

Agreement between measured and self-reported weight in older women. Results from the British Women's Heart and Health Study

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Abstract

Background: previous studies of the accuracy of self-reported weight have been criticised for using inadequate methods and have included only young or middle aged adults. Self-report is more likely to be relied upon in both clinical and research practice in older age groups. The cultural pressures that may cause the tendency among younger women to underestimate their weight, particularly when they are overweight, may operate differently in older women.

Objective: to determine the accuracy of self-reported weight among older women.

Methods: national cross sectional survey of women aged 60–79 from 9 towns across England, Scotland and Wales. Self-reported weight from a participant questionnaire was compared to measured weight at examination.

Results: of 2729 women who were invited, 1636 (60%) returned the questionnaire (of whom 1549 gave a self-reported weight) and 1384 (51%) attended for examination (of whom 1381 were weighed). In total there were 1310 (48% of the total invited sample) with complete self-report and measured weight. Self-reported and measured weight were highly correlated (Pearson's correlation coefficient, 0.982 95% confidence interval, 0.979–0.983) and self-reported weight differed from measured weight by only 1.0 kg (95% confidence interval 0.8 kg, 1.1 kg) on average. However, a difference plot, with limits of agreement at -4.0 kg to $+6.0$ kg (95% confidence intervals: lower limit -4.3 kg, -3.8 kg; upper limit $+5.7$ kg, $+6.2$ kg) revealed poor agreement between methods. Obese individuals, in particular, were more likely to underestimate their weight.

Conclusions: though self-report of weight by women in their 60s and 70s is highly correlated, at an individual level differences between self-report and measured weight are frequently large. Obese individuals, in particular, tend to underestimate their weight. Self-report of weight should not be relied upon in prospective epidemiological studies or clinical practice when accuracy at the level of the individual is required.

Keywords: *obesity, older women, weight*

Introduction

Increasing levels of obesity present a major public health problem at all ages but particularly among elderly people [1–3]. Health policy guidelines in the UK and in other countries require that levels of obesity are monitored in the population and in individuals in the clinical setting so that preventive initiatives can be appropriately targeted [1, 4]. Weight measurement is also important in research to ascertain the importance of obesity in the aetiology of chronic diseases and the important factors that lead to obesity. Although large national lifestyle surveys such as the Health Survey for England [3, 5] use standardised

measures of weight, many local surveys do not have the funding necessary for individual examinations and instead rely on self-reported weight in postal questionnaires. Weight change, independent of level of obesity at baseline may influence health outcomes [6–9] and although most prospective studies measure weight at baseline, many rely on self-report of weight at follow-up [6, 7, 10]. In the clinical setting also there are situations where it is more feasible to rely on self-reported weight.

Several studies that have concluded that self-report is accurate have used correlation to compare measured and self-reported weight [11, 12], though this approach may be misleading [13]. For example, perfect correlation

between two methods could be obtained if one always measured twice as much as the other, since correlation simply assesses the extent of linearity between two measures. Other studies using better statistical methods have reported systematic inaccuracies, with heavier individuals having a greater tendency to underestimate their weight than lighter individuals [14–16]. These studies have been conducted on young and middle aged participants—despite the fact that self-report may be relied on more in the elderly. Prospective studies are most likely to rely on self-report at follow-up, when cohort members are older. In the clinical setting, self-report may be more convenient than measuring weight in older patients. It may not be appropriate to generalise findings from these studies to older populations, since the systematic discrepancies between heavier and lighter individuals are most likely the result of cultural ideals regarding weight [15, 16]. Elderly people, particularly those who remember food shortages and rationing during the war years, may not share these ideals and may be less concerned about their physical appearance.

We present data from the British Women's Heart and Health Study, a cohort of women aged 60–79, comparing self-report with measured weight.

Methods

Participants

We used data from the British Women's Heart and Health Study, a sample of 60–79 year old women, from 23 towns across England, Scotland and Wales. The selection of towns, practices and participants was based on the British Regional Heart Study, a prospective cohort study of men that was initiated over 20 years ago [17, 18]. The towns were selected to represent all major geographic regions and reflect variations in coronary heart disease (CHD) mortality and environmental risk factors. In each town, the study sample was obtained from a general practitioner (GP) age-sex register, with the practices chosen to reflect the social composition of the town. The study population consisted of women aged 60–79. A random sample, age stratified in five year age bands, of between 300–350 women taken from the age-sex register of each general practice were invited to participate, with a further postal reminder sent to non-responders. Those who wished to participate but could not attend because of mobility problems were offered transport to the examination centre.

For participants from the first 9 towns involved in the study a self-completed health questionnaire—which asked for weight in stones and pounds, as well as details about health problems and a large number of cardiovascular disease risk factors—was sent out with the invitation to attend the study examination centre. After fieldwork in the first 9 towns was completed, the

invitation to attend for examination was sent without the health questionnaire. The health questionnaire was then given to participants at the end of the examination with a stamped envelope in which to return it. This change was done in order to increase the response in the belief that some potential participants may have been put off by the lengthy questionnaire. Self-reported weight for participants after the ninth town was therefore obtained after they had been informed of their examination weight. Consequently only data from subjects from the first 9 towns were used in this study. No significant differences in age, measured weight, socio-economic class or self-reported educational achievement were found between the first 9 towns and the remainder of the study sample. Self-reported weight was converted to kilograms by multiplying the total weight in pounds by 0.454. Subjects who attended were weighed within six weeks of returning their questionnaire, without shoes in a light dressing gown, on a Soehnle portable scale to the nearest 100 g. Height was measured without shoes using a Harpenden Stadiometer and was recorded to the nearest millimeter. All measurements were undertaken by a team of three nurses who had undergone intensive training before fieldwork began. Women attended for examination at any time between 9am and 5.30pm and all participants had been asked to fast for six h before they attended.

Analysis

We calculated correlation between self-report and actual weight using Pearson's correlation coefficient. A plot as described by Bland and Altman [13] was used to examine individual agreement between measured and self-reported weight. The difference (measured weight minus self-reported weight) was plotted against the mean of the two measurements. Limits of agreement were calculated as the mean difference plus 2 standard deviations, and 95% confidence intervals (CI), calculated using Bland and Altman's method, were used to assess the precision of these limits [13].

We assessed the effect of obesity on accuracy of self-report by calculating the mean difference for different categories of body mass index (BMI— kg/m^2), calculated from measured weight and height and assessing the trend across categories using Cuzick's test for trend of ordered groups [19]. All analyses were undertaken using *Stata version 6.0*.

Results

Of 2729 women who were invited, 1636 (60%) returned the questionnaire (of whom 1549 gave a self-reported weight) and 1384 (51%) attended for examination (of whom 1381 were weighed). In total there were 1310 (48% of the total invited sample) with complete self-report and measured weight. When women who

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responded fully (complete questionnaire and attended) were compared to those who were invited but did not respond, there was no difference in GP recorded myocardial infarction, angina or cancer. However, non-responders were more likely to have a GP record of a stroke (3.6% versus 1.7% $P < 0.01$) and were slightly older (70.0 years versus 68.7 years $P = 0.04$). When those who attended for examination—but had not provided a self-report of their weight—were compared to those who attended but had provided a self-report of their weight, there was no difference in mean age, mean

measured weight and estimated body mass index. There was no significance between nurse variation in the measurements of weight and height.

Self-report and measured weight were highly correlated—Pearson's correlation coefficient, 0.982 95% CI (0.979–0.983) (Figure 1). The mean difference between measured and self-reported weight was +0.97 kg (95% CI 0.8 kg, 1.1 kg). The 95% limits of agreement were -4.0 kg to $+6.0$ kg (95% CI: lower limit -4.3 kg, -3.8 kg; upper limit $+5.7$ kg, $+6.2$ kg) (Figure 2). Less than half of the sample, 44.3% (95% CI

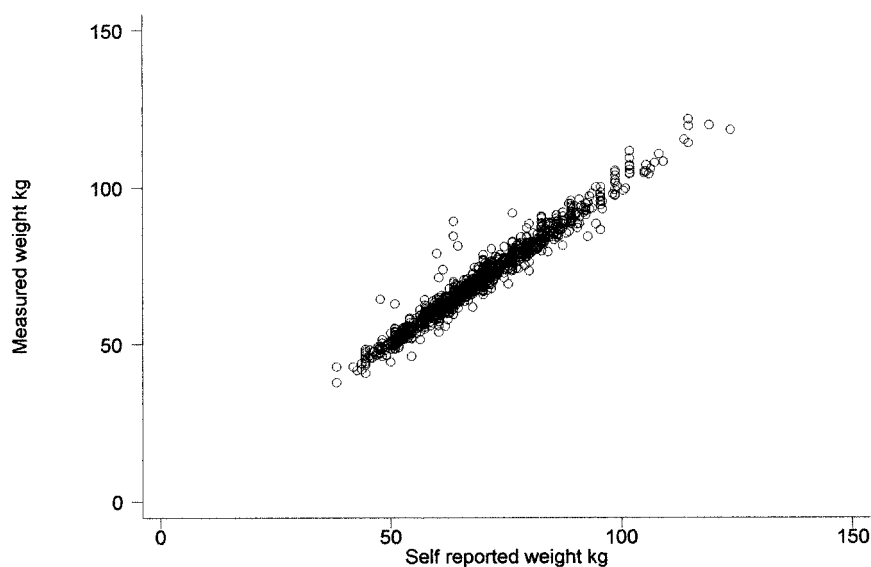


Figure 1. Correlation between self-reported and measured weight.

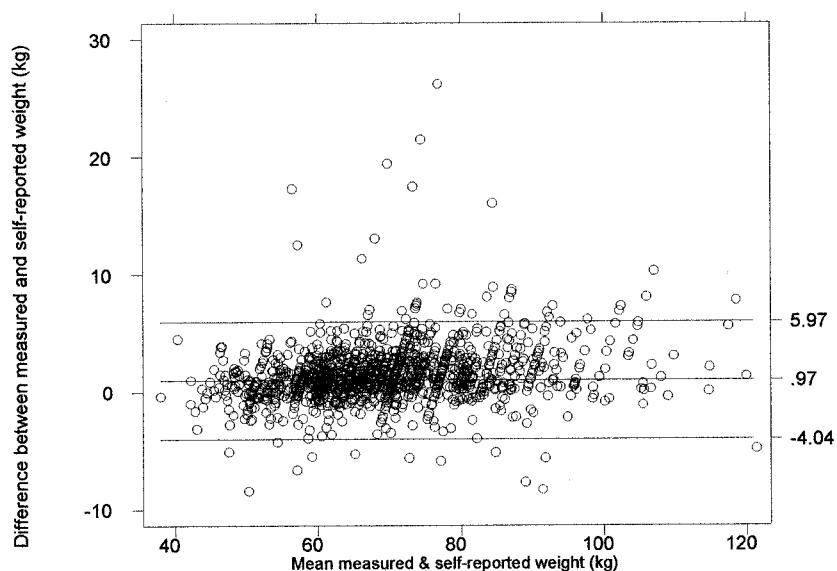


Figure 2. Bland-Altman plot—difference between measured and self-reported weight (kg) plotted against mean of measured and self-reported weight, British women age 60–79 years ($n = 1310$). Horizontal lines represent the mean difference for the whole group ($+0.97$ kg) and 95% limits of agreement (-4.03 kg to $+5.97$ kg).

Table 1. Mean difference between measured and self-report weight, for categories of obesity, in British women aged 60–79

Mean weight difference (measured weight minus self-report weight) kg (95% CI)	Total sample <i>n</i> = 1310	Aged 60–69 <i>n</i> = 733	Aged 70–79 <i>n</i> = 577
Underweight BMI < 20	–0.52 (–1.09, 0.05)	–0.27 (–1.11, 0.57)	–0.91 (–1.61, –0.21)
Normal BMI 20–24.9	0.35 (0.14, 0.56)	0.51 (0.21, 0.81)	0.16 (–0.12, 0.44)
Overweight BMI 25–29.9	0.88 (0.71, 1.05)	0.87 (0.64, 1.10)	0.88 (0.63, 1.13)
Obese BMI > 29.9	1.84 (1.50, 2.18)	1.85 (1.41, 2.29)	1.81 (1.27, 2.37)
	<i>P</i> trend < 0.001	<i>P</i> trend < 0.001	<i>P</i> trend < 0.001

CI, confidence interval; BMI, body mass index.

41.5%, 47.1%), had a difference of less than 1 kg in either direction between self-reported and measured weight. A similar proportion 43.1% (CI 40.4%, 47.1%) underestimated their weight by more than 1 kg and 12.6% (CI 10.8%, 14.6%) overestimated their weight by more than 1 kg. Misclassification within thirds of the distribution of measured weight were minimal. For example, 93.8% of those in the highest third of self-reported weight were in the top third of measured weight and none were in the lowest third; 91.9% of those in the lowest third of self-reported weight were in the lowest third of measured weight with only 0.3% in the highest third of measured weight. There was a significant trend towards greater underestimation of weight with increasing obesity (Table 1). This trend was similar both in women aged 60–69 and in those aged 70–79.

Discussion

The finding that self-reported and measured weight are highly correlated and that the mean difference between measured and self-reported weight is only 1 kg suggests a high degree of accuracy in self-reporting of weight by elderly women, on average. However, the estimated limits of agreement suggest that in this group a large proportion of individuals may underestimate their weight by as much as 6 kg or over-estimate it by as much as 4 kg. Over 40% of the self-reported weights were 1 kg or more below the measured weight. We had thought that the older population in our study would be less likely than younger groups to show an association between underestimation of weight and obesity, but our results show a similar trend across categories of obesity to those found among women from two other UK studies of adults under the age of 64 [14, 15]. In our study, the tendency to greater underestimate among the more obese was found among both women in their 60s and those in their 70s. Even in their 60s and 70s, women may be influenced by cultural ideals that promote thinness. Alternatively, it may be that women who are overweight are less likely to weigh themselves—perhaps

because they are less concerned about their weight, and therefore estimate their weight with a lower level of accuracy. Cognitive impairment may also increase inaccuracy in older women. We are unable in this study to assess the impact of cognitive impairment on accuracy of self-reported weight, since we did not undertake formal assessments of cognitive impairment and our study design precluded the participation of most women with cognitive impairment. If obesity and cognitive impairment were associated, an increasing trend of underestimation of weight with increased levels of obesity might be attributable to cognitive impairment, although this association is not established.

Study limitations

Our response is consistent with other baseline data collection in large epidemiological surveys requiring clinical attendance [3, 14]. Responders were younger and less likely to have a stroke than non-responders, which may limit the generalisability of our findings, though within the study similar results were found for those under the age of 70 compared to those over 70. Women who have experienced a stroke may have greater levels of cognitive impairment and therefore be less accurate in their self-report. These differences between responders and non-responders do not affect the conclusions of this study that self-report of weight in elderly women can be inaccurate. We have no details of differences in levels of obesity or other factors such as smoking, which may affect obesity between responders and non-responders. However, the distribution of body mass index (based on measured weight and height) in our study is similar to that for older women in the Health Survey for England [3] and since more obese individuals are more inclined to report their weight their possible exclusion does not alter our conclusions that self-reported weight is sometimes inaccurate.

It has been suggested that the level of inaccuracy of self-reports of weight may have been underestimated in some studies by selective non-response, with, for example those with perceived ‘undesirable’ weight ignoring requests for this information [14].

This is unlikely to have affected the results of our study. The primary aim of the British Women's Heart and Health Study is to determine the aetiology and management of cardiovascular disease and other major causes of ill health in a nationally representative sample of elderly women and the questionnaire requests a large amount of health-related information. It is unlikely that the one question on weight will have dissuaded individuals from responding and among those who did respond, a greater proportion (95%) completed this question than completed many other questions. There were no differences in body mass index based on measured weight between those who attended and had provided a self-report of their weight and those who attended and had not completed the self-report question on weight. Although other UK studies of middle aged women and men have found no sex difference in the level of inaccuracy of self-reported weight [14, 15], our results may not be generalisable to older men. Men of this generation may have different views of weight gain than similar aged women or younger men.

Implications

The appropriateness of using self-reported weight will depend upon the context and in particular the need for individual level accuracy. The low level of the mean difference (only 1 kg), the high degree of correlation and the low level of misclassification across a third of the measured and self-reported distributions means that self-report may be satisfactory in population surveys conducted to describe the distribution of obesity.

A number of studies have found that weight change, including loss, is detrimental to health [6–9]. One review concluded that although the results of these studies were consistent and 'intriguing', the lack of any biologically plausible explanation for weight loss being associated with increasing mortality was problematic [20]. The use of self-reported weight at follow-up in many of these studies may have produced bias in the results. If obese people are more likely to underestimate their weight at follow-up, and as they will have been measured and classified as obese at baseline, a spurious excess weight loss will tend to be found amongst those who were obese at baseline. Therefore any association between weight loss and increased mortality may reflect an association between baseline obesity and mortality. These studies may thus illustrate the potential problems of relying on self-reported weight in prospective aetiological research.

In the clinical setting visual appearance may limit the extent to which patients can convincingly under- or over-estimate their weight by a meaningful amount, though screening health checks are sometimes undertaken using a questionnaire that is completed outside the surgery.

We conclude that for research and clinical practice where accuracy of individual weight is required, self-report should not be relied upon in older women.

Key points

- In a sample of 1310 women aged between 60–79, self reported and measured weight are highly correlated and the mean difference between measured and self-reported weight is just 1 kg.
- On an individual level, the range of inaccuracy varies from an underestimation of 6 kg to an overestimation of 4 kg for 95% of the sample. Forty-three percent of the sample underestimated their weight by more than 1 kg.
- Obesity was associated with a greater tendency to underestimate weight and this was so for both women aged 60–69 and those aged 70–79.
- If individual level accuracy is required in research and clinical practice, self-report of weight in older women should not be relied upon.

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