

Weight status in Chinese children: maternal perceptions and child self-assessments

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Background: Inaccurate parental perceptions of child weight status as well as children's own misperceptions can reduce motivation to adopt optimal nutritional and physical activity behaviors, thereby increasing overweight and obesity risk in child populations in the U.S. and elsewhere. Using population-based data from nine provinces of China, we analyzed the accuracy of maternal perceptions and children's self-assessments of weight status.

Methods: The data were collected from 1265 children aged 6 to 18 years with self-reported weight status perceptions during the 2006 China Health and Nutrition Survey. Among these children, 863 had maternal estimation of child weight status. Descriptive and multiple regression analyses are conducted to find variations in the misperception of children's weight status.

Results: Among overweight children ($n=176$), 69% underestimated their weight status; 72% mothers of the overweight children ($n=143$) also underestimated their child's weight status. Less than one-quarter of overweight children and their mothers chose the correct classification of weight status. Multiple regression analyses showed that as children's body-mass-index (BMI)-for-age increased, the odds that mothers underestimated their weight status increased. Low maternal weight was significantly associated with maternal underestimation of child weight status but not with child's underassessment.

Conclusions: Underestimation of childhood overweight is common among both mothers and children in China, particularly for children with the highest BMI. School-based BMI reporting may be beneficial in alerting

parents and children to the problem and encouraging communication with health care providers.

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Key words: childhood obesity; Chinese; weight status

Introduction

Childhood obesity rates have soared in many developed nations including the United States, where obesity is related to escalating rates of type 2 diabetes, hypertension, metabolic syndrome, and dyslipidemia among children.^[1-3] Research has suggested that most overweight children will grow up to become overweight adults,^[4] and as a result, childhood obesity trends are a strong predictor of long-term increases in adult disease burden.^[5] Sharp increases in childhood obesity rates are also of growing concern in populous developing nations such as China, which has over 222 million children under the age of 15.^[6] In the Chinese population, the prevalence of overweight, while lower than in the U.S., increased from 5.2% in 1991 to 13.2% in 2006.^[7] There has also been a concomitant rise in the prevalence of adverse child health conditions such as metabolic syndrome, which is increasingly seen in overweight and obese Chinese children.^[8]

Accurate parental perception of weight status is thought to be a key aspect of successful childhood obesity management and prevention,^[9] because children's parents have considerable influence on a child's diet and activity patterns, especially at younger ages.^[10,11] Unfortunately, research on parental perceptions of child weight status, much of which has been done in developed countries,^[9] indicates that parents often do not accurately identify their overweight children as overweight.^[12-14] Researchers have found that the accuracy of parental perceptions of children's weight status varies by demographic and other characteristics of parents and children, although in many cases the evidence is not entirely consistent. Maternal educational attainment has been shown to be significantly related to perception of child weight in some but not all studies;

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where education was significant, less-educated mothers were more likely to underestimate their children's weight than mothers with higher education.^[15,16] Mothers of physically active children are less likely to underestimate children's weight status.^[17] Weight status perceptions appear to be more accurate among parents of older children compared to younger children,^[13,16,18,19] although some researchers have found no differences by child age.^[15,20-22] Mothers may also be more likely to accurately recognize daughters as being overweight than they are sons,^[21,23-25] however some studies showed no difference by child gender.^[15,16,20,26] On the other hand, some parental attributes hypothesized to be important have not generally been shown to be associated with perceptions of child weight status. For example, a study by Maynard and colleagues^[23] found that poverty to income ratio, census region of residence, and race/ethnicity were not significant predictors for misclassification of children's weight status.

In addition to parental perceptions, children's own views about their weight status are relevant in influencing their dietary intake and physical activity, and children who accurately perceive their own weight status tend to report higher levels of healthy weight-related behaviors.^[27] Research has found that overweight children often fail to accurately identify their own weight status. A recent US study by Edwards et al,^[27] for example, showed that about 30% of overweight children underestimated their weight status as compared to their body mass index (BMI) category computed from self-reported height and weight. Another study using self-reported height and weight to calculate BMI found that more than 20% of overweight adolescents perceived themselves as underweight.^[28] Edwards and colleagues^[27] also found that overweight boys, compared to girls, were more likely to misperceive their overweight status. A British study found that underestimation was greatest among adolescent boys and ethnic minorities.^[29] One study comparing children's self-perceived weight status to parental assessment found that parents provided more accurate assessments, although both parents and children were often inaccurate in identifying child obesity.^[30]

Limited research has examined parental perceptions and/or child self-assessment of overweight status in China. A study in a relatively prosperous Chinese province suggests that one-fifth of overweight boys perceived their weight as normal, while all of the overweight girls studied perceived themselves as overweight, and 30% of normal weight girls also perceived themselves as overweight.^[31] A study conducted in middle and high school students from four large Chinese cities also found that boys were more likely than girls to underestimate their weight status.^[32] Another study conducted in secondary school students

from two large cities in Southern China found that about 30% of children and 40% of parents underestimated children's weight.^[33] Since these studies involved children from a small selected area of China, it is unclear whether the findings would be similar among Chinese children more generally.

In this paper, we analyze the accuracy of maternal perceptions and children's self-assessments of overweight status in the Chinese population and examine factors associated with inaccurate weight status perceptions. Given what is known from prior research, largely from developed countries, we hypothesized that a sizable proportion of overweight Chinese children and their mothers would underestimate child weight status. We also expected that the tendency to misperceive child weight status among Chinese parents and children would be greater among mothers with lower educational attainment, and also greater when children were younger and among male children than female children.

Methods

The data for the study were collected from participants aged 6 to 18 years during the 2006 China Health and Nutrition Survey, an ongoing, population-based longitudinal survey, which was designed to assess changes in population health and nutrition as a result of changes in social and economic conditions in China. The survey took a sample from nine provinces that differ substantially in economic development and health outcomes. Informed consent for participation in this survey was obtained, and the survey was approved by the institutional review board of the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety, and the China Center for Disease Control and Prevention. Details on the survey design and data available for child participants have been previously published.^[34-36] A total of 1279 children aged 6 to 18 years participated in the 2006 survey. The analytic sample for the present study included 1265 children who identified their weight status in answer to the question, "Do you think you are now underweight, normal or overweight?" Because the parent interview asked about perceptions of child weight status ("Do you think your child is underweight, normal, or overweight?") only for the oldest child in the family, a total of 863 of the children in the sample had data on maternal perception ratings with similar response categories for inclusion in the analyses.

Each child's weight and height were measured in a clinical setting using standardized measurement techniques. BMI was computed as the individual's weight divided by height squared. Each child's BMI-for-

age was compared with the 2000 National Center for Health Statistics Growth Charts, which are recommended by the World Health Organization for international comparisons.^[37] "Obesity" was defined as ≥ 95 th percentile, "overweight" as < 95 th percentile and ≥ 85 th percentile, "normal weight" as < 85 th percentile and ≥ 5 th percentile, and "underweight" as < 5 th percentile of BMI.^[38] However, the International Obesity Task Force defined overweight as a BMI for age and sex corresponding to an adult BMI of 25 or more.^[39] Similar to other childhood overweight research,^[40,41] overweight and obesity were combined into a single weight status category (overweight) for the analyses in this study.

Child age was classified into two groups (6-12 and 13-18). Mothers' education was classified into two groups as less than high school and high school or more. Mothers' weight and height were physically measured using standardized techniques and maternal BMI was calculated as described above. Rural/urban residence was identified through Chinese household registration information which categorizes residents into "rural" or "non-rural" status. Descriptive statistics were calculated for maternal BMI and children's age, weight, height, and BMI-for-age z-score. Linear contrasts were used to calculate mean differences and statistical significance determination was adjusted using a Bonferroni test to obtain an overall α of 0.05. Thus, the significance level for each comparison was set at $P \leq 0.017$. Frequency analyses were conducted to examine the accuracy of

maternal and child classifications of weight status in the overweight groups.

Multivariate logistic regression analysis was employed to identify predictors of 1) maternal underestimation of children's overweight status, and 2) child self-underassessment of their overweight status. The significance level for the logistic regression analyses was set at $P \leq 0.05$. All analyses were performed using SAS version 9.1. Because survey weights are not available in the China Health and Nutrition Survey dataset, all analyses were unweighted.

Results

Descriptive statistics reported by gender and weight status for children in the sample are shown in Table 1. Overweight boys and girls were significantly younger and shorter than boys and girls of normal weight. Overweight children were less likely to live in rural areas compared to those who were underweight or normal weight. Mothers of overweight boys and girls had higher BMI values than mothers with underweight children. Mothers of overweight girls also had higher BMI values than mothers with normal weight girls.

Comparisons of mothers' perceptions of their children's weight status with the child's measured weight status for boys and girls are shown in Table 2. Among overweight boys, 28.1% of their mothers

Table 1. Descriptive characteristics of children aged 6 to 18 years ($n=1265$)

Characteristics	Boys			Girls		
	Underweight ($n=89$, 13.3%)	Normal weight ($n=470$, 70.1%)	Overweight ($n=111$, 16.6%)	Underweight ($n=90$, 15.1%)	Normal weight ($n=440$, 73.9%)	Overweight ($n=65$, 10.9%)
Age (y)	11.8 (3.4)	12.1 (3.3)	10.8 [†] (3.3)	11.7 (3.1)	12.2 [*] (3.3)	10.2 [†] (2.8)
Weight (kg)	29.5 (10.6)	39.0 [*] (14.3)	51.7 ^{**†} (26.2)	28.1 (8.9)	37.7 [*] (11.9)	47.8 ^{**†} (23.9)
Height (cm)	141.2 (19.1)	146.0 (19.0)	139.6 [†] (22.2)	139.2 (16.9)	144.2 [*] (16.5)	130.8 ^{**†} (20.6)
Rural residence (%)	71.9 (4.8)	66.4 [*] (2.2)	56.8 ^{**†} (4.7)	80.0 (4.2)	62.0 [*] (2.3)	58.5 ^{**†} (6.1)
Maternal BMI [‡] (kg/m ²)	20.8 (2.9)	23.7 (8.9)	24.4 [*] (5.6)	21.4 (2.8)	23.2 (4.0)	24.3 ^{**†} (5.2)
Maternal education [‡] (% of under high school)	87.8 (12.7)	77.5 (3.4)	77.5 (8.6)	83.3 (1.7)	75.2 (3.3)	70.4 (10.9)

Values are mean/percentage (standard deviations). *: $P \leq 0.017$ versus underweight of same sex; †: $P \leq 0.017$ versus normal weight of same sex; ‡: Sample limited to 863 mothers with data on perception of child weight status.

Table 2. Maternal perception of weight status of children by measured weight status for boys and girls ($n=863$)

Maternal perception	Boys			Girls		
	Underweight ($n=49$)	Normal weight ($n=315$)	Overweight ($n=89$)	Underweight ($n=54$)	Normal weight ($n=302$)	Overweight ($n=54$)
Underweight	49.0 (9.7)	22.5 (2.5)	7.9 [*] (2.9)	48.1 (9.1)	18.5 (2.3)	11.1 [*] (4.5)
Normal	44.9 (9.3)	74.9 (3.4)	64.0 (7.9)	48.1 (9.1)	75.2 (3.3)	61.1 (10.2)
Overweight	2.0 [*] (2.0)	1.9 [*] (0.8)	28.1 (5.5)	0.0 (0.0)	5.0 [*] (1.3)	27.8 [*] (7.0)
Don't know	4.1 [*] (2.9)	0.6 [*] (0.4)	0.0 (0.0)	3.7 [*] (2.6)	1.3 [*] (0.7)	0.0 (0.0)

Values are percentages (standard errors). *: Sample size less than 10.

perceived them to be overweight. The majority of mothers (64.0%) perceived their overweight sons as normal weight, and 7.9% believed they were underweight. Similarly, 27.8% of mothers of overweight girls accurately classified their daughter's weight status, whereas 61.1% of these mothers perceived their daughter to be normal weight and 11.1% were rated as underweight. Overall, 72.0% of mothers of overweight children incorrectly classified their children as "normal weight" or "underweight". Among normal weight children, 20.6% of mothers incorrectly classified their children as underweight (22.5% of boy's mothers and 18.5% of girl's mothers). Mothers were more likely to consider their normal-weight child to be underweight than overweight.

Comparisons of children's self-assessment of their weight status with their measured weight status for boys and girls are shown in Table 3. Patterns of misperception by both male and female overweight children are very similar to those seen among their mothers. Only 27.0% of overweight boys and 26.2% of overweight girls perceived their weight status accurately, and most perceived themselves as normal weight (61.3% of boys and 60.0% of girls). Overall, 69.3% of overweight

children incorrectly classified themselves as "normal weight" or "underweight". Among normal-weight children, 18.5% of boys and 15.5% of girls incorrectly classified themselves as underweight. Like their mothers, they were more likely to consider themselves to be underweight than overweight.

Among overweight children ($n=140$), comparisons of children's self-assessment of their weight status with their mothers' perception of weight status are shown in Table 4. In over three-quarters of the cases, maternal and child perceptions were congruent, with only 23.0% of overweight children correctly classified as overweight by themselves and by their mothers.

Table 4. Self-assessment of weight status of overweight children by maternal perception of weight status of overweight children ($n=140$)

Child self-assessment	Maternal perception		
	Underweight	Normal	Overweight
Underweight	4.3* (1.7)	4.3* (1.7)	0.0 (0.0)
Normal	4.3* (1.7)	50.4 (4.2)	5.8* (2.0)
Overweight	0.0 (0.0)	5.0* (1.9)	23.0 (3.6)
Don't know	0.0 (0.0)	2.9* (1.4)	0.0 (0.0)

Values are percentages (standard errors). *: Sample size less than 10.

Table 3. Self-assessment of weight status of children by measured weight status ($n=1265$)

Self-assessment	Boys			Girls		
	Underweight ($n=89$)	Normal weight ($n=470$)	Overweight ($n=111$)	Underweight ($n=90$)	Normal weight ($n=440$)	Overweight ($n=65$)
Underweight	37.1 (6.3)	18.5 (1.9)	9.0 (2.8)	37.8 (6.3)	15.5 (1.8)	7.7* (3.4)
Normal	57.3 (7.7)	73.8 (2.8)	61.3 (7.0)	54.4 (7.5)	71.6 (2.8)	60.0 (9.3)
Overweight	0.0 (0.0)	4.3 (0.9)	27.0 (4.8)	2.2* (1.6)	8.4 (1.3)	26.2 (6.3)
Don't know	5.6* (2.5)	3.4 (0.8)	2.7* (1.6)	5.6* (2.5)	4.5 (1.0)	6.2* (3.1)

Values are percentages (standard errors). *: Sample size less than 10.

Table 5. Odds ratios and 95% confidence intervals for predictors of maternal underassessment and children self-underassessment in overweight children ($n=140$)

	Maternal underassessment		Children self-underassessment	
	Crude	Adjusted	Crude	Adjusted
Children's sex				
Boys	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Girls	1.02 (0.48-2.16)	1.15 (0.48-2.74)	0.85 (0.41-1.73)	0.78 (0.37-1.67)
Age group				
6-11 y	1.61 (0.77-3.38)	1.50 (0.66-3.42)	1.41 (0.69-2.86)	1.38 (0.66-2.90)
12-18 y	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
BMI-for-age z-score	3.66* (1.70-7.85)	4.47* (1.96-10.18)	1.59 (0.87-2.91)	1.66 (0.88-3.12)
Maternal BMI	0.96 (0.90-1.02)	0.92* (0.86-0.99)	0.96 (0.90-1.02)	0.95 (0.89-1.01)
Maternal education				
Under high school	2.34† (1.05-5.21)	2.37 (0.83-6.78)	1.21 (0.55-2.68)	1.00 (0.38-2.59)
High school or more	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Residence				
Urban	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Rural	2.34† (1.05-5.21)	1.42 (0.55-3.66)	1.46 (0.73-2.94)	1.43 (0.62-3.30)

Values are odd ratios (95% confidence intervals). *: P value <0.001, †: P value <0.05.

Table 5 presents results of multivariate logistic regressions modeling maternal underestimation and child self-underassessment of weight status among overweight children ($n=140$). Factors significantly associated with the maternal underestimation of children overweight status were the BMI z-score and maternal BMI value. Higher child BMI-for-age z-scores were associated with increased odds of maternal underestimation of child weight status. On the other hand, higher maternal BMI values were associated with lower odds of underestimating child overweight status. In modeling children's likelihood of under-assessing their weight status, neither BMI-for-age z-score nor maternal BMI value was a significant factor. Child's age, maternal education level, and place of residence were not significant predictors of underestimation of overweight status in either of the multivariate models.

Discussion

Findings from this study suggest that misperception of child weight status among Chinese mothers and their children is widespread. Close to three-quarters of mothers of overweight children considered their children to be normal or underweight, and a similar proportion of overweight children did not accurately perceive their own weight status. In a previous research regarding maternal misperceptions in China, a study in two provinces found the rate to be somewhat lower at 40%.^[33] The population data from nine provinces analyzed here, however, is likely to be more representative of China overall. Several US studies have also found somewhat lower rates of maternal underestimation of child weight status in the range of 45%-52%,^[18,42] however in the sample studied by Baughcum et al,^[15] the rate was similar to the present study at 79%. With regard to child self-perceptions, findings from the present analyses that close to three-quarters of overweight Chinese children view themselves as normal or underweight is higher than that seen in the past research in China and in the US, where underestimation rates ranged from 20% to 33%.^[27,28,31,33] One difference between past research and the present study is that this study used measured height/weight, and many prior studies used self-reported heights/weights.

To our knowledge, few studies have compared maternal perceptions and child self-assessments of weight status. In contrast to one US study that found parents to have more accurate perceptions,^[30] our findings suggest that Chinese mothers and children are equally likely to hold inaccurate views regarding children's weight status. This is perhaps not surprising, since parental attitudes and beliefs are often communicated to and adopted by their children. The

finding among overweight children that two-thirds of them and of their mothers are not cognizant of weight as an issue suggests a lower likelihood that a supportive environment for healthful eating or regular exercise will be stressed within these households. Further research is needed, however, to understand the extent to which perceived child weight status is associated with health-related behaviors and routines within families.

Although reasons surrounding misclassification of overweight status among Chinese children are not well-understood, two factors were identified as important in the present multivariate analyses of maternal perceptions. First, mothers with lower BMIs were more likely to underestimate their children's overweight status than mothers with higher BMIs. This suggests that mothers who are overweight themselves may have a better understanding of what the term "overweight" means from personal experience and through education and counseling by health care providers. The second significant finding was that the higher the child's BMI-for-age z-score, the greater the odds that their mothers would underestimate their overweight status. It may reflect reluctance among mothers of more severely overweight children to recognize or admit to themselves that their child has a weight problem, which deserves additional research. Once other factors were taken into consideration, child age, maternal education, and rurality of residence did not significantly affect the odds of weight status misclassification for mothers or children.

In considering the implications of the present study, several limitations should be borne in mind. Because the number of overweight children included in the analyses is relatively small, additional research with larger samples is needed to gain a more complete understanding of the effects of children's age, maternal education, and rurality of residence in perceiving child overweight status in China. Because this survey was not weighted, researchers should cautiously make inferences about the whole Chinese population. It would also be desirable to identify datasets for analysis that include additional relevant characteristics such as family poverty status and characteristics of the social and residential environment.

The present findings have implications for interventions to reduce the prevalence of overweight among children, in China as well as elsewhere. Parental education and involvement have been found to be critical in successful programs to change children's dietary and physical activity behaviors in America,^[18,43] and public education campaigns to foster such involvement among families in other countries could yield considerable benefits for their children. Additionally, programs like school-based BMI reporting may be beneficial. These programs, which have become

increasingly common in the US,^[44] are designed to provide accurate information about child weight status to parents. Once the parents are aware that their child's weight is in the overweight or obese range, it may motivate them to consult their health care provider and take ameliorative action.

Our findings also have important implications for pediatricians and family physicians, especially those working in China. Providers need to find effective ways to help parents and children to recognize overweight status when it is present, which may be a particular issue for families in which mothers are not themselves overweight. It is also important for providers to educate families and children about the importance for long-term health of attaining and maintaining body weight in the normal range. Childhood obesity treatment continues to be a challenge among health care providers,^[45] and encouraging accurate weight perceptions among parents and children is likely to be a critical step toward successful management of pediatric obesity.^[46]

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Contributors: Yao N proposed the study and wrote the first draft. Yao N analyzed the data. Both authors contributed to the design and interpretation of the study and to further drafts.

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