

# Parental perception of child weight and its association with weight-related parenting behaviours and child behaviours: a Chinese national study

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## Abstract

**Objective:** Parents commonly fail to correctly recognize the weight status of their child. Whether parental perception of child weight is associated with weight-related parenting behaviours and child behaviours is unclear. The present study aimed to investigate the distribution of parental perception of child weight and its associations with weight-related parenting behaviours and child behaviours in China.

**Design:** Cross-sectional study.

**Setting:** Seven provinces in China.

**Subjects:** A total of 47 417 children aged 6–17 years and their parents were included from a national survey in 2013. Parental perception of child weight, weight-related parenting behaviours and child behaviours were self-reported. Child's weight and height were objectively measured.

**Results:** A total of 30.5% of parents underestimated and 8.7% overestimated the child's weight. Parental underestimation was more common among younger children, boys and children with a lower BMI Z-score. Parents who perceived that their child had a healthy weight (accurately or inaccurately) were more likely to prepare breakfast for the child, exercise with him/her, set apart his/her exercise time, restrict his/her screen time, and were less likely to store soft drinks for the child. Children perceived to have a healthy weight, regardless of their actual weight status, behaved healthier on dietary intake, physical activity and homework time.

**Conclusions:** Parental underestimation of their child's weight was prominent in China, especially among younger children, boys and children with a lower BMI Z-score. Parental recognition of their child being overweight did not appear to translate into healthy changes in weight-related parenting behaviours or child behaviours.

**Keywords**  
Childhood obesity  
Parental perception  
Parenting behaviour  
Dietary intake  
Physical activity

Childhood obesity remains a global public health issue<sup>(1)</sup>. A target of obesity interventions is the promotion of healthy lifestyle changes, including diet, physical activity and sedentary behaviour of children. Given that parents are influential in modelling eating behaviours<sup>(2)</sup> and physical activity for their children, parents' active participation is important in effective childhood obesity interventions. The perception that their child is overweight or obese should be an important step for parents to act in their child's weight-management programme<sup>(3)</sup>. However, previous studies have affirmed that large proportions of

parents fail to recognize that their child is overweight or obese<sup>(4–7)</sup>. For instance, a meta-analysis showed that half of parents underestimated the overweight/obese status of their child<sup>(7)</sup>. The correlates of parental misperception of child weight include child's age<sup>(6–8)</sup>, gender<sup>(7–10)</sup>, ethnicity<sup>(11)</sup>, BMI<sup>(7,10,12)</sup>, parental education level<sup>(12)</sup>, parental weight status<sup>(7–9)</sup> and socio-economic status<sup>(11)</sup>, which indicates that the extent of this misperception varies in different populations.

Given that parental underestimation of their child's weight is prevalent, it is important to determine whether this underestimation affects weight-related parenting behaviours and child behaviours, thus influencing the

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child's weight status. However, a few studies have found controversial results on the association of parental perception with parenting behaviours or child behaviours<sup>(12–14)</sup>. A study of 482 overweight pre-school children and their mothers in Kuwait found that the mothers' accurate perception of their child's weight was associated with their plans to control the weight of their pre-school child<sup>(13)</sup>. Another study in the UK targeting 361 children aged 6–8 years and their parents reported that the children whose weight status was misperceived by their parents tended to get a lower score on a 'healthy' dietary pattern than those who were correctly perceived<sup>(14)</sup>. However, a study consisting of 783 overweight and obese 5-year-old children and their parents in the Netherlands demonstrated that parental misperception of the weight of their child was not associated with their intention to improve weight-related behaviours of their child or with the child meeting the guidelines for these behaviours<sup>(12)</sup>. Considering the crucial role of parents in family-based obesity interventions<sup>(15)</sup>, the unclear relationship between parental perception and weight-related parenting behaviours or child behaviours should be explored.

Only a few studies with a small sample size<sup>(16–18)</sup> have reported Chinese parents' perception of their child's weight, which may be distinct from those in Western countries due to different ethnicities, socio-economic status and cultural contexts. A survey of children aged 6–18 years showed that 72% of mothers underestimated the overweight status of their child<sup>(17)</sup>. Furthermore, only one study examining the relationship between parental perceptions and parenting behaviours in adolescents suggested that parents with correct perception were more likely to monitor the diet and physical activity of their child and gave more positive reinforcement for manifesting healthy behaviours than those who were wrong perceivers<sup>(18)</sup>. The related situation in Chinese primary-school children is still unknown, the parents of whom might play even more important roles in modelling the child's behaviours in the family. Using a national large sample, our study aimed to investigate parental perception of their child's weight and its demographic correlates, and to examine the associations between parental perception and weight-related parenting behaviours and child behaviours among Chinese children.

## Methods

### *Study design and participants*

The present study was a baseline survey of a multicentre school-based obesity intervention programme among Chinese children (trial registration number: NCT02343588)<sup>(19,20)</sup> conducted between September and November 2013. The protocol of the study was reviewed and approved by the Ethics Committee of Peking University. All participating children and their parents signed informed consent forms.

Multistage random cluster sampling was applied in the recruitment. First, seven provinces in China (i.e. Liaoning, Tianjin, Ningxia, Shanghai, Chongqing, Hunan and Guangdong) were selected using the judgement sampling method. Second, schools were stratified by district and school size and then twelve to seventeen primary and secondary schools were randomly selected through the probability-proportional-to-size sampling method in each of the selected provinces. With the agreement of the principals, all students in grades 1–5, 7–8 and 10–11 were invited to participate (students in grades 6, 9 and 12 were not contacted due to study load). In total, 65 347 students from fifty primary schools and forty-five secondary schools and their parents participated in the study. We excluded students with age <6 years ( $n$  193) or  $\geq 18$  years ( $n$  346), those who lacked data about BMI ( $n$  2291) or parental perception of child weight ( $n$  10 696), and those whose parent questionnaire was not filled out by the parents ( $n$  4404). Finally, 47 417 students and their parents were included in the sample for analyses. No significant difference was observed in child age or gender between those in the analytic sample and those who were excluded.

### *Measurements*

Standardized questionnaires were used to measure sociodemographic characteristics, perception of weight status from parents and child, weight-related parenting behaviours and child weight-related behaviours. All questionnaires were delivered in class by trained investigators and were filled out by both parents and children. The questionnaires had been piloted and revised before the study, being found to be sufficiently reliable and acceptable to the children and their parents<sup>(20)</sup>.

### *Sociodemographic characteristics*

Child birth date, gender, parental education level, current height (in centimetres), current weight (in kilograms) and monthly family income were evaluated in the questionnaires. BMI was calculated as weight (in kilograms) divided by the square of height (in metres). Parental underweight, overweight and obesity were defined using the Chinese criteria for adults<sup>(21)</sup> as BMI <18.5 kg/m<sup>2</sup>, BMI  $\geq 24$  but <28 kg/m<sup>2</sup> and BMI  $\geq 28$  kg/m<sup>2</sup>, respectively.

### *Perception of weight status from parent and child*

Parental perception of child weight was assessed by asking: 'How do you feel about current weight status of your child?' ('thin', 'about the right weight' or 'fat'). The responses were explained as perceived underweight ('thin'), healthy weight ('about the right weight') and overweight ('fat'). Child self-perception of weight status was assessed by asking: 'How do you feel about your current weight status?' ('very thin', 'rather thin', 'average', 'rather fat' or 'very fat'). The responses were explained as perceived underweight ('very thin' or 'rather thin'),

healthy weight ('average') and overweight ('very fat' or 'rather fat'). Parental and child perceptions were compared with the child's actual weight status to define underestimation, accurate estimation and overestimation of child weight.

#### *Weight-related parenting behaviours*

Parents responded to the following questions: (i) 'Did you prepare breakfast for your child in the past week?'; (ii) 'Did you store soft drinks (e.g. cola and juice) at home in the past week?'; (iii) 'Did you buy soft drinks for your child in the past week?'; (iv) 'Did you restrict exercise time of your child such that he/she had more time for homework or other important things in the past week?'; (v) 'Did you set apart exercise time for your child in the past week?'; and (vi) 'Did you restrict screen time of your child in the past week?' The response options were 'never', 'seldom', 'sometimes', 'often' and 'always' for questions (i) to (v), and 'yes' or 'no' for question (vi). Parents also reported daily time of exercise with their child over the past week.

#### *Child's weight-related behaviours*

Dietary intake, screen time, homework time and physical activity in the past seven consecutive days were evaluated using the questionnaires. The children reported the frequency (days) and amount (servings) of fruits, vegetables, meat products and soft drinks; and frequency (days or times) of breakfast, high-energy snack (e.g. chocolates and candies), fried food (e.g. fried chicken and fried pancake) and Western fast food (e.g. KFC and McDonald's) consumption. The mean daily intakes of fruits, vegetables, meat products and soft drinks were calculated by the formula: mean daily intake = [days × (amount in each of those days)]/7. Screen time was assessed by summarizing the daily time of viewing television and using computers. Homework time was assessed by asking daily time of doing work after school. Moderate-to-vigorous physical activity (MVPA) was measured by summarizing the daily time of vigorous (e.g. running and basketball) and moderate (e.g. cycling and badminton) physical activities.

#### *Child's actual weight status*

The children's height (in centimetres) and weight (in kilograms) were measured by trained technicians in a standardized procedure. Height was measured using a portable stadiometer (Yilian TZG, China), whereas weight was measured using a lever scale (Hengxing RGT-140, China). BMI was calculated and the age- and gender-specific cut-offs of BMI for malnutrition<sup>(22)</sup> and overweight (including obesity)<sup>(23)</sup> of Chinese children were used for the classification of weight status. Given that the Chinese criteria for overweight<sup>(23)</sup> do not include cut-offs for children aged 6 years, we used the WHO standards<sup>(24)</sup> to define overweight for this population. BMI Z-score of the children was calculated using the WHO standards<sup>(25)</sup>.

#### **Statistical analysis**

All statistical analyses were performed using the statistical software package IBM SPSS Statistics version 19.0. The continuous and categorical variables were presented as mean and standard deviation, and as number and percentage, respectively. Differences in demographic variables between boys and girls were evaluated via Pearson  $\chi^2$  tests. Correlates of parental underestimation of child weight (*v.* accurate perception) were assessed through binary logistic regression analysis, adjusting for child's age, gender, BMI Z-score, area, parental education level, monthly family income, parental weight status, region and school. For children of healthy weight, those who were overestimated by parents were excluded in the regression analyses. Binary logistic regression analyses were performed to evaluate the associations of parental perception of child weight with weight-related parenting behaviours and child behaviours, adjusting for child's age, gender, region and school. A two-tailed  $P < 0.05$  was considered statistically significant in all analyses.

#### **Results**

The present study included 47 417 children aged 6–17 years (49.4% girls) and their parents. Table 1 presents the characteristics of the participants. The prevalence of underweight and overweight (including obesity) was 6.6 and 24.7%, respectively. Overall, 30.5% of the parents underestimated and 8.7% overestimated the weight status of their child. Parental underestimation was prevalent among healthy-weight (29.1%) and overweight children (42.9%). The weight of the boys was more likely to be underestimated than that of the girls (35.8 *v.* 25.1%,  $P < 0.001$ ). Only 68.4% of the children had concordant perceptions with their parents, and 46.2% of both children and parents had accurate assessment of the child's weight. The parents provided slightly more accurate assessment than the children themselves (60.8 *v.* 59.8%,  $P < 0.001$ ; Table 2). The proportion of parental underestimation decreased and the proportion of accurate estimation increased for children in the higher age group ( $P_{\text{trend}} < 0.001$ ; see online supplementary material, Supplemental Fig. 1). When using the WHO standards for underweight and overweight<sup>(24)</sup> in all children, the prevalence of underweight and overweight (including obesity) was 2.9 and 26.9%, respectively, and 34.8% of the parents underestimated and 7.4% overestimated the weight of their child (Supplemental Table 1).

For both healthy-weight and overweight children respectively, older age (adjusted OR (AOR) = 0.90, 95% CI 0.88, 0.92 and AOR = 0.76, 95% CI 0.74, 0.79), girls (*v.* boys, AOR = 0.40, 95% CI 0.38, 0.42 and AOR = 0.38, 95% CI 0.34, 0.41) and higher BMI Z-score (AOR = 0.19, 95% CI 0.18, 0.20 and AOR = 0.18, 95% CI 0.16, 0.20) were negatively associated with parental underestimation of

**Table 1** Sociodemographic characteristics of the study population of children aged 6–17 years and their parents (*n* 47 417) from seven provinces in China, September–November 2013

Characteristic	Total		Boys (50.7%)		Girls (49.3%)		<i>P</i> †
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Age (years)							<0.001
6.0–8.9	15 451	32.6	8037	33.5	7414	31.6	
9.0–11.9	12 096	25.5	6441	26.9	5655	24.1	
12.0–14.9	11 423	24.1	5665	23.6	5758	24.6	
15.0–17.9	8447	17.8	3828	16.0	4619	19.7	
Area							0.688
Urban	29 225	61.6	14 753	61.5	14 472	61.7	
Rural	18 192	38.4	9218	38.5	8974	38.3	
Paternal education level							0.092
Junior high school or below	19 556	42.2	9992	42.6	9564	41.7	
Senior high school or junior college	19 916	42.9	10 023	42.7	9893	43.1	
College or above	6909	14.9	3433	14.6	3476	15.2	
Maternal education level							0.033
Junior high school or below	21 319	46.0	10 910	46.6	10 409	45.4	
Senior high school or junior college	19 368	41.8	9676	41.3	9692	42.3	
College or above	5656	12.2	2826	12.1	2830	12.3	
Monthly family income							0.030
<5000 RMB	12 824	31.2	6238	30.6	6586	31.9	
5000–8000 RMB	7790	19.0	3916	19.2	3874	18.8	
≥8000 RMB	8607	21.0	4313	21.1	4294	20.8	
Refuse to disclose	11 816	28.8	5942	29.1	5874	28.5	
Paternal weight status							0.139
Underweight	997	2.2	479	2.1	518	2.3	
Healthy weight	21 734	48.4	10 941	48.1	10 793	48.7	
Overweight	17 058	38.0	8667	38.1	8391	37.8	
Obese	5121	11.4	2642	11.6	2479	11.2	
Maternal weight status							0.003
Underweight	3223	7.2	1707	7.5	1516	6.8	
Healthy weight	31 528	70.0	15 951	70.2	15 577	69.9	
Overweight	8568	19.0	4261	18.7	4307	19.3	
Obese	1692	3.8	814	3.6	878	3.9	

†Differences in characteristic variables between boys and girls were evaluated using Pearson  $\chi^2$  tests; *P* < 0.05 indicates significance.

**Table 2** Parental perception of their child's weight by the child's self-perception and measured weight status; children aged 6–17 years and their parents (*n* 47 417) from seven provinces in China, September–November 2013

Parental perception	Child's self-perception of weight							
	Underweight		Healthy weight		Overweight		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Measured underweight ( <i>n</i> 3144)								
Underweight	2048	67.9	186	6.2	18	0.6	2326	74.0
Healthy weight	369	12.2	188	6.2	12	0.4	606	19.3
Overweight	158	5.2	22	0.7	17	0.6	212	6.7
Measured healthy weight ( <i>n</i> 32 564)								
Underweight	6470	20.7	2280	7.3	311	1.0	9462	29.1
Healthy weight	3383	10.8	13 203	42.3	2510	8.0	19 795	60.8
Overweight	727	2.3	1206	3.9	1150	3.7	3307	10.2
Measured overweight ( <i>n</i> 11 709)								
Underweight	71	0.6	147	1.3	303	2.7	561	4.8
Healthy weight	142	1.3	2208	19.7	1911	17.0	4461	38.1
Overweight	73	0.7	631	5.6	5743	51.1	6687	57.1
Overall ( <i>n</i> 47 417)								
Underweight	8589	18.9	2613	5.7	632	1.4	12 349	26.0
Healthy weight	3894	8.6	15 599	34.3	4433	9.7	24 862	52.4
Overweight	958	2.1	1859	4.1	6910	15.2	10 206	21.5

their child's weight. Furthermore, healthy-weight children were more likely to be underestimated if their respective mothers were underweight (AOR = 1.15, 95% CI 1.03, 1.27; Table 3).

Table 4 shows the associations between parental perception of child weight and weight-related parenting behaviours. In total, a large majority of the parents reported that they prepared breakfast for their child

**Table 3** Correlates of parental underestimation of their child's weight (v. accurate estimation); children aged 6–17 years and their parents (n 47 417) from seven provinces in China, September–November 2013

	Healthy-weight children (n 29 257)†				Overweight children (n 11 709)			
	Crude model		Adjusted model‡		Crude model		Adjusted model‡	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age (years)	0.92**	0.91, 0.92	0.90**	0.88, 0.92	0.93**	0.91, 0.94	0.76	0.74, 0.79
Gender								
Boys	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Girls	0.58**	0.55, 0.60	0.40**	0.38, 0.42	0.80**	0.74, 0.86	0.38**	0.34, 0.41
Child BMI Z-score	0.25**	0.24, 0.26	0.19**	0.18, 0.20	0.35**	0.32, 0.37	0.18**	0.16, 0.20
Area								
Urban	1.03	0.98, 1.09	0.81	0.58, 1.13	1.05	0.98, 1.13	1.02	0.47, 2.20
Rural	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Paternal education level								
Junior high or below	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Senior high or junior college	1.08**	1.02, 1.13	1.07	0.99, 1.16	0.95	0.87, 1.03	1.01	0.89, 1.14
College or above	1.08*	1.01, 1.17	1.10	0.98, 1.25	1.05	0.94, 1.17	1.02	0.85, 1.22
Maternal education level								
Junior high or below	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Senior high or junior college	1.03	0.98, 1.09	0.96	0.89, 1.04	1.02	0.95, 1.11	1.06	0.94, 1.20
College or above	1.01	0.93, 1.09	0.92	0.81, 1.04	1.17*	1.04, 1.31	1.11	0.92, 1.35
Monthly family income								
<5000 RMB	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
5000–8000 RMB	1.06	0.99, 1.15	0.97	0.89, 1.07	0.80**	0.72, 0.90	0.92	0.80, 1.06
≥8000 RMB	1.13**	1.05, 1.22	0.99	0.90, 1.09	0.71**	0.64, 0.79	0.96	0.83, 1.12
Refuse to answer	1.05	0.98, 1.13	0.98	0.90, 1.06	0.79**	0.72, 0.88	0.99	0.87, 1.12
Paternal weight status								
Underweight	1.15	0.98, 1.36	1.05	0.87, 1.26	0.92	0.66, 1.27	1.02	0.69, 1.52
Healthy weight	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Overweight	0.86**	0.81, 0.91	1.05	0.98, 1.12	0.85**	0.78, 0.92	0.91	0.82, 1.01
Obese	0.66**	0.60, 0.73	0.90	0.81, 1.01	0.77**	0.69, 0.86	0.88	0.77, 1.00
Maternal weight status								
Underweight	1.53**	1.40, 1.68	1.15*	1.03, 1.27	1.14	0.94, 1.37	0.95	0.76, 1.20
Healthy weight	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Overweight	0.75**	0.70, 0.81	1.02	0.94, 1.10	0.90*	0.83, 0.99	1.03	0.93, 1.15
Obese	0.74**	0.63, 0.87	1.10	0.92, 1.32	0.74**	0.63, 0.87	0.99	0.81, 1.21

Ref., referent category.

OR and 95% CI were derived from binary logistic regression analysis.

\**P* < 0.05, \*\**P* < 0.01.

†Healthy-weight children who were overestimated by parents are excluded from the analysis (n 3684, 10.3% of healthy-weight children).

‡Adjusted for each other, region and school.

(90.0%) and restricted their screen time (92.4%). Over half of the parents bought soft drinks for their child (55.9%) and nearly one-third stored soft drinks at home (31.1%). Of the parents, 56.3% never or seldom restricted exercise time of their child. A substantial proportion of the parents set apart exercise time for their child (81.1%) and 57.1% of parents exercised with their child over the past week. Parental perception that their child was of healthy weight, regardless of the actual weight status, was positively associated with exercising with the child and setting apart the child's exercise time. For underweight children, parental overestimation was negatively associated with buying soft drinks for the child. For healthy-weight children, accurate parental perception was positively associated with parents preparing breakfast for the child and restricting their screen time and negatively associated with storing soft drinks at home. For overweight children, parental underestimation was positively associated with parents preparing breakfast for them.

The majority of the children consumed ≤1 serving meat products/d (73.1%), had breakfast every day (84.8%), and spent ≤2 h/d on screen time (77.2%) and ≤2 h/d on homework time (66.8%). But only a minority of children consumed ≥2 servings fruits/d (25.6%), ≥3 servings vegetables/d (19.6%) or accomplished ≥1 h MVPA/d (31.2%). A substantial proportion of children consumed soft drinks (33.9%), high-energy snacks (25.5%), fried food (43.0%) and Western fast foods (51.9%). Parental accurate estimation of healthy-weight children was positively associated with the child consuming ≥2 servings fruits/d and ≤1 serving meat products/d, having breakfast every day, avoiding fried food, accomplishing ≥1 h MVPA/d and spending ≤2 h/d on screen time and ≤2 h/d on homework time. In addition, parental underestimation of overweight children was positively associated with the child consuming ≤1 serving meat products/d, avoiding soft drinks and spending ≤2 h/d on screen time, but negatively associated with avoiding Western fast foods (Table 5).

**Table 4** Associations between parental perception of their child's weight and weight-related parenting behaviours; children aged 6–17 years and their parents (*n* 47 417) from seven provinces in China, September–November 2013

Behaviour items	Parental perception											
	Total		Underestimate		Accurate		Overestimate		Underestimate		Overestimate	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	OR	95% CI	OR	95% CI
<b>Underweight children (<i>n</i> 3144)</b>												
Prepares breakfast for child (always, often or sometimes)	2861	91.6	–	–	2116	91.5	745	91.6	–	–	1.08	0.77, 1.53
Stores soft drink at home (never or seldom)	2167	69.2	–	–	1610	69.5	557	68.4	–	–	1.10	0.90, 1.36
Buys soft drinks for child (never or seldom)	1342	42.9	–	–	983	42.5	359	44.2	–	–	1.25*	1.03, 1.52
Exercises with child (>0 h/d)	1671	56.3*	–	–	1219	55.1	452	59.9	–	–	1.43**	1.16, 1.77
Restricts child's exercise time (never or seldom)	1708	54.7	–	–	1270	54.9	438	53.9	–	–	1.07	0.88, 1.30
Sets apart child's exercise time (always, often or sometimes)	2510	80.6**	–	–	1827	79.1	683	84.8	–	–	1.49**	1.15, 1.94
Restricts child's screen time (yes)	2854	91.7	–	–	2101	91.2	753	92.8	–	–	1.18	0.82, 1.70
<b>Healthy-weight children (<i>n</i> 32 564)</b>												
Prepares breakfast for child (always, often or sometimes)	29 119	90.0**	8467	90.0	17 772	90.4	2880	87.5	0.95	0.87, 1.03	0.79**	0.70, 0.89
Stores soft drinks at home (never or seldom)	22 355	69.0*	6476	68.8	13 663	69.4	2216	67.3	0.95	0.90, 1.00	0.90**	0.83, 0.97
Buys soft drinks for child (never or seldom)	14 174	43.7	4128	43.8	8623	43.8	1423	43.2	0.96	0.91, 1.01	1.02	0.94, 1.10
Exercises with child (>0 h/d)	17 298	56.1**	5002	55.8	10 697	57.2	1599	50.6	0.80**	0.75, 0.84	0.90*	0.83, 0.98
Restricts child's exercise time (never or seldom)	18 235	56.3*	5194	55.3	11 211	57.0	1830	55.7	0.99	0.94, 1.04	0.98	0.91, 1.06
Sets apart child's exercise time (always, often or sometimes)	26 211	81.1**	7536	80.3	16 102	82.0	2573	78.3	0.82**	0.77, 0.88	0.83**	0.75, 0.91
Restricts child's screen time (yes)	29 813	92.3**	8753	93.2	18 086	92.1	2974	90.7	0.96	0.87, 1.06	0.85*	0.74, 0.97
<b>Overweight children (<i>n</i> 11 709)</b>												
Prepares breakfast for child (always, often or sometimes)	10 429	89.7**	4566	91.5	5863	88.3	–	–	1.34**	1.17, 1.54	–	–
Stores soft drinks at home (never or seldom)	7972	68.4	3460	69.3	4512	67.7	–	–	1.01	0.93, 1.10	–	–
Buys soft drinks for child (never or seldom)	5287	45.4*	2324	46.5	2963	44.5	–	–	1.02	0.94, 1.11	–	–
Exercises with child (>0 h/d)	6697	59.9**	3002	63.0	3695	57.6	–	–	1.19**	1.09, 1.30	–	–
Restricts child's exercise time (never or seldom)	6570	56.4**	2738	54.9	3832	57.6	–	–	0.96	0.89, 1.04	–	–
Sets apart child's exercise time (always, often or sometimes)	9420	81.1**	4148	83.2	5272	79.6	–	–	1.30**	1.17, 1.44	–	–
Restricts child's screen time (yes)	10 809	93.0	4654	93.4	6155	92.7	–	–	0.94	0.80, 1.11	–	–

Differences in behaviour items between parental perception groups were evaluated using Pearson  $\chi^2$  tests.

OR and 95% CI were derived from binary logistic regression analysis, in which the dependent variable is the single behaviour item. Both underestimation and overestimation groups are compared with the accurate estimation group, while adjusting for age, gender, region and school.

\* $P < 0.05$ , \*\* $P < 0.01$ .

## Discussion

The current national study indicated that nearly 40% of school-aged children and adolescents had their weight status misperceived by their parents, among which underestimation was much more prominent than overestimation. Higher probabilities of parental underestimation were found for younger children, boys and children with a lower BMI Z-score. The parents who perceived their child as having a healthy weight, whether accurately or not, tended to behave better on certain weight-related parenting behaviours. Moreover, the children who were perceived as having a healthy weight were more likely to behave healthily on certain weight-related behaviours.

Only 60.8% of Chinese parents accurately perceived their child's weight, which was lower than the percentage in a representative sample of US children (74%)<sup>(5)</sup>, indicating that Chinese parents should improve in identifying the weight of their child. Specifically, approximately 43% of the parents failed to recognize the overweight status of their child, although this value is lower than the estimated percentages from two meta-analyses (51 and 62%, respectively)<sup>(6,7)</sup> and previous studies of Chinese children (89 and 72%, respectively)<sup>(16,17)</sup>. A traditional belief exists in China that being fat reflects affluence, which may have led Chinese mothers to consider that being overweight is not a big health issue<sup>(16)</sup>. Furthermore, the epidemic of overweight in Chinese children may have 'normalized' this health condition and contributed to parents' inability to

**Table 5** Associations between parental perception of their child's weight and the child's weight-related behaviours; children aged 6–17 years and their parents (n 47 417) from seven provinces in China, September–November 2013

Behaviour item	Parental perception											
	Total		Underestimate		Accurate		Overestimate		Underestimate		Overestimate	
	n	%	n	%	n	%	n	%	OR	95% CI	OR	95% CI
<b>Underweight children (n 3144)</b>												
Fruits (≥2 servings†/d)	724	24.2*	–	–	512	23.1	212	27.6	–	–	1.05	0.84, 1.32
Vegetables (≥3 servings†/d)	590	19.7	–	–	432	19.4	158	20.7	–	–	1.05	0.82, 1.34
Meat products (≤1 serving†/d)	2094	70.3**	–	–	1517	68.5	577	75.5	–	–	1.03	0.82, 1.30
Breakfast (= 7 d/week)	2572	84.8**	–	–	1947	86.3	625	80.6	–	–	0.91	0.69, 1.19
Soft drinks (= 0 cup/week)	1067	36.3	–	–	806	36.7	261	35.1	–	–	1.04	0.84, 1.29
High-energy snacks (= 0 d/week)	740	24.6	–	–	550	24.5	190	24.9	–	–	1.13	0.90, 1.43
Fried food (= 0 time/week)	1351	45.3**	–	–	1039	46.8	312	41.1	–	–	0.94	0.77, 1.15
Western fast foods (= 0 time/week)	1552	52.1**	–	–	1122	50.5	430	56.8	–	–	1.04	0.85, 1.27
MVPA (≥1 h/d)	816	29.6	–	–	592	28.7	224	32.4	–	–	1.10	0.87, 1.38
Screen time (≤2 h/d)	2102	78.1**	–	–	1599	79.3	503	74.4	–	–	0.89	0.68, 1.17
Homework time (≤2 h/d)	1963	66.5**	–	–	1429	65.0	534	70.8	–	–	1.10	0.86, 1.39
<b>Healthy-weight children (n 32 564)</b>												
Fruit (≥2 servings/d)	7820	25.2**	2102	23.4	4922	25.9	796	25.9	0.89**	0.84, 0.95	0.91	0.83, 1.00
Vegetable (≥3 servings/d)	5984	19.3**	1641	18.2	3678	19.4	665	21.5	0.97	0.90, 1.03	1.01	0.92, 1.12
Meat products (≤1 servings/d)	22 676	73.2**	6421	71.5	13 914	73.5	2341	76.3	0.94*	0.88, 1.00	0.98	0.89, 1.08
Breakfast (= 7 d/week)	26 552	84.6**	7859	86.3	16 259	84.7	2434	78.4	0.96	0.89, 1.04	0.83**	0.75, 0.92
Soft drinks (= 0 cup/week)	10 385	34.1	2992	33.9	6424	34.4	969	32.5	0.95	0.90, 1.00	0.93	0.85, 1.01
High-energy snacks (= 0 d/week)	7785	25.0*	2316	25.6	4754	24.9	715	23.3	1.00	0.94, 1.06	0.93	0.84, 1.02
Fried food (= 0 time/week)	13 391	43.1**	3967	44.0	8261	43.5	1163	37.8	0.96	0.91, 1.01	0.89**	0.82, 0.97
Western fast foods (= 0 time/week)	16 041	51.7**	4564	50.7	9799	51.7	1678	54.8	0.96	0.91, 1.01	0.95	0.87, 1.03
MVPA (≥1 h/d)	8809	30.8*	2441	29.5	5503	31.4	865	31.0	0.89**	0.84, 0.95	0.96	0.88, 1.06
Screen time (≤2 h/d)	21 471	77.1**	6167	77.0	13 382	77.9	1922	72.2	0.95	0.89, 1.02	0.85**	0.77, 0.94
Homework time (≤2 h/d)	20 321	66.6**	6151	69.8	12 302	65.8	1868	61.9	1.00	0.94, 1.06	0.87**	0.79, 0.96
<b>Overweight children (n 11 709)</b>												
Fruits (≥2 servings/d)	3022	27.1*	1348	28.3	1674	26.2	–	–	1.06	0.97, 1.17	–	–
Vegetables (≥3 servings/d)	2297	20.6	981	20.6	1316	20.5	–	–	0.97	0.88, 1.08	–	–
Meat products (≤1 servings/d)	8171	73.5**	3596	76.0	4575	71.6	–	–	1.17**	1.06, 1.29	–	–
Breakfast (= 7 d/week)	9633	85.5	4128	86.1	5505	85.0	–	–	1.06	0.94, 1.20	–	–
Soft drinks (= 0 cup/week)	3588	32.8**	1648	35.4	1940	30.8	–	–	1.11*	1.01, 1.21	–	–
High-energy snacks (= 0 d/week)	3052	27.3	1282	27.0	1770	27.5	–	–	0.95	0.86, 1.04	–	–
Fried food (= 0 time/week)	4739	42.4	1983	41.7	2756	42.9	–	–	0.97	0.89, 1.06	–	–
Western fast foods (= 0 time/week)	5823	52.2	2448	51.7	3375	52.6	–	–	0.91*	0.84, 0.99	–	–
MVPA (≥1 h/d)	3390	32.8**	1379	31.5	2011	33.8	–	–	1.00	0.91, 1.10	–	–
Screen time (≤2 h/d)	7910	77.3**	3425	78.6	4485	76.4	–	–	1.18**	1.06, 1.31	–	–
Homework time (≤2 h/d)	7433	67.4**	3311	70.5	4122	65.1	–	–	1.06	0.96, 1.16	–	–

MVPA, moderate-to-vigorous physical activity. Differences in behaviour items between parental perception groups were evaluated using Pearson  $\chi^2$  tests. OR and 95% CI were derived from binary logistic regression analysis, in which the dependent variable is the single behaviour item. Both underestimation and overestimation groups are compared with the accurate estimation group, adjusting for age, gender, region and school. \* $P < 0.05$ , \*\* $P < 0.01$ . †A serving of fruit or vegetable is equivalent to 100 g, whereas a serving of meat product is equivalent to 75 g.

recognize that their child is overweight<sup>(16)</sup>. Parental unawareness of their child's overweight status draws attention since it may pose barriers for parents to take measures to address the problem. Moreover, parental underestimation may influence overweight children's self-assessment of their weight, as well as their desire to lose weight and improve their lifestyle<sup>(26)</sup>. In addition, a substantial proportion (29%) of parents underestimated the healthy-weight status of their child, which is much higher than the percentages in a meta-analysis (14%)<sup>(7)</sup> and a US study (10%)<sup>(5)</sup>. Parental underestimation of healthy-weight children also warrants attention, because this may lead parents to encourage their child to consume extra food to facilitate weight gain, thereby elevating the child's risk of future obesity<sup>(27)</sup>. We observed a similar distribution in weight perception between the children themselves and

their parents (approximately 68% of children received concordant perceptions), indicating that weight perception from parents and children were closely related, which was supported by previous studies<sup>(18,26)</sup>. Interventions targeting either parental or self-perception of child weight should take the potential interaction into account.

When assessing the correlates of parental underestimation, we found that parents were more likely to underestimate the weight status of younger children, which was supported by other studies<sup>(6–8)</sup>. A possible explanation is that weight increase in younger children indicates good nutrition and parents believe that their child could grow out of the excess weight condition. In a qualitative study, low-income mothers described overweight pre-school children as 'thick' or 'solid' and tended to not believe that the children were overweight so long as

they were physically active and had a good appetite<sup>(28)</sup>. Another study also demonstrated that parents tended to normalize their pre-school child's excess body weight as 'toddler pudge' or 'cute baby fat'<sup>(29)</sup>. Considering that overweight in early childhood can persist into later life<sup>(30)</sup>, early identification of overweight may present crucial opportunities for obesity prevention and intervention.

Furthermore, parents were more likely to underestimate the weight of boys than of girls, which was consistent with some<sup>(7,31)</sup> but not all literature<sup>(12)</sup>. Although this trend may be affected by gender difference in body composition<sup>(32)</sup>, it is more possible to be explained by differential social norms about the ideal body size for boys and girls. Healthy-weight girls tend to be perceived as having a healthy weight or even slightly overweight according to the social desire for slimness, whereas healthy-weight boys may be considered thin because the expectation for boys is that they should be big and strong<sup>(7)</sup>. Boys perceived as underweight may be encouraged to eat a substantial amount of food to gain a larger body size, placing them at a higher risk of being overweight.

Parents tend to be most influential in shaping the lifestyle of their child, especially their eating behaviours and determining what food is available for them. In our study, it was noticed that over half of the parents bought soft drinks for their child and that nearly one-third stored soft drinks at home. Given that the consumption of sugar-sweetened beverages has been proved to be positively associated with obesity<sup>(33)</sup>, Chinese parents should be educated about the harmfulness of soft drinks.

Although parents' awareness of their child's weight is suggested to be an important first step for the child's enrolment in an obesity management programme<sup>(3)</sup>, the relationship between parental perception of child weight and weight-related parenting behaviours was seldom discussed<sup>(12,13,18)</sup>. Contrary to popular belief, we found that parents who accurately recognized that their child was overweight were less likely to prepare breakfast for them, exercise with them and set apart exercise time for them. Similarly, parents who misperceived their healthy-weight child as being overweight were less likely to prepare breakfast for them, exercise with them, set apart exercise time for them and restrict their screen time, but were more likely to store soft drinks for them. These results imply that parental recognition that their child is overweight, accurate or not, may be an insufficient motivation to change parenting behaviours regarding their child's weight. Alternatively, those who accurately perceived their child's overweight status may have improved their weight-related parenting behaviours, but the changes were too slight to be detected. Jaballas *et al.* reported that 40% of parents who considered their child as overweight believed that overweight was a condition that would be outgrown<sup>(34)</sup>. Psychological factors such as belief and confidence may also mediate in the association between the perception and implementation of behaviours. Parents who perceive

their child as overweight may lack intention to improve their child's weight or do not believe that they can change it through effort. Another possible explanation is that an accurate identification of their child being overweight is not a prerequisite for parents to improve weight-related health behaviours, which may likely be universal to all parents (i.e. most parents want their child to be healthy)<sup>(12)</sup>. Thus, more research is warranted to clarify the associations between parental perception and weight-related parenting behaviours and to explore the potential barriers.

Regarding the child's weight-related behaviours, overweight children who were accurately recognized by parents tended to consume more meat products, soft drinks and spend more screen time than those who were underestimated by parents. In addition, children of healthy weight but wrongly considered overweight were more likely to skip breakfast, consume fried food, and spend more screen and homework time. A hypothesis is that children who are perceived by parents as overweight may have certain undesirable behavioural characteristics themselves, such as consuming more meat and fried food. A qualitative study by Jain *et al.* revealed that children were not believed to be overweight by their mother if they were active and had a healthy diet<sup>(28)</sup>. Furthermore, two longitudinal studies in Dutch and Australian children showed that parental identification of their child being overweight was not protective against further weight gain<sup>(35,36)</sup>. An important gap exists between parental recognition of their child's overweight/obesity and improvement in weight-related parenting behaviours or child behaviours. This implies that health education targeting parents to correctly identify their child's overweight or obesity alone is not sufficient to improve parenting behaviours and child behaviours. Therefore, future obesity intervention involving parents should motivate them on how to promote healthy behaviours of their children or directly engage children in healthy diet and exercise with the involvement of their parents. Although parents hold responsibility of lifestyle guidance for their child, the wider environment beyond the family can still weaken parental influences. Digital marketing techniques using social networking software and mobile phone apps give food and beverage industries access to children without parental oversight<sup>(37)</sup>.

From another point of view, parental underestimation of healthy-weight children was negatively associated with the children consuming more fruits and less meat products and taking more MVPA. This should be taken into consideration, since less fruit and more meat intake and shorter time of MVPA might lead to higher obesity risk. Yet, given the current cross-sectional design, additional research using longitudinal data is needed to provide better insight into the influence of parental perception of their child's weight on the child's weight-related behaviours over time.

The current study presents two strengths. First, we investigated parental perception of child's weight in a large national sample in Chinese children. Second, we examined parental perception of child's weight in relation to both weight-related parenting behaviours and child's behaviours, which has been investigated only in very limited studies. Since a considerable proportion of parents misperceived their child's actual weight, it makes sense to examine the relationship between parental misperception and parenting behaviours and child's behaviours that could impact child's weight. Nevertheless, limitations should be considered when interpreting the findings. First, the cross-sectional design determines that one should be very careful when examining the directionality of associations between parental misperception and weight-related parenting behaviours or child behaviours. Second, children's weight-related behaviours were measured with questionnaires, which might lead to information bias.

## Conclusion

Parental underestimation of child's weight was prominent among healthy-weight and overweight Chinese children. Higher probabilities of parental underestimation were found among younger children, boys and children with a lower BMI Z-score. Parents' correct recognition that their child was overweight did not appear to translate into healthier changes in weight-related parenting behaviours or the child's behaviours. Future obesity intervention involving parents should motivate them on how to promote their child's healthy behaviours or directly engage the child in healthy diet and exercise with parents' involvement.

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suggestions in the analysis and approved the final manuscript. All authors read and approved the submission of the final manuscript. *Ethics of human subject participation:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Ethics Committee of Peking University. Written informed consent was obtained from all subjects.

## Supplementary material

To view supplementary material for this article, please visit <https://doi.org/10.1017/S136898001800006X>

## References

1. Lobstein T, Jackson-Leach R, Moodie ML *et al.* (2015) Child and adolescent obesity: part of a bigger picture. *Lancet* **385**, 2510–2520.
2. Johannsen DL, Johannsen NM & Specker BL (2006) Influence of parents' eating behaviors and child feeding practices on children's weight status. *Obesity (Silver Spring)* **14**, 431–439.
3. Davidson K & Vidgen H (2017) Why do parents enrol in a childhood obesity management program?: a qualitative study with parents of overweight and obese children. *BMC Public Health* **17**, 159.
4. Regber S, Novak M, Eiben G *et al.* (2013) Parental perceptions of and concerns about child's body weight in eight European countries – the IDEFICS study. *Pediatr Obes* **8**, 118–129.
5. Chen HY, Lemon SC, Pagoto SL *et al.* (2014) Personal and parental weight misperception and self-reported attempted weight loss in US children and adolescents, National Health and Nutrition Examination Survey, 2007–2008 and 2009–2010. *Prev Chronic Dis* **11**, E132.
6. Rietmeijer-Mentink M, Paulis WD, van Middelkoop M *et al.* (2013) Difference between parental perception and actual weight status of children: a systematic review. *Matern Child Nutr* **9**, 3–22.
7. Lundahl A, Kidwell KM & Nelson TD (2014) Parental underestimates of child weight: a meta-analysis. *Pediatrics* **133**, e689–e703.
8. Hudson E, McGloin A & McConnon A (2012) Parental weight (mis)perceptions: factors influencing parents' ability to correctly categorise their child's weight status. *Matern Child Health J* **16**, 1801–1809.
9. Manios Y, Moschonis G, Karatzi K *et al.* (2015) Large proportions of overweight and obese children, as well as their parents, underestimate children's weight status across Europe. The ENERGY (European Energy balance Research to prevent excessive weight Gain among Youth) project. *Public Health Nutr* **18**, 2183–2190.
10. Aljunaibi A, Abdulle A & Nagelkerke N (2013) Parental weight perceptions: a cause for concern in the prevention and management of childhood obesity in the United Arab Emirates. *PLoS One* **8**, e59923.
11. de Hoog ML, Stronks K, van Eijsden M *et al.* (2012) Ethnic differences in maternal underestimation of offspring's weight: the ABCD study. *Int J Obes (Lond)* **36**, 53–60.
12. Remmers T, van Grieken A, Renders CM *et al.* (2014) Correlates of parental misperception of their child's weight status: the 'Be Active, Eat Right' study. *PLoS One* **9**, e88931.
13. Al-Qaoud NM, Al-Shami E & Prakash P (2010) Kuwaiti mothers' perception of their preschool children's weight status. *J Dev Behav Pediatr* **31**, 505–510.

14. Almoosawi S, Jones AR, Parkinson KN *et al.* (2016) Parental perception of weight status: influence on children's diet in the Gateshead millennium study. *PLoS One* **11**, e0144931.
15. Magarey AM, Perry RA, Baur LA *et al.* (2011) A parent-led family-focused treatment program for overweight children aged 5 to 9 years: the PEACH RCT. *Pediatrics* **127**, 214–222.
16. Chen S, Binns CW, Maycock B *et al.* (2014) Chinese mothers' perceptions of their child's weight and obesity status. *Asia Pac J Clin Nutr* **23**, 452–458.
17. Yao NL & Hillemeier MM (2012) Weight status in Chinese children: maternal perceptions and child self-assessments. *World J Pediatr* **8**, 129–135.
18. Wen X & Hui SS (2011) Chinese parents' perceptions of their children's weights and their relationship to parenting behaviours. *Child Care Health Dev* **37**, 343–351.
19. Institute of Child and Adolescent Health of Peking University (2012) The Health Information Platform of Primary and Secondary School Students of Plan 1147. <http://www.health1147.bjmu.edu.cn/> (accessed January 2017).
20. Chen Y, Ma L, Ma Y *et al.* (2015) A national school-based health lifestyles interventions among Chinese children and adolescents against obesity: rationale, design and methodology of a randomized controlled trial in China. *BMC Public Health* **15**, 210.
21. Chen C & Lu FC, Department of Disease Control, Ministry of Health, People's Republic of China (2004) The guidelines for prevention and control of overweight and obesity in Chinese adults. *Biomed Environ Sci* **17**, Suppl., 1–36.
22. National Health and Family Planning Commission of the People's Republic of China (2014) Screening Standard for Malnutrition of School-age Children and Adolescents. <http://www.moh.gov.cn/zw/gkzt/pqt/201407/38b15c0a1ed444e8908e12752decaffa.shtml> (accessed January 2017).
23. Group of China Obesity Task Force (2004) Body mass index reference norm for screening overweight and obesity in Chinese children and adolescents. *Zhonghua Liu Xing Bing Xue Za Zhi* **25**, 97–102.
24. World Health Organization (2007) *Growth Reference 5–19 Years*. Geneva: WHO; available at [http://www.who.int/growthref/who2007\\_bmi\\_for\\_age/en/](http://www.who.int/growthref/who2007_bmi_for_age/en/)
25. de Onis M, Onyango AW, Borghi E *et al.* (2007) Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* **85**, 660–667.
26. Huang JS, Donohue M, Becerra K *et al.* (2009) Relationship between parents' and children's weight perceptions results of a survey. *Infant Child Adolesc Nutr* **1**, 15–20.
27. Tschamler JM, Conn KM, Cook SR *et al.* (2010) Underestimation of children's weight status: views of parents in an urban community. *Clin Pediatr (Phila)* **49**, 470–476.
28. Jain A, Sherman SN, Chamberlin LA *et al.* (2001) Why don't low-income mothers worry about their preschoolers being overweight? *Pediatrics* **107**, 1138–1146.
29. Eli K, Howell K, Fisher PA *et al.* (2014) 'A little on the heavy side': a qualitative analysis of parents' and grandparents' perceptions of preschoolers' body weights. *BMJ Open* **4**, e006609.
30. Singh AS, Mulder C, Twisk JWR *et al.* (2008) Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev* **9**, 474–488.
31. Li J, Lei J, Wen S *et al.* (2014) Sex disparity and perception of obesity/overweight by parents and grandparents. *Paediatr Child Health* **19**, e113–e116.
32. Karlsson AK, Kullberg J, Stokland E *et al.* (2013) Measurements of total and regional body composition in preschool children: a comparison of MRI, DXA, and anthropometric data. *Obesity (Silver Spring)* **21**, 1018–1024.
33. Malik VS, Popkin BM, Bray GA *et al.* (2010) Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation* **121**, 1356–1364.
34. Jaballas E, Clark-Ott D, Clasen C *et al.* (2011) Parents' perceptions of their children's weight, eating habits, and physical activities at home and at school. *J Pediatr Health Care* **25**, 294–301.
35. Gerards SM, Gubbels JS, Dagnelie PC *et al.* (2014) Parental perception of child's weight status and subsequent BMIz change: the KOALA birth cohort study. *BMC Public Health* **14**, 291.
36. Robinson E & Sutin AR (2016) Parental perception of weight status and weight gain across childhood. *Pediatrics* **137**, e20153957.
37. World Health Organization (2013) *Marketing of Foods High in Fat, Salt and Sugar to Children: Update 2012–2013*. Copenhagen: WHO Regional Office for Europe.