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Impulsivity as a moderator of the associations between child maltreatment types and body mass index

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Abstract

Child maltreatment has emerged as an important risk factor for adult obesity (Danese & Tan, 2014; Hemmingsson, Johannsson, & Reynisdottir, 2014). However, there is a need for research delineating the factors that play a role in this association. Impulsivity has been shown to be associated with both child maltreatment (Ouyang, Fang, Mercy, Perou, & Grosse, 2008) and body mass index (BMI; Cortese et al., 2008; Thamotharan, Lange, Zale, Huffhines, & Fields, 2013). Further, given previous research showing that adverse events interact with impulsivity to predict hazardous drinking behaviors (Fox, Bergquist, Gu, & Sinha, 2010), there is reason to hypothesize that child maltreatment might interact with impulsivity to predict other adverse health outcomes, such as elevated BMI. Accordingly, the current study examined whether impulsivity moderated the association between child maltreatment types (i.e., physical abuse, physical neglect, sexual abuse, emotional abuse, and emotional neglect) and BMI. The sample was comprised of 500 undergraduate students (49.6% male) between the ages of 18 and 25 years. Regression analyses suggested that maltreatment types and impulsivity were not uniquely associated with BMI. However, impulsivity moderated the association between childhood sexual abuse and adult BMI, such that BMI was highest at high levels of both sexual abuse and impulsivity. Impulsivity did not moderate the associations between the other child maltreatment types and BMI. Limitations, future directions, and clinical implications of this research are discussed.

Keywords

child maltreatment; impulsivity; BMI

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Child maltreatment is a multifaceted and heterogeneous public health problem that has been the focus of considerable research and debate over many decades (e.g., Barnett, Manly, & Cicchetti, 1991; Gilbert et al., 2009; Lewis, McElroy, Harlaar, & Runyan, 2016). Although the knowledge acquired from such efforts is far from complete, the existing evidence has made a substantial contribution to the understanding of child maltreatment by identifying many of its causes and consequences (e.g., Gilbert et al., 2009; Munro, Taylor, & Bradbury-Jones, 2014). For example, researchers have consistently documented that child maltreatment is a risk factor for a host of mental and physical health problems, including substance use and abuse (Dube et al., 2006; Lo & Cheng, 2007), internalizing symptoms (Brown, Fite, Stone, & Bortolato, 2016; Gilbert et al., 2009), externalizing symptoms (Gilbert et al., 2009; Richey, Brown, Fite, & Bortolato, in press), eating disorders (Fosse & Holen, 2006), and obesity (Danese & Tan, 2014).

With regard to obesity, although some research indicates a link between child maltreatment and BMI among youth (e.g., Keeshin et al., 2013), a recent meta-analysis concluded that overall, child maltreatment is not associated with child and adolescent obesity (Danese & Tan, 2014). In contrast, several systematic reviews and meta-analyses found that child maltreatment is associated with elevated risk for obesity in adulthood (Danese & Tan, 2014; Hemmingsson et al., 2014). Although some continuity exists between adolescence and emerging adulthood, there are challenges that are unique to each developmental period (Arnett, 2007). For example, emerging adulthood is characterized by developmental transitions (e.g., college, marriage, and full-time employment), and theorists have suggested that identity development and exploration is most critical during the emerging adult years (Arnett, 2005; Arnett, 2007). Additionally, there seems to be gradual, biological processes that occur in the aftermath of childhood maltreatment that are associated with a progressive increase in BMI over time (Danese & Tan, 2014). These developmental transitions and processes might help explain why researchers have posited that the consequences associated with child maltreatment might become salient during emerging adulthood (Wright, Crawford, & Del Castillo, 2009).

Despite this assertion, there is a lack of research examining how child maltreatment might contribute to obesity during emerging adulthood, although preliminary evidence suggests that emotional abuse, sexual abuse, and physical neglect are associated with BMI and eating or weight problems among emerging adults (Johnson, Cohen, Kasen, & Brook, 2002; Roenholdt, Karsberg, & Elklit, 2012). Existing evidence in this area is further limited by an exclusive focus on one or two maltreatment types (e.g., sexual abuse alone or sexual abuse and physical abuse) or use of a total maltreatment score (Danese & Tan, 2014). Given evidence indicating that maltreatment types are differentially linked to outcomes (Brown et al., 2016; Connor, Steingard, Cunningham, Anderson, & Melloni, 2004; van Veen et al., 2013), more research is needed to elucidate how exposure to different maltreatment types might uniquely impact BMI.

Finally, researchers have called for studies examining factors, including impulsivity, which might mediate or moderate the associations between child maltreatment types and obesity in emerging adulthood (Shin & Miller, 2012). The current study responds to this call and contributes to the existing literature by empirically examining whether impulsivity might

moderate the associations between child maltreatment types and BMI among emerging adults.

Child Maltreatment and BMI

The existing empirical evidence yields strong support for the association between child maltreatment and BMI, with researchers suggesting that this link might be explained by increased inflammation (Danese & Tan, 2014; Hepgul et al., 2012; Rohde et al., 2008). Specifically, psychosocial stressors, such as child maltreatment, have been linked to heightened inflammatory activity (e.g., higher levels of C-reactive protein), an important correlate of obesity (Choi, Joseph, & Pilote, 2012; Hepgul et al., 2012). Thus, it is no surprise that researchers have consistently shown that child maltreatment predicts adult BMI and obesity (Aaron & Hughes, 2007; Boynton-Jarrett, Rosenberg, Palmer, Boggs, & Wise, 2012; Greenfield & Marks, 2009). For example, Rohde et al. (2008) examined associations between child maltreatment, obesity, and depression in a sample of middle-aged women and found that exposure to child maltreatment (i.e., sexual and physical abuse) was associated with a twofold increase in the risk of obesity. These findings have been reinforced by subsequent research demonstrating that individuals with maltreatment histories were more likely to be obese than those who did not report such experiences (Greenfield & Marks, 2009; Helton & Liechty, 2014; Nagl, Steinig, Klinitzke, Stephan, & Kersting, 2016; Williamson, Thompson, Anda, Dietz, & Felitti, 2002).

Despite consensus that child maltreatment is a risk factor for adult obesity (Danese & Tan, 2014; Helton & Liechty, 2014; Shin & Miller, 2012), no studies have examined the differential associations between all five maltreatment types and BMI among emerging adults. Among adult samples, findings are inconsistent with regard to the specificity of maltreatment effects (Midei, Matthews, & Bromberger, 2010; Pederson & Wilson, 2009; Thomas, Hyppönen, & Power, 2008; van Reedt Dortland, Giltay, van Veen, Zitman, & Penninx, 2012). For example, Midei et al. (2010) found that only physical and sexual abuse were associated with BMI among middle-aged women. Pederson and Wilson (2009) found that severity of emotional abuse and emotional neglect, but not severity of physical abuse, physical neglect, and sexual abuse, were associated with adult BMI among women between the ages of 19 and 49 years. However, after controlling for the severity of other maltreatment types, only the severity of emotional neglect was significantly associated with BMI. These mixed results highlight the need for further research examining the specificity of the associations between different maltreatment types and BMI, particularly among emerging adults, as such research might yield important implications for prevention and intervention efforts.

The Moderating Role of Impulsivity

Impulsivity, a personality trait or cognitive style characterized by behavioral disinhibition, includes a tendency to respond quickly without much planning or forethought (Brodsky et al., 2001; Patton, Stanford, & Barratt, 1995). There are several reasons to postulate that impulsivity might moderate the association between child maltreatment and BMI. Guided by the toxic stress framework, child maltreatment might lead to prolonged activation of the

stress response system, which is associated with increased risk of stress-related disorders, including obesity (Shonkoff, 2010; Sinha & Jastreboff, 2013). This process might be moderated by executive functions, such as impulse control.

The empirical literature supports this theory as research indicates that adults with maltreatment histories report higher levels of impulsivity than adults who deny such experiences (Brodsky et al., 2001), with research suggesting that all five maltreatment types are associated with impulsivity (Somer, Ginzburg, & Kramer, 2012). Impulsivity is believed to play a role in the onset and maintenance of obesity (Altfas, 2002). Indeed, studies have consistently found that higher levels of impulsivity are associated with obesity (Cortese et al., 2008; Thamotharan et al., 2013). Researchers have hypothesized that individuals with high levels of impulsivity are more likely to overeat; this tendency, which might be attributed to their lack of planning and reward sensitivity, may impact weight gain (Schag, Schönleber, Teufel, Zipfel, & Giel, 2013; Thamotharan et al., 2013; Yeomans, Leitch, & Mobini, 2008). However, this hypothesis has not been empirically evaluated in the context of maltreatment.

The moderation hypothesis is further supported by research showing that impulsivity moderated the association between stress exposure and maladjustment (Fox et al., 2010). For example, in a sample of adults, Fox et al., (2010) found that impulsivity moderated the association between adverse life events and hazardous drinking behavior, such that a combination of high exposure to adverse life events and high levels of impulsivity was positively associated with hazardous drinking. In light of these findings, it is reasonable to hypothesize that impulsivity might also moderate the impact of child maltreatment on other adverse health outcomes (i.e., elevated BMI), such that the associations between child maltreatment types and BMI will be stronger for individuals with higher levels of impulsivity.

Current Study

Accumulating evidence suggests that child maltreatment is associated with adult obesity (Danese & Tan, 2014; Helton & Liechty, 2014; Shin & Miller, 2012). However, research in this area is limited in a number of ways, including a lack of studies examining how all five maltreatment types (i.e., physical abuse, physical neglect, sexual abuse, emotional abuse, and emotional neglect) might differentially relate to BMI among emerging adults. Additionally, there is a need for research examining factors that might play a role in these associations. The current study aims to fill the gaps in the current literature by examining the associations between child maltreatment types and BMI in a sample of emerging adults and evaluating whether impulsivity moderated these associations.

In line with previous findings (e.g., Danese & Tan, 2014; Rohde et al., 2008), it was hypothesized that child maltreatment types would be positively associated with adult BMI. However, given the lack of research examining how maltreatment types might differentially relate to BMI during emerging adulthood and inconsistent findings with adults (Midei et al., 2010; Pederson & Wilson, 2009), no hypotheses were made about which maltreatment types might be most strongly linked to BMI. It was also hypothesized that impulsivity would

moderate the associations between child maltreatment and BMI, such that the child maltreatment types would be more strongly positively associated with BMI at high levels of impulsivity.

Methods

Participants

Participants included 500 college undergraduate students between the ages of 18 and 25 ($M = 18.96$, $SD = 1.22$, 49.6% male) recruited from a large public university in the Midwestern United States. The racial/ethnic composition of the sample was 71.6% Caucasian, 10.2% Asian, 7.4% Mixed Race/Other, 6.0% Hispanic, 3.6% African American, and 1.2% Native American (see Table 1 for additional sample demographics). Recruitment occurred through the university's online experiment tracking system; interested students signed up to participate for course credit after reading a brief study description.

Procedures

The current project was a part of a larger study that examined biological and environmental influences of behavior in emerging adults. Participants provided informed consent prior to completing a one-hour web-based survey that included measures of childhood maltreatment and impulsivity. Height and weight were also obtained by trained research staff in a private location. Upon completion of the study, participants received three credits for their undergraduate psychology course and a \$5 gift card as compensation for their time and effort. Additionally, because of the sensitive nature of some survey questions, all participants were provided with a referral list for local mental health agencies. The procedures presented above were approved by the local Institutional Review Board prior to data collection.

Measures

Demographics—Demographic information including participant age, sex, and race/ethnicity were collected via a self-report questionnaire.

Childhood Maltreatment—The Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998) was used to assess for childhood exposure to five different maltreatment types: physical abuse, physical neglect, emotional abuse, emotional neglect, and sexual abuse. Participants were asked to provide retrospective reports of the frequency of maltreatment during their childhood on a 5-point Likert scale from “Never True” (1) to “Very Often True” (5). The CTQ includes 28 items, three of which are validity items to assess for denial or minimization. Previous research has shown that the CTQ has strong psychometric properties in both community and clinical samples (e.g., Bernstein & Fink, 1998; Paivio & Cramer, 2004; Scher, Stein, Asmundson, McCreary, & Forde, 2001). Consistent with these previous validation studies, the internal consistency of the CTQ subscales in the current sample were all $\alpha > .81$, with the exception of physical neglect ($\alpha = .56$). The current study used the mean score for each maltreatment type subscale for analyses.

Impulsivity—The Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995) was used to assess for impulsivity. The BIS-11 is comprised of 30 items which assess impulsivity across

three domains (i.e., attention, motor, and planning). Participants were asked to indicate the extent to which each item (e.g., “I plan tasks carefully.”) described the way they think and act on a 4-point Likert Scale from “Rarely/Never” (1) to “Almost Always/Always” (4). The current study used the mean score for analyses. Previous research has shown that the BIS-11 has strong psychometric properties in both community and clinical samples, including good internal consistency and construct validity (for a review see Stanford et al., 2009). The internal consistency of the BIS-11 in the current sample was good ($\alpha = .83$).

BMI—Trained research staff obtained height and weight while participants wore no shoes and light clothing. Height was collected to the nearest 0.1 centimeter using a standard stadiometer, and weight was collected to the nearest 0.1 pound using a digital flat scale. Height and weight measurements were converted into meters and kilograms, respectively, in order to calculate BMI (kg/m^2). According to the Center for Disease Control (2015), BMI between 18.5 and 24.9 is considered healthy weight, between 25.0 and 29.9 is considered overweight, and above 30.0 is considered obese.

Depression Symptoms—The Short Mood and Feelings Questionnaire (SMFQ; Sharp, Goodyer, & Croudace, 2006) was used to assess for symptoms of depression. The SMFQ is comprised of 13-items. Participants were asked to indicate the extent to which an item was indicative of their feelings and actions over the past two weeks. Items are rated on a 3-point Likert scale from “Not True” (0) to “True” (2). The current study used the mean score for analyses, with higher scores indicating greater depressed mood. Prior studies have shown that the SMFQ has good psychometric properties (Sharp et al., 2006), including good criterion validity (Angold et al., 1995; Thapar & McGuffin, 1998). The internal consistency of the SMFQ in the current sample was excellent ($\alpha = .90$).

Data Analysis Plan

Descriptive statistics and bivariate correlations were first calculated among all study variables. Next, the moderating effect of impulsivity on the prospective associations between childhood maltreatment types and adult BMI was examined by estimating hierarchical multiple regression models using IBM SPSS Statistics Version 23. Participant age, sex, race/ethnicity, and depression symptoms were examined as possible covariates in the regression models because research has documented the associations between these variables, child maltreatment, and BMI (Baker et al. 2009; Danese & Tan, 2014; Helton & Liechty, 2014). The current sample was characterized by low proportions of specific racial/ethnic minority groups. Thus, race/ethnicity was dichotomized, such that Caucasian was coded 0 and racial/ethnic minority was coded 1 (see Table 1 for the percentage of participants in each classification). In order to account for the statistical overlap between child maltreatment types, each regression model controlled for the other four maltreatment types. All independent variables were mean-centered prior to analyses to aid the interpretation of interactive effects.

At the first step of the hierarchical multiple regression models, covariates (i.e., age, sex, race/ethnicity, depression symptoms, and the alternate child maltreatment types) and independent variables (i.e., target childhood maltreatment type and impulsivity) were

entered into the regression model in order to control the effects of the covariates and to examine the unique effects of the independent variables on BMI. At the second step of the hierarchical multiple regression models, the interaction between the target maltreatment type and impulsivity (e.g., physical abuse X impulsivity) was added to the list of variables to examine the proposed interactive effect on BMI. Significant interactions were conditioned at low (-1 SD), moderate (mean), and high ($+1$ SD) levels of impulsivity to interpret the nature of the interactions (Aiken & West, 1991).

Results

Preliminary Analyses

Means in the current sample, displayed in Table 1, were comparable with those typically found in emerging adult samples with regards to child maltreatment exposure (Mitchell & Mazzeo, 2005), impulsivity (Dean et al., 2013), and BMI (Huang, Shimel, Lee, Delancey, & Strother, 2007). Emotional abuse and emotional neglect were the most commonly reported child maltreatment types, with 6.4% of the sample reporting moderate to severe levels of emotional abuse or emotional neglect. Correlations between all study variables are displayed in Table 2.

As shown, the five child maltreatment types were all positively correlated. Women in the study tended to be younger, have lower BMIs, greater depression symptoms, and report less exposure to physical neglect and emotional neglect than male participants; male participants reported less sexual abuse than female participants. Older participants reported greater exposure to four of the five maltreatment types (i.e., physical abuse, physical neglect, emotional abuse, and emotional neglect) than younger participants. Racial/ethnic minority participants reported greater exposure to all five maltreatment types, had higher BMIs, and endorsed greater depression symptoms than Caucasian participants. With the exception of physical neglect, all the other child maltreatment types and impulsivity were positively associated with depression symptoms. Participants reporting more emotional abuse and emotional neglect also reported higher levels of impulsivity. All five maltreatment types, depression symptoms, and impulsivity were statistically unrelated to BMI.

Regression Analyses

Multiple hierarchical regression models were conducted to determine whether impulsivity moderated the associations between child maltreatment types and weight status. First, BMI was regressed on age, gender, race/ethnicity, depression symptoms, physical abuse, physical neglect, sexual abuse, emotional abuse, emotional neglect, and impulsivity (see Table 3). The model was significant $F(10, 456) = 2.45, p = .01$, with these variables accounting for 5.1% of the variance in BMI. Gender was negatively associated with BMI; however, race/ethnicity was positively associated with BMI. Age, physical abuse, physical neglect, sexual abuse, emotional abuse, emotional neglect, and impulsivity were statistically unrelated to BMI.

Next, each interaction term between a child maltreatment type and impulsivity (e.g., physical abuse X impulsivity) was added separately as second steps of the model. Results

indicated that the interactions of physical abuse and impulsivity ($\beta = .02, p = .63$), physical neglect and impulsivity ($\beta = .07, p = .16$), emotional abuse and impulsivity ($\beta = .06, p = .23$), and emotional neglect and impulsivity ($\beta = .05, p = .25$) on BMI were not significant. However, when the interaction between sexual abuse and impulsivity was added to the model, a significant interaction was evident ($\beta = .16, p = .00$), indicating the impulsivity moderated the association between sexual abuse and BMI.

Following Aiken and West's (1991) recommendations, the significant interaction between sexual abuse and impulsivity was probed at low (-1 SD), moderate (mean), and high ($+1$ SD) levels of impulsivity to interpret the nature of the interactions. Results revealed a significant association at high levels of impulsivity ($\beta = .21, p = .00$), but not at moderate ($\beta = .05, p = .34$) or low levels of impulsivity ($\beta = -.12, p = .09$). As shown in Figure 1, greater exposure to sexual abuse was associated with higher weight status at high levels of impulsivity only.

Discussion

The link between child maltreatment and adult obesity has garnered considerable empirical support in the literature (e.g., Aaron & Hughes, 2007; Boynton-Jarrett et al., 2012; Danese & Tan, 2014; Greenfield & Marks, 2009; Rohde et al., 2008). The current study advanced the research in this area by examining the effects of child maltreatment types on BMI in emerging adulthood and by evaluating impulsivity as a moderator of these associations.

In line with the existing evidence (Holland et al., 2013; Huang et al., 2007), results from the current study showed that male and racial/ethnic minority participants had higher BMIs than female and Caucasian participants, respectively. With regard to maltreatment, results showed that, compared to Caucasian participants, racial/ethnic minority participants reported greater exposure to all five maltreatment types. This finding echoes that of Baker et al. (2009), who found that adult participants who identified as Hispanic, American Indian, or "other" reported higher levels of exposure to child maltreatment types than Caucasian participants.

Another finding of the current study was that depression symptoms were not statistically related to BMI in the current study. This finding is supported by a systematic review and meta-analysis by Luppino et al. (2010), who found depression to be more strongly linked to obesity when a clinical diagnosis of depression derived from a diagnostic clinical interview, rather than depression symptoms endorsed on a self-report measure, was used. It is possible that the results of the current study may have been different if a diagnostic instrument was used as a measure of depression. However, Luppino et al. (2010) found that depression was associated with being overweight among participants aged 20 years and older and that this link was not statistically significant among participants younger than 20-years-old (Luppino et al., 2010). Given the mean age of our sample, our finding of no association between depression symptoms and BMI might add further support to the literature suggesting that depression and BMI are unrelated among emerging adults (Erol, Toprak, & Yazici, 2006). Additional studies are needed to determine whether this hypothesis is valid.

Contrary to the first hypothesis, none of the child maltreatment types were significantly associated with BMI. This finding is inconsistent with findings from earlier studies, including those collectively finding that all five child maltreatment types were positively related to adult BMI or obesity (Danese & Tan, 2014; Nagl et al., 2016; van Reedt Dortland et al., 2012; Williamson et al., 2002), as well as those finding that emotional abuse, sexual abuse, and physical neglect were associated with BMI and eating or weight problems in emerging adults (Johnson et al., 2002; Roenholdt et al., 2012). These discrepant findings might be explained by differences in measurement of child maltreatment. For example, the current study assessed history of child maltreatment with the CTQ, the most validated and widely used retrospective maltreatment questionnaire (Schwarze, Hallhammer, Stroeble, Lieb, & Mobascher, 2015). Other studies have assessed maltreatment using alternative self-report questionnaires (e.g., Conflicts Tactics Scale; Williamson et al., 2002) and interviews (e.g., Childhood Trauma Interview; van Reedt Dortland et al., 2012).

Alternatively, these discrepancies might be attributed, in part, to age-related differences in the influence of child maltreatment on BMI. Existing evidence suggests that child maltreatment is not significantly associated with obesity and BMI among children and adolescents, but is positively associated with obesity and BMI in adults (Danese & Tan, 2014). Contrary to two previous studies (Johnson et al., 2002; Roenholdt et al., 2012), the current findings might suggest that child maltreatment is also unrelated to BMI among emerging adults. However, it is important to note that the Johnson et al. (2002) and Roenholdt et al. (2012) studies sampled the general emerging adult population, whereas the current study was specific to college students. It is believed that individuals who have experienced more severe child maltreatment are less likely to appear in a sample of college students, who might be highly functioning, in part, because they have greater access to legitimate coping strategies than their same age peers who do not attend college (Broidy, 2001; Bottoms, Rudnicki, & Epstein, 2013). Thus, trauma-related outcomes might be less evident among emerging adults who attend college and more pronounced among those who do not. Future research might attempt to examine these hypotheses further.

In partial confirmation of the hypothesis that impulsivity would moderate the associations between child maltreatment types and BMI, results from the current study revealed that impulsivity moderated the link between sexual abuse and BMI. More specifically, greater exposure to childhood sexual abuse was associated with elevated BMI in emerging adulthood, but this was only true for individuals characterized by high levels of impulsivity. When paired with impulsivity, childhood sexual abuse, compared to the other four maltreatment types, might be more likely to influence weight status because of the intrusive and intimate nature of the act(s), including the perpetrator's contact with the child's body (Williams, 1993). Interestingly, the results of prior research have indicated that compared to non-sexual trauma exposure, experiences of sexual trauma are more strongly associated with alterations in arousal and reactivity symptoms associated with posttraumatic stress disorder (Guina, Nahhas, Kawalec, & Farnsworth, 2016), which has been linked to impulsivity (Roley, Contractor, Weiss, Armour, & Elhai, 2016). There are likely mediators of the association between childhood sexual abuse and BMI that could help account for the association (e.g., disordered eating, emotion dysregulation, low self-esteem, negative body image; Briere & Scott, 2007; Lanius, Bluhm, & Frewen, 2011; Lavender, Gratz, &

Anderson, 2012; Wonderlich et al., 2001); however, these variables were not examined in the current study. Future studies are needed to further elucidate these associations.

Limitations and Conclusions

When interpreting the results of the current study, it is important to consider several limitations. First, the current study was cross-sectional, which limits the inferences that can be made about directionality and causality; future studies using longitudinal designs are necessary to determine the temporal relationships of the variables. Another limitation of the current study is the use of a college sample. Although this population is appropriate given the hypothesis that the effects of child maltreatment are likely to emerge during this developmental period, it is important to note that the current sample may not be representative of the entire population of individuals exposed to child maltreatment, particularly given the low prevalence rate of maltreatment and lack of data on participants' socioeconomic status in the current sample. It would be interesting for future studies to examine how impulsivity might influence the associations between child maltreatment types and BMI among samples of emerging adults reporting greater prevalence of child maltreatment, and whether socioeconomic status might play a role in these associations. Additionally, participants included in the current study were restricted in racial, ethnic, and educational diversity; therefore, future research with more diverse samples is needed to determine generalizability of the current findings.

There are also limitations with respect to the measures used in the current study. First, child maltreatment was measured using a retrospective, self-report measure, which could introduce biases surrounding social desirability or inaccurate recall. There is evidence to suggest that retrospective, self-report measures of child maltreatment can produce accurate reports (Hardt & Rutter, 2004); however, future studies might benefit from using multiple informants. In addition, although the measure of childhood maltreatment used in the current study has been shown to be valid and widely used, the internal consistency of the physical neglect subscale was low. The low reliability of the subscale, which has been shown to be consistent across studies (e.g., Bernstein & Fink, 1998; Paivio & Cramer, 2004), may suggest that the findings related to this subscale need to be interpreted with caution. An exclusive reliance on self-report survey data to assess symptoms of depression and impulsivity is also a limitation. Future research might employ laboratory-based behavioral tasks and diagnostic interviews.

In light of the previous research (Danese & Tan, 2014; Wilson, Hansen, Li, 2011), another limitation of the current study was that it was not possible to attain data regarding other contextual or psychological factors that might influence the associations of interest (e.g., neuropsychological functioning and participants' childhood BMI). For example, Danese and Tan (2014) hypothesized that children who are obese might be more likely to be maltreated. Inconsistent with their hypothesis, the authors found that child maltreatment was not significantly associated with child weight status. Child maltreatment was, however, associated with a gradual increase in weight status over time. These findings might suggest that it is unlikely that the results of the current study can be attributed to reverse causality.

Despite these limitations, the current study is a step toward understanding the contexts in which individuals might be more vulnerable to the effects of child maltreatment on BMI. It appears that greater exposure to childhood sexual abuse, when paired with high levels of impulsivity, contributes to elevated BMI among emerging adults. This finding is particularly significant given that impulsivity is a common symptom found across a number of disorders regularly treated by clinicians, including substance use disorders, disruptive behavior disorders, and personality disorders (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). However, the moderating effect of impulsivity on the associations between child maltreatment types and BMI was specific to sexual abuse, as impulsivity did not moderate the associations between any of the other maltreatment types (i.e., physical abuse, physical neglect, emotional abuse, and emotional neglect) and BMI. These findings have several clinical implications.

Research has shown that, in the aftermath of maltreatment, individuals demonstrate higher levels of impulsivity and distractibility, which might interfere with therapeutic interventions that draw on cognitive processes (e.g., impulse control and sustained attention) to alleviate trauma-related symptoms (Carrion, Wong, & Kletter, 2013). Another study showed that higher levels of impulsivity decreased the likelihood of successful weight loss treatment outcome (Nederkoorn, Jansen, Mulken, & Jansen, 2007). Together, these findings highlight the clinical relevance of impulsivity, as it might predict treatment response among both individuals with maltreatment histories and those participating in weight loss treatment programs.

With respect to clinical implications, it would appear that therapeutic interventions with survivors of childhood sexual abuse might target impulsivity in hopes of attenuating risk of and addressing elevated BMI. Regarding treatment options, existing evidence has identified several therapeutic interventions which might be useful in addressing impulsivity. For example, research suggests that dialectical behavior therapy (DBT) is effective in reducing impulsivity by promoting distress tolerance skills whereby clients are taught to distract and soothe themselves while thinking through the pros and cons of their actions (Baer, 2015; van den Bosch, Koeter, Stijnen, Verheul, & van den Brink, 2005). However, research is needed to determine whether evidence-based therapeutic interventions that address the effects of child maltreatment, such as trauma-focused cognitive behavioral therapy (TF-CBT), might also reduce impulsivity. With respect to weight loss interventions, a recent study found that a lifestyle and physical activity intervention program led to reductions in BMI and impulsivity (Kulendran et al., 2014). Given the current findings, this program might be particularly well suited for survivors of childhood sexual abuse; however, further research is needed.

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Figure 1.
The moderating role of impulsivity in the association between sexual abuse and BMI.

Table 1

Sample demographics

	Percentage or mean (<i>SD</i>)	Potential range
Age in years	18.96 (1.22)	18 to 25
18	43.2%	
19	34.9%	
20	12.8%	
21	6.0%	
22	1.2%	
23	0%	
24	.8%	
25	1.0%	
Gender		
Male	49.6%	
Female	50.4%	
Race/Ethnicity		
Caucasian	71.6%	
Racial/ethnic minority	28.4%	
Year in school		
Freshman	60.8%	
Sophomore	27.2%	
Junior	9.2%	
Senior	2.8%	
Child maltreatment types		
Physical abuse	1.25 (.54)	1 to 5
Physical neglect	1.27 (.45)	1 to 5
Emotional abuse	1.47 (.71)	1 to 5
Emotional neglect	1.62 (.74)	1 to 5
Sexual abuse	1.13 (.54)	1 to 5
Impulsivity	2.10 (.35)	1 to 4

Note. *SD* = Standard Deviation.

Table 2

Correlations, means, and standard deviations of study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Age	–										
2. Gender	–.17**	–									
3. Race/Ethnicity	.07	.06	–								
4. Depression Symptoms	–.06	.17**	.12**	–							
5. Physical Abuse	.14**	–.02	.20**	.09*	–						
6. Physical Neglect	.10*	–.13**	.17**	.05	.38**	–					
7. Sexual Abuse	–.00	.12*	.15**	.13**	.28**	.30**	–				
8. Emotional Abuse	.14**	.08	.16**	.27**	.57**	.42**	.42**	–			
9. Emotional Neglect	.10*	–.09*	.19**	.19**	.35**	.59**	.23**	.59**	–		
10. Impulsivity	–.03	–.02	.03	.31**	.06	.07	.03	.17**	.11*	–	
11. BMI	–.02	–.10*	.14**	.03	.07	.06	.05	.03	.01	.05	–

Note. *M* = Mean. *SD* = Standard Deviation.* $p < .05$.** $p < .01$. Gender (1 = male, 2 = female). Race/ethnicity (0 = Caucasian, 1 = racial/ethnic minority).

Table 3

Regression analyses predicting BMI

BMI			
$R^2 = .05, F(10, 456) = 2.45, p = .01$			
	β	<i>SE</i>	<i>p</i>
Age	-.04	.16	.39
Gender	-.13 **	.38	.01
Race/Ethnicity	.14 **	.42	.00
Depression Symptoms	.05	.47	.32
Physical Abuse	.05	.43	.37
Physical Neglect	.07	.53	.22
Sexual Abuse	.04	.39	.39
Emotional Abuse	.00	.40	1.00
Emotional Neglect	-.09	.35	.14
Impulsivity	.03	.53	.57

Note.*
 $p < .05$.**
 $p < .01$. Gender (1= male, 2=female). Race/ethnicity (0 = Caucasian, 1 = racial/ethnic minority).