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Longitudinal Analysis of Weight Perception and Psychological Factors in Chinese Adolescents

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Abstract

Objectives—To investigate associations of overweight status and perception with trajectories of psychological distress in adolescents.

Methods—Longitudinal data for 6,970 Chinese adolescents were included. The multivariate Curve-of-Factor Latent Growth Curve Models were adopted to examine trajectories of psychological distress symptoms and associations with overweight status and perception.

Results—After controlling for actual overweight status, psychological distress symptoms were weakly but significantly associated with overweight perception ($\gamma=0.08$ for boys and $\gamma=0.10$ for girls, $P<0.05$) and misperception ($\gamma=0.06$ for boys and $\gamma=0.09$ for girls, $P<0.05$).

Discussion—Our findings help understanding associations of overweight perception and psychological well being of adolescents.

Keywords

weight perception; Chinese adolescents; psychological distress

Introduction

Weight perception, which refers to the perception of one's body shape, is an important dimension of body image concern and plays a significant role in related behaviors.¹ The negative psychological effects of poor body image and distorted weight perception, such as low self-esteem, anxiety and depression, have been reported in some studies conducted in Western societies.^{2–7} Participants who perceive themselves as overweight may often feel isolated or discriminated against in social situations. Some studies related negative body image or weight dissatisfaction to poor psychological functioning, including family disharmony,^{7,8} dislike of school, or trouble with teachers.^{7,9} The underlying mechanisms have been presumably related to the Reflected Self-Appraisal Hypothesis and Social Comparison Theory^{10–12} which mainly involve cultural norms and social desirability of ideal weight and the process of self-appraisal and social comparison of body image and physical attractiveness. The Reflected Self-Appraisal Hypothesis is based on Cooley's concept of the "looking-glass self", which posits that an individual's self-concept, defined as the internalized view we have of ourselves, is socially constructed through the judgment of others and self appraisal.^{11–13} The Social Comparison Theory suggests that people engage in a process of self-evaluation, comparing themselves to others who they believe possess desirable social and cultural traits and, in turn, engage in behaviors designed to achieve the desired characteristics.¹⁰ Based on these mechanisms, the beliefs, feelings and thoughts about our body (weight, size, shape, function, capacities and appearance) are affected and refined by external social influences when we make external social comparisons with others and internalize the reflected appraisals. Given that overweight is viewed as a less desirable and more stigmatizing characteristic in the American culture, the process of self-appraisal or social comparison may explain why overweight individuals are at a heightened risk for negative psychological and behavioral outcomes, beyond the health risks of overweight.^{14,15} These underlying mechanisms are especially assumed to be operative in adolescents^{16,17} when dramatic changes occur in cognitive functioning as well as physical and psychological development.

Excessive weight concern and dissatisfaction with body image among children and adolescents are now just as prevalent as obesity in these age groups in both Eastern and Western societies.¹⁸ In mainland China, especially in the larger cities located in the interior and on the east coast, rapid economic development, modernization and industrialization during the last decade have resulted in a significant increase in body mass index (BMI) and a greater risk of obesity.^{19–21} As indicated in a recent dynamic analysis on obesity prevalence using data from the National Surveys on Chinese Students' Constitution and Health (NSCSCH) in 1985, 1991, 1995 and 2000, the prevalence of pediatric obesity has increased alarmingly in the developed metropolitan areas of China since the 1990s.²² In Xie et al study conducted on a representative sample of Chinese adolescents aged 11 to 14 years in Wuhan, China in 1999, 12.5% of boys and 9.2% of girls were overweight or obese.²³ Studies relating weight perception to psychological distress are very limited in Chinese child and adolescent populations. Shifts in cultural beliefs and ideals of beauty may also be occurring as a possible result of exposure to pervasive imported Western media, advertising, fashion and lifestyle among adolescents and youths.²⁴ A somewhat heavier body type was once considered to be a symbol of family fertility and wealth in China. While this belief may still exist in some rural and less economically developed areas, it seems to have become a thing of the past in urban areas and is gradually being replaced by a preference for a slim physique in girls.^{23–25} This shift in body ideal is mainly attributable to the impact of advertising from TVs, magazines and newspapers, and to the popularization of hyper-slim movie stars, pop music idols and models.²⁴ Studies evaluating ideal body size expectancy and eating disorders reveal that the pursuit of a slim physique has clearly become a collective phenomenon among girl Chinese high school and university students.^{24,25} Our previous findings from cross-sectional analyses in representative samples of adolescents in Wuhan²³ and 6 other large cities in China²⁶ showed that boys and girls with

overweight perception or misperception experienced relatively higher levels of perceived stress, anxiety and depressive symptoms than those without overweight perception or misperception. Results of one survey conducted in 3 urban and 3 rural middle schools revealed 5.8% of boys and 6.7% of girls had unhealthy weight reducing behaviors such as dieting, using diet pills or tea, and self-induced vomiting in the past week.²⁷ A couple of school-based studies in China have reported varying rates for the prevalence of eating disorders, from 1.3% to 5.21% among females aged 15 to 24 years old.^{28,29} In a recent study of 2103 adolescents and young adults living in China, 2.3% participants were found to meet the full DSM-IV criteria for an eating disorder or an eating disorder not otherwise specified (EDNOS).³⁰

As adolescence is a critical period of life characterized by remarkable changes in cognitive functioning as well as physical and psychological development,^{7,17} the underlying psychosocial process relevant to overweight perception or misperception and psychosocial adjustment problems is assumed especially operative.¹⁴ Longitudinal data with repeated measures of overweight status, weight perception and symptoms of psychological distress are needed to capture the potential growth trajectories of psychological distress symptoms and examine their dynamic interrelationships overtime with the body weight perception during adolescence. In addition, multiple symptoms of psychological distress such as anxiety, perceived stress and depressive symptoms are often co-occurring in adolescents.³¹ Scant efforts in the past have been made to quantify the development of co-morbidly occurring multiple symptoms of psychological distress with a statistically sound analysis. In this study, we try to replicate our previous findings from baseline cross-sectional analyses with longitudinal data from the China Seven Cities Study (CSCS). In the CSCS study, 3 gateway symptoms of psychological distress (i.e. perceived stress, hostility and depressive symptoms), weight status and perception were repeatedly measured in 2 follow-up cohorts of 7th and 10th graders living in 7 large cities located in 4 geographical regions of China.^{26,32,33} An advanced and novel statistical approach was employed to link overweight status and weight perception to the developmental course of co-occurring multiple psychological distress symptoms in Chinese adolescents. Our results are expected to greatly contribute to the current body of literature of psychological influences of overweight and overweight perception in adolescents during the growth spurt period.

METHODS

Data Sources and Sample Selection

We utilized data from a longitudinal health promotion program conducted in the years 2002–2004 among 2 cohorts of 7th and 10th graders in the CSCS. The purposes of the CSCS were to assess the psychosocial, economical and cultural influences on cigarette use, alcohol drinking, and overweight which would lead to the development of a community-based intervention program. The 7 cities were located in 4 regions in China: the Northeastern (Harbin, Shenyang), Central (Wuhan), Southwestern (Chengdu, Kunming), and Coastal (Hangzhou, Qingdao) regions. Detailed sampling procedures were described in our previous published papers.^{26,32,33} A stratified sampling strategy was adopted to randomly select middle, traditional high and professional high school samples in each city. In each city, districts with the highest, middle, and the lowest residential incomes were identified. Within each identified district, the middle and traditional high were grouped according to 3 levels of academic performance. One middle school and one traditional high school were randomly selected from each of the 9 (3 levels × 3 districts) clusters to participate in the study. One class each from grades 7, 8 (middle school), 10 and 11 (high school) were recruited for the study. For the professional high schools, only one school was selected from each district. These professional schools were matched across districts based on number enrolled, type of occupational training, and male/female student ratios. Two academic majors were randomly selected and students in each of the 10th and

11th grades in these majors were recruited. Parents of the students were also invited to participate in the study. Parents completed their questionnaires at home while students completed the questionnaire during class time, and classroom teachers were not present during the survey period. Questionnaire items were translated from English to Mandarin, then back translated to English by separate translators fluent in both languages and trained in behavioral science theory and tobacco use research. To insure that each item captured the proper idiomatic language, each item was reviewed for consensus by a group of English and Chinese-speaking tobacco researchers and graduate students. The final versions of the questionnaires were approved by the Education Committees and CDC research teams in each of the 7 participating Chinese cities prior to administration. The study protocol was approved by the Institution's Committee on Human Participants from the University of Southern California and the Education Committees and CDC research teams in each of the 7 participating Chinese cities. In the present study, the initial analysis sample at baseline in the year 2002 was 6,970 after we excluded 240 cases with biological extreme observations of weight, height, and missing reports of age, weight, height, and weight perception. The sample size in the follow-up was reduced to 6,118 (87.8% of baseline sample) in year 2003 and 5,209 (74.7% of baseline sample) in the year 2004.

Measures

Perceived stress—Three items were adapted from Cohen's perceived stress scale.^{34–35} Participants were asked about the frequency of any of the following problems they had experienced in the past month: (1) "How often have you felt nervous and 'stressed'?" (2) "How often have you found that you could not cope with all the things that you had to do?" and (3) "How often have you felt difficulties piling up so high that you could not overcome them?" The response scales were "Never (0 days)," "Almost Never (1–2 days)," "Sometimes (3–5 days)," "Fairly Often (6–15 days)," and "Very Often (15+ days)." The responses were recoded from 0 to 4, and summed for all 3 items as a composite score. Cronbach's alpha was 0.83, 0.87 and 0.84 in the years 2002–2004.

Hostility—Three items were adapted from Buss-Durkee³⁶ to assess participants' levels of hostility. The items included (1) "I lose my temper easily," (2) "I can't help being a little rude to people I don't like," and (3) "Lately, I have been kind of grouchy." The response options included "strongly disagree," "disagree," "agree," and "strongly agree." Cronbach's alpha was 0.67, 0.76 and 0.71 in the years 2002–2004.

Depressive symptoms—The short form of the Center for Epidemiological Studies Depression Scale (CES-D) was used to measure participants' depressive symptoms.^{37, 38} The 3 items were: "Think about how you felt during the past 7 days. On how many of these days (1) did you have trouble shaking off sad feelings? (2) did you feel depressed? (3) did you feel sad?" Participants were asked to rate the frequency of each symptom during the past week on a 4-point Likert scale representing "0–1 day," "2–3 days," "4–5 days," and "6–7 days." Cronbach's alpha was 0.84, 0.87 and 0.85 in the years 2002–2004.

BMI and overweight status—Measurements of height and weight were collected using a standard calibrated scale and stadiometer, with participants wearing light clothes with either thin socks or barefoot. Body weight was measured to the nearest 0.1 pounds then subsequently converted to kilograms and height was recorded to the nearest 0.1 centimeters. Body mass index was calculated as weight in kilograms divided by height in meters squared. Overweight status was defined based on BMI at or greater than the 85th age- and gender-specific percentile cutoffs of the International Obesity Task Force (IOTF) BMI reference data.³⁹

Overweight perception and misperception—Participants were asked to describe their body weight status in terms of the following response options: “too thin,” “relatively thin,” “all right,” “relatively heavy,” and “too heavy.” This item was adopted from the Youth Risk Behavior Surveillance System (YRBSS) (<http://www.cdc.gov/HealthyYouth/yrbs/index.htm>) to assess self-perception of weight status. This measure has been widely used in several previous studies.^{23,40–43} Participants who described themselves as relatively heavy or too heavy were classified as ‘perception of overweight’. Participants who described themselves as relatively heavy or too heavy but were not actually overweight were classified as ‘misconception of overweight’.

Other baseline covariates—Some previous papers have indicated that socioeconomic status (reflected by parental education and family income levels) and puberty status may not only be related to overweight risk and weight perception, but also correlated with depressive symptoms. Controlling for the effects of these variables may enable us to have a better and clearer understanding of the independent relationships between weight perception and psychological factors. Taking puberty as an example, driven by both growth and sex hormones, adolescents during puberty experience sexual maturation and a fast accumulation in both lean and fat mass. Early maturation in both boys and girls has been suggested to enhance the risk of being overweight and further influence the severity of obesity in adulthood.^{44,45} For boys, in addition to the increase in fat mass accumulation, most of the weight gain is explained by an increase in muscle tissue, while for girls the physical changes of puberty involve significant deposition of fat mass on abdomen, buttocks and thighs.⁴⁶ The increase in fat mass accumulation is significantly greater in girls than boys. Because of this additional weight and body fat, puberty is associated with a rise in body dissatisfaction.⁴⁷ Significant relationships between early onset of menarche and lower ratings of body image were observed in large-scale studies.⁴⁸ Socioeconomic status can be another example. There are a large number of previous studies linking socioeconomic status (SES) with risk of obesity, and a positive association of obesity risk with urbanization, education, and other indicators of high SES status in developing countries including China have been revealed.⁴⁹ Class or level of socioeconomic status was also reported to have a consistent relationship with weight concern. To be specific, higher-class female subjects were more likely to place greater importance on physical appearance and thin ideal body size, and reported higher levels of body dissatisfaction than lower-class subjects.⁵⁰

Parents’ education levels—Father and mother’s education levels were provided by students’ parents and surveyed in categorical increments ranging from illiterate to college diploma or higher. Years of education were obtained by converting these categories to corresponding school years. The highest level of education attained by either the father or the mother was retained and further collapsed into 3 categories: below senior high school, senior high school, and college.

Family income—Monthly family income was determined by parents’ response to the question “What is your total monthly family income from all sources?” The response options ranged from “<100 yuan/month” (<\$12 USD/month) to “>10,000 yuan/month” (>\$1,200 USD/month), and was collapsed into “≤500 yuan/month” (≤\$60 USD/month), “501–2,000 yuan/month” (\$61–240 USD/month), and “>2,000 yuan/month” (>\$240 USD/month).

Pubertal status—In the baseline questionnaire, girls were asked to report the age of their first menses, and boys were asked to report the age when they first noticed changes in their Adams’ apple, voice, or the growth of a beard as a proxy for measurement of pubertal status. The original questions were: “How old were you when you had your first menstruation(for girls)?” and “How old were you the first time you found that your Adam’s apple got bigger,

or that your voice changed, or that you had started to grow a beard (for boys)?". Participants who reported "has not happened yet" were defined as "pre-pubertal status," while participants giving specific ages were defined as "peri/post-pubertal status." This measure has been used earlier to assess the pubertal status in Chinese adolescents.⁵¹

Data Analysis

Descriptive statistics (mean, standard deviation, and percentage) were calculated to reflect the background characteristics of the sample. The longitudinal associations of overweight and overweight perception with symptoms of psychological distress were analyzed in the Latent Growth Curve Modeling (LGCM) approach. In LGCM approach, trajectory of variables changing over time can be described in latent growth factors (e.g. intercept and linear slope).⁵² In this study, adolescent's symptoms of psychological distress were repeatedly measured by 3 different constructs (i.e. hostility, perceived stress, and depressive symptom experience). In our preliminary analyses, unconditional LGCM was constructed for each of the psychological symptoms. In addition to a linear model with fixed slope loadings (i.e. 1, 2, 3), an unspecified nonlinear model with parts of the slope loadings being freely estimated was constructed as well. Comparison of the goodness of fit indicated no significant difference in model fittings between the two models and the linear model should be parsimonious and good enough to reasonably characterize the shape of change trajectory for each psychological symptom. Exploratory factor analysis conducted at each wave suggested one underlying common factor with adequate factor loadings for perceived stress, hostility, and depressive symptoms respectively (time 1: 0.82, 0.82 and 0.65; time 2: 0.83, 0.79 and 0.68; time 3: 0.84, 0.82 and 0.60). Therefore, statistically we applied a multivariate Curve-of-Factor LGCM approach to describe trajectories of common higher order constructs of psychological distress.^{53–55}

Figure 1 depicts the model tested in this study. In this model, multiple symptoms of psychological distress (i.e. hostility, perceived stress and depressive symptoms) measured at each time point were factor-analyzed to produce factor scores for the purpose of modeling change trajectory of psychological distress. The common factors obtained at 3 time points were then used as time-varying indicators to define intercept and slope factors of psychological distress growth curve. Repeatedly measured weight status and weight perception were incorporated as time-varying covariates predicting psychological distress. Moreover, the growth factors were also regressed on baseline covariates (i.e. grade, puberty, parental education, family income and city residence) with consideration of random variation in the growth factors across individuals. The key hypotheses we aim to test are related to the dynamic interrelationships between overweight status, overweight perception and misperception and multiple symptoms of psychological distress over time. We hypothesize that the overweight status, overweight perception or overweight misperception will be related to higher risk of the development of co-occurring multiple symptoms of psychosocial distress. We also considered alternative multivariate LCGM approach such as the Factor-of-Curve modeling procedure that uses second-order common factors to describe the relations among the first-order growth factors (i.e. intercepts and slopes) of different symptoms of psychological distress.^{53,55} However, the unconditional model provided a poor fitting with the data: $\chi^2=1580$ (df=30), $P<0.01$, the relative chi-square=52.7, CFI=0.88, and RMSEA=0.086 (95% CI= 0.083–0.090). Consequently, we did not explore other Factor-of-Curve alternatives.

Several indices were used in this study to evaluate the fit of a model: (1) the χ^2 statistic, which needs to be non-significant ($P>0.05$). Since the χ^2 statistic is sensitive to sample size and can be a difficult index to satisfy, a relative chi-square calculated by the chi-square fit index divided by degrees of freedom was used as well in an attempt to make it less dependent on sample size. A cutoff of 2 or 3 for an acceptable model has been recommended^{56,57}, but it is ever allowed

to be as high as 5 to consider a model adequate fit⁵⁸. (2) the Comparative Fit Index (CFI), which needs to be greater than .90; and 3) Root Mean Square Error of Approximation (RMSEA), a population-based index of badness of fit, which measures the amount of error in the model. The RMSEA for a model with good fit should ideally be <0.05, though a fit of < 0.08 is considered acceptable.^{56,59} SAS (version 9.12) and Mplus (version 4.1) were used for data management and all preliminary and formal hypothesis-testing analyses. In this study, the percentage of missing data across all psychological and weight-related variables ranged from 15.0% to 15.7% at the 2nd wave and from 27.2% to 31.1% at the 3rd wave of follow-up. Baseline control variables of puberty, parental education and family income had less than 8% of missing data. Comparisons of baseline characteristics, weight-related variables, and composite scores of psychological measures between participants who had missing responses in the follow-up waves and those who did not, revealed no significant difference. Full information maximum likelihood (FIML) built in the Mplus software was applied to compute maximum likelihood parameter estimates and standard errors from data with missing values.^{60–62} FIML provides efficient estimation of statistical parameters from incomplete data^{60–62} and thus allows retention of the complete sample for all analyses. Parameter estimates from FIML provide less biased information than ad hoc procedures such as list-wise deletion, pair-wise deletion, or single imputation of means.^{60–62} Because gender difference in weight status, weight perception, and their relationships with psychological distress were observed in our previous analyses with baseline data, a multiple-group approach of Curve-of-Factor LGM analysis was originally considered to make gender comparisons. However, the linear unconditional measurement multiple-group model (e.g. a multiple-group model containing no covariates) exhibited a substantial difference in change trajectory measurement patterns between boys and girls with a poor model fitting with CFI of 0.379 and RMSEA of 0.238 (95% CI: 0.233–0.242). The substantial variation of underlying change trajectory in the measurement model suggested a common development model that does not exist across gender. Therefore, stratified models of LGM analysis approach built on different gender-specific measurement models were conducted and reported in this paper.

RESULTS

General Characteristics

General characteristics of psychological variables, weight status, and weight perception across 3 waves and baseline control variables were presented in Table 1a and Table 1b. Consistent with our previous observation with baseline data,^{26,32} more boys than girls were overweight ($P<0.01$), while substantially more girls perceived or misperceived themselves as overweight than did boys at each of the follow-up waves ($P<0.01$). Compared with boys, girls reported significantly higher levels of hostility, perceived stress and experience of depressive symptoms ($P<0.01$).

Unconditional Model of LGM Analysis

A linear unconditional model was constructed for boys and girls separately to examine the viability of the Curve-of-Factor LGM. The model fit for boys was $\chi^2(df=20)=42.4$, $P<0.01$, the relative chi-square=2.12, CFI=0.996 and RMSEA=0.018, which suggested the model fit the data very well. In this multivariate LGCM, the factor loading of the variable hostility was specified as a fixed parameter (i.e. 1.00) as a metric reference for the first-order common factor of psychological distress, while the loadings for the other variables (i.e. perceived stress and depressive symptoms) were freely estimated and constrained to be equal across time. These loadings were statistically significant and sizable ($\lambda_a=3.02$, $t=22.6$ for perceived stress; $\lambda_b=1.79$, $t=25.50$ for depressive symptoms). The mean levels of the higher order common factors of the psychological distress intercept and slope were statistically significant (standardized intercept: $M_i=4.03$, $t=22.3$; standardized slope: $M_s=-0.39$, $t=9.1$). On average,

the level of psychological distress was slightly but significantly decreased over time with significant variations among individuals in their initial status (variance of intercept $D_i=0.04$, $t=9.7$) and growth trajectory (variance for slope $D_s=0.008$, $t=4.9$). The correlation between intercept and slope (R_{is}) was -0.45 ($t=4.1$), which suggested adolescents with higher initial level of psychological distress would experience greater decrease of change trajectory over time.

Similar results were observed in the unconditional model for girls. The model fit very well with $\chi^2(df=20)=58.4$, $P<0.01$, the relative chi-square=2.92, CFI=0.995 and RMSEA=0.023. Loadings for the first-order common factor of psychological stress were 2.90 ($t=27.0$) for perceived stress and 2.15 ($t=27.4$) for depressive symptoms. There was a significant decline of the average level of initial status ($M_i=4.70$, $t=26.7$) with a negative slope ($M_s=-0.22$, $t=4.63$). The correlation between initial status and slope trajectory (R_{is}) was -0.27 ($t=2.39$), indicating a trend of higher initial level of distress and greater decrease over time.

Conditional Model of LGCM Analysis

In the conditional models, we incorporated repeated measures of actual, perceived and misperceived overweight status as time-varying covariates and related them to the repeated first-order common factor of psychological distress on these time-varying covariates. For boys and girls separately, five different models were constructed in a hierarchical order (M_1 : actual overweight only; M_2 : perceived overweight only; M_3 : perceived overweight and actual overweight; M_4 : misperceived overweight; M_5 : misperceived overweight and actual overweight). In all these models, the second-order growth factors (i.e. intercept and slope) were regressed on baseline control variables (i.e. grade, puberty, parental education, family income, and city residence). We also compared two models with and without equality constraints specified for regression coefficients from three time-varying covariates to two repeated dependent variables, and did not observe substantial and significant difference in model fit. Therefore, the model with equal regression coefficients for time-varying covariates was chosen for hypothesis-testing. Results of parameter estimates and fitting indices for each model are summarized in Table 2. All models fit the data very well with CFI ranging from 0.951 to 0.964 and RMSEA ranging from 0.021 to 0.032. In both boys and girls, overweight perception (In M_2 : $\gamma=0.05$ for boys and $\gamma=0.09$ for girls, $P<0.05$) and misperception (In M_4 : $\gamma=0.06$ for boys and $\gamma=0.08$ for girls, $P<0.05$) were significantly related to psychological distress, while no significant relationship was observed between actual overweight and symptoms of psychological distress (in M_1 for boys and girls). The significance for overweight perception (In M_3 : $\gamma=0.08$ for boys and $\gamma=0.10$ for girls, $P<0.05$) and misperception (In M_5 : $\gamma=0.06$ for boys and $\gamma=0.09$ for girls, $P<0.05$) remained even after adjustment of actual overweight status.

DISCUSSION

This study represents the first longitudinal analysis effort examining associations of overweight status and perception with change trajectory of psychological distress in Chinese adolescents. The proportion of overweight perception and misperception in the overall sample was consistently high over 3 years of follow-up, which was about 40% in overweight perception and 25% of misperception. In line with our previous research,^{23,26} relatively higher proportion of girls than boys perceived or misperceived themselves overweight, although the prevalence of overweight was higher in boys. As an important aspect of body image, weight self-perception is most likely to reflect dissatisfaction with and concerns about body weight.¹ The high proportion of overweight perceptions and unrealistic, distorted perceptions compared with the actual weight status of our participants suggest that weight dissatisfaction and weight concerns are common in Chinese adolescents amid a rapidly transitioning economic climate with its resultant changing nutritional and daily living habits. Future research is needed to investigate

how these weight concerns and attitudes might be related to healthy and unhealthy weight control behaviors in this adolescent population.

In this study, slight but significant decline in experience of psychological distress symptoms was observed during the follow-up time period, and the significant variation around the group means across individuals was also evident. Both boys and girls who perceived or misperceived overweight status consistently reported slightly but significantly higher levels of psychological distress symptoms than their counterparts without overweight perception or misperception even after controlling for actual overweight status. This observation, together with other similar reports in the literature,^{7,23,26,63,64} may further confirm our previous conclusion that weight perception may transcend actual body weight as a predictor of detrimental psychological effects, which may suggest a relatively more important role of weight perception, rather than the biological variable of body fat, in prediction of depressive psychological morbidity and other negative psychological outcomes.^{23,26}

In interpreting the results of this study, several limitations must be noted. First, in order to keep the survey short, a minimum of items representing each construct were retained. This may jeopardize the reliability of our psychological measures. Secondly, although BMI has been widely used as an effective screening assessment tool for overweight and obesity in large-scaled epidemiological studies, it does not capture adiposity. Therefore, more reliable and accurate biological measures on general and central adiposity need to be considered in future studies.

CONCLUSION

The findings of this study confirm our previous observations on the association of experience of psychological distress symptoms with overweight perception and misperception. As both overweight and weight concerns increase in China, promoting appropriate and realistic body image ideals may become a critical component of obesity prevention programs to ensure the physical and psychological well being of adolescents. Additional research is required to investigate adverse psychological effects of misperceptions of overweight among Chinese students, especially as Westernization will likely continue. Further studies should also address the impact of Westernization on lifestyle behaviors including diet and physical activity, body image, and important psychological correlates such as depression and eating disorders.

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Fig 1.

The multivariate Curve-of-Factor Latent Growth Curve Model. Y_1 – Y_3 : hostility at time 1–time3; Y_4 – Y_6 : perceived stress at time 1–time 3; Y_7 – Y_9 : depressive symptoms at time 1–time 3. F_1 – F_3 : common factor of psychological distress at time 1–time 3. λ_a and λ_b : factor loadings equally constrained across time. E_1 – E_9 : residual error terms for Y_1 – Y_9 . D_1 – D_3 : disturbance of F_1 – F_3 . F_4 – F_5 : intercept and slope factors of change trajectory. M_i and M_s : means of intercept and slope. D_i and D_s : variances of intercept and slope. R_{is} : covariance between intercept and slope. X_1 – X_3 : repeated measures of overweight status and perception. γ : regression coefficient from time-varying X_1 – X_3 to time-varying F_1 – F_3 , and was equally constrained across time. C_1 – C_5 : baseline control variables including grade, puberty, parental education, family income and city residence.

Table 1

Table 1a. Sample Characteristics Over Study Period						
Total			Male		Female	
	Mean	SD	Mean	SD	Mean	SD
Psychological Factors						
Depressive Symptoms (3 items)						
2002	1.50	0.68	1.43	0.65	1.57	0.69
2003	1.48	0.69	1.43	0.68	1.53	0.69
2004	1.36	0.63	1.31	0.61	1.41	0.64
Hostility (3 items)						
2002	2.35	0.54	2.27	0.56	2.42	0.51
2003	2.25	0.61	2.14	0.63	2.35	0.58
2004	2.28	0.60	2.19	0.63	2.37	0.56
Perceived Stress (3 items)						
2002	2.48	0.89	2.39	0.89	2.57	0.88
2003	2.40	0.89	2.27	0.89	2.52	0.87
2004	2.34	0.94	2.18	0.96	2.49	0.90

Table 1b. Sample Characteristics Over Study Period						
Total			Male		Female	
	n	%	n	%	n	%
Weight Status and Weight Perception						
Overweight						
2002	1253	17.98	771	22.51	482	13.60
2003	930	15.83	606	21.42	324	10.64
2004	742	15.45	470	20.65	272	10.76
Perceived Overweight						
2002	2814	40.37	1007	29.40	1807	50.97
2003	2415	40.79	838	29.31	1577	51.50
2004	1991	39.22	702	28.81	1289	48.84
Misperceived Overweight						

Table 1b. Sample Characteristics Over Study Period

	Total			Male			Female		
	n	%	n	%	n	%	n	%	
2002	1713	24.58	347	10.13	1366	38.53			
2003	1577	26.85	316	11.17	1261	41.41			
2004	1225	25.50	256	11.25	969	38.33			
	Other Control Variables at Baseline (2002)								
Grade									
7th	2895	41.54	1480	43.21	1415	39.92			
10th	4075	58.46	1945	56.79	2130	60.08			
Puberty									
Prepubertal	1114	16.11	634	18.67	480	13.64			
Peri/Postpubertal	5802	83.89	2762	81.33	3040	86.36			
Parental Education									
Below High School	1734	26.80	852	27.00	882	26.61			
High School	2713	41.93	1336	42.33	1377	41.54			
College or above	2024	31.28	968	30.67	1056	31.86			
Family Income									
<=500 yuan	876	13.63	424	13.53	452	13.73			
501–2,000 yuan	3980	61.95	1968	62.80	2012	61.14			
>2,000 yuan	1569	24.42	742	23.68	827	25.13			
City Residence									
ChengDu	1126	16.15	536	15.65	590	16.64			
HangZhou	849	12.18	406	11.85	443	12.50			
ShenYang	1122	16.10	547	15.97	575	16.22			
WuHan	965	13.85	470	13.72	495	13.96			
Harbin	924	13.26	471	13.75	453	12.78			
KunMing	988	14.18	513	14.98	475	13.40			
QingDao	996	14.29	482	14.07	514	14.50			

Table 2

Parameter Estimates and t Values in the Conditional Models

	Estimate [#]	t Value	X ² (df)	p for X ²	Relative X ²	RMSEA	CFI
Male							
M1: OWT	-0.011(-0.021--0.022)	1.56	337.6(116)	<0.001	2.9	0.024	0.963
M2: POWT	0.022(0.046-0.049)	3.61	339.2(116)	<0.001	2.9	0.024	0.963
M3: POWT + OWT			367.2(142)	<0.001	2.6	0.022	0.963
POWT	0.038(0.079-0.083)	5.13					
OWT	-0.034(-0.064--0.069)	4.05					
M4: MPOWT	0.040(0.057-0.059)	4.77	344.5(116)	<0.001	2.9	0.024	0.962
M5: MPOWT + OWT			359.4(142)	<0.001	2.5	0.021	0.964
MPOWT	0.039(0.056-0.058)	4.56					
OWT	-0.003(-0.006)	0.42					
Female							
M1: OWT	0.003(0.004-0.005)	0.32	505.4(116)	<0.001	4.3	0.031	0.953
M2: POWT	0.040(0.092-0.093)	7.19	532.2(116)	<0.001	4.5	0.032	0.95
M3: POWT + OWT			553.1(142)	<0.001	3.8	0.029	0.951
POWT	0.041(0.095-0.096)	7.27					
OWT	-0.011(-0.016--0.018)	1.23					
M4: MPOWT	0.035(0.080)	6.5	528.5(116)	<0.001	4.5	0.032	0.951
M5: MPOWT + OWT			550.8(142)	<0.001	3.8	0.028	0.951
MPOWT	0.040(0.092)	6.98					
OWT	0.026(0.037-0.042)	2.79					

[#] Unstandardized estimates are not in parentheses and range of standardized estimates are in parentheses. OWT: Overweight; POWT: Perceived overweight; MPOWT: Misperceived overweight. All conditional models controlled for baseline grade, puberty, parental education, family income and city residence. t values equal to or greater than 1.96 are significant at p<0.05. M1-M5: Model 1-5.