


# Unhealthy weight control behaviors mediate the association between weight status and weight-specific health-related quality of life in treatment-seeking youth who are obese

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## Abstract

**Purpose** Examine whether unhealthy and extreme weight control behaviors (WCBs) mediate the relationship between youth weight status and disease-specific health-related quality of life (HRQOL) in treatment-seeking youth who are overweight and obese (OV/OB).

**Method** 82 youth 10–17 years of age who were OV/OB and attending an outpatient obesity-related medical appointment completed measures assessing unhealthy and extreme WCBs and disease-specific HRQOL. Parents completed a demographic questionnaire and medical staff measured youth height and weight.

**Results** Regression analyses revealed that unhealthy WCBs mediated the associations between youth weight status and emotional and social avoidance disease-specific HRQOL, such that higher body mass index (BMI) predicted unhealthy WCBs, which were ultimately associated with poorer emotional and social HRQOL. Mediation analyses were not significant for total, physical, teasing/marginalization, and positive attributes disease-specific HRQOL. In addition, extreme WCBs did not

mediate the association between youth weight status and any subscales of the disease-specific HRQOL measure.

**Discussion** Weight status is an important predictor of disease-specific HRQOL in OV/OB youth; however, the association with emotional and social HRQOL is partially accounted for by youth engagement in unhealthy WCBs. Clinicians and researchers should assess WCBs and further research should explore and evaluate appropriate intervention strategies to address unhealthy WCBs in pediatric weight management prevention and treatment efforts.

**Keywords** Childhood obesity · Weight control behaviors · Health-related quality of life

## Introduction

Pediatric obesity is currently a significant public health concern. More than 30 % of youth 2–19 years of age are overweight or obese (OV/OB) [1]. Childhood OV/OB is

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associated with a myriad of negative short- and long-term health and psychosocial outcomes [2–4]. Being OV/OB in childhood has also been linked to increased weight status in adulthood [5], premature morbidity and mortality [6], and increased health care costs [7]. While pediatric OV/OB significantly affects children and society on many levels, children's everyday abilities and functioning are also compromised. Identifying mechanisms that are associated with negative outcomes are an integral piece to developing targeted interventions for youth who are OV/OB.

Health-related quality of life (HRQOL) is a multidimensional construct that examines the impact of diseases on areas of functioning [8]. HRQOL in youth is typically assessed via parent-proxy or youth report on generic and disease-specific measures [9]. Generic measures consist of items that apply to both healthy and chronic disease populations and allow for comparisons between illness groups [8]. Alternatively, disease-specific HRQOL measures have been developed in order to detect and quantify changes in HRQOL in patients with specific pediatric illnesses, such as diabetes and asthma [8].

There is a large body of research demonstrating that youth who are OV/OB have significantly impaired HRQOL compared to their non-OV/OB peers when generic HRQOL measures are utilized [10]. In addition, higher weight status predicts reduced HRQOL in pediatric OV/OB [11–13]. However, a limitation of the current body of research is the common use of generic HRQOL measures and limited focus on weight-specific HRQOL in youth who are OV/OB despite the clinical utility of weight-specific HRQOL measures for identifying intervention targets, predicting treatment success, and measuring meaningful change over time [14, 15]. A weight-specific youth self-report HRQOL measure, Sizing Me Up, was developed and validated by Zeller and Modi (2009) for use in pediatric obesity populations and examined in a community-based sample [16]. Previous studies have demonstrated the reliability and validity of the measure and significant associations between youth weight status and domains of disease-specific HRQOL [16, 17]. Yet, research models examining generic and weight-specific HRQOL in pediatric OV/OB often control for youth weight status (i.e., hold it constant) rather than exploring how weight status may be related to other factors that have established associations with HRQOL. More research is needed to better understand potential mediators that influence the association between weight and HRQOL in pediatric OV/OB.

Recent research has identified body image and self-esteem as accounting for a small to moderate portion (19–24 %) of the association between BMI and HRQOL in adolescents who are OV/OB [18]. To date, the few studies utilizing the Sizing Me Up measure have examined

associations between individual factors, such as parenting stress [19] and social support [20], and weight-specific HRQOL in treatment-seeking youth who were OV/OB. However, no studies to date have identified mediators that may explain the potential association between weight status and disease-specific HRQOL in youth who are OV/OB. Previous research suggests that there are factors in addition to body image and self-esteem that may explain the link between BMI and HRQOL in pediatric OV/OB. Body image disturbance and low self-esteem are commonly associated with disordered eating patterns, including unhealthy weight control behaviors [21]. Given unhealthy weight control behaviors have been linked to reduced HRQOL and increased weight status [13, 22], weight control behaviors could serve as an underlying factor to explain the BMI-HRQOL association.

Weight control behaviors (WCBs) are strategies used to lose weight or prevent future weight gain and range from healthy (e.g., eating more fruits and vegetables), to unhealthy (e.g., skipping meals), to extreme (e.g., self-induced vomiting) [23]. Research suggests that the relationship between obesity and WCBs in childhood may perpetuate one another, with obesity placing children at greater risk for developing unhealthy WCBs, which in turn is associated with further weight gain [24]. For example, 76 % of adolescent girls with obesity reported engaging in unhealthy WCBs and 17.9 % endorsed extreme WCBs compared to 50.5 and 10.1 %, respectively, in non-OV/OB adolescent girls [25]. Engagement in unhealthy and extreme WCBs places youth at risk for future weight gain and the development of eating disorders [21]. A recent study found that engagement in unhealthy WCBs predicted reduced emotional HRQOL in youth with OV/OB [13]. Similar to previous studies examining HRQOL in youth who are OV/OB, youth weight status was controlled for and a generic measure of HRQOL was utilized. Additional research is needed with a disease-specific HRQOL measure to better understand associations between increased weight status and engagement in unhealthy and extreme WCBs in youth who are OV/OB. Examining whether WCBs mechanistically influence the relationship between youth weight status and disease-specific HRQOL is warranted to inform further research, assessment, and intervention efforts.

The purpose of the current study was to examine relations between weight status, unhealthy and extreme WCBs, and disease-specific HRQOL in treatment-seeking youth with OV/OB. Based on previous research, it was hypothesized that youth weight status would significantly predict disease-specific HRQOL and that unhealthy and extreme WCBs would mediate this relationship by accounting for at least part of the association between weight status and disease-specific HRQOL in youth who are OV/OB.

## Methods

### Participants and procedures

Participants were 82 youth who were OV/OB and attending a pediatric obesity clinic with their parent or caregiver. Data examined come from a larger cross-sectional study examining WCBs in youth with OV/OB, which was approved by the governing Institutional Review Board. Inclusion criteria for the larger study included youth 10–17 years of age, accompanied by a parent or guardian to their medical appointment, attending an outpatient appointment in the pediatric obesity clinic, and being OV/OB [equal to or above the 85th percentile for body mass index (BMI) based on established norms for age and gender]. After presenting for their scheduled clinic appointments, eligible families were approached by a trained research assistant to obtain parent consent and youth assent to participate in the larger study. Youth and parents completed questionnaires independently while waiting to be seen by the medical team. A trained research team member was available to administer measures and answer questions. Families received a small amount of compensation after the completion of the questionnaires.

### Measures

#### *Weight status*

Youth height and weight measurements were performed by trained medical staff as part of normal clinical care in the outpatient pediatric obesity clinic. The measurements were obtained from each participant's medical chart. Height and weight information were then used to calculate the youth's BMI  $z$  score based on age and gender norms [26].

#### *Weight control behaviors*

The measure used to assess youth's unhealthy and extreme WCBs was adapted from one created by Neumark-Sztainer and colleagues [27]. The questionnaire assessed use of healthy, unhealthy, and extreme WCBs in the past year by youth indicated whether or not they had engaged in specific behaviors "to lose weight or keep from gaining weight." For the purposes of this study we focused on unhealthy and extreme WCBs due to their association with future weight gain [21] and potential to inform future interventions. Responses classified as unhealthy WCBs included six items: skipping meals, eating very little food, fasting, smoking more cigarettes, using a food substitute, and skipping breakfast. Extreme WCBs included four items: taking diet pills, self-induced vomiting, using laxatives,

and using diuretics. These classifications were derived from prior research [25, 28]. Separate scores were calculated for unhealthy and extreme WCBs, with possible scores ranging from 0–6 to 0–4, respectively.

#### *Disease-specific health-related quality of life (HRQOL)*

To assess disease-specific HRQOL, youth completed Sizing Me Up [17], which was developed for youth who are OV/OB. Youth answered 22 items utilizing a 4-point Likert scale (1 = None of the Time to 4 = All the Time). Sizing Me Up consists of five scales: Emotional Functioning, Physical Functioning, Social Avoidance, Social Attributes, and Teasing/Marginalization. Responses were averaged and then transformed to a 0–100 scale, with higher scores indicating higher, or better, HRQOL. A total score is also calculated by summing and transforming all items. The measure has good internal consistency (Cronbach's alpha = 0.82) and test-retest reliability (intraclass correlation = 0.78) for the Total score [17]. In our sample of youth with OV/OB (e.g.,  $M$  youth age = 12.93) internal consistency Cronbach's alphas ranged from 0.92 (Emotional) to 0.48 (Positive Attributes) for the subscales and for the Total scale was 0.87, which is slightly higher than found in the initial validation study of treatment-seeking youth with OV/OB [17] and in a community-based sample [16].

#### *Demographic information*

Parents completed a family background information form in order to gather information about youth and parent age, gender, race and ethnicity, as well as parental marital status and family income.

### Data analysis

Descriptive statistics were conducted to evaluate demographic characteristics of the sample and the main variables of interest (e.g., weight status, unhealthy and extreme WCBs, and disease-specific HRQOL). Potential covariates (e.g., youth gender, age, and race/ethnicity) were identified through  $t$  tests, correlations, and ANOVAs. Correlations were also conducted between the variables of interest. To examine whether unhealthy and extreme WCBs mediate the relation between weight status and disease-specific HRQOL, mediation analyses were conducted using the SPSS macro PROCESS [29], specifically model 4. The macro conducted bootstrapped unstandardized multiple linear regressions with 5000 samples and provided estimates of the direct and indirect effects of the predictor variable (e.g., youth weight status) at the values of the mediator variable (e.g., unhealthy and extreme WCBs)

[30]. In the model, youth weight status (e.g., BMI  $z$  score) was the independent variable, the dependent variable was disease-specific HRQOL (e.g., Sizing Me Up subscales: Emotional Functioning, Physical Functioning, Social Avoidance, Social Attributes, Teasing/Marginalization, and Total), and the mediators were unhealthy and extreme WCBs. Covariates identified from preliminary analyses were also included in the mediation models. All statistical analyses were conducted using SPSS (22.0) for Windows (SPSS Inc., Chicago, IL, USA).

## Results

### Demographic and descriptive information

Participants included 82 treatment-seeking youth 10–17 years of age ( $M = 12.93$ ,  $SD = 2.04$ ) with OV/OB whose average BMI  $z$  score was 2.33 ( $SD = 0.43$ ) (See Table 1 for Demographics). Over 90 % ( $n = 75$ ) of youth were obese. Slightly more youth were female (53.7 %) than male. Half of youth participants were identified as Caucasian, 29.3 % African American, 11.0 % Hispanic/Latino, and the remaining 9.7 % were identified as Other or race/ethnicity was not reported. Most caregivers accompanying the youth to the pediatric obesity medical appointment were mothers (86.6 %). Most caregivers were married (56.1 %), average caregiver age was 41.95 years ( $SD = 10.18$ ), and median family income was in the \$20,000–39,999 range.

Skewness and kurtosis for the main study variables were all acceptable ( $<1.5$ ). Sample descriptive information for the continuous variables of interest in this study are displayed in Table 2. In general, 74.4 % of youth in this study reported using at least one unhealthy WCB in the past 1 year and 17.1 % reported using at least one extreme WCB. It is important to note that all of the youth reporting extreme WCBs were obese. These rates are consistent with previous reports of engagement in WCBs in youth with OV/OB [13, 25]. On the Sizing Me Up questionnaire, 45.1 % of youth ( $n = 37$ ) reported HRQOL scores below the recommended clinical cut-off for potential clinical intervention (e.g., 68) [16]. However, the Sizing Me Up total and subscale scores from this sample were mostly consistent with previous research [16, 17].

### Covariate analyses

Correlational analyses with main study variables revealed that youth age was not significantly correlated with youth BMI  $z$  score, unhealthy or extreme WCBs, or with subscales of disease-specific HRQOL.  $T$  tests examining gender differences were significant for emotional [ $t(80) = 2.25$ ,  $p = 0.027$ ] and positive attributes

**Table 1** Demographic information for participating children and parents

Total sample ( $N = 82$ )	
Youth characteristics	
Age [in years; $M$ ( $SD$ )]	9.88 (1.37)
Children 10–13 years (%)	58.5
Adolescents 14–17 years (%)	41.5
BMI $z$ score [ $M$ ( $SD$ )]	2.33 (0.43)
Overweight [85th–94th BMI percentile (%)]	8.5
Obese [95th and above BMI percentile (%)]	91.5
Gender (% female)	53.7
Race/ethnicity (%)	
Non-hispanic white	50.0
Non-hispanic black/African American	29.3
Hispanic white	11.0
Other	7.3
Unknown	2.4
Parent characteristics	
Age [in years; $M$ ( $SD$ )]	41.95 (10.18)
Relationship to youth (%)	
Mother	86.6
Father	3.7
Stepparent	6.1
Grandparent	3.7
Marital status (%)	
Married	56.1
Divorced/separated	17.1
Single/never married	22.0
Other	4.9
Family income (median)	\$20,000–39,999

[ $t(80) = 2.06$ ,  $p = 0.043$ ] disease-specific HRQOL. Specifically, boys reported significantly higher disease-specific HRQOL in these domains compared to girls [Sizing Me Up Emotional: Boys  $M$  ( $SD$ ) = 70.03 (27.66), Girls  $M$  ( $SD$ ) = 54.99 (32.19); Sizing Me Up Positive Attributes: Boys  $M$  ( $SD$ ) = 42.54 (16.09), Girls  $M$  ( $SD$ ) = 35.13 (15.68)]. ANOVAs examining race/ethnicity differences were significant for youth BMI  $z$  score [ $F(3,76) = 4.68$ ,  $p = 0.005$ ]; specifically, youth identified as African American/Black had higher BMI  $z$  scores ( $M = 2.58$ ,  $SD = 0.31$ ) compared to youth identified as Caucasian ( $M = 2.20$ ,  $SD = 0.45$ ). No other statistically significant gender or race/ethnicity differences were found. Youth gender and race/ethnicity were included as covariates in subsequent analyses.

### Intercorrelations

Youth BMI  $z$  score was significantly positively associated with unhealthy WCBs [ $r(81) = 0.25$ ,  $p = 0.024$ ] and

**Table 2** Means and standard deviations of weight status, unhealthy weight control behaviors, and disease-specific health-related quality of life in treatment-seeking overweight and obese youth

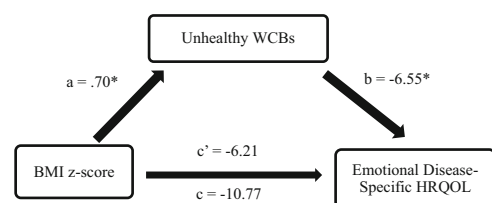
Measure	Descriptive statistics			
	<i>N</i>	<i>M</i>	SD	Observed range
BMI <i>z</i> score	82	2.33	0.43	1.31–3.18
Unhealthy WCBs	81	1.82	1.37	0–5
Extreme WCBs	82	0.21	0.49	0–2
Sizing Me Up total	82	65.91	15.45	12.12–90.91
Sizing Me Up emotional functioning	82	61.96	30.93	0–100
Sizing Me Up physical functioning	82	76.75	21.35	6.67–100
Sizing Me Up teasing/marginalization	82	73.98	28.10	0–100
Sizing Me Up positive attributes	82	38.56	16.58	5.56–72.22
Sizing Me Up social avoidance	82	87.80	15.64	33.33–100

BMI body mass index, WCB weight control behavior

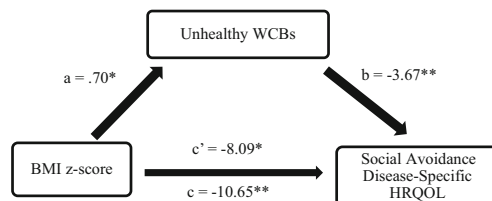
negatively correlated with physical [ $r(82) = -0.34, p = 0.002$ ], teasing/marginalization [ $r(82) = -0.25, p = 0.021$ ], social avoidance [ $r(82) = -0.28, p = 0.011$ ], and total [ $r(82) = -0.29, p = 0.009$ ] disease-specific HRQOL. Thus, as youth weight status increased, reports of engagement in unhealthy WCBs increased, and some domains of weight-specific HRQOL decreased. Unhealthy WCBs were also significantly negatively associated with emotional [ $r(81) = -0.33, p = 0.003$ ], teasing/marginalization [ $r(81) = -0.28, p = 0.012$ ], social avoidance [ $r(81) = -0.36, p = 0.001$ ], and total [ $r(81) = -0.29, p = 0.008$ ] disease-specific HRQOL, where reports of more engagement in unhealthy WCBs were associated with decreases in disease-specific HRQOL. Unhealthy and extreme WCBs were also significantly associated with each other [ $r(81) = 0.23, p = 0.044$ ]. Extreme WCBs were not significantly correlated with any other variables of interest.

**Weight control behaviors mediation analyses**

When controlling for youth gender and race/ethnicity, the bootstrapped mediation model revealed that unhealthy WCBs did not mediate the association between BMI *z* score and total disease-specific HRQOL. Additional analyses were conducted to determine whether unhealthy WCBs mediated the relationship between BMI *z* score and specific domains of disease-specific HRQOL (e.g., subscales from Sizing Me Up). After controlling for youth gender and race/ethnicity, the mediation models were significant for emotional and social avoidance disease-specific HRQOL. Figures 1 and 2 depict the mediation models and report the bootstrapped estimates of the indirect effects, as well as the unstandardized B weights for the path coefficients. BMI *z* score was positively related to unhealthy WCBs (i.e., more unhealthy WCBs), which then was negatively associated with emotional disease-specific HRQOL (i.e., poorer emotional HRQOL). The relationship



**Fig. 1** Mediation model of unhealthy WCBs mediating the relation between BMI *z* score and disease-specific emotional HRQOL in overweight and obese youth. Estimate of the indirect effect =  $-4.56$ ; bootstrapped 95 % confidence interval =  $-13.9433, -0.2275$ . \* $p \leq 0.05$



**Fig. 2** Mediation model of unhealthy WCBs mediating the relation between BMI *z* score and disease-specific social avoidance HRQOL in overweight and obese youth. Estimate of the indirect effect =  $-2.56$ ; bootstrapped 95 % confidence interval =  $-7.7489, -0.0387$ . \* $p \leq 0.05, **p \leq 0.01$

between youth weight status and emotional disease-specific HRQOL was mediated by unhealthy WCBs, which is evidenced by the confidence interval not containing zero (see Fig. 1). The mediational model accounted for 17.2 % of the variance in emotional disease-specific HRQOL [ $F(4,74) = 3.85, p = 0.007$ ]. For social avoidance disease-specific HRQOL, the results of the mediation model were similar and are presented in Fig. 2. BMI *z* score was positively related to unhealthy WCBs, which then was negatively associated with social avoidance disease-specific HRQOL. This mediational model accounted for 19.1 % of the variance in social avoidance disease-specific HRQOL [ $F(4,74) = 4.37, p = 0.003$ ]. The mediational models



were not significant for physical, teasing/marginalization, and positive attributes disease-specific HRQOL. The models examining extreme WCBs as a mediator between youth BMI *z* score and disease-specific HRQOL were not significant.

## Discussion

This study is the first to our knowledge to examine WCBs as a mediator of the relationship between weight status and disease-specific HRQOL in pediatric OV/OB. Unhealthy WCBs partially mediated the association between youth weight status and emotional and social avoidance disease-specific HRQOL. Our findings are consistent with other research that found WCBs are associated with emotional domains of generic HRQOL [13]. However these findings expand previous research by examining disease-specific HRQOL. Unhealthy WCBs may be an important mechanism in the association between weight and emotional and social functioning in youth with OV/OB. Specifically, as youth weight status increases so does engagement in unhealthy WCBs which in turn is associated with poorer emotional and social disease-specific HRQOL. While further research is needed to replicate these findings, these results suggest that specific attention should be paid to the emotional and social functioning of treatment-seeking youth with OV/OB of increasing weight status, particularly in relation to unhealthy WCBs, in assessment, prevention, and treatment settings.

Unhealthy WCBs did not mediate the relation between weight status and the disease-specific HRQOL physical, teasing/marginalization, and positive attributes domains. As the findings of this study are novel, additional research will need to determine whether these findings can be replicated. As some unhealthy WCBs utilized by children and adolescents may be secretive or hard to notice, they may be less likely to serve as a mechanism in the association between weight status and teasing/marginalization as peers may not be aware of these behaviors. In addition, the physical effects of some unhealthy WCBs may not be prominent enough to have a significant impact if youth have been engaging in unhealthy WCBs for a short period of time or with limited frequency.

Extreme WCBs, such as using diet pills, self-induced vomiting, and using laxatives and diuretics, did not mediate the association between weight status and disease-specific HRQOL. In addition, extreme WCBs were not significantly associated with any of the other variables of interest, with the exception of unhealthy WCBs. The lack of findings may be due to OV/OB youth in this study reporting relatively low engagement in extreme WCBs and thus limiting statistical power to detect significant effects. Specifically,

more than 82 % of the sample did not endorse engaging in any extreme WCBs. For OV/OB youth, engagement in unhealthy WCBs, such as skipping meals, appears more common and it is possible that these behaviors may have a greater influence on disease-specific HRQOL if engaged in more frequently or regularly. Given that unhealthy WCBs are associated with future weight gain [21], our findings suggest that health care providers (e.g., physicians, psychologists, dieticians) working with youth who are OV/OB and their families should provide education and targeted intervention to reduce engagement in unhealthy WCBs and help families develop alternative strategies for weight management. In addition, if replicated by further research, current findings support the integration of treatments targeting pediatric obesity and disordered eating behaviors in youth [31].

Our findings should be interpreted with caution as unhealthy WCBs mediated the association between youth weight status and emotional functioning and social avoidance but no other domains of disease-specific HRQOL (e.g., physical, teasing/marginalization, and positive attributes). Future research should continue to examine other potential mediators that may play a role in the association between youth weight status and other areas of functioning. Additional limitations of the current study should be taken into account. Specifically, this study only included youth with OV/OB attending a pediatric obesity specialty medical appointment and results may not generalize to non-OV/OB youth or youth with OV/OB not receiving obesity specific medical treatment. Although the statistical design (i.e., mediation) was based on previously established temporal associations, the design of this study was cross-sectional so causal conclusions cannot be drawn. There is a need to conduct longitudinal research to confirm the cross-sectional model identified here that suggests unhealthy WCBs temporally mediate the association between youth weight status and emotional and social weight-specific HRQOL. In addition, our sample size was relatively small. Larger samples would expand our findings by allowing for the examination of youth and parent specific factors (e.g., youth age, youth gender, parent weight status, etc.) that may be associated with unhealthy and extreme WCBs in order to identify specific groups who may be at more risk for engaging in problematic WCBs and experiencing reduced weight-specific HRQOL. The WCB measure implemented in this study had youth indicate whether or not they engaged in WCBs in a 1 year period, which did not allow for examination regarding how often youth engaged in each unhealthy and extreme WCBs. Future research should incorporate measures that assess frequency of WCBs in a more narrow time period. To assess disease-specific HRQOL the Sizing Me Up measure was utilized, which was created for children 5–13 years of age. Youth in

this study ranged in age from 10 to 17. However, in our older sample of treatment-seeking youth who were OV/OB the internal consistency of the measure was better than reported previously [16, 17]. Future research should continue to examine the validity and reliability of Sizing Me Up in older OV/OB samples, as there are no other no-cost disease-specific HRQOL measures for this population that may be cost-effective and practical to implement in pediatric obesity specific research and clinical endeavors.

In sum, unhealthy WCBs mediated the association between weight status and disease-specific HRQOL. Thus, as weight status increases youth who are OV/OB report increased engagement in unhealthy WCBs, which then are associated with poorer emotional and social disease-specific HRQOL. However, extreme WCBs were not associated with disease-specific HRQOL and did not mediate the association between youth weight status and HRQOL. This highlights the salient role that more commonly exhibited unhealthy WCBs, such as skipping meals and dieting, can play in regards to weight status and disease-specific HRQOL in OV/OB youth. Interventions should target engagement in unhealthy WCBs to prevent future weight gain and reduce negative associations with disease-specific HRQOL. Additional research examining WCBs and disease-specific HRQOL is needed to confirm our findings and investigate other mechanisms that may influence the impact of OV/OB in multiple domains of functioning in youth who are OV/OB.

#### Compliance with ethical standards

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

**Ethical approval** This study was conducted in compliance with the American Psychological Association Ethics Code. This study was reviewed and approved by the governing Institutional Review Board.

**Informed consent** All participants gave informed consent/assent prior to participating in the study.

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