

Weight Stigma as a Predictor of Distress and Maladaptive Eating Behaviors During COVID-19: Longitudinal Findings From the EAT Study

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Abstract

Background Weight stigma is common for people with obesity and harmful to health. Links between obesity and complications from COVID-19 have been identified, but it is unknown whether weight stigma poses adverse health implications during this pandemic.

Purpose We examined longitudinal associations between pre-pandemic experiences of weight stigma and eating behaviors, psychological distress, and physical activity during the COVID-19 pandemic in a diverse sample of emerging adults.

Methods Participants ($N = 584$, 64% female, mean age = 24.6 ± 2.0 years, mean body mass index [BMI] = 28.2) in the COVID-19 Eating and Activity over Time (C-EAT) study were cohort members of the population-based longitudinal study EAT 2010–2018. Weight stigma reported by participants in 2018 was examined as a predictor of binge eating, eating to cope, physical activity, depressive symptoms, and stress during COVID-19. Data were collected via online surveys during the U.S. outbreak of COVID-19 in 2020.

Results Pre-pandemic experiences of weight stigma predicted higher levels of depressive symptoms ($\beta = 0.15$, $p < .001$), stress ($\beta = 0.15$, $p = .001$), eating as a coping strategy ($\beta = 0.16$, $p < .001$), and an increased likelihood of binge eating (odds ratio = 2.88, $p < .001$) among young adults during the COVID-19 pandemic but were unrelated to physical activity. Although associations remained after accounting for demographic characteristics and BMI, the magnitude of longitudinal associations was attenuated after adjusting for prior levels of the outcome variables.

Conclusions Young adults who have experienced weight stigma may have increased vulnerability to distress and maladaptive eating during this pandemic. Public health messaging could be improved to support people of diverse body sizes and reduce the harmful consequences of weight stigma.

Keywords: Weight · Stigma · Eating · Stress · COVID-19

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The COVID-19 pandemic has created significant and immediate changes to people's communities, living situations, daily routines, lifestyles, and access to resources, collectively creating considerable stress and upheaval for many individuals. People's behaviors and psychological responses to this public health emergency are important in maintaining their emotional and physical health during this unprecedented time period. This may be particularly true for people with high body weight as obesity has been identified as a risk factor for complications of COVID-19 [1–3].

While links with obesity and COVID-19 have received attention both in research and national news headlines [4], it is important to acknowledge the social stigma that people face because of their high body weight and how

this may be relevant during the pandemic [5–7]. Weight stigma is a common and prevalent experience for people with high body weight [8] and has damaging consequences for their health. In addition to contributing to psychological distress [9], considerable evidence shows that weight stigma has both short- and long-term consequences for weight-related health [10, 11], including lower physical activity [12, 13] and unhealthy eating behaviors and weight gain [14–16]. Furthermore, there is emerging evidence suggesting that weight stigma predicts negative health consequences more strongly than weight status itself independent of body mass index (BMI) [14, 17, 18]. It is possible that people who have experienced weight stigma may have increased vulnerability to adverse health behaviors during the COVID-19 pandemic. On top of heightened societal anxiety and stress in the USA during the COVID-19 outbreak, individuals who have experienced weight stigma tend to have more anxiety [9] and depression [19], engage in less physical activity [13], more often use food to cope with stress [14], and engage in more binge eating [14]. Psychological distress and unhealthy eating and activity behaviors may be exacerbated because of the pandemic due to constrained access to the resources and coping strategies (e.g., social support) that individuals often use to help maintain emotional and physical well-being [20, 21].

Understanding whether weight stigma elevates risk for health challenges during the pandemic represents a critical first step for the development of health messaging, responses, and support during outbreaks of COVID-19 and similar public health emergencies. Furthermore, previous evidence demonstrating that news messaging about obesity and its health risks can reinforce weight stigma, dieting intentions, and negative weight-related attitudes [22, 23] underscores the importance of examining weight stigma during this time period of heightened media attention to obesity as a risk factor for COVID-19 complications. However, almost nothing is known about weight stigma in the context of COVID-19. A recent prospective study found that experiences of weight discrimination reported by U.S. adults ($N = 2,094$) in February 2020 (just prior to the virus outbreak in the USA) were associated with greater concerns about becoming ill from COVID-19, increased engagement in precautionary behaviors, such as frequent hand washing, and perceived declines in emotional closeness to their community during the pandemic—none of which were associated with higher BMI [24]. While these findings provide novel insights suggesting that weight discrimination may lead to increased sensitivity, concern, and vigilance in response to COVID-19, it is not yet known whether adults who have experienced weight stigma may be at heightened risk for maladaptive eating behaviors or psychological distress during the pandemic that may worsen their health.

To investigate this timely and unanswered question, we examined longitudinal associations between emerging adults' prepandemic experiences of weight stigma (assessed in 2018), eating behaviors, physical activity, and psychological well-being during the initial months of the U.S. outbreak of COVID-19. Specifically, we assessed whether prepandemic experiences of weight stigma predicted maladaptive eating behaviors (e.g., binge eating and eating to cope with negative feelings), physical activity, stress, and depressive symptoms during the spring and early summer months of the COVID-19 outbreak in the USA and whether such associations remained after accounting for participants' BMI.

Methods

Study Design and Sample

Participants in the COVID-19 Eating and Activity over Time (C-EAT) study were members of the EAT 2010–2018 longitudinal study cohort who were invited to complete a follow-up, online survey in 2020 during the initial months of the U.S. outbreak of COVID-19. The EAT 2010–2018 study is a population-based investigation of weight-related health behaviors and associated factors among young people who were attending secondary school in Minneapolis-St. Paul, MN, in 2009–2010 [25, 26]. The C-EAT survey was designed to capture how weight-related health behaviors may change as a result of events related to COVID-19 and to identify areas in need of immediate attention to avoid adverse health consequences. Email and text message invitations to participate in the online C-EAT survey were sent to the 1,568 cohort members who had completed the most recent follow-up survey in 2017–2018. Invitations were sent in April 2020 and responses had been received from 37% of the sample ($n = 584$) after approximately 3 months. All participants were mailed a financial incentive following survey completion. The University of Minnesota Institutional Review Board Human Subjects Committee approved all protocols.

Table 1 presents participant characteristics for the analytic sample. The C-EAT survey sample included 375 females, 201 males, and 8 participants identifying with another gender identity. The sample had a mean age of 21.9 ± 2.0 years in 2018 and 24.6 ± 2.0 years at the follow-up in 2020. Although C-EAT survey participants were less likely than 2018 survey participants to identify as male, identify their race as African American or Black, and have a parent of lower socioeconomic status (SES), the respondents in 2020 were of diverse backgrounds. Ethnic/racial backgrounds as reported by participants were 30.2% White, 24.3% Asian American, 17.1% Hispanic, 16.8%

Table 1. Participant characteristics

Variable	% (n)
Gender ^a	
Female	64.2 (375)
Male	34.4 (201)
Another gender identity	1.4 (8)
Race/ethnicity ^b	
White	30.2 (176)
African American/Black	16.8 (98)
Hispanic	17.1 (100)
Asian American	24.3 (142)
Other ^c	11.6 (68)
Socioeconomic status ^b	
Low	31.5 (181)
Lower middle	20.0 (115)
Middle	17.4 (100)
Upper middle	19.4 (111)
High	11.7 (67)
Weight teasing ^d	43.0 (249)

^aEAT-2020.

^bEAT-2010.

^cOther refers to individuals who self-reported an ethnic group other than the four pan-ethnic groups (e.g., Native American).

^dEAT-2018.

African American or Black, and 11.6% other (e.g., Hawaiian, Pacific Islander, Native American, and Mixed). The distribution across categories of parental SES based primarily on baseline educational attainment was: 31.5% low, 20.0% lower middle, 17.4% middle, 19.4% upper middle, and 11.7% high. Most survey respondents (90%) were living in Minnesota at the time they completed the C-EAT survey.

Survey Measures

The C-EAT survey was based on measures used in prior EAT surveys [27]. The measures were largely identical at baseline (i.e., 2018) and outcome (i.e., 2020), with the main difference being the time frame provided as reference (i.e., “past year” at baseline and “past month” at outcome). Text was included to inform participants that the goal of this follow-up survey was to learn how their experiences with the COVID-19 outbreak may be influencing their eating behaviors and well-being.

Psychological distress, eating behaviors, and physical activity during COVID-19

We examine five outcome variables assessed during the COVID-19 pandemic: depressive symptoms, stress, binge eating, eating as a coping strategy, and physical

activity. To assess depressive symptoms, participants were asked to respond to a six-item scale that was originally developed by Kandell and Davies [28] but modified to focus on the past month. The scale assesses how often one has been bothered or troubled by six depressive symptoms, including feeling unhappy, sad, or depressed; feeling hopeless about the future; feeling nervous or tense; worrying too much about things; having sleep difficulties; and feeling too tired to do things [28]. Item responses on a scale of 1 (*not at all*) to 3 (*very much*) were summed such that higher scores indicate greater depressive symptoms ($\alpha = 0.88$). Participants’ perceived stress was measured using an established tool that asked for them to indicate their average level of stress in the past 30 days, with response options ranging from 1 (*Not at all stressed*) to 10 (*Very stressed*) [29, 30].

Binge eating was assessed with two questions adapted from the adult version of the Questionnaire on Eating and Weight Patterns-Revised: “In the past month, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge-eating)?” and “During the times when you ate this way, did you feel you couldn’t stop eating or control what or how much you were eating?” (Yes/No responses) [31]. This measure has good psychometric properties in adults and allowed for confidently categorizing those who indicated binge eating with loss of control as engaging in binge eating [32]. Finally, to assess eating as a coping strategy, participants completed the five-item coping subscale of the Motivations to Eat Scale, in which participants indicated the frequency that they engaged in eating as a coping mechanism [33]. The tool was modified to focus on eating in the past month (e.g., eating “as a way to help you cope” and “as a way to comfort yourself”) [33]. Prior research has reported strong psychometric properties and found the subscale scores to be positively correlated with binge eating [33]. Response options on a scale of 1 (*Almost never* or *Never*) to 5 (*Almost always* or *Always*) were averaged to create a composite variable ($\alpha = 0.93$).

To assess physical activity, participants completed a modified version [34] of the Godin Leisure Time Exercise Questionnaire [35], in which they reported how many hours they spent engaged in strenuous, moderate, and mild exercise during the past week. Participant responses to the three types of physical activity (*none*, *less than 0.5 hr*, *0.5 to 2 hr*, *2.5 to 4 hr*, *4.5 to 6 hr*, and *6+ hr* per week) were recoded using the midpoints of each response choice (i.e., 0, 0.3, 1.3, 3.3, 5.3, and 8 hr per week) and summed to indicate the total weekly hours of physical activity ($M = 6.16$, standard deviation = 5.71).

In addition to the above dependent variable measures, for descriptive purposes, we also assessed participants’ perceived influence of COVID-19 on their

eating behaviors, stress or mood, and physical activity. Specifically, participants were asked whether recent events related to COVID-19 influenced their (a) eating behaviors, (b) stress or mood, and/or (c) physical activity (response options: 1 = *No*, 2 = *Yes, somewhat*, and 3 = *Yes, very much*).

Prepandemic weight stigma

The EAT 2018 survey assessed participants' experiences of general weight teasing. Specifically, a tool developed for the EAT surveys was used to ask participants how often they are teased about their weight (1 = *Never*, 2 = *Less than once a year*, 3 = *A few times a year*, 4 = *A few times a month*, and 5 = *At least once a week*) [36]. Presuming that the prevalence rather than the frequency of weight teasing would impact outcomes [36, 37] during COVID-19, this variable was operationalized dichotomously in a manner consistent with prior research; the experience of weight teasing was defined by any response other than *Never* [36, 38].

Covariates

Given sociodemographic (e.g., gender and race/ethnicity) and anthropometric (i.e., BMI) differences in weight teasing [39, 40], the analyses also included several covariates that could function as possible confounders. The original school-based survey asked participants to report their race/ethnicity and several indicators of SES. SES was primarily determined by the highest education level of either parent. Additional variables were used to reduce the impact of missing data and to prevent SES misclassification: family eligibility for public assistance, adolescent eligibility for free or reduced-price school lunch, and maternal and paternal employment status. The validity of this adolescent-reported SES measure was examined by making comparisons with parental report of educational attainment and annual household income as reported on the parent survey conducted in 2009–2010 [41]. Gender was based on participant-reported gender identity in 2020. BMI was computed based on participants' report of height and weight at the time of EAT 2018 survey completion; emerging adults' self-reports of height and weight were previously found to be adequately valid for the assessment of BMI [42].

Analytic Plan

Analyses were conducted in Statistical Package for the Social Sciences. First, descriptive information regarding the influence of COVID-19 on stress/mood, eating behaviors, and physical activity was considered. Second, unadjusted and adjusted associations between prepandemic

weight stigma and health measures during the COVID-19 pandemic were examined. After unadjusted chi-square and independent samples *t*-tests were conducted, a series of adjusted regression models were built. Given 579 cases with complete data on weight stigma, using two-sided tests with $\alpha = 0.05$, we had >80% power to detect effect size differences between weight stigma groups (i.e., those who did vs. did not experience weight stigma) of Cohen's $d = 0.24$ (for continuous outcomes depressive symptoms, stress, eating to cope, and physical activity) and odds ratio (OR) = 2.0–2.4 (for the dichotomous binge-eating outcome with prevalence 5%–10%). We examined how depressive symptoms, stress, eating behaviors, and physical activity during COVID-19 vary between individuals who did versus did not experience weight stigma (0 = no weight teasing and 1 = at least one experience of weight teasing) prior to the COVID-19 pandemic (i.e., assessed in 2018). Whereas linear regression was used to predict continuous outcomes (i.e., depressive symptoms, stress, eating to cope, and physical activity), logit models were constructed to predict binge eating (0 = no binge eating and 1 = binge eating). These models accounted for gender (male and another gender identity, with female coded as the reference group), race/ethnicity (four dummy-coded variables, with White coded as the reference group), and SES (four dummy-coded variables, with middle SES coded as the reference group). Then, to examine whether the associations between pre-COVID-19 weight stigma and during-COVID-19 health persist after accounting for participants' body weight, each model was rerun controlling for pre-COVID-19 BMI (grand mean centered to facilitate interpretation). Finally, the regression models were examined adjusting for baseline levels (i.e., at 2018) of the outcome variables, with the exception of eating to cope, which was not assessed at baseline.

Moderation analyses tested whether the effect of weight stigma on the outcome variables differed as a function of survey completion during state-mandated stay-at-home orders (March 26 to May 17, 2020) versus after these orders were lifted during gradual phases of state reopening (May 18 through summer 2020). Nonsignificant interactions indicated similar effects of weight stigma on health and eating behaviors regardless of when the survey was completed during the COVID-19 pandemic. In addition, exploratory analyses examining whether the associations between weight stigma and health varied between males and females were tested with two-way interactions (differential effects among individuals identifying with another gender identity were not tested due to low sample size). Although tests of interaction have lower power, the interaction terms were not significant across each of the outcomes, suggesting that the associations function similarly across males and females.

Results

Descriptive Information

Previous experiences of weight teasing were reported by 43% of participants. No gender differences in weight teasing were documented, $\chi^2(2) = 0.24, p = .885$. Most participants indicated that the recent events related to COVID-19 influenced their stress or mood, eating behaviors, and physical activity “somewhat” (stress or mood: 37%; eating behaviors: 47%; physical activity: 40%) or “very much” (stress or mood: 47%; eating behaviors: 28%; physical activity: 46%).

Longitudinal Associations Between Weight Stigma and Health During COVID-19

To examine whether stress, depressive symptoms, eating behaviors, and physical activity during the COVID-19 pandemic varied between individuals who experienced pre-pandemic weight stigma versus those who did not, a series of unadjusted chi-square and independent samples *t*-tests were conducted. Individuals who reported experiencing weight teasing 2 years prior to the COVID-19 outbreak experienced higher levels of depressive symptoms ($t(565) = -3.31, p = .001$), stress ($t(574) = -2.93, p = .004$), eating to cope ($t(497.19) = -3.99, p < .001$), and were more likely to binge eat during the pandemic ($\chi^2(1) = 21.17, p < .001$). In contrast, the association between pre-pandemic weight teasing and physical activity was nonsignificant ($t(577) = 1.37, p = .171$).

Table 2 displays a summary of the regression models predicting health during COVID-19. We interpret, first, the effects of weight stigma over and above sociodemographic covariates (i.e., gender, race/ethnicity, and SES; Model 1) and, thereafter, we describe weight stigma effects above and beyond the aforementioned sociodemographic covariates, as well as participants' BMI (Model 2).

After adjusting for sociodemographic characteristics, those who experienced weight stigma prior to the COVID-19 pandemic reported higher levels of depressive symptoms ($\beta = 0.15, p < .001$), stress ($\beta = 0.15, p = .001$), and eating to cope ($\beta = 0.16, p < .001$) during the pandemic compared to those who had never been teased about their weight. Although the standardized β estimates represent effects small in magnitude [43], even small effects at the population-based level can have important implications. Pre-pandemic weight stigma increased the likelihood of binge eating during the COVID-19 pandemic (OR = 2.88, $p < .001$) such that the odds of binge eating were nearly three times greater for those teased about their weight prior to COVID-19 compared to those who were never teased about their weight.

Finally, pre-pandemic weight stigma was not significantly associated with physical activity during the COVID-19 pandemic ($\beta = -0.02, p = .688$).

As shown in Model 2 of Table 3, the effects of weight stigma on depressive symptoms ($\beta = 0.15, p = .001$), stress ($\beta = 0.14, p = .001$), eating to cope ($\beta = 0.15, p = .001$), and binge eating (OR = 2.79, $p < .001$) persisted even after accounting for participants' BMI. Therefore, above and beyond BMI, prior experiences of weight teasing predicted elevated depressive symptoms, stress, eating as a coping strategy, and likelihood of binge eating during the COVID-19 pandemic. Moreover, weight stigma effects were retained for binge eating, even after adjusting for pre-pandemic binge eating (OR = 2.41, $p = .002$). In contrast, nonsignificant associations emerged for depressive symptoms, stress, and physical activity, indicating that the effects of weight stigma were attenuated when controlling for the outcome variables at baseline.

Discussion

Findings of our study indicate that pre-pandemic experiences of weight stigma predicted higher levels of stress, depressive symptoms, eating to cope with stress, and an increased likelihood of binge eating among young adults during the COVID-19 pandemic. These longitudinal associations remained even after accounting for participants' demographic characteristics (i.e., gender, race/ethnicity, and SES) and BMI. Furthermore, the lack of significant interactions based on gender indicated that these adverse health outcomes associated with weight stigma are present regardless of gender identity. Collectively, these findings suggest that young adults who have experienced weight stigma have increased vulnerability for binge eating and psychological distress during the pandemic.

Notably, the odds of engaging in binge eating during COVID-19 were nearly three times higher for individuals in our sample who were teased about their weight prior to the pandemic compared to those who were never teased about their weight. These findings align with many previous studies demonstrating a clear relationship between weight stigma and binge eating across community and treatment-seeking samples [44–46], including evidence that weight stigma uniquely contributes to binge eating independent of BMI [46]. This relationship may be amplified during times of pandemic, possibly due to heightened negative affect, stress, and/or rumination, which prior work has identified as potential mechanisms underlying links between weight stigma and binge eating [47, 48]. Moreover, given previous evidence that binge eating and depression contribute to excess weight gain [49, 50] and recent

Table 2. Summary of regression models predicting psychological stress, eating behaviors, and physical activity during COVID-19

Predictors	Health outcomes during COVID-19									
	Depressive symptoms		Stress		Binge eating		Eating to cope		Physical activity	
	Model 1 β	Model 2 β	Model 1 β	Model 2 β	Model 1 OR	Model 2 OR	Model 1 β	Model 2 β	Model 1 β	Model 2 β
Main predictor										
Weight stigma	0.15***	0.15**	0.15**	0.14**	2.88***	2.79***	0.16***	0.15**	-0.02	-0.02
Covariates										
Gender (female)										
Male	-0.18***	-0.18***	-0.24***	-0.24***	0.50*	0.51*	-0.16***	-0.16***	0.08	0.08*
Another gender identity	-0.03	-0.02	-0.04	-0.04	0.71	0.79	0.00	0.01	0.04	0.03
Race/ethnicity (White)										
African American/Black	-0.09	-0.09	-0.05	-0.05	0.71	0.69	-0.01	-0.01	-0.12*	-0.12*
Hispanic	-0.04	-0.04	-0.08	-0.08	0.91	0.84	-0.09	-0.09	-0.06	-0.06
Asian American	-0.12*	-0.12*	-0.16**	-0.16**	0.78	0.81	-0.07	-0.07	-0.13*	-0.14**
Other ^a	-0.03	-0.02	-0.03	-0.03	1.38	1.25	0.05	0.05	-0.09	-0.09
SES (middle)										
Low	0.01	0.01	-0.01	-0.02	1.84	2.00	0.17**	0.16**	0.00	0.00
Lower middle	-0.06	-0.06	-0.02	-0.02	1.47	1.50	0.09	0.08	0.01	0.01
Upper middle	-0.01	-0.02	-0.06	-0.07	1.26	1.36	0.09	0.09	0.06	0.06
High	0.03	0.03	0.01	0.01	0.25	0.28	0.00	0.00	0.18**	0.18**
Body mass index	-	-0.03	-	0.02	-	1.01	-	0.05	-	0.02

Betas represent standardized estimates in the regression models predicting depressive symptoms, stress, eating to cope, and physical activity. Odds ratios (ORs) represent coefficients in the regression models predicting binge eating (no = 0, yes = 1).

SES socioeconomic status.

^aOther refers to individuals who self-reported an ethnic group other than the four pan-ethnic groups (e.g., Native American).

****p* < .001, ***p* < .01, **p* < .05.

evidence that people with obesity are at heightened risk for poor COVID-19-related outcomes [1–3], our study findings emphasize the relevance of weight stigma to the COVID-19 pandemic.

With additional outbreaks and more cases of COVID-19 expected in the coming months [51], it is important to identify and support individuals who may be prone to worse health during these times of pandemic. Recent cross-sectional evidence suggests that regardless of infection status, the COVID-19 pandemic is negatively impacting the psychological well-being and weight-related health behaviors of individuals with obesity [52]. This evidence, in conjunction with studies linking obesity with risk for complications of COVID-19, suggests that individuals with obesity may be particularly vulnerable to adverse health outcomes during this pandemic. Because of their high body weight,

these individuals are also at increased risk of experiencing weight stigma [8]. Our findings further suggest that weight stigma may place people at risk for psychological distress and maladaptive eating behaviors during the pandemic regardless of their weight status. Thus, public health messaging during this time period could be improved to better support the well-being of people across diverse body sizes, recognizing that experiences of weight stigma may contribute to worsened health during the pandemic independent of individuals' current BMI. Supportive public health messaging related to eating behaviors and psychological well-being may be particularly important during periods of self-isolation and quarantine when people have fewer social support resources available and may be more susceptible to psychological distress and/or more likely to engage in maladaptive eating behaviors.

Finally, it is interesting to note that prepandemic weight stigma predicted binge eating and eating to cope in our sample but not physical activity during COVID-19. There may be several reasons for this finding. First, while some evidence has demonstrated links between experiences of weight stigma and lower physical activity [12, 13], other studies have reported mixed findings or no relationship between these constructs, particularly for weight-based teasing in which associations appear to be stronger for motivational aspects of physical activity (e.g., self-efficacy) rather than actual engagement in physical activity [53, 54]. Our findings align with this evidence suggesting that weight teasing may have a limited impact on engagement in physical activity. Alternatively, the lack of relationship observed between weight stigma and physical activity may reflect the limited opportunities for physical activity during the COVID-19 pandemic for participants in our sample. During periods of stay-at-home orders and gradual reopening of businesses and public facilities, typical outlets for physical activity (e.g., gyms, pools, parks, and yoga studios) were limited or completely inaccessible [55]. Thus, challenges related to access and safe opportunities for engaging in physical activity, rather than stigma, may be more salient for physical activity during the pandemic. This may be one reason for the significant association observed between SES and physical activity in our sample, showing that individuals with the highest SES engaged in more physical activity compared to those of lower SES during this time period. This finding suggests that access to resources for physical activity (e.g., a home gym, treadmill, and personal trainer) predicts engagement in activity during COVID-19, regardless of one's history of weight stigma. It is also noteworthy that eating to cope emerged as a significant difference between SES groups in our sample (as shown in Table 2). Specifically, participants from low SES backgrounds reported engaging in eating as a coping strategy during COVID-19 more frequently than those from middle SES backgrounds. It may be that the exacerbation of financial stressors for people in low SES groups during this pandemic (particularly during stay-at-home orders when many people were prevented from working or obtaining their regular income) increased their likelihood of eating in response to stress. Additional research examining these associations is warranted.

Certain limitations in our study should be taken into account when interpreting findings. Our sample was comprised of emerging adults, most of whom were residing in one state during the study period. Thus, our findings may not extend to people of other ages or those living in other areas across the USA. It will also be important for future research to study a broader range of health behaviors that may be affected by weight stigma during times

of pandemic. Furthermore, although beyond the scope of the current study, there could be additive effects of experiencing weight stigma coupled with stigma based on other social identities, such as race/ethnicity and/or sexual orientation. For example, just as adolescents who are bullied for multiple social identities (as opposed to one) have more negative outcomes [56], it is possible that young adults who have experienced multiple types of stigma (e.g., mistreatment based on weight *and* race *and* sexual orientation) may be particularly vulnerable to distress amid public health emergencies.

Finally, although our study findings are, to the best of our knowledge, the first to demonstrate longitudinal associations between prepandemic experiences of weight stigma and adverse health during COVID-19, it will be important for future research to examine how weight stigma is manifested during this pandemic and its implications for people's health and health behaviors. For example, researchers have noted an influx of weight-themed posts on social media platforms during COVID-19, including many memes featuring weight-stigmatizing content and exaggerated depictions of people overeating and gaining weight during the pandemic [5]. Studying the effects of stigmatizing social media on health behaviors during the pandemic is warranted, particularly in light of our study findings suggesting that weight stigma predicts maladaptive eating and distress during this time period.

Our study offers several important strengths and novel insights to the emerging literature of COVID-19 research. First, our timely focus on emerging adults aligns with the Centers for Disease Control and Prevention's recent report that individuals of all ages (not just older adults) are at risk of severe illness from COVID-19 [57]. Research on younger populations is, therefore, critical to understanding the range of health risks related to COVID-19. In addition, the longitudinal design of our study and the ethnically and economically diverse sample indicate the temporal nature of weight stigma as a unique contributor to maladaptive eating and distress for people across diverse backgrounds during the COVID-19 outbreak. Our findings importantly identify weight stigma, independent of BMI, as a factor that may worsen eating behaviors and psychological distress for male and female young adults during this pandemic. These increased health risks, particularly for binge eating, indicate a need for supportive and educational resources to help lessen the negative impact of stigma on eating behaviors throughout the pandemic for individuals who have been mistreated because of their weight. Furthermore, our findings suggest that weight stigma—not just obesity—warrants attention in research and discourse related to COVID-19 and should be considered in public health messaging during times of pandemic. While high BMI may be a risk factor for complications of COVID-19, it

is important to consider how to effectively communicate about links between body weight and COVID-19 since messages that induce shame or stigma about weight may contribute to and reinforce adverse health consequences. As the COVID-19 pandemic continues, careful consideration is warranted in public health messaging to better support the health and well-being of people of diverse body sizes.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards The authors declare that they have no conflicts of interest.

Authors' Contributions D.N.-S. conceptualized the larger project EAT study design which provided the source of data. N.L. managed the collection of data. R.M.P. formulated the research questions and drafted the manuscript. L.M.L. conducted the data analysis with input from M.E.E. and N.L., and contributed to drafting of the manuscript. All authors assisted with interpretation of the results, contributed to and thoroughly reviewed the final manuscript.

Ethical Approval This study was conducted in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards, and all procedures involving research study participants were approved by the University of Minnesota's Institutional Review Board Human Subjects Committee.

Informed Consent Written informed consent was obtained from all individual participants included in the study.

References

- Sattar N, McInnes IB, McMurray JJV. Obesity as a risk factor for severe COVID-19 infection: Multiple potential mechanisms. *Circulation*. 2020;142:4–6.
- Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA*. 2020;323:2052–2059.
- Malavazos AE, Corsi Romanelli MM, Bandera F, Iacobellis G. Targeting the adipose tissue in COVID-19. *Obesity (Silver Spring)*. 2020;28:1178–1179.
- Reinberg S. Obesity ups odds for dangerous lung clots in COVID-19 patients. 2020. Available at <https://www.usnews.com/news/health-news/articles/2020-05-19/obesity-ups-odds-for-dangerous-lung-clots-in-covid-19-patients>. Accessibility verified May 29, 2004.
- Pearl RL. Weight stigma and the “quarantine-15”. *Obesity*. 2020;28:1180–1181.
- Bhasker AG, Greve JW. Are patients suffering from severe obesity getting a raw deal during COVID-19 pandemic? *Obes Surg*. 2020. doi: 10.1007/s11695-020-04677-z.
- Salas XR, Kirk S, Forhan M, et al. Weight bias, obesity stigma, and COVID-19. 2020. Available at <https://obesitycanada.ca/oc-news/weight-bias-obesity-stigma-and-covid-19/>. Accessibility verified June 2, 2004.
- Spahlholz J, Baer N, König HH, Riedel-Heller SG, Luck-Sikorski C. Obesity and discrimination—A systematic review and meta-analysis of observational studies. *Obes Rev*. 2016;17:43–55.
- Alimoradi Z, Golboni F, Griffiths MD, Broström A, Lin CY, Pakpour AH. Weight-related stigma and psychological distress: A systematic review and meta-analysis. *Clin Nutr*. 2019;39:2001–2013.
- Wu YK, Berry DC. Impact of weight stigma on physiological and psychological health outcomes for overweight and obese adults: A systematic review. *J Adv Nurs*. 2018;74:1030–1042.
- Papadopoulos S, Brennan L. Correlates of weight stigma in adults with overweight and obesity: A systematic literature review. *Obesity (Silver Spring)*. 2015;23:1743–1760.
- Vartanian LR, Pinkus RT, Smyth JM. Experiences of weight stigma in everyday life: Implications for health motivation. *Stigma Health*. 2018;3:85–92.
- Jackson SE, Steptoe A. Association between perceived weight discrimination and physical activity: A population-based study among English middle-aged and older adults. *BMJ Open*. 2017;7:e014592.
- Puhl RM, Wall MM, Chen C, Bryn Austin S, Eisenberg ME, Neumark-Sztainer D. Experiences of weight teasing in adolescence and weight-related outcomes in adulthood: A 15-year longitudinal study. *Prev Med*. 2017;100:173–179.
- Sutin AR, Terracciano A. Perceived weight discrimination and obesity. *PLoS One*. 2013;8:e70048.
- Puhl RM, Himmelstein MS, Pearl RL. Weight stigma as a psychosocial contributor to obesity. *Am Psychol*. 2020;75:274–289.
- Sutin AR, Stephan Y, Terracciano A. Weight discrimination and risk of mortality. *Psychol Sci*. 2015;26:1803–1811.
- Tomiya AJ, Carr D, Granberg EM, et al. How and why weight stigma drives the obesity “epidemic” and harms health. *BMC Med*. 2018;16:123.
- Robinson E, Sutin A, Daly M. Perceived weight discrimination mediates the prospective relation between obesity and depressive symptoms in U.S. and U.K. adults. *Health Psychol*. 2017;36:112–121.
- Grav S, Hellzèn O, Romild U, Stordal E. Association between social support and depression in the general population: The HUNT study, a cross-sectional survey. *J Clin Nurs*. 2012;21:111–120.
- Munt AE, Partridge SR, Allman-Farinelli M. The barriers and enablers of healthy eating among young adults: A missing piece of the obesity puzzle: A scoping review. *Obes Rev*. 2017;18:1–17.
- Frederick DA, Tomiyama AJ, Bold JG, Saguy AC. Can she be healthy at her weight? Effects of news media frames on antifat attitudes, dieting intentions, and perceived health risks of obesity. *Stigma Health*. 2019;5:247–257.
- Frederick DA, Saguy AC, Sandhu G, Mann T. Effects of competing news media frames of weight on antifat stigma, beliefs about weight and support for obesity-related public policies. *Int J Obes (Lond)*. 2016;40:543–549.
- Sutin AR, Robinson E, Daly M, et al. Body mass index, weight discrimination, and psychological, behavioral, and interpersonal responses to the Coronavirus pandemic. *Obesity*. 2020;28:1590–1594.
- Arcan C, Larson N, Bauer K, Berge J, Story M, Neumark-Sztainer D. Dietary and weight-related behaviors and body

- mass index among Hispanic, Hmong, Somali, and white adolescents. *J Acad Nutr Diet.* 2014;114:375–383.
26. Larson N, Laska M, Neumark-Sztainer D. Food insecurity, diet quality, home food availability, and health risk behaviors among emerging adults: Findings from the EAT 2010–2018 study. *Am J Public Health.* 2020;110:1422–1428. doi:10.2105/AJPH.2020.305783.
 27. Larson NI, Wall MM, Story MT, Neumark-Sztainer DR. Home/family, peer, school, and neighborhood correlates of obesity in adolescents. *Obesity (Silver Spring).* 2013;21:1858–1869.
 28. Kandel DB, Davies M. Epidemiology of depressive mood in adolescents: An empirical study. *Arch Gen Psychiatry.* 1982;39:1205–1212.
 29. Nelson MC, Lust K, Story M, Ehlinger E. Credit card debt, stress and key health risk behaviors among college students. *Am J Health Promot.* 2008;22:400–407.
 30. Errisuriz VL, Pasch KE, Perry CL. Perceived stress and dietary choices: The moderating role of stress management. *Eat Behav.* 2016;22:211–216.
 31. Yanovski SZ. Questionnaire on eating and weight patterns—revised (QEWPR). *Obes Res.* 1993;1:319–324.
 32. Nangle DW, Johnson WG, Carr-Nangle RE, Engler LB. Binge eating disorder and the proposed DSM-IV criteria: Psychometric analysis of the Questionnaire of Eating and Weight Patterns. *Int J Eat Disord.* 1994;16:147–157.
 33. Jackson B, Cooper L, Mintz L, Albino A. Motivations to eat: Scale development and validation. *J Res Pers.* 2003;37:297–318.
 34. Graham DJ, Wall MM, Larson N, Neumark-Sztainer D. Multicontextual correlates of adolescent leisure-time physical activity. *Am J Prev Med.* 2014;46:605–616.
 35. Godin G, Shephard RJ. Godin leisure-time exercise questionnaire. *Med Sci Sports Exer.* 1997;26(Suppl. 6):S36–S38.
 36. Bucchianeri MM, Eisenberg ME, Wall MM, Piran N, Neumark-Sztainer D. Multiple types of harassment: Associations with emotional well-being and unhealthy behaviors in adolescents. *J Adolesc Health.* 2014;54:724–729.
 37. Gower AL, Borowsky IW. Associations between frequency of bullying involvement and adjustment in adolescence. *Acad Pediatr.* 2013;13:214–221.
 38. Puhl RM, Telke S, Larson N, Eisenberg ME, Neumark-Sztainer D. Experiences of weight stigma and links with self-compassion among a population-based sample of young adults from diverse ethnic/racial and socio-economic backgrounds. *J Psychosom Res.* 2020;134:110134.
 39. Salmon S, Turner S, Taillieu T, Fortier J, Afifi TO. Bullying victimization experiences among middle and high school adolescents: Traditional bullying, discriminatory harassment, and cybervictimization. *J Adolesc.* 2018;63:29–40.
 40. Lanza HI, Echols L, Graham S. A silver lining: The role of ethnic diversity on co-occurring trajectories of weight status and peer victimization across early adolescence. *J Adolesc Health.* 2018;63:554–560.
 41. Bruening M, MacLehose R, Loth K, Story M, Neumark-Sztainer D. Feeding a family in a recession: Food insecurity among Minnesota parents. *Am J Public Health.* 2012;102:520–526.
 42. Quick V, Wall M, Larson N, Haines J, Neumark-Sztainer D. Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *Int J Behav Nutr Phys Act.* 2013;10:37.
 43. Cohen J. *Statistical Power Analysis for the Behavioral Sciences.* 2nd ed. Hillsdale, NJ: Lawrence Erlbaum; 1988.
 44. Vartanian LR, Porter AM. Weight stigma and eating behavior: A review of the literature. *Appetite.* 2016;102:3–14.
 45. Almeida L, Savoy S, Boxer P. The role of weight stigmatization in cumulative risk for binge eating. *J Clin Psychol.* 2011;67:278–292.
 46. Durso LE, Latner JD, Hayashi K. Perceived discrimination is associated with binge eating in a community sample of non-overweight, overweight, and obese adults. *Obes Facts.* 2012;5:869–880.
 47. Wellman JD, Araiza AM, Solano C, Berru E. Sex differences in the relationships among weight stigma, depression, and binge eating. *Appetite.* 2019;133:166–173.
 48. Wang SB, Lydecker JA, Grilo CM. Rumination in patients with binge-eating disorder and obesity: Associations with eating-disorder psychopathology and weight-bias internalization. *Eur Eat Disord Rev.* 2017;25:98–103.
 49. Sonnevile KR, Horton NJ, Micali N, et al. Longitudinal associations between binge eating and overeating and adverse outcomes among adolescents and young adults: Does loss of control matter? *JAMA Pediatr.* 2013;167:149–155.
 50. Luppino FS, de Wit LM, Bouvy PF, et al. Overweight, obesity, and depression: A systematic review and meta-analysis of longitudinal studies. *Arch Gen Psychiatry.* 2010;67:220–229.
 51. Meyer R, Madrigal AC. A devastating new stage of the pandemic. 2020. Available at <https://www.theatlantic.com/science/archive/2020/06/second-coronavirus-surge-here/613522/>. Accessibility verified July 2, 2004.
 52. Almondoz JP, Xie L, Schellinger JN, et al. COVID-19 stay-at-home orders on weight-related behaviors among patients with obesity. *Clin Obes.* 2020;e12386. doi:10.1111/cob.12386.
 53. Watanabe PI, Fontana FE, Silva MPD, Mazzardo O, Bacil EDA, Campos W. Association between weight-teasing and physical activity in adolescents. *Rev Paul Pediatr.* 2017;35:309–315.
 54. Gayes LA, Steele RG. Comparison of two measures of weight criticism in youth: Associations with physical activity engagement and attitudes, weight status, and health-related quality of life. *J Pediatr Psychol.* 2015;40:228–237.
 55. Safely reopening Minnesota. Available at <https://staysafe.mn.gov>. Accessibility verified July 20, 2020.
 56. Mulvey KL, Hoffman AJ, Gönültaş S, Hope EC, Cooper SM. Understanding experiences with bullying and bias-based bullying: What matters and for whom? *Psychol Violence.* 2018;8:702–711.
 57. Centers for Disease Control and Prevention. CDC updates, expands list of people at risk of severe COVID-19 illness. 2020. Available at <https://www.cdc.gov/media/releases/2020/p0625-update-expands-covid-19.html>. Accessibility verified July 6, 2004.