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## Perceived weight in youths and risk of overweight or obesity six years later

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### Abstract

**Objective**—To examine the association between perceived overweight in adolescents and the development of overweight or obesity later in life.

**Methods**—This paper uses data from a prospective, two-wave cohort study. Participants are 2445 adolescents 11-17 years of age who reported perceived weight at baseline and also had height and weight measured at baseline and at follow-up six years later sampled from managed care groups in a large metropolitan area.

**Results**—Youths who perceived themselves as overweight at baseline were approximately 2.5 times as likely to be overweight or obese six years later compared to youths who perceived themselves as average weight (OR= 2.45, 95% CI=1.77-3.39), after adjusting for weight status at baseline, demographic characteristics, major depression, physical activity and dieting behaviors. Those who perceived themselves as skinny were less likely to be overweight or obese later (OR=0.36, 95% CI=0.27-0.49).

**Conclusions**—Perceived overweight was associated with overweight or obesity later in life. This relationship was not fully explained by extreme weight control behaviors or major depression. Further research is needed to explore the mechanism involved.

### Keywords

Obesity; perceived weight; children; adolescence

### Introduction

High prevalence of obesity among children, adolescents, and adults in the United States is well known (1, 2). Negative health consequences of obesity in adults are well established (3-6). Compared with normal weight adults, adults with a BMI  $\geq 40$  are 7.37 (95% confidence interval (CI)=6.39-8.50) times as likely to have diagnosed type 2 diabetes, 6.38

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(95% CI=5.67-7.17) times as likely to have elevated blood pressure (BP), 1.88 (95% CI=1.67-2.13) times as likely to have high cholesterol levels, 2.72 (95% CI=2.38-3.12) times as likely to have asthma, 4.41 (95% CI=3.91-4.97) times as likely to have arthritis, and 4.19 (95% CI=3.68-4.76) times as likely to have self-reported fair or poor health (3). Obese children and adolescents are at considerable risk for increased morbidity, including hypertension and dyslipidemia (5). Approximately 60% of overweight children and adolescents have at least one additional risk factor for cardiovascular disease, such as elevated BP, hyperlipidemia, or hyperinsulinemia, and more than 25% have two or more of these risk factors (4). The financial burden of overweight and obesity is substantial (4, 7).

Considerable evidence has established relationships between behavioral determinants such as physical inactivity and high calorie intake and the development of obesity (8-10). Psychosocial factors have received increasing attention given the multifactorial nature of obesity. Recent studies have shown that depressed youths were more likely to become obese (11), and youths who perceived themselves as overweight were more likely to develop symptoms of major depression (12). The role of perceived overweight has been shown to be implicated in development of obesity (13, 14). A study, conducted by Cuypers et al. (13), found that normal weight adolescents (13–19 yrs) who perceived themselves as overweight gained more weight than those who did not perceive themselves as overweight at follow-up 11 years later; the relationship between perceived weight and weight status later in life was somewhat stronger in females than in males. Similarly, Neumark- Sztainer et al. (14) reported that those who perceived themselves as being overweight or were worried about gaining weight were more likely to be overweight five years later. While Cuypers, Neumark- Sztainer et al. report perceived overweight increases the risk of becoming overweight, other studies show perceived overweight is associated with compensatory weight loss behaviors (15-17). Extreme weight control behaviors may partly explain the relationship between perceived overweight and weight gain (14, 18-20). Studies found that children and adolescents with overestimation of weight status or perceived overweight are more likely to practice unsafe dieting and extreme weight loss behaviors (14, 18, 21). Unhealthy weight control behaviors such as skipping meals, reporting fasting behaviors, use of food substitutes (powders or special drinks) or the use of diet pills (20) are all associated with increased weight gain (14, 19, 20). Studies also showed that major depression potentially mediates the relationship between perceived overweight and later obesity (11, 12).

The study by Cuypers et al. was conducted among normal weight adolescents and did not fully control for dieting behaviors (13), and both studies by Cuypers, Neumark- Sztainer et al. did not control for major depression (13, 14). Our study examined the relationship between perceived overweight and overweight or obesity six years later among both normal weight and overweight or obese children, when adjusting for multiple covariates including, but not limited to, dieting behaviors, and major depression using data from Teen Health 2000 (TH2K). TH2K was a large community-based sample of adolescents 11-17 years of age, which primarily aimed to assess the prevalence of DSM-IV psychiatric disorders among children and adolescents. We include data of only those adolescents who reported perceived weight at baseline and also had height and weight measured at baseline beginning in 2000 and at follow-up six years later in 2006. We hypothesize that greater perceived weight increases the risk for development of obesity at follow-up and that this association will differ by gender.

## Methods

### Sample

The sample was selected from households in the Houston metropolitan area enrolled in two local health maintenance organizations (12, 22). One youth, aged 11 to 17 years, was sampled from each eligible household, oversampling for ethnic minority households. Initial recruitment was by telephone contact with parents. A brief screener was administered on ethnic status of the sample youths and to confirm data on age and sex of youths. Every household with a child 11 to 17 years of age was eligible. Because there were proportionately fewer minority subscriber households, sample weights were developed and adjusted by poststratification to reflect the age, ethnic, and sex distribution of the 5-county Houston metropolitan area in 2000. The precision of estimates are thereby improved and sample selection bias reduced to the extent that it is related to demographic composition (23). Thus, the weighted estimates generalize to the population 11 to 17 years of age in a metropolitan area of 4.7 million people.

Data at baseline were collected on sample youths and one adult caregiver using computer-assisted personal interviews and self-administered questionnaires. The computerized interview contained the structured psychiatric interview and demographic data on the youths and the household. Height and weight measures were conducted after the completion of the interviews. The interviews and measurements were conducted by trained, lay interviewers. The interviews took on average 1 to 2 hours, depending on the number of psychiatric problems present. Interviews, questionnaires, and measurements were completed with 4175 youths at baseline, representing 66% of the eligible households. There were no significant differences among ethnic groups in completion rates. A total of 2514 youths (60% of baseline dyads) were followed up approximately six years later using the same assessment battery used at baseline. Of those, 2445 youths who reported perceived weight at baseline and whose height and weight were measured at baseline and six years later were included in the analyses. There was no marked ethnic or gender difference between those who were lost to follow-up and those who remained in the study.

All information used in this paper was collected from the youths, except for the income which was collected from the parents. Youths and parents were interviewed in separate rooms and so data was anonymous to each other. All youths and parents gave written informed consent prior to participation. All study forms and procedures were approved by the University of Texas Health Science Center Committee for Protection of Human Subjects.

## Measures

### Perceived weight

Perceived weight was measured by asking whether adolescents perceive themselves as: (a) skinny; (b) somewhat skinny; (c) average weight; (d) somewhat overweight; or (e) overweight; adolescents who rated themselves as somewhat overweight or overweight are scored as having perceived overweight (12). The perceived weight measure was originally used in the Oregon Adolescent Depression Project with high school students in the late 1980s by Lewinsohn PM et al. (24) and later by Burns CM et al. in 1995 (25). Based on Lewinsohn PM et al., internal consistency reliability and stability of this measure was satisfactory. In term of validity, our data shows a significant relationship between perceived weight and body satisfaction. Of those who perceived themselves as overweight, 73% were dissatisfied with their weight.

## Body mass index (BMI) and weight status

Height and weight were measured using standard field procedures (26). BMI is defined as weight in kg/squared height in meter (kg/m<sup>2</sup>). For individuals whose age was less than 20 years old, weight status was categorized as healthy weight — BMI < 85<sup>th</sup> percentile, overweight — 85<sup>th</sup> BMI < 95<sup>th</sup> percentile and obese — BMI ≥ 95<sup>th</sup> percentile (2). For those whose age was 20 or higher, weight status was categorized as healthy weight — BMI < 25, overweight — 25 BMI < 30 and obese — BMI ≥ 30 (1). Individuals categorized as healthy weight also included those who were underweight.

## Covariates

Covariates included age, gender, ethnicity, family income, weight status, major depression, physical activity, and dieting behavior at baseline (11, 12, 22). These factors have previously been shown to be associated with weight status (11, 12, 14, 19, 20, 27, 28), as well as perceived weight (12, 29-32). Major depression was defined as at least one major depressive episode in the previous 12 months using DSM-IV criteria (33). Age was categorized as 12 or younger, 13-15, and 16 or older. Family income was categorized as less than \$35,000, \$35,000 - \$64,999, and \$65,000 or more. Physical activity was measured with an item that asks on how many days in the past week youth walked or bicycled at least 30 min. Responses are 0, 1, 2, 3, 4, 5, 6 or 7 days. Scores were dichotomized as “0 days” and “1 day or more” in the past week. Dieting behavior was measured by asking five items: (1) refused to eat foods you thought would make you fat; (2) made yourself throw up; (3) took pills to lose weight; (4) took laxatives; (5) fasted for at least 24 hours. The time referent was past month. The items were summed, yielding a score of 0 – 5, and dichotomized into 0 and 1.

## Analyses

First, the crude relationship between perceived weight at baseline (perceived skinny, average or overweight) and weight status six years later (overweight or obese vs. healthy weight) was examined. The relationship was then adjusted for age, gender, ethnicity, family income, weight status, major depression, physical activity, and dieting behavior at baseline. The relationship between perceived weight and future weight status appears to differ by gender (13), so we examined the association between perceived weight at baseline and weight status six years later separately for males and females. In children and adolescents aged 2-19 years old, body composition is influenced by age and gender, therefore the definition of overweight or obesity differs from that for adults aged 20 years or older (1, 2). To examine whether differences in overweight or obesity definition between these two age groups influenced the relationship between perceived weight and future weight status, separate analyses were performed for youths < 20 years of age and adults ≥ 20 at the follow-up time point.

The estimated odds ratios and their 95% confidence limits were calculated using survey logistic regression (Proc Surveylogistic) procedures in SAS V9.3 (34) and Taylor series approximation to compute the standard error of the odds ratio. Lepkowski and Bowles (1996) have indicated that the difference in computing standard error between this method and other repeated replication methods such as the jackknife is very small (35).

## Results

Female youths were more likely to perceive themselves as overweight than male youths ( $p < 0.05$ ). Latino Americans were more likely to perceive themselves as overweight than European Americans or African Americans ( $p < 0.05$ ). About 40% of overweight youths and 74% of obese youths perceived themselves as overweight. Youths who were involved in physical activities or dieting behaviors were less likely to perceive themselves as overweight

( $p < 0.05$ ). In contrast, those who experienced major depression were more likely to perceive themselves as overweight. Prevalence of overweight or obesity 6 years later was higher among those who perceived themselves as overweight than those who perceived themselves as average weight at baseline (81% vs. 44%); those who perceived themselves as skinny at baseline were less likely to be overweight or obese 6 years later (15%) (Table 1).

Perceived weight among all youths predicted weight status six years later. After controlling for potential confounders, youths who perceived themselves as overweight at baseline were approximately 2.5 times as likely to be overweight or obese six years later compared to youths who perceived themselves as average weight (Table 2). The relationship appeared to be similar across genders: Males: OR=2.61, 95% CI=1.59-4.28; females: OR=2.32, 95% CI=1.50-3.59). Our study also showed that regardless of baseline weight status (healthy weight, overweight or obesity), those who perceived themselves as overweight were more likely to be overweight or obese 6 years later compared with those who perceived themselves as average weight.

Table 3 presents the odds of being obese by perceived weight across age groups. A significant relationship between perceived weight at baseline and weight status 6 years later exists, regardless of age at the follow-up time point. The relationship was slightly stronger among those who were younger than 20 years (OR=2.90, 95% CI=1.85-4.53) than those who were 20 years or older (OR=1.68, 95% CI=1.03-2.73) at follow-up.

## Discussion

Our study showed that perceived weight among children and adolescents predicted weight status six years later after controlling for baseline weight status, major depression, demographic characteristics, physical activity and dieting behavior. Those who perceived themselves as overweight were approximately 2.5 times as likely to be overweight or obese six years later as compared to those who perceived themselves as average weight. In contrast, those who perceived themselves as skinny were less likely to be overweight or obese later (OR=0.36, 95% CI=0.27-0.49).

These findings are consistent with findings from several previous studies (13, 14). Cuypers et al. (13) examined the relationship between perceived weight among normal weight adolescents (13–19 yrs) and BMI at follow-up 11 years later found that adolescents who perceived themselves as overweight at baseline had a larger weight gain (0.66 BMI units) compared to those who did not perceive themselves as overweight. These authors also found a slightly stronger association between perceived overweight and weight gain 11 years later for females than for males. Our study did not show a significant gender difference: OR=2.32, 95% CI=1.50-3.59 for females and OR=2.61, 95% CI=1.59-4.28 for males.

Our analyses also showed that those who perceived themselves as overweight were more likely to be overweight or obese later compared to those who perceived themselves as average weight. Conversely, those who perceived themselves as skinny were less likely to be overweight or obese later compared with those who perceived themselves as average weight, and this relationship appeared to be stronger among females (OR=0.26, 95% CI=0.17-0.41) than males (OR=0.45, 95% CI=0.30-0.67). Previous studies compared the future prevalence of overweight between those who perceived themselves as overweight and those who did not perceive themselves as overweight at baseline. Individuals who did perceive themselves as overweight might perceive themselves as skinny or average weight; combining those with ‘perceived skinny’ and those with ‘perceived average weight’ into one group ‘not perceived overweight’ might lead to biased findings.

Previous study showed that perceived overweight is associated with weight control behaviors (15-17). Our study and the studies by Cuypers et al. (13) and by Neumark-Sztainer et al. (14) showed perceived overweight were associated with greater risk for obesity. How can weight control behaviors be associated with weight gain? Liechty et al. (21) found that children and adolescents with distorted body-image or overestimation of weight status were more likely to practice unsafe dieting and extreme weight loss behaviors such as vomiting, use of laxatives and diet pills than those without distorted body image. Similar studies have reported that perceived overweight in youths is associated with binge eating and extreme weight control behaviors (14, 18). Unhealthy weight control behaviors such as skipping meals, reporting fasting behaviors, use of food substitutes (powders or special drinks) or the use of diet pills (20) are all associated with increased weight gain (14, 19, 20). Our study showed that those who were involved in dieting behaviors were less likely to perceive themselves as overweight, and the relationship between perceived overweight at baseline and overweight or obesity at follow-up 6 years later was still significant after controlling for dieting behaviors, major depression, and other covariates. Weight control behaviors or major depression did not fully explain the relationship between perceived weight and weight status later. Another possible reason to explain this relationship is that perceived overweight negatively influences one's psychological well-being and can lead to increased stress (30, 36), which is believed to be associated with weight status as stress triggers hormonal responses resulting in fat accumulation in visceral adipose tissues (37). Further studies on the mechanisms of this relationship are needed.

Our study showed that youths who perceived themselves as skinny were less likely to be overweight or obese 6 years later compared with those who perceived themselves as average weight. This relationship remained significant after controlling for weight status at baseline. Previous studies by Cuypers, Neumark-Sztainer et al. did not separate out those who perceived themselves as skinny from those who perceived themselves as average weight. We have not found any other studies that examined this relationship. Further studies are needed to confirm this relationship and to examine mechanisms involved.

Our study had limitations. A total of 4175 youths participated in wave 1 (baseline), representing 66% of the eligible households, and 60% of baseline dyads were followed 6 years later. Even though there was no marked ethnic or gender difference between those who were lost to follow-up and those who remained in the study, nonresponse bias was possible. Another possible limitation was that our findings were adjusted for baseline characteristics, but not for time-variant factors that could have confounded the studied association.

## Conclusion

Future weight gain appears to be influenced by self-perceived weight. This relationship was not fully explained by extreme weight control behaviors or depression. Further research is needed to explore the mechanisms involved.

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**Table 1**

Unweighted distribution of perceived weight at baseline by other baseline characteristics and weight status at follow-up (N=2445).

		Perceived weight at baseline		
		Skinny (n=690)	Average (n=1144)	Overweight (611)
<b>Baseline characteristics*</b>				
Gender	Male	27.7	50.0	22.3
	Female	28.7	43.7	27.6
	<i>p-Value</i>	<0.05		
Age	16+	26.1	48.2	25.7
	Between 13 and 15	26.8	47.1	26.2
	12 or less	32.4	45.2	22.4
	<i>p-Value</i>	0.052		
Ethnicity	European American	33.1	43.5	23.4
	African American	27.2	50.2	22.6
	Latino American	24.5	45.8	29.7
	Other	15.7	50.9	33.3
	<i>p-Value</i>	<0.05		
Family Income	\$65,000+	29.2	46.4	24.4
	\$35,000 - \$64,999	28.2	47.8	24.0
	<\$35,000	27.1	45.4	27.5
	<i>p-Value</i>	>0.05		
Weight status	Healthy weight	42.5	51.4	6.1
	Overweight	4.4	55.5	40.1
	Obesity	1.7	24.2	74.1
	<i>p-Value</i>	<0.05		
Physical activity	No	27.4	44.4	28.2
	Yes	28.6	48.1	23.4
	<i>p-Value</i>	<0.05		
Dietary behavior	No	27.8	46.4	25.9
	Yes	32.9	51.4	15.7
	<i>p-Value</i>	<0.05		
Major depression	No	28.5	46.9	24.6
	Yes	10.8	40.5	48.7
	<i>p-Value</i>	<0.05		
<b>Weight status at follow-up**</b>				

	Perceived weight at baseline		
	Skinny (n=690)	Average (n=1144)	Overweight (611)
Healthy weight	85.1	55.9	18.8
Overweight	12.2	28.9	26.8
Obesity	2.8	15.2	54.3
<i>p-Value</i>		<0.05	

\* Columns add up to 100%.

\*\* Rows add up to 100%.

**Table 2**

Odds ratios for overweight or obesity at follow-up by baseline perceived weight.

Baseline perceived weight	Weight status six years later			
	Crude OR, 95% C.I.		Adjusted OR, 95% C.I.	
	Healthy weight	Overweight/Obese	Healthy weight	Overweight/Obese
<b>Total<sup>a</sup></b>				
Perceived skinny	1	0.24 (0.19-0.31) †	1	0.36 (0.27-0.49) †
Perceived average	1	1	1	1
Perceived overweight	1	5.45 (4.24-7.00) †	1	2.45 (1.77-3.39) †
<b>By gender<sup>b</sup></b>				
<b>Male</b>				
Perceived skinny	1	0.28 (0.20-0.40) †	1	0.45 (0.30-0.67) †
Perceived average	1	1	1	1
Perceived overweight	1	7.13 (4.72-10.77) †	1	2.61 (1.59-4.28) †
<b>Female</b>				
Perceived skinny	1	0.19 (0.13-0.29) †	1	0.26 (0.17-0.41) †
Perceived average	1	1	1	1
Perceived overweight	1	5.12 (3.69-7.11) †	1	2.32 (1.50-3.59) †
<b>By baseline weight status<sup>c</sup></b>				
<b>Healthy weight</b>				
Perceived skinny	1	0.36 (0.27-0.48) †	1	0.35 (0.26-0.48) †
Perceived average	1	1	1	1
Perceived overweight	1	1.56 (0.98-2.48)	1	1.81 (1.08-3.05) †
<b>Overweight/Obese</b>				
Perceived skinny	1	0.33 (0.13-0.81) †	1	0.45 (0.16-1.27)
Perceived average	1	1	1	1
Perceived overweight	1	2.74 (1.85-4.05) †	1	3.25 (2.10-5.04) †

<sup>a</sup> Adjusting for age, gender, ethnicity, family income, physical activity, dietary behavior, weight status, and major depression at wave 1.

<sup>b</sup> Adjusting for age, ethnicity, family income, physical activity, dietary behavior, weight status, and major depression at wave 1.

<sup>c</sup> Adjusting for age, gender, ethnicity, family income, physical activity, dietary behavior, and major depression at wave 1.

† Odds ratios are statistically significant (p<0.05).

**Table 3**

Odds ratios for overweight or obesity at follow-up by baseline perceived weight, stratified by age groups at the follow-up time point.

	Weight status six years later			
	Crude OR, 95% C.I.		Adjusted* OR, 95% C.I.	
	Healthy weight	Overweight/Obese	Healthy weight	Overweight/Obese
<b>Less than 20 (yrs)</b>				
Perceived skinny	1	0.22 (0.14-0.36) †	1	0.39 (0.23-0.67) †
Perceived average	1	1	1	1
Perceived overweight	1	6.52 (4.52-9.40) †	1	2.90 (1.85-4.53) †
<b>20 or older (yrs)</b>				
Perceived skinny	1	0.23 (0.17-0.32) †	1	0.31 (0.21-0.44) †
Perceived average	1	1	1	1
Perceived overweight	1	4.88 (3.44-6.92) †	1	1.68 (1.03-2.73) †

\* Adjusting for age, gender, ethnicity, family income, physical activity, dietary behavior, weight status and major depression at wave 1.

† Odds ratios are statistically significant ( $p < 0.05$ ).