Mismatch in Children’s Weight Assessment, Ideal Body Image, and Rapidly Increased Obesity Prevalence in China: A 10-Year, Nationwide, Longitudinal Study

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Objective: This study examined secular trends in children’s weight-status assessment, measured weight status, and ideal body image and their associations with subsequent changes in BMI, and it explored the differences between sociodemographic groups in China.

Methods: Longitudinal data from the China Health and Nutrition Survey of 4,605 children aged 6 to 17 collected between 2000 and 2011 were used and fitted to mixed models.

Results: From 2000 to 2011, overweight/obesity prevalence increased from 6.5% to 16.8%, but the percentage of children with self-perceived weight status as “fat” remained around 2.0%; 49.0% of children underestimated their weight status at baseline. Self-perceived body image of most participants was tracked during follow-up. Children who perceived themselves as being fat at baseline had a higher BMI increase over time during follow-up than those with an average body image (β [SE]=0.99 [0.14] kg/m² per year, P<0.001). Boys, young children, recent cohorts, and rural children had higher BMI increases than their counterparts. Over time, the thin-body silhouette became more desirable (8.4 percentage points higher, P<0.001).

Conclusions: Chinese children experience a large incongruence between their weight-status assessment, ideal body image, and actual weight status. Health promotion programs should examine their role in assisting children in developing a healthy body image and gaining greater self-motivation toward promoting a healthy lifestyle.

Introduction

Along with its impressive economic development and rapid integration in the global market over the past 3 decades, China has experienced an alarming increase in overweight/obesity (OWB) rates, even faster than many high-income countries (1-3) in both children and adults (4,5). Recent data from across the nation have shown that 42% of Chinese adults and 15% of Chinese children have OWB (6,7). Furthermore, boys are two times more likely to have OWB than girls, and OWB is more prevalent in urban than in rural areas (7), trends uncommon across the globe and unique to the country of China. It has been speculated that the increasingly high rates and unique patterns of the obesity epidemic in China are somehow connected to traditional Chinese culture and current social norms.

For example, self-perceived body image reflects family, peer, and societal perspectives of health and influences an individual’s health behaviors and risk of obesity (8). Obesity has been socially devalued and highly stigmatized in today’s modern culture and in Westernized society, whereas thinness has been associated with beauty, self-efficacy, and success (9). However, in spite of the rapid increase of OWB rates in recent decades (10), chubby babies are regarded as ideal compared with babies of a healthy weight or thin babies (11,12), and obesity is not recognized as a negative health state among many people in China.
Parents consider a larger body size for young children desirable, displaying a reflection of the family’s wealth (10,11). A recent study found that mothers were two times more likely to underestimate their boys’ weight status compared with their girls’ (24.4% vs. 10.3%) (7). Similarly, in China, boys with normal weight or overweight are more likely than girls to perceive themselves as underweight, whereas girls with normal weight or underweight are more likely than boys to share self-perceptions that their weight is too heavy (13). Moreover, the literature has suggested that, in general, boys favor muscular features while girls prefer being thin (14). Consequently, differences in self-perceived body image by gender may contribute to the higher rates of OWB in Chinese boys than girls (10).

Previous studies have shown a significant association between underestimation of personal weight status and reduced self-perception of personal adverse health behaviors (15), alongside less effort made to lose weight (16,17). Also, those who simply view themselves as having obesity are at higher risk of having obesity. Longitudinal analysis has indicated that self-perceived weight status as having OWB might lead to increased screen time, unhealthy dietary habits (18), greater increases in BMI, and increased risk of obesity in adults and children (19,20). Furthermore, body dissatisfaction among children, complicated by the internalized influence of obesity stigma by family, peers, or social media, could be linked to greater psychosocial distress, low self-esteem, and less motivation for healthy weight management (21).

Although several studies in China have examined the cultural characteristics of body image and related sociodemographics, little is known about how children’s body image has changed over time in consideration of the recent rapid increase in obesity and the longitudinal association between child body image and BMI change after considering cohort effects.

Using nationwide longitudinal survey data, this study examined (1) secular trends in body image and differences across groups; (2) the impact of body image on subsequent weight gain throughout childhood; and (3) how the association differs by gender, age, cohort, and residential area. Lessons learned in studying the sociocultural influence on obesity in China may provide useful insights for fighting the global obesity epidemic.

**Methods**

**Study design and study sample**

The China Health and Nutrition Survey (CHNS), started in 1989, was conducted by the University of North Carolina at Chapel Hill and the Chinese Center for Disease Prevention and Control. It is a long-term, prospective, open-cohort study that applies a multistage, random-clustering sampling design to gather information from about 4,400 households with a total of 26,000 individuals in 9 original provinces and, in later waves, 15 provinces and municipal cities. CHNS was not designed to be nationally representative, but it covers areas that account for approximately 45% of China’s total population, varying substantially in geography, economic development, public resources, and health indicators. Therefore, it is a reasonable representation of the various socioeconomic factors affecting people’s health and nutritional status in China. Data on individuals were collected through in-home visit interviews and survey questionnaires. Detailed information about CHNS has been provided elsewhere (22). Informed consent was obtained from all participants.

The present study includes children aged 6 to 17 at baseline in the years 2000, 2004, 2006, 2009, and 2011 and their follow-ups until 2011, as specific data for child body image were collected for those ages and years. Sample size varied by the number of participants across survey year, (e.g., 2,079 children in 2000, 1,536 in 2011). Children missing data for age, gender, weight and height measurements (5.9% of total participants), and body image (5.9% of available participants) were excluded from our analysis. For longitudinal data analysis, we had 4,605 children at baseline, and 2,324 children (having ≥ two BMI measurements during follow-up) were available for follow-up to examine BMI changes.

**Assessment and measures**

**Child weight status.** Child weight and height were measured to the nearest 0.1 kg and 0.1 cm in light indoor clothing and without shoes by trained and certified staff during the detailed physical examination. Child BMI (weight in kilograms/height in meters squared) was calculated, and a change in BMI per year was used to show weight gain during follow-up (23). Child weight status was classified as underweight, normal weight, or OWB based on the International Obesity Task Force BMI cutoffs, which corresponded to BMI levels of 18.5, 25, and 30 at age 18, respectively (24). After age 18, WHO classification of underweight, normal weight, and OWB (BMI=18.5, 25, and 30 as cutoffs) was employed.

**Child body image.** Children were asked to choose which silhouette (nine pictures representing very thin to severe obesity) was most like them (self-perceived body image) and which one they wanted their body to look like (desired body image) using a silhouette-matching task. This measure has often been used to relate body image with other characteristics and health factors (25). Self-assessed body image has shown substantial correlation with actual BMI or weight status (25). Our study grouped the nine silhouettes into three levels: thin (silhouettes 1 to 3), average (silhouettes 4 to 6), and fat (silhouettes 7 to 9). The group average served as the reference in data analysis.

**Parental and household characteristics.** To consider the influence of family and household characteristics on the associations between child weight status and body image, we used parental weight status (overweight, obesity, without OWB), highest parental education (up to primary school, middle school, vocational/college/higher degree[s]), household income per capita (tertiles), and residence (rural, urban) in our analysis. Parental weight status was classified using the Chinese BMI cutoff points for overweight (24≤BMI<28 kg/m²) and obesity (BMI≥28 kg/m²) with measured anthropometrics.

**Statistical analysis**

First, we cross-sectionally described the distributions of children’s actual weight status, self-perceived body image, and desired body image in 2000 versus 2011 to examine their differences after 10 years and by stratified groups of gender, age (two age groups were created: age 6-11 and age 12-17), and residential area using a χ² test.

For the longitudinal analysis, we described children’s baseline characteristics (n=4,605) in terms of sociodemographics and distributions of actual weight status, self-perceived body image, and desired body image and discrepancies between self-perceived body image versus actual weight status. For longitudinal trajectories of an individual’s weight status and self-perceived body image during follow-up, we used the Stata “xxtab” command to show the average fraction of time spent...
in a specific weight-status or body-image category during follow-up in each demographic subgroup.

Finally, we tested the longitudinal associations between self-perceived body image and subsequent annual BMI changes during follow-up, using body image and anthropometrics at least 2 years post baseline \((n=2,324)\). Mixed models were applied for each subgroup, i.e., by gender, baseline weight status, cohort after 2006 versus before 2006 (classified by the midpoint of 2000-2011), and urban versus rural after considering the CHNS sampling methods. Our models included fixed and random effects (assigning individuals to independent intercepts) and adjusted for child age, gender, baseline weight status, interaction between self-perceived body image and weight status at baseline, household income level, parental education, residential area, parental weight status, and child cohort (except for the stratified variable).

Analyses were conducted using SAS version 9.3 (SAS Institute, Cary, North Carolina) and Stata software version 14 (StataCorp, College Station, Texas). The effect size was presented as beta coefficients with SEs. Statistical significance was set at \(P<0.05\).

Results

Cross-sectional comparison of obesity rate and body image between 2000 and 2011

In 2011, the childhood OWB rate nearly tripled compared with that in 2000, increasing from 6.5% to 16.8%, and the underweight rate dropped \((P<0.001)\). However, no significant difference was shown in self-perceived body image during this period. More than half of the children surveyed continued to think of themselves as “thin,” and only
2% retained self-perceived weight status as “fat.” In contrast, over time, the thin-body silhouette became more desirable (8.4 percentage points higher), while the obesity silhouette became less desirable (−1.2 percentage points, \( P < 0.001 \); Figure 1).

The stratified analysis (Table 1) showed that children’s self-perceived body image did not change over time regardless of age or residential area. However, boys had significant changes in self-perceived body image over time. Boys were less likely to consider themselves as thin (−6.1 percentage points) and more likely to perceive themselves as fat (1.7 percentage points). Girls showed no changes over time. However, boys still had more inconsistency in their body perception (40.3% consistent) than girls (45.0% consistent; Figure 1). Compared with their actual measured weight status, boys’ underestimates and overestimates in their body image did not change significantly between 2000 and 2011. Only girls’ underestimates became even greater (39.2% to 49.1%).

### Study subjects’ characteristics and body image at baseline

Overall, 31.0% of the subjects were from urban areas at baseline in our longitudinal analysis. While 11.2% of children had OWB, only 2.3% perceived their bodies as fat. Only 44.1% of children had a self-perceived body image consistent with their measured weight status; 49.0% perceived their body image under their actual weight status, and 6.9% perceived their body image above their actual weight. Very few children desired the obesity silhouette (1.0%), and 57.4% selected the average silhouette as ideal (Table 2).

### Tracking of child weight status and self-perceived body image during follow-up

To investigate whether children changed their body image as well as their weight-status variation during follow-up, we reported an individual’s self-perceived body image and weight status as a probability of change (Table 3). Overall, more than two-thirds of the children’s weight status and self-perceived body image remained the same when children belonged to one of the weight status or body image groups. Most of the demographic factors did not affect the remaining probability. However, adolescents (12-17 years old) had a higher remaining probability than young children (6-11 years old). Only about 10% of adolescents changed their weight status and self-perceived body image. The majority of adolescents kept a consistent body image during childhood.

### Longitudinal effects of self-perceived body image on subsequent BMI change during follow-up

Children who perceived themselves as fat at baseline had a higher BMI increase during follow-up than those with an average body image (\( \beta [SE] = 0.99 [0.14] \text{ kg/m}^2 \text{ per year}, P < 0.001 \); Table 4). Stratified analysis showed that the association between child body image and later BMI changes differed by child age, gender, cohort, and residential area. Adolescents had less increase in BMI (−0.78 [SE = 0.33] \text{ kg/m}^2 \text{ per year}, \( P < 0.05 \)), while young children (6-11 years old) had a higher BMI increase (1.25 [SE = 0.17] \text{ kg/m}^2 \text{ per year}, \( P < 0.001 \)) after having self-perceived their body image as fat at baseline compared with those with an average body image. In contrast, self-perceived thinness led
adolescents to a 0.34 kg/m² per year higher BMI increase than those with an average body image.

Boys (β [SE] = 1.37 [0.19] kg/m² per year, \( P < 0.001 \)) had BMI gain that was about two times higher than girls (0.62 [0.21] kg/m² per year, \( P < 0.01 \)) from their self-perceived body image as fat at baseline. Children who did not have OWB (1.13 [SE = 0.13] kg/m² per year, \( P < 0.001 \)) and children who had OWB (0.97 [SE = 0.29] kg/m² per year, \( P < 0.001 \)) at baseline had similar levels of subsequent BMI gain. Only recent cohorts (≥ 2006; β [SE] = 2.59 [0.36], \( P < 0.001 \)) and rural children (β [SE] = 1.34 [0.18], \( P < 0.001 \)) showed a significant association between self-perceived body image as fat and later BMI increase, while previous cohorts (≤ 2004) and urban children did not.

**Discussion**

To our knowledge, this is the first study in China that has examined body image, OWB, and subsequent BMI change using nationwide longitudinal data. Studying the world’s second-largest economy and the nation with the largest population with OWB in the world yields several important findings. First, OWB prevalence in Chinese children nearly tripled, from 6.5% to 16.8%, about 1 percentage point annually, between 2000 and 2011. However, children’s self-perception of having obesity remained at about 2.0%. Second, about half of all children had a thinner body image, and only 44% had a body image consistent with their measured weight status. Desired body image became thinner after 10 years. Third, a longitudinal analysis revealed that more than two-thirds of child weight status and self-perceived body image remained the same during follow-up. Fourth, children who perceived themselves as fat at baseline were more likely to gain 1.0 kg/m² per year more in BMI than those with an average body image. Boys, young children (< 12 years old), and rural children had higher BMI gains than girls, older children, and urban children. In contrast, older children had a lesser BMI increase after perceiving themselves as fat at baseline compared with those with an average body image at baseline. Only recent cohort members (≥ 2006) had a significant association between self-perceived obesity and subsequent BMI increase; older cohort members did not.

In previous studies, children’s body image has shown a significant association with their subsequent weight change (8,26). For example, underestimating weight status in both adults and children has been presumed to cause an impeded perception of adverse health behaviors as well as less effort to lose weight (15,27). When people had an accurate weight perception, they showed >13 times higher odds for trying to lose weight in the cross-sectional analysis (16). On the other hand, the self-perceived versus desired body image discrepancy acts as a psychological stressor leading to depression, binge eating, and less physical activity (28). Children desiring thinner bodies were more likely to attempt dieting to change their weight and were less likely to feel that they had enough physical activity compared with those who had consistent self-assessed body image versus desired body image (29). Other longitudinal studies have revealed that being labeled as fat or having a negative self-perceived body image is associated with higher weight gain (e.g., β in BMI = 0.38 [SE = 0.13], \( P < 0.01 \) (19) and 0.25 [95% CI:...
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0.10-0.39 (20)) and an increased risk of obesity (e.g., odds ratio of having obesity = 1.6 [95% CI: 1.20-2.30] (30)) than their counterparts (31,32). Increased screen time, less breakfast consumption (18), and depression symptoms among children perceiving themselves as fat have suggested that children's body dissatisfaction is accompanied by greater psychosocial distress and low self-esteem regardless of gender, age, weight status, ethnicity, or socioeconomic status (33), which has evolved from internalized stigmatization of obesity by family, peers, and social media (21). Even children without overweight who assessed themselves as having overweight had a greater weight gain into young adulthood (difference in BMI: 0.66 [95% CI: 0.1-1.2]), as evidenced in an 11-year follow-up, than those who perceived themselves as having normal weight (34).

In China, children's self-perceived weight status has been shown to be substantially influenced by their mothers’ perceptions of the child's weight status. In one study, mothers and children had 77.1% agreement in their perception of the child's weight status, and about 10% of children and their mothers underestimated the weight status of the child (32). In particular, several studies have found that Chinese boys are more likely to underestimate their weight status than girls (7,13). Girls are more likely to be sensitive to their body size (35) and have greater discrepancies between current weight and desired weight than boys in general (36). China also showcases unique gender-specific cultural views on body image. The preference for thinness in girls and muscular features in boys is prevalent (14). Chinese girls are more likely to group terms such as “prettier” and “normal” with “skinny” than Western ethnic groups (37). Also, Chinese parents and grandparents have a stereotypical image of children—chubby boys and slim girls (12). As a result, boys have had higher rates of adverse health behaviors, such as frequent sugar-sweetened beverage intake and excessive screen time, but have shown less interest in their weight status and have tried to lose weight less than girls (38,39). Our study found that fewer boys perceived their bodies as fat in general (36). China also showcases unique gender-specific cultural views on body image. The preference for thinness in girls and muscular features in boys is prevalent (14). Chinese girls are more likely to group terms such as “prettier” and “normal” with “skinny” than Western ethnic groups (37). Also, Chinese parents and grandparents have a stereotypical image of children—chubby boys and slim girls (12). As a result, boys have had higher rates of adverse health behaviors, such as frequent sugar-sweetened beverage intake and excessive screen time, but have shown less interest in their weight status and have tried to lose weight less than girls (38,39). Our study found that fewer boys perceived their bodies as fat in comparison to girls (38,39). In addition, we found that only rural children and recent cohorts had a high BMI increase from self-perception as fat compared with urban children and the previous cohort after adjusting for demographic covariates. In 2011, childhood obesity was about 1.5 times more prevalent in urban than rural areas in China (40). Rural people may not view...
Longitudinal associations of baseline self-assessed body image and subsequent yearly average BMI change by age, cohort, gender, and residence in CHNS 2000 to 2011 (n = 2,324)

| Self-assessed body image at baseline (reference = average) | Perceived as fat (“fat”) | Perceived as thin (“thin”) |
|-----------------------------------------------------------|--------------------------|---------------------------|
| Among all: β (SE) in annual average BMI increase (kg/m²) | 0.99 (0.14)**     | −0.02 (0.07)   |
| **Analysis stratified by** |                          |                           |
| Age at baseline (Y) |                          |                           |
| 6-11 (n = 1,613)   | 1.25 (0.17)**     | −0.09 (0.09)   |
| 12-17 (n = 711)    | −0.78 (0.33)*     | 0.34 (0.14)*    |
| Gender             |                          |                           |
| Boys (n = 1,052)   | 1.37 (0.19)*****   | −0.10 (0.10)   |
| Girls (n = 1,272)  | 0.62 (0.21)*****   | 0.08 (0.11)    |
| Cohort             |                          |                           |
| Year ≤ 2004 (n = 1,743) | 0.01 (0.14) | 0.11 (0.07)   |
| Year ≥ 2006 (n = 581) | 2.59 (0.36)*****   | −0.30 (0.21)   |
| Measured weight status at baseline |                          |                           |
| With overweight/obesity (n = 287) | 0.97 (0.29)***** | −0.14 (0.15)   |
| Without overweight/obesity (n = 2,156) | 1.13 (0.13)***** | −0.04 (0.03)   |
| Residence          |                          |                           |
| Urban (n = 658)    | 0.45 (0.24)*       | 0.11 (0.13)    |
| Rural (n = 1,666)  | 1.34 (0.18)*****   | −0.03 (0.09)   |

*P<0.1, **P<0.05, ***P<0.01.

*Participants having ≥ two BMI measurements during follow-up and body image at baseline were included in this analysis; therefore, sample size became smaller.

**Age ranged from 7 to 28 years old. Self-perceived body size as “average” (silhouettes 4-6) used as reference in models.

***BMI increase (kg/m²) per year = difference in BMI between follow-up and baseline/ follow-up years. Mixed model after adjustment for child age (age 6-11/age 12 and above), gender, weight status at baseline, interaction between self-perceived body image and weight status at baseline, household income level (tertiles), parental education (up to primary school/middle school/vocational or college degree or higher), residential area (urban/rural), parental weight status (without overweight/with overweight/ with obesity), and cohort and considering CHNS sampling methods and hierarchical data structure. Subgroup analysis applied same mixed model except for stratified variable.

CHNS, China Health and Nutrition Survey.

Obesity negatively, and therefore they do not react promptly to fatness after perceiving it. Educational programs on childhood obesity could help Chinese children to have a balanced body image without negative feelings about their body. Exercising self-control and making wise diet choices with an appropriate goal of weight management could be promising. More research is needed to confirm our findings and to examine the cohort effect on body image and obesity in China.

Although there was a significantly higher BMI gain among children who perceived themselves as fat than among those having an average body image in general, there was an associated age difference. Older children decreased their BMI gain after perceiving themselves as fat, and they increased their BMI gain after perceiving themselves as thin. Adolescents were more likely to have a body image consistent with their measured weight status and to maintain their body image over time than young children. The body image concern among teens may be strong enough to exert a positive influence on motivating health behaviors with social support (41).

This study had some limitations. Because data on body image, diet, and physical activity were not collected comparably between children and adults in the CHNS, we could not track the children’s body image in adulthood and its associations with health behaviors. We examined the cohort effect on body image and longitudinal BMI trajectory association with a few years’ difference between available waves in the CHNS. However, this study has important strengths as well. It used 10-year longitudinal data from a nationwide sample and studied secular trends and cohort effects on children’s body image and their association with obesity risk. This study provides useful insights to help fight the obesity epidemic in China and other countries worldwide.

In conclusion, from 2000 to 2011, children’s perception of being “fat” did not change much, but childhood obesity rates increased rapidly in China. However, more Chinese children viewed thinness as desirable. Children who perceived themselves as fat still had a faster BMI increase with age than those with an average body image, especially among boys, young children, rural children, and recent cohorts. Health promotion programs in China should address the rapid increase in childhood obesity by promoting culturally sensitive programs, including assisting children in developing a healthy body image and encouraging self-motivation in weight management, especially for young children and children in recent cohorts and rural areas. In addition, parents should be empowered to help their children to develop an appropriate body image and maintain a healthy body weight.

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