Weight Misperception Among Chinese Children and Adolescents: Evidence from the Repeated China Health and Nutrition Survey

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Abstract

Objective: Weight misperception has been reported as a common problem in high-income countries, but there is a paucity of high quality empirical evidence in low- and middle-income countries, especially among children and adolescents. This study estimates the prevalence of weight misperception and investigates changes over time among children and adolescents in China, as well as identify factors which may affect this weight misperception.

Design: The China Health and Nutrition Survey (CHNS), which is a repeated, representative cross-sectional study employing multistage random cluster processes.

Setting: A Chinese national survey across 15 provinces and municipal cities.

Participants: Data from with children and adolescents aged 6-16 years from six consecutive waves of between 2000 and 2015 were included.

Results: The final sample totaled 7,110 children and adolescents. The overall prevalence of weight misperception was largely stable between 2000 and 2015 (range: 34.1% to 37.3%). Sex and age group were associated with weight misperception, with boys and younger participants more likely to misperceive their weight status. In addition, dieting and being physically active or inactive was associated with increased rates of weight misperception.

Conclusions: Weight misperception is common among youth in China, and unequally shared with several subpopulations at increased risk. Researchers and health promotors are called to recognize weight misperception when addressing overweight and obesity countermeasures, and more tailored public health initiatives are warranted to more effectively reach those with weight misperceptions.

Keywords: Weight status; Weight misperception; Children and adolescents; Epidemiology; China.

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1. Introduction

Overweight and obesity in childhood and adolescence is a complex issue, and is known to increases the likelihood of adverse social, economic and health consequences over the life-course [1]. While these negative sequalae are well known, rates of overweight and obesity in children and adolescents continue to worsen across the globe. Between 1975 and 2016 the worldwide prevalence of obesity increased over eight-fold among children and adolescents (i.e., from 0.7% to 5.6% in girls, and 0.9% to 7.8% in boys) [2]. Although overweight and obesity rates among children and adolescents have plateaued in some high-income countries, they are now increasing in many low- and middle-income countries (LMICs) [2, 3]. Consequently, an estimated 340 million of children and adolescents were overweight or obese in 2016 [4]. Overweight and obesity are largely preventable but this, in part, relies on individual responsibility. Fundamental to this responsibility is having an accurate weight self-perception.

Like overweight and obesity itself, weight misperception (conceptualized as a discrepancy between measured and perceived weight status) is associated with a wide range of health problems, including eating disorders [5-7], and psychological symptoms [6, 8]. Among individuals within a normal weight range, those who perceive themselves as overweight are more likely to have unhealthy weight loss behaviors [9]. In contrast, overweight individuals who underestimate their weight status may have lower intention for healthy eating [10], are less likely to control their weight [11], and are associated with increased risk of some obesity-related problems such as cardiovascular disease [12].

Similar to overweight and obesity, weight misperception has been initially reported as a problem in high-income countries [9, 10, 13, 14]. More recently, there is emerging evidence that this is also an issue within LMICs [15-17], including China, where mean body-mass index (BMI) and obesity rates have increased steadily since the early 1980s [18]. Although a number of large nationwide prevention programs targeting overweight and obesity have been implemented in China over recent years, their efficacy is likely to have been hampered by this weight misperception. Overweight and obese individuals who underestimate their weight

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status, thereby normalize their body size, are unlikely to consider their excess weight as a health problem, resulting in low intentions for weight loss.

Concurrently, China has witnessed dramatic shifts in cultural beliefs and body image ideals following the rapid economic growth in recent decades [19, 20]. These shifts have exerted additional influence on citizen's perception of their body image. Not surprisingly, a high proportion of Chinese children and adolescents now report body-image dissatisfaction [21]. Further complicating matters, there is some evidence that weight misperception in China was found to be prevalent among children and adolescents [17, 22]. In comparison with adults, children and adolescents are more vulnerable since they are experiencing a critical period in the life-course which encompasses elements of biological growth and major social role transitions [23, 24]. As such, it is important to reliably understand the magnitude of weight misperception among youth in China, and whether it is significantly worsening over time.

Extant literature focusing on weight misperception within LMICs is rare and frequently limited to convenience sampling strategies, single cross-sectional designs, and lack of follow-up over a longer timeframe. Furthermore, understanding the factors that affect weight misperception is necessary for health professionals in developing tailored public health programs aimed at addressing weight misperception and co-occurring outcomes. Prior findings from high-income countries and some middle-income countries indicated that weight misperception in adults is susceptible to a range of factors, which might vary by countries due to different participant characteristics [10, 25, 26]. Whether the influence of these factors on youth in China is open to conjecture, due to its unique cultural and socioeconomic characteristics, and thus they warrant further investigation.

Using data collected from the repeatedly implemented China Health and Nutrition Survey (CHNS), this study aimed to estimate the prevalence of weight misperception among children and adolescents in China and investigates changes in this prevalence over time. The study also aimed to investigate and report on the demographic, family, and sociocultural factors associated with weight misperception.

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2. Methods

2.1. Study design

The CHNS is a repeated, nationally representative, cross-sectional study. It is an internationally collaborative project between the University of North Carolina at Chapel Hill and the Chinese Center for Disease Control and Prevention, and was designed to examine how the social and economic transformation of Chinese society affects a wide array of nutrition and health-related outcomes [27]. Initiated in 1989, the CHNS has been conducted 11 times, with the latest survey undertaken in 2015. However, information on body image was collected since 2000. Therefore, six consecutive CHNS measurement waves were employed for the current study; the first measurement wave started in 2000, when both measured and perceived weight status were elicited, through to 2015.

2.2. Participants

Detailed information on the CHNS study population, sample, and quality control procedures appear in https://www.cpc.unc.edu/projects/china/about/design/sample. In brief, the study population is drawn from multiple districts (i.e., provinces and autonomous cities) of China, with variation in a wide range of socioeconomic factors and other related health, nutritional and demographic measures. A multistage, random cluster process was used to draw the sample surveyed in each of the districts. Counties in the districts were stratified by income (low, middle, and high) and a weighted sampling scheme was used to randomly select four counties in each district. Villages and townships within the counties and urban/suburban neighborhoods within the cities were selected randomly. For the current study, children and adolescents aged between 6 years and 16 years deriving from the CHNS measurement waves of 2000, 2004, 2006, 2009, 2011, and 2015 were eligible for our analyses.

2.3. Primary Measure

Weight and height were measured by trained interviewers while the participants wore light clothing with shoes removed. Weight was measured to the nearest 0.1 kg using a

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calibrated scale. Height was measured using a fixed stadiometer and recorded to the nearest 0.1 cm. BMI was calculated through dividing weight in kilograms by the square of height in meters (kg/m^2). In accordance with the WHO Child Growth Standards [28, 29], BMI-for-age Z-scores was selected as an indicator of measured weight status. Under this criterion, measured weight status, which was collapsed into three categories using the standard deviation scores (SDs): underweight (<−2 SDs); normal weight (−2 SDs to 1 SDs); and overweight (>1 SD).[29] Children with BMI z-scores<-5 or >5 were flagged as being biologically implausible and were excluded. Perceived weight status was measured by "Do you think you are now underweight, normal or overweight?". Weight misperception was defined as discordance between the measured and perceived weight status classifications.

2.4. Demographic, family, lifestyle, and media-related variables

In addition to the primary variables, information about demographic, family, lifestyle, and media-related variables was collected from the CHNS questionnaire. The choice of these variables that might produce an influence on weight misperception was based on the relevant literature [24, 30]. Five indicators were selected as demographic variables, including sex, age group, locality, ethnicity, and region of residence. Paternal and maternal presence were assessed as family variables. We considered physical activity, dieting, fast food consumption, snacking while watching TV, and watching TV while eating meals as lifestyle variables. In addition, access to internet and TV-bedroom were evaluated as media-related variables. A detailed description of the names, measures, response options, and codings of these variables are presented within the Supplementary Materials Table S1.

2.5. Statistical analysis

Reporting of analyses were informed by the STROBE guidelines (www.strobe-statement.org). Frequencies together with weighted percentages on participants' demographic characteristics were described by measurement waves. Weight misperception for the total observations was calculated, and trends in the prevalence were described.

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The pattern of weight misperception rates over time was investigated using degree-2 fractional polynomial regression models from the set of powers (−2; −1; −0.5; 0; 0.5; 1; 2; 3) [31]. The best time polynomial specification was then used in all pursuant regression analyses. In addition to the overall rates, we stratified the sample by age group and sex to explore whether weight misperception was equally distributed between these subgroups.

The potential factors of weight misperception were explored through complete case multivariable analyses. As conventionally employed logistic regression models produce biased and inflated estimates when the outcome of interest is not rare, a modified Poisson regression approach (with log-link function and robust variance estimator) was used to estimate prevalence ratios (PRs) directly [32]. A base model (BM) and adjusted models were employed. For the BM, only demographic variables (i.e., sex, age group, ethnicity, region of residence, and locality) were analyzed. A fully adjusted model was subsequently conducted. Rather than employing bivariable analyses to screen risk factors, all candidate variables were included in the adjusted model regardless of their statistical significance [33]. The area under the curve of the receiver operating characteristic (AUC) was used to assess this adjusted model's predictive accuracy. In accordance with Hosmer and Lemeshow's recommendations, an AUC of 0.5 indicates no discrimination, 0.7-0.8 is regarded as acceptable, 0.8-0.9 is regarded as excellent, and more than 0.9 is regarded as outstanding [34]. Finally, in an effort to account for the missing data, sensitivity analyses were conducted on all regression models using chained equations multiple imputation (M=50) methods [35]. All demographic and study variables were included within the multiple imputations. PRs and associated 95% confidence intervals (CIs) were reported, and Wald's type III χ^2 statistic used to determine variable significance within these regression models. All the analyses were performed with Stata SE version 18.0 (StataCorp, College Station, TX, USA), with a two-sided $p \leq 0.05$ considered significant.

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3. Results

3.1. Participants

The final sample was composed of 1,149 (16.1%) participants from measurement wave 1 (2000), 1,355 (19.1%) from measurement wave 2 (2004), 1,072 (15.1%) from measurement wave 3 (2006), 1,016 (14.3%) from measurement wave 4 (2009), 1,420 (20.0%) from measurement wave 5 (2011), and 1,098 (15.4%) from measurement wave 6 (2015) and when combined totaled 7,110 children and adolescents. Participants' mean age was 11.0 years (range: 6-16 years), and 3,393 (47.7%) were female. Table 1 describes the participants' demographic characteristics. Overall, 55.8% (3,966) were children aged 6-11 years, 14.7% (1,042) were identified as ethnic minority, 19.5% (1,390) were from North, 17.3% (1,232) from West, 30.0% (2,132) from East, and 33.1% (2,356) were from Central China, and 63.3% (4,455) were living in rural areas.

3.2. Weight misperception: distribution of measured and perceived weight status

Valid measured and self-report perception data were available from all 7,110 participants. Based on anthropometric measurements, 1,011 (14.2%) children and adolescents were classified as underweight, 5,054 (71.1%) as normal, and 1,045 (14.7%) as overweight. For perceived weight status, 1,445 (20.3%), 4,885 (68.7%), and 780 (11.0%) reported being underweight, normal, and overweight, respectively. Table 2 presents the matched distribution of these measured and perceived weight status classifications. Overall, 2,530 (35.6%) participants misperceived their weight status. The majority of underweight (57.2%) and overweight (62.3%) participants misperceived their measured weight classification. In contrast, most individuals within the normal range (74.3%) perceived themselves accurately.

3.3. Prevalences of weight misperception

The overall prevalence of weight misperception was 35.6%; ranging from 34.1% in 2000 to 37.3% in 2011. Patterns in weight misperception over measurement waves were investigated using degree-2 fractional modified Poisson regression models. There was no

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evidence for a first or second order relationships, implying that the prevalence of weight misperception was largely constant over the study period. Figure 1 depicts the estimated prevalence of weight misperception and associated 95% confidence intervals (CIs) by year, together with the overall constant-only estimated mean prevalence and associated 95% CI.

The potentially differential influence of age group and sex on weight misperception was next investigated. In modified Poisson regression analyses, a significant difference in misperception was found between sexes ($p=0.02$) and age groups ($p<0.001$), but no evidence for an age group×sex interaction existed ($p=0.52$). In these analyses, the estimated prevalence ratio (PR) for male misperception was 1.08 (95% CI: 1.01, 1.15) that of females, and 1.24 (95% CI: 1.16, 1.32) for children compared to adolescents. The estimated prevalence of weight misperception for male children was 40.3% (95% CI: 38.4%, 42.2%), for female children was 37.2% (95% CI: 35.3%, 39.3%), for male adolescents was 32.7% (95% CI: 30.8%, 34.7%), and for female adolescents was 30.2% (95% CI: 28.4%, 32.2%).

3.4. Potential factors affecting weight misperception

In the 2000 measurement wave, two variables of interest (access to internet and TV-bedroom) were not collected, and thus this secondary analysis was limited to the 2004-2015 measurement waves (N=5,961). The distribution of weight misperception for demographic and potentially confounding variables for this subsample appears in Table 3.

For the BM (N=5,939; 99.6%), the effects of demographic variables (i.e., sex, age group, ethnicity, region of residence, and locality) on weight misperception (Table 3) were initially investigated. In this model, age group was significant ($p<0.001$), with younger participants more likely to misperceive their weight status than adolescents. Sex was also significant ($p=0.02$); with boys having a higher PR of weight misperception compared to girls. In contrast, ethnicity, locality, and region of residence were all non-significant.

Following the BM model, a complete case multivariable model was undertaken (N=3,292; 55.2%) investigating the effects of family, lifestyle, and media-related variables on

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weight misperception; see Table 3. Among the considered potential factors affecting weight misperception, the median pairwise correlation was 0.01, with the highest between paternal and maternal presence (r=0.56). In this model age group remained significant (p=0.005), as did physical activity (p<0.001), but all other considered variables were non-significant. As before, weight misperception among children had higher PR than adolescents. Interesting, both too little and too much self-reported physical activity was also associated with higher PR estimates of weight misperception. The estimated AUC for this model was 0.58 (95% CI: 0.56, 0.60), which is not considered predictive acceptable, suggesting that other important unmeasured confounders exist [34]. However, there was no evidence that the model assumptions were violated (deviance goodness-of-fit p>0.99).

Given that only 55.2% of the subsample was utilized in the complete case multivariable analysis, a sensitivity analysis was undertaken using multiple imputed data (M=50). Table 3 and Figure 2 presents estimated PRs and associated 95% CIs of the factors associated with weight misperception derived from both complete case (N=3,292) and multiple imputed (N=5,961) analyses. In the multiple imputed multivariable modified Poisson regression analysis, age group remained significant (p<0.001), as did sex (p=0.009), physical activity (p<0.001) and whether participants were on a diet (p=0.002). The direction of the effect sizes for age group, sex and physical activity were the same as described earlier. Being on a diet was, however, a new addition to this suite of significant variables – with those reporting dieting having estimated adjusted PR of weight misperception 1.20 (95% CI: 1.07, 1.35) higher than their counterparts not dieting. When compared to the complete case PR estimates, the multiple imputed estimates generally exhibited modest shrinkage towards the null, with age group and dieting being notable exceptions; see Figure 2.

4. Discussion

Weight misperception among youth in China was observed to be common and largely constant between 2000 and 2015. Our prevalence estimates are somewhat smaller relative to those (range: 34.5%-56.6%) found in other studies targeting children and adolescents in China [7, 17, 22], likely due to convenience sampling bias within these studies. When comparing

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between countries, our prevalence estimates are comparable to reports from some other LMICs [16] and high-income countries [36]. Overall, these findings reinforce the view that weight misperception is a common public health challenge for youth in China. Since weight misperception can limit the effectiveness of public health initiatives aimed at reducing excess weight in this population, implementing prevention programs recognizing this discordance need to be developed or tailored accordingly.

Both age group and sex were associated with weight misperception among children and adolescents. The prevalence decreased as age groups increased, a finding consistent with the literature [14]. One plausible interpretation for this finding is the higher cognitive ability for older than younger age groups. In comparison with girls, boys in this study seem more likely to misperceive their weight status. It is possible that the pursuit of muscularity in boys may lead them to underestimate their weight status despite a high BMI [37, 38]. It is also possible that girls have greater awareness of their weight status since they may be relatively more concerned about their body image. Owing to cultural norms and societal pressures from mass and social media, girls tend to demonstrate greater anti-fat attitudes and more positive views of thinness compared to boys [39]. These sex differences are supported by two additional studies conducted in Chinese children and adolescents [17, 22]. Although studies in other similarly aged populations but in different countries have also observed the reverse, with more females than males misperceiving their weight [8, 40].

Another priority of this study was to explore potential factors that affect weight misperception among children and adolescents. In addition to the frequently evaluated demographic factors, a range of family, lifestyle, and media-related factors were considered in our analyses, resulting in some significant findings. These findings were largely reliable even though a set of different models were employed, underlining that the factors identified in our analyses might be significant predictors of weight misperception among children and adolescents. Such information is important since it would assist health professionals in identifying subgroups in which weight misperception is most prevalent, which could guide future program development and implementation efforts targeting this population.

A finding of interest was that healthy eating and recommended physical activity levels reduced the risk of weight misperception among children and adolescents. Our results suggest that children and adolescents who are on a diet to lose/gain weight are more likely to misperceive their weight status. In support, several other studies have demonstrated the relationship between disordered eating behaviors and weight misperception among children and adolescents [41-43]. In addition, compared with the appropriate physical activity levels, both a higher and lower level of physical activity were associated with a greater risk of weight misperception. It is possible that individuals being physically active are more likely to underestimate their weight status, and perhaps have a higher ratio of muscle to fat. In contrast, individuals being physically inactive, especially those who have a lower ratio of muscle to fat, may overestimate their weight status. In line with this, several studies have confirmed that weight misperception is more prevalent among those being physically active [10, 44], and some other studies found weight misperception to be associated with physical inactivity [26, 41, 45, 46]. Overall, these findings support that living a healthy nutritional and physical lifestyle may assist in reducing weight misperception among children and adolescents.

In addition to the aforementioned factors, it is noteworthy that several factors were not significantly associated with weight misperception. Although it might be interpreted that these factors do not affect weight misperception, some of these null findings warrant further investigation. For instance, since parents are critical in the socialization of young children, their weight-related attitudes ought to play an important role in the development of weight bias in their children. This has been supported by a range of studies, including Rich and colleagues who found that parental body dissatisfaction was associated with attributing negative traits to overweight and positive traits to thinness [47]. Spiel and colleagues found that father was crucial in the transmission of weight bias among children, especially boys [48]. Other researchers showed that parents can positively or negatively influenced their children's weight attitudes through the modelling of weight and dieting behaviors as well as their reinforcement through comments [49, 50]. In contrast, neither paternal presence nor maternal presence was associated with children's weight misperception in our analyses; those living with father/mother showed similar risk to others not living in this arrangement. Our results

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reveal that although parents exert important influence on their children, solely living with father/mother does not significantly attenuate weight misperception. Future studies are needed to evaluate the effect of other parental factors on weight misperception.

4.1. Strengths and limitations

Whilst this study encompasses important strengths, including the robust survey design, the large representative sample (i.e., multistage, random cluster sampling was applied, resulting in a wide spread of participants across China), and the repeated follow-up measures, which together have contributed to producing reliable and robust estimates, several limitations should be noted. Despite measured BMI z-scores, data collected for perceived weight status and other variables were primarily self-reported, which may lead to recall bias and response bias. Another limitation is that the repeated cross-sectional design of this study provided only correlational instead of causal relations. This study is also limited to exploring the factors that may affect weight misperception, since other non-specified factors were not analyzed. In addition, whilst the majority of geographical regions were consistent across the study period, three mega cities joined this cohort since 2011 and three more provinces joined since 2015, contributing to potential sampling bias. Furthermore, information on body image was only collected from 2000, limiting our ability to identify the trend over a longer timeframe. Meanwhile, much has happened since the latest CHNS (held over 2015), including the outbreak of COVID-19, and so more recent patterns may be different.

5. Conclusions

Using a repeated cross-sectional design utilizing data from six representative CHNS surveys, we assessed the prevalence and correlates of weight misperception among Chinese children and adolescents. The findings reveal that weight misperception is common and largely constant among youth in China. Weight misperception is also unequally distributed, and more prevalent within a range of subpopulations (e.g., boys, young children, those on a diet, and those being physically active or inactive). Researchers and health promotors are called to recognize weight misperception when addressing overweight and obesity

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countermeasures, and more tailored public health initiatives are warranted to more effectively reach those at risk.

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Authorship: L.M. conceived the paper, cleaned the database, performed the data analysis, and drafted the initial manuscript. P.J.S. reviewed the study protocol, re-performed and finalized the data analysis, and reviewed and revised the manuscript. Both authors approved the final version of the paper.

Ethical Standards Disclosure: This study is a secondary analysis of deidentified participants collected as part of the China Health and Nutrition Survey (CHNS). These data are publicly available at ww.cpc.unc.edu/projects/china/data/datasets/index.html. Identification of and dissemination to study participants is not possible or applicable given the nature of collection, public use and non-identifiable CHNS. This study was conducted according to the guidelines laid down in the Declaration of Helsinki.

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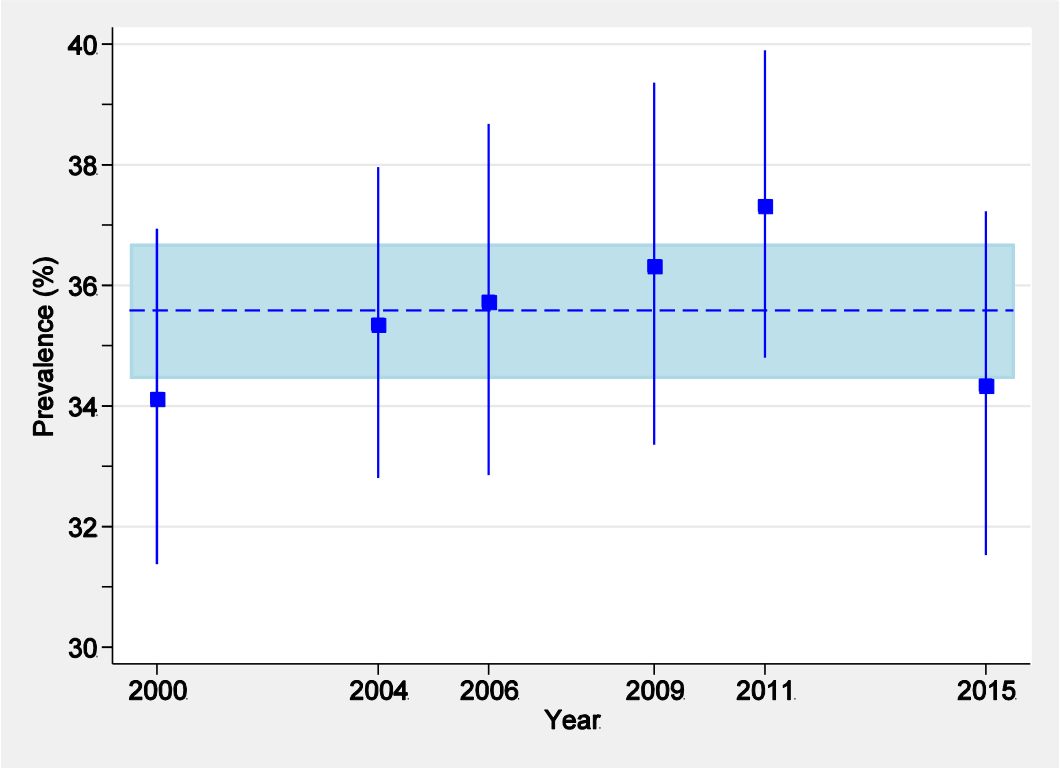

Figure 1. Estimated prevalence of weight misperception (squares) and associated 95% confidence intervals (CI; solid lines) by year, together with the overall estimated mean prevalence (dashed line) and associated 95% CI (shaded area)

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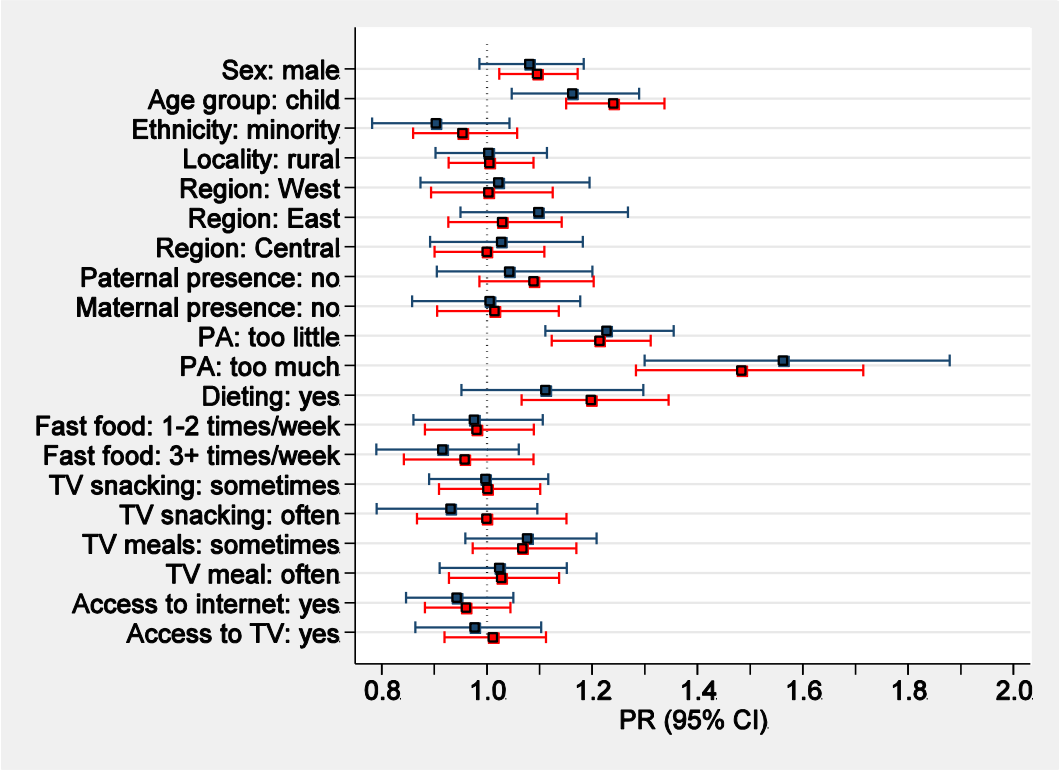

Figure 2. Estimated prevalence ratio (PR) and associated 95% CI of factors associated with weight misperception derived from complete case (blue; N=3,292) and multiple imputed (red; N=5,961) analyses from 2004 to 2015

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Table 1. Participants' demographic characteristics by measurement wave.

	2000	**2004**	**2006**	**2011**	**2014**	**2015**	**Total**
	(N=1,149)	(N=1,355)	(N=1,072)	(N=1,016)	(N=1,420)	(N=1,098)	(N=7,110)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Age (6-11 years)	541 (47.1)	624 (46.1)	597 (55.7)	560 (55.1)	858 (60.4)	786 (71.6)	3,966 (55.8)
Sex (girls)	583 (50.7)	643 (47.5)	507 (47.3)	454 (44.7)	686 (48.3)	520 (47.4)	3,393 (47.7)
Ethnicity (minority)*	153 (13.4)	199 (14.7)	181 (16.9)	172 (17.0)	180 (12.7)	157 (14.4)	1,042 (14.7)
Region of residence							
North	241 (21.0)	316 (23.3)	227 (21.2)	154 (15.2)	267 (18.8)	185 (16.8)	1,390 (19.5)
West	147 (12.8)	227 (16.8)	169 (15.8)	186 (18.3)	304 (21.4)	199 (18.1)	1,232 (17.3)
East	494 (43.0)	444 (32.8)	317 (29.6)	304 (29.9)	285 (20.1)	288 (26.2)	2,132 (30.0)
Central	267 (23.2)	368 (27.2)	359 (33.5)	372 (36.6)	564 (39.7)	426 (38.8)	2,356 (33.1)
Locality (rural)[§]	741 (68.4)	882 (65.4)	703 (65.6)	676 (66.5)	779 (54.9)	674 (61.4)	4,455 (62.7)

Note: *missing values for 7 (2000), 2 (2009), 4 (2011), 9 (2015) participants; [§]missing data for 66 (2000), 6 (2004), 1 (2015) participants.

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Table 2. Participants' distribution of measured and perceived weight status (N=7,110).

Measured weight status	**Perceived weight status**			**Total**	**Overall discrepancy (misperception)**
	Underweight	Normal	Overweight		
Underweight	433 (42.8)	546 (54.0)	32 (3.2)	1,011 (14.2)	578 (57.2)
Normal	947 (18.7)	3,753 (74.3)	354 (7.0)	5,054 (71.1)	1,301 (25.7)
Overweight	65 (6.2)	586 (56.1)	394 (37.7)	1,045 (14.7)	651 (62.3)
Total	1,445 (20.3)	4,885 (68.7)	780 (11.0)	7,110 (100)	2,530 (35.6)

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Table 3. Distribution of weight misperception for demographic and potentially confounding variables, together with estimated proportional odds (PRs) and associated 95% confidence intervals (CIs) for a base model including demographic variables (N=5,939), a complete case multivariable models (N=3,292), and multivariate multiple imputed model (N=5,961) using modified Poisson regression analyses.

		Misperception		**Base model**		**Multivariable (complete case)**		**Multivariable (multiple imputed)**	
	N	n	(%)	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)
Sex									
Male	3,151	1,174	(37.3)	1.08	(1.01, 1.16)	1.08	(0.99, 1.18)	1.10	(1.02, 1.17)
Female	2,810	964	(34.3)	1	(reference)	1	(reference)	1	(reference)
Age group									
Child (6-11 years)	3,425	1,342	(39.2)	1.25	(1.16, 1.34)	1.16	(1.05, 1.29)	1.24	(1.15, 1.34)
Adolescent (12-16 years)	2,536	796	(31.4)	1	(reference)	1	(reference)	1	(reference)
Ethnicity									
Han Chinese	5,057	1,827	(36.1)	1	(reference)	1	(reference)	1	(reference)
Minority	889	307	(34.5)	0.95	(0.86, 1.05)	0.90	(0.78, 1.04)	0.95	(0.86, 1.06)
Region of residence									
North	1,149	407	(35.4)	1	(reference)	1	(reference)	1	(reference)
West	1,085	381	(35.1)	0.97	(0.87, 1.09)	1.02	(0.87, 1.20)	1.00	(0.89, 1.12)
East	1,638	601	(36.7)	1.01	(0.91, 1.12)	1.10	(0.95, 1.27)	1.03	(0.93, 1.14)
Central	2,089	749	(35.9)	0.99	(0.90, 1.09)	1.03	(0.89, 1.18)	1.00	(0.90, 1.11)

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Locality									
Urban	2,240	788	(35.2)	1	(reference)	1	(reference)	1	(reference)
Rural	3,714	1,346	(36.2)	1.02	(0.95, 1.09)	1.00	(0.90, 1.11)	1.00	(0.93, 1.09)
Paternal presence									
Yes	4,841	1,701	(35.1)			1	(reference)	1	(reference)
No	1,118	436	(39.0)			1.04	(0.90, 1.20)	1.09	(0.99, 1.20)
Maternal presence									
Yes	5,124	1,818	(35.5)			1	(reference)	1	(reference)
No	836	320	(38.3)			1.01	(0.86, 1.18)	1.01	(0.91, 1.14)
Physical activity									
Too little	1,674	665	(39.7)			1.23	(1.11, 1.35)	1.21	(1.12, 1.31)
About right	3,526	1,162	(33.0)			1	(reference)	1	(reference)
Too much	207	104	(50.2)			1.56	(1.30, 1.88)	1.48	(1.28, 1.71)
Dieting									
No	5,412	1,908	(35.3)			1	(reference)	1	(reference)
Yes	452	196	(43.4)			1.11	(0.95, 1.30)	1.20	(1.07, 1.35)
Fast food consumption									
<1-2 times/week	3,188	1,155	(36.2)			1	(reference)	1	(reference)
1-2 times/week	876	310	(35.4)			0.98	(0.86, 1.11)	0.98	(0.88, 1.09)
≥3 times/week	666	230	(34.5)			0.92	(0.79, 1.06)	0.96	(0.84, 1.09)

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Snacking while watching TV							
Seldom	2,883	1,025	(35.6)	1	(reference)	1	(reference)
Sometimes	1,117	407	(36.4)	1.00	(0.89, 1.12)	1.00	(0.91, 1.10)
Often	425	154	(36.2)	0.93	(0.79, 1.10)	1.00	(0.87, 1.15)
Eat meals while watching TV							
Seldom	2,319	807	(34.8)	1	(reference)	1	(reference)
Sometimes	1,129	421	(37.3)	1.08	(0.96, 1.21)	1.07	(0.97, 1.17)
Often	982	360	(36.7)	1.02	(0.91, 1.15)	1.03	(0.93, 1.14)
Access to internet							
No	3,966	1,464	(36.9)	1	(reference)	1	(reference)
Yes	1,881	633	(33.7)	0.94	(0.85, 1.05)	0.96	(0.88, 1.04)
TV-bedroom							
No	4,798	1,709	(35.6)	1	(reference)	1	(reference)
Yes	946	347	(36.7)	0.98	(0.86, 1.10)	1.01	(0.92, 1.11)

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