

Title: The association between maternal perceptions of own weight status and weight status of her child: Results from a national cohort study

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Objectives: To examine the relationship between maternal self-reported and measured height and weight, maternal perceived weight status and measured body mass index (BMI), and maternal perceived child weight status and measured child BMI.

Setting and Design: Population representative National Longitudinal Study of Children Growing Up in Ireland.

Methods: Height and weight of 7655 mothers and their 9 year old children were objectively measured using standard measurement techniques. Mother's perceptions of their own weight status and the weight status of their child were reported. The association between accurate perceptions of the mother for herself and her child was tested.

Results: Mothers overestimated their height by a mean of 0.5cm (SD=2.9), underestimated their weight by a mean of 1.4kg (SD=3.8), consequently underestimating their BMI by a mean of 0.6kg/m² (SD=1.7). The majority (60%) of obese mothers correctly categorised their own weight status. Only 17% of mothers of obese children correctly categorised the weight status of their child. Overweight/obese mothers who correctly categorised their own weight status were more likely to correctly categorise their overweight/obese child compared to those who incorrectly categorised their own weight status (44% vs. 23%, 95%CI for difference 13-28%, p<0.001 for girls; 37% vs. 27%, 95%CI 2-18%, p=0.02 for boys; significantly greater difference for girls compared to boys, p=0.04).

Conclusions: Maternal perceptions of their own weight status tend to be more accurate than maternal perceptions of their overweight or obese child. Overweight/obese mothers who correctly categorised their own weight status were more likely to correctly categorise their overweight/obese child.

INTRODUCTION

Accurate self-perception of weight status is important for weight maintenance and control[1, 2] and may be a key determinant to weight loss[3-5]. Male and female adults tend to overestimate their height and underestimate both their weight and body mass index (BMI)[6], particularly in overweight/obese populations[7]. In recent years, as levels of overweight/obesity have increased, the prevalence of individuals accurately identifying themselves as overweight/obese has declined significantly[8]. Such erroneous perceptions of weight status may result in missed opportunities to change behaviours and lifestyles to address overweight and obesity[2].

One overweight parent doubles the risk of obesity in childhood; two overweight parents further increases this risk[9]. Overweight/obese parents tend to have inaccurate perceptions of the true weight status of their child[8]. Parents often underestimate the weight and BMI and overestimate the height of their child[10], particularly if their child is overweight/obese[11, 12]. This may result in continued weight gain for the child. Worldwide, 43 million children are overweight or obese; 92 million others are at risk of overweight[13]. Overweight in childhood is predictive of overweight in adulthood[14, 15]. Overweight children are at significantly increased risk of type 2 diabetes mellitus, cardiovascular disease, stroke and specific cancers[16, 17]. Overweight in childhood reduces life expectancy by 5-20 years[18].

There is a need for the development of effective public health interventions to address the increasing prevalence of childhood overweight and obesity[19-21]. A clear understanding of the determinants of childhood overweight/obesity is critical to inform such intervention[22]. These determinants include the accuracy of mothers' perceptions of their own weight status, maternal perceptions of the weight status of their child and whether these perceptions are associated. To our knowledge, such analysis has not been conducted in a population representative sample. The aims of this study were to: 1) examine whether differences exist between maternal self-reported and measured height, weight and BMI categorisation in a population representative sample; 2) examine maternal perceptions of their own weight status and the weight status of their child and 3) examine whether overweight or obese mothers with accurate perceptions of their own weight status are more/less likely to correctly categorize their overweight or obesity child.

METHODS

Participants

Data from 8,568 9 year-old school children and their caregivers living in the Republic of Ireland was examined. This data was collected as part of a nationally representative cohort study of children in the Republic of Ireland (the Growing Up in Ireland (GUI) study). A two-stage sampling methodology was conducted for the GUI study, and has previously been described[23]. Briefly, a probability proportionate to size (PPS) sampling method was used to select 1,105 of the national total of 3,177 primary schools in Ireland. 82.3% of selected schools agreed to participate. Stage 2 involved the random selection from all eligible children within each school, with 57% of selected children (and their families) participating in the study. At the time of sample selection in 2006, the children included in this study represented approximately 14% of all children aged 9 years that lived in the Republic of Ireland. The distribution of the sample was weighted by correcting to known population characteristic of children and their families based on findings from the Census of Population in Ireland 2006. Family structure, social class, economic and disadvantaged status were some of the variables accounted for in the weights. Both parent/guardian and study child written informed consent was received prior to data collection. The Irish Health Research Board's Research Ethics Committee provided ethical approval for the GUI study.

Self/proxy-reported weight, height, BMI and weight status

Computer-assisted personal interviews were conducted by trained social interviewers. The interviews were conducted with both the study child and both parents/guardians in the study child's home. Parents of the study child were asked to nominate the parent that spent most time in the company of the study child as the primary caregiver. The primary caregiver acted as the primary respondent for the remainder of the study. In the GUI study, only 2% of the study children's primary caregivers were their fathers (98% mothers). Due to the small number of male primary caregivers in this sample (n=187 compared to n=8381 females), this report focusses on female primary caregivers only (mothers). A self-report of height (cm), weight (kg) and self-perceived weight status (categorised as very underweight, moderately underweight, slightly underweight, about the right weight, slightly overweight, moderately overweight and very overweight) was recorded for all mothers. Maternal perception of the weight status of their children was also recorded using the same categories. Due to low frequencies, the "moderately" and "very" underweight categories were combined as were the "moderately" and "very" overweight categories for the children.

Measurement of weight and height

Trained interviewers obtained measures of height and weight using validated methods during the household interview visit [24]. Height was measured using a Leicester portable height stick to the nearest 0.1 cm, and was recorded to the nearest cm. Weight was measured using a portable flat mechanic scale (SECA 761, Seca Ltd., Birmingham, United Kingdom) to the nearest 0.5 kg, and was recorded to the nearest kg. Both the mother and study child wore light clothing when weighed. Maternal BMI was calculated as weight in kilograms/(height in metres)² and categorised as underweight (BMI <20 kg/m²), normal (BMI <25 kg/m²), overweight (BMI ≥25 and <30 kg/m²) or obese (≥30 kg/m²) according to the World Health Organization BMI categorisation[25]. The International Obesity Taskforce cut-offs were used to categorize BMI for the study children[26].

Statistical Analysis

Differences between self-reported and measured height, weight and BMI of the mothers were calculated and tested for normality. Median differences (interquartile range) are presented for skewed data and mean difference (SD) for normally distributed data. Differences were compared across BMI categories (normal, overweight, obese) using non-parametric tests for independent samples or one-way ANOVA. Trends in differences across the BMI categories were tested for significance using Spearman's rank correlation. A two-way mixed single measure intraclass correlation coefficient (ICC) was used to assess the extent of agreement between mother's self-reported and objectively measured height and weight. A Z-test for proportions was used to compare percentages across groups. A chi-square test was used to test the association between perceptions of the mother about her own weight and her child's weight.

Statistical analysis was carried out using SPSS version 20 for Windows and SAS Version 9.2 for Windows. A 5% level of significance was used for all statistical tests.

RESULTS

In total, 8,381 mothers with a mean age of 39 years (SD 5.6; range 26-50) participated in the GUI study. Measured height was available for 94% of mothers (n=7910); mean height was 163cm (SD 6). Measured weight was available for 92% of mothers (n=7677); median weight was 67kg (first quartile=60kg, third quartile=77kg). Complete data were available for BMI calculation in 7655 mothers; measured BMI data identified 1% as underweight, 47% as healthy, 32% as overweight and 20% as obese. Median BMI was 25.2 kg/m² (first quartile=22.7, third quartile=28.8kg/m²).

The mean difference between mothers' self-reported and measured height (self-reported height minus measured height) was +0.5cm (SD=2.9), indicating that, on average, mothers in this study slightly overestimated their height. The mean difference between self-reported and measured weight (self-reported weight minus measured weight) was -1.4kg (SD=3.8), indicating that weight was underestimated on average. High levels of agreement were observed between self-reported and measured height and weight (ICC=0.89 for height and 0.95 for weight). The mean difference between BMI measures (BMI derived from self-reported data minus BMI derived from measured data) was -0.6 (SD=1.7), indicating that BMI was underestimated on average using self-reported data. BMI calculated using self-reported height and weight correctly categorised 92% of mothers with a healthy measured BMI; 74% of overweight mothers and 74% of obese mothers.

The underestimation of weight and BMI increases with BMI category; with obese mothers underestimating their weight by an average of 2 kg (Table 1). Differences in BMI were more variable in the obese category (as evidenced by the significantly longer error bars when compared to the underweight, normal and overweight mothers in Figure 1). While the trend for differences in height, weight and BMI for the mothers were statistically significant across their measured BMI category ($p < 0.001$), this is influenced by the large sample size.

Table 2 compares the mother's self-perceived weight status and their measured BMI categories. Most mothers (71%) with a healthy BMI correctly categorised themselves as 'about the right weight'. 76% of overweight mothers correctly categorised themselves as overweight (slightly/moderately/very), while only 60% of obese mothers identified themselves as moderately/very overweight.

Measured height and weight were available for 94% of study children (n=7916). Measured BMI categories of the boys (n=4076, 51% of sample) identified 78% as healthy weight, 17% as overweight and 5% as obese. Measured BMI categories of the girls (n=3840, 49% of sample)

identified 70% as healthy weight, 22% as overweight and 8% as obese. Significantly more girls than boys were overweight or obese (30% vs. 22%, 95% CI for the difference 6-10%, $p < 0.001$) [27].

Maternal perception of their son's/daughter's weight status compared with his/her measured BMI category is presented in Table 3. Most mothers of children in the healthy BMI category categorised them as underweight or 'about the right weight' (98% for boys and 97% for girls). However, only 39% of mothers of overweight boys and 46% of overweight girls categorised their children as overweight (slightly/moderately/very) and only 18% of mothers of obese boys and 18% of obese girls identified their children as moderately/very overweight.

Overweight or obese mothers were more likely to have an overweight or obese child in the study compared to mothers who were underweight or had a healthy BMI (34% vs. 18%, 95% CI for the difference 14-19%, $p < 0.001$). Overweight and obese mothers with accurate perceptions of their own weight status were more likely to have accurate perceptions of their overweight or obese children (Table 4). 44% of overweight or obese mothers with accurate perceptions about their own weight correctly categorised their overweight or obese daughter compared to just 23% of those with inaccurate perceptions (Difference = 21%, 95% CI 13-28%, $p < 0.001$). 37% of overweight or obese mothers with accurate perceptions about their own weight correctly categorised their overweight or obese son compared to 27% of those with inaccurate perceptions (Difference = 10%, 95% CI 2-18%, $p = 0.02$). The effect was significantly greater for girls, with overweight or obese mothers more likely to miscategorise their overweight or obese daughters compared to the overweight or obese sons (Difference between boys and girls = 11%, 95% CI for difference 0.4 - 22%, $p = 0.04$).

DISCUSSION:

In this population representative sample, mothers of 9 year old children tended to overestimate their height and underestimate their weight, consistent with existing research[6, 7, 28]. Although the difference between BMI calculated from self-reported weight and height and BMI calculated from measured data was smaller than that previously reported ($1.2\text{kg}/\text{m}^2$ [29] compared to $0.6\text{kg}/\text{m}^2$ in this study), the standard deviation of the difference is large ($\text{SD}=1.7$), suggesting the difference between self-reported and measured height and weight continues to be significantly variable [7].

In the GUI sample, the majority of mothers (71% of normal weight mothers; 76% of overweight mothers; 60% of obese mothers) accurately perceived their own weight status. These findings differed significantly from previous large scale publications. In the current study, obese mothers that identified themselves as moderately/very overweight were deemed to have correctly categorised their weight status, while overweight mothers that identified themselves as slightly/moderately overweight were deemed to have correctly categorised their weight status. This differed to categories for overweight/obese utilized in existing research, whereby a single category of “overweight” has been used. When the overweight categories in GUI were combined, the sensitivity of obese mothers’ perceptions of weight status increased to 95%. These findings are relatively consistent with previous literature, where 66.2% of normal weight mothers, 75.8% of overweight mothers and 94.7% of obese mothers had accurate self-perceptions of their weight status[30].

Parental weight status is an influential factor in childhood obesity[9, 31]. In our study, overweight or obese mothers were more likely to have an overweight or obese child. Maternal misperceptions of their child’s weight status may result in mothers not identifying their child’s current weight status as problematic[32]. When maternal perception of the weight category of their child was examined in this study, poor sensitivity was observed for both male and female children who were overweight or obese. This is in contrast with a similar US-based research study, whereby two-thirds (66.7%) of mothers correctly categorised their overweight child as overweight[12]. In the present study, overweight or obese mothers with accurate perceptions of their own weight status were, however, significantly more likely to correctly categorise their overweight or obese child’s weight status.

Maternal misperception of a child’s weight status may be due to misunderstanding of the terms overweight and obese, or due to a poor ability to recognize overweight[12, 33, 34]. However, mothers tended to accurately perceive their own weight categories, so it is unlikely that they

misunderstood the terms or could not recognise overweight and obese in themselves. Alternatively, the IOTF cut-offs for overweight and obesity reflect the patterns of overweight and obese children and adolescents from 1963 through to 1993[26]. The prevalence of overweight/obesity in youth has increased significantly since the data used to develop the IOTF cut-points was collected. Mothers may now be more likely to estimate their child's weight status by comparison with others. This, consequently, may explain the disagreement in maternal perceptions of a child's weight status and the IOTF derived weight status. An alternative hypothesis is that mothers miscategorised their child's weight status due to their own reluctance to accept that their child is overweight or obese[12, 33, 34]. Regardless, it is a major public health concern that the majority of mothers of overweight or obese children underestimate their child's weight status. As these mothers do not currently perceive their child's weight status as problematic, they may be less likely to seek or implement behaviour modification strategies[2, 32].

The large, population representative sample in this study is a significant strength, with 14% of Irish 9 year old children included in the sample. Additionally, due to the sampling weights utilized in this analysis, these findings are applicable at a population level. Trained interviewers used valid measurement techniques to assess height and weight. However, BMI, while useful in population studies, can be a poor tool for assessing an individual's adiposity.

CONCLUSION

This paper highlights that the majority of mothers of 9 year old children in this sample have accurate perceptions of their own weight status. However, less than half of mothers with overweight children perceive their child as slightly, moderately or very overweight and only 17.6% of mothers with obese children perceive their child as moderately or very overweight. Overweight and obese mothers with accurate perceptions of their own weight status, however, were more likely to have accurate perceptions of their overweight or obese children. If a mother does not identify her child as overweight or obese, she is less likely to support measures to modify lifestyles behaviours to prevent further weight gain, which in turn has significant public health implications.

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Competing Interests:

The authors have no competing interests to declare.

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“What is already known on this topic”:

Statement 1: The prevalence of overweight/obesity is at epidemic proportion, with few public health interventions having a meaningful impact on addressing this issue.

Statement 2: Parental influences play an important role in the development of overweight/obesity in childhood.

Statement 3: Little is known about the association between maternal perceptions of their own-weight status and the weight status of their child.

"What this study adds":

Statement 1: The majority of obese mothers correctly identified themselves as moderately or very overweight.

Statement 2: Only 17.6% of mothers with obese children correctly identified them as moderately or very overweight.

Statement 3: Overweight or obese mothers with accurate perceptions about their own weight were more likely to correctly categorise their overweight or obese child.

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Table 1: Median (IQR) for differences in self-reported and measured height, weight and BMI of mothers by measured BMI categories.

| | Underweight (n=78) | Healthy (n=3589) | Overweight (n=2465) | Obese (n=1523) |
|--|-------------------------------|-----------------------------|--------------------------------|---------------------------|
| BMI difference (kg/m²) | 0.4 (1.5) | -0.2 (1.3) | -0.7 (1.6) | -1.2 (2.8) |
| Height difference (cm) | 0 (4) | 0 (3) | 0 (3) | 1 (3) |
| Weight difference (kg) | 1 (3) | 0 (3) | -1 (3) | -2 (6) |

Trend across BMI categories for all measured differences was found to be significant at the 0.001 level.

Table 2. Maternal self-perception of weight status by measured BMI categories.

| Self-Perception Measured BMI | Very/Moderately Underweight | Slightly underweight | About the right weight | Slightly overweight | Moderately/Very Overweight |
|---|------------------------------------|-----------------------------|-------------------------------|----------------------------|-----------------------------------|
| Underweight (n=78) | 12 (15%) | 33 (42%) | 32 (41%) | 1 (1%) | 0 (0%) |
| Healthy (n=3587) | 42 (1%) | 206 (6%) | 2545 (71%) | 744 (21%) | 50 (1%) |
| Overweight (n=2465) | 12 (0.5%) | 27 (1%) | 558 (23%) | 1497 (61%) | 371 (15%) |
| Obese (n=1524) | 6 (0.4%) | 13 (0.9%) | 54 (4%) | 532 (35%) | 919 (60%) |

Table 3: Maternal perception of child’s weight status by study child’s measured BMI categories.

| Perception Measured BMI | Underweight or about the right weight | Slightly overweight | Moderately/Very Overweight |
|------------------------------------|--|--------------------------------|---------------------------------------|
| Boys (n= 4074) | | | |
| Healthy (n=3181) | 3122 (98%) | 59 (2%) | - |
| Overweight (n=677) | 410 (61%) | 250 (37%) | 17 (2%) |
| Obese (n=216) | 39 (20%) | 135 (62%) | 38 (18%) |
| Girls (n=3840) | | | |
| Healthy (n=2690) | 2608 (97%) | 81 (3%) | - |
| Overweight (n=855) | 461 (54%) | 369 (43%) | 25 (3%) |
| Obese (n=296) | 68 (23%) | 176 (59%) | 52 (18%) |

Table 4 The association between overweight and obese mothers' perceptions of their own weight status and their overweight or obese child's weight status

| | | Perception of own overweight/obesity | | Total | P-value |
|---|-----------|--------------------------------------|-----------|-----------|----------|
| | | Incorrect | Correct | | |
| Perception of son's overweight/obesity (n=588) | Incorrect | 141 (73%) | 247 (63%) | 388 (66%) | p=0.02 |
| | Correct | 53 (27%) | 147 (37%) | 200 (34%) | |
| | | | | | |
| Perception of daughter's overweight or obesity (n=723) | Incorrect | 170 (77%) | 281 (56%) | 451 (62%) | p <0.001 |
| | Correct | 51 (23%) | 221 (44%) | 272 (38%) | |

Interaction between sex and perception of the mothers weight status was found to be non-significant (p=0.063).