Self-reporting weight and height: misclassification effect on the risk estimates for acute myocardial infarction

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Background: The accuracy of self-reported weight and height to measure obesity has been evaluated, but no information is available on the possible error effects of self-reporting when estimating the association between body mass index (BMI) categories and the occurrence of acute myocardial infarction (AMI). We aim to evaluate if two different sources of information on height and weight (reported vs. measured) result in different risk estimates for non-fatal AMI events. Methods: A population-based case-control study was conducted with 732 cases of first AMI and 1914 community controls, recruited from the same catchment area of hospitals. As part of an interview, participants self-reported their height and weight immediately before having it measured. Data were analysed separately by sex and age strata (<45; >45 years). Results: Women under-reported their weight and over-reported their height, and the mean differences between measured and self-reported data were significantly larger in controls. Male controls also under-reported their weight, but cases over-reported it. After adjustment, in younger women the use of self-reported data underestimated the AMI risk according to BMI categories, but in older ones the self-reporting overestimated AMI risk, although with no statistical significance. In younger men, the association between AMI and self-reported obesity (BMI $\geq$ 30 kg/m$^2$) was overestimated in $\sim$50% (measured: OR = 2.05, 95% CI 1.08–3.87; self-reported: OR = 3.06, 95% CI 1.56–6.00). In older participants, a significant association was only found for overweight men when using self-reported data. Conclusions: Self-reporting of height and weight produced a differential misclassification and biased risks for AMI according to BMI, affecting not only the magnitude, but also the estimates direction.

Keywords: bias, body height, body weight, case–control studies, myocardial infarction

Introduction

Self-reported weight and height are often used to replace actual measurements in epidemiological investigations designed to assess cardiovascular risk factors.\textsuperscript{1–4} However, self-reported data may not accurately describe the true anthropometric parameters, and the magnitude of the bias might be affected by several characteristics, such as sex, age or socioeconomic status. Studies on the accuracy of self-reported data may not accurately describe the true fatness could result in recall bias.\textsuperscript{24,25} Therefore, anthropometric indices derived from self-reported information may contribute to an exposure misclassification and biased risk estimates.\textsuperscript{26–29}

Studies evaluating measured and self-reported weight or height consistently showed that this information is strongly correlated, but could represent large differences, particularly when subjects are classified into categories.\textsuperscript{10–12,15–20,30–32} Even the magnitude of obesity status seems to increase directly the unreliability in self-reporting weight.\textsuperscript{12,17,32} However, there is no data available describing the effect of such misclassification when assessing the association between BMI categories and the occurrence of acute coronary syndromes.

The purpose of this study was to evaluate the effect of self-reported weight and height on the risk estimates for acute myocardial infarction (AMI) according to strata of BMI.

Participants and methods

Participants were recruited as part of a previously described population-based case–control investigation on risk factors for AMI.\textsuperscript{33,34} The study was conducted with Portuguese Caucasian adults ($\geq$18 years), recruited between 1999 and 2003 in Porto, a large urban centre in the north-west of the country with almost 300 000 inhabitants.

Cases were patients consecutively admitted to the Cardiology Department of the four hospitals providing acute coronary care in Porto, who survived beyond the fourth day after a first diagnosis of an AMI. The diagnosis was based on conventional clinical symptoms, electrocardiographic and serum enzyme measurements, considering infarction with and without ST segment elevation, according to the criteria defined by the European Society of Cardiology and the American College of Cardiology.\textsuperscript{35}

Community controls were recruited from the same catchment area of participating hospitals and were selected within the non-institutionalized adult population of Porto (the EPIPorto study), by random digit dialling, using households as the sampling unit. After identifying the households, residents’ age and sex were ascertained, and one resident among all aged $\geq$18 years was randomly selected. Refusals replacement was not allowed.
The response rate was 99% for myocardial infarction patients and 70% for community participants (different characteristics of participants and non-participants had little or no impact on the direction or magnitude of AMI risk estimates, as previously described).34

A rapid evaluation of the participants’ cognitive function was carried out using the Mini-Mental State Examination36 in participants older than 64 (subjects were excluded when scoring <24 due to cognitive impairment).

Out of 2485 community participants, 114 (4.6%) were excluded due to previous clinical or silent infarction according to self-reported data or/and a 12-lead electrocardiogram, 9 due to incomplete information or physical disability and 46 because they scored <24 in the Mini-Mental State Examination.

During the study period, 1248 patients with an incident AMI were identified, but 330 were excluded. The reasons for exclusion were: refusal to participate (n = 3), physical or mental inability to collaborate (n = 67), death (n = 37), incomplete interview (n = 85) or Mini-Mental State Examination scoring <24 (n = 138).

After the exclusions, the sample included 3234 subjects: 2316 controls (1449 women and 867 men) and 918 cases (222 women and 696 men). Out of these, 233 controls and 95 cases were unaware of their height or weight, and for 169 controls and 91 cases the current or reported anthropometrics data were missing. The final study sample included 1914 community controls (1160 women and 754 men) and 732 cases of a first AMI (149 women and 583 men).

Patients were interviewed during the hospital stay, after clinical stabilization, and controls were invited to visit the Department to be evaluated by face-to-face interviews. Data on cases and controls were collected during the same study period, by the same set of trained interviewers, using the same standard structured questionnaire, requesting information on social, demographic, behavioural and medical characteristics. During interview, cases and controls were asked to self-report current weight and height. Afterwards, with subjects in light clothing and barefoot, body weight was measured to the nearest 0.1 kg using a digital scale (SECA®), and height was measured to the nearest centimetre using a wall stadiometer (SECA®). BMI [weight (kg)/height (m²)] was calculated using the measured and the self-reported weight and height, and subjects were classified into four categories according to the World Health Organization criteria,17† < 18.5, 18.5–24.9, 25.0–29.9 and ≥30.0 kg/m². The first two categories were combined because the group with BMI < 18.5 kg/m² had few subjects (20 controls and 3 cases using measured data and 24 controls and 6 cases using self-reported data) and the new category was used as reference class for the risk estimates.

**Statistical analysis**

The accuracy of self-reported height and weight was determined by evaluating the differences between self-reported and actual height and weight measurements. Quantitative variables are presented as mean ± standard deviation. Unpaired student t-test and analysis of variance and Mann–Whitney test were used to compare means between cases and controls. Proportions were compared using the chi-square test.

The association between BMI categories (independent variable) and AMI (dependent variable) was estimated by odds ratios and respective 95% confidence intervals (95% CI) using unconditional logistic regression (age, education, smoking and family history of myocardial infarction were considered as confounders).

Data were analysed separately by sex and age strata (≤45 vs. >45 years), using the statistical software STATA® version 9.0.

**Ethics**

The Ethics Committees of the four participating hospitals approved the study and every participant provided signed informed consent, in accordance with the Helsinki Declaration II.

**Results**

Female cases of both age groups were less educated and reported more often a family history of infarction than controls (table 1). Also, younger female cases were more likely current smokers and obese than controls. Male cases were more frequently less educated, married and current smokers compared with controls. Only the younger male cases reported more frequently a family history of infarction and had higher BMI than the respective controls.

As shown in table 2, generally women tended to underreport their weight, except young AMI women, and the mean differences between reported and measured weight were significantly larger in controls than in cases. Among men, while controls of both ages underestimated their weight, cases overestimated it. Height was overestimated by cases and controls of both sexes and age groups, but larger mean differences between controls and myocardial infarction cases were found in men, particularly in older (table 2). The differential reporting between cases and controls was almost unchanged when evaluated according to other variables which are usually viewed as risk factors for cardiovascular disease, such as education, family history of myocardial infarction, smoking and alcohol intake (results not presented).

Table 3 shows the risk of AMI across categories of BMI, crudely and after adjusting for age, education, smoking and family history of AMI, and after stratification by age groups (≤45; >45 years).

In younger women, the use of self-reported weight and height underestimated the AMI risk according to BMI categories, but in the older ones the self-reporting information overestimated AMI risk, although with no statistical significance.

In men aged ≤45 years, the association between AMI and obesity by using self-reported data was overestimated in ~50% (BMI ≥30 kg/m², OR = 2.05, 95% CI 1.08–3.87 with measured data; OR = 3.06, 95% CI 1.56–6.00 with self-reported data). In older participants, a significant association was only found for overweight men, who had a 35% increase in AMI risk when using BMI calculated by self-reported data (OR = 1.34, 95% CI 1.00–1.91). No significant association was found when using measured data (OR = 1.14, 95% CI 0.82–1.60).

**Discussion**

The results of our study indicate that, in general, weight was underestimated and height overestimated. The error in reporting data was differential between controls and myocardial infarction cases, with significantly larger errors in controls than cases, particularly in men. This differential misclassification leads to biased estimates for AMI events according to BMI categories.

Our findings are consistent with previous reviews, which described that women and men frequently under-report their weight and over-report their height, with women having larger differences between self-reported and measured data.38,39

Moreover, the present study provides additional data on the different behaviours of community controls and AMI patients. In men of both age groups (≤45 vs. >45 years), we found opposite behaviours on weight reporting between controls, who underestimated it, and cases, who overestimated it.
On the other hand, female cases of AMI misreported the information in the same direction as controls, but the differences between true and stated values were almost nil among cases.

For both sexes, the mean differences between reported and measured data were numerically small, but this type of information was not our primary goal, since weight and height are usually used to classify individuals according to BMI categories. Our results showed that the mean differences between self-reported and measured data, even small, have consequences for the distribution of subjects by BMI categories, leading to a differential misclassification in cases and controls, the effect of which is particularly common in the specific case of BMI. This misclassification error must be taken into account not only when we are interpreting the association with BMI categories, but also when this variable is used as a confounder, which is particularly common in the specific case of BMI.

According to previous findings, it is probable that individuals, namely community controls, tend to report their weight and height more to conform to the current body image level. Controls were selected within the adult population of Porto, Portugal and was done providing acute coronary care in Porto, Portugal and was done during the eighth day.

As previously discussed, if a confounder is misclassified, the effect of which suggests a low likelihood of non-response bias. According to the demographic and social variables assessed, little or no impact on risk estimates of myocardial infarction among overweight and obese subjects.

Some methodological issues on sample selection and information assembly must be discussed. The recruitment of myocardial infarction cases was performed in all hospitals providing acute coronary care in Porto, Portugal and was done consecutively, which should minimize selection bias at this level. Controls were selected within the adult population of the same catchment area of hospitals where AMI cases were admitted. A previous comparison between participants (~70%) and refusals showed that non-participants had little or no impact on risk estimates of myocardial infarction, according to the demographic and social variables assessed, which suggests a low likelihood of non-response bias.

The collection of data on cases was done during the hospitalization and only incident cases were included, minimizing recall bias inherent to observational studies. These procedures also contributed to avoid potential bias due to behavioural modifications after the acute event.

In conclusion, we found that due to the differential misclassification within cases and controls, the effect of BMI when using self-reported data on AMI risk was overestimated.
**Table 2** Comparison of measured and self-reported weight and height between controls and AMI cases, by sex and age strata

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<tr>
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<th>Women</th>
<th>Men</th>
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<tbody>
<tr>
<td></td>
<td>n = 431</td>
<td>n = 36</td>
<td>P</td>
<td>n = 729</td>
<td>n = 113</td>
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<td>n = 256</td>
<td>n = 257</td>
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<td><strong>Weight (kg)</strong></td>
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<tr>
<td>Measured</td>
<td>62.1 ± 11.22</td>
<td>68.0 ± 13.51</td>
<td>0.003</td>
<td>67.0 ± 11.89</td>
<td>68.68 ± 13.09</td>
<td>0.167</td>
<td>75.9 ± 12.97</td>
<td>77.8 ± 12.01</td>
<td>0.097</td>
<td>74.62 ± 11.75</td>
<td>73.7 ± 10.30</td>
<td>0.264</td>
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<tr>
<td>Self-reported</td>
<td>61.2 ± 10.62</td>
<td>68.2 ± 14.28</td>
<td>0.002</td>
<td>66.0 ± 11.58</td>
<td>68.41 ± 12.96</td>
<td>0.062</td>
<td>75.2 ± 12.35</td>
<td>78.3 ± 12.57</td>
<td>0.002</td>
<td>73.9 ± 11.27</td>
<td>74.2 ± 10.3</td>
<td>0.771</td>
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<tr>
<td>Means difference</td>
<td>0.87 ± 2.24</td>
<td>-0.24 ± 4.18</td>
<td>0.046</td>
<td>0.99 ± 2.58</td>
<td>0.26 ± 2.64</td>
<td>&lt;0.001</td>
<td>0.72 ± 3.01</td>
<td>-0.50 ± 2.99</td>
<td>&lt;0.001</td>
<td>0.71 ± 2.92</td>
<td>-0.04 ± 2.50</td>
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<td><strong>Height (cm)</strong></td>
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<tr>
<td>Measured</td>
<td>158.9 ± 5.99</td>
<td>156.1 ± 6.03</td>
<td>0.009</td>
<td>154.6 ± 5.82</td>
<td>154.0 ± 5.43</td>
<td>0.361</td>
<td>172.2 ± 6.45</td>
<td>168.9 ± 6.50</td>
<td>&lt;0.001</td>
<td>167.4 ± 6.58</td>
<td>167.2 ± 6.30</td>
<td>0.622</td>
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<tr>
<td>Self-reported</td>
<td>160.6 ± 6.15</td>
<td>158.0 ± 5.77</td>
<td>0.013</td>
<td>157.2 ± 6.24</td>
<td>156.6 ± 5.89</td>
<td>0.296</td>
<td>173.6 ± 6.58</td>
<td>170.2 ± 6.41</td>
<td>&lt;0.001</td>
<td>169.3 ± 6.62</td>
<td>168.4 ± 7.14</td>
<td>0.236</td>
</tr>
<tr>
<td>Means difference</td>
<td>-1.76 ± 2.72</td>
<td>-1.52 ± 2.92</td>
<td>0.616</td>
<td>-2.60 ± 3.62</td>
<td>-2.51 ± 4.27</td>
<td>0.500</td>
<td>-1.40 ± 2.46</td>
<td>-1.27 ± 0.32</td>
<td>0.087</td>
<td>-1.92 ± 2.50</td>
<td>-1.27 ± 3.87</td>
<td>0.001</td>
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<td><strong>Body mass index (kg/m²)</strong></td>
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<tr>
<td>Measured</td>
<td>24.6 ± 4.55</td>
<td>28.0 ± 5.84</td>
<td>&lt;0.001</td>
<td>28.0 ± 4.83</td>
<td>28.9 ± 5.25</td>
<td>0.075</td>
<td>25.6 ± 4.10</td>
<td>27.2 ± 3.77</td>
<td>&lt;0.001</td>
<td>26.6 ± 3.70</td>
<td>26.4 ± 3.30</td>
<td>0.357</td>
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<tr>
<td>Self-reported</td>
<td>23.8 ± 4.32</td>
<td>27.3 ± 5.76</td>
<td>&lt;0.001</td>
<td>26.7 ± 4.48</td>
<td>27.9 ± 5.13</td>
<td>0.011</td>
<td>24.9 ± 3.72</td>
<td>27.0 ± 3.97</td>
<td>&lt;0.001</td>
<td>25.7 ± 3.43</td>
<td>26.2 ± 3.35</td>
<td>0.170</td>
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<tr>
<td>Means difference</td>
<td>0.86 ± 1.20</td>
<td>0.63 ± 1.94</td>
<td>0.709</td>
<td>1.33 ± 1.64</td>
<td>1.01 ± 2.04</td>
<td>0.024</td>
<td>0.66 ± 1.39</td>
<td>0.23 ± 1.27</td>
<td>&lt;0.001</td>
<td>0.85 ± 1.32</td>
<td>0.22 ± 1.75</td>
<td>&lt;0.001</td>
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</table>

Results presented are mean ± SD.

**Table 3** Acute myocardial infarction risk according to body mass index (BMI) categories, defined using measured vs. self-reported data, by sex and age strata

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<td><strong>BMI (kg/m²)</strong></td>
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<td>25.0–29.9</td>
<td>3.28 (1.46–7.35)</td>
<td>2.29 (1.02–5.16)</td>
<td>0.013</td>
<td>1.78 (0.68–4.63)</td>
<td>0.92 (0.36–2.36)</td>
<td>0.046</td>
<td>1.10 (0.66–1.84)</td>
<td>1.33 (0.83–2.13)</td>
<td>0.062</td>
<td>0.82 (0.48–1.42)</td>
<td>1.10 (0.67–1.81)</td>
<td>0.087</td>
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<td>≥30.0</td>
<td>4.89 (1.97–12.1)</td>
<td>5.08 (2.13–12.1)</td>
<td>0.001</td>
<td>1.90 (0.62–5.84)</td>
<td>1.56 (0.55–4.42)</td>
<td>0.009</td>
<td>1.50 (0.89–2.51)</td>
<td>1.93 (1.15–3.23)</td>
<td>0.001</td>
<td>0.98 (0.56–1.72)</td>
<td>1.39 (0.80–2.42)</td>
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<td><strong>BMI (kg/m²)</strong></td>
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<td>25.0–29.9</td>
<td>1.98 (1.35–2.92)</td>
<td>2.80 (1.90–4.12)</td>
<td>0.001</td>
<td>1.65 (1.02–2.65)</td>
<td>2.70 (1.68–4.33)</td>
<td>0.009</td>
<td>0.99 (0.73–1.35)</td>
<td>1.24 (0.92–1.68)</td>
<td>0.001</td>
<td>1.14 (0.82–1.60)</td>
<td>1.34 (1.00–1.91)</td>
<td>0.001</td>
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<tr>
<td>≥30.0</td>
<td>2.46 (1.55–4.16)</td>
<td>3.82 (2.17–6.72)</td>
<td>0.001</td>
<td>2.05 (1.08–3.87)</td>
<td>3.06 (1.56–6.00)</td>
<td>0.009</td>
<td>0.67 (0.42–1.04)</td>
<td>1.15 (0.72–1.85)</td>
<td>0.001</td>
<td>0.75 (0.46–1.21)</td>
<td>1.16 (0.70–1.91)</td>
<td>0.001</td>
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</table>

a: Odds ratio adjusted for age, education, smoking and family history of acute myocardial infarction.

BMI (overweight: BMI 25.0–29.9 kg/m²; obesity: BMI ≥30.0 kg/m²).
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Funding


Conflict of interest: None declared.

Key points

- The accuracy of self-reported weight and height to measure obesity has been evaluated in different populations, consistently showing that self-reported and measured data are strongly correlated, however, information on the possible error effects due to self-reporting when estimating the association between BMI categories and the occurrence of myocardial infarction is missing.
- Due to some differential misclassification within cases and controls, this study showed that the use of self-reported weight and height could inaccurately affect not only the magnitude, but also the direction of the risk estimates.
- Therefore, result’s interpretation and public health decisions based on studies using self-reported BMI must be carefully done.

References


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