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Original Article

Adolescent Overweight, Obesity and Chronic Disease-Related Health Practices: Mediation by Body Image

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Key Words

Adolescents · Obesity · Body image · Chronic disease-related health practices

Abstract

Background/Aims: To examine whether body image mediates the association between overweight/obesity and chronic disease-related health practices (CDRHP), including lack of physical activity (PA), infrequent breakfast consumption (IBC), screen-based media use (SBM), and smoking. **Methods:** The 2006 Health Behaviors in School-Age Children survey was administered to a nationally representative sample of US students ($n = 8,028$) in grades 6–10 (mean age = 14.3 years). Outcome variables included self-reported measures of PA, SBM, IBC, and smoking. Body image was assessed with 5 items from the Body Investment Scale ($\alpha = 0.87$) asking for agreement/disagreement with statements about one's body. Stratifying on gender, an initial regression model estimated the association between overweight/obesity and CDRHP. Mediation models that included body image were then compared to the initial model to determine the role of body image in the relationship between overweight/obesity and CDRHP. **Results:** Among boys, body image mediated the relationships of overweight/obesity with SBM, and of obesity with IBC. Among girls, it mediated the relationships of obesity with PA, IBC, and smoking, and of overweight with SBM. **Conclusion:** As the prevalence of overweight/obesity among adolescent boys and girls remains high, efforts to improve their body image could result in less frequent engagement in CDRHP.

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Introduction

Overweight and obesity among US adolescents remain a public health concern with a third of youth aged 12–19 years being overweight or obese [1]. Of particular concern is the co-occurrence of overweight/obesity with health practices that are associated with chronic diseases such as diabetes and cardiovascular diseases [2]. These health practices include smoking [3], sedentary behavior [4], lack of physical activity (PA) [4], and, as recent studies are showing, infrequent breakfast consumption (IBC) [5]. Given that health practices established during adolescence are likely to be sustained into adulthood, understanding processes by which youth obesity is associated with chronic disease-related health practices (CDRHP) could provide benefits that extend well beyond the adolescent years [6].

Association of Overweight with Chronic Disease-Related Health Practices

The association of adolescent overweight/obesity with smoking varies by gender and geographic location. Among US adolescents, early adolescent (<15 years) overweight and obese girls were 1.75 and 1.77 times more likely to smoke, respectively, than their normal-weight peers, and mid-adolescent (≥ 15 years) obese girls were 2.05 times more likely to smoke. No associations were observed for boys in this sample [7]. However, among a nationally representative sample of Danish school children, a mirror pattern was observed, with a positive association between overweight and smoking only observed among boys [8]. The systematic review of the association of overweight with smoking by Potter et al. [9] supports these conflicting gender differences, which may be dependent on weight concerns and smoking stage.

Overweight and obesity have been negatively associated with breakfast consumption and PA, and positively associated with screen-based media use (SBM) across multiple countries [5, 10]. In a cross-national study of the association of overweight with lifestyle factors, Haug et al. [5] showed that the odds of breakfast consumption among overweight adolescents ranged from 0.48 (the Netherlands) to 0.79 (Finland), while those of PA ranged from 0.50 (Iceland) to 0.78 (Germany and Greece).

Association of Body Image with Obesity and Chronic Disease-Related Health Practices

Perceptions of body image may be an essential component of pathways linking adolescent overweight/obesity and CDRHP. Adolescent overweight and obesity have been associated with the development of a negative body image [11]. Negative body image is associated with a multitude of adverse behavioral and health outcomes including impaired mental health (depression, low self-esteem) [12], poorer self-reported health [13], risk behaviors (substance use and abuse) [14], internalizing and externalizing problem behavior [15], lower engagement in PA [16], increased sedentary behavior [16], and poor dietary choices (unhealthy dieting, poor dietary intake) [17]. In contrast, positive body image has been linked to less weight-related concerns and behaviors as well as to parental and peer attitudes encouraging healthy eating [18].

However, no identified study has examined the possible mediating effect of body image on the associations of overweight/obesity with CDRHP. This is a useful inquiry because the presence of a mediating role for body image may have implications for prevention programs: improving body image among overweight/obese adolescents may lead to greater engagement in PA, less SBM, less smoking, and more frequent breakfast consumption.

Studies examining the association of weight status and body image with CDRHP outcomes are limited by several factors. They either included weight status or body image as predictors, but rarely both variables simultaneously [8, 19]. Research suggests, however, that both measures are intimately linked and that failure to account for one may alter the association of the other with the outcome (e.g., confounding) [5, 6, 13]. Further, studies in adult women are showing that, rather than functioning as an independent covariate, body image may actually be a mediator of the association of overweight/obesity with outcomes such as depression [20] and weight loss [21]. Similar mediating pathways have not been examined for skipping breakfast or smoking, although these behaviors are highly prevalent among overweight/obese youth [6, 22, 23]. Finally, most of the research examining the role of body image has focused only on girls, and it is not clear the extent to which body image may also be a useful mediator for the association of overweight/obesity with CDRHP among boys.

Gender Differences in Body Image

Gender differences in body image are observed, with girls reporting worse body image than boys [24]. Pubertal changes during adolescence trigger modifications in physical appearance, weight, and fat distributions. Adjusting to these changes and accepting one's physique is one of the essential developmental tasks of adolescence [25]. However, adolescents, particularly girls, are confronted with messages from the media, peers, and parents highlighting thinness as an ideal body size [26], thus impeding acceptance of their own bodies and fostering negative body image [27]. In contrast, boys are exposed to images of ideal muscular physiques which, when unreachable, may also trigger a negative body image [24].

Theoretical Framework

Social comparison as well as stress and coping theories provide a useful framework for this study. Social comparison theory posits that individuals compare themselves to others to establish similarities and differences about their own attributes, skills, and social expectations [28]. These evaluative comparisons may generate negative outcomes, particularly when the gap between the individuals' own attributes and those of the comparison object is wide, thus making it difficult for individuals to conform to the ideal attribute. In the case of overweight/obese adolescents, idealized thin body images are often impossible to attain, therefore creating a constant internal state of stress [28].

According to the stress and coping theory, adolescents use a variety of coping strategies to deal with stressors, some of which may actually be maladaptive and exacerbate the stressor instead of eliminating it [29]. This may be particularly true for adolescents dealing with the stress of excess weight or negative body image. Previous research has identified children and adolescents resorting to increased TV viewing time [30], smoking [31], and unhealthy eating patterns [17] to cope with stress, all behaviors that may reinforce overweight/obesity and affect adolescents' future risk for chronic disease. Adolescents who are experiencing the stress of negative body image may resort to such maladaptive coping strategies. Further, adolescents may shy away from some health-enhancing behaviors because of the increased stigma they may face. For example, overweight/obese adolescents experience increased weight criticism during PA, which is associated with reduced sports enjoyment, avoidance of exercise, and lower intensity PA [32]. Reducing exposure to the stressor, in this case, negative body image, may therefore lead to lower engagement in unhealthy behavior.

Purpose of the Study

The primary purpose of this study is to determine whether body image mediates the association between overweight/obesity and CDRHP among adolescents.

Material and Methods

Sample

We conducted the United States 2005/6 Health Behavior in School-Aged Children (HBSC) study, a quadrennial survey of a nationally representative school-based sample. More information on the methods and procedures can be found at www.hbsc.org. A three-stage stratified clustered sampling, with classes as the sampling units, was used to select a sample of American students in grades 6–10 during the 2005/6 academic school year. African-American and Hispanic students were oversampled to provide better population estimates for these minorities.

Self-report questionnaires were administered in the classrooms; the data collection process was designed to assure the anonymity and confidentiality of the students' responses. Ethics approval was obtained from the Eunice Kennedy Shriver National Institute of Child Health and Human Development Institutional Review Board.

Of the students eligible for the study, 87% (9,227) completed the questionnaire. For logistical reasons, half of the 6th graders who completed the questionnaire were not asked the question on body image and were therefore excluded from the analysis, as were respondents who did not identify their gender (n for analysis = 8,028).

Measures

Physical Activity

Students were provided with a definition of PA and examples of moderate-to-vigorous PA. It was then assessed with a question asking about the number of days the respondent engaged in at least 60 min of PA over the last week. Response options ranged from 0 to 7 days.

Screen-Based Media Use

Responses to questions asking how many hours per a) weekday and b) weekend day respondents watched 1) television or 2) played on a computer or game console during their free time were combined into a single continuous measure of sedentary behavior. Response options were none, 0.5 h, 1–7 h or more hours. Mean hours per day of television and computer use were calculated and summed to create an SBM score.

Breakfast Consumption

Respondents indicated how often they usually had breakfast on weekdays and weekends (response options: 0–5 days for weekdays; 0–2 days for weekends). Answers to both questions were averaged to calculate weekly breakfast consumption.

Cigarette Smoking

Respondents indicated on how many occasions they had smoked cigarettes in the last 30 days (range: 'never' to '40 times or more'). This measure was dichotomized to reflect any use.

Body Mass Index Measurement and Obesity Classification

BMI was computed from adolescents' self-reported height and weight, which studies have shown to be adequate estimates for actual height and weight [33]. BMI-for-age percentiles for each gender were derived using the CDC (Centers for Disease Control and Prevention) 2000 growth chart [34]. BMI-for-age weight status categories and the corresponding percentiles, using the CDC 2000 growth chart for US children, were as follows: adolescents were considered *underweight* if their BMI was <5th percentile; *normal weight* if their BMI was ≥5th but <85th percentile; *overweight* if their BMI was ≥85th but <95th percentile; and *obese* if their BMI was ≥95th percentile. For these analyses, we excluded underweight respondents, who constituted only 4% of the sample.

Body Image

Body image was assessed as a continuous variable created from the mean of 5 items ($\alpha = 0.87$) from the body image subscale part of the Body Investment Scale (BIS) [35]. The first subscale of the BIS was constructed to measure body image feelings as well as attitudes and measures several aspects of body image: evaluation, attitudes, and emotions. This scale has been validated and used in other studies [36] to assess body image in adolescents. Questions asked the respondents how much they agreed or disagreed with the following five statements: 'I am frustrated with my physical appearance', 'I am satisfied with my appearance', 'I hate my body', 'I feel comfortable with my body', and 'I feel anger toward my body'. The scale ranged from 1 to 5, with higher scores indicating more positive body image.

Measures of PA, SBM, breakfast consumption, and smoking were coded such that higher values indicate more engagement in the behavior.

Demographic Characteristics

Demographic characteristics included gender, age, race/ethnicity (White/Black/Hispanic/Other), and family affluence scale (FAS). FAS, an indicator of adolescents' socioeconomic status (SES), was constructed from questions about family wealth. The scale was categorized into tertiles and has good content and external validity [37].

Analysis

We used STATA 9.0 for all analyses to adjust for the cluster-based sampling design of HBSC. Weights (defined as the inverse probability of selection) were applied to provide nationally representative estimates. Descriptive statistics (frequencies, weighted percents, means) were computed for all variables. Bivariate statistics identified the associations between weight status, body image, and health practices (these results are not displayed given that they are very similar to those from the multivariable analysis). Indicators for other health behaviors (e.g. dieting) were not included, as they may act as mediators between weight status and the health practices under investigation. Linear or logistic regression models, stratified by gender, were then fitted to obtain adjusted estimates for the association of weight status to health practices variables. We chose to stratify models by gender given the established evidence of the differential association of weight status to body image [11] and to health practices [3] among boys and girls.

Following the approach of Baron and Kenny [38], we established that body image acts as a mediator if three steps in the regression analysis are verified: Overweight/obesity is significantly associated with body image (step 1). Body image is significantly related to CDRHP in multiple regression models including overweight/obesity and controlling for respondents' race/ethnicity, SES, and age (step 2). Finally, when body image is added to the initial models, a previously significant relationship between overweight/obesity and health practices is no longer significant (complete mediation) or significantly reduced (partial mediation) (step 3). Partial mediation was established by using the Sobel test.

For each model, we also conducted a joint Wald test of the coefficients for overweight and obesity to assess whether they were significantly different from each other. If the Wald test was not significant, we concluded that the association of overweight with CDRHP was not significantly different from that of obesity with CDRHP.

Results

Sample Description

Approximately 50% of the sample were boys. Most respondents were non-Hispanic Whites and of middle SES. Mean age was 14 years for boys and girls (range: 9.7–17.3 years) (table 1). About 68% of the total sample were of normal weight, 18% were overweight, and 14% were obese. Boys were significantly more likely than girls to report positive body image, PA, SBM, and breakfast consumption. They were also more likely than girls to be overweight/obese.

Table 1. Sample characteristics: Prevalence and means

	Boys (n = 3,878), %	Girls (n = 4,150), %	Total (n = 8,028), %
Weight status***			
Normal/underweight	66.2	72.2	69.3
Overweight	18.5	15.9	17.2
Obese	15.2	11.8	13.5
Race/ethnicity			
White	42.3	39.2	40.7
Black	19.1	19.2	19.2
Hispanic	25.6	28.4	27.0
Other	13.0	13.2	13.1
Family affluence			
Low	27.0	28.1	27.6
Middle	48.8	48.4	48.6
High	24.2	23.5	23.8
Smoking			
No	86.2	85.0	85.6
Yes	13.8	15.0	14.4
Age, mean (SE)	14.35 (0.08)	14.27 (0.07)	14.3 (0.07)
Body image, mean (SE)***	4.06 (0.02)	3.55 (0.03)	3.80 (0.02)
Physical activity, mean (SE)***	4.83 (0.07)	3.83 (0.08)	4.31 (0.07)
Screen-based media use, mean (SE)***	4.19 (0.10)	3.44 (0.10)	3.81 (0.10)
Breakfast consumption, mean (SE)***	2.82 (0.04)	2.47 (0.04)	2.64 (0.04)

***p < 0.001 indicates significant differences across gender.

Table 2. Regressions for the association of body image with the CDRHP

	Dependent variables			
	physical activity, β (95% CI)	screen-based media use, β (95% CI)	breakfast consumption, β (95% CI)	smoking, OR (95% CI)
Body image				
Boys	0.50 (0.38; 0.62)	-0.28 (-0.38; -0.17)	0.22 (0.15; 0.28)	0.83 (0.71; 0.99)
Girls	0.26 (0.16; 0.35)	-0.16 (-0.27; -0.06)	0.28 (0.22; 0.33)	0.73 (0.65; 0.81)

Race/ethnicity and family affluence significantly differed by overweight/obesity for boys and girls (table 1), with more Hispanic and African-American adolescents, and those of middle SES, being obese. About a quarter of the obese girls reported smoking, but smoking did not differ by overweight/obesity among boys. Body image was most positive, PA highest, breakfast consumption most frequent, and SBM lowest for normal-weight boys and girls.

Steps 1 and 2 of Baron and Kenny's Mediation Analyses for Boys and Girls

Overweight and obesity were negatively associated with body image among boys and girls (tables 2, 3), in accordance with step 1 of Baron and Kenny's mediation analyses, whereby the independent variable is significantly associated with the mediator. Controlling for race/ethnicity, SES, and age, positive body image was associated with more PA and breakfast

Table 3. Regressions for the association weight status^a and body image

	Body image, β (95% CI)	
	boys	girls
Weight status ^b		
Overweight	-0.36 (-0.49; -0.22)	-0.55 (-0.67; -0.44)
Obese	-0.66 (-0.78; -0.54)	-1.02 (-1.13; -0.91)

^aModels control for race/ethnicity, socio-economic status, and age.
^bNormal/underweight is the reference group.

consumption and with less SBM and smoking among boys and girls (table 4), thereby verifying step 2 of Baron and Kenny’s mediation analyses.

Step 3 of Baron and Kenny’s Mediation Analysis for Boys

Table 4 presents the coefficients from the multivariable regression models for boys. The initial models evaluate the association of overweight/obesity with CDRHP, controlling for age, race/ethnicity, and SES. For boys, overweight and obesity were negatively associated with PA and positively associated with SBM, with the associations being stronger for obesity (Wald tests: $p < 0.05$). Obese boys were also less likely than normal-weight ones to report breakfast consumption. No associations were observed between overweight/obesity and smoking.

When body image was added to the models, the strength of the association between overweight/obesity and PA decreased, as evidenced by significant Sobel t-tests. The associations between overweight/obesity and SBM as well as between obesity and breakfast consumption were no longer significant when body image was taken into account.

Step 3 of Baron and Kenny’s Mediation Analysis for Girls

In the initial models for girls, obesity was negatively associated with PA and breakfast consumption and positively associated with SBM and smoking (table 5). Overweight was positively associated with SBM, but the association was significantly less than the association between obesity and SBM (Wald tests: $p < 0.05$). Overweight was not associated with PA, breakfast consumption, or smoking.

When body image was added to the models, the parameter estimates for the associations between obesity and health practices and between overweight and SBM were reduced. The degree of reduction varied across health practices, but for most outcomes, previously significant associations between weight status (mainly obesity) and health practices became nonsignificant after taking body image into account.

Discussion

These analyses of a nationally representative sample of boys and girls confirm our hypothesis regarding the mediating role of body image across gender and behaviors: For boys, having a negative body image completely accounted for the positive association between

Table 4. Weight status, body image, and obesity-related health practices: mediation models for boys

Dependent variables		physical activity			screen-based media use			breakfast consumption			smoking		
	IM, β (95% CI)	MM, β (95% CI)	change in β, %	IM, β (95% CI)	MM, β (95% CI)	change in β, %	IM, β (95% CI)	MM, β (95% CI)	change in β, %	IM, β (95% CI)	MM, β (95% CI)	change in β, %	
Weight status													
Overweight	-0.41 (-0.69; -0.12)	-0.24 (-0.50; -0.01)	41	0.36 (0.01; 0.72)	0.27 (-0.08; 0.63)	CM	-0.16 (-0.38; 0.07)	-0.09 (-0.33; 0.16)	NAIM	1.12 (0.88; 1.44)	1.06 (0.84; 1.34)	NAIM	
Obese	-0.59 (-0.94; -0.31)	-0.29 (-0.53; -0.05)	51	0.41 (0.11; 0.71)	0.26 (-0.06; 0.58)	CM	-0.31 (-0.50; -0.12)	-0.18 (-0.38; 0.02)	CM	0.96 (0.70; 1.31)	0.85 (0.63; 1.15)	NAIM	
Body image	-	0.46 (0.33; 0.58)	-	-	-0.23 (-0.34; -0.13)	-	-	0.19 (0.12; 0.27)	-	-	0.82 (0.70; 0.97)	-	
Model Fit													
R-squared	0.04	0.07		0.12	0.12		0.04	0.05		-	-		
F (df)	9.49 (8; 86)***	14.62 (9; 85)***		17.50 (8; 86)***	18.52 (9; 85)***		9.93 (8; 86)**	13.82 (9; 85)***					
p value ^a	0.000	0.024		0.014	0.158		0.001	0.223		0.603	0.499		

^ap value for joint test of significance (Wald test) (overweight vs. obese). ***p < 0.001.

All models control for race/ethnicity, socio-economic status, and age. Normal/underweight is the reference group. IM = Initial model; MM = mediation model with body image; CM = complete mediation; NAIM = no association in the initial model.

Table 5. Weight status, body image and obesity-related health practices: mediation models for girls

Dependent variables		physical activity			screen-based media use			breakfast consumption			smoking		
	IM, β (95% CI)	MM, β (95% CI)	change in β , %	IM, β (95% CI)	MM, β (95% CI)	change in β , %	IM, β (95% CI)	MM, β (95% CI)	change in β , %	IM, β (95% CI)	MM, β (95% CI)	change in β , %	
Weight status													
Overweight	-0.21 (-0.47; 0.05)	-0.07 (-0.33; 0.18)	NAIM	0.30 (0.04; 0.57)	0.24 (-0.02; 0.50)	CM	-0.21 (-0.44; 0.02)	-0.06 (-0.31; 0.19)	NAIM	1.32 (0.97; 1.79)	1.16 (0.85; 1.58)	NAIM	
Obese	-0.31 (-0.56; -0.05)	-0.06 (-0.32; 0.21)	CM	0.56 (0.14; 0.97)	0.44 (0.01; 0.86)	21%	-0.41 (-0.64; -0.19)	-0.14 (-0.41; 0.12)	CM	1.67 (1.24; 2.20)	1.25 (0.93; 1.68)	CM	
Body image	-	0.24 (0.16; 0.34)	-	-	-0.12 (-0.22; -0.01)	-	-	0.26 (0.19; 0.33)	-	-	0.74 (0.66; 0.82)	-	
Model Fit													
R-squared	0.03	0.05		0.13	0.14		0.04	0.07		-	-		
F (df)	5.98 (8; 86)***	7.42 (9; 85)**		20.11 (8; 86)***	17.48 (9; 85)***		12.74 (8; 86)***	25.24 (9; 85)***					
p value ^a	0.040	0.817		0.002	0.019		0.002	0.545		0.001	0.320		

^ap value for joint test of significance (Wald test) (overweight vs. obese). ***p < 0.001.

All models control for race/ethnicity, socio-economic status, and age. Normal/underweight is the reference group. IM = Initial model; MM = mediation model with body image; CM = complete mediation; NAIM = no association in the initial model.

overweight/obesity and SBM and between obesity and IBC, and it partially explained the negative association between overweight/obesity and PA. Among girls, having a negative body image completely mediated the association of obesity with PA, breakfast consumption, and smoking, partially mediated that of obesity with SBM, and completely mediated that of overweight with SBM. These findings point to the usefulness of evaluating body image to understand processes influencing the association of overweight/obesity with CDRHP.

As suggested by social comparison theory, adolescents engage in comparative evaluations with external attributes to establish commonalities and differences with their own attributes. For overweight/obese adolescents, comparing their body image to impossibly thin standards publicized by the media and society results in stress that is sometimes addressed through maladaptive coping strategies such as increased SBM [30], smoking [7], or an inadequate dietary lifestyle (e.g. skipping breakfast) [17], all behaviors that could either result in maintaining overweight/obesity or worsening the negative health consequences of obesity. Furthermore, the desire of overweight/obese adolescents to conform to their peer group may conflict with a potential engagement in health-promoting behaviors, given that such behaviors conflict with processes and values that are central to adolescence (e.g. risk taking, being 'cool') [39].

Compared to overweight/obese individuals in other developmental stages (such as children and adults), overweight/obese adolescents are more likely to demonstrate maladaptive coping through engagement in risk behavior. Overweight/obese adolescents experience impaired peer relationships, stigmatization, and weight bias. These stressful life events, in combination with the normative challenges of adolescence and the stress of managing an unhealthy weight, may make adolescents more susceptible to engaging in health-risk behaviors. [7]

To our knowledge, this is the first study examining the mediating role of body image in the overweight/obesity-CDRHP association among adolescents, particularly among boys, who have traditionally not been the focus of body image research. However, previous studies have identified the use of maladaptive coping strategies such as poor dietary habits and negative self-talk as a reaction to weight stigma among adults [40]. Negative body image has been firmly established as a potential stressor for adolescents, particularly for those who are overweight or obese. As suggested by the stress and coping theory, experiencing a negative body image is therefore likely to trigger coping strategies aimed at mitigating the emotional and physiologic imbalances caused by a negative body image. Unfortunately, among overweight and obese adolescents, such coping strategies could involve practices such as smoking and increased SBM, which are maladaptive and may worsen obesity or its negative health consequences.

Our findings show that overweight/obesity is negatively associated with PA and breakfast consumption and positively associated with SBM and smoking. These associations varied by gender and degree of overweight: *obesity* was associated with all CDRHP across gender (except smoking for boys), but the association of *overweight* with CDRHP was more limited. For boys, it was only associated with PA and SBM, while among girls, it was only associated with SBM. While different studies have established associations of overweight/obesity with PA/SBM [4, 10], smoking [7], and skipping breakfast [5], this is the first study to examine the association of varying degrees of overweight with multiple CDRHP, across gender, and in a national sample. These findings suggest that prevention efforts aimed at curtailing the obesity epidemic could also simultaneously address other CDRHP to prevent such risk behaviors from becoming habitual and being sustained in adulthood.

The association between overweight/obesity and CDRHP was stronger for obese compared to overweight adolescents across gender and behavior. The stronger association of obesity with CDRHP could possibly relate to greater experiences with stress and stigma.

Previous studies have shown that obesity was associated with more negative outcomes than overweight [7], thereby confirming that greater deviations from appearance ideals were significant factors in the relationship of overweight/obesity with risk behaviors. Indeed, in this study, obesity was more strongly associated with poor body image – a potential source of stress – than overweight. The poorer the body image, the greater the stressful experience, and the stronger the engagement in CDRHP (table 4).

Body image was negatively related to overweight/obesity, SBM, and smoking, and positively related to PA and breakfast consumption, across gender and after controlling for age, race/ethnicity, and family affluence. These findings are in line with previous research showing that overweight/obesity is a strong and consistent risk factor for developing a negative body image in adolescence [11] and that negative body image is associated with CDRHP [14, 16, 17]. Negative body image has also been associated with a host of health-compromising practices among adults, including less walking/jogging and a worse diet, suggesting that the adverse consequences of a negative body image may be similar across the life course.

These findings should be interpreted in light of the limitations and strengths of this study. One important limitation lies in the cross-sectional nature of the data that makes it difficult to test for the temporal sequence of these events. In this study, we hypothesized that overweight/obesity among adolescents leads to a negative body image, which would, in turn, lead to greater engagement in CDRHP. Although these assumptions are justified and in line with previous research documenting the association of overweight/obesity with body image and that of body image with CDRHP, we cannot completely rule out different causal directions. For example, PA may promote a positive body image which could lead to healthier weight (e.g. through weight maintenance). Our results can therefore be further strengthened by testing these relationships using longitudinal data.

Another limitation relates to our inability to draw a distinction between adolescents with and without obesity-related comorbid conditions (e.g. diabetes). Overweight/obese adolescents with one or more of these conditions may have different body image perceptions than those with no conditions. Furthermore, the addition of comorbid conditions may alter the association of overweight/obesity with CDRHP. Indeed, different findings have emerged regarding the association of chronic conditions with CDRHP such as smoking, with studies showing positive [41] or negative [42] associations. If chronic conditions are indeed associated with an increased risk of smoking and other CDRHP, more research is needed to determine the extent of the association of overweight/other chronic conditions with body image and to determine whether negative body image is still as effective a mediator in the association of overweight/other chronic conditions with CDRHP.

This study relied on subjective measures of height and weight to compute the BMI score, and, although these measures are adequate estimates of actual height and weight [33], objective measurements would provide a stronger argument for these relationships. Finally, although body image was an effective mediator of the relationship of overweight/obesity with CDRHP, the small R^2 of the regression models suggests that factors other than body image may play a stronger role in the association of overweight/obesity with CDRHP.

Despite these limitations, our study has several strengths. First, these analyses were based on a representative sample of US adolescents with varying degrees of overweight, which enabled us to examine the mediating effect of a negative body image across different subgroups, rather than only focusing on clinical samples with the most extreme cases of obesity. As our results have shown, the association between overweight/obesity and CDRHP differed by weight status, as did the mediating effect of body image. Other notable strengths include the use of previously tested and validated measures and the simultaneous investigation of the association of overweight/obesity with multiple CDRHP.

These findings also have implications for public health practice. Prevention programs that address PA, sedentary behavior, unhealthy eating (skipping breakfast), and smoking among adolescents should include an assessment of body image along with weight status, as these factors might be contributing to the adolescents' engagement in these CDRHP. As this study showed, perceptions of body image may be an important determinant of engagement in CDRHP. Therefore, altering body image perceptions to be more positive may facilitate behavior modification and less engagement in CDRHP.

Future research should also investigate the applicability of the proposed framework to different subgroups of adolescents. For example, while the prevalence of a negative body image is higher among White girls than African-American girls, we had no a priori reasons for assuming that our framework will not be applicable to both groups. Even though the prevalence of negative body image differs among the two groups, we would expect, based on stress and coping theory, that in either group a negative body image will lead to greater engagement in CDRHP. However, this hypothesis needs to be investigated in future studies.

Conclusions

In conclusion, these findings suggest that a negative body image effectively mediates the association of overweight/obesity with CDRHP, although, as indicated by the overall model fit (small R^2), additional mediators need to be investigated. Prevention strategies and programs may benefit from promoting more positive body image perceptions, especially among overweight/obese youth. As the prevalence of overweight/obesity among adolescent boys and girls remains high, efforts to improve their body image could result in greater engagement in PA, more frequent breakfast consumption, and reduction in smoking and SBM, all changes that could reduce the clinical health consequences of overweight/obesity.

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Disclosure Statement

The authors declare no conflict of interest.

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