

## Report on Childhood Obesity in China (5) Body Weight, Body Dissatisfaction, and Depression Symptoms of Chinese Children Aged 9-10 Years<sup>1</sup>

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**Objective** To investigate the relationship between body weight, body dissatisfaction and depression symptoms among Chinese children. **Methods** The fasting body weight and height of the third and fourth grade students ( $n=3886$ , aged 9 or 10 years) from 20 schools in Beijing, China, were measured, and the students were asked to choose the figures of body image and to complete the self-reported children's depression inventory (CDI) questionnaire. **Results** The CDI Cronbach's alpha was 0.81. The total CDI score was  $9.60 \pm 7.50$ , 13.2% of children (boys 16.7% vs girls 9.5%) were at risk of developing depression symptoms. Overweight girls, but not boys, had significantly higher total CDI score than their normal weight counterparts. Both obese girls and boys showed a higher negative self-esteem score. More than one fifth underweight girls still wanted to be thinner while more than one third obese boys still wanted to be heavier. Children who wanted to be thinner showed slightly higher scores of ineffectiveness and negative self-esteem. After introducing the body dissatisfaction into the model, overweight was still associated with total CDI score among girls and obesity was still associated with negative self-esteem among both boys and girls. **Conclusion** Overweight girls show a significantly higher depression symptom score than their normal weight counterparts, which maybe partially explained by body dissatisfaction. Obese boys and girls are both more likely to suffer from low self-esteem, which is partially explained by body dissatisfaction.

**Key words:** Depression symptoms; Body dissatisfaction; Overweight; Children

### INTRODUCTION

It is commonly believed that overweight children are unhappy with their weight and experience more psychosocial distress, particularly depressive symptoms<sup>[1-2]</sup>. Body mass index (BMI) is related to body dissatisfaction in children, particularly in girls. Body dissatisfaction is higher in overweight and obese children and adolescents than in their normal-weight counterparts<sup>[3-4]</sup>. Researches have shown that adult women and female adolescents have a connection between depression and body weight<sup>[5-8]</sup>. Among a clinical sample of obese children and adolescents, 50 percent of subjects are classified as depressed<sup>[8]</sup>. Erermis *et al.*<sup>[9]</sup> reported that the obese group has a slightly higher score than normal weight controls. Rierdan and Koff<sup>[10]</sup> reported that it was the weight-related body image and perception of body weight rather than the

objective BMI or actual weight categories that significantly predict depressive symptoms. The relationship between depression symptoms and BMI in preadolescent girls seems to be explained by an excess of overweight concerns<sup>[11]</sup>. It is hypothesised that body image or weight perception might have a mediating effect on the relationship between actual body weight and depressive psychological symptoms.

Higher body dissatisfaction has also been found among overweight and obese girls and boys in China<sup>[11]</sup>. Among Chinese adolescent girls, high body mass index (BMI) is significantly related to higher self-reported depression symptoms<sup>[12]</sup>. Perceived overweight adolescent boys and girls are more likely to experience depression than their normal weight and underweight counterparts<sup>[13]</sup>. But there is limited information on the relationship between body weight and depression, as well as between body dissatisfaction and depression among younger

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children in China.

This study focused on the following aspects in a large population-based sample of nine and ten years old girls and boys living in Beijing, China:

Whether body weight is associated with depression symptoms;

Whether body weight is associated with body dissatisfaction;

Whether body dissatisfaction is associated with depression;

Whether body dissatisfaction could account for a relationship between body weight and depression symptoms.

## SUBJECTS AND METHODS

### *Subjects*

The study population was a representative sample of 9 and 10 years old students in 2005 of the third and fourth grade from 20 schools in urban Beijing, China. Parents were informed of the study in writing and given the opportunity to refuse their children's participation. Children could refuse participation at any time. The study obtained a response from 96% of the selected student population. Approximately 2% of these responses were excluded because of missing or invalid information. Classroom surveys and physical measures were completed during regular school days by trained investigators.

The Human Investigation Review Committee at the National Institute for Nutrition and Food Safety, Chinese Center for Disease Control and Prevention, provided ethical approval. Written informed consent was obtained from all parents and subjects before the study.

### *Measures*

**Body weight status** Fasting body weight was measured in the morning using a digital electronic scale (Seca, model 890, Hamburg) to the nearest 0.1 kg with the subject only wearing underwear. Height was measured to the nearest 0.1 cm using a standard steel strip stadiometer in bare footed subjects.

Overweight was defined using age- and sex-specific BMI cut-off points developed by the Working Group for Obesity in China (WGOC), as body mass index (BMI) for age and sex between the 85th and the 95th percentiles, whereas obesity was defined as BMI at the 95th percentile or higher, underweight was defined as BMI at the 5th percentile or lower<sup>[14]</sup>.

**Body dissatisfaction** Body image was assessed by the Ma silhouette<sup>[11]</sup>, which was developed from

Collins silhouette<sup>[15]</sup> and adapted to the Chinese situation. There were two arrays of pictures for boys or girls, respectively. Each array had seven black-white line-drawn silhouettes ranging from very thin to very fat<sup>[11]</sup>. Subjects were asked to select one picture that fits best with each of the following statements: (1) "looks most like YOU" (for current own body image), (2) "you would most want to look like" (for ideal body image). A higher score indicates a larger body image.

Subtracting the ideal body image from the current body image yields the body dissatisfaction (BD) rating. The BD rating ranges from -6 to 6. BD = 0 means no discrepancy between the current and ideal body images. A mismatch of one position was described as body dissatisfaction ( $BD \geq 1$  or  $BD \leq -1$ ). A BD rating of  $>0$  indicated that the boy/girl's current body image was bigger than his/her ideal body image (want to be thinner), while a BD rating of  $<0$  indicated that the boy/girl's current body image was smaller than his/her ideal body image (want to be heavier)

**Depression symptoms** The children's depression inventory (CDI) developed by Kovacs<sup>[16]</sup> has been used most often to measure depression symptoms among normal children, which was designed to survey cognitive, effective, and behavior manifestations of depression in children and adolescents. It contains 27-item self-rating scales ranging from 0 to 2 that yield total scores from 0 to 54, where a higher score reflects greater symptomatology. Kovacs<sup>[16]</sup> has specified a 19-point cutoff as the ideal threshold discriminating children at risk of depression from non-depressed children. The CDI has shown good test-retest reliability, internal consistency, and construct validity<sup>[17]</sup>. The validity and reliability of the Chinese version are sufficient<sup>[18]</sup>.

The CDI factors are labeled as negative mood, interpersonal problems, ineffectiveness, anhedonia, and negative self-esteem, the definitions of the CDI self-report factor scales are listed in the CDI manual<sup>[16]</sup>, where ineffectiveness reflects negative evaluation of one's ability and school performance, and negative self-esteem reflects low self-esteem, self-dislike, feeling of being unloved, and a tendency to have thoughts of suicide.

Total score was the overall depressive symptomatology across the five factor scales.

### *Statistic Analysis*

**Bivariate analyses** As recommended by Matthey and Petrovski<sup>[19]</sup> that the CDI is better suited as a continuous measure of mood rather than the cutoff scores which should not be used to screen for the likely presence or absence of depression. We

compared the total CDI score and five factor scores among underweight, normal weight, overweight and obese children, as well as among the children who were not satisfied with their body image, by analysis of variance (ANOVA) with the Tukey post-hoc comparisons. The proportion of body dissatisfaction was described by gender and BMI status.

*Multivariate analyses* Multivariate tests of the effect of underweight, overweight and obesity on the total CDI score and factor scores were conducted. The data were then analyzed while the body dissatisfaction status was further controlled.

Hierarchical linear model of SAS PROC MIXED was used to examine the outcomes as a function of both student level characteristics and school level

predictors.

## RESULTS

The CDI Cronbach's alpha was 0.81 in the current study, while internal consistency reliability estimates for the 5 subscales of the CDI were 0.75, 0.48, 0.71, 0.81, and 0.75 for negative mood, interpersonal problem, ineffectiveness, anhedonia and negative self-esteem, respectively.

A total of 3886 students were selected from grade three and four of 20 primary schools in urban Beijing in the summer of 2005 in the study. The characteristics of the students are shown in Table 1.

TABLE 1

Characteristics (%) of the Subjects

	Boys	Girls	All
Total ( <i>n</i> )	1987	1899	3886
Age (Years)			
9	47.2	46.7	46.9
10	52.8	53.3	53.1
BMI Status <sup>1,*</sup>			
Underweight	4.4	5.0	4.7
Normal Weight	61.1	74.8	67.8
Overweight	16.9	10.4	13.7
Obesity	17.6	9.8	13.8
Mother's BMI Status <sup>2</sup>			
Underweight	6.4	6.4	6.4
Normal Weight	69.3	67.0	68.1
Overweight	19.8	20.8	20.3
Obesity	4.5	5.8	5.2
Father's BMI Status <sup>2</sup>			
Underweight	2.3	2.3	2.3
Normal Weight	43.6	44.2	43.9
Overweight	49.3	48.9	49.1
Obesity	4.8	4.6	4.7
Mother's Educational Level <sup>3</sup>			
Low	18.9	17.3	18.1
Middle	33.8	35.6	34.7
High	47.3	47.1	47.2
Father's Educational Level <sup>3</sup>			
Low	17.8	15.6	16.7
Middle	37.0	37.5	37.2
High	45.2	46.9	46.1
Family's Income <sup>4</sup>			
Low	28.4	29.7	29.0
Middle	57.2	53.4	55.3
High	14.4	16.9	15.7
Children's Depression Inventory Score (CDI, ( $\bar{x} \pm s$ ))	10.8±7.9	8.3±6.8	9.6±7.5
Depression (CDI≥19)	16.7	9.5	13.2

*Note.* <sup>1</sup>Defined according to the Chinese reference developed by the Working Group for Obesity in China (WGOC). Overweight: BMI between the 85th and the 95th percentiles; obesity: BMI≥the 95th percentile; underweight: BMI≤the 5th percentile; significant difference between boys and girls,  $\chi^2$ -test, \* $P$ <0.05. <sup>2</sup>Body weight of parents. Underweight: BMI<18.5 kg/m<sup>2</sup>; overweight: BMI between 24 kg/m<sup>2</sup> and 25 kg/m<sup>2</sup>; obesity: BMI≥28 kg/m<sup>2</sup>. <sup>3</sup>Educational level: Low: lower than junior middle school; Middle: high middle school; High: college/university or above. <sup>4</sup>Family's income: Low: < 2000 Yuan/Month; Middle: 2000-6000 Yuan/Month; High: ≥6000 Yuan/Month.

No significant difference was found in age, parent's BMI status, parent's educational level and family economic level between boys and girls. Significantly more boys were classified as overweight or obese than girls. The total CDI score of boys was  $10.8 \pm 7.9$ , which was significantly higher than that of girls. Totally, 13.2% of children (boys 16.7% vs girls 9.5%,  $P < 0.05$ ) were at risk of developing depression symptoms ( $CDI \geq 19$ ).

#### Bivariate Analyses

Overweight girls, had a significantly higher total CDI score, but the absolute difference was small.

Overweight and obese girls also showed a significantly higher level of ineffectiveness score than underweight girls. Both obese boys and girls showed a significantly higher negative self-esteem score than their normal weight counterparts (Table 2).

One third children wanted to be thinner and one third wanted to be heavier. After stratified by BMI status, more underweight boys wanted to be heavier than underweight girls, while more obese girls wanted to be thinner than obese boys (Table 3). More than one fifth underweight girls still wanted to be thinner while more than one third obese boys still wanted to be heavier (Table 3).

TABLE 2

Children's Depression Inventory Score According to Their BMI Status ( $\bar{x} \pm s$ )

BMI Status	Children's Depression Inventory Score					
	Total	Negative Mood	Interpersonal Problem	In-effectiveness	Endogenous Depression	Negative Self-esteem
Boys						
Underweight	12.0±8.9	2.8±2.5	1.5±1.6	2.1±1.8	3.5±3.3	2.1±2.1 <sup>ab</sup>
Normal Weight	10.7±7.9	2.4±2.2	1.6±1.4	1.8±1.8	3.0±2.9	1.9±1.9 <sup>b</sup>
Overweight	10.3±7.8	2.3±2.2	1.6±1.4	1.7±1.8	2.7±2.7	1.9±1.8 <sup>ab</sup>
Obesity	11.3±7.4	2.6±2.2	1.7±1.4	1.9±1.8	2.9±2.6	2.2±1.8 <sup>a</sup>
Girls						
Underweight	7.0±5.1 <sup>b</sup>	1.6±1.6	1.1±0.9	0.8±1.2 <sup>b</sup>	2.3±2.0	1.2±1.5 <sup>c</sup>
Normal Weight	8.2±6.7 <sup>ab</sup>	1.9±2.0	1.2±1.0	1.1±1.4 <sup>ab</sup>	2.4±2.6	1.5±1.7 <sup>bc</sup>
Overweight	9.4±7.3 <sup>a</sup>	2.3±2.1	1.3±1.1	1.3±1.6 <sup>a</sup>	2.6±2.8	1.8±1.8 <sup>ab</sup>
Obesity	8.7±7.5 <sup>ab</sup>	1.8±2.1	1.3±1.1	1.2±1.5 <sup>ab</sup>	2.4±2.8	2.0±1.9 <sup>a</sup>

Note. <sup>a,b,c</sup>One-way ANOVA performed with Tukey post-hoc analysis to compare the effects of BMI status and body dissatisfaction on depression symptoms. <sup>a,b,c</sup>Values not sharing the same superscript denote significant difference.

TABLE 3

Body Dissatisfaction Distribution According to BMI Status

BMI Status	Body Dissatisfaction (n, %)				
	$\leq -3$	-2 or -1	0	1 or 2	$\geq 3$
Boys					
Underweight	39 (44.8)	22 (25.3)	17 (19.5)	6 (6.9)	3 (3.5)
Normal Weight	280 (23.1)	143 (11.8)	506 (41.7)	108 (8.9)	176 (14.5)
Overweight	19 (5.7)	62 (18.5)	63 (18.8)	78 (23.2)	114 (33.8)
Obesity	49 (14.0)	64 (18.2)	34 (9.7)	143 (40.7)	61 (17.4)
Total	387 (19.5)	291 (14.7)	620 (31.2)	335 (16.9)	354 (17.7)
Girls					
Underweight	7 (7.5)	38 (40.4)	29 (30.9)	11 (11.7)	9 (9.5)
Normal Weight	225 (15.9)	266 (18.7)	463 (32.6)	320 (22.5)	146 (10.3)
Overweight	37 (18.7)	23 (11.6)	19 (9.6)	84 (42.4)	35 (17.7)
Obesity	20 (10.7)	23 (12.3)	5 (2.7)	94 (50.3)	45 (24.1)
Total	289 (15.2)	350 (18.4)	516 (27.2)	509 (26.8)	235 (12.4)

Note. Body dissatisfaction (BD) = current body image - ideal body image. A BD rating of  $>0$  indicated that the boy/girl's current body image was bigger than his/her ideal body image (want to be thinner), while a BD rating of  $<0$  indicated that the boy/girl's current body image was smaller than his/her ideal body image (want to be heavier).

Boys who wanted to be thinner showed significantly higher scores of ineffectiveness and negative self-esteem than those who wanted to keep their current body image. Girls who wanted to be heavier and thinner showed a significantly higher total CDI score and a higher score of the four factors including negative mood, ineffectiveness, anhedonia, and negative self-esteem (Table 4).

*Multivariate Analyses*

Among girls, the estimated Z value of school and residual was 1.72 ( $P=0.04$ ) and 30.63, respectively. These estimates suggested that schools differed in

their average total CDI score and there were even more variations among students within schools. Similar results were found after body dissatisfaction was introduced into the models.

The overweight girls still showed a significantly higher CDI score after the body dissatisfaction was introduced into the model, but the estimated value was a little less (Table 5). Overweight and obese girls all showed a significantly higher negative self-esteem score (Table 5).

Only negative self-esteem score was significantly higher in obese boys, which was still significant after the body dissatisfaction was introduced into the model (Table 5).

TABLE 4

Children’s Depression Inventory Score According to Their Body Dissatisfaction Status ( $\bar{x} \pm s$ )

BD Status	Children’s Depression Inventory Score					
	Total	Negative Mood	Interpersonal Problem	In-effectiveness	Endogenous Depression	Negative Self-esteem
Boys						
Want to Be Heavier	10.6±7.8	2.4±2.2	1.6±1.4	1.8±1.7 <sup>ab</sup>	2.9±2.8	1.9±1.8 <sup>ab</sup>
Keep Same Body Image	10.4±8.0	2.3±2.3	1.7±1.4	1.7±1.8 <sup>b</sup>	2.9±2.9	1.8±1.8 <sup>b</sup>
Want to Be Thinner	11.3±7.8	2.5±2.2	1.7±1.4	1.9±1.8 <sup>a</sup>	3.1±2.8	2.2±2.0 <sup>a</sup>
Girls						
Want to Be Heavier	8.7±7.2 <sup>a</sup>	2.1±2.1 <sup>a</sup>	1.2±1.1	1.2±1.5 <sup>ab</sup>	2.5±2.7 <sup>a</sup>	1.6±1.7 <sup>a</sup>
Keep Same Body Image	7.3±6.3 <sup>b</sup>	1.6±1.9 <sup>b</sup>	1.2±0.9	1.0±1.4 <sup>b</sup>	2.1±2.4 <sup>b</sup>	1.3±1.6 <sup>b</sup>
Want to Be Thinner	8.6±6.7 <sup>a</sup>	2.0±2.0 <sup>a</sup>	1.2±1.0	1.2±1.5 <sup>a</sup>	2.5±2.6 <sup>a</sup>	1.7±1.7 <sup>a</sup>

*Note.* <sup>a,b,c</sup>One-way ANOVA performed with Tukey post-hoc analysis to compare the effects of BMI status and body dissatisfaction on depression symptoms. <sup>a,b,c</sup>Values not sharing the same superscript denote significant difference.

TABLE 5

Hierarchical Linear Analysis of the Effect of BMI Status on Children’s Depression Symptoms with or Without Introducing Body Dissatisfaction

Status	Total CDI Score		Negative Self-esteem Score	
	Estimate	Standard Error	Estimate	Standard Error
Girls				
Model 1				
Underweight	-1.2	0.7	-0.3	0.2
Overweight	1.3 <sup>*</sup>	0.5	0.3 <sup>*</sup>	0.1
Obese	0.6	0.5	0.4 <sup>*</sup>	0.1
BMI Status Effect	F(3,56)=3.59	P=0.02	F(3,56)=6.79	P=0.01
Model 2				
Underweight	-1.2	0.7	-0.3	0.2
Overweight	1.1 <sup>*</sup>	0.5	0.3	0.1
Obese	0.3	0.5	0.4 <sup>*</sup>	0.1
Want to Be Heavier	1.2 <sup>*</sup>	0.4	0.3 <sup>*</sup>	0.1
Want to Be Thinner	1.0 <sup>*</sup>	0.4	0.3 <sup>*</sup>	0.1
BMI Status Effect	F(3,56)=2.65	P=0.06	F(3,56)=4.73	P=0.01
Body Dissatisfaction Effect	F(2,38)=5.19	P=0.01	F(2,38)=4.13	P=0.02

(to be continued)

(Continued)

Status	Total CDI Score		Negative Self-esteem Score	
	Estimate	Standard Error	Estimate	Standard Error
Boys				
Model 1				
Underweight	1.1	0.9	0.2	0.2
Overweight	-0.4	0.5	0.0	0.1
Obese	0.6	0.5	0.3*	0.1
BMI Status Effect	F(3,56)=1.46	P=0.24	F(3,56)=3.35	P=0.03
Model 2				
Underweight	1.2	0.9	0.2	0.2
Overweight	-0.7	0.5	0.0	0.1
Obese	0.3	0.5	0.2*	0.1
Want to Be Heavier	0.0	0.5	0.1	0.1
Want to Be Thinner	1.0	0.5	0.3*	0.1
BMI Status Effect	F(3,56)=1.69	P=0.18	F(3,56)=2.20	P=0.10
Body Dissatisfaction Effect	F(2,38)=2.77	P=0.08	F(2,38)=4.00	P=0.03

Note. Hierarchical linear model of SAS PROC MIXED was applied, \* $P < 0.05$ .

## DISCUSSION

This study suggested that boys living in urban Beijing had a higher CDI score than girls, and more boys were at risk of developing depression symptoms. Overweight girls showed a significantly higher depression symptom score than their normal weight counterparts, which maybe partially explained by body dissatisfaction. Both obese boys and girls were more likely to suffer from low self-esteem, which could be partially explained by body dissatisfaction.

Depression is one of the most psychological problems in adolescents<sup>[20]</sup> and the rates of depression have been increasing over the last several decades<sup>[21-22]</sup>. As reported by Scheidt *et al.*<sup>[23]</sup>, 49% of adolescent girls and 34% of adolescent boys show weak depression symptoms, while 29% USA youths and 35%-50% Mexican-American youths have depression symptoms<sup>[24-25]</sup>. The CDI has been used most often to measure depressive symptoms among normal children. The prevalence of depressive risk in our sample was 13.2% when the cutoff point of 19<sup>[16]</sup> was taken as the threshold. This figure is in line with other epidemiologic studies that reported prevalence rates of depressive risk ranging from 5%-20%<sup>[26-31]</sup> using self-report CDI.

Overweight children display more psychosocial problems though the extent of these problems is usually small. In our sample, overweight was associated with mildly increased depression symptoms among girls. Previous studies showed that adult women and female adolescents have a

connection between depression and body weight in Western countries<sup>[5-8]</sup> and China<sup>[12]</sup>. Our results indicate that in younger Beijing girls, body weight is also associated with depression symptoms. We also found a higher body dissatisfaction in overweight and obese Beijing children.

Theoretically, elevated body mass results in body dissatisfaction because overweight is not currently considered socially desirable<sup>[32]</sup>, and body dissatisfaction may in turn increase the chance of depression<sup>[5,10,33]</sup>. So body dissatisfaction is thought to be related with body mass and depression. Cognitive aspects of body-image disturbance rather than actual body dimensions, may play a more important role in the etiology of depression<sup>[1,32]</sup>. However, in our sample, both overweight and body dissatisfaction were associated with depression symptoms, the relationship between body weight and depression symptoms could only partially explained by body dissatisfaction. It might also be the case that non-weight-related aspects of body dissatisfaction, as well as other characteristics related with body weight, are also very important in promoting depression.

This is the first study in younger children to explore the relationship between body weight, body dissatisfaction, and depression symptoms in China. The results indicate that body weight-related body dissatisfaction and depression symptoms may occur in younger children, which should be considered in future pediatric weight management programs in China. The international childhood depression measurement of CDI used in our study could also provide the chance to compare the results with other

studies. The Chinese version CDI has been translated into English and has shown higher validity and reliability in Chinese children<sup>[18]</sup>. The Cronbach's coefficient alpha estimate was 0.85 and split half reliability was 0.83 of the Chinese version CDI<sup>[18]</sup>, not less than the English versions<sup>[16,25]</sup>. In the current sample, the Cronbach's coefficient alpha estimates were 0.81 for total score and 0.48-0.81 for subscales.

One limitation of the present study is that the results are based on cross-sectional observations. Therefore, whether the associations represent cause or consequence of childhood overweight remains unknown. Another limitation is that we did not include information on body weight teasing and eating behavior, as teasing from family, peers, and teachers may account for the relationship between body weight, body dissatisfaction and depression<sup>[34-37]</sup>. Children's diet and physical activity patterns may be related to body weight and depression<sup>[38-41]</sup>, but they were not included in current analyses. Further analyses of our project should focus on the association of diet and physical activity patterns with depression, and the intervention effect of diet and physical activity on the improvement of depression symptoms in younger children living in Beijing.

There is evidence that even moderate levels of depression have a negative impact on children and are associated with significant impairments in school and peer functioning in children<sup>[42-43]</sup>. Gotlib *et al.*<sup>[44]</sup> found that adolescents with a high score on depression questionnaires, but do not meet diagnostic criteria for depression, have as much psychosocial dysfunction as those who meet diagnostic criteria for depression. So the expert panels recommend a multidisciplinary approach to pediatric weight management programs, including psychosocial factors in the assessment and therapeutic programs<sup>[45-46]</sup>. Some body weight intervention programs focusing a healthy lifestyle do result in positive psychological improvement<sup>[38,40,47]</sup>. We are currently implementing a school-based and parents-involved obesity intervention program focusing on physical activity in Beijing. The improvement of depression and anxiety symptoms will be evaluated after 1 year intervention.

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