independent variables.

5.4 Distribution of errors on self-reported body height

Both men and women firefighters over-reported their height. About 59% of male and 28% of female participants over-reported their height by more than 25 mm. Table 6 shows the distribution of errors on self-reported height by gender. On average, both men and women firefighters over-reported their height by 29 and 17 mm, respectively (including seven outliers). The variability (standard deviation) of the reporting errors was 18 mm for men and 16 mm for women. Reporting error in height also varied by geographic location. About 62% of firefighters in Fort Worth, TX, 64% in Philadelphia, PA, 52% in Phoenix, AZ and 58% in Rockville, MD over-reported their height more than 25 mm. Rockville, MD group on average had a smaller mean estimation error as compared to the Philadelphia, PA and Fort Worth, TX groups.

5.5 Difference between measured weight (and height) and adjusted weight (and height) from self-reported data based on existing models developed from the NHANES II civilian survey

The NHANES II study provided four equations for adjusting self-reported weight and height to match measured weight and height, using a stepwise multiple regression with age, race, education, 0 and 5 end-digit preference and BMI as independent variables (Rowland 1990). The information was useful in nutrition status and obesity prevalence studies in the areas where direct measurements were not available and self-reported data were offered.

For men, the adjusted weight (pounds) = −4.1259 + 1.0185 (self-reported weight in pounds) − (Equation 1; $R^2 = 0.95$) and the adjusted height (inches) = 7.1987 + 0.8865 (self-reported height in inches) +0.0222 (age in years)−0.0004 (age^2) − (Equation 2; $R^2 = 0.89$).

For women, the adjusted weight (pounds) = −3.1974 + 1.0438 (self-reported weight in pounds) −0.0175 (age in years) − (Equation 3; $R^2 = 0.96$) and the adjusted height (inches) = 7.4583 + 0.8745 (self-reported height in inches) +0.0424 (age in years) −0.0007 (age^2) − (Equation 4; $R^2 = 0.85$)

By applying the above equations for the firefighter data in this study, the differences between measured weight and adjusted weight, as well as between measured height and adjusted height are summarised in Table 7. Case-wise deletion of missing data related to the equations was employed; also excluded in the analyses were six men and one woman who had a difference of more than 13 kg between their self-reported and measured weight to minimise the influence of outliers.

The results showed that the NHANES II equations on body weight developed from a civilian population did not fit the firefighter population well. Although no statistical significance was found between the means of the equation-adjusted data and the measured data, the variability (standard deviation) for each gender–BMI category is relatively large, with the standard deviation ranging from 1.3 to 5.0 kg for men and from 1.6 to 11.9 kg for women. The probability for error of ±2.2 kg or above from adjustment by equations is 57% for men and 45% for women; these were estimated based on the assumption of a normal distribution of body weight with difference in the mean for −0.5 kg and standard deviation of 3.8 kg for men and difference in the mean for 0.3 kg and standard deviation of 3.6 kg for women.

For body height, the equations overestimated 14 mm ($p < 0.05$) on average for men and 9 mm on average for women. The variability (standard deviation) was 18 mm for men and 14 mm for women. Thus, the probability for error of ±25 mm or above from adjustment by equations is 33% for men and 14% for women.

6. Discussion

6.1 Factors associated with self-reporting errors on body weight and height

Literature has reported factors associated with self-reporting errors on body weight. Among the factors are gender, age, overweight status, 0 and 5 end-digit preference (Niedhammer et al. 2000; Rowland 1990) and the presence of diabetes (Wada et al. 2005). Women tended to underreport body weight and the older group (age ≥60) of men underreported weight to a greater degree than the young group (Kuczmarski, Kuczmarski, and Najjar 2001; Niedhammer et al. 2000). Underweight persons over-reported their weight whereas severely overweight individuals underreported their weight (Rowland 1990). A strong digit preference of 0 and 5 was observed in self-reported weight (by pounds) in which rounding down was pronounced among the severely overweight women (Rowland 1990). Men with diabetes had a large reporting error, overestimating their weight in one report (Wada et al. 2005) and underestimating their weight in the other study (Bolton-Smith et al. 2000). The current firefighter anthropometry study showed similar trends of gender and overweight status effects. Effect of age was not observed in the firefighter population; a possible reason was that very few participating firefighters were aged 60 and above. End-digit preference by pound was not used and the presence of diabetes was not registered in this study.

Similarly, self-reporting errors on body height were reported in the literature to be correlated with measured height, overweight status, age, educational level and occupation. People below median height over-reported more than those above median height in the mid-age and older groups; and overweight people over-reported their heights over their nonoverweight

counterparts (Rowland 1990). Also, errors on reported body height were notably larger for older age groups (≥70 years) (Kuczmarski, Kuczmarski, and Najjar 2001). In addition, the higher the educational level, the smaller the overestimation of height; and occupation displayed the same trend, with higher-education occupations associated with smaller overestimation of height (Niedhammer et al. 2000). The current firefighter anthropometry study showed no significant effect of these factors, considering that educational level is comparable with period of service (continuing training) and occupation is equivalent to job title in this study. Instead, gender was found to be a significant factor in reporting error for body height among firefighters. These differences between firefighters and the general population are likely a reflection that firefighters have unique anthropometric characteristics as compared to the general population.

While this study has used the standard BMI classification to evaluate the difference in reporting errors on body weight and height among different BMI groups, the study does not imply a fit or unfit of the groups. The study established that firefighters have a different height and weight distribution than the general population. A firefighter who is severely overweight relative to the general population may be in fact more muscular due to training. The descriptors, light, mid, heavy and very heavy, may represent the firefighters groups better than those used in the standard BMI classification (i.e. underweight, mid-weight, overweight and severely overweight).

6.2 Magnitude and distribution of self-reporting errors on body weight and height

This firefighter anthropometry study found that 73% of male and 76% of female participants reported their weight within a ±2.2- kg difference from their true weight (measured weight) and that about 41% of male and 72% of female participants reported their height within ±25 mm. A previous study on the general population showed that 62% of men and 70% of women reported their weight within a ±2.2- kg difference from their measured weight and that 67% of male and 74% of female participants reported their height within ±25 mm (Rowland 1990). It is likely that firefighter groups were more attentive to their weight but not height as compared to the general population due to frequent firefighter capacity evaluation tests and equipment fit assessments. A similar finding for law enforcement officers was reported in Martin et al. (1975) where subjects overestimated their height by 26 mm on average but estimated their weight within 0.23 kg.

6.3 Feasibility of error-rectification equations

While equations are available in the literature for correcting errors associated with self-reported body weight and height, the calculations developed from a civilian population did not fit the firefighter population well as demonstrated in Table 7. The deviation likely resulted from the fact that the firefighter population had significantly different anthropometric characteristics compared to those of the general population (Hsiao et al. 2014). Another possible contributor is that the error-rectification equations (Rowland 1990) were 22 years old at the time of this study. The trend of being overweight is growing in the community and the old equations would not reflect the change. Unfortunately, there were no updated or comparable equations available for direct comparisons to verify this hypothesis. Three age-specific error-rectification equations for correcting self-reported body weight

among elders (aged ≥60 years) were reported by Kuczmarski, Kuczmarski and Najjar (2001); these equations, however, were not particularly useful to the firefighter group in that there were very few active firefighters in the age category of ≥60 years.

Four equations to correct the 'systematic errors' were developed from self-reported height and weight for the firefighterspecific population. The equations provide a possible fix for certain missing data, or to estimate the actual height and weight if a self-reported survey on firefighter anthropometry is deemed to be necessary in the future. A forward stepwise regression was used to develop the equations, considering self-reported weight, height, age, period of service, job title and BMI as independent variables. Adjusted weight for men (kg) = 20.53418 + 0.56579 × (self-reported weight in kg) + 0.00228 × (self-reported weight in kg)^2 − (Equation 5; adjusted R^2 = 0.93). Adjusted height for men (mm) = 68.16988 + 0.93895 × (self-reported height in mm) + 0.41971 × (BMI), where BMI = (self-reported weight in kg)/(self-reported height in m)^2 − (Equation 6; adjusted R^2 = 0.93). Adjusted weight for women (kg) = −1.1126 + 1.03117 × (self-reported weight in kg) − (Equation 7; adjusted R^2 = 0.93). Adjusted height for women (mm) = 209.8434 + 0.8655 × (self-reported height in mm) − (Equation 8; adjusted R^2 = 0.94). Each R^2 represents the proportion of variance in actual weight or height explained by the predictor variables in each equation. The 'prediction power' for height (Equations 6 and 8) is better than that of the NHANES II study (Equations 2 and 4) for both men (0.93 vs. 0.89) and women (0.94 vs. 0.85). The difference in prediction power for weight between this firefighter study and the NHANES II study was marginal for both men (0.93 vs. 0.95; Equations 5 vs. 1) and women (0.93 vs. 0.96; Equations 7 vs. 3). Literature has shown that 'neither simple linear prediction equations nor multiple-regression prediction equations in nutrition surveys have been more than marginally successful in correcting misclassification error resulting from bias and random error associated with self-reported values' (Rowland 1989, 1129). The proposed correction equations for firefighters in this study have an acceptable prediction power. Yet, the sustainability of self-reported anthropometric data in the long run is a practical question to be discussed.

6.4 Sustainability of self-reported anthropometric data

A biomedical study of 1573 Australian adults found that participants overestimated their height by 14 mm and underestimated their weight by 1.7 kg (Taylor et al. 2006). A study of 4567 respondents in Canada showed that on average, males over-reported their height by 10 mm, and females by 5 mm. Females under-reported their weight by an average of 2.5 kg and males by 1.8 kg (Shields, Gorber, and Tremblay 2008). A systematic review on comparing direct and self-reported measures in 64 citations indicated a general trend of under-reporting for weight and over-reporting for height, although the degree of the trend varies for men and women and the characteristics of the population being examined. Standard deviations were large, indicating that there was a great deal of individual variability in the reporting of results (Gorber et al. 2007). A comparable literature review on accuracy of self-reported height and weight in women revealed that 21 out of 26 studies found that women overestimated height and all 34 studies reported that women underestimated weight. Although mean variations between self-reported and measured values were small, a significant percentage of women in study groups had very large errors (Engstrom et al.

2010). These results lead to an understanding that direct measurement of height and weight should be performed whenever possible for optimal measurement in clinical practice and clinically oriented research.

This firefighter study revealed that underreporting in weight in men was most common in overweight and severely overweight firefighters by 0.5 and 1.6 kg, respectively. For women, on average, underreporting of their weight was 0.3 , 1.7 and 6.3 kg by mid-weight, overweight and severely overweight groups, respectively. On the other hand, over-reporting weight was observed by mid-weight and underweight men by an average of 0.8 and 2.0 kg, respectively. Moreover, eight outliers of self-reported weight were observed. These outcomes, in particular with a great deal of individual variability in reporting of results, suggest that the self-reported approach is not a sustainable option for anthropometric surveys, even for physically active professional groups, such as firefighters, since it is undependable for some important subgroups. Many fire apparatus designs, such as protective gear and fire truck cab and seat arrangements, need to accommodate extreme anthropometric circumstances (i.e. important subgroups). Use of self-reported data which contain potential significant errors is not a viable option for safety and economic reasons.

7. Conclusion

Many firefighters, even as a professional group which undergoes annual physical examinations, certain capacity evaluation tests, and frequent equipment fit assessments, may not necessarily be attentive to their body height and weight. On average, both male and female firefighters overestimated their body height (29 ± 18, 17 ± 16 mm) while underestimating their weight (−0.4 ± 4.1, −1.1 ± 3.6 kg). Self-reported anthropometric information (weight and height) was undependable in important population subgroups and reporting errors on weight were associated with overweight status. Equations available in the literature for correcting errors associated with self-reported body weight and height based on civilian population did not fit the firefighter population.

Four stepwise polynomial regression equations were developed to correct the ‘systematic errors’ from self-reported height and weight for the firefighter-specific population. These equations provide a possibility to fix certain missing data. Due to the fact that self-reported anthropometric information was undependable in important population subgroups, the self-reported approach is not a sustainable option for substituting for a professional anthropometric survey to lessen survey cost for protective equipment design applications, even for physically active professional groups, such as firefighters.

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Practitioner Summary

This study along with literature revealed that the self-reported approach is not a sustainable option for anthropometric surveys, even for gathering data from physically active professional groups, such as firefighters, who presumably are knowledgeable of their body dimensions. Self-reported anthropometric information is undependable in important population subgroups.

Table 1

The stratified sample (3-age × 3-race/ethnicity × 2-gender combinations) in the study.

	Male									Female			
	White			Black			Hispanic/other						
Data age collection site	**18–32**	**33–44**	**45–65**	**18–32**	**33–44**	**45–65**	**18–32**	**33–44**	**45–65**	**18–32**	**33–44**	**45–65**	**Total**
Phoenix, AZ	46	47	43	3	3	3	13	17	13	7	7	8	210
Philadelphia, PA	49	55	52	6	5	11	4	5	2	7	8	5	209
Rockville, MD	63	62	63	10	8	9	8	9	6	8	13	5	264
Fort Worth, TX	55	72	59	7	14	14	9	9	9	5	10	5	268
Total measured	213	236	217	26	30	37	34	40	30	27	38	23	951

Table 2

Main effects ANOVA least square means comparisons of errors of self-reported body weight (kg).

Selected variables	*n*	Mean	SEM	*p*	Significance[a]
Gender				0.022	
Men	817	− 0.29	0.29		A
Women	81	− 1.36	0.52		B
Race				0.470	
White	705	− 1.02	0.31		
Black	90	− 0.95	0.51		
Other	103	− 0.50	0.49		
Age group				0.927	
18–32 (young)	283	− 0.90	0.46		
33–44 (mid-age)	324	− 0.76	0.39		
45 + (senior)	291	− 0.83	0.44		
Period of service				0.939	
60 months ≤(new)	265	− 0.79	0.49		
61–120 months (mid)	171	− 1.00	0.46		
121–240 months (senior)	234	− 0.77	0.41		
≥ 241 months (extended)	228	− 0.75	0.49		
Job title				0.948	
Officer	216	− 0.95	0.40		
Master firefighter	31	− 0.90	0.78		
Firefighter	589	− 0.86	0.30		
Other	62	− 0.60	0.57		
Geographic location				0.533	
Fort Worth, TX	260	− 0.99	0.41		
Rockville, MD	250	− 0.68	0.40		
Philadelphia, PA	196	− 1.07	0.44		
Phoenix, AZ	192	− 0.57	0.43		
BMI				< 0.001	
Mid-weight (+ under)	361	0.43	0.37		A
Overweight	256	− 0.92	0.41		B
Severely overweight	281	− 1.99	0.41		C

[a]Means in the same variable category with different letters were significantly different.

Table 3

Analysis of effects of gender, BMI and gender × BMI on errors of self-reported body weight (kg).

Gender	BMI	*n*	Mean	SE	95% CI of mean (L)	95% CI of mean (U)	*p*	Significance[a]
Male		838	− 0.41	0.14	− 0.68	− 0.14	< 0.001	A
Female		83	− 2.76	0.63	− 4.00	− 1.53		B
	Mid + U	364	0.24	0.29	− 0.32	0.81	< 0.001	A
	Over	270	− 1.10	0.44	− 1.96	− 0.24		B
	Severe	287	− 3.90	0.81	− 5.49	− 2.31		C
Male	Mid + U	312	0.82	0.15	0.52	1.112	0.12	
Male	Over	247	− 0.14	0.17	− 0.44	0.22		
Male	Severe	282	− 1.24	0.16	− 1.55	− 0.93		
Female	Mid + U	55	− 0.32	0.35	− 1.01	0.38		
Female	Over	22	− 1.74	0.56	− 2.84	− 0.64		
Female	Severe	6	− 6.23	1.07	− 8.33	− 4.12		

[a]Means in the same variable category with different letters were significantly different.

Table 4

Deviation of self-reported weight from measured weight (by gender × BMI).

	Self-reported heavier than measured		Reported correctly ±2.2 kg	Self-reported lighter than measured		Mean ± SEM (kg)	SD (kg)
	≥4.5 kg	2.3–4.4 kg		−2.3 to −4.4 kg	≤ − 4.5 kg		
Males (*n* = 845)	24 (2.8%)	77 (9.1%)	620 (73.4%)	80 (9.5%)	44 (5.2%)	− 0.4 ± 0.1	4.1
Underweight (*n* = 3)	0.0%	1 (33.3%)	2 (66.7%)	0.0%	0.0%	2.0 ± 0.8	1.4
Mid-weight (*n* = 309)	14 (4.5%)	42 (13.6%)	236 (76.4%)	13 (4.2%)	4 (1.3%)	0.8 ± 0.1	2.3
Overweight (*n* = 249)	4 (1.6%)	19 (7.6%)	197 (79.1%)	22 (8.8%)	7 (2.8%)	−0.5 ± 0.3	4.4
Severely overweight (*n* = 284)	6 (2.1%)	15 (5.3%)	185 (65.1%)	45 (15.8%)	33 (11.6%)	− 1.6 ± 0.3	4.9
Females (*n* = 83)	0.0%	3 (3.6%)	63 (75.9%)	13 (15.7%)	4 (4.8%)	−1.1 ± 0.4	3.6
Underweight (*n* = 0)	–	–	–	–	–	–	–
Mid-weight (*n* = 55)	0.0%	3 (5.5%)	46 (83.6%)	5 (9.1%)	1 (1.8%)	−0.3 ± 0.2	1.6
Overweight (*n* = 22)	0.0%	0.0%	15 (68.2%)	5 (22.7%)	2 (9.1%)	−1.7 ± 0.4	1.8
Severely overweight (*n* = 6)	0.0%	0.0%	2 (33.3%)	3 (50.0%)	1 (16.7%)	−6.2 ± 4.6	11.3

Table 5

Univariate mean comparisons of errors of self-reported body height (mm).

Selected variables	*n*	Mean	SEM	*p*	Significance[a]
Gender				<0.001	
Men	820	28	1		A
Women	81	17	2		B
Race				0.799	
White	707	22	1		
Black	90	23	2		
Other	104	23	2		
Age group				0.985	
18–32 (young)	284	23	2		
33–44 (mid-age)	326	23	2		
45 + (senior)	291	23	2		
Period of service				0.830	
60 months ≤ (new)	265	22	2		
61–120 months (mid)	172	23	2		
121–240 months (senior)	236	24	2		
≥ 241 months (extended)	228	23	2		
Job title				0.070	
Officer	214	25	2		
Master firefighter	32	23	4		
Firefighter	592	25	1		
Other	63	19	3		
Geographic location				< 0.0001	
Fort Worth, TX	261	27	2		A
Philadelphia, PA	195	25	2		AB
Phoenix, AZ	193	22	2		BC
Rockville, MD	252	18	2		C
BMI				0.352	
Mid-weight (+ under)	364	22	2		
Overweight	255	23	2		
Severely overweight	282	24	2		

[a] Means with the same letter were not significantly different.

Table 6

Deviation of self-reported height from measured height.

Distribution of differences between self-reported height and measured height (by gender and geographic location)		Self-reported taller than measured		Reported correctly ±25mm	Self-reported shorter than measured		Mean ± SEM (mm)	SD (mm)
		≥51mm	26–50mm		−26 to −50mm	≤ − 51mm		
Gender	Males (*n* = 861)	98 (11.4%)	407 (47.3%)	355 (41.2%)	1 (0.1%)	0 (0.0%)	29 ±1	18
	Females (*n* = 87)	2 (2.3%)	22 (25.3%)	63 (72.4%)	0 (0.0%)	0 (0.0%)	17 ±2	16
Geographic location	Fort Worth, TX (*n* = 268)	36 (13.4%)	129 (48.1%)	103 (38.4%)	0 (0.0%)	0 (0.0%)	32 ±1	18
	Philadelphia, PA (*n* = 207)	30 (14.5%)	103 (49.8%)	74 (35.7%)	0 (0.0%)	0 (0.0%)	31 ±3	19
	Phoenix, AZ (*n* = 209)	19 (9.1%)	89 (42.6%)	101 (48.3%)	0 (0.0%)	0 (0.0%)	27 ±1	17
	Rockville, MD (*n* = 264)	15 (17.0%)	108 (40.9%)	140 (53.0%)	1 (0.4%)	0 (0.0%)	24 ±1	17

Table 7

Mean and standard deviation of weight and height differences (self-reported with adjustment by equations minus measured) by gender–BMI category.

	Adjustment by NHANES II equations			Measured weight					
Measured-body weight category by gender (kg)	**Mean**	**SE of mean**	**SD**	**Mean**	**SE of mean**	**SD**	**Diff in mean**	**STD of Diff**	**Prob. for error >±2.2 kg**
Males (n = 844)	92.4	0.50	14.5	92.9	0.51	14.9	− 0.5	3.8	57%
Underweight (n = 3)	66.8	6.3	10.9	65.4	6.7	11.7	1.4	1.3	
Mid-weight (n = 309)	80.6	0.47	8.3	80.2	0.47	8.2	0.4	2.3	
Overweight (n = 248)	91.9	0.50	7.9	92.4	0.45	7.1	− 0.5	3.5	
Severely overweight (n = 284)	106.0	0.72	12.2	107.5	0.71	11.9	− 1.5	5.0	
Females (n = 83)	72.9	1.37	12.5	72.6	1.41	12.8	0.3	3.6	45%
Underweight (n = 0)	–	–	–	–	–	–	–	–	
Mid-weight (n = 55)	66.5	0.85	6.3	65.7	0.84	6.2	0.8	1.6	
Overweight (n = 22)	81.9	1.57	7.4	81.9	1.52	7.1	0	1.8	
Severely overweight (n = 6)	97.9	7.6	18.6	101.7	5.0	12.2	− 3.8	11.9	
Measured-body height category by gender (mm)	**Mean**	**SE of mean**	**SD**	**Mean**	**SE of mean**	**SD**	**Diff in mean**	**SD of Diff**	**Prob. for error >±25mm**
Males (n = 844)	1782	2	61	1768	2	67	14[a]	18mm	33%
Females (n = 83)	1677	6	56	1668	6	57	9	14mm	14%

Note: SE of Mean, standard error of mean; Diff in Mean, difference in the Mean; SD of Diff, standard deviation of self-reported with adjustment by equations minus measured.

[a]Denotes statistical significance.