Ethnic inequalities in early overweight: determinants and consequences

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Chapter

Ethnic differences in maternal underestimation of offspring’s weight: the ABCD study

Marieke LA de Hoog, Karien Stronks, Manon van Eijsden, Reinoud JBJ Gemke, Tanja GM Vrijkotte

ABSTRACT

Objective: To determine ethnic variation in maternal underestimation of their child’s weight status and the explanatory role of socio-economic status (SES), acculturation and parental BMI.

Method: A multi-ethnic sample of 2,769 normal or overweight/obese children (underweight children excluded) aged 5-7 years was examined (ABCD study), comprising five ethnic subgroups: Dutch (n=1,744), African descent (n=184), Turkish (n=86), Moroccan (n=161), and other non-Dutch (n=592). Data on mothers’ perception of their child’s weight status (5-point scale from ‘too low’ to ‘too high’), SES, acculturation, parental BMI and the children’s height and weight were collected. Underestimation was defined by comparing maternal perception with the actual weight status of her child (IOTF guidelines). Ethnic differences in underestimation were calculated in the normal weight and overweight/obese categories.

Results: Underestimation ranged from 3.6% (Dutch) to 15.7% (Moroccan) in normal weight children, and from 73.0% (Dutch) to 92.3% (Turkish) in overweight/obese children. After correction for ethnic differences in child’s BMI, higher odds ratios (ORs) for underestimation were found in the Turkish (normal weight: OR 6.83; 95%CI 2.33-20.05 and overweight: OR 2.80; 95%CI 1.12-6.98) and Moroccan (normal weight: OR 11.55; 95%CI 5.28-25.26) groups (reference is Dutch group). Maternal educational level and immigrant generation largely explained the ethnic differences, with a minor contribution of maternal age. After correction, ORs remained higher in the Moroccan group (OR 4.37; 95%CI 1.79-10.62) among the normal weight children.

Conclusion: Mothers frequently underestimate the actual weight status of their child, especially mothers from Turkish or Moroccan origin. Having a lower SES, being first-generation immigrant and a young mother are important determinants in explaining these differences. Because weight perceptions may affect weight gain and almost all mothers of overweight/obese children underestimate their child’s weight, health professionals should help mothers (particularly those from ethnic minority groups) to acquire a realistic perception of their children’s weight status.
INTRODUCTION

Many migrant groups of non-western origin living in Western societies have high levels of overweight/obesity in childhood and adulthood.\(^1^\)\(^-\)\(^3\) The prevalence of childhood overweight in some ethnic minorities are higher compared to children from the host population\(^4^\)\(^-\)\(^8\) and it is known that childhood obesity in general tracks into adulthood.\(^9^,\)\(^10\) In addition to the (future) health disadvantages (e.g. type 2 diabetes, hypertension, and increased cardiovascular risk\(^11^,\)\(^12\)), children and adults with overweight/obesity are more prone to social and emotional problems.\(^13\)

To help prevent such (future) problems, recognition by parents is of critical importance in the early identification of childhood overweight. If overweight is recognized early in life, prevention and treatment strategies are more likely to be successful.\(^14^,\)\(^15\) On the other hand, maternal underestimation of their child’s weight may promote an unfavourable weight gain, in both normal weight children who are perceived as being too slim, as well as in overweight children who are perceived as having a healthy weight.\(^14\)

Studies on the perception of the child’s weight show that identification of overweight in offspring is commonly underestimated by mothers.\(^16^\)\(^-\)\(^20\) Manios et al. found that 38% of the mothers underestimated their child’s weight status. Focusing on the heavier children, overall 70% of the mothers did not recognize their child as being at risk for overweight (≥85\(^{th}\) and <95\(^{th}\) percentile; body mass index (BMI)-for-age) and 50% did not recognize their child as being overweight or obese (≥95\(^{th}\) percentile; BMI-for-age).\(^15^,\)\(^21\) Parental perception may be influenced by the child’s characteristics (such as age and gender), as well as parental age, educational level/socio-economic status (SES), BMI and ethnic and/or other socio-cultural factors.\(^15^,\)\(^20^,\)\(^22^,\)\(^23\)

Few studies have primarily focused on ethnic differences in the underestimation of children’s weight. Most studies in which associations were found between ethnicity and maternal/parental perception were done in the USA.\(^22^\)\(^-\)\(^26\) For example, Jain et al. reported a high degree of underestimation in black mothers.\(^24\) Some studies on the perception of body weight among adults showed that overweight men/women from some ethnic minorities were more likely to perceive their own weight as normal.\(^27^\)-\(^29\) The greater acceptance of larger body size in some cultures may account for these differences.\(^30^,\)\(^31\) Due to a higher prevalence of overweight in some ethnic groups, overweight is more common in the familial and social environment.\(^32\) Furthermore, in some cultures overweight is regarded as a sign of affluence and thinness may be more strongly associated with poor health.\(^31\)

Until now, no studies have investigated maternal underestimation of their child’s weight in a European multi-ethnic population with specific focus on the explanatory factors. Therefore, the present study explores ethnic differences in maternal underestimation of their child’s weight in normal and overweight/obese children, with the aim to identify and quantify the explanatory role of SES, acculturation and parental BMI.
METHODS

Subjects

The design and rationale of the Amsterdam Born Child and their Development (ABCD) study have been described previously.33 In brief, between January 2003 and March 2004, 8,266 pregnant women were included in the study after their first antenatal visit to an obstetric caregiver (phase 1). They filled out an extensive pregnancy questionnaire about socio-demographic data, obstetric history, lifestyle, dietary habits, and psychosocial conditions. Of these respondents, 7,863 women gave birth to a viable singleton infant and 6,575 women gave permission to collect information obtained from the Youth Health Care (phase 2).

Phase three of the study started in the summer of 2008. Around two weeks after their ABCD child’s fifth birthday, 6,161 mothers who initially gave permission for follow-up were sent a questionnaire in which they were also asked for permission regarding participation of their child in the ABCD health check. The questionnaire returned by 4,488 mothers, provided information on the child’s health, development and behaviour. Furthermore, it contained items regarding mother’s perception of the child’s weight, maternal lifestyle and familiar diseases. All questionnaires were translated into English and Turkish. Various physical measurements took place in 3,263 children aged 5-7 years.33

Of these 3,263 children, underweight children (n=396; their weight cannot be underestimated) and children whose questionnaire was not filled in by their biological of adoptive mother (n=94) were excluded. The final sample included 2,769 normal and overweight/obese singleton children for whom the 5-year questionnaire was filled in by their biological or adoptive mother, and height and bodyweight measurement of the child was available.

The study was approved by the review board of all Amsterdam hospitals and the Registration Committee of Amsterdam. All participating women gave written consent.

Measurements

Ethnicity was based on the country of birth of the child’s mother and her mother to include both first-generation (born outside the Netherlands) and second-generation (born in the Netherlands, but with a mother born in another country) immigrant mothers. Due to comparable ethnic background, we combined the people from Surinam (Surinam-Creole), Antilles, Ghana and other south Saharan African countries into the “African descent” group. In the present study five ethnic groups were distinguished: Dutch native (n=1,744), African descent (n=182), Turkish (n=86), Moroccan (n=161) and ‘other’ (n=592). The ‘other’ group comprises first and second generation mothers from areas all over the world i.e. the North Africa (except Morocco), North America, South America, Asia (except Turkey) and Europe. This brings the total number of ethnicities in this group over sixty-five, which leaves too small numbers per ethnic group to analyse separately.
To assess mothers’ perception of their child’s weight status, mothers were asked to complete the statement ‘I feel my child’s weight is...’ by choosing one of the following five responses: ‘much too low, too low, normal, too high or much too high.’ Height and bodyweight data of the child were obtained during the ABCD health check. Height was measured to the nearest millimetre using a Leiceher portable height measure (Seca), and bodyweight to the nearest 100 gram using a calibrated weighing scale (Marsden, model MS-4102).

The primary outcome variable for this study was maternal underestimation of their child’s weight (yes/no). Weight status was based on the International Obesity Task Force (IOTF) BMI guidelines which are gender and age specific.34,35 BMI is a specific and moderately sensitive instrument to identify overweight in children from the age of 2 years onwards.34,36 Underestimation occurred when: 1) children actually overweight or obese were perceived by their mothers as having ‘normal,’ ‘too low’ or ‘much too low’ bodyweight, and 2) children actually having normal weight were perceived by their mothers as having ‘too low’ or ‘much too low’ bodyweight.

Four groups of potential explanatory factors were distinguished: 1) SES, 2) level of acculturation, 3) parental BMI, and 4) gender. The SES factors included: maternal education (low, middle/high), employment before pregnancy (yes vs. no), financial status (draw up savings, just enough and able to save), and maternal age. Factors included for the level of acculturation were: language proficiency (poor vs. high) and generation (first generation vs. born in the Netherlands). Maternal and paternal BMI (kg/m²) were included, based on self-reported height and weight.

**Data analysis**

To reclaim the cases with missing or invalid values, multivariate imputation by chained equation (MICE) was used after descriptive analyses with R statistics.37 MICE is a method of handling non-response by imputing incomplete data by fully conditional specifications (FCS).37 Most imputed variables had a missing percentage of ≤ 2%, except for paternal BMI (16%) and maternal BMI (9%).

Differences between ethnic groups were examined with c²-tests or, if appropriate, the Fisher test (categorical data) or ANOVA (continuous data). Univariable logistic regression analyses were performed after imputation to determine the association maternal underestimation with all potential associated factors based on previous literature. We controlled for potential effect modification between ethnicity and the covariates by use of interaction terms. Furthermore, multivariable analyses were done to assess the differences in underestimation of the mother per ethnicity. In a crude model, we calculated the association between underestimation and ethnicity including the BMI of the child to correct for differences in BMI between ethnic groups. To account for the nonlinear association between BMI and underestimation, and the interaction effect between ethnicity and BMI, we used restricted cubic splines (rcs) according to Harrell38 to adjust for BMI. To show the ethnic differences in maternal underestimation we chose to analyse the association between ethnicity and underestimation for two BMI values: BMI 15.5 kg/m² (normal weight) and BMI 18 kg/m².
(overweight). The crude model was extended with those covariates which had the strongest association with the outcome (education level, immigrant generation, maternal age and maternal BMI) to obtain adjusted estimates of the relationship of interest.

The results are presented as odd ratios (OR) and 95% confidence intervals (CI) using the Dutch group as reference. Statistical analyses were conducted using SPSS version 18.0 (SPSS Inc.) and R 2.11.1. A p-value <0.05 was regarded as statistically significant.

RESULTS

General characteristics according to ethnic group are shown in Table 1. Dutch women were generally older, had the lowest BMI, and had a higher education (p<0.03). Prevalence of overweight/obesity at the age of 5 years was lowest in Dutch children (7.4%) and considerably higher in Turkish children (30.6%) and Moroccan children (28.0%).

High percentages of maternal underestimation were found in overweight children in all ethnic groups (Table 2). Overall 79.1% with an overweight/obese child, and 5.7% of the mothers with a normal weight child, underestimated their child’s weight, with large differences between ethnicities. The lowest percentage of underestimation was found in the Dutch group (3.6% in the normal weight children and 73.0% in the overweight/obese children) and the highest in the Turkish (15.3 and 92.3%) and Moroccan (15.7% and 82.2%) groups. By separating the overweight from the obese children in general, 85.5% of the mothers who had an overweight child did not perceive their child as too heavy, as did 52.6% of the mothers with an obese child.

The univariable analyses evaluated to what extent the determinants were associated with underestimation in the overall group (Table 3). All factors were associated with underestimation, except for gender. Interactions with ethnicity were non-significant (log likelihood: p>0.05).

Figure 1 shows the estimated ORs for underestimation for the ethnic groups (Dutch group is reference), as a function of BMI of the child (adjusted for measured BMI of the child). For the African descent group, the ORs for underestimation were lower in the higher BMI range. In the Turkish group, the ORs for underestimation were generally higher across all BMI values, but became non-significant with increasing BMI. For the Moroccan group the ORs for underestimation were higher in the normal weight children and became similar to the Dutch group with increasing BMI. The ORs of the ‘other’ group were the most similar to the Dutch reference group.

Table 4 presents data on the crude and multivariable association between underestimation and ethnicity in the normal weight (BMI 15.5 kg/m²) and overweight (BMI 18 kg/m²) group. In the crude analyses of the normal weight children the OR for maternal underestimation was higher in the Turkish (OR: 6.89; 95%CI: 2.34-20.26) and Moroccan (OR: 11.20, CI: 5.17-24.26) groups compared to the Dutch group. After adding the explanatory variables
### Table 1: General characteristics according to the ethnic groups.

<table>
<thead>
<tr>
<th></th>
<th>Dutch</th>
<th>African descent</th>
<th>Turkish</th>
<th>Moroccan</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=1744</td>
<td>N=184</td>
<td>N=86</td>
<td>N=161</td>
<td>N=592</td>
</tr>
<tr>
<td></td>
<td>mean (SD) or %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Related to SES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal age (year)</td>
<td>38.3 (3.8)</td>
<td>35.2 (5.9)</td>
<td>32.6 (5.8)</td>
<td>33.7 (5.2)</td>
<td>37.5 (4.6)</td>
</tr>
<tr>
<td>Maternal education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>6.3</td>
<td>28.3</td>
<td>52.9</td>
<td>52.5</td>
<td>14.7</td>
</tr>
<tr>
<td>Middle/high</td>
<td>93.7</td>
<td>71.7</td>
<td>47.1</td>
<td>47.5</td>
<td>85.3</td>
</tr>
<tr>
<td>Employment before pregnancy % yes</td>
<td>91.2</td>
<td>61.8</td>
<td>41.2</td>
<td>44.1</td>
<td>76.2</td>
</tr>
<tr>
<td>Financial status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draw up savings</td>
<td>9.0</td>
<td>28.8</td>
<td>10.8</td>
<td>25.5</td>
<td>14.9</td>
</tr>
<tr>
<td>Just enough</td>
<td>19.0</td>
<td>30.6</td>
<td>67.5</td>
<td>43.1</td>
<td>27.6</td>
</tr>
<tr>
<td>Able to save</td>
<td>72.0</td>
<td>40.6</td>
<td>21.7</td>
<td>31.4</td>
<td>57.5</td>
</tr>
<tr>
<td><strong>Related to degree of acculturation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language proficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>8.1</td>
<td>25.0</td>
<td>20.6</td>
<td>6.3</td>
</tr>
<tr>
<td>High</td>
<td>100</td>
<td>91.9</td>
<td>75.0</td>
<td>79.4</td>
<td>93.7</td>
</tr>
<tr>
<td>Immigrant generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st generation</td>
<td>0</td>
<td>78.6</td>
<td>74.1</td>
<td>76.4</td>
<td>58.6</td>
</tr>
<tr>
<td>Born in the Netherlands</td>
<td>100</td>
<td>24.1</td>
<td>25.9</td>
<td>23.6</td>
<td>41.4</td>
</tr>
<tr>
<td><strong>Related to the parents</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal BMI (kg/m²)</td>
<td>23.2 (3.7)</td>
<td>26.1 (6.6)</td>
<td>26.2 (4.4)</td>
<td>26.7 (4.9)</td>
<td>23.9 (5.1)</td>
</tr>
<tr>
<td>Paternal BMI (kg/m²)</td>
<td>24.8 (2.9)</td>
<td>25.6 (3.5)</td>
<td>26.1 (3.1)</td>
<td>26.6 (4.7)</td>
<td>24.9 (3.7)</td>
</tr>
<tr>
<td><strong>Related to the child</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child age (yr)</td>
<td>5.7 (0.5)</td>
<td>5.9 (0.6)</td>
<td>5.9 (0.5)</td>
<td>6.1 (0.5)</td>
<td>5.8 (0.5)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>50.3</td>
<td>46.2</td>
<td>50.6</td>
<td>56.5</td>
<td>46.5</td>
</tr>
<tr>
<td>Girl</td>
<td>49.7</td>
<td>53.8</td>
<td>49.4</td>
<td>43.5</td>
<td>53.5</td>
</tr>
<tr>
<td>BMI child (kg/m²)</td>
<td>15.6 (1.1)</td>
<td>16.2 (1.9)</td>
<td>16.7 (1.9)</td>
<td>16.8 (1.9)</td>
<td>15.7 (1.4)</td>
</tr>
<tr>
<td>Overweight/obese % yes</td>
<td>7.4</td>
<td>19.1</td>
<td>30.6</td>
<td>28.0</td>
<td>10.3</td>
</tr>
</tbody>
</table>

### Table 2: Percentage underestimation in the total group and per ethnicity in the different weight categories.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Dutch</th>
<th>African descent</th>
<th>Turkish</th>
<th>Moroccan</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underestimation %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>13.5</td>
<td>8.7</td>
<td>22.0</td>
<td>38.8</td>
<td>34.4</td>
<td>15.8</td>
</tr>
<tr>
<td>Normal weight child</td>
<td>5.7</td>
<td>3.6</td>
<td>5.9</td>
<td>15.3</td>
<td>15.7</td>
<td>8.5</td>
</tr>
<tr>
<td>Overweight/obese child</td>
<td>79.1</td>
<td>73.0</td>
<td>87.9</td>
<td>92.3</td>
<td>82.2</td>
<td>79.1</td>
</tr>
<tr>
<td>Overweight child n=235</td>
<td>85.5</td>
<td>-*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Obese child n=57</td>
<td>52.6</td>
<td>-*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* No percentages were calculated due to small numbers
(maternal age, BMI and education, and generation) into the model the OR remained significantly higher in the Moroccan group (OR: 4.37; 95%CI: 1.79-10.62).

The OR for maternal underestimation in the overweight children was higher in the Turkish (OR: 2.80; 95%CI: 1.12-6.96) group, but became non-significant after adding the explanatory variables.

Variable-by-variable analysis showed that maternal educational level and immigrant generation largely explained the ethnic differences in underestimation in normal weight children and in overweight/obese children. In addition to educational level and immigrant generation, maternal age partly explained the ethnic differences in maternal underestimation. Maternal BMI was an independent predictor for maternal underestimation; however, it did not explain the ethnic differences (results not shown).

Table 3: Univariable odds ratios (OR) between maternal underestimation and the SES, acculturation, parental and child factors.

<table>
<thead>
<tr>
<th>Related to SES</th>
<th>N</th>
<th>Underestimation OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (year)</td>
<td>2769</td>
<td>0.91 (0.89-0.93)</td>
</tr>
<tr>
<td>Maternal education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>380</td>
<td>4.13 (3.21-5.32)</td>
</tr>
<tr>
<td>Middle/high</td>
<td>2389</td>
<td>ref</td>
</tr>
<tr>
<td>Employment before pregnancy</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>506</td>
<td>ref</td>
</tr>
<tr>
<td>No</td>
<td>2263</td>
<td>2.78 (2.18-3.54)</td>
</tr>
<tr>
<td>Financial status</td>
<td></td>
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</tr>
<tr>
<td>Draw up savings</td>
<td>350</td>
<td>2.58 (1.91-3.50)</td>
</tr>
<tr>
<td>Just enough</td>
<td>679</td>
<td>3.30 (1.78-2.96)</td>
</tr>
<tr>
<td>Able to spare</td>
<td>1740</td>
<td>ref</td>
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<tr>
<td>Related to degree of acculturation</td>
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<tr>
<td>Language proficiency</td>
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<td></td>
</tr>
<tr>
<td>Poor</td>
<td>106</td>
<td>4.39 (2.91-6.61)</td>
</tr>
<tr>
<td>High</td>
<td>2663</td>
<td>ref</td>
</tr>
<tr>
<td>Immigrant generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st generation</td>
<td>2093</td>
<td>2.94 (2.34-3.70)</td>
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<tr>
<td>Born in the Netherlands</td>
<td>676</td>
<td>ref</td>
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<tr>
<td>Related to the parents</td>
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<tr>
<td>Maternal BMI (kg/m²)</td>
<td>2769</td>
<td>1.09 (1.06-1.11)</td>
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<tr>
<td>Paternal BMI (kg/m²)</td>
<td>2769</td>
<td>1.06 (1.03-1.10)</td>
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<td>Related to the child</td>
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<tr>
<td>Gender</td>
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<tr>
<td>Boy</td>
<td>1374</td>
<td>ref</td>
</tr>
<tr>
<td>Girl</td>
<td>1395</td>
<td>1.07 (0.86-1.33)</td>
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</tbody>
</table>
### Table 4: Multivariable analysis: association between underestimation and ethnicity for normal weight (BMI=15.5) and overweight (BMI=18) children.

<table>
<thead>
<tr>
<th>BMI</th>
<th>Ethnicity</th>
<th>Crude OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.5</td>
<td>Dutch</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>African descent</td>
<td>1.08 (0.27-4.35)</td>
<td>0.49 (0.11-2.21)</td>
</tr>
<tr>
<td></td>
<td>Turkish</td>
<td>6.83 (2.33-20.05)</td>
<td>2.56 (0.79-8.33)</td>
</tr>
<tr>
<td></td>
<td>Moroccan</td>
<td>11.55 (5.28-25.26)</td>
<td>4.53 (1.84-11.16)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1.79 (0.94-3.39)</td>
<td>1.18 (0.58-2.43)</td>
</tr>
<tr>
<td>18</td>
<td>Dutch</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>African descent</td>
<td>1.85 (0.96-3.55)</td>
<td>0.92 (0.43-1.96)</td>
</tr>
<tr>
<td></td>
<td>Turkish</td>
<td>2.80 (1.12-6.98)</td>
<td>1.28 (0.47-3.47)</td>
</tr>
<tr>
<td></td>
<td>Moroccan</td>
<td>1.38 (0.73-2.60)</td>
<td>0.62 (0.30-1.28)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1.18 (0.69-1.99)</td>
<td>0.70 (0.37-1.30)</td>
</tr>
</tbody>
</table>

Abbreviations: OR = odds ratio; CI = confidence interval. Crude: Ethnicity adjusted for BMI of the child.

**Model 1:** As in crude model, with the addition of maternal age and BMI, education level and immigrant generation.

**Figure 1:** Estimated ORs (depicted on log-scale) for maternal underestimation per ethnic group (Dutch is reference group), as a function of the child’s BMI (adjusted for the measured BMI of the child).
DISCUSSION

This study provides insight into ethnic differences in the maternal ability to correctly estimate their child’s weight status at age 5 years in different child bodyweight categories (normal and overweight), and the factors associated with underestimation by the mother. It was found that the percentage of maternal underestimation is high, irrespective of the ethnic background. Maternal underestimation occurred mainly in mothers with an overweight child, although mothers with a normal weight child also underestimated their child’s weight. Overall, mothers with an overweight/obese child underestimated their child’s weight in 79.1% of the cases. The highest percentage of underestimation occurred among the Turkish mothers, which was partly due to the high percentage of overweight children in this group. Moroccan and Turkish mothers more often perceive the weight of their normal weight child to be ‘too low’. African descent mothers with an obese child tend to have fewer difficulties correctly estimating their child’s weight status compared to the Dutch mothers.

The current study identified several determinants increasing the risk for underestimation of their child’s weight. More specifically, educational level, immigrant generation and (to a lesser extent) maternal age, are important determinants related to underestimation. Other studies on maternal perception also found high rates of underestimation of their child’s weight. For example, Harnack et al. found underestimation not only in ethnic minority groups or low educated parents, but also in a predominantly white, well-educated population;39 they found that 90.7% of the parents with overweight preschoolers classified their child as average weight, compared with the 85.5% in our multi-ethnic population. Another study on parental perception in the Netherlands reported rates similar to those in our study.40 This underlines that classification of overweight is difficult for mothers throughout society. Others reported that mothers who underestimate may be in denial and may not want to recognise the overweight problem.22,41

Although parental lack of awareness of childhood overweight appears to be evident across all levels of parental education and ethnicities, studies in the USA found high percentages of maternal underestimation in ethnic minority groups.22-26,42 For example, Killion et al. reported that a high percentage of mothers from African-American descent perceived their children (4-5 years old) to be thinner than their actual body size.23 We also found a high percentage of underestimation in the African descent mothers. However, the ORs for underestimation are similar to those in the ethnic Dutch mothers. This may be because our ‘African descent’ group is composed of all those from south Saharan African origin with different cultures; the ORs for underestimation may in fact differ between these smaller groups.

Unlike the African descent mothers, the Turkish and Moroccan mothers are more likely to underestimate their normal weight (Turkish and Moroccan) and overweight (Turkish) child. Besides the negative implications for non-awareness of overweight in a child, also normal weight children (whose weight was considered to be too low) may be at risk of
developing overweight. These children are more likely to be pressurised to eat and have a higher risk of unfavourable weight development than children whose weight is considered to be 'just right'. This study revealed several determinants explaining why these Turkish and Moroccan mothers are more likely to underestimate.

The influence of lower education and income on the ability to classify the weight of the child is well reported. Educational level is a measure for SES. In addition to educational level, we also used employment and financial status to examine the association between maternal underestimation and SES. Although each SES factor was related to maternal underestimation, the multivariate analysis showed that maternal educational level was the strongest independent SES determinant related to ethnic differences in maternal underestimation. The ethnic differences in maternal underestimation in the Turkish and Moroccan groups are partly explained by their lower education level.

Besides education level, it was found that ethnic minority mothers born abroad (first generation) have higher levels of underestimation. This suggests that first-generation immigrant mothers are more related to their home culture than the minority mothers born in the Netherlands, and that obesity is generally more accepted in these cultures. Furthermore, a heavier weight in childhood may be seen as healthy, which supports our finding of higher ORs for maternal underestimation in the normal weight Moroccan and Turkish children. Studies on the acculturation of Turkish people report the importance of maintaining their own culture in the private (socio-emotional, value-related) domain. Turkish mothers of first-generation immigrants may be more influenced by their original values regarding overweight, which might explain the high ORs for maternal underestimation in this group.

In the present study, maternal age also partly explained the association between underestimation and ethnicity. The minority mothers were younger and had a higher percentage for underestimation. Although maternal BMI is an independent factor associated with underestimation, it did not explain the ethnic differences. Mothers with a lower BMI are reported to be more aware of their child's weight. In contrast to earlier reports, we found no association between gender and underestimation; however, this difference may be the result of different age groups and cultural differences between the studies.

The present study has several strengths. It is a large multi-ethnic population-based study, and data on anthropometrics, weight perception and social environment are comprehensive. To our knowledge, this is the first study addressing ethnic differences in maternal underestimation and their explanatory determinants in a European cohort. Most studies on this topic are single race and thus unable to differentiate between ethnic groups, or provide data on specific racial/ethnic groups. A limitation of our study is the relatively small group of children with obesity. Because we were unable to calculate ORs in this subgroup, the apparently higher ORs for underestimation in Turkish children cannot be proven. More research is needed to examine differences in underestimation among the high BMI regions. Moreover, the group included in the present study (participating in phase 3) has
a higher education level and are less ethnically diverse. Due to this selection bias, the prevalence of maternal underestimation and the explanatory role of the determinants may be underestimated.

Maternal/parental recognition and acknowledgement of their child’s weight are critical steps in the success of interventions aimed at preventing overweight. It may be difficult to perceive a child’s weight, especially when the parents live in an obesogenic environment with a high prevalence of overweight/obesity. It could be that, for them, “overweight is the new normal weight” and so if one’s child looks like all the other children, a mother may not realize that their child is at risk. A lower educational level, being a young mother, and being born in a foreign country play an important role in underestimation. This suggests that socio-cultural factors may contribute to the higher degree of underestimation, especially among Turkish and Moroccan mothers. Our findings may be of particular value to youth health care physicians who need to identify which parents are most in need of advice/education regarding their child’s weight. However, more research is needed concerning the impact of maternal underestimation on their child’s weight.

ACKNOWLEDGEMENTS

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