The effect of perceived body weight on suicidal ideation among a representative sample of US adolescents

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Abstract There is no published report on the sex differences in the prospective influence of perceived body weight on suicidal ideation in adolescents. To examine sex differences in the longitudinal relationship between perceived body weight and suicidal ideation among a representative sample of US middle and high school students. Two waves of longitudinal data from 7th–12th grade US adolescents (N = 4,717) in the National Longitudinal Study of Adolescent Health were analyzed using hierarchical multivariable logistic regression for suicidal ideation 1 year after perceived body weight was measured. Overweight perception significantly increased the risk for suicidal ideation in girls (adjusted odds ratio in the full model = 1.41, $p < .05$) but not in boys after controlling for previously well-documented risk factors of suicidal ideation. Overweight perception appears to increase the risk for suicidal ideation in girls. It is important to address perceived body weight among girls in suicide prevention interventions.

Keywords Perceived body weight · Suicidal ideation · Adolescent health

Introduction

Suicide during adolescence has become a significant health problem in the United States. According to the *National Vital Statistics Reports* (Xu et al., 2010), suicide has been identified as the third leading cause of death among adolescents and young adults. Numerous risk factors of suicide during adolescence have been well documented. These risk factors include depression, hopelessness, family history of suicidal behavior, physical disability, impulsivity, living apart from biological parents, and substance use disorders (Bridge et al., 2006). Recently, there has been an increasing interest in perceived body weight as one of the potential risk factors of suicide among adolescents.

Perceived body weight of oneself, which is often associated with certain feelings and attitudes toward one's body, is an important component of body image. Studies report that perceived body weight in adolescents, especially among girls, is sensitive to sociocultural influences (Knauss et al., 2008; McCabe & Ricciardelli, 2001; Ricciardelli & McCabe, 2011; Smolak et al., 2005). Society implicitly or explicitly puts pressure on female adolescents to make themselves look thin (McCabe & Ricciardelli, 2001; Ricciardelli & McCabe, 2011). As a result, many adolescent girls are less satisfied with their body weights or shapes and are more likely to adopt strategies to lose weight than adolescent boys (McCabe & Ricciardelli, 2001). In contrast, sociocultural pressure for adolescent boys to attain muscularity has been reported in the literature (McCabe & Ricciardelli, 2001; Smolak et al., 2005). Consequently, the prevalence of body dissatisfaction seems to increase and peak during adolescence (Littleton & Ollendick, 2003). This is concerning because body dissatisfaction, which is closely related to perceived body weight, can lead to the development of depression (Mamun et al., 2007; Rierdan & Koff, 1997) that in turn can trigger suicidal ideation (Bridge et al., 2006; Mazza & Reynolds, 1998; Reifman & Windle, 1995). Despite the proposed role of perceived body weight as a risk factor of suicide, few studies have investigated this relationship using longitudinal data.

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Previous studies among adolescents on the relationship between perceived body weight and suicidal ideation or attempts have analyzed cross-sectional data (Dave & Rashad, 2009; Eaton et al., 2005; Kim et al., 2009; Swahn et al., 2009; Whetstone et al. 2007). The results of these studies are not necessarily consistent. One of the reasons for these inconsistent findings may have to do with lack of prospective longitudinal design to examine the relationship between perceived body weight and suicidal ideation, a necessary condition to establish causality. Another reason might be lack of representativeness of the sample in these studies. Selection bias may lead to different results depending on the makeup of the sample. Thus, it is imperative to analyze the prospective longitudinal data of a representative sample of US adolescents to investigate the relationship between perceived body weight and suicidal ideation.

It also deserves mention that not all the prior studies took into account the role of sex and depression in suicidal ideation. Sex differences in perceived body weight have been well established in the literature (Knauss et al., 2008; McCabe & Ricciardelli, 2001; Ricciardelli & McCabe, 2011; Smolak et al., 2005). Thus, it is important to examine sex differences in the relationship between perceived body weight and suicidal ideation. Likewise, depression must be included in the investigation of suicidal ideation because depression is a well-established predictor of suicidal ideation or attempts (Bridge et al., 2006; Mazza & Reynolds, 1998; Reifman & Windle, 1995). In terms of measures of depression, all the other previous studies of perceived body weight on suicidal ideation measured depression with only one question item (Dave & Rashad, 2009; Kim et al., 2009; Swahn et al., 2009). As depression is a mental disorder characterized by disruptions in social, behavioral, and biological facets of life, it is difficult, if not impossible, to assess depression adequately with only one item. Given the importance of depression as a predictor of suicidal ideation or attempts, it is important to use a scale that measures depression with a high reliability and validity in examining suicidal ideation.

This study was conducted to examine sex differences in the longitudinal relationship between perceived body weight and suicidal ideation among a representative sample of US middle and high school students. We tested whether perceived body weight prospectively affected suicidal ideation while controlling for 3 different sequential sets of covariates: (1) demographic and physical characteristics, such as age, race/ethnicity, body mass index (BMI), and physical disability; (2) psycho-behavioral covariates, such as impulsivity, smoking, alcohol use, marijuana use, and family history of suicidal behavior; and (3) depressive symptoms. This sequential method was chosen to examine whether or not perceived body weight can predict suicidal

ideation even after controlling for well-documented psycho-behavioral risk factors for suicidal ideation and then depressive symptoms in addition to these psycho-behavioral risk factors. All analyses were performed by sex because sex differences are noted in perceived body weight (McCabe & Ricciardelli, 2001), suicidal ideation (Bridge et al., 2006), and depression (Piccinelli & Wilkinson, 2000).

Methods

Data

The National Longitudinal Study of Adolescent Health (Add Health) is a longitudinal study of a nationally representative sample of 7th through 12th grade adolescents in the United States. Add Health provides a unique opportunity to examine how behaviors and social environments are linked to health outcomes during adolescence. The first phase (Wave 1) of in-home interviews was conducted in 1995 from April to December. Audio computer-assisted self-interviewing (audio-CASI) was used to maintain respondents' anonymity and to minimize the potential influence of interviewers and parents (Turner et al., 1998). The school response rate was 70 % and the student response rate was 79 % at Wave 1. The second phase of data collection (Wave 2) was conducted approximately a year later (88 % response rate) using the same protocol as Wave 1. Details of the sampling procedure are reported elsewhere (Sieving et al., 2001; Swallen et al., 2005). The present study analyzed Wave 2 public-use data of adolescents who attended school (N = 6,376; Udry, 1998). Students who had missing data on suicidal ideation at Wave 2 (n = 1,659) were dropped from analysis, reducing the analysis sample size to 4,717. The characteristics of respondents with missing data on suicidal ideation were not significantly different (all $ps > .05$) from those who remained in our analysis sample in terms of age (15.3 vs. 14.9 years), sex (51 boys vs. 48 %), race/ethnicity (44 non-Whites vs. 39 %), and perceived body weight (17 vs. 16 % were underweight; 52 % were about the right weight; and 31 vs. 32 % were overweight). The study protocol of this secondary data analysis was approved by the sponsoring institution's Committee on Human Subjects.

Measures

The outcome variable, suicidal ideation, was assessed at Wave 2 by asking the question "During the past 12 months, did you ever seriously think about committing suicide?" The responses were coded as 0 = no and

1 = yes. All the independent variables and covariates of the present study were measured at Wave 1. The major independent variable, perceived body weight, was assessed by asking students if they perceived themselves as very underweight, slightly underweight, about the right weight, slightly overweight, or very overweight. The responses were collapsed into three categories: underweight, about the right weight, and overweight. The major control variable, respondents' depressive symptoms, was assessed by the 20 items of the Center for Epidemiologic Studies-Depression Scale (CES-D; Radloff, 1977). Two items were slightly modified from the CES-D to measure depressive symptoms in the past 12 months rather than in the past week. Each item was scored from 0 to 3, producing a range of 0–60 for a total score. Total scores were dichotomized at ≥22 for boys and ≥24 for girls to improve the ability to detect depression in the adolescents (Garrison et al., 1991; Roberts et al., 1991).

The risk factors for adolescent suicides identified in the literature were included in our analyses to examine their prospective influence on suicidal ideation. Family history of suicidal behavior was assessed by asking if anyone in the respondent's family had tried to commit suicide during the past 12 months (0 = no, 1 = yes). Physical disability was measured by asking whether the respondent had difficulty using his or her hands, arms, legs, or feet because of a permanent physical condition (0 = no, 1 = yes). Impulsivity was measured by asking if the respondent usually went with a "gut feeling" when making a decision without thinking too much about the consequence of each alternative. Respondents' BMIs were calculated based on their self-reported height (inches) and weight (pounds) using the following formula: $BMI = weight/height^2 \times 703$. Using the BMI percentile for sex and age suggested by the Centers for Disease Control and Prevention (CDC) growth charts (Kuczmarski et al., 2002), respondents were categorized into three groups: underweight (≤15th percentile), normal (16th–84th percentile), and overweight (≥85th percentile). Smoking was measured by asking whether the respondent smoked cigarettes at least 1 day during the past 30 days (0 = no, 1 = yes). Alcohol use was measured by asking whether the respondent consumed an alcoholic beverage at least 1 day in the past 12 months (0 = no, 1 = yes). Marijuana use was measured by asking whether the respondent used marijuana at least once in his or her lifetime (0 = no, 1 = yes). Demographic variables included sex (male or female), age, and race/ethnicity (White, Black, Hispanic, or others).

Statistical analysis

SAS version 9.3 was used to manage and analyze Add Health data. To investigate the relationship between perceived body weight and suicidal ideation among adolescents, we conducted hierarchical multivariable logistic regression analyses by sex, adjusting for 3 different sequential sets of covariates: (1) demographic and physical characteristics, (2) psycho-behavioral covariates, and (3) depressive symptoms. The Hosmer–Lemeshow test was used to examine the goodness of fit of each model to the data. Deviance statistics (−2 log likelihood) were employed to test nested models. SURVEYFREQ, SURVEYMEANS, and SURVEYLOGISTIC procedures were used to account for multistage stratified cluster sampling design and sample weights. Analyses were conducted on data that had been weighted to be nationally representative.

Results

The sex-specific percentages of suicidal ideation by all key variables are shown in Table 1. The average age for all the boys and girls was 15.0 years ($SD = 0.11$) and 14.8 years ($SD = 0.11$), respectively. The overall percentage of suicidal ideation was much higher in girls than in boys (14.4 vs. 7.9 %; $p < .001$). Girls were more likely to perceive themselves as overweight compared to boys (40.0 vs. 23.4 %; $p < .001$) whereas boys were more likely to think of themselves as underweight than were girls (22.0 vs. 10.7 %; $p < .001$). Depression was positively associated with suicidal ideation in both boys and girls ($p < .001$). Perceived body weight was positively associated with suicidal ideation in girls ($p = .014$) but not in boys ($p = .220$).

Tables 2 and 3 show logistic regression results for suicidal ideation by sex. The Hosmer–Lemeshow test for the logistic regression models produced χ^2 ranging from 6.1 ($p = .637$) to 14.0 ($p = .081$), which indicates the good model fit of each model. Perceived body weight was not a significant predictor for suicidal ideation among boys in any of the three adjusted models. In the full model (Model 3), smoking and depression were the only independent predictors for suicidal ideation among boys. Smoking (adjusted odds ratio [AOR] = 1.57) and depression (AOR = 3.14) were predictive of an increased risk for suicidal ideation 1 year later among boys, controlling for age, race/ethnicity, BMI group, physical disability, impulsivity, alcohol use, marijuana use, and family history of suicidal behavior.

For girls, perceived body weight was a significant predictor for suicidal ideation 1 year later in each of the three adjusted models. In the full model, girls who perceived themselves as overweight increased the odds of suicidal ideation 1 year later by 1.41 times compared to girls who perceived themselves as having about the right weight. Girls who reported a family history of suicidal behavior and marijuana use were at a significantly higher risk of

Table 1 Percentages of adolescents reporting suicidal ideation 1 year after (N = 4,717)

Independent variables	Boys (n = 2,257)		Girls (n = 2,460)	
	Total (n)	Suicidal ideation (%)[a]	Total (n)	Suicidal ideation (%)[a]
Total	2,257	7.9	2,460	14.4
Race/ethnicity				
White	1,382	8.3	1,479	15.3
Black	491	5.3	575	11.8
Hispanic	259	8.1	283	12.4
Others	119	9.4	120	15.7
Body mass index group				
Underweight	127	6.0	143	11.0
Normal	1,394	7.6	1,608	13.5
Overweight	694	8.6	592	15.8
Physical disability				
Yes	45	11.5	48	30.1
No	2,212	7.8	2,412	14.1
Impulsivity				
Agree	991	6.7	836	15.8
Neither agree nor disagree	439	10.2	535	13.8
Disagree	818	8.4	1,071	13.4
Smoking				
Not in the past 30 days	1,679	6.5	1,888	12.0
1 or more days in the past 30 days	565	12.2	561	21.4
Alcohol use				
Not in the past 12 months	1,245	5.8	1,402	11.3
1 or more days in the past 12 months	992	10.3	1,043	18.5
Marijuana use				
Never tried	1,631	6.6	1,909	12.0
1 or more times in lifetime	579	11.3	526	22.7
Family history of suicidal behavior				
Yes	92	10.7	134	33.5
No	2,145	7.8	2,308	13.2
Depression scale (CES-D)				
<22 (<24 for girls)	2,108	7.5	2,282	13.6
≥22 (≥24 for girls)	77	20.5	108	32.0
Perceived body weight				
Underweight	500	7.1	263	12.8
About the right weight	1,241	7.4	1,216	12.5
Overweight	516	9.9	979	17.2

CES-D Center for Epidemiologic Studies-Depression Scale

[a] Weighted percentages

suicidal ideation than girls who did not report such a family history or marijuana use in both adjusted models. In the full model, as with boys, depression (AOR = 2.25) was predictive of an increased risk for suicidal ideation 1 year later among girls. For both sexes, deviance statistics (i.e., −2 log likelihood which indicates a badness of model fit: the lower the deviance statistic, the better fit the model is) indicated a significantly better fit of Model 3 than Model 2 ($p < .001$) and of Model 2 than Model 1 ($p < .001$) to the data.

We did not control for overweight perception, BMI group, and depression at Wave 2 in the regression models because of the concern about multicollinearity (Tabachnick & Fidell, 2007, pp. 437–505). A diagnostic procedure suggested by Hosmer and Lemeshow (2000, pp. 91–142) where standard errors were examined with and without these variables at Wave 2 indicated the presence of multicollinearity. Instead of controlling for the key variables at Wave 2, we have created new variables of perceived

Table 2 Logistic regression for suicidal ideation 1 year after among boys (N = 2,257)

Independent variables	Model 1[a]		Model 2[b]		Model 3[c]	
	AOR	(95 % CI)	AOR	(95 % CI)	AOR	(95 % CI)
Perceived body weight						
Underweight	0.89	(0.55–1.43)	0.88	(0.53–1.46)	0.80	(0.49–1.33)
About the right weight (ref)	1.00		1.00		1.00	
Overweight	1.29	(0.75–2.21)	1.41	(0.83–2.41)	1.33	(0.79–2.25)
Body mass index group						
Underweight	0.76	(0.35–1.68)	0.78	(0.35–1.74)	0.76	(0.33–1.77)
Normal (ref)	1.00		1.00		1.00	
Overweight	0.98	(0.56–1.71)	0.81	(0.47–1.39)	0.86	(0.48–1.55)
Physical disability						
Yes	1.68	(0.56–5.04)	1.64	(0.51–5.28)	1.56	(0.47–5.21)
No (ref)	1.00		1.00		1.00	
Impulsivity						
Agree			0.69	(0.44–1.08)	0.70	(0.45–1.11)
Neither agree nor disagree			1.06	(0.64–1.75)	1.16	(0.70–1.91)
Disagree (ref)			1.00		1.00	
Smoking						
Not in the past 30 days (ref)			1.00		1.00	
1 or more days in the past 30 days			1.67	(1.12–2.48)*	1.57	(1.06–2.33)*
Alcohol use						
Not in the past 12 months (ref)			1.00		1.00	
1 or more days in the past 12 months			1.38	(0.85–2.26)	1.34	(0.81–2.23)
Marijuana use						
Never tried (ref)			1.00		1.00	
1 or more times in lifetime			1.27	(0.82–1.95)	1.29	(0.83–2.00)
Family history of suicidal behavior						
Yes			1.40	(0.68–2.89)	1.33	(0.63–2.81)
No (ref)			1.00		1.00	
Depression scale (CES-D)						
<22 (ref)					1.00	
≥22					3.14	(1.75–5.63)**
−2LL	4,913,866		4,608,302		4,451,509	

AOR adjusted odds ratio, *CI* confidence interval, *ref* reference category, −2LL −2 log likelihood

[a] Adjusted for demographic and physical characteristics, such as age, race/ethnicity, body mass index group, and physical disability

[b] Adjusted for all the variables in model 1 plus psycho-behavioral covariates, such as impulsivity, smoking, alcohol use, marijuana use, and family history of suicidal behavior

[c] Adjusted for all the variables in model 2 plus depressive symptoms

* p < .05, ** p < .01

overweight, overweight status, and depression that indicate changes from Wave 1 to Wave 2 (see Table 4). We also substituted these new variables for the corresponding variables at Wave 1 and ran the same logistic regression models as original models in Tables 2 and 3 to see if different results would emerge. This way we were able to reflect the changes from Wave 1 to Wave 2 in the key variables on the regression models and at the same time avoid the multicollinearity. In terms of significant pre-

dictors, the results were the same as those in Tables 2 and 3. Girls who had overweight perception at both Wave 1 and Wave 2 were more likely to think about committing suicide compared to girls who had no overweight perception across the two waves. However, girls who had overweight perception only at Wave 1 or at Wave 2 were not different from girls who had no overweight perception across the two waves in terms of odds of thinking about committing suicide. In summary, it was long-term, chronic

Table 3 Logistic regression for suicidal ideation 1 year after among girls (N = 2,460)

Independent variables	Model 1[a]		Model 2[b]		Model 3[c]	
	AOR	(95 % CI)	AOR	(95 % CI)	AOR	(95 % CI)
Perceived body weight						
Underweight	0.90	(0.54–1.48)	0.94	(0.55–1.61)	0.97	(0.57–1.65)
About the right weight (ref)	1.00		1.00		1.00	
Overweight	1.48	(1.09–1.99)*	1.41	(1.04–1.93)*	1.41	(1.03–1.92)*
Body mass index group						
Underweight	0.90	(0.46–1.75)	1.00	(0.50–2.00)	0.92	(0.45–1.89)
Normal (ref)	1.00		1.00		1.00	
Overweight	0.91	(0.64–1.29)	0.96	(0.67–1.37)	0.96	(0.65–1.42)
Physical disability						
Yes	2.14	(1.12–4.08)*	2.13	(0.99–4.61)	2.18	(0.96–4.94)
No (ref)	1.00		1.00		1.00	
Impulsivity						
Agree			1.09	(0.77–1.56)	1.07	(0.74–1.55)
Neither agree nor disagree			1.03	(0.68–1.54)	1.03	(0.68–1.56)
Disagree (ref)			1.00		1.00	
Smoking						
Not in the past 30 days (ref)			1.00		1.00	
1 or more days in the past 30 days			1.28	(0.84–1.96)	1.25	(0.82–1.91)
Alcohol use						
Not in the past 12 months (ref)			1.00		1.00	
1 or more days in the past 12 months			1.34	(0.98–1.83)	1.33	(0.97–1.83)
Marijuana use						
Never tried (ref)			1.00		1.00	
1 or more times in lifetime			1.73	(1.23–2.43)**	1.70	(1.21–2.38)**
Family history of suicidal behavior						
Yes			3.05	(1.92–4.83)**	2.98	(1.90–4.69)**
No (ref)			1.00		1.00	
Depression scale (CES-D)						
<24 (ref)					1.00	
≥24					2.25	(1.21–4.21)*
−2LL	6,836,390		6,335,486		6,172,852	

AOR adjusted odds ratio, *CI* confidence interval, *ref* reference category, −2LL, −2 log likelihood

[a] Adjusted for demographic and physical characteristics, such as age, race/ethnicity, body mass index group, and physical disability

[b] Adjusted for all the variables in model 1 plus psycho-behavioral covariates, such as impulsivity, smoking, alcohol use, marijuana use, and family history of suicidal behavior

[c] Adjusted for all the variables in model 2 plus depressive symptoms

* $p < .05$, ** $p < .01$

overweight perception that was predictive of suicidal ideation in girls.

To better understand the changes from Wave 1 to Wave 2 in the key variables of interest, we have computed Phi correlation coefficients (see Table 5). Compared to boys, higher correlations were shown in girls between perceived overweight and depression at Wave 1 and suicidal ideation at Wave 2.

Discussion

This is the first study that investigated sex differences in the prospective influence of perceived body weight on suicidal ideation among a representative sample of US adolescents. Overweight perception significantly increased the risk for suicidal ideation only in girls 1 year after the measurement of perceived body weight across all three

Table 4 Changes in perceived overweight, overweight status, and depression from Wave 1 to Wave 2 and their adjusted odds ratios in predicting suicidal ideation

Variables (Wave 1 → Wave 2)	Boys				Girls			
	Total	(%)[a]	AOR	(95 % CI)[b]	Total	(%)[a]	AOR	(95 % CI)[b]
Perceived overweight								
No → No (ref)	1,613	(70.6)	1.00		1,270	(51.5)	1.00	
No → Yes	127	(6.0)	1.06	(0.47–2.38)	208	(8.5)	1.07	(0.59–1.94)
Yes → No	139	(6.1)	0.93	(0.43–2.00)	220	(8.9)	1.30	(0.73–2.32)
Yes → Yes	377	(17.3)	1.60	(0.86–2.98)	758	(31.0)	1.56	(1.07–2.28)*
Overweight status[c]								
No → No (ref)	1,297	(58.0)	1.00		1,555	(67.9)	1.00	
No → Yes	200	(9.6)	1.24	(0.59–2.62)	165	(7.7)	0.72	(0.37–1.40)
Yes → No	84	(4.2)	0.78	(0.34–1.81)	74	(3.4)	1.35	(0.69–2.66)
Yes → Yes	599	(28.1)	0.97	(0.48–1.94)	488	(21.0)	0.82	(0.53–1.27)
Depressed (CES-D)								
No → No (ref)	1,993	(93.6)	1.00		2,124	(91.1)	1.00	
No → Yes	45	(2.6)	7.81	(2.95–20.7)**	97	(4.2)	4.21	(2.47–7.17)**
Yes → No	53	(2.6)	2.04	(0.74–5.59)	72	(3.2)	1.72	(0.79–3.71)
Yes → Yes	23	(1.2)	9.06	(3.46–23.7)**	35	(1.4)	5.86	(2.10–16.3)**

AOR adjusted odds ratio, *CI* confidence interval, *ref* reference category, *CES-D* Center for Epidemiologic Studies-Depression Scale

[a] Weighted percentages

[b] AOR and 95 % CI estimates on Model 3 (the full model) when the corresponding variables at Wave 1 in Tables 2 and 3 were replaced with these change variables from Wave 1 to Wave 2

[c] Based on body mass index

Table 5 Correlations between Wave 1 and Wave 2 in suicidal ideation, perceived overweight, overweight status, and depression

Wave 1	Wave 2			
	Suicidal ideation	Perceived overweight	Overweightstatus	Depression
Boys				
Suicidal ideation	0.30	0.03	0.01	0.11
Perceived overweight	0.04	0.66	0.50	0.04
Overweight status	0.02	0.52	0.70	0.01
Depression	0.09	0.01	−0.07	0.29
Girls				
Suicidal ideation	0.33	0.12	0.03	0.12
Perceived overweight	0.06	0.64	0.50	0.06
Overweight status	0.03	0.48	0.72	−0.01
Depression	0.11	0.04	0.02	0.24

All the correlations are Phi coefficients

adjusted models. This result stayed the same when changes from Wave 1 to Wave 2 in perceived overweight, overweight status, and depression were substituted for the corresponding variables at Wave 1 although it did not hold for girls who did not have overweight perception any longer at Wave 2.

Girls who had overweight perception at both waves were more likely to think about committing suicide whereas girls who had overweight perception only at Wave 1 or at Wave 2 were not different from girls who had no overweight perception across the two waves. This finding has important implications. First, it indicates that the effect of perceived overweight on suicidal ideation in girls may not necessarily operate contemporaneously. Rather, it suggests that long-term, chronic overweight perception is predictive of suicidal ideation in girls. Another implication is that the effect of overweight perception on suicidal ideation should be investigated using a prospective longitudinal design given the non-contemporaneous nature of the relationship.

Literature consistently identifies depression as a primary predictor for suicidal ideation (Bridge et al., 2006; Mazza & Reynolds, 1998; Reifman & Windle, 1995; Swahn et al., 2009). The finding in the present study confirms this for both sexes. It may be reasonable to hypothesize that depression mediates the effect of perceived overweight on suicidal ideation. Thus, we had suspected that adding depression to the final step of sequential regression models would make perceived overweight become no longer significant. Contrary to our expectation, however, perceived overweight remained significant even after controlling for depression among girls. Actually the same result was reported by a recent study (Swahn et al., 2009). This result indicates partial rather than full mediation of depression between overweight perception and suicidal ideation (Baron & Kenny, 1986). Although this study cannot pinpoint the mechanism by which perceived overweight affects suicidal ideation among girls, the results imply that depression may not be the only channel through which perceived overweight affects suicidal ideation among adolescent girls. Literature indicates that low self-worth, little support from peers (Groholt et al. 2000; Wichstrom, 2000) and anger expression (Daniel et al., 2009) are also risk factors for suicidal ideation/attempts among adolescents. Given that adolescents who are dissatisfied with their body weight or shape may be susceptible to increased inward or outward expression of anger, low self-worth and little support from peers (Brausch, & Muehlenkamp, 2007), these risk factors might be potential channels through which overweight perception affects suicidal ideation.

The finding of this study that overweight perception significantly increased the risk for suicidal ideation only in girls is contrary to some previous cross-sectional studies (Dave & Rashad, 2009; Kim et al., 2009; Whetstone et al., 2007) that found a significant association between perceived overweight and suicidal ideation for both sexes. This discrepancy illustrates the importance of using a prospective longitudinal design to investigate a causal relationship. Without the establishment of temporal precedence, we cannot be sure if a putative cause led to an outcome of interest. The discrepancy in the finding between previous cross-sectional studies and the present study also suggests an important implication. Given that depression was an independent predictor for suicidal ideation for both sexes, the discrepancy between previous cross-sectional studies and the present study indicates that the link from perceived overweight to depression either might be weaker for boys than girls (which was actually shown in the correlational analyses in this study) or might have dissipated for the duration of 1 year for boys. Another possible interpretation is that the insignificant association between overweight perception and suicidal ideation among boys is due to lack of statistical power. The magnitude of adjusted odds ratios of overweight perception was comparable between boys and girls. Thus, inadequate statistical power might have induced the insignificant association among boys.

The finding that correlations between perceived overweight at Wave 1 and suicidal ideation at Wave 2 were higher in girls than in boys further suggests higher susceptibility to suicidal ideation in girls with perceived overweight than their male counterparts. Given that girls are more concerned about their physical appearance than boys (Jones et al., 2004; Knauss et al., 2008; McCabe & Ricciardelli, 2001), this result is not surprising. This finding implies, however, that health professionals and practitioners should make efforts to help girls with perceived overweight overcome their physical dissatisfaction and boost their self-esteem in order to prevent them from having suicidal ideation or attempts.

Another related finding of note is that underweight perception did not have a significant effect on suicidal ideation in boys as well as in girls. Despite sociocultural pressure for boys to attain muscular bodies (McCabe & Ricciardelli, 2001; Smolak et al., 2005), perceived underweight did not affect boys' suicidal ideation. This indicates that boys may be less emotionally vulnerable than girls to sociocultural pressure on body appearance. Further research using a longitudinal study design with at least three time points is necessary to confirm the mediational causal link from perceived overweight to depression to suicidal ideation and its sex differences.

Our finding that depression, marijuana use, and family history of suicidal behavior had a positive effect on suicidal ideation, especially in girls, is in line with previous studies (Beautrais et al., 1998; Brent & Mann, 2005; Gould et al., 1998; Hallfors et al., 2004; Weissman et al., 1999). A recent review study of adolescent suicides showed that mood disorders, substance abuse, and family history of suicidal behavior have a stronger and more convergent relationship with adolescent suicides than other risk factors, such as impulsivity and physical disability (Bridge et al., 2006). It should be noted that depression was a significant predictor for suicidal ideation 1 year later for both boys and girls above and beyond the combined effect of all the other predictors included in this study. This indicates that (a) depression might be the strongest prospective predictor for suicidal ideation among adolescents or (b) depression might be the proximate predictor for suicidal ideation or a mediator between other predictors and suicidal ideation.

The findings of this research are subject to limitations. First, because our sample was composed of school-attending students, the findings of this study may not be applicable to the adolescents who dropped out of school. Second, family history of suicidal behavior in our study was assessed by asking respondents whether or not anyone

in their families had tried to commit suicide during the past 12 months rather than in their lifetime. Twelve months might not be sufficiently long enough to capture a family history of suicidal behavior, which might have led to the statistical nonsignificance among boys in our study. However, this is unlikely to have confounded our major finding of the relationship between perceived body weight and suicidal ideation because family history of suicidal ideation was one of the control variables and that such relationship was investigated through sequential models in which the relationship was stable across the three models. Third, unobserved differences across adolescents might have driven the association between overweight perception and suicidal ideation among adolescent girls. Due to the nature and data source of this study (i.e., a secondary data analysis of a public-use Add Health dataset), analysis was limited to the information available in the public-use dataset. It would be desirable for future research to expand control variables, which may help identify and capture unobserved heterogeneity that may provide part of the association between overweight perception and suicidal ideation. Fourth, although overweight perception was not associated with suicidal ideation among boys in any of the models, this may reflect lack of statistical power. Fifth, some behavioral questions of the Add Health dataset that were included in this study do not have an equal time frame (e.g., lifetime exposure to marijuana but alcohol use in the past 12 months). This inconsistency in the time frame of the question stem might have caused confusion among some respondents.

Despite these limitations, the findings of this study contribute to the literature by providing information on sex differences in the prospective influence of perceived body weight on suicidal ideation among a representative sample of US adolescents. Long-term, chronic overweight perception significantly increased the risk for suicidal ideation only in girls, even controlling for demographic characteristics, physical disability, impulsivity, smoking, alcohol and marijuana use, family history of suicidal behavior, and depressive symptoms. This underlines the importance of addressing perceived body weight among girls in suicide prevention interventions. Secondary school programs addressing overweight perception and body image should be developed and implemented to prevent adolescents, especially female students, from committing suicide.

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