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Relationship of Pressure to be Thin with Gains in Body Weight and Fat Mass in Adolescents

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Abstract

Background—Sociocultural pressure to be thin is commonly reported by adolescents; yet, to what extent such pressure is associated with weight gain has not been evaluated longitudinally.

Objective—Examine whether pressure to be thin was positively associated with weight and fat gain in adolescents.

Methods—Participants were 196 healthy adolescent (age 15±1y) girls (65%) and boys of varying weights (BMI 25±7 kg/m²) studied at baseline and 1-year follow-up. At baseline, adolescents and their mothers reported pressure to be thin by questionnaire. At baseline and follow-up, BMI was calculated and fat mass was assessed with air displacement plethysmography. Multiple regression

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Conflicts of Interest

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was used to examine associations between baseline pressure to be thin and 1-year changes in BMI and fat mass.

Results—Accounting for multiple covariates, including baseline BMI or fat, adolescent-reported pressure from parents and peers, and mother-reported pressure toward their teen were associated with greater gains in either adolescent BMI or fat ($ps<.05$). Adolescent weight status was a moderator of multiple effects ($ps<.05$).

Conclusions—Parental and peer pressure to be thin were associated with increases in BMI and fat mass during adolescence, particularly in heavier adolescents. Further research is necessary to clarify how this association operates reciprocally and to identify underlying explanatory mechanisms.

Keywords

Adolescents; Pressure to be thin; BMI; Body fat; Weight gain

Introduction

Overweight/obesity are major public health problems in adolescents, with 35% of 12-19y olds being overweight or obese (BMI 85th percentile) (1). For a number of reasons, adolescence is a critical period for understanding potentially modifiable factors that influence excessive weight gain (2). Having obesity as an adolescent heightens the risk of adult obesity and the likelihood of developing adverse health co-morbidities to a greater degree than adult-onset obesity (3). Further, adolescence is notable for a host of dynamic biopsychosocial changes; lifestyle patterns established during adolescence likely influence lifetime trajectories of BMI (2).

One particular challenge of adolescence, especially salient for youth with overweight/obesity and for females, is conflicting messages between the naturally-occurring increases in body fat that accompany puberty and the Western sociocultural ideal of thinness (4). “Pressure to be thin” refers to sociocultural messages embracing the “thin ideal,” a culturally-defined concept of physical beauty characterized by an ultra-thin or lean body shape (5). Pressure to be thin is espoused by Western media and also can be transmitted by parents and peers (6). Pressure to be thin encompasses social reinforcement of thinness (e.g., complimenting thinness or weight loss) as well as overt criticism or teasing about weight, reported by 16-30% of teens (7, 8). Pressure to be thin is a prospective risk factor for worsening of adolescents’ body dissatisfaction, disordered eating, and other unhealthy weight control (9-12). In separate investigations, many of these constructs—body dissatisfaction, disordered eating, and unhealthy weight control—predict more excessive gains in adolescents’ BMI or adiposity (13-15).

Despite the connections of pressure to be thin with body dissatisfaction and unhealthy eating and weight-control, and the associations between these factors and excess weight gain, surprisingly little research has evaluated the relationship of pressure to be thin with weight gain. In cross-sectional studies, adolescents who are overweight or obese self-report more pressure to be thin than lean adolescents (16). In one longitudinal study, adolescent girls

who perceived weight-teasing from family were twice as likely to become overweight 5y later, than girls who reported no weight teasing (17). In another study, pre-adolescent girls' perceptions of weight stigma predicted the maintenance or onset of obesity in adolescence (18).

In this study, we investigated how pressure to be thin from mothers, fathers, and same-sex friends related to BMI and fat gain. We expanded upon the existing literature in several important ways. We measured adolescents' perceptions of pressure from multiple, key interpersonal figures, and we also surveyed mothers about pressuring their adolescents to be thin. This method addressed to what extent the associations of pressure with BMI and fat gain were consistent across relationships and robust across multiple informants, as opposed to only being a function of adolescents' perceptions. We hypothesized that pressure from all sources would be associated with greater gains in BMI and fat. Further, we included adolescent girls, as well as boys, of varying weights to evaluate initial weight status (lean vs. overweight/obese) and sex as moderators of pressure to be thin and BMI and fat gain. We anticipated that the associations between pressures and BMI and fat gain might be more pronounced among heavier teens. Adolescents with overweight/obesity experience more pressure to be thin than lean youth, and they could be more adversely affected by pressure to fit an ideal to which their bodies do not conform (16). We also predicted that the effects of pressure to be thin might be stronger for girls, compared to boys. We hypothesized that girls would be more susceptible to pressure to be thin given the greater focus on thinness in the female Western cultural ideal of attractiveness (19, 20).

Methods

Participants and procedures

Participants were healthy volunteers participating in a non-treatment study investigating eating behaviors (ClinicalTrials.gov ID: NCT00631644). Individuals were eligible to participate if they were: (a) 13-17y and (b) in good general health. Individuals were excluded if they: (a) reported a significant chronic illness; (b) were using medication likely to affect weight or appetite; (c) were pregnant; (d) were receiving weight-loss treatment; or (e) had a psychiatric condition that would impede study adherence. Adolescents provided written assent and parents/guardians gave written consent. The study was approved by the NICHD IRB.

Participants were seen in a pediatric clinic at the NIH Clinical Center for two outpatient visits (baseline, follow-up) spaced 1-year apart. At both assessments, adolescents were instructed to adhere to an overnight fast initiated at 10:00pm the night before. The following measures were evaluated in this study.

Medical history and physical exam

At baseline, participants underwent a medical history and a physical examination performed by an endocrinologist or nurse practitioner. Boys' testicular volume (mL) was measured using a set of orchidometer beads as standards according to Prader (21); girls' breast development was assigned according to Tanner (22). Testicular volume and breast staging

were used to categorize adolescents into: pre-puberty (boys: testes < 3 mL; girls: Tanner stage 1), early/mid-puberty (boys: testes 4–15 mL; girls: Tanner stages 2–3), and late puberty (boys: testes > 15 mL; girls: Tanner stages 4–5). Because few adolescents were in pre-puberty, we combined pre-puberty and early/mid-puberty adolescents in analyses using puberty as a covariate.

Pressure to be thin

At baseline, the pressure to be thin subscale of the Pressure to be Physically Attractive Questionnaire (23) was completed by participants to assess their perceptions of how frequently mothers, fathers, and same-sex friends displayed social reinforcement of thinness toward the teen. The subscale consists of three items per relationship: (a) “This person gives me compliments when I look like I’ve lost weight;” (b) “This person compliments me when I look *thin*,” and (c) “This person gives me compliments when I’m wearing something that makes me look *skinny*.” Responses are rated on a 5-point Likert scale ranging from 1=not at all to 5=almost always, and are averaged separately to evaluate pressure from each source (i.e., mother figure, father figure, same-sex friend). This measure has good internal reliability, convergent validity with other pressure to be thin surveys, and predictive validity for adolescent disordered eating (23).

Mothers completed a parallel version of the questionnaire at baseline (23). Mothers reported to what extent they pressured the teen to be thin. For example: “I give my son/daughter compliments when it looks like he/she has lost weight.” This scale has demonstrated acceptable internal reliability (23).

BMI and body fat

BMI and body fat were collected at baseline and follow-up. Height was measured in triplicate, with shoes removed, to the nearest millimeter by a calibrated stadiometer (Holtain, Crymmych, Wales). Fasting weight was measured to the nearest 0.1 kg with a calibrated digital scale (Scale-Tronix, Wheaton, IL). BMI (kg/m^2) was calculated. Body composition was measured using air-displacement plethysmography (Body Pod, Life Measurement Inc., Concord, CA) to determine fat mass (kg). In pediatric samples, air displacement plethysmography correlates with dual-energy X-ray absorptiometry in estimating changes in fat (24).

The primary outcomes were changes in BMI and fat mass. As a secondary outcome, we determined degree of excessive weight gain, which is calculated as the actual 1-year BMI change less the expected 1-year BMI change, derived from growth-chart data (25).

Data analytic plan

All analyses were conducted using SPSS version 22 (SPSS, Inc., Chicago, IL). Data were evaluated for skewness and kurtosis; all variables approximated a normal distribution. Descriptive information was generated at baseline and follow-up. Hierarchical multiple regressions were performed with BMI or fat mass change as the primary dependent variables. In step 1, covariates were entered as baseline BMI or fat, sex, race/ethnicity, baseline age, growth in height, puberty, and time to follow-up. In step 2, we entered pressure

to be thin. We evaluated each source (i.e., adolescent-reported pressure from mothers, fathers, same-sex friends and mother-reported pressure) in separate models because of anticipated multi-collinearity among these constructs. We also entered baseline weight status (lean versus overweight/obese). In step 3, we added the interaction of weight status and pressure. Pressure variables were mean-centered prior to their entry into the model and interaction terms. We evaluated parallel models to test the interaction between sex and pressure. Significant interactions were interpreted by evaluating the effect of pressure separately by subgroup to interpret the meaning of the interaction. To facilitate interpretation and clinical utility, we evaluated categorical, baseline weight status (lean versus overweight/obese) as a moderator; however, we also evaluated models using continuous, baseline BMI and continuous, baseline fat mass as moderators.

Results

Preliminary analyses

One-hundred ninety six lean (61%; $n=119$), overweight (15%; $n=29$), and obese (24%; $n=48$) adolescents participated at baseline (Table 1). One-hundred fifty-eight mothers of adolescents were surveyed about pressure to be thin; adolescents who had a mother participate did not differ from adolescents who did not have a mother participate on any baseline variable ($ps=.11-.84$).

At baseline, adolescents with overweight/obesity reported greater pressure to be thin from mothers ($M\pm SD$ 3.0 $\pm$ 1.3 v. 2.2 $\pm$ 1.2, $p<.001$), fathers (2.2 $\pm$ 1.2 v. 1.8 $\pm$ 1.0, $p<.01$), and same-sex friends (2.6 $\pm$ 1.3 v. 2.0 $\pm$ 1.1, $p<.01$) than lean adolescents. Mothers of adolescents with overweight/obesity reported greater pressure toward their adolescent compared to mothers of lean adolescents (2.4 $\pm$ 1.1 v. 1.6 $\pm$.94, $p<.001$). Adolescents' perceptions of pressure from mothers, fathers, and same-sex friends were all interrelated (r -values=.60-.73, $ps<.001$). Mother-reported pressure was correlated with adolescent-reported pressure from mothers ($r=.42$, $p<.001$).

Follow-up assessments occurred 1.1 $\pm$.2y later. One hundred sixty-two adolescents (82%) participated at follow-up. Adolescents who did not have follow-up data did not differ from adolescents who completed a follow-up in all baseline measures ($ps=.06-.91$).

Pressure to be thin and BMI change

Figures 1A-D depict the series of relationships of pressure to be thin with adolescent BMI change, as well as the significant interactions with weight status. Adjusting for baseline BMI, puberty, sex, age, race/ethnicity, growth in height, and time to follow-up, adolescent-reported pressure from mothers (standardized regression coefficient $\beta=.19$, $p=.03$), fathers ($\beta=.19$, $p=.02$), and same-sex friends ($\beta=.24$, $p=.01$) were positively associated with adolescent BMI gain, such that more pressure related to greater BMI gain. Controlling for the same covariates, mother-reported pressure to be thin was positively associated with adolescent BMI gain ($\beta=.28$, $p=.01$).

Adolescent baseline weight status significantly interacted with adolescent-reported pressure from mothers, $F(10, 148)=3.78$, same-sex friends, $F(10, 147)=4.16$, and mother-reported

pressure, $F(10, 117)=3.82$ (all $p<.05$) in the prediction of BMI gain. Adolescent weight status was not a significant moderator of adolescent-reported pressure from fathers and BMI gain ($p=.08$). In subgroup analyses stratified by adolescent weight status to interpret these interactions, adolescent-reported pressure from same-sex friends ($\beta=.34, p=.02$) and mother-reported pressure toward the teen ($\beta=.40, p=.01$) were positively related to BMI gain in overweight/obese adolescents, but not in lean adolescents ($p>.24$). Adolescent-reported pressure from mothers had a positive, trend association with BMI gain in overweight/obese adolescents ($\beta=.28, p=.06$), but not lean adolescents ($p=.21$).

All significant moderator effects were replicated if weight status was replaced with baseline BMI, as a continuous variable (Table S1). Sex was not a moderator of any index of pressure to be thin and BMI change ($p=.36-.92$).

Pressure to be thin and adolescent fat mass change

Adjusting for baseline fat mass, puberty, sex, age, race/ethnicity, growth in height, and time to follow-up, adolescent-reported pressure to be thin from mothers ($\beta=.26, p=.004$; Figure 2A), fathers ($\beta=.19, p=.02$; Figure 2B), and same-sex friends ($\beta=.19, p=.04$; Figure 2C) were each, positively associated with adolescent fat mass change, such that more perceived pressure related to greater fat mass gain. Accounting for the same covariates, mother-reported pressure to be thin predicted adolescent fat mass change ($\beta=.27, p=.01$), in that more reported pressure from mothers related to greater gains in adolescents' body fat.

Weight status was not a significant moderator of adolescent-reported pressure and fat mass gain ($p>.13$). However, adolescents' weight status was a significant moderator of mother-reported pressure and adolescent fat mass change, $F(10, 112)=3.11$ ($p=.01$). Mother-reported pressure was positively related to fat mass gain in overweight/obese adolescents ($\beta=.47, p=.01$), but not lean adolescents ($\beta=.05, p=.70$; Figure 2D).

When weight status was replaced with fat mass, adolescent baseline fat mass remained a significant moderator of mother-reported pressure ($\beta=.56, p=.008$) on fat mass change, and also became a significant moderator of adolescent-reported pressure from mothers ($\beta=.27, p=.003$) and same-sex friends ($\beta=.22, p=.02$) on fat mass change (Table S2). Sex was not a moderator of any pressure index and fat mass change ($p=.20-.93$).

Secondary outcome of excessive weight gain

Adolescent-reported pressure from mothers ($\beta=.20, p=.01$), fathers ($\beta=.22, p=.004$), and same-sex friends ($\beta=.21, p=.01$) were each, positively associated with higher than expected BMI gain. Mother-reported pressure also predicted adolescents' higher than expected BMI gain ($\beta=.27, p=.003$). Neither weight status nor sex were significant moderators of any pressure variable and excessive weight gain ($p>.10$).

Post-hoc parsimonious modeling of BMI and fat outcomes

For each BMI and adiposity variable, we evaluated a parsimonious model that included all of the pressure variables that were significant predictors in the separate regressions. Because weight status was frequently a moderator, we stratified these analyses by weight status. In

models including all covariates and pressure variables, mother-reported pressure was the only significant predictor, among the pressure variables, of adolescents' BMI gain ($\beta=.44$, $p=.04$) and excessive weight gain ($\beta=.38$, $p=.02$) in adolescents with overweight/obese only. Mother-reported pressure was a trend-level predictor of fat mass gain ($\beta=.45$, $p=.067$). When examined simultaneously, none of the pressures were significant predictors of changes in BMI indices or adiposity outcomes in lean adolescents.

Discussion

Parental and peer messages about thinness were associated with greater BMI and fat gain over a one-year period, after controlling for a number of potential confounds. Further inspection revealed that adolescents' weight status was generally a significant moderator, such that pressure was related to BMI gain only in adolescents who were overweight/obese or heavier at baseline.

Data from the current study are consistent with previous cross-sectional reports that adolescents with overweight/obesity perceive more pressure to be thin from peers and family than lean adolescents (16). Our results are also consistent with prior longitudinal studies finding that pre-adolescent and adolescent girls who perceived weight-related teasing or criticism in their family were more likely to become or maintain overweight/obesity than girls without a history of weight-related teasing or criticism (17, 18). One contribution of the current study was the inclusion of both adolescent perceptions of pressure and mothers' ratings of pressure toward their adolescents; lending support to the idea that pressure to be thin may not entirely be a matter of adolescents' perceptions, but may reflect actual interactions with others.

In contrast to past studies that operationalized pressure to be thin as weight-teasing and criticism (17, 18), in the current study pressure to be thin was assessed as frequency of comments reinforcing thinness, which were not necessarily overtly critical. Indeed, positive comments about perceived weight loss in adolescents who have overweight/obesity could even be interpreted as encouragement. The current findings suggest that more subtle messages reinforcing thinness, which occur frequently in Western culture and may not be easily recognizable as harmful (10), could have a potential adverse impact on weight-related outcomes. Yet, the reverse, as well as reciprocal effects are likely. Adolescents who were overweight/obese reported more pressure to be thin from their relationships, and mothers of overweight/obese adolescents reported more pressure toward their adolescents. Thus, overweight/obese adolescents elicit more frequent pressure to be thin from parents and peers due to their weight. Further, relationships between pressure and BMI or adiposity change that we observed primarily were apparent in adolescents with overweight/obesity, heavier BMI, and higher adiposity. It is also likely that adolescents who were overweight/obese at baseline had a genetic and epigenetic predisposition to being heavier, and thus, were more likely to gain excess weight due to these same factors. Although we did not measure pressure to be thin at follow-up, other studies have found that heavier children elicit more restrictive feeding practices, for instance, from parents over time (26).

As we only had two time points in our study, we were unable to evaluate explanatory mechanisms that underlie the association between pressure to be thin and BMI and adiposity outcomes. In future research, it would be valuable to evaluate potential intervening variables such as body dissatisfaction, body size perception, dieting and binge-eating (9, 17, 27). From an identity-threat theoretical framework, pressure to be thin is posited to degrade self-esteem by threatening an individual's social identity (28). In turn, low self-esteem and related psychological constructs (e.g., coping, loneliness, and depressed affect) plausibly may alter lifestyle behaviors that promote a positive energy balance (29). Physiological factors also may be explanatory. For instance, exposure to weight stigma has been proposed to promote excessive weight gain through hypercortisol secretion (30).

Strengths of this study are the inclusion of a racially/ethnically diverse sample of adolescents; utilization of multiple informant reports; use of objective BMI measurements; and evaluation of fat mass in addition to BMI. One limitation is that pressure from fathers and friends were reported only by adolescents. Pressure to be thin was assessed only as social reinforcement of thinness, which cautions comparison to previous studies that evaluated weight criticism or teasing instead. Future research would benefit from pinpointing the specific thin ideal messages that impact excess weight gain and from differentiating the influences of complimenting thinness as compared to critical weight-related comments. Also, we had fewer boys than girls in the sample; thus, sex may not have been a moderator due to inadequate power to detect that effect. Furthermore, due to the correlational design, third variable explanations cannot be ruled out. Physical activity, daily diet, and parent weight, among other potential confounding factors, were not measured, and future research would benefit from inclusion of these variables.

It is important to note that parents and peers may intend to make weight-related comments that are complimentary or health-promoting, as opposed to critical. Using alternative methodologies to evaluate pressure to be thin, such as parent-adolescent recorded dialogues or ecological momentary assessments, may help to characterize the pressure to be thin construct and to more clearly operationalize this phenomenon. In turn, a more informed characterization of pressure to be thin in adolescence may shed light on how experts can intervene to facilitate dialogues that promote effective messages about weight and health and ultimately, healthier weight outcomes in adolescents at-risk for chronic obesity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

BMI	Body mass index
BMI_z	Body mass index standard score

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What is known

- Sociocultural pressure to be thin is reported by 16-30% of adolescents
- Adolescents with overweight/obesity report more pressure to be thin than lean adolescents
- Pressure to be thin predicts unhealthy weight control behaviors

What this study adds

- Adolescent-reported pressure to be thin from parents and peers predicted greater adolescent BMI/fat gain
- Mother-reported pressure on the adolescent was also associated with greater BMI/fat gain
- Pressure to be thin effects were stronger in adolescents with overweight/obesity than lean adolescents

Figure 1.

Relationships of baseline adolescent-reported pressure from mothers (A; $\beta_{\text{overweight/obese}} = .28$, $p = .06$; $\beta_{\text{lean}} = .13$, $p = .21$), fathers (B; $\beta_{\text{all subjects}} = .19$, $p = .02$), and same-sex friends (C; $\beta_{\text{overweight/obese}} = .34$, $p = .02$; $\beta_{\text{lean}} = .12$, $p = .24$) and mother-reported pressure from mothers (D; $\beta_{\text{overweight/obese}} = .40$, $p = .01$; $\beta_{\text{lean}} = .11$, $p = .37$) with continuous changes from baseline to follow-up in adolescent BMI (kg/m^2). Weight status (BMI < 85th percentile versus BMI $\geq$ 85 percentile) was a significant moderator of the relationships of adolescent-reported pressure from mothers ($p = .03$), adolescent-reported pressure from same-sex friends ($p = .03$) and mother-reported pressure from mothers ($p = .02$) with BMI change. Estimates adjusted for baseline BMI, baseline age, sex, race/ethnicity, puberty, growth in height, and time to follow-up.

Figure 2.

Relationships of baseline adolescent-reported pressure from mothers (A; $\beta_{\text{all subjects}} = .26$, $p = .004$), fathers (B; $\beta_{\text{all subjects}} = .19$, $p = .02$), and same-sex friends (C; $\beta_{\text{all subjects}} = .19$, $p = .04$) and mother-reported pressure from mothers (D; $\beta_{\text{overweight/obese}} = .47$, $p = .01$; $\beta_{\text{lean}} = .05$, $p = .70$) with continuous changes from baseline to follow-up in adolescent fat mass (kg). Weight status (BMI < 85th percentile versus BMI $\geq$ 85 percentile) was a significant moderator of the relationship of mother-reported pressure from mothers ($p = .01$) with fat change. Estimates adjusted for baseline fat mass, baseline age, sex, race/ethnicity, puberty, growth in height, and time to follow-up.

Table 1

Descriptive information of participant characteristics at baseline and follow-up

Characteristic	% (n)
Sex	
Female	64.8 (127)
Male	35.2 (69)
Race/ethnicity	
Non-Hispanic White	56.1 (110)
Non-Hispanic Black	27.0 (53)
Asian	5.1 (10)
Multiple races	5.6 (11)
Hispanic	6.1 (12)
Baseline weight status	
Lean (BMI<85 percentile)	60.7 (119)
Overweight (BMI 85-94 percentile)	14.8 (29)
Obesity (BMI 95 percentile)	24.5 (48)
Baseline pubertal status	
Pre-puberty (Tanner stage 1)	1.0 (2)
Early/mid puberty (Tanner stages 2-3)	18.7 (36)
Late puberty (Tanner stages 4-5)	80.3 (155)

	Mean ± SD		
	Baseline	Follow-up	Change
Age (y)	15.3 ± 1.4	16.4 ± 1.4	1 ± .7
BMI (kg/m ²)	24.6 ± 7	24.8 ± 6.6	.5 ± 1.7
BMI z-score	.74 ± 1	.68 ± 1	-.03 ± 1
BMI percentile	.69 ± .26	.68 ± .26	-.004 ± .11
Fat mass (kg)	19.2 ± 14.4	19.1 ± 13.5	-.9 ± 4.6
Percent body fat (%)	26.6 ± 11.5	26 ± 11.4	-.7 ± 5.8

BMI = body mass index; SD = standard deviation.