



HHS Public Access

Author manuscript

Obesity (Silver Spring). Author manuscript; available in PMC 2019 April 03.

Published in final edited form as:

Obesity (Silver Spring). 2018 November ; 26(11): 1777–1784. doi:10.1002/oby.22310.

Mismatch in children's weight assessment, ideal body image and rapidly increased obesity prevalence in China: A 10-year nationwide longitudinal study

Jungwon Min, PhD, MS¹, Alice Fang Yan, MD, PhD², and Youfa Wang, MD, PhD, MS^{1,3,*}

¹Systems-Oriented Global Childhood Obesity Intervention Program, Fisher Institute of Health and Well-being, College of Health, Ball State University, Muncie, IN

²Community and Behavioral Health Promotion, Joseph J. Zilber School of Public Health, University of Wisconsin-Milwaukee, Milwaukee, WI

³Department of Nutrition and Health Sciences, College of Health, Ball State University, Muncie, IN

Abstract

Objectives: 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 National Survey of 4,605 children aged 6-17 collected during 2000-2011 were used and fitted to mixed models.

Results: Overweight/obesity prevalence increased from 6.5% to 16.8%, but children's fat body perception remained around 2.0% between the years 2000 and 2011; 49.0% of children underestimated their weight status at baseline. Self-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-ups than those with an average body image (β [SE] = 0.99[0.14]kg/m²/year, $p < 0.001$). Boys, young, recent cohort, and rural children had higher BMI increases than their counterparts. Over time, thin body silhouette became more desirable (8.4% p 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

Users may view, print, copy, and download text and data-mine the content in such documents, for the purposes of academic research, subject always to the full Conditions of use:http://www.nature.com/authors/editorial_policies/license.html#terms

***Correspondence:** Youfa Wang, MD, PhD, MS, John & Janice Fisher Endowed Chair of Wellness, Associate Director, Fisher Institute of Health and Well-being, Director, Systems-Oriented Global Childhood Obesity Intervention Program, Professor, Department of Nutrition and Health Sciences, College of Health, Ball State University, Office: HP 302, Muncie, IN 47306, USA, Phone: 765-285-8121, youfawang@gmail.com.

Author contributions: JM was responsible for the research idea, study design, data management and analysis, interpreting the analysis results, and drafting the manuscript. YW directed the study, secured research funding, provided administrative support, and critically revised the manuscript. AY critically revised the manuscript. All authors contributed to study design, data analysis, and writing of the manuscript. JM had full access to the data used in the study, and all authors had final responsibility for the decision to submit for publication.

Disclosure: The authors declared no conflict of interest.

examine their role in assisting children in developing healthy body images and gaining greater self-motivation towards promoting a healthy lifestyle.

Keywords

Body image; childhood obesity; overweight; trends; China

Introduction

Along with its impressive economic development and rapid integration in the global market over the past three 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 shows that 42% of Chinese adults and 15% of 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 is 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, personal body image reflects family, peer, and societal perspectives of health and influences individuals' health behaviors and risk of obesity.⁸ Obesity is socially devalued and highly stigmatized in today's modern culture and westernized society, whereas thinness is 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 to healthy weight or thin babies^{11,12} and obesity is not recognized as a negative health status 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 to their girls' (24.4% vs. 10.3%).⁷ Similarly in China, normal and overweight boys are more likely than girls to perceive themselves as underweight, while normal or underweight girls are more likely than boys to share self-perceptions of weight being too heavy.¹⁴ Moreover, literature suggests that in general, boys favor muscular features while girls prefer being thin.¹³ Consequently, differences in personal 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 aversion to self-perception of personal practice of adverse health behaviors¹⁵ alongside less effort made to lose weight.^{16,17} Also, those who simply view themselves as obese are at higher risk of having obesity. Longitudinal analysis indicated that self-perceived weight status as having OWB might lead to increased screen time, unhealthy dietary habits,¹⁸ greater increases in body mass index (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 socio-demographics, there is little 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 residence area. Lessons learned in studying the sociocultural influence on obesity in China may provide useful insights for fighting the global obesity epidemic.

Materials and methods

1. 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, which applies a multistage random clustering sampling design to gather information from about 4,400 households with a total of 26,000 individuals in nine 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. Thus, 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 is provided elsewhere.²² Informed consent was obtained from all participants.

The present study includes children aged 6-17 years at baseline in the years of 2000, 2004, 2006, 2009 and 2011 and their follow-ups up to 2011, as specific data for child body image was collected for those ages and years. Sample size varied by the number of participants across survey year, e.g., 2,079 children in 2000 and 1,536 in 2011. Children missing data for age, gender, weight/height measurements (5.9% of total participants), and body images (5.9% out 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 points during follow-up) were available for follow-up to examine BMI changes.

2. Assessment and measures

1) Child weight status—Child weight and height were measured to the nearest 0.1kg and 0.1cm in light indoor clothing and without shoes by trained and certified staff during the detailed physical examination. Child BMI (kg/m^2) 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 (IOTF) BMI cutoffs, which corresponded to BMI levels of 18.5, 25, and 30 at age 18, respectively.²⁴

After age 18, WHO classification of normal weight, OWB (BMI = 18.5, 25, and 30 as cutoffs) was employed.

2) Child body image—Children were asked to choose which silhouette (9 pictures representing being very thin to very obese) was most like them (self-assessed body image) and which one they wanted their body to look like (desired body image) using a silhouette-matching task. This measure is often used to relate body image with other characteristics and health factors.²⁵ Self-assessed body image showed 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.

3) 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, obese, not 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 analysis. Parental weight status was classified using the Chinese BMI cut-off points for overweight (BMI < 28kg/m²) and obese (BMI ≥ 28 kg/m²) with measured anthropometrics.

3. Statistical analysis

First, we cross-sectionally described the distributions of children's actual weight status, self-assessed and desired body images in 2000 vs. 2011 to examine their differences after ten years and by stratified groups of gender, age (two age groups were created as 6-11 and 12-17 years), and residence area using X² test.

For longitudinal analysis, we described children's baseline characteristics (n=4,605) in terms of sociodemographics and distributions of the child's actual weight status, self-assessed and desired body images, and discrepancies between self-assessed body image vs. actual weight status. For longitudinal trajectories of individual's weight status and self-body image during follow-up, we used the STATA "xttab" command to show the average fraction of time spent in a specific weight status/body image during follow-up in each demographic subgroup.

Finally, we tested the longitudinal associations between self-assessed body image and subsequent annual BMI changes during follow-up, using body image and anthropometrics at least two years post-baseline (n=2,324). Mixed models were applied for each subgroup, i.e., by gender, baseline weight status, cohort after 2006 vs. before 2006 (classified by the midpoint of 2000-2011), and urban/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-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 9.3 (SAS Institute, Cary, NC) and STATA 14 (StataCorp. College Station, TX). The effect size was presented as beta coefficients with standard errors. Statistical significance was set at p < 0.05.

Results

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

Compared to that in 2000, in 2011 the childhood OWB rate nearly tripled, 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 being “thin,” and only 2% retained self-perceived weight status as being fat. In contrast, over time, the thin body silhouette became more desirable (8.4 percentage points higher), while the fat body became less desirable (−1.2 percentage points, $p < 0.001$, Figure 1).

The stratified analysis (see 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 to be thin (−6.1%p) and more likely to perceive themselves as fat (1.7%p). Girls showed no changes over time.

Both boys and girls became having OWB significantly; they preferred underweight more and overweight less in terms of desired body shape (data not shown, all $p < 0.01$). Boys’ underestimates and overestimates in their body image compared to their actual measured weight status did not change significantly between 2000 and 2011; however, girls’ underestimates became even greater (39.2% to 49.1%). Boys had more inconsistency in their body perception (consistent: 40.3%) than girls (consistent: 45.0%; Figure 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 weight status under their actual weight status, and 6.9% perceived their weight status above their actual weight. Very few children desired a fat body (1.0%), and 57.4% selected average body silhouette size as ideal (see Table 2).

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

To investigate whether children have changed their body image along with their weight status variation during follow-up, we reported an individual’s self-perceived body image and weight status as a probability of change (see Table 3). Overall, more than 2/3 of children’s weight status and self-perceived body image remained the same when children belonged to one of the weight status/body image groups. Most of the demographic factors did not affect the remaining probability. The lowest remaining probability existed with children who perceived themselves as fat and having non-OWB parents; for children who ever rated themselves as fat, 57.6% of these children’s observed perceptions during follow-up were also fat.

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-body image on subsequent BMI change during follow-up

We tested the association between children's first self-body image and weight gain trajectory during follow-up and found that children who perceived themselves as fat at baseline had a higher BMI increase during follow-up than those with an average body image (β [SE]= 0.99[0.14] kg/m²/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 of an increase in BMI (-0.78 [SE= 0.33] kg/m² per year, $p < 0.05$), while young children (6-11 years old) had a higher BMI increase (1.25 [SE= 0.17] kg/m² per year, $p < 0.001$) after having self-perceived their body image as fat at baseline compared to those with an average body image. In contrast, self-perceived thinness led adolescents to a 0.34 kg/m²/year higher BMI increase than those with an average body image.

Boys (β [SE]= 1.37[0.19], $p < 0.001$) had about two times higher BMI gain than girls (0.62 [0.21], $p < 0.01$) 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 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 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 having OWB in the world yields several important findings. First, OWB prevalence in Chinese children had nearly tripled, from 6.5% to 16.8%, about one percentage point annually between 2000 and 2011. However, children's fat body perception 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 ten years. Third, a longitudinal analysis revealed that more than 2/3 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/year higher 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 lower BMI increase after perceiving themselves as fat at baseline compared to those with an average body image at baseline. Only recent cohort members (2006) had a significant association between fat body image and subsequent BMI increase, but older cohort members did not.

Children's body image has shown a significant association with their subsequent weight change in the previous studies.^{8,26} For example, underestimating weight status in both adults

and children has been presumed to cause impeded perception on adverse health behaviors and less effort for losing 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 Also, the self-assessed vs. 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 less likely to feel they had enough physical activity than those having consistent self-assessed vs. desired body images.²⁹ However, other longitudinal studies have revealed that being labeled as fat or having negative self-body image are associated with higher weight gain (e.g., β in BMI = 0.38 (SE= 0.13), $p<0.01$)¹⁹ and 0.25 [95% CI= 0.10-0.39])²⁰ and an increased risk of obesity (e.g., OR [95% CI], of having obesity= 1.6 [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 suggested that children's body dissatisfaction is accompanied by greater psychosocial distress and low self-esteem, regardless of gender, age, weight status, ethnicity or socio-economic status,³³ which evolved from internalized stigmatization of obesity by family, peers, and social media.²¹ Even non-overweight children who assessed they were 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 normal weight.³⁴

In China, children's self-perceived weight status was substantially influenced by their mothers' perceptions of the child's weight status. 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 were more likely to underestimate their weight status than girls.^{7,14} While girls are more likely to be sensitive to their body size³⁵ 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.¹³ Chinese girls are more likely to group terms such as prettier and normal to 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 had higher rates of adverse health behaviors, such as frequent sugar-sweetened beverage intake and excessive screen time, but showed less interest in their weight status and tried to lose weight less than girls.^{38,39} Our study found that fewer boys perceived their bodies as fat compared to girls, and boys had about two times higher BMI increase than girls after perceiving themselves as fat. Thus, as boys' self-perception of body as fat, their risk of having severely obese is much higher than girls, which may cause higher weight gain than girls due to internalized stigmatization, body dissatisfaction, psychosocial distress, and low self-esteem.

In addition, we found that rural children and the recent cohort only had a high BMI increase from self-perception as fat compared to 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.⁴⁰ Rural people may not view obesity negatively, and thus 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 future 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 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. Since data on body image, diet, and physical activity were not collected comparable between children and adults in 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 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 its association with obesity risk. This study provides useful insight to help fight the obesity epidemic in China and other countries worldwide.

In conclusion, during 2000-2011, children's perception of being fat has not changed much, but childhood obesity rates have increased rapidly in China. Increasingly more Chinese children view 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 to assist children in developing healthy body images, 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 appropriate body image and maintain healthy body weight.

Acknowledgments

Funding: The present study is funded in part by a research grant from a Global Center of Excellence Award (NIH, U54 HD070725), which were led by Prof. Youfa Wang. The U54 project (U54 HD070725) is funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) and by the Office of Behavioral and Social Sciences Research, NIH. During 2010-2011, as the principal investigator, Prof. Wang led an international collaboration team consisting of more than fifty investigators from multiple institutions in several countries, designed the project and secured funding support from the NIH and partner institutions, and established an obesity research center at Johns Hopkins University. The content of the paper is solely the responsibility of the authors and does not necessarily represent the official views of the funders.

References

1. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. *Int J Pediatr Obes*. 2006;1(1):11–25. [PubMed: 17902211]

2. Ogden CL, Carroll MD, Lawman HG, et al. Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 Through 2013-2014. *JAMA*. 2016;315(21):2292–2299. [PubMed: 27272581]
3. Lobstein T, Jackson-Leach R, Moodie ML, et al. Child and adolescent obesity: part of a bigger picture. *Lancet*. 2015;385(9986):2510–2520. [PubMed: 25703114]
4. Wang Y, Mi J, Shan XY, Wang QJ, Ge KY. Is China facing an obesity epidemic and the consequences? The trends in obesity and chronic disease in China. *Int J Obes (Lond)*. 2007;31(1):177–188. [PubMed: 16652128]
5. Wang Y, Monteiro C, Popkin BM. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am J Clin Nutr*. 2002;75(6):971–977. [PubMed: 12036801]
6. Mi YJ, Zhang B, Wang HJ, et al. Prevalence and Secular Trends in Obesity Among Chinese Adults, 1991-2011. *American journal of preventive medicine*. 2015;49(5):661–669. [PubMed: 26275960]
7. Wang VH, Min J, Xue H, Du S, Xu F, Wang H, Wang Y. What factors may contribute to sex differences in childhood obesity prevalence in China?. *Public Health Nutr*. 2018;26:1–9.
8. Meissner W The self and the body: I. The body self and the body image. *Psychoanalysis & Contemporary Thought*. 1997; 20(4): 419–448.
9. Di Pasquale R, Celsi L. Stigmatization of Overweight and Obese Peers among Children. *Front Psychol*. 2017;8:524. [PubMed: 28473781]
10. Sun H, Ma Y, Han D, Pan CW, Xu Y. Prevalence and trends in obesity among China's children and adolescents, 1985-2010. *PLoS One*. 2014;9(8):e105469. [PubMed: 25140709]
11. Cheng TO. China's little emperors: medical consequences of China's one-child policy. *Int J Cardiol*. 2013;168(6): 5121–5125. [PubMed: 24071388]
12. Jiang J, Rosenqvist U, Wang H, Greiner T, Lian G, Sarkadi A. Influence of grandparents on eating behaviors of young children in Chinese three-generation families. *Appetite*. 2007;48(3):377–383. [PubMed: 17166624]
13. Chen H, Jackson T. Predictors of changes in body image concerns of Chinese adolescents. *J Adolesc*. 2009;32(4):977–994. [PubMed: 18926567]
14. Xie B, Chou CP, Spruijt-Metz D, et al. Weight perception and weight-related sociocultural and behavioral factors in Chinese adolescents. *Prev Med*. 2006;42(3):229–234. [PubMed: 16458956]
15. Mathieu ME, Drapeau V, Tremblay A. Parental Misperception of Their Child's Body Weight Status Impedes the Assessment of the Child's Lifestyle Behaviors. *Int J Pediatr*. 2010;2010.
16. Yost J, Krainovich-Miller B, Budin W, Norman R. Assessing weight perception accuracy to promote weight loss among U.S. female adolescents: a secondary analysis. *BMC Public Health*. 2010;10:465. [PubMed: 20696060]
17. Duncan DT, Wolin KY, Scharoun-Lee M, Ding EL, Warner ET, Bennett GG. Does perception equal reality? Weight misperception in relation to weight-related attitudes and behaviors among overweight and obese US adults. *Int J Behav Nutr Phys Act*. 2011;8:20. [PubMed: 21426567]
18. Farhat T, Iannotti RJ, Caccavale LJ. Adolescent overweight, obesity and chronic disease-related health practices: mediation by body image. *Obes Facts*. 2014;7(1): 1–14.
19. Robinson E, Hunger JM, Daly M. Perceived weight status and risk of weight gain across life in US and UK adults. *Int J Obes (Lond)*. 2015;39(12):1721–1726. [PubMed: 26248659]
20. Robinson E, Sutin AR. Parental Perception of Weight Status and Weight Gain Across Childhood. *Pediatrics*. 2016;137(5).
21. Ratcliffe D, Ellison N. Obesity and internalized weight stigma: a formulation model for an emerging psychological problem. *Behav Cogn Psychother*. 2015;43(2):239–252. [PubMed: 25632949]
22. CHNS data collection 2016 Available: <http://www.cpc.unc.edu/projects/china/about/design/datacoll>. Accessed Jan. 29, 2016.
23. WHO Child Growth Standards. 2006 Geneva, Switzerland: World Health Organization (WHO) Press.

24. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320(7244):1240–1243. [PubMed: 10797032]
25. Marsh H, and Roche L. Predicting self-esteem from perceptions of actual and ideal ratings of body fatness: Is there only one ideal supermodel? *Research Quarterly for Exercise & Sport*. 1996; 6, 13–23.
26. Wang Y, Liang H, Chen X. Measured body mass index, body weight perception, dissatisfaction and control practices in urban, low-income African American adolescents. *BMC Public Health*. 2009;9:183. [PubMed: 19523206]
27. Duncan DT. Parental misperception of their child's weight status: clinical implications for obesity prevention and control. *Obesity (Silver Spring)*. 2011;19(12):2293. [PubMed: 22108706]
28. Solomon-Krakus S, Sabiston CM, Brunet J, Castonguay AL, Maximova K, Henderson M. Body Image Self-Discrepancy and Depressive Symptoms Among Early Adolescents. *J Adolesc Health*. 2017;60(1):38–43. [PubMed: 27793726]
29. Min J, Yan AF, Wang VHC, Wang Y. Obesity, body image, and its impact on children's eating and exercise behaviors in China: A nationwide longitudinal study. *Prev Med*. 2018;106:101–106. [PubMed: 29066373]
30. Hunger JM, Tomiyama AJ. Weight labeling and obesity: a longitudinal study of girls aged 10 to 19 years. *JAMA Pediatr*. 2014;168(6):579–580. [PubMed: 24781349]
31. Sutin AR, Terracciano A. Body weight misperception in adolescence and incident obesity in young adulthood. *Psychol Sci*. 2015;26(4):507–511. [PubMed: 25749701]
32. Min J, Wang VH, Xue H, Mi J, Wang Y. Maternal perception of child overweight status and its association with weight-related parenting practices, their children's health behaviours and weight change in China. *Public Health Nutr*. 2017:1–8.
33. van den Berg PA, Mond J, Eisenberg M, Ackard D, Neumark-Sztainer D. The link between body dissatisfaction and self-esteem in adolescents: similarities across gender, age, weight status, race/ethnicity, and socioeconomic status. *J Adolesc Health*. 2010;47(3):290–296. [PubMed: 20708569]
34. Cuypers K, Kvaloy K, Bratberg G, Midthjell K, Holmen J, Holmen TL. Being Normal Weight but Feeling Overweight in Adolescence May Affect Weight Development into Young Adulthood-An 11-Year Followup: The HUNT Study, Norway. *J Obes*. 2012;2012:601872. [PubMed: 22666556]
35. Birbeck D and Drummond M. Interviewing, and listening to the voices of, very young children on body image and perceptions of self. *Early Child Development and Care*. 2005; 175:579–596.
36. Jung F, Spahlholz J, Hilbert A, Riedel-Heller SG, Luck-Sikorski C. Impact of Weight-Related Discrimination, Body Dissatisfaction and Self-Stigma on the Desire to Weigh Less. *Obes Facts*. 2017;10(2):139–151. [PubMed: 28434008]
37. Veldhuis J, Te Poel F, Pepping R, Konijn EA, Spekman ML. "Skinny is prettier and normal: I want to be normal"-Perceived body image of non-Western ethnic minority children in the Netherlands. *Body Image*. 2017;20:74–86. [PubMed: 28006714]
38. Chang H, Xu F, Xue H, Wang Y. Changes in Physical Activity Patterns and Dietary Intake in Chinese Youth and their Associations with Obesity: A Longitudinal Study in Nanjing City, China. *The FASEB Journal*. 2016; 30(1): suppl 667.6.
39. Cheung PC, Ip PL, Lam ST, Bibby H. A study on body weight perception and weight control behaviours among adolescents in Hong Kong. *Hong Kong Med J*. 2007;13(1):16–21. [PubMed: 17277387]
40. Jia P, Xue H, Zhang J, Wang Y. Time Trend and Demographic and Geographic Disparities in Childhood Obesity Prevalence in China-Evidence from Twenty Years of Longitudinal Data. *Int J Environ Res Public Health*. 2017;14(4).
41. Yayan EH, Celebioglu A. Effect of an obesogenic environment and health behaviour-related social support on body mass index and body image of adolescents. *Glob Health Promot*. 2017:1757975916675125.

What is already known about this subject?

- Not only weight status underestimation, but also being labeled as fat has been revealed as a contributing factor to obesity, possibly due to the internalized stigmatization of obesity by family, peers, and social media.
- The striking increase in childhood overweight/obesity, social media, and cultural view (e.g., the gender difference in stereotypical image of children) may influence body image among Chinese children.
- No previous studies have examined how the body image of children has changed over time in line with the recent rapid increase in obesity in China.

What does this study add?

- The Chinese nationwide survey showed that the prevalence of childhood overweight had about tripled, but children's perception of being fat remained at 2% during 2000-2011.
- Self-body image of most original participants tracked during follow-up as the same as baseline.
- During follow-up, children who perceived themselves as being fat at baseline had a higher BMI increase subsequently, especially among boys, young, recent cohort, and rural children than their counterparts.

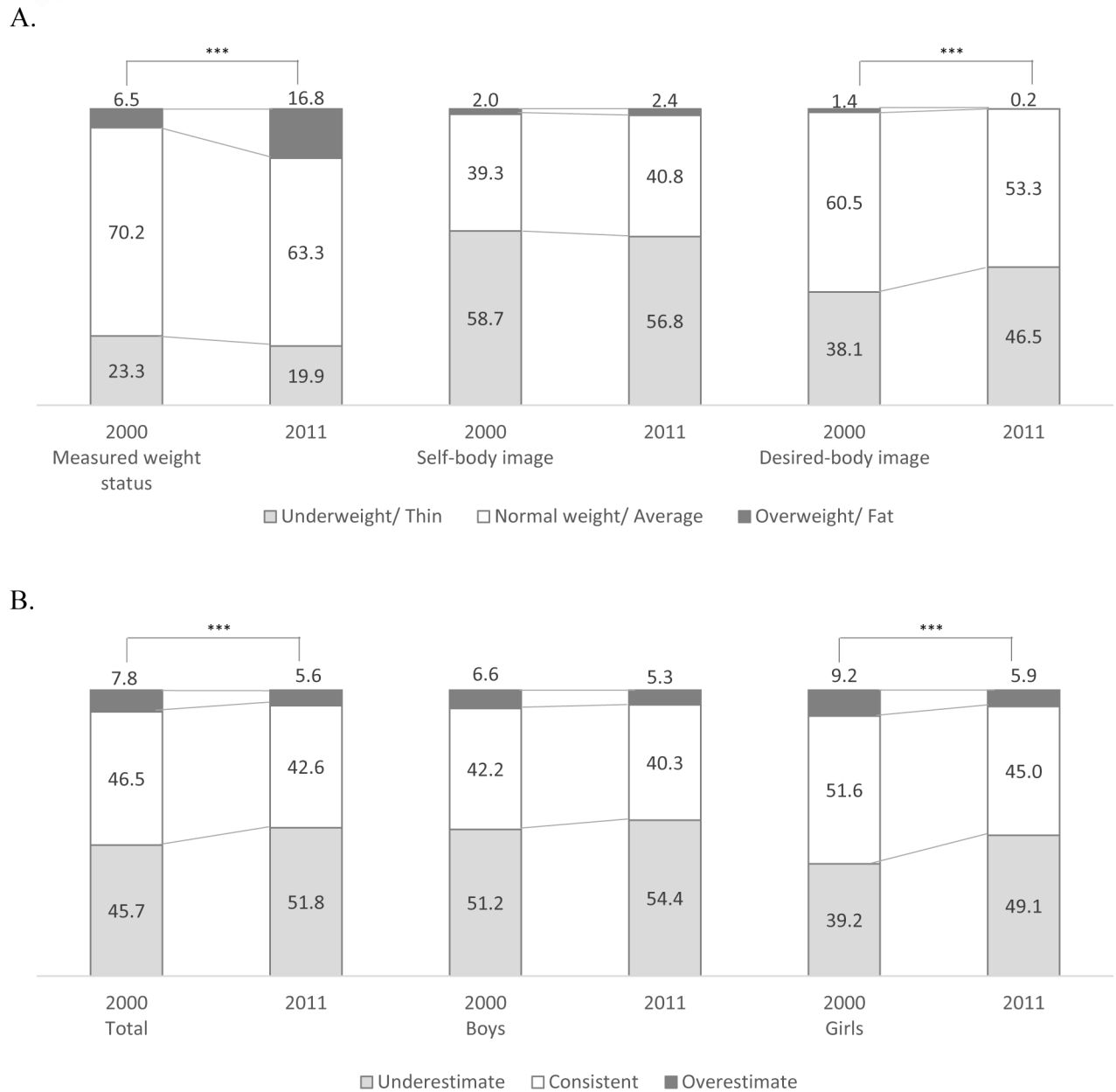


Figure 1. Cross-sectional distributions of child weight status (%)¹ and self-assessed and desired-body images (%)² in 2000 (n=2,079) and 2011 (n=1,536) among 6 to 17-year-old children in the China Health and Nutrition Survey (CHNS)³

A. Child measured weight status (based on BMI), and self-assessed and desired-body images (based on self-report)⁴

B. Sex difference in self-assessed body image vs. measured weight status (based on BMI)⁵ X² test was used to compare wave difference. *** p<0.001.

¹Child weight status was classified by the extended International Obesity Task Force BMI cut-offs.

²Children's body image ratings using nine silhouettes for, 1) that was most like them and 2) the one they would most like to look like were grouped into three levels: thin (silhouettes 1-3), average (silhouettes 4-6), and fat (silhouettes 7-9).

³We selectively presented the secular trend using 2000 and 2011 data with cross-sectional analysis.

⁴Boys and girls had significant changes in weight status and desired body image over time, except for the girls' self-body image.

⁵Child estimation of weight status was categorized as consistent/under-/over-estimate by comparing their body image with actual weight status based on the measured and calculated BMI and the International Obesity Task Force BMI cut-offs.

Table 1.

Cross-sectional comparison of self-assessed body image¹ between 2000 (n=2,079) and 2011 (n=1,536) by demographic characteristics among 6 to 17-year-old children in China Health and Nutrition Surveys (CHNS)²

	Self-assessed body image (%) ¹						p-value for time difference
	2000			2011			
	Thin	Average	Fat	Thin	Average	Fat	
All	58.7	39.4	2.0	56.8	40.8	2.4	0.41
Gender							
Boys	61.9	36.4	1.7	55.8	40.8	3.4	<0.01
Girls	54.9	42.8	2.3	57.9	40.7	1.3	0.20
p ³	<0.01			0.02			
Age							
6-11yr	62.0	35.4	2.6	58.2	39.3	5.5	0.23
12-17yr	56.0	42.6	1.4	54.9	42.9	2.2	0.45
p ³	<0.001			0.35			
Residence							
Rural	61.5	36.8	1.7	58.5	39.0	2.5	0.18
Urban	51.2	46.1	2.7	54.0	43.7	2.3	0.62
p ³	<0.001			0.19			

¹ Children's self-ratings using nine silhouettes for the most like them were grouped into three levels: being thin (silhouettes 1-3), average (silhouettes 4-6), and fat (silhouettes 7-9).

² We selectively presented the secular trend using the 2000 and 2011 data with cross-sectional analysis. The standard error of estimating self-assessed body image (%) varied between 0.3% to 1.3%. X² test was used to examine significant body image difference in terms of survey year, gender, age, and residential area.

³ P-value for testing between group differences.

Table 2.

Sociodemographic characteristics (%) of 6 to 17-year-old children and their body images from baseline data collected in the China Health and Nutrition Survey (CHNS) of 2000, 2004, 2006, 2009, and 2011 (n=4,605)

Baseline characteristics	%	Baseline weight status and body image	%
Sex		Measured weight status based on BMI ³	
Boy	53.2	Underweight	21.2
Girl	46.8	Normal weight	67.6
Age		Overweight	11.2
6-11 years	60.1	Self-assessed body image ⁴	
12-17 years	39.9	Thin	57.9
Parental obesity ¹ (n=4169)		Average	39.8
Overweight/obese	48.8	Fat	2.3
Others	51.2	Desired body image ⁴	
Highest parental education ² (n=4529)		Thin	41.6
< Middle school	18.0	Average	57.4
Middle & high school	66.9	Fat	1.0
Advanced degree(s)	15.1	Self-body image vs. measured weight status	
Residence		Consistent	44.1
Urban	31.0	Underestimate	49.0
Rural	69.0	Overestimate	6.9

Although CHNS started in 1989, in the present study 'baseline data' refers to the first observation of participants from pooled data of CHNS rounds in 2000, 2004, 2006, 2009 and 2011 in our longitudinal analysis. Participants with child height, weight, age, gender, and body images at least once during follow-up were included in data analysis. The standard error of estimating sociodemographic characteristics (%) varied between 0.1% to 0.7%.

¹Parental weight status was classified using the Chinese BMI cut-off points for overweight (24 BMI <28.0 kg/m²) and obese (> 28.0 kg/m²).

²Highest parental education was defined by the higher achieved degree of either parent.

³Child weight status was classified by the extended International Obesity Task Force BMI cut-offs, which correspond to BMI= 18.5, 25 and 30 at age 18, respectively.

⁴Children's self-ratings using nine silhouettes for 1) that was most like them and 2) the one they would most like to look like were grouped into three levels: thin (silhouettes 1-3), average (silhouettes 4-6), and fat (silhouettes 7-9).

Table 3.

Comparing longitudinal maintaining probability of measured weight status and self-assessed weight status (“body image”) at follow-up by baseline characteristics among 6 to 17-year-old children in the China Health and Nutrition Survey (CHNS) 2000 to 2011 (n=4,605)¹

	Measured weight status (%)			Self-assessed body image (%)		
	underweight	normal weight	overweight	thin	average	fat
All	79.5	90.4	79.0	85.0	78.8	67.9
By baseline characteristics						
1. Child sex						
Boy	79.0	90.6	79.1	84.9	77.6	67.2
Girl	80.0	90.3	78.8	85.0	80.2	69.1
2. Child age						
6-11 years	72.3	86.3	74.4	80.3	71.6	61.5
12-17 years	92.5	97.0	95.1	93.6	91.6	90.9
3. Parental weight status						
Overweight/obese	79.3	92.0	82.6	85.4	81.6	70.2
Other	79.7	88.6	69.5	84.0	75.6	57.6
4. Parental education						
< Middle school	79.2	89.7	74.7	85.6	76.7	64.0
Middle & high school	80.0	89.8	75.4	84.2	78.0	63.9
Advanced degree(s)	78.3	93.7	88.2	85.7	82.0	73.0
5. Family residence						
Urban	79.7	91.9	83.5	85.0	81.1	68.3
Rural	79.5	89.8	76.3	84.9	77.7	67.6

¹Participants with weight status defined by IOTF and body image (up to 18 years old) during follow-up were included in this analysis. The standard error of estimating maintaining probability (%) varied between 0.4% to 0.7%.

Children’s self-ratings using nine silhouettes for 1) that was most like them and 2) the one they would most like to look like were grouped into three levels: thin (silhouettes 1-3), average (silhouettes 4-6), and fat (silhouettes 7-9).

STATA xttab command was used for longitudinal analysis of remaining probability (within % in conditional transition probability), which presents the average fraction of the time spent in a specific weight status/body image during follow-up. For example, conditional on whether a child ever rated him/herself as “thin,” 84.9% of the child’s observations were “thin.”

Table 4.

Longitudinal associations of baseline self-assessed weight status and subsequent yearly average BMI change, by age, cohort, gender, and residence: China Health and Nutrition Survey (CHNS) 2000 to 2011 (n=2,324)^a

	Self-assessed weight status at baseline (reference= Average)	
	1. Perceived fat ('Fat')	2. Perceived thin ('Thin')
	β (SE) in annual average BMI increase (kg/m ²) ^b	
Among all	0.99 (0.14) ***	-0.02 (0.07)
Analysis stratified by:		
1) age at baseline		
6-11 years (n=1,613)	1.25 (0.17) ***	-0.09 (0.09)
12-17 years (n=711)	-0.78 (0.33) *	0.34 (0.14) *
2) 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)
3) 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)
4) measured weight status at baseline		
Overweight/obese (n=287)	0.97 (0.29) ***	-0.14 (0.15)
Non-overweight/obese (n=2,156)	1.13 (0.13) ***	-0.04 (0.03)
5) residence		
Urban (n=658)	0.45 (0.24) \pm	0.11 (0.13)
Rural (n=1,666)	1.34 (0.18) ***	-0.03 (0.09)

^a Participants having two BMI points during follow-up and the body image at baseline were included in this analysis. Thus, the sample size became smaller. Participant' age was ranged from 7 to 28-year-old. Self-body size 'average' (4-6 silhouettes) was used as a reference in models.

^b BMI increase (kg/m²) per year = difference in BMI between follow-up and baseline/follow-up years.

A mixed model was used after adjustment for child age (6 to 11-years-old/12 and above), gender, weight status at baseline, interaction between self-body image and weight status at baseline, household income level (tertiles), parental education (up to primary school/ middle school degree/ vocational or college degree or higher), residential area (urban/ rural), parental weight status (non-overweight/ overweight/ obese), and cohort and considering CHNS sampling methods and hierarchical data structure. Subgroup analysis applied the same mixed model except for the stratified variable.

p<0.001,

**
p<0.01,

*
p<0.05,

\pm
p<0.1.