Original Article

The Mediating Effect of Body Dissatisfaction in Association between Obesity and Dietary Behavior Changes for Weight Loss in Chinese Children*

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Abstract

Objective The aim of this study was to analyze the mediating effect of body dissatisfaction in correlation between obesity and dietary behavior changes for weight loss (DBCWL).

Methods A total of 680 primary and middle school students were included in this study. Their body height, weight, and waistline were effectively measured, and they were also evaluated to assess their body dissatisfaction, perception of dietary behaviors, and DBCWL. The correlation among these factors was analyzed using mediating effect models.

Results The prevalence of overweight/obesity and abdominal obesity was significantly higher in males than in females ($P < 0.05$). Overweight/obesity, abdominal obesity, and body dissatisfaction significantly increased the risk for DBCWL (*OR* = 2.57, 2.77, and 1.95, respectively). Overweight/obesity and abdominal obesity significantly increased the risk for body dissatisfaction (*OR* = 6.00 and 4.70, respectively). Significant mediating effects of body dissatisfaction were observed in correlation between overweight/obesity and DBCWL and between abdominal obesity and DBCWL (*OR* = 2.20 and 1.92, respectively; $P < 0.05$), and the proportions of mediating effects among the total effects were 48.89% and 46.60%, respectively.

Conclusion Body dissatisfaction might play an important mediating effect in association between DBCWL and obesity, which indicates that guiding children to correctly recognize their body might be more conducive than promoting obese children toward weight loss through dietary behavior changes.

Key words: Children and adolescents; Obesity; Body dissatisfaction; Dietary behavior changes for weight loss

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INTRODUCTION

There has been an increase in the prevalence of childhood obesity across the world within less than one generation, with a more rapid increase in middle-income and low-income countries[1]. In China, it has been reported that the prevalence of childhood obesity among boys and girls aged 7–18 years increased substantially from 1985 to 2014, and was by 9.1% in 2014[2].

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Childhood obesity increases the risks for adulthood obesity and serious health conditions such as hypertension, dyslipidemia, cardiovascular disease, diabetes, sleep-disordered breathing, and infertility[3-5], and it has emerged as one of the most serious public health challenges.

Obesity increases the risk for not only several diseases but also severe psychological consequences, one among which is body dissatisfaction, i.e., the discrepancy in perception between the real and an idealized body shape. Due to the widespread increase in the prevalence of childhood obesity, the problem of body dissatisfaction has become increasingly common among children, particularly girls. One study reported that 50% of girls aged 7–11 years expected to be more slender than their current perceived body[6]. In addition, the prevalence of body dissatisfaction was found to be higher among obese children than among children with normal weight. Mulasi-Pokhriyal et al. observed that approximately 70% of obese children in their study desired to lose weight[7]. Another research demonstrated that body dissatisfaction was a risk factor for restrictive diets, compensatory behaviors, binge eating, and eating disorders[8].

It has been well established that adverse dietary factors are important risk factors for obesity, including the consumption of excess dietary fat and refined carbohydrates and sugared soft drinks and unhealthy dietary behaviors[9]. Stankiewicz et al. reported that 91.0% of children believed that vegetables and fruits were helpful in maintaining their health[10]. Changes in meal patterns may affect dietary intakes and thus provide potential behavioral targets for intervention programs to prevent the development of obesity and specific chronic diseases[11].

Correlations may exist among obesity, body dissatisfaction, and CWL. It is not known whether body dissatisfaction is the mediating factor between obesity and DBCWL. Addressing this issue could provide an important opinion for developing more effective measures for weight loss. Therefore, this study was conducted to explore the mediating effects of body dissatisfaction in correlation between obesity and DBCWL.

METHODS

Participants

Using the stratified cluster sampling method, a total of 720 Chinese children and adolescents studying from Grades 2 to 5 in elementary schools and from Grades 1 to 2 in middle schools in Beijing city were selected for this study. The effective sample size was 680 comprising 333 boys and 347 girls. Informed consent was signed before conducting the investigation.

Measurements

Body height, weight, and waistline of the study participants were measured according to the requirements of the Chinese National Survey on Students' Constitution and Health (CNSSCH) research rules[12]. The participants were required to wear only light clothes and stand straight barefoot for conducting the measurements. All measurements were performed by professional technicians who had passed a training course for conducting anthropometric measurements. Body mass index (BMI) was calculated as body weight (kg)/square of body height (m^2). Overweight/obesity was defined according to the BMI reference of working group on obesity in China (WGOC)[13]. Waist-to-height ratio (WHtR) was calculated as waist (cm)/height (cm), and abdominal obesity was defined as WHtR ≥ 0.46[14].

Questionnaire Investigation

Dietary behaviors and DBCWL of the study participants were evaluated in this study. The students' dietary behaviors comprised six items of perception, including consumption of vegetables or fruits, dried food, Western fast food, high-calorie snacks, sugared beverages, and a breakfast every day. Students were asked to answer their perception of these factors by responding to some questions such as 'Do you think eating less vegetable or fruit is right?' The answer included Yes or No. DBCWL were evaluated by the following one question: 'Have you lost your body weight by changing your dietary behaviors in the recent 2 weeks?' The answer included Yes or No.

The Ma body figural shape was used to evaluate the body image attitude of the participants. The Ma body figural shape ranging from very thin to very fat is composed of seven figure drawings for each gender, which are respectively scored as '1, 2, 3, 4, 5, 6, and 7'. Participants were asked to select one drawing that fits best with each of the following statements: (1) which one do you think is the right one for you now? This aspect was assessed to survey the self-body shape perception. (2) Which one would you most want to look like? This parameter was

assessed to survey the expected shape perception. The difference in scores between the self-body shape perception and the expected shape perception was used to calculate body dissatisfaction rating. If the body dissatisfaction rating is equal to 0, it indicates body satisfaction; otherwise, it is considered as body dissatisfaction[15].

Statistical Analysis

Statistical analysis was conducted using the SPSS23.0 software. The enumerated data were represented by frequency, and the difference between groups were compared using a chi-square test. Based on the theory of mediating effects proposed by Baron and Kenny[16], body dissatisfaction was considered as a mediator factor (*M*), obesity (*X*) was considered as an independent variable, and DBCWL were considered as a dependent variable (*Y*) for mediating the effect analysis. The total effect (c) of factor X on factor Y can be decomposed into direct effect (c') and mediating effect (ab). '*a*' was the effect of factor *X* on factor *M*, and '*b*' was the effect of factor *M* on factor *Y* after adjusting for factor *X* (Figure 1). Logistic regression models were used to analyze the mediating effects, which were subsequently evaluated using the Sobel method.

RESULTS

Among the 680 students, 36.6% were overweight/obesity, 40.4% had abdominal obesity, 70.1% had body dissatisfaction, 72.4% had DBCWL, and > 80% had correct perceptions about dietary behaviors. The prevalence of overweight/obesity and abdominal obesity was significantly higher in males than in females ($P < 0.001$). However, the rate of correct perception about the consumption of dried foods and Western fast food was significantly lower in males than in females ($P < 0.05$). The rates of DBCWL and correct perception about the consumption of sugared beverages, breakfast, dried foods, Western fast food, and high-calorie snacks were significantly higher in students aged 7– years than in students aged 11– years ($P < 0.05$) (Table 1).

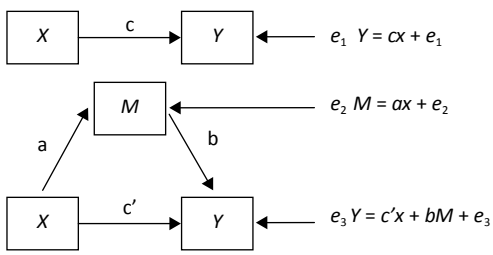

Figure 1. The mediating effect model.

As shown in Table 2, after adjusting for gender and age, overweight/obesity, abdominal obesity, and body dissatisfaction significantly increased the risk for DBCWL (*OR* = 2.57, 2.77, and 1.95, respectively). Furthermore, overweight/obesity and abdominal obesity significantly increased the risk for body dissatisfaction (*OR* = 6.00 and 4.70, respectively). However, no significant correlation was found between the perception of dietary behaviors and DBCWL and between DBCWL and body dissatisfaction. There was also no significant correlation among overweight/obesity, abdominal obesity, and dietary behavior perception (Table 3).

The above-described results revealed that obesity, body dissatisfaction, and DBCWL were significantly correlated. The mediating effect models were used to determine the mediating effect of body dissatisfaction in correlation between obesity and DBCWL after adjusting for gender and age using logistic regressions (Figure 2). The results of this analysis demonstrated significant mediating effects of body dissatisfaction in correlation between overweight/obesity and DBCWL and between abdominal obesity and DBCWL, with the *OR* values being 2.20 and 1.92, respectively ($P < 0.05$) (Table 4). The proportions of mediating effects among the total effects were 48.89% and 46.60% for overweight/obesity and abdominal obesity, respectively.

DISCUSSION

In this study, there were 36.6% of children with overweight/obesity and 40.4% with abdominal obesity, which were higher than those among children from the general population in China. However, these proportions were similar to those among children from developed countries. In China, the prevalence rates of overweight and obesity were found to be 13.3% and 6.9% among boys and 8.9% and 1.8% among girls, respectively, according to the 2010 Chinese National Survey on Students' Constitution and Health (CNSSCH) data[17]. The prevalence of overweight or obesity among children in areas with a higher economic level was found to be higher than that among children in areas with a lower economic level[18]. The children in this study were selected from elementary and middle schools in Beijing city, which might be the reason for the higher prevalence of overweight or obesity than that of national data (2010). Zuraikat et al. reported a prevalence of 36% for both obesity and overweight

among school-age children in Pennsylvania[19]. Similarly, Freitas et al. found childhood overweight or obesity, as among 31.6% of children in Portugal[20]. In addition, results of the present study demonstrated that the prevalence of overweight/obesity was significantly higher in boys than in girls, Which is consistent with the finding reported by Song et al., who also observed a higher prevalence of overweight/obesity in boys than in girls[21]. However, results from developed countries indicate a higher prevalence of obesity in girls than in boys[22]. The higher prevalence of obesity in boys than in girls observed in this study and previous research may be due to the unhealthy dietary behaviors that were more common among boys than among girls. Furthermore, this study demonstrated that the rate of correct perception about the consumption of dried foods and Western

Table 1. The rate of DBCWL, body dissatisfaction, obesity and dietary behavior perception by gender and ages (%)

Variables	Total (*n* = 680)	Gender		x^2	*P*	Ages (years)		x^2	*P*
		Female (*n* = 333)	Male (*n* = 347)			7– (*n* = 337)	11– (*n* = 343)		
Overweight/obesity				15.77	< 0.001			1.46	0.226
No	63.4	70.9	56.2			61.1	65.6		
Yes	36.6	29.1	43.8			38.9	34.4		
Abdominal obesity				10.44	0.001			0.01	0.911
No	59.6	65.8	53.6			59.3	59.8		
Yes	40.4	34.2	46.4			40.7	40.2		
Body dissatisfaction				0.19	0.662			0.02	0.900
No	22.9	22.2	23.6			23.1	22.7		
Yes	70.1	77.8	76.4			76.9	77.3		
DBCWL				0.13	0.723			6.77	0.009
No	27.6	27.0	28.2			23.1	32.1		
Yes	72.4	73.0	71.8			76.9	67.9		
More eating vegetable or fruit				0.13	0.723			2.90	0.088
No	17.6	17.1	18.2			15.1	20.1		
Yes	82.4	82.9	81.8			84.9	79.9		
Less drinking sugared beverage				0.61	0.436			21.75	< 0.001
No	14.0	12.9	15.0			7.7	20.1		
Yes	86.0	87.1	85.0			92.3	79.9		
Having a breakfast per day				0.09	0.764			5.21	0.022
No	8.4	8.7	8.1			5.9	10.8		
Yes	91.6	91.3	91.9			94.1	89.2		
Less eating dried food				7.93	0.005			15.79	< 0.001
No	17.1	12.9	21.0			11.3	22.7		
Yes	82.9	87.1	79.0			88.7	77.3		
Less eating western fast food				11.21	0.001			7.24	0.007
No	17.9	12.9	22.8			13.9	21.9		
Yes	82.1	87.1	77.2			86.1	78.1		
Less eating high-calorie snacks				1.43	0.231			17.71	< 0.001
No	16.8	15.0	18.4			10.7	22.7		
Yes	83.2	85.0	81.6			89.3	77.3		

fast food was significantly lower in males than in females.

In this study, 70.1% of children and adolescents had body dissatisfaction, which was similar to previous results from developing countries, but slightly lower than that from developed countries. Li et al.[23] reported that 69.9% of Chinese children were dissatisfied with their body size. Furthermore, Mulasi-Pokhriyal et al. reported that 79% of girls and 69% of boys aged 9–18 years in the United States were discontented with their physical appearance[7]. Studies have also indicated that girls were more dissatisfied with their body than boys[24,25]. However, there was no significant difference in the prevalence of body dissatisfaction between boys and girls in the present study, which may be related to the higher rates of obesity among boys than among girls. This study also showed that overweight/obesity and abdominal obesity significantly increased the risk for body dissatisfaction (*OR* = 6.00 and 4.70, respectively, after adjusting for gender and age). Similarly, Ferrari et al. reported that both BMI and BF% were significantly associated with body dissatisfaction (*OR* = 5.25 and 2.42, respectively)[26]. Serious body dissatisfaction was especially found among obese girls[27].

In the present study, > 80% of the students were found to have correct perceptions about eating

Table 2. The influence of obesity and dietary behaviors perception on DBCWL and body dissatisfaction

Variables	*N*	DBCWL		Body dissatisfaction	
		%	*OR* (95% *CI*)	%	*OR* (95% *CI*)
Overweight/obesity					
No	431	66.1	Reference	68.2	Reference
Yes	249	83.1	2.57 (1.73–3.80)	92.4	6.00 (3.58–10.05)
Abdominal obesity					
No	405	64.9	Reference	67.9	Reference
Yes	275	83.3	2.77 (1.89–4.05)	90.5	4.70 (2.97–7.43)
Body dissatisfaction					
No	156	61.5	Reference		
Yes	524	75.6	1.95 (1.33–2.86)		
Less eating vegetable or fruit					
Yes	120	74.2	Reference		
No	560	72.0	0.86 (0.55–1.35)		
More drinking sugared beverage					
Yes	95	72.6	Reference		
No	585	72.3	0.87 (0.53–1.43)		
Having a breakfast per day					
No	57	66.7	Reference		
Yes	623	72.9	1.26 (0.70–2.26)		
Less eating dried food					
No	116	70.7	Reference		
Yes	564	72.7	1.01 (0.64–1.58)		
Often eating western fast food					
Yes	122	66.4	Reference		
No	558	73.7	1.34 (0.87–2.05)		
More eating high-calorie snacks					
Yes	114	66.7	Reference		
No	566	73.5	1.27 (0.82–1.97)		

behaviors. This finding was consistent with that of Triches et al. who reported that 90.8% of children correctly responded to the questions concerning foods[28]. Furthermore, the rate of correct perception about the consumption of dried foods and Western fast food was significantly lesser in males than in

Table 3. The influence of obesity and body dissatisfaction on dietary behaviors perception

Variables	*N*	Less eating vegetable or fruit		More drinking sugared beverage		Having a breakfast per day	
		%	*OR* (95% *CI*)	%	*OR* (95% *CI*)	%	*OR* (95% *CI*)
Obesity							
No	431	84.0	Reference	84.9	Reference	91.2	Reference
Yes	249	79.5	0.73 (0.48–1.09)	88.0	1.27 (0.79–2.05)	92.4	1.12 (0.62–2.00)
Abdominal obesity							
No	405	84.9	Reference	85.4	Reference	91.6	Reference
Yes	275	78.5	0.65 (0.43–0.97)	86.9	1.15 (0.73–1.82)	91.6	0.99 (0.56–1.73)
Body dissatisfaction							
No	156	83.3		88.5		94.2	
Yes	524	82.1	0.92 (0.57–1.48)	85.3	0.75 (0.43–1.31)	90.8	0.61 (0.29–1.28)
Variables	***N***	**Less eating dried food**		**Often eating western fast food**		**More eating high-calorie snacks**	
		%	*OR* (95% *CI*)	%	*OR* (95% *CI*)	%	*OR* (95% *CI*)
Obesity							
No	431	82.4	Reference	83.3	Reference	83.1	Reference
Yes	249	83.9	1.18 (0.77–1.82)	79.9	0.86 (0.57–1.29)	83.5	1.03 (0.67–1.58)
Abdominal obesity							
No	405	83.0	Reference	82.7	Reference	83.2	Reference
Yes	275	82.9	1.06 (0.70–1.61)	81.1	0.97 (0.64–1.45)	83.3	1.03 (0.68–1.56)
Body dissatisfaction							
No	156	84.0	Reference	80.8	Reference	81.4	Reference
Yes	524	82.6	0.89 (0.54–1.46)	82.4	1.10 (0.69–1.75)	83.8	1.18 (0.74–1.90)

Table 4. The mediating effect of body dissatisfaction in correlation between obesity and DBCWL

Model	Effect	*β*	*Se*	*Wald*	*P*	*OR* (95% *CI*)
Model 1	a	1.79	0.26	46.25	< 0.001	6.00 (3.58–10.05)
	b	0.44	0.20	4.63	0.031	1.55 (1.04–2.30)
	c'	0.83	0.21	16.04	< 0.001	2.30 (1.53–3.45)
	ab	0.79	0.38	4.32	0.038	2.20 (1.05–4.64)
Model 2	a	1.55	0.23	43.68	< 0.001	4.70 (2.97–7.43)
	b	0.42	0.20	4.30	0.038	1.52 (1.02–2.27)
	c'	0.92	0.20	21.03	< 0.001	2.51 (1.69–3.72)
	ab	0.65	0.32	4.14	0.042	1.92 (1.02–3.59)

Note. All analysis adjusted for gender and ages. a, the effect of overweight/obesity or abdominal obesity on body dissatisfaction; b, the effect of body dissatisfaction on DBCWL after controlling overweight/obesity or abdominal obesity; c', the direct effect of overweight/obesity or abdominal obesity on DBCWL controlling body dissatisfaction; ab, the mediating effect of body dissatisfaction on correlation between overweight/obesity or abdominal obesity and DBCWL.

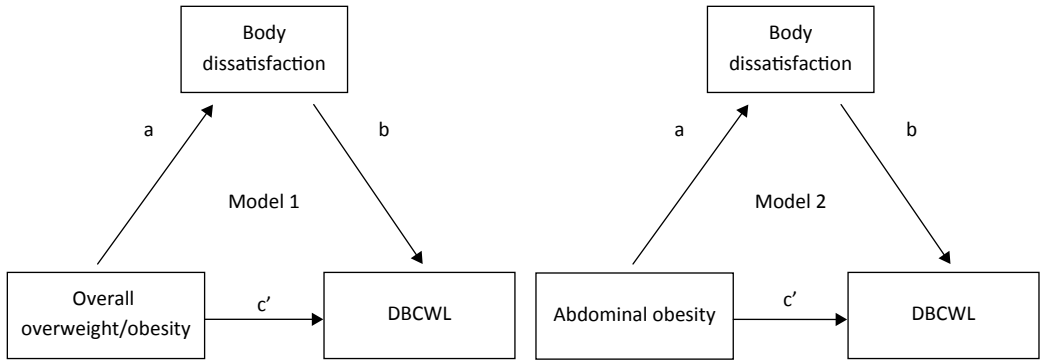

Figure 2. The mediating effect models of body dissatisfaction in the correlation between obesity and DBCWL.

females in this study, which may be associated with the fact that girls were more concerned about their body than boys and more expected to become thinner[29]. It is well known that improvement of dietary behaviors is an important measure for weight loss. In this study, although 72.4% of children had DBCWL, there was no significant correlation between dietary behavior perception and DBCWL. Therefore, improving the dietary behavior perception was found to be insufficient to improve DBCWL, which was consistent with the results of previous studies[28,30-34].

Results of this study revealed that overweight/obesity, abdominal obesity, and body dissatisfaction significantly increased the risk for DBCWL (*OR* = 2.57, 2.77, and 1.95 after adjusting for gender and age, respectively). Moreover, the mediating effect models among obesity, body dissatisfaction and DBCWL was conducted. The proportions of 48.89% and 46.60% of the mediating effects of body dissatisfaction in association between DBCWL and overweight/obesity and between DBCWL and abdominal obesity indicate that body dissatisfaction plays about half the role in DBCWL. Body dissatisfaction should be considered as an important psychological problem while analyzing the aspects of dietary behavior improvement for weight loss to provide correct guidance to children and adolescents. Moreover, it is important to distinguish obese children with and without body dissatisfaction to implement effective measures for preventing obesity. In addition, we must focus more on body dissatisfaction among children with normal weight and DBCWL. These children may display restrictive dietary behaviors to realize their healthy growth and development.

There were several limitations in the present cross-sectional study. First, it was not clear whether the correct dietary behaviors occurred before or after being obese, which was a limitation to interpret an association between obesity and dietary behavior perception. Second, the causal relationship among obesity, body dissatisfaction, and DBCWL could not be explained. Finally, the DBCWL was unclearly defined as healthy or unhealthy dietary behaviors changes for weight loss.

CONCLUSION

This study demonstrated that body dissatisfaction might exert mediating effects between obesity and DBCWL in Chinese children, which indicated that guiding children to correctly recognize their body might be more conducive than promoting obese children toward weight loss through dietary behavior changes.

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CONFLICT OF INTEREST STATEMENT

All authors have no conflict of interest.

AUTHOR CONTRIBUTION

GAO HQ and WANG BX collected and analyzed the data, prepared the first draft of the manuscript, and had equivalent contribution. SUN LL, LI T, and WU L analyzed the data. FU LG and MA J conceived and designed the research and revised the manuscript.

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