

# Parental and Child Factors Associated with Under-Estimation of Children with Excess Weight in Spain

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**Abstract** *Objective* Understanding obesity misperception and associated factors can improve strategies to increase obesity identification and intervention. We investigate underestimation of child excess weight with a broader perspective, incorporating perceptions, views, and psychosocial aspects associated with obesity. *Methods* This study used cross-sectional data from the Spanish National Health Survey in 2011–2012 for children aged 2–14 years who are overweight or obese. Percentages of parental misperceived excess weight were calculated. Crude and adjusted analyses were performed for both child and parental factors analyzing associations with underestimation. *Results* Two–five year olds have the highest prevalence of misperceived overweight or obesity around 90%. In the 10–14 year old age group approximately 63% of overweight teens were misperceived as normal weight and 35.7 and 40% of obese males and females. Child gender did not affect underestimation, whereas a younger age did. Aspects of child social and mental health were associated with under-estimation, as was short sleep duration. Exercise, weekend TV and

videogames, and food habits had no effect on underestimation. Fathers were more likely to misperceive their child's weight status; however parent's age had no effect. Smokers and parents with excess weight were less likely to misperceive their child's weight status. Parents being on a diet also decreased odds of underestimation. *Conclusions for practice* This study identifies some characteristics of both parents and children which are associated with under-estimation of child excess weight. These characteristics can be used for consideration in primary care, prevention strategies and for further research.

**Keywords** Child obesity · Epidemiology · Weight misperception

## Significance Statement

*What is already known:* High rates of parental underestimation of child excess weight have been reported with rates associated with child age and parental gender. Underestimation is also associated with lower levels of intervention. *What this study adds:* Underestimation rates are high in Spain and highest with younger children. Aspects of parental perception of child's social and mental health were associated with under-estimation, as was short sleep duration. Smokers, parents on a diet and parents with excess weight were less likely to underestimate their child's excess weight status.

## Introduction

Child obesity is considered an important public health problem world-wide. High prevalence of child obesity has

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been documented throughout the developed world including Spain (Sanchez-Cruz et al. 2013; van; Stralen et al. 2012; Wang and Lobstein 2006). Prevalence of child and adolescent overweight has been measured at 26% and obesity 12.6% (Sánchez-Cruz et al. 2013). Child obesity has been associated with both short- and long-term consequences, with metabolic risk profiles tracking into adulthood (Singh et al. 2008; Twig et al. 2016; Weiss et al. 2004, 2003, 2003).

Effective strategies to combat and reverse child obesity have been on the public agenda in many countries for a number of decades, with the most recent World Health Organization (WHO) Commission on Ending Childhood Obesity being published in 2016 (World Health Organization 2015). While public health strategies have generally succeeded in raising awareness in parents regarding child obesity and its consequences (Hardus et al. 2003), this does not appear to have translated to correct identification of excess weight by parents in their own children (Lundahl et al. 2014). Many parents consider overweight children to be healthy and normal with high rates of parental underestimation of child weight measured in many international studies over the last decade (Eli et al. 2014; He and Evans 2007). These high percentages of underestimation of child excess weight are concerning. Parents and families need to be aware of an obesity issues in their family and be willing, able and ready to make the necessary life style changes needed as we do not fix what we do not know is a problem.

A number of international studies have found consistently high prevalences of underestimation of excess weight in children (De La et al. 2009; Hudson et al. 2012; Katz 2015; Lundahl et al. 2014). Underestimation reported has been associated with parental gender, child age and varying results for socio-economic status and child gender. Socio-cultural differences may explain some of the differences seen in results for child gender and socio-economic status. However, factors other than child age, parental gender, education or income level have not been included in these studies. Perceptions and beliefs of weight take place within a wider social discourse, and families need to negotiate complex and often contradictory messages when constructing beliefs and actions relating to obesity management (Thomas et al. 2014). Furthermore, images and stereotypes of obesity, particularly in children, may influence parents' own views on obesity and the weight status of their own children (Eli et al. 2014; Thomas et al. 2014).

Understanding rates of underestimation and associated factors can improve and target strategies to increase obesity awareness, improve identification within families, remove barriers to correct weight status identification such as stigma, and improve subsequent appropriate management.

This study investigated underestimation of child excess weight status with a broader perspective incorporating

perceptions, views, and psychosocial aspects associated with obesity, using secondary analysis of data from the Spanish National Health Survey. Specifically, this study had two objectives: (1) To identify the prevalence of parental underestimation of child weight status in Spain, and (2) To identify the associated characteristics with parents incorrectly identifying their child's weight status, specifically those associated with parents who perceive an overweight/obese child as being normal weight.

## Methods

### Study Design and Population

This study used cross-sectional data from the Spanish National Health Survey in 2011–2012 which was conducted by the Spanish Ministry of Health and the National Institute of Statistics. The National Health Survey uses multi-stage stratified random sampling of all households in Spain, with strata based on municipality size. Questionnaires were conducted by a trained interviewer via computer-assisted personal interviews. Three questionnaires were conducted in each selected household: one household questionnaire, one adult questionnaire, and one child questionnaire if a child lived in the household. Household response rate was 89.62%. More detailed information on methodology can be found on the National Health Survey section on the Ministry of Health, Social Security and Equality website (<http://www.msssi.gob.es/estadEstudios/estadisticas/encuesta-Nacional/encuesta2011.htm>) (Spanish Ministry of Health and Social Policies 2013).

Our population sample was restricted to cases that met the following criteria: (1) household had a child questionnaire, (2) where the child was aged between 2 and 14 years inclusive, (3) the child was overweight or obese, and (4) the person responding to the questionnaires was their parent.

Exclusion criteria included cases where child weight perception status was missing. Ceuta and Melilla were also excluded as they are extra-metropolitan Spanish cities in North Africa with different demographic characteristics to peninsula Spain. After exclusions criteria were applied, the total sample size was 914. For analyses investigating the parental characteristics associated with underestimation of child obesity, only cases where the adult surveyed was the same as the informant were used (i.e. the adult questionnaire was filled out by the person themselves and not their spouse or partner). The sample size for these final analyses was 544.

## Variables

Data on Body Mass Index (BMI) were derived from parent reported height and weight in cm and kg. BMI for sex and age was categorized as obese, overweight, normal weight or underweight as per the latest World Obesity Federation definitions for BMI cut-offs for under the age of 18 (World Obesity Federation 2013). The National Health Survey reports ages in year, and therefore for the purpose of this calculation all children were assumed to be at the midpoint of their age-year.

Parental perception of child weight status was measured using a single question—“And, in relation to his/her height, you would say their weight was \_\_\_\_\_: (1) Significantly higher than normal, (2) Somewhat higher than normal, (3) Normal, and (4) Lower than normal. This variable was parent-reported. This variable was then combined with BMI status to create the binary primary outcome variable: parental underestimation of child’s weight—yes/no. Underestimation was defined as case where a child with a BMI in the overweight or obese range whose parents considered their weight in relation to height to be normal.

Independent factors for analysis were chosen based on literature search of factors associated with child obesity, adult obesity and factors associated with perception and stigma of obesity (Gray et al. 2009; Hardus et al. 2003; Jain et al. 2001; Warschburger 2005). The factors were divided into child and adult factors then further categorized into: General Characteristics, Perceived Health, Social and Mental Health, Exercise and Rest, and Food Behaviors.

Parental education level was approximated using the highest education level achieved by either parent or legal guardian. Education levels were coded to correspond with education levels according to the International Standard Classification of Education (ISCED)(United Nations Educational Scientific and Cultural Organization 2014) and grouped into the following categories: (1) Illiterate/no formal education, Primary level education, and (2) Secondary level and non-university education, and University.

## Statistical Analysis

Data were analysed using SPSS version 20. General demographic details for the sample population were calculated, including percentages of male vs female parents, level of education of parents, nationality, child gender and mean parental age and BMI. Obesity and overweight combined overall prevalence and prevalence for the different age groups were calculated.

Using only cases with obese or overweight children, percentage of children whose weight was correctly identified and under-perceived was calculated. Next percentages of

misperceived excess weight were calculated for males and females separately and for each age group.

Finally crude and then adjusted analyses were performed using binary logistic regression for each of the factors analyzing any association with underestimation. Effect size of each factor on underestimation of excess weight for each variable was reported.

## Ethics Statement

As per the National Health Survey guidelines, parental/guardian consent to participation was required prior to collecting data on minors. All National Health Survey data files consist of anonymous data and cases for analysis and are freely available for public use online.

## Results

Characteristics of the sample population after exclusion of cases with normal weight and underweight children are shown in Table 1. Total sample size was 914 cases, 88.5% Spanish parents with an average age of 39.2 years, an average BMI of 26.4, 53.3% were female, and 66.1% had a minimum of secondary or tertiary education. Children were male in 55.9% of cases. Overall 29.8% of males suffered from excess weight and 26.8% of females. Breakdown of characteristics by child age group and parental gender can be found in Table 1.

Amongst overweight children, 75.9% were misperceived as being normal weight or underweight and 73.5% of children with obesity were underestimated as being normal weight or underweight. Table 2 shows the overall frequency of misperceived excess weight, and its distribution by child age and sex. 2–5 year olds have the highest prevalence of misperceived overweight or obesity with 93.9% of overweight boys and 95.4% of overweight girls having their weight status underestimated and 87.8 and 91.2% of obese males and females having their weight status underestimated. The 10–14 year old age group had less risk of having their weight status underestimated with approximately 63% of overweight males and females being misperceived as normal weight and 35.7 and 40% of obese males and females having their weight status under-estimated.

Table 3 shows the child characteristics that were associated with underestimation of excess weight. Child gender did not affect underestimation, whereas a younger age did. In terms of child social and mental health odds of weight status underestimation decreased if the child had frequent headaches, was a loner, is teased frequently by other children, gets along better with adults and is easily frightened. Short sleep duration decreased odds of underestimation of excess weight, whereas exercise amount had no effect on

**Table 1** General characteristics of our sample population in Spain 2011–2012 (Only overweight/obese children; Source: Spanish National Health Survey 2011–2012)

	Overall N=914 % (n)	2–5 year olds N=293 % (n)	6–9 year olds N=320 % (n)	10–14 year olds N=301 % (n)
<b>General demographics</b>				
Max education level parents				
Primary	33.0 (302)	28.3 (83)	31.2 (100)	39.5 (119)
Secondary/tertiary	67.0 (612)	71.7 (210)	68.8 (220)	60.5 (182)
<b>Adult characteristics</b>				
Responder nationality				
Spanish	88.5 (809)	85.7 (251)	89.4 (286)	90.4 (272)
Other	11.5 (105)	14.3 (42)	10.6 (34)	9.6 (29)
Age	39.17	37.02	39.05	41.38
BMI	26.43	26.08	26.32	26.89
Sex				
Male	46.7 (427)	51.2 (151)	40.6 (130)	48.5 (146)
Female	53.3 (487)	48.5 (142)	59.4 (190)	51.5 (155)
<b>Father</b>				
Nationality (n = 427)				
Spanish	89.2 (381)	86.1 (130)	90.0 (117)	91.8 (134)
Other	10.8 (46)	13.9 (21)	10.0 (13)	10.8 (12)
Age	39.10	37.64	39.43	40.25
BMI	27.4	27.38	27.26	27.55
<b>Mother (n = 487)</b>				
Nationality				
Spanish	87.9 (428)	85.2 (121)	88.9 (169)	89.0 (138)
Other	12.1 (59)	14.8 (21)	11.1 (21)	11.0 (17)
Age	39.22	36.3	38.79	42.47
BMI	25.56	24.68	25.66	26.26
<b>Child characteristics</b>				
Sex				
Male	55.7 (509)	50.5 (148)	53.8 (172)	62.8 (189)
Female	44.3 (405)	49.5 (145)	46.2 (148)	37.2 (112)
<b>BMI (n = 3219)</b>				
Male—overweight	19.8 (338)	13.3 (66)	22.6 (111)	22.4 (161)
Male—obese	10.0 (171)	16.5 (82)	12.4 (61)	3.9 (28)
Female—overweight	16.6 (251)	14.8 (65)	20.1 (89)	15.3 (97)
Female—obese	10.2 (154)	18.3 (80)	13.3 (59)	2.4 (15)

**Table 2** Under-estimated excess-weight per Age and Sex of children in Spain 2011–2012. (Source: Spanish National Health Survey 2011–2012)

	Overall % under-estimated (n), 95% CI	2–5 year olds % under-estimated (n), 95% CI	6–9 year olds % under-estimated (n), 95% CI	10–14 year olds % under-estimated (n), 95% CI
<b>Males</b>				
Overweight	75.7 (256), 70.9, 80.0	93.9 (62), 84.9, 97.7	83.8 (93), 75.8, 89.5	62.7 (101), 55.1, 69.8
Obese	69.6 (119), 62.3, 76.0	87.8 (72), 79.0, 93.2	60.7 (37), 48.1, 71.9	35.7 (10), 20.7, 54.2
<b>Females</b>				
Overweight	76.1 (191), 70.4, 81.0	95.4 (62), 86.2, 98.4	76.4 (68), 66.6, 84.0	62.9 (61), 53.0, 71.8
Obese	77.9 (120), 70.7, 83.8	91.2 (73), 83.0, 95.7	69.5 (41), 56.8, 79.8	40.0 (6) 19.8, 64.3

**Table 3** Child characteristics in Spain 2011–2012 associated with underestimation of excess weight status (Spanish National Health Survey 2011–2012)

Child Characteristics	n	Crude OR	P	Adjusted OR*	P
Sex (female reference)	914	0.846	0.280	0.988	0.943
Age (10–14 year reference)	301				
6–9 year old	320	2.039	0.000	2.010	0.000
2–5 year old	293	7.745	0.000	7.599	0.000
Perceived health					
Perceived health (ok/poor/very poor reference)	73				
Good/very good	841	1.529	0.105	1.718	0.059
Social/mental health					
Frequent headache/stomach ache (Yes, somewhat reference)	144				
No	624	1.642	0.011	<b>1.494</b>	<b>0.048</b>
Loner, plays alone (absolutely, somewhat reference)	163				
No	604	1.718	0.004	<b>1.743</b>	<b>0.004</b>
Is constantly moving (yes reference)	469				
No	299	0.506	0.000	<b>0.622</b>	<b>0.005</b>
Cries/is sad frequently (Yes reference)	79				
No	688	1.593	0.059	1.592	0.071
Teased by other children (Yes/Somewhat reference)	152				
No	612	1.538	0.002	<b>1.871</b>	<b>0.002</b>
Gets along better with adults (Yes reference)	269				
No	499	1.573	0.006	<b>1.451</b>	<b>0.029</b>
Easily frightened/scared of many things (yes, somewhat reference)	311				
No	457	1.538	0.008	<b>1.794</b>	<b>0.001</b>
Exercise and rest					
Sleep duration (adequate reference)	720				
Short	194	0.979	0.910	<b>1.616</b>	<b>0.018</b>
Exercise (never, occasionally, few times per month reference)	792				
Few times per week	121	1.148	0.531	0.924	0.736
TV weekdays (1 + hours daily reference)	631				
Less than an hour	214	1.609	0.014	<b>1.632</b>	<b>0.018</b>
Never	67	3.368	0.003	<b>3.152</b>	<b>0.007</b>
TV weekends (more than 1 h)	721				
Less than hour	139	1.814	0.013	1.598	0.064
Never	51	3.483	0.009	1.815	0.054
Videogames weekdays (more than 1 h)	215				
Less than 1 h	229	1.495	0.048	1.161	0.488
Never	469	2.756	0.000	1.430	0.085
Videogames weekends (more than 1 h reference)	388				
Less than 1 h	170	1.296	0.203	0.950	0.813
Never	353	2.606	0.000	1.192	0.408
Food habits					
Frequency soft drinks (Never, less than once per week reference)	570				
Few times per week	265	0.732	0.067	1.080	0.679
Daily	78	0.507	0.008	0.750	0.294
Frequency fast foods (daily/few times per week reference)	351				
Never, less than per week	562	1.384	0.036	1.072	0.674
Frequency fruits (daily Reference)	526				
Less than daily	388	0.904	0.515	1.082	0.632
Frequency vegetables (daily reference)	328				

**Table 3** (continued)

Child Characteristics	n	Crude OR	P	Adjusted OR*	P
Less than daily	586	1.228	0.193	1.345	0.078

\*Adjusted for: sex, age, SES

Numbers in bold indicate significant p value

underestimation. A child that never watched weekday television was more likely to have their weight status underestimated; however weekend TV and videogames were not associated with underestimation. A child’s food habits were also not associated with underestimation of weight status.

Adult parent characteristics associated with underestimation of child weight status are shown in Table 4. Adult males were more likely to misperceive their child’s weight status, however age did not affect underestimation rates. A

smoker was less likely to misperceive their child’s weight status, as is a parent who is overweight or obese themselves. Parental exercise and sleeping habits did not show any association with underestimation. Parents who never eat fast food had lower odds of misperceiving their child’s weight compared with those that eat fast food once or more per week (0.67, p=0.03). The odds of underestimation were 0.43 for parents that were on a diet compared with parents who were not.

**Table 4** Adult parent characteristics in Spain 2011–2012 associated with underestimation of child excess weight status. (Source: Spanish National Health Survey 2011–2012)

Adult characteristics	n	Crude OR	P	Adjusted OR*	P
Sex (female reference)	362				
Male	182	1.975	0.002	<b>2.101</b>	<b>0.001</b>
Age <sup>#</sup>	544	0.974	0.083	1.035	0.085
SES household (secondary/tertiary reference)	366				
Illiterate/Primary	178	0.638	0.025	<b>0.609</b>	<b>0.017</b>
Health/quality of life					
Perceived QoL	543	1.026	0.000	<b>1.024</b>	<b>0.000</b>
Smoking (smoker reference)	207				
No/ex-smoker	337	1.793	0.003	<b>1.779</b>	<b>0.004</b>
Weight status (obese/overweight reference)	299				
Underweight/normal weight	232	1.686	0.010	<b>1.904</b>	<b>0.003</b>
Exercise/rest					
Sleep duration (<8 h reference)	302				
8 or more hours	242	0.780	0.200	0.826	0.333
Activity during Free time (several times per week reference)	41				
None, occasionally	502	0.987	0.971	1.208	0.617
Food habits					
Frequency sugary drinks (once or more per week reference)	246				
Never, less than 1 per week	297	0.995	0.978	1.099	0.639
Frequency fast food (once or more reference)	183				
Never, less than once per week	361	0.526	0.003	<b>0.603</b>	<b>0.025</b>
Frequency vegetables	521				
Never, less than once per week	23	1.051	0.918	1.173	0.749
Frequency fruit	489				
Never, less than once per week	55	0.672	0.187	0.665	0.190
On diet (no reference)	505				
Yes	39	0.400	0.007	<b>0.423</b>	<b>0.013</b>

\*Adjusted for sex, age, and educational level

<sup>#</sup>Adjusted for sex, child age, and household educational level

Numbers in bold indicate significant p value

## Discussion

This study showed high rates of parental underestimation of child excess weight status. Child age, factors associated with child social/mental health, child sleep duration, child TV watching, parental gender and parent being on a diet were found to be significant moderators of this effect. Child gender, exercise levels and diet did not appear to moderate weight status underestimation.

Several international studies have shown similarly high misperception rates, with 63% of parents incorrectly perceiving their overweight child to be within the normal weight range in a study including 8 European countries, and a recent meta-analysis reporting 50.7% of parents under-estimated their overweight child's weight (Eli et al. 2014; Lundahl et al. 2014). These studies also report larger percentages of misperception for younger children (Carnell et al. 2005; He and Evans 2007; Lundahl et al. 2014). Parental education levels and child's gender show varying results as moderators of this effect (He and Evans 2007). Our findings are slightly higher than the misperception rates in Spain in 2006/2007 found by Salcedo (Salcedo et al. 2010), who found that approximately 60% of parents misperceived their overweight child as being normal weight for children aged 5–15. However, this is consistent with the increasing trend of misperception of child weight status found by Salcedo in the afore-mentioned study (Salcedo et al. 2010).

The high percentage of misperception of excess weight is thought to be due to a “generational shift in social norms related to body weight” (Hansen et al. 2014). Individuals, or parents, gauge their weight status comparing with others rather than assessing their weight status on an absolute scale (Hansen et al. 2014). As obesity prevalence has increased over time so has the perceived normal weight, and a corresponding increase in misperception of child obesity amongst parents has been measured (Salcedo et al. 2010). Parents may also be rejecting the possibility of obesity in their children due to stigma and ideas of victim and parent blaming which appear pervasive in our societies (Eli et al. 2014; Hardus et al. 2003). Concepts of chubbiness in preschool-age children being normal, healthy and a sign of good parenting is also widely accepted and may also contribute to the overall high misperception of excess weight as the largest proportion of misperception occurs in younger children (Eli et al. 2014; Falconer et al. 2014; Hansen et al. 2014; Hudson et al. 2012; Lundahl et al. 2014).

Child age is strongly associated with underestimation of excess weight with increasing odds of underestimation with a decreasing age. This association is consistent with international studies with younger obese children being less likely to be correctly identified as such (Eli et al. 2014; Hudson et al. 2012; Lundahl et al. 2014). This age related

phenomenon is partly associated with visual comparison and partly due to the belief that a little extra chubbiness in early childhood is normal, healthy, a sign of good parenting and will be grown out of (Eli et al. 2014; Falconer et al. 2014; Hansen et al. 2014; Hudson et al. 2012; Lundahl et al. 2014). Interestingly, child gender was not associated with underestimation of excess weight in our study. Other studies have found this association (He and Evans 2007; Hudson et al. 2012).

In general, there is a negative stigma associated with obesity and there has been much research exploring the psychosocial impact of obesity (Warschburger 2005). Public perception of obesity often includes judgements of lazy, unintelligent, poor diet, excess food consumption, fewer friends, anxious and other psychosocial impairments (Gray et al. 2009; Hardus et al. 2003; Warschburger 2005). In this study we included aspects of these and found that aspects of parental psychosocial evaluation of their child were strongly associated with the likelihood of underestimation of excess weight status. Few studies deal with factors outside of child age, gender and socio-economic status when considering parental underestimation of child weight status. However, our results are consistent with a study by Jain et al. who demonstrated that mothers were not concerned about the weight status of their children if they were physically active and socially accepted (Jain et al. 2001). These results also correspond with studies that demonstrate psychosocial impairment associated with obesity (Warschburger 2005). These results need further confirmation with specifically designed studies.

Other factors shown to be make up lay perception of child obesity causes include diet, physical activity and modern technology such as television (Hardus et al. 2003). Interestingly in our study these factors overall were not associated with parental perception of the excess weight status of their child. The most likely reason for this difference is that our study measures perceptions of obesity and perceptions of associated factors rather than objective weight status and objectively measured associated factors. Potentially, alongside underestimation of weight status is also a misperception of the lifestyle factors associated with obesity. Therefore if a parent does not identify obesity risk factors in their child the likelihood of misperception of obese status may increase. Perceptions of short sleep duration and weekday television viewing were the only two factors which were associated with an increased correct identification of the overweight or obese status of their child. Videogames, diet and physical activity were not associated. Potentially population obesity education strategies, which have often cited television and sedentary activity is factors to reduce to combat child obesity, have as yet not focused on or included videogames. While parents and the public in general are very aware that diet is a major factor in child

obesity (Hardus et al. 2003), a child's diet is influenced by their parents and is likely to be very similar to the parental diet, especially in younger children (Salvy et al. 2011). Perceptions of one's own diet are often skewed (Stubbs et al. 2014), and perceptions of their child's weight status may affect reporting of their child's diet (Livingstone et al. 2004). Potentially, a parent who considers their own diet to be healthy will also consider their child's diet to be healthy or parents may be unaware they are creating an obesogenic dietary environment. Furthermore, parents may reject the possibility that what they consider occasional treats could be contributing to their child's weight status and maybe too frequent. This also ties into parental blaming and stigma and parents may be resistant to the diagnosis of child obesity when considering family diet (Eli et al. 2014). The statistically significant associations seen in the crude analysis, disappeared when adjusted for age, suggesting that diet patterns observed in our data are more a reflection of age and the decreasing influence of parents and their knowledge of the child's diet with increasing maturity (Livingstone et al. 2004).

Our study showed a number of parental characteristics that were associated with underestimation of child obesity. The odds of underestimation were less than 1 if the parent was female or with excess weight themselves. This is consistent with findings in other studies (He and Evans 2007; Hudson et al. 2012). Parents who are overweight themselves may be more aware of the potential of obesity in their children and the lifestyle factors influencing that. This was further corroborated by the strong association between parents on a diet and correct perception of their child's excess weight status. The existence of an association between level of education and perception of child excess weight is inconsistent in literature with varying results (Carnell et al. 2005; He and Evans 2007; Hudson et al. 2012; Salcedo et al. 2010). In our study the odds of underestimation were less than 1 if the level of parent education was of primary level, this is similar to the findings by Salcedo et al. (Salcedo et al. 2010). Non-smokers were also more likely to misperceive their child's excess weight status; possibly because non-smoking status has been shown to be associated with higher health literacy (von Wagner et al. 2007).

Overall parental diet, sleep and exercise characteristics were not associated with underestimation of child excess weight. The lack of association with parental dietary factors has been touched on above. However, frequency of fast-food in the parent's diet was associated with underestimation of child's excess weight. Potentially parents are aware of the unhealthy nature of fast food and potential consequences of frequent consumption. This needs further investigation and may tie into health literacy.

We should note some of the study's weaknesses and how they may impact on the interpretation of this study.

Firstly, the cross-sectional nature of this study, which does not allow for causal analysis or interpretation and so, all the associations seen in this study could go in either direction. The data were also collected in a subjective manner so all characteristics reflect parental opinion and may be subject to bias. However, the large sample does remove some of this bias and when considering factors influencing parental perceptions of child weight their perceptions of other child characteristics may be more important than objective characteristics. This study used secondary analysis using data from the Spanish National Health survey. Therefore this is not a study specifically designed to investigate parental underestimation of excess weight in their children. This caused problems with design, its cross-sectional nature, and residual confounding. Lastly we should note that this study is in a Spanish population and therefore some of the parental perceptions may be influenced by cultural nuances and therefore caution should be applied when generalizing results to other populations.

Aside from these weaknesses, this study also has some strengths. The data were collected as part of a large national survey and is representative of the Spanish population. The large sample size is also a strength of this study.

While public health campaigns have raised awareness of child obesity (Hardus et al. 2003), this isn't translating into correct identification of the weight status of parents' own children. Understanding the why, who and how parents misperceive the weight status of their children may be an important aspect in tackling the issue of child obesity. One cannot fix a problem that one does not know exists (Katz 2015). However, care must be taken not to increase parental awareness and as a result cause issues of stigma or victim blaming. Raised awareness must go hand in hand with combating the stigma, social images and underestimation of the causes of child obesity. This study identifies some characteristics not previously studied, of both the parents and the child, which are associated with under-estimation of child excess weight. These characteristics can be used for consideration in primary care, prevention strategies and for further research. However, more research with specifically designed studies to investigate these associations is needed.

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