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Unhealthy Weight Control Behaviors and Substance Use Among Adolescent Girls: The Harms of Weight Stigma

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Introduction

Unhealthy weight control behaviors (UWCBs), such as laxative use or self-induced vomiting to control or reduce weight, are common among adolescents and young adults (Neumark-Sztainer, Wall, Guo, Story, Haines, & Eisenberg, 2006). The prevalence of UWCBs significantly varies by gender (Loth et al., 2015), where overall prevalence is higher among girls (58%) as compared to boys (31%; Neumark-Sztainer et al., 2006). The high prevalence of UWCBs has become a growing public health concern due to their persistence over time (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011) and tendency to co-occur with other maladaptive behaviors, such as substance use (SU; Swanson et al., 2011; Hudson et al., 2007; Root et al., 2010). Concurrent unhealthy weight control behaviors and substance use (UWCB-SU) is associated with poorer psychiatric health (Swanson et al., 2011) and a higher mortality rate (Gilchrist, Gruer, & Atkinson, 2007) than either maladaptive behavior alone, which has generated an interest in uncovering etiological pathways related to its development. Yet, one notable challenge in understanding the complexities underlying UWCB-SU development is the substantial gender differences in SU risk factors (Tuchman, 2010) and use profiles (Pisetsky et al., 2008), which points to the need to examine SU across gender identities separately. To this end, adolescent girls and transgender adolescents report higher rates of UWCBs and substance use (Diemer et al., 2015; SAMHSA, 2013; Ridenour et al., 2005; Wiederman, 1996; Gadalla & Piran, 2007) and report greater psychiatric consequences when compared to boys (Diemer et al., 2015; Gilchrist, Gruer, & Atkinson, 2007). Thus, concurrent UWCB-SU may be perceived a larger problem among girls and transgender adolescents, which calls for the need to identify underlying risk factors for its onset among these groups. The current study focuses only on adolescent girls, as data from transgender adolescents is not available. The study aims to identify potential factors that

either magnify or attenuate the relationship between UWCB among adolescent girls and later SU, the findings from which may be translated into improved preventive efforts.

Substance use is more common among women who also endorse UWCBs, where approximately 5–11% of women who report UWCBs also report substance dependence as compared to 2–5% of women who report substance dependence and not UWCB (Gadalla & Piran, 2008). To this end, a large body of literature has found UWCBs to reliably predict later SU among girls and women (Harrop & Marlatt, 2010; Measelle, Stice, & Hogansen, 2006; Franko et al., 2005), suggesting that the emergence of UWCBs temporally precedes SU. While the temporality of concurrent UWCB-SU has been established, little research has been done to examine the potential factors that magnify or attenuate the associations between UWCBs and SU in adolescent girls. Specifically, past research has identified personality traits, such as openness (Martin et al., 2015) and novelty seeking (Krug et al., 2009) as moderators in the relationship between UWCBs and substance use among girls in college. Given the limited amount of research in this area, more research examining potential moderating factors related to UWCB-SU is needed.

From a functional contextual perspective, behaviors only have meaning within the context with which they occur (Hayes et al., 2013). From this perspective, the extent to which one maladaptive behavior (e.g., UWCBs) relates to another behavior (e.g., SU) is only examined holistically when an individual's context and its associated influence on an individual are considered. For example, maladaptive behaviors, such as UWCBs (Rawal, Park, & Williams, 2010) or SU (Wenzlaff & Wegner, 2000), are likely to emerge when individuals seek to suppress or avoid a wide range of psychological experiences (Hayes et al., 1999), including thoughts, sensations, and urges. Thus, because heightened weight-related concerns are common among girls who engage in UWCBs (Neumark-Sztainer et al., 2002; Killen et al., 1996), it is likely that these UWCBs develop as a maladaptive behavior in attempt to suppress, avoid, or diminish such weight-related concerns. From this perspective, new maladaptive behaviors, such as SU, are likely to emerge when something magnifies the psychological experience, thus preventing the original behavior from serving its function.

Stigmatizing experiences have been shown to negatively impact psychological health (Gaddis, Ramirez, & Hernandez, 2018) and risk behaviors (Yang et al., in press). Thus, one potential factor that may magnify the impacts of UWCBs on substance use is weight stigma. Weight stigma has been defined as victimization and bullying specifically as it relates to weight and size (Puhl, Neumark-Sztainer, Austin, Leudicke, & King, 2014). The increasing rate of weight stigma has become a growing public health concern (Puhl et al., 2014), as adolescent girls who experience weight stigma are at heightened risk of developing eating disorders (Haines, Kleinman, Rifas-Shiman, Field, & Austin, 2010) and SU (Hatzenbeuhler, Keyes, & Hasin, 2009), among other psychiatric disorders and physical health consequences (Hatzenbeuhler, Keyes, & Hasin, 2009). From a functional perspective, the psychological burdens or harms of weight stigma are likely important factors related to the development of future SU.

A large body of research has demonstrated the impact of weight-based social identity threat on both physical and psychological health (e.g., Hunger, Major, Blodom, & Miller, 2015;

Puhl, Moss-Racusin, Schwartz, & Brownell, 2008; Major, Eleizer, & Rieck, 2012). Weight-based social identity threat has been defined as the situational state wherein an individual experiences concern that they have been or will be discriminated against or devalued based on their weight or shape (Hunger et al., 2015). This social identity threat is driven by the societal devaluation of larger bodies and consequently the negative stereotypes associated with larger body shapes (Hunger et al., 2015; Major, Eleizer, & Rieck, 2012). Experiences of weight stigma and its associated harms have been associated with increased motivation to avoid and escape stigma (Hunger et al., 2015), and thus may impact whether an individual initiates additional maladaptive health behaviors such as SU (e.g., Koball & Carels, 2011). However, girls who engage in UWCB but either do not experience weight stigma or its associated harms might have less contextual influence to initiate additional maladaptive behaviors. Thus, the harms of weight stigma may in fact magnify the relationship between UWCBs and SU among girls. Consistent with this perspective, the perceived harms of weight stigma have been associated with UWCBs (Vartanian & Porter, 2016; Libbey, Story, Neumark-Sztainer, & Boutelle, 2008), and an increased likelihood to use coping strategies of avoidance (Puhl & Luedicke, 2011), which highlights the importance of weight stigma and its associated harms. Thus, the current study examines the extent to which weight stigma (e.g., weight teasing from peers or parents) and its associated harms magnify or attenuate the longitudinal relationship between UWCBs in adolescence and SU in young adulthood.

Etiological theories of UWCBs and SU suggest that heightened negative affect plays an important role in the development of both maladaptive behaviors (Cook, Wonderlich, & Lavendar, 2014). Thus, it is possible that girls who report UWCBs and heightened negative affect may be more susceptible to weight-based social identity threat, thus pushing them to seek alternative ways to cope with their responses to stigma (e.g., by using substances). Similarly, individuals with a higher BMI have been found to experience weight stigma more frequently (Puhl & Brownell, 2006). Thus, the present study seeks to elucidate the role of weight-related concerns, depressive symptoms, and BMI in whether girls experienced the associated harms of weight stigma (e.g., weight-based social identity threat) in response to weight stigma.

In sum, UWCBs have been shown to predict SU among girls and women, resulting in a wide range of psychiatric health consequences over time (Swanson et al., 2011). Guided by a functional perspective, the current study seeks to examine whether weight stigma, as measured by teasing about weight or shape from parents or peers, and its associated harms (e.g., being bothered by weight stigma) magnify or attenuate the effect of UWCBs, negative affect (e.g., depressive symptoms), and weight-related concerns on SU at baseline on SU at 10-year follow-up among girls. It was hypothesized that girls who experience the harms of stigma would have greater weight-related concerns and negative affect than girls who report weight stigma alone, or girls who do not report weight stigma while controlling for covariates related to substance use and UWCBs (e.g., age). Moreover, it was hypothesized that the effect of UWCB on SU would be stronger among girls who experience the harm of stigma than it would be for girls who do not report weight stigma without experiencing weight-based social identity threat and girls who do not report weight stigma. It was also hypothesized that the impacts of unhealthy weight control behaviors, depressive symptoms,

and weight-related concerns on substance use function differently among girls related to their experiences, or lack thereof, with weight stigma and its perceived harms.

Method

Study Design and Population

Data for this analysis were drawn from baseline and 10-year follow-up measurement occasions from the population-based Project EAT (Eating and Activity in Teens and Young Adults), a longitudinal study of dietary intake, physical activity, weight control behaviors, weight status, and factors associated with these outcomes among young people. At Time 1 (1998–1999), surveys and anthropometric measures were designed as a cross-sectional study of adolescents enrolled at middle and high schools in the metropolitan areas of Minneapolis-St. Paul (Neumark-Sztainer, Story, Hannan, & Moe, 2002; Neumark-Sztainer, Story, Hannan & Croll, 2002). Given growing research interest in the eating and weight-related health of young people, efforts were made to collect follow-up data at five-year intervals to examine changes in the eating patterns, weight control behaviors, and weight status of the original participants as they progressed through adolescence and emerging adulthood among participants from the original sample who provided sufficient contact information at baseline (Neumark-Sztainer et al., 2006, Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011; Larson, Neumark-Sztainer, Harwood, Eisenberg, Wall, & Hannan, 2011). The University of Minnesota's Institutional Review Board Human Subjects Committee approved all protocols used in Project EAT at each time point. More details on data collection procedures have been previously published (Larson, Neumark-Sztainer, Story, van den Berg, & Hannan, 2011).

Of the original 4,746 Project EAT participants, 1,304 (27.5%) were lost to follow-up, primarily owing to missing contact information at baseline ($n=411$) and no address found at follow-up ($n=712$). There were 2,287 adults (1030 men and 1257 women) who responded to both baseline and 10-year follow up, representing 66.4% of those for whom contact information was available and 48.2% of the original cohort. Attrition from the cohort over time has not occurred completely at random and thus to account for missing data, inverse probability weighting was used for all analyses (Little, 1986). Weights were derived as the inverse of the estimated probability that an individual responded at baseline and 10-year follow-up several baseline covariates, including demographics, weight status, parental living situation, and grades in school. Weighting minimizes potential response bias due to missing data and allows for extrapolation back to the original school-based sample. Prior to weighting, non-completers were more likely to be male, non-white, and of a higher BMI at baseline than completers. After weighting, there were no significant differences between the current study's analytic sample and the baseline full sample on these baseline variables ($P>0.20$).

Participants

The weighted analytic sample includes girls and women who participated at baseline and 10-year follow-up. The 10-year follow-up data were utilized because participants were aged 20 to 31, which has been identified as the optimal developmental time point to examine problematic substance use (Courtney & Polich, 2009). The mean age of the sample was

14.9±1.7 years at baseline and 25.2±1.7 at follow-up. The mean BMI was 22.4±4.7 kg/m² at baseline and 26.2±6.4 kg/m² at 10-year follow-up. At baseline, the sample was 18.5% low SES, 18.2% low medium SES, 26.2% medium SES, 21.1% medium high SES, 12.9% high SES, and 3.1% were missing SES value. Within the analytic sample, 45.6% of the participants self-identified as White, 20.1% Black or African American, 5.2% Hispanic, 20.6% Asian, 0.3% Hawaiian or other Pacific Islander, 3.9% Native American, and 4.4% self-identified as Mixed race/ethnicity. The analyses included race as a dichotomous variable, where 51.7% of girls self-identified as Non-White.

Measures

The analyses include baseline reports all of the measures, as well as substance use at 10-year follow-up. Two-week survey test-retest reliability data were collected from a subsample of adolescents at baseline ($n = 161$), from which the validity of the survey was established (Neumark-Sztainer, Story, Hannan, & Croll, 2002). An additional study regarding the reliability of the measures used in the current sample with relevant study variables has since been published (Larson, Neumark-Sztainer, Story, van den Berg, & Hannan, 2011).

Gender.—Gender at baseline was determined with one question: “Are you ...?” with response options: (1) Male, and (2) Female. Gender at follow-up was measured with the same question and response options. Participants who self-identified as female at either time point were included in the study.

Unhealthy Weight Control Behaviors.—Unhealthy weight control behaviors were measured from a modified version of the Pound of Prevention Survey (Jeffrey & French, 1999), which included specific behaviors that are not typically recommended for weight management. Because substance use prevalence varies by the severity of UWCBs (Loth et al., 2015), only extreme UWCBs were included in the present study (test-retest agreement = 95%). Participation in extreme weight control practices during the past year was assessed with the following question: “*During the past year, did you do any of the following to lose weight or keep from gaining weight?: (1) made myself vomit (throw up); (2) took diet pills; (3) used laxatives; or (4) used diuretics?*” UWCB scores reflect the sum of the four dichotomous items.

Substance Use.—The substance use measure was adapted from the Voice of Connecticut Youth Survey (Sherwood, Neumark-Sztainer, Story, Beuhring, & Resnick, 2002). All available substance use data collected at baseline and 10-year follow-up were included in the study. Substance use was assessed with the following question: “*How often have you used the following during the past year (12 months)? (1) cigarettes; (2) beer, wine, hard liquors; or (3) marijuana.*” Response categories for each substance type ranged from 1 to 5, where higher scores indicate a greater frequency of use. The analyses modeled substance use as a sum of the three substances, resulting in a variable with a range from 3–15. The Cronbach’s alpha ($\alpha = .79$) indicates that the substance use variable maintains sufficient internal consistency.

Weight Stigma and Perceived Harms.—Items capturing weight stigma and stigma reactivity were derived from the Perception of Teasing Scale (POTS; Thomson, Cattarin, Fowler, & Fisher, 1995). Weight stigma and its associated harms were assessed with four questions: (1) “*Have you ever been teased or made fun of by other kids because of your weight?*”; (2) “*If yes, how much did this [being teased or made fun of] bother you?*”; (3) “*Have you ever been teased or made fun of by family members because of your weight?*”; and (4) “*If yes, how much did this [being teased or made fun of] bother you?*” Response options for questions 1 and 3 include: yes or no. Response options for Questions 2 and 4 include: (1) I have not been teased because of my weight by other kids; (2) Not at all; (3) A little bit; (4) Somewhat; and (5) Very much. Weight stigma and its associated harms were dichotomized, where participants were categorized as having experienced weight stigma if they responded “yes” to either Question 1 or Question 3. Participants were categorized as having experienced the harms of stigma if they reported that they were “*a little bit,*” “*somewhat,*” or “*very much*” bothered by the weight stigma they experienced either by their friends or family. Past studies have included a dichotomous variable to represent experiences of weight stigma (van den Berg, Neumark-Sztainer, Eisenberg, & Haines, 2008; Neumark-Sztainer, Falkner, Story, Perry, Hannan, & Mulert, 2002) and other similar constructs (i.e. bullying victimization), as past work has shown that even infrequent victimization is associated with poor psychosocial outcomes (Gower & Borowsky, 2013).

Weight Concern.—Weight concern was captured with two questions (Neumark-Sztainer, Wall, Story, & Perry, 2003): “I think a lot about being thinner” (Test-retest $r=0.77$) and “I am worried about gaining weight.” (Test-retest $r=0.72$). Response options ranged from “strongly disagree” to “strongly agree.” The Cronbach’s alpha ($\alpha = .83$) and test-retest values ($r = 0.77$) among the baseline sample indicates that the weight concern variable has sufficient internal consistency. Scores in the baseline sample range from 2–8, where higher mean scores indicate greater weight concerns.

Depressive symptoms—were assessed using seven items from the Kandel and Davies Depressive Mood Scale (1982). Participants were asked, “During the past 12 months, how often have you been bothered or troubled by the following: feeling too tired to do things; having trouble going to sleep or staying asleep; feeling unhappy, sad or depressed; feeling hopeless about the future; feeling nervous or tense; worrying too much about things; changes in your appetite.” Three response options were available including, “not at all”, “somewhat” and “very much”; higher scores indicate more severe depressive mood (Cronbach’s Alpha = 0.83; test-retest $r = 0.79$).

Covariates.—The analyses included the following covariates: (1) participant age in years; (2) participant race; (3) social economic status; (4) participant baseline and 10-year follow-up self-reported Body Mass Index (BMI; $[\text{weight in kg}]/[\text{height in meters}]^2$), which retained high correlations with measured BMI at baseline ($r = 0.85$; Puhl et al., 2017; Himes, Hanna, Wall, & Neumark-Sztainer, 2005). Self-report BMI was further validated in a subsample of 63 boys and 63 girls from the Project EAT 10-year follow-up sample, which showed very high correlations between self-reported BMI and measured BMI ($r = .98$; Sirard, Hannan, Cutler, & Neumark-Sztainer, 2013); and (5) substance use at baseline. Participants’ race was

assessed with one question “Do you think of yourself as: white; black or African American; Hispanic of Latino; Asian American; Hawaiian or Pacific Islander; or American Indian or Native American.” For the analyses, race was dichotomous (white/non-white) due to small numbers in some categories, as has been previously done with linear regression (Eisenberg, Berge, Fulkerson, & Neumark-Sztainer, 2012; Graham, Sirard, Neumark-Sztainer, 2011). Participants’ socioeconomic status (SES) was captured by 5 unique categories (Neumark-Sztainer et al., 2011). The SES categories were developed using classification tree methodology (Breiman, Friedman, Olshen, & Stone, 1984), for which the prime determinant of SES classification was the highest education level of either parent. Other SES considerations included family eligibility for free/reduced-prices school lunch, parent employment status, and public assistance status.

Analyses

Participants were split into three groups characterized by their experiences with weight stigma: no weight stigma (Group 1); weight stigma only (Group 2); and weight stigma with perceived harms (Group 3). A total of 9 girls reported no experiences of weight stigma but did report reactivity; they were excluded from the analysis because it is unlikely that girls would experience the harms of stigma if they did not experience stigma and the sample size among the group was too small to analyze further ($N=9$). An additional 99 girls were unable to be placed in a group because they were missing responses for weight stigma ($N=77$) and/or perceived harms ($N=99$). The 99 girls who were not included in the analytic sample due to missingness were not significantly different from Groups 1–3 in terms of age. A higher proportion of girls with missing responses on the weight stigma items identified as Non-White (83.8%) than those in Groups 1–3 (47.3 – 62.1%). Girls with missing weight stigma responses also reported a higher BMI ($M=24.2$) than Groups 1 and 2 ($M=21.2 – 21.5$) and lower socioeconomic status ($M=2.6$) than girls in Groups 1 and 3 ($M=2.9 – 3.0$). Among the resulting analytic sample of 1,148 girls, 623 (54.3 %) reported no weight stigma (Group 1), 107 (9.3 %) reported weight stigma only (Group 2), and 418 (36.4 %) reported weight stigma with perceived harms (Group 3). The descriptive statistics for the entire sample and each of the weight stigma groups are presented in Table 1.

In a first step, a one-way ANOVA was conducted to examine mean differences in weight-related concerns, depressive symptomology, BMI, and the study variables (e.g., UWCBs and SU) across the three weight stigma groups to elucidate potential risk or protective factors related to stigma reactivity among those who experience weight stigma. In a second step, a moderated regression analysis was conducted to determine whether weight stigma group membership magnified or attenuated the relationship between UWCBs among adolescent girls and SU at 10-year follow-up. The moderated regression tested both the main effect of UWCBs among adolescent girls on SU at 10-year follow-up, and the interactive effect of weight stigma group membership and UWCBs in adolescence on SU at 10-year follow-up. Age, non-white race, SES, BMI, weight concern, depression, and substance use at baseline were included as covariates. It is likely that the impacts of UWCBs, depressive symptoms, weight-related concerns, and other study covariates (e.g., BMI and baseline substance use) in adolescent girls on SU 10 years later function differently among girls related to their experiences, or lack thereof, with weight stigma and its perceived harms.

Thus, in a third step, a stratified linear regression was run to further explore the extent to which extreme UWCB at baseline predicted substance use at 10-year follow-up among girls and women, across the three unique weight stigma groups. The same covariates included in the moderated regression were included in the stratified regression analysis.

Item-level missingness (e.g., participant non-response to a single item) was relatively low, with only 0.8–1.1% missing across the study variables and 0–9.9% missing among the covariates. Pairwise deletion was used to handle missing data (Muthén, Muthén, & Asparaouhov, 2015), which has been shown to perform better than other missing data methods (e.g., listwise deletion; Enders, 2011).

Results

ANOVA Results with Comparisons by Weight Stigma Group

The results from the ANOVA analysis indicate that there are significant differences in mean UWCBs, weight concerns, depressive symptoms, baseline and follow-up BMI, baseline SU, and SES among the three weight stigma groups (see Table 1). In general, adolescent girls in Group 3, characterized by experiences of weight stigma with perceived harms, reported the highest mean scores on the variables of interest (e.g., UWCBs or depressive symptoms) when compared to girls who reported no weight stigma (Group 1) and girls who reported weight stigma only (Group 2). More specifically, adolescent girls in Group 3 reported significantly higher mean UWCB scores, weight concerns, depressive symptoms and higher baseline and follow-up BMIs ($p < .01$), as compared to adolescent girls in Groups 1 and 2. Further, girls in Group 3 reported significantly higher baseline SU when compared to Group 1 ($p = .01$), but reported no baseline substance use differences when compared to Group 2. Moreover, UWCBs, weight concern, BMI, or baseline substance use mean scores did not significantly differ among adolescent girls in Groups 1 and 2 ($p > .05$). However, adolescent girls in Group 2 reported significantly higher mean depressive symptoms ($p = .002$) when compared to adolescent girls in Group 1. The three weight stigma groups reported significantly different mean SES scores, where adolescent girls in Group 1 reported significantly higher SES scores than girls in Group 2 and Group 3 ($p < .05$). Finally, the ANOVA revealed no mean differences in age or substance use or 10-year follow-up across weight stigma groups ($p > .05$).

Moderated Regression Analysis Results

The results of the moderated regression analysis revealed a marginal moderating effect of weight stigma on the relationship between UWCBs in adolescent girls and substance use at 10-year follow-up ($\beta = .05$, $SE = .03$, $p = .08$), while controlling for the main effect of UWCBs, baseline substance use, weight concern, depressive symptoms, age, non-white race, and SES, as well as BMI at baseline and follow-up. Because the moderating role of weight stigma with perceived harms on the relationship between UWCBs among adolescent girls and SU at 10-year follow-up was marginally significant and is strongly supported by theory, a stratified regression model was conducted to examine the role of weight stigma and its associated harms on the relationship between UWCBs and SU in more detail.

Stratified Regression Analysis Results across Weight Stigma Groups

The results from the stratified regression are presented in Table 2. The results indicate that UWCBs at baseline predict SU at 10-year follow-up among girls who experience weight stigma with perceived harms (Group 3, $\beta = .14$, $SE = .05$, $p = .004$). Standardized multiple regression betas (β) may be interpreted similarly to a Pearson r coefficient, where effect sizes range from small (0.1 – 0.3), medium (0.3 – 0.5), to large (0.5 – 1.0). Thus, the effect of UWCBs among adolescent girls on SU at 10-year follow-up is small, where SU at 10-year follow-up increases .14 standard deviations for every standard deviation increase of 1 in baseline UWCBs. Results also indicate that UWCBs at baseline did not predict substance use at 10-year follow-up among girls who did not experience stigma (Group 1, $\beta = .04$) and girls who experienced weight stigma only (Group 2, $\beta = -.12$).

Discussion

Guided by a functional perspective, the current study aimed to: (1) elucidate factors related to weight-based social identity threat; and (2) examine the role of weight stigma and its perceived harms on the relationship between UWCBs, depressive symptoms, and weight concerns in adolescence and SU 10 years later among adolescent girls. Because weight-based social identity threat may determine whether girls resort to substance use in attempts to suppress their response to weight stigma, the current study aimed to elucidate factors (e.g., weight concerns or depressive symptoms) and characteristics (e.g., BMI) associated with the experiencing the associated harms of weight stigma. It was hypothesized that girls who experience weight stigma and its associated harms (e.g., weight-based social identity threat) are more likely to seek alternative maladaptive behaviors, such as SU, to reduce or suppress their internal response to weight stigma.

The ANOVA results from the current study (see Table 1) revealed significant differences mean differences in a range of factors across weight stigma groups. These group differences may elucidate factors associated with weight stigma with its associated harms among adolescent girls. Specifically, girls who report weight stigma with perceived harms (Group 3) reported significantly higher mean UWCBs, weight concern, and depressive symptomology at baseline and BMI at baseline and 10-year follow-up as compared to girls who reported no weight stigma (Group 1) and weight stigma only (Groups 2). There were no significant differences in baseline substance use across group.

Individuals with a higher BMI tend to experience weight stigma more frequently (Puhl & Brownell, 2006). Thus, it is possible that the increased exposure to stigma results in weight-based social identity threat (Hunger et al., 2015). Similarly, UWCBs and weight concerns may be associated with weight-based social identity threat. For example, it is possible that the perceived harms of weight stigma may increase UWCBs as a means to cope. It is also possible that UWCBs increase the risk of weight-based social identity threat, as experiences of weight stigma may be particularly harmful to girls who are already using unhealthy weight control methods to reduce or control their weight. Moreover, adolescent girls with heightened weight-related concerns may be more likely to experience weight-based social identity threat because experiences of weight stigma may be interpreted as a confirmation of their own beliefs about their weight and shape concerns.

The results from the ANOVAs also revealed that adolescent girls in Group 1 reported significantly lower mean depressive symptomology as compared to girls Group 2. This finding suggests that depressive symptoms were, on average, higher among girls who experienced stigma and even higher among girls who experienced weight stigma with perceived harms. It is possible that depressive symptomology increases the risk of experiencing weight-based social identity threat (Cook, Wonderlich, & Lavendar, 2014) or that weight-based social identity threat increases depressive symptomology. Given the cross-sectional nature of the ANOVA analyses, the temporal relationship cannot be determined. However, past research (Eisenberg, Neumark-Sztainer, Haines, & Wall, 2006; Eisenberg, Neumark-Sztainer, & Story 2003) suggests that experiences of weight stigma may increase depressive symptomology and that girls with higher depressive symptomology may be more likely to report weight stigma with perceived harms when compared to girls with lower depressive symptomology.

The results from the initial moderated regression revealed a marginal moderating effect of weight stigma and the perceived harms of weight stigma on the relationship between UWCBs among adolescent girls and SU at 10-year follow-up. However, because the moderating role of weight stigma with perceived harms on the relationship between UWCBs and SU is supported by the theories from a functional contextual perspective (Hayes et al., 2013) and weight-based social identity threat (Hunger et al., 2015; Major et al., 2012), a stratified regression model was conducted to examine whether the impacts of UWCBs, depressive symptoms, and weight concern at baseline on substance use at 10-year follow-up function differently based on exposure to weight stigma and its perceived harms. The results from the stratified regression analysis (see Table 2) revealed a small effect of UWCBs during adolescence on SU at 10-year follow-up among girls who experienced weight stigma with perceived harms. Yet, UWCBs during adolescence did not predict SU at 10-year follow-up among girls who did not experience weight stigma and girls who experienced weight stigma but not its associated harms. Depressive symptoms and weight concerns at baseline did not predict SU at follow-up across any of the weight stigma groups.

The significant effect of UWCBs at baseline on substance use at follow-up among girls who experience weight stigma and its associated harms, but not among girls who do not experience weight stigma or experience weight stigma only suggests that the associated harms of weight stigma may be more important in predicting subsequent substance use than the experience of stigma itself. This finding is consistent with the weight-based social identity threat (Hunger et al., 2015; Major et al., 2012) and functional contextual (Hayes et al., 2013) models, wherein there is heightened risk of substance use among individuals who experience the personal harms of weight stigma, as compared to those who do not experience weight stigma and those who experience weight stigma but do not receive its associated harms. The study findings are also consistent with a commonly accepted theory (Stasiewicz & Maisto, 1993), which suggests that experiences resulting in negative emotional responses (e.g., weight stigma with perceived harms) are likely to increase the risk of substance use in an attempt to avoid the negative internal response (Measelle, Stice, & Hogansen, 2006). While the results from the stratified regression offer important insights into the role of weight stigma with perceived harms on the relationship between UWCBs

among adolescent girls and SU at 10-year follow-up, the marginal effect of the moderated regression analysis suggest that the results should be interpreted with caution.

Limitations

The current study includes a large and diverse population of adolescent and young adult girls and tests a theoretically-driven research question with rich longitudinal data. However, some limitations should be noted. Specifically, the current study did not measure the severity of weight stigma experienced by adolescent girls. Thus, it is possible that the severity of weight stigma ultimately determines whether adolescent girls experience the perceived harms of stigma. Further, the current study operationalized gender identity as a binary construct and thus does not adequately categorize or capture individuals who prefer different gender identifiers (e.g., transgender, agender, or genderqueer). Recent research has highlighted important health disparities related to eating pathology and substance use in gender diverse populations (Diemer et al., 2015). Thus, future studies with a more complete account of gender identity should examine the relationship between UWCBs and substance use, as moderated by weight stigma and its perceived harms. The current study also does not include a measure of extreme fasting or other health jeopardizing weight control behaviors, or the frequency with which UWCBs were used; the role of these factors in subsequent substance use could therefore not be accounted for and should be addressed in future research. Due to the limited amount of data collected on substance use behaviors in Project EAT, the current study operationalized substance use as cigarettes, alcohol, and marijuana. Future studies should examine the role of weight stigma and its perceived harms on the relationship between UWCBs and illicit substances (e.g., cocaine or opioids).

Conclusions

Taken together, the results of the current study have implications regarding factors (e.g., weight concerns, depressive symptoms, BMI) associated with weight-based social identity threat. Moreover, the results of the current study suggest that weight stigma with perceived harms may magnify the association between extreme UWCB in adolescence and substance use in emerging adulthood, whereas weight stigma alone does not. This study provides additional data regarding the potential harms of weight stigma exposure and presents a need for a reduction in weight stigma and its associated harms at the societal level. Public health initiatives should seek to reduce the rates of weight stigma experienced by adolescent girls from both their peers and family members. Adolescent healthcare providers and program administrators can work to identify and eliminate clinic policies and structural elements that intentionally or unintentionally stigmatize individuals based on weight status. Reducing the weight stigma in the clinic setting and teaching adolescents healthy alternative coping strategies to deal with weight stigma may contribute to preventing future substance use in vulnerable girls and women. Finally, clinicians working with adolescent girls who endorse UWCB should inquire about patients' experiences of weight stigma and whether they experienced its associated harms. Helping adolescents develop healthy alternative coping strategies to the weight stigma they experience may be an aspect of treatment for adolescent girls engaged in mental health counseling.

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Abbreviations used:

UWCB	Unhealthy weight control behavior
EAT	(Eating and Activity in Teens and Young Adults)
SES	socioeconomic status
BMI	body mass index

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Table 1.

Descriptive statistics and ANOVA results among study predictors and covariates at baseline and substance use at 10-year follow-up across the full sample and three weight stigma groups

Characteristic	Full Sample N = 1,147			Group 1: No Stigma N = 623 54.3%		Group 2: Stigma Only N = 107 9.3%		Group 3: Stigma with Perceived Harms N = 418 36.4%		F, p
	Range	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
<i>Study Variables^a</i>										
UWCB	0–4	0.2	0.5	0.1	0.4	0.1	0.3	0.3	0.6	12.3, < .001
Substance Use ^b	3–15	6.1	2.7	6.1	2.1	6.1	2.6	6.4	2.9	1.6, .213
Weight Concern	3–12	7.7	2.6	7.1	3.5	7.0	2.7	8.7	6.1	51.4, < .001
Depression	7–21	12.8	3.1	11.9	3.0	12.9	3.0	14.0	3.0	57.3, < .001
Baseline BMI	13–51	22.4	4.7	22.1	3.5	22.6	4.6	25.3	6.1	60.0, < .001
Follow-up BMI	16–57	26.0	6.3	24.6	5.0	25.0	6.3	28.4	7.4	53.9, < .001
<i>Covariates</i>										
Age (years)	11–18	14.9	1.7	14.9	1.7	14.9	1.8	15.0	1.6	1.5, .227
Non-White ^c		52.7		47.3		62.2		52.8		
SES	1–5	2.9	1.3	3.0	1.3	2.8	1.4	2.9	1.9	3.5, .029
Baseline Substance Use	3–15	4.7	2.7	4.5	2.5	5.1	2.9	5.0	2.9	5.4, .004

Note. N = number of participants, SD = standard deviation, UWCB = unhealthy weight control behaviors, BMI = Body Mass Index (kg/m²)

^a = all reported values are from baseline reports unless otherwise noted

^b = reported at 10-year follow-up

^c = reported in percentages

Table 2.

The standardized effects of UWCB, weight concerns, and depression among adolescent girls at baseline on substance use at 10-year follow-up across weight stigma groups, after adjusting for covariates

Predictors	No Weight Stigma			Weight Stigma Only			Weight Stigma with Perceived Harms		
	β	<i>SE</i>	<i>p</i>	β	<i>SE</i>	<i>p</i>	β	<i>SE</i>	<i>p</i>
UWCB	.04	.04	.35	-.12	.10	.23	.14	.05	.004
Weight Concern	.01	.02	.73	.07	.11	.54	-.04	.06	.50
Depression	.01	.04	.78	-.01	.09	.96	.04	.05	.42
Covariates									
Age (years)	-.25	.04	<.001	-.03	.09	.75	-.23	.05	<.001
Non-White	-.14	.04	<.001	.01	.20	.97	-.17	.05	.001
SES	.11	.04	.005	.22	.12	.05	.01	.05	.86
Follow-up BMI	-.01	.03	.86	.01	.05	.72	-.07	.05	.26
Baseline BMI	-.01	.04	.91	-.05	.15	.78	-.01	.04	.86
Baseline Substance Use	.37	.04	<.001	.42	.15	<.001	.45	.05	<.001

Notes. UWCB = unhealthy weight control behaviors; β = standardized regression coefficient, *SE* = standard error, BMI = Body Mass Index (kg/m²)