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(2022)

Childhood maltreatment and disordered eating: The mediating role of emotion regulation.

Appetite, 172, Article number: 105952.

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<https://doi.org/10.1016/j.appet.2022.105952>

**Childhood Maltreatment and Disordered Eating: The Mediating Role of Emotion
Regulation**

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Abstract

Childhood maltreatment is pervasive and can result in life-long adverse physical and mental health challenges, including a heightened risk for disordered eating. Current treatments for disordered eating have limited long-term success, partly because the psychological processes involved are not well understood. The current research examined two different components of emotion regulation (expressive suppression and cognitive reappraisal) and three components of cognitive emotion regulation (intrusive thoughts, thought suppression attempts, and successful thought suppression) as potential psychological mechanisms mediating the relationship between various forms of childhood maltreatment and disordered eating behaviours. Data was drawn using an online survey in an Australian community sample. In total, 461 individuals participated (76.80 percent female, $M=43.04$ years, $SD=16.23$). Participants completed measures for childhood maltreatment (Childhood Trauma Questionnaire – Short Form), disordered eating behaviour (Three Factor Eating Questionnaire – Revised 21), emotion regulation (Emotion Regulation Questionnaire) and thought suppression (Thought Suppression Inventory – Revised). Bootstrapping tests revealed significant mediation pathways between all forms of childhood maltreatment (physical, emotional and sexual abuse, and physical and emotional neglect), and eating behaviours (cognitive restraint, uncontrolled eating and emotional eating), through the emotion regulation strategies of cognitive reappraisal, intrusive thoughts and successful thought suppression. Further longitudinal studies are needed to clarify the direction of causality in these findings of emotion regulation strategies mediating the relationships between childhood maltreatment and disordered eating behaviours.

Key words: Childhood maltreatment, disordered eating, cognitive reappraisal, expressive suppression, thought suppression, intrusive thoughts

1. Introduction

Bingeing, purging, restrictive eating and preoccupation with food are commonly observed at subclinical levels in community populations (Wollenberg et al., 2015). Despite not reaching clinical threshold, these disordered eating (DE) behaviours put individuals at an increased risk for adverse health outcomes including excess weight and obesity, diabetes, cardiovascular disease and certain cancers (da Luz et al., 2017; Hudson et al., 2007; O'Brien et al., 2016). DE has also been associated with an increased risk for eating disorders, higher levels of mood and anxiety disorders, substance use, personality disorders, lower self-esteem and significant diminishment in quality-of-life (Neumark-Sztainer et al., 2011; Peterson et al., 2005; Stice et al., 2001; Wade et al., 2012). An Australian study estimated 16 percent of Australian adults and 32 percent of adolescents to be affected by DE (National Eating Disorders Collaboration [NEDC], 2019; Sparti et al., 2019). A national self-report survey of adolescents in the United States showed 22 percent of females and 11 percent of males had engaged in DE behaviour within the previous 30 days (Pisetsky et al., 2008). These high prevalence estimates highlight the need for prevention and early intervention for minimising the negative impacts of DE. However, a lack of understanding of the aetiology and psychological processes leading to DE, results in interventions only being marginally effective (Hymowitz et al., 2017).

This study focuses on understanding the psychological processes associated with three eating behaviours measured by the Three Factor Eating Questionnaire: uncontrolled eating, emotional eating, and cognitive restraint (Cappelleri et al., 2009; Karlsson et al., 2000). Uncontrolled eating is a disordered eating behaviour characterised by a feeling of one's eating being out-of-control, and the overconsumption of food when exposed to external food cues (Cappelleri et al., 2009; Karlsson et al., 2000). Uncontrolled eating has been associated with binge eating, consuming higher calorie food, higher BMI and less successful weight-loss

attempts (Anglé et al., 2009; Duarte et al., 2020). Emotional eating is a disordered eating behaviour that involves overeating in response to emotional states (Cappelleri et al., 2009; Karlsson et al., 2000), and is associated with weight fluctuations (Keller & Siegrist, 2015) and higher BMI (Lazarevich et al., 2016) in both men and women. Cognitive restraint refers to the intellectual regulation of eating behaviour to control weight (Cappelleri et al., 2009; Karlsson et al., 2000). It is a complex construct. On one hand it has been considered a disordered eating behaviour, with evidence of cognitive restraint being associated with increased metabolic cardiovascular risk factors (Lopez-Cepero et al., 2018) and higher body mass index (Löffler et al., 2015). While on the other hand, cognitive restraint has been associated with weight loss in weight control interventions (Svensson et al., 2014), and in overweight or obese women (Urbanek et al., 2015). Given the conflicting findings regarding cognitive restraint, some authors propose that currently it cannot be considered healthy or unhealthy, as the consequences of cognitive restraint may be context-dependent or moderated by various psychological constructs (Bryant et al., 2019; Schaumberg et al., 2016). For the purpose of this study, it was therefore considered a neutral eating behaviour. This allowed the associations found with two accepted disordered eating behaviours to be contrasted with the associations found with a neutral eating behaviour.

Childhood maltreatment (CM) includes all acts that result in probable or actual harm to a child's physical and mental health and development in the context of a caring, power or trust relationship (World Health Organization [WHO], 2020). CM is a worldwide issue; the WHO (2020) figures show that one in five women and one in 13 men reported being sexually abused when aged from 0 to 17 years. Furthermore, three out of four children aged between two and four years regularly experience physical and/or psychological violence from their parent or caregiver (WHO, 2020). CM can be defined in terms of five forms of maltreatment: childhood physical abuse (CPA), childhood physical neglect (CPN), childhood emotional

abuse (CEA), childhood emotional neglect (CEN) and childhood sexual abuse (CSA) (Bernstein et al., 2003).

Childhood maltreatment (CM) has been found to be a significant risk factor for DE (Guillaume et al., 2016; Hasselle et al., 2017). Historically, research on CM and DE highlighted CSA and CPA, with links to adult obesity and greater BMI in both clinical and nonclinical populations (Felitti et al., 1998; Hemmingsson et al., 2014; Hussey et al., 2006). There is evidence, however, suggesting that CEA may be the most prevalent form of CM, demonstrating unique associations with DE behaviours including drive for thinness, body dissatisfaction, and bingeing and purging behaviours (Burns et al., 2012; Kent et al., 1999). Given these findings, there is a need to better understand the associations between different forms of CM and different presentations of DE, as well as the mediating psychological mechanisms linking CM with DE.

A study by Strodl and Wylie (2020) examined the direct and indirect effects between experience with five forms of CM as measured by the Childhood Trauma Questionnaire Short Form (Bernstein et al., 2003) and three eating behaviours measured by the Three Factor Eating Questionnaire R21 (Cappelleri et al., 2009). They found a significant direct association between CEA and cognitive restraint, and between CSA and emotional eating. The study also identified numerous indirect effects between the five measures of CM and three measures of DE via negative beliefs about emotions. However, the size of these effects indicated the presence of other mediating variables that might be potential targets for psychological interventions into DE.

Michopoulos and colleagues (2015) suggested targeting aspects of emotion regulation may be useful in treating DE. Emotion regulation is a person's ability to regulate positive and negative emotions, through cognitive and behavioural processes (Gross & Barrett, 2011). Emotionally abusive or neglectful environments, inconsistent discipline, corporal punishment

and low monitoring tend to lead to poor emotion regulation capabilities in children (Cloitre et al., 2008). This results in both maladaptive emotion regulation and a lack of adaptive emotion regulation (Danner et al., 2014). Mills et al. (2015) reported a positive relationship for CEA and CEN with emotion dysregulation, and a negative correlation with functional emotion regulation measures. Taken together, these findings support that CM can disrupt the development of adaptive emotion regulation skills and foster maladaptive emotion regulation.

Evidence of indirect paths from CM to DE via emotion dysregulation has grown in recent years. Burns et al. (2012) reported that emotion dysregulation partially mediated the relationship between CEA and DE. Moulton et al. (2015) found significant indirect effects for CM and DE, through emotion dysregulation and disassociation. However, emotion regulation is a complex theoretical construct. Mills and colleagues (2015) highlighted the problem of conceptualising emotion regulation as a single process rather than recognising the diverse subcomponents of emotion regulation.

Gross's (1998) process model distinguishes between adaptive antecedent-focused and maladaptive response-focused emotion regulation strategies. Cognitive reappraisal is considered a proactive and controlled response, that involves altering the way an experience is constructed to decrease its emotional effect (Gross & John, 2003). In contrast, expressive suppression is a conscious form of response modulation that involves an individual inhibiting the behavioural expression of his or her emotions (Gross & John, 2003). When individuals use adaptive emotion regulation strategies, such as cognitive reappraisal, their tendency to eat in response to negative emotions is reduced (Evers et al., 2010; Taut et al., 2012). In contrast, individuals who engage in maladaptive emotion regulation strategies, such as emotion suppression, are more likely to increase their food intake, specifically for comfort food, over control groups (Evers et al., 2010; Görlach et al., 2016; Vohs & Heatherton, 2000).

Another important emotional regulation strategy is thought suppression, which is the process of attempting to keep unwanted and intrusive thoughts out of mind (Wegner & Zanakos, 1994). The use of thought suppression can lead to food cravings (Erskine & Georgious, 2010; Barnes & Tantleff-Dunn, 2010) and has been shown to associate with and predict higher levels of eating disorder psychopathology (Barnes et al., 2013; Barnes & Tantleff-Dunn, 2010). Lavender and colleagues (2012) reported that thought suppression fully mediated the relationships between negative affect and global DE symptoms. Thought suppression may be considered maladaptive when it involves unsuccessful thought suppression attempts and unwanted intrusive thoughts, and adaptive when it involves successful thought suppression attempts (van Schie et al., 2016). This study will therefore examine whether these specific emotion regulation strategies may mediate the relationship between CM and DE.

1.1. The present study

This study aimed to build upon prior research by Strodl and Wylie (2020), which found that negative beliefs about emotions mediated the association between childhood trauma and disordered eating. This will be done by investigating another potential mediator between childhood maltreatment and disordered eating. In particular, this study will examine subcomponents of emotion regulation as potential psychological processes linking distinct forms of CM and DE. Given the evidence that adults exposed to CM are more likely to have less adaptive and more maladaptive emotion regulation strategies available to them, and DE practices have been associated with use of maladaptive emotion regulation strategies, the following hypotheses were tested. The first hypothesis represents the use of adaptive emotion regulation strategies, while the second hypothesis represents the use of maladaptive emotion regulations strategies.

1. A significant indirect effect will be present between each type of CM, through lower use of cognitive reappraisal and successful thought suppression with emotional eating and uncontrolled eating. In contrast, it is hypothesised that these indirect effects will not be found with cognitive restraint.
2. A significant indirect effect will be present between each type of CM, through greater use of expressive suppression, and both intrusive thoughts and thought suppression attempts, independently with, emotional eating and uncontrolled eating. In contrast, it is hypothesised that these indirect effects will not be found with cognitive restraint.

2. Method

2.1. Participants

Participants were required to be aged 18 or over, reside in Australia, not have a current or previous diagnosis for an eating disorder, and not anticipate high distress from answering questions relating to CM or DE. In total, 3481 people clicked through to the online participant information sheet. Of those, 777 people consented to participate, however 315 people did not complete the study, the majority of those exited prior to completion of demographic information. The final sample of 461 participants included 76.8 percent female, 23.2 percent male. Participant ages ranged from 18 to 80 years ($M = 41.42$, $SD = 16.68$). Table 1 details participant's demographic characteristics.

INSERT TABLE 1 ABOUT HERE

2.2. Measures

2.2.1. Demographic items. The demographic information gathered included age, gender, marital status, education level, employment status, annual income, and English-speaking background.

2.2.2. Coronavirus questions. Data collection took place from June until September 2020, in the context of the coronavirus (COVID-19) pandemic which impacted many aspects of individuals' day-to-day lives. Questions about participant's current and pre-pandemic eating behaviour were included. Individuals were asked if their eating behaviour was impacted by COVID-19, both for frequency of behaviour and volume of food. Approximately 55 percent of participants reported their use of cognitive restraint was the same as prior to COVID-19 restrictions (approximately 21 percent reported more than before). Approximately 65 percent reported uncontrolled eating and emotional eating was the same as prior to COVID-19 restrictions (approximately 20 percent and 27 percent respectively reported more than before).

2.2.3. Childhood Trauma Questionnaire-Short Form (CTQ-SF). The CTQ-SF is a retrospective assessment of exposure to experiences of childhood trauma for adults (Bernstein et al., 2003). The questionnaire includes 28-items on a five-point Likert scale, measuring five forms of childhood maltreatment, including emotional, physical and sexual abuse, and emotional and physical neglect. An additional sixth subscale identifies an individual's propensity for minimisation or denial. Example questions include 'People in my family said hurtful or insulting things to me', and 'Someone threatened to hurt me or tell lies about me unless I did something sexual with them'. A summed score for each maltreatment subscale was calculated, with higher scores indicating greater exposure severity. Adequate psychometric properties have been reported, including internal reliability (Forde et al., 2012), construct validity (Spinhoven et al., 2014), and good retest reliability (Jiang et al., 2018). The internal reliability in the present study was excellent, emotional abuse ($\alpha = .90$), physical abuse ($\alpha = .82$), sexual abuse ($\alpha = .96$), emotional neglect ($\alpha = .92$), and physical neglect ($\alpha = .81$).

2.2.4. Three-Factor Eating Questionnaire (TFEQ-R21). The TFEQ-R21 measures three eating behaviours: cognitive restraint (CR), uncontrolled eating (UE) and emotional eating (EE; Cappelleri et al., 2009). Questions 1-20 are measured on a four-point Likert-type scale, and question 21 on an eight-point numerical scale. A mean score is calculated for each eating behaviour, with higher scores indicating higher levels of disordered eating. Example questions include 'I deliberately take small helpings to control my weight', 'Being with someone who is eating, often makes me want to also eat' and 'When I feel sad, I often eat too much'. The TFEQ-R21 has evidenced adequate to good internal reliability (Cappelleri et al., 2009), good construct validity (Duarte et al., 2015), and good test-retest reliability (Czegledi & Urban., 2009). The internal reliability for this study ranged from good to excellent, CR ($\alpha = .78$), EE ($\alpha = .95$), and UE ($\alpha = .89$).

2.2.5. Thought Suppression Inventory – Revised (TSI – R). The TSI-R is a 21-item Likert-type self-reporting tool that measures three factors of thought suppression: intrusive thoughts (IT), thought suppression attempts (TSA), and successful thought suppression (STS; van Schie et al., 2016). Responses range from '1' strongly disagree to '5' strongly agree, with total sum score calculated for each factor. Total scores range between 7 and 35, with higher scores representing higher use of that strategy. Example questions include 'I have thoughts that I cannot stop', 'I wish I could stop thinking of certain things', and 'I succeed in controlling unwanted thoughts whenever it is necessary'. Mixed psychometric performance has been reported. The IT sub-scale has demonstrated strong scale strength, good test-retest correlations and sufficient reliability; the STS has demonstrated medium scale strength, acceptable test-retest correlations, and sufficient reliability; however, the TSA has demonstrated weaker scale strength, weaker test-retest correlations, and sufficient reliability (van Schie et al., 2016). For the present study, the internal reliabilities were excellent for the TSA ($\alpha = .81$), IT ($\alpha = .90$), and STS ($\alpha = .85$).

2.2.6. Emotion Regulation Questionnaire (ERQ). The ERQ (Gross & John, 2003) is a 10-item Likert-type self-reporting questionnaire measuring individual differences in use of cognitive reappraisal ('When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm') and expressive suppression ('When I am feeling negative emotions, I make sure not to express them'). From the 7-point Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree), a mean score was calculated for each factor. Preece et al. (2020) reported good criterion-related validity with expressive suppression scores positively correlating with psychological distress and alexithymia while cognitive reappraisal scores negatively correlated with psychological distress and alexithymia. Excellent internal reliability for cognitive reappraisal and acceptable reliability for expressive suppression were also reported. The internal reliability for the present study was excellent, cognitive reappraisal ($\alpha = .90$), and expressive suppression ($\alpha = .83$).

2.3. Procedure

This research was approved by the QUT Human Research Ethics Committee (Approval Number: 2000000247). The study was administered online via WorldAPP KeySurvey Version 8.26. Evidence supports the advantage of using a multi-strategy approach when recruiting a normative convenience sample (Nolte et al., 2015). Study participants were recruited using an online snowballing technique, through emails to university students, being featured in several community group newsletters, and through a social media campaign targeting Australian Facebook users. The university psychology students were offered course credit for their participation. All other participants were given the opportunity to enter a random-prize-draw to win one of two AUD\$50 gift cards. Prior to completing the questionnaire, participants were directed to the 'Participant Information Sheet' explaining the purpose of the research, inclusion criteria, confidentiality, and the researcher's contact

information. Participants were informed that the data could be submitted anonymously and voluntarily.

2.4. Statistical analyses

The independent variable was childhood maltreatment (CM) and included scores for CEA, CPA, CSA, CEN and CPN from CTQ-SF. The dependent variables were the three eating behaviours measured by the TFEQ-21, namely cognitive restraint, uncontrolled eating, and emotional eating. The mediating variable was emotion regulation and included scores for expressive suppression and cognitive reappraisal from ERQ, and thought suppression attempts, intrusive thoughts, and successful thought suppression from TSI-R. Analyses were conducted using IBM Statistical Package for the Social Sciences (SPSS), version 26 and Hayes (2013) PROCESS Macro. A missing data analysis revealed less than two percent of data was missing for each item. Data for scale items was imputed using expectation maximisation methodology, which is appropriate for self-report measures (El-Masri & Fox-Wasylyshyn, 2005). Scale scores were calculated using the replaced dataset. No breaches to normality, linearity, homoscedasticity, independence of error or multicollinearity were present, and no influential outliers were identified.

Given that the main analyses involve assessment of indirect effects, we used the sample size table from Fritz and MacKinnon (2007) to estimate the minimum sample size required to test indirect effects. For bias-corrected bootstrapping with a power of 0.80 and assuming the alpha and beta path coefficients were either very small or small, the minimum sample size required ranged between 368 and 462 participants. Bivariate correlations were firstly calculated for the psychometric tests and demographic variables. Next, multiple hierarchical regression analyses were conducted to determine if the effect of each dimension of the independent variable on each dimension of the dependent variable covaried with demographic variables. As age, gender, and socio-economic status have previously been

identified as covariates of DE (e.g. Coffino et al., 2018; Minnich et al., 2017), these factors were controlled for in step one. Socioeconomic status was operationalised incorporating annual income and education history. Gender was dummy coded with males used as the reference category.

As per the methodology used in Strodl and Wylie (2020) to explore similar mediation hypotheses, tests for indirect effects were conducted using bootstrapping via Hayes PROCESS Macro. In this study, the hypotheses were tested by entering one form of CM, all TSI-R and ERQ subscales, with one form of DE, with all other subscales of CM entered as covariates. Contemporary mediation hypotheses testing involves analysing bootstrapped confidence intervals through Hayes' PROCESS Macro to demonstrate indirect effects (Hayes, 2018). Indirect effects were analysed with 5,000 bootstrapped samples and bias corrected confidence intervals. Hayes (2018) suggest that significant total indirect effects are not a prerequisite for investigating specific indirect effects. Significant indirect effects were established when the confidence intervals relating to indirect effects did not include zero.

3. Results

3.1. Descriptive statistics

The descriptive statistics for the independent, mediation and dependent variables are presented in Table 2.

INSERT TABLE 2 ABOUT HERE

3.2. Bivariate analyses

A number of significant bivariate correlations for the dependent and demographic variables were detected. Age was negatively related to uncontrolled eating ($r = -.30, p < .05$), and emotional eating ($r = -.14, p < .05$). Similarly, income was also negatively related to uncontrolled eating ($r = -.14, p < .05$) and emotional eating ($r = -.12, p < .05$). Education was negatively related to uncontrolled eating ($r = -.16, p < .05$). Positive associations were

detected for female gender and cognitive restraint ($r = .10, p < .05$), and emotional eating ($r = .10, p < .05$). Based on these significant correlations, age, gender, income, and education were included as covariates in this study. See Supplementary Table A for all bivariate correlations.

Table 2 presents the bivariate correlations for the psychometric variables. Significant small to medium strength bivariate associations were found for all CTQ-SF subscales and the emotional eating scale. Cognitive restraint evidenced a small significant association with CEA. Uncontrolled eating demonstrated significant small positive correlations with all CM subscales except for CPN.

Cognitive restraint demonstrated significant small positive correlations with thought suppression attempts, successful thought suppression and cognitive reappraisal. Uncontrolled eating and emotional eating both displayed significant small to medium strength positive associations with intrusive thoughts, suppression attempts and expressive suppression subscales, and small negative associations with successful thought suppression and cognitive reappraisal.

Significant medium to large correlations were seen between the maltreatment types, suggesting some participants were exposed to more than one form of maltreatment. Significant large correlations were evidenced between uncontrolled eating and emotional eating which indicated some participants were prone to more than one DE type. The bivariate correlations reported provide an initial indication that the relationships between the independent, mediation and dependent variables correlate to support the hypothesised relationships.

3.3. Main analyses

3.3.1. Hierarchical multiple regression

The results of the hierarchical multiple regression, run to examine the relationship between five forms of CM on three eating behaviours, controlling for demographic variables age, sex, and socioeconomic status, are presented in Table 3. In step one, the demographic covariates accounted for a significant proportion of the variance in uncontrolled eating, $R^2 = .10$, $F(4, 448) = 12.34$, $p < .001$; and emotional eating, $R^2 = .04$, $F(4, 449) = 4.00$, $p = .003$. However, they did not account for a significant proportion of the variance in cognitive restraint, $R^2 = .01$, $F(4, 448) = 0.87$, $p = .38$. Younger age was a significant predictor of uncontrolled eating, $t(454) = -6.00$, $p < .001$. Both having a lower income, $t(454) = -2.09$, $p = .04$ and younger age, $t(454) = -2.31$, $p = .02$ significantly predicted emotional eating.

In step two, the addition of CM to the model accounted for a significant change in the proportion of variance explained in uncontrolled eating, $\Delta R^2 = .05$, $\Delta F(5, 443) = 5.60$, $p < .001$; and emotional eating, $\Delta R^2 = .06$, $\Delta F(5, 444) = 5.91$, $p < .001$. However, no significant change in the proportion of variance explained for cognitive restraint was evidenced, $\Delta R^2 = .02$, $\Delta F(5, 444) = 1.80$, $p = .19$.

After controlling for demographic variables and CM, small significant effects were noted. Higher levels of emotional abuse, $t(452) = 3.24$, $p = .001$, explained a significant proportion of the variance in uncontrolled eating. Lastly, higher levels of sexual abuse, $t(454) = 2.72$, $p = .007$, and emotional abuse, $t(454) = 2.43$, $p = .02$, explained a significant proportion of the variance in emotional eating.

INSERT TABLE 3 ABOUT HERE

3.3.2. Test of indirect effects

3.3.2.1. Cognitive restraint. The tests of indirect effects with cognitive restraint as the dependent variable are displayed in Table B of the supplementary material. Figure 1

illustrates the significant direct and indirect pathways. An indirect effect was found between CEN, cognitive reappraisal and cognitive restraint. That is, those who reported higher levels of childhood emotional neglect, also reported experiencing lower levels of cognitive reappraisal, and in turn higher levels of cognitive restraint. The second indirect effect found was between CEA, successful thought suppression and cognitive restraint. That is, the participants who reported higher levels of childhood emotional abuse, also reported lower levels of successful thought suppression, which in turn was associated with higher levels of cognitive restraint.

INSERT FIGURE 1 ABOUT HERE

3.3.2.2. Uncontrolled eating. The tests of indirect effects with uncontrolled eating as the dependent variable are displayed in Table C in the supplementary material. Figure 2 illustrates the significant direct and indirect pathways. A significant small positive indirect effect was demonstrated for CEA, CPA, CSA, CEN, and CPN. In particular, CPN, CEA, CPA and CSA were all associated with higher levels of intrusive thoughts, which in turn was associated with higher levels of uncontrolled eating. In contrast, higher levels of CEN was associated with lower levels of cognitive reappraisal, which in turn was associated with lower levels of uncontrolled eating.

INSERT FIGURE 2 ABOUT HERE

3.3.2.3. Emotional eating. Tests of indirect effects with emotional eating as the dependent variable are presented in Table D in the supplementary material. Figure 3 demonstrates the significant direct and indirect pathways. The three forms of childhood abuse (CEA, CPA and CSA) were all associated with higher levels of intrusive thoughts, which in turn was associated with higher levels of emotional eating. In contrast, higher levels of CEN

was associated with lower use of cognitive reappraisal, which in turn was associated with lower levels of emotional eating.

INSERT FIGURE 3 ABOUT HERE

4. Discussion

The present study extends the previous literature on disordered eating (DE) in the general population by providing evidence of indirect paths from childhood maltreatment (CM) through subcomponents of emotion regulation. This exploratory cross-sectional analysis partially supported the hypothesised multiple mediation models, with indirect effects from CM through higher levels of intrusive thoughts and lower levels of cognitive reappraisal in uncontrolled and emotional eating. While indirect effects were also found with cognitive reappraisal and successful thought suppression mediating the relationships between two forms of CM and cognitive restraint.

4.1. Hypothesis 1

The findings partially supported the hypothesis that indirect effects would be evidenced between all forms of CM and the two DE behaviours through decreased use of adaptive emotion regulation strategies: cognitive reappraisal and successful thought suppression. Our study only found this hypothesised indirect effect between childhood emotional neglect and both uncontrolled eating and emotional eating. That is, the participants who reported higher levels of childhood emotional neglect were less likely to utilise cognitive reappraisal and so in turn were more likely to experience higher levels of uncontrolled eating and emotional eating. This mediating association was not found for any other form of CM. Neither did the use of successful thought suppression mediate the associations between any of the CM and the two DE behaviours.

Given the lack of consensus on the harmful versus beneficial effects of cognitive restraint in the literature, we considered cognitive restraint a neutral eating behaviour for the purpose of this study. As such, we did not expect to find the same pattern of indirect effects that were present for uncontrolled eating and emotional eating with cognitive restraint. However, in contrast to these expectations, we did find two indirect effects between CM and cognitive restraint. In the first, we found that the participants who experienced higher levels of childhood emotional neglect, tended to have lower use of cognitive reappraisal and so in turn experienced higher levels of cognitive restraint. Similarly, those who reported higher levels of emotional abuse tended to utilise lower levels of successful thought suppression and in turn experienced higher levels of cognitive restraint. Dietary restriction has been reported to increase the subjective perception of being in control (Slade, 1982) which was supported in the current study by the positive associations for cognitive reappraisal and successful thought suppression with restrictive eating.

Evidence linking the experience of CM with difficulties in emotion regulation are well documented. Conway et al. (2004) explained that when a child grows up in an environment characterised by volatility and stress, the child may learn to become more passive, while also developing an attentional bias to threats outside their control. This hypervigilance to threat may support the child's short-term self-preservation. However, Weissman et al. (2019) suggested this may be at the expense of developing adaptive functioning skills, such as problem solving or cognitive reappraisal. To the authors knowledge, successful thought suppression has not been investigated within the context of CM. However, there is growing research on the impact of CM on abnormal neurological functioning when engaging in cognitive reappraisal (Lee et al., 2020; McLaughlin et al., 2015). Cognitive reappraisal and thought suppression employ top-down processes and engage similar neuronal networks to regulate emotions (Gagnepain et al., 2017; Zilverstand et al.,

2017). From the results of this study, it would seem that children who are exposed to trauma in childhood, particularly to either emotional neglect or emotional abuse, are less likely to learn adaptive emotion regulation strategies such as cognitive reappraisal or successful thought suppression. This appears to make it more likely for these individuals to engage in the three eating behaviours measured in this study.

Preacher and Hayes (2008) advise that significant total indirect effects are not a requirement for investigating specific indirect effects. As this study was exploratory in nature, these specific indirect relationships were notable. In this study, both cognitive reappraisal and successful thought suppression demonstrated significant positive correlations with cognitive restraint. There is a lack of empirical evidence linking deficits in adaptive emotion regulation and successful restrictive eating practices in nonclinical populations. However, high levels of negative affect have been reported to interrupt an individual's capacity for cognitive control required for dietary restraint, leading restrained eaters to engage in binge eating (Kukk & Akkermann, 2019). Haynos and colleagues (2018) found in a nonclinical sample, individuals who endorsed damaging restrictive eating had general difficulties with emotion regulation, and specific deficits in selecting suitable emotion regulation strategies when distressed, constraining impulsive behaviour, and engaging in goal-directed behaviour. In support of the findings of Haynos and colleagues (2018), this study found that decreased engagement of cognitive reappraisal and/or successful thought suppression was associated with greater endorsement of cognitive restraint.

4.2. Hypothesis 2

The hypothesis that significant indirect effects would be evidenced between all forms of CM and DE, through elevated levels of expressive suppression, and both thought suppression attempts and intrusive thoughts, was partly supported. Of the three maladaptive emotion regulation strategies examined, only intrusive thoughts proved to be a significant

mediator. Intrusive thoughts mediated the relationship between three forms of childhood abuse (emotional abuse, physical abuse, and sexual abuse) and two forms of disordered eating behaviours (uncontrolled eating and emotional eating). In addition, intrusive thoughts mediated the relationship between physical neglect and uncontrolled eating. These indirect effects were not found for cognitive restraint.

Elevated levels of intrusive thoughts have been strongly associated with CM (Barzilay et al., 2019a), and have been conceptualised as a universal indicator for general psychopathology (Barzilay et al., 2019b). The association between CM and intrusive thoughts was consistent across most of the maltreatment types, which could suggest that unwanted intrusive thoughts are a general consequence of maltreatment, and not specific to a maltreatment type. These maladaptive subcomponents of emotion regulation have been hypothesised to relate to impulsive eating behaviours (Weinbach et al., 2018). As such, it makes sense that these indirect effects were evidenced for the two reactive DE behaviours, and not for cognitive restraint.

Given that differential emotion regulation strategies appear to be associated with specific eating behaviours (e.g. Haynos et al., 2018; Strodl & Wylie, 2020), investigating emotion regulation strategies that are more closely related to the overcontrol of thoughts and emotions, in relation to cognitive restraint, could provide more valuable insight into this behaviour. In addition, while the strength of the indirect effects found in this study were largely comparable to the strength of the indirect effects found in Strodl and Wylie (2020), it is notable that the strength of the indirect effect between childhood emotional abuse, intrusive thoughts and emotional eating and uncontrolled eating were the strongest across both studies.

4.3. Implications and future directions

Within the existing literature, emotion dysregulation had typically been modelled with CM as single construct rather than researchers investigating the specific outcomes of CM types (e.g. Sistad et al., 2021). The associations reported in this study generally do not support the idea that different types of CM result in different emotion regulation difficulties. Instead, most forms of CM were associated with both uncontrolled eating and emotional eating via intrusive thoughts. Future research may benefit from investigating the nature of the content and form of the intrusive thoughts that are most strongly associated with uncontrolled and emotional eating.

Another implication of the current study related to the role of thought suppression. The findings failed to detect an indirect effect for thought suppression attempts, which should go hand-in-hand with intrusive thoughts if it was to be recognised as being part of the emotion regulation process. Existing research has modelled thought suppression as a unidimensional construct (e.g. Höping & de Jong-Meyer, 2003); or when a three-factor structure has been tested (e.g. Rassin, 2003; van Schie et al., 2016), the mediation effects have been tested using parallel modelling. Issues with measuring thought suppression as a unidimensional construct have been well documented (e.g. Höping & de Jong-Meyer, 2003; Rassin, 2003). There is a possibility that thought suppression may be better modelled as a sequential mediation model, rather than a parallel model (Preacher & Hayes, 2008) to gain new insights into the unique contribution of thought suppression in relation to intrusive thoughts and ensuing psychopathology. However, this recommendation requires empirical testing.

Lastly, the findings of this study support the compelling evidence that emotion regulation deficits may represent a core underlying factor in the aetiology and maintenance of subclinical DE (Sloan et al., 2017). A recent meta-analysis identified the habitual use of a range of emotion regulation strategies including acceptance, behavioural avoidance,

distraction, experiential avoidance, expressive suppression, mindfulness, problem-solving, reappraisal, rumination, and worry (Naragon-Gainey et al., 2017). The study established that these factors had little redundancy, reasonable discriminant validity and little correlation between factors. Future research should investigate whether this broader range of emotion regulation strategies may also be important mediators of the association between CM and DE.

4.4. Limitations

Despite the contributions of this research, some limitations must be noted. Data collection took place during the immediate COVID-19 pandemic, the impacts of which is unclear. The participants in this study estimated that compared to their eating behaviour prior to COVID-19 restrictions, 55% engaged in cognitive restraint and 65% engaged in uncontrolled and emotional eating at similar levels. It is likely that additional social or emotional factors associated with COVID-19 may have modified the eating behaviours of the remaining participants. For example, systematic reviews of people's emotional responses to the COVID 19 pandemic have consistently shown elevated levels of mental health problems throughout the world (Cénat et al., 2021; Wu et al., 2021). . It is therefore likely that participants in this study were in a heightened state of stress when completing the survey, which may impact the generalisability of the findings. In the current sample, significantly higher scores were observed on all psychometric test scores, than comparative data, except for cognitive reappraisal and successful thought suppression. This could indicate the current sample had elevated levels of psychopathology which may have affected the results. Indeed, there is emerging evidence that distress and social isolation associated with COVID-19 increases emotional eating (Cecchetto et al., 2021). However, the impact of COVID-19 upon eating behaviours is complex as 24 percent, 15 percent and 8 percent of our participants also reported decreases in cognitive restraint, uncontrolled eating and emotional eating,

respectively. As such, the impact of COVID-19 upon our results is unknown and our findings need to be replicated in a post-pandemic population.

Another limitation was the overrepresentation of female participants in the sample, which meant that inferences about gender-differences could not be made. Although gender was controlled for as a covariate, Mills et al. (2015) highlighted that gender-differences can be of specific interest when investigating eating behaviour, and a more representative sample should be pursued in future research. In addition, our study limited the measure of race or ethnicity to asking the participants whether they came from an English-speaking background. This restricted the clarity of the generalisability of the findings.

An important limitation also concerns the validity of the self-reporting tool used to measure thought suppression. The TSI-R is a relatively new measure with limited psychometric performance testing across different populations. While the internal reliability in the current sample was excellent, more replication studies are needed. Another limitation of this study was that the external validity was limited because only self-report measures were used which can be subject to social desirability biases (Kuncel & Tellegen, 2009). Future studies should consider implicit measures of emotion regulation to reduce response bias. A further limitation was the cross-sectional nature of this study, preventing causal interpretations being made. Future studies would benefit from using a longitudinal design. As this was one of the first studies to investigate the indirect effects of these emotion regulation strategies in relation to CM and DE in a community sample, further research is necessary to determine if the findings are generalisable.

5. Conclusion

Unfortunately, CM is a worldwide problem. The literature has identified that exposure to CM can result in a heightened risk of DE. To date, interventions for disordered eating behaviours have had only moderate effectiveness, possibly due to the mechanisms linking CM to DE

being poorly understood. This study examined the indirect effects of emotion regulation strategies between CM and DE behaviours. The findings revealed that elevated levels of CM were associated with increased levels of DE, through direct and indirect pathways. Significant indirect pathways were detected though positive associations with intrusive thoughts, and an inverse relationship with cognitive reappraisal with uncontrolled eating and emotional eating. In addition, an inverse mediating relationship was found between childhood emotional neglect, cognitive reappraisal and cognitive restraint, as well as between childhood emotional abuse, successful thought suppression and cognitive restraint. While developing interventions that identify and support families at risk of CM, improving targeted interventions that lessen the negative consequences of maltreatment in adults is also important. The findings from this study provide important direction on emotion regulation strategies being possible psychological targets for future interventions for disordered eating resulting from CM.

Author contributions

DD and ES designed the study. DD oversaw the data collection. DD performed the data analysis under the supervision of ES. DD was the primary author of the manuscript with ES and HK reviewing and revising the manuscript. All authors have approved the final article.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare no competing interests.

Data code and availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Table 1Demographic Characteristics of Sample (*N*=461)

Characteristic	<i>n</i> (%)
Marital status	
Single	134 (29.1)
Married	187 (40.7)
Divorced	36 (7.8)
Co-habiting	71 (15.4)
Other	32 (7.0)
Highest level of education	
Year 10 High School	10 (2.2)
Year 12 High School	79 (17.1)
Technical College (TAFE)	67 (14.5)
Bachelor's degree	152 (33.0)
Post-Graduate Degree/Diploma	71 (15.4)
Master/Doctoral Degree	83 (17.97)
Employment status	
Full-time	219 (47.5)
Part-time/casual	94 (20.4)
Self-employed	48 (10.4)
Unemployed	74 (16.1)
Homemaker	26 (5.6)
Annual income	
\$0 - \$14,999	87 (19.2)
\$15,000 - \$34,999	91 (20.1)
\$35,000 - \$49,000	48 (10.6)
\$50,000 - \$64,999	37 (8.2)
\$65,000 - \$74,999	30 (6.6)
\$75,000 - \$99,999	68 (15.0)
\$100,000 - \$159,999	59 (13.0)
\$160,000+	33 (7.3)
English speaking background	
Yes	399 (86.6)
No	62 (13.4)

Table 2

Bivariate Correlations, Means (SD) and Comparison Means (SD) for Independent and Dependent Variables

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Emotional Abuse	-												
2. Physical Abuse	.61***	-											
3. Sexual Abuse	.32***	.30***	-										
4. Emotional Neglect	.75***	.54***	.32***	-									
5. Physical Neglect	.59***	.48***	.36***	.69***	-								
6. TSI (a)	.43***	.19**	.28***	.34***	.29***	-							
7. TSI (b)	.18***	0.04	.13***	.09	.13**	.40***	-						
8. TSI (c)	-.20***	-0.06	-.14**	-.18***	-.13**	-.52***	.11*	-					
9. ERQ (a)	-.21***	-.12***	< -.01	-.29***	-.16***	-.35***	.20***	.44***	-				
10. ERQ (b)	.19***	.19***	.13***	.25***	.17***	.27***	.32***	.06	-.05	-			
11. TFEQ - CR	.10*	.05	.09	.06	.04	.02	.14**	.16***	.21***	.07	-		
12. TFEQ - UE	.23***	.10*	.11**	.11**	.06	.42***	.25***	-.18***	-.18***	.18***	-.02	-	
13. TFEQ - EE	.27***	.10*	.18***	.17***	.10**	.45***	.22***	-.20***	-.20***	.16***	-.06	.73***	-
Mean (SD)	10.95 (5.31)	7.68 (3.57)	7.23 (4.68)	11.51 (5.06)	7.61 (3.99)	20.80 (6.38)	24.01 (4.78)	19.04 (5.22)	4.60 (1.24)	3.73 (1.42)	2.48 (0.63)	2.27 (0.69)	2.41 (0.92)

Note. $N = 462$; TSI = Thought Suppression Inventory - Revised. ERQ = Emotion Regulation Questionnaire. TSI (a) intrusive thoughts; TSI (b) = thought suppression attempts; TSI (c) = successful thought suppression; ERQ (a) = cognitive reappraisal; ERQ (b) = expressive suppression. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3

Hierarchical Multiple Regression Analysis of CM for Cognitive Restraint, Uncontrolled Eating, and Emotional Eating

	Cognitive Restraint			Uncontrolled Eating			Emotional Eating		
	<i>B</i> (95% CI)	β	<i>sr</i> ²	<i>B</i> (95% CI)	β	<i>sr</i> ²	<i>B</i> (95% CI)	β	<i>sr</i> ²
Step 1									
Constant	2.40 (2.18, 2.62)			2.91 (2.69, 3.14)			2.63 (2.32, 2.95)		
Age	<.01 (<.01, <.01)	-.01	<.01	-.01 (-.02, -.01)	-.29*	.07	-.01 (-.01, .00)	-.11*	.01
Female	.13 (-.02, .04)	.09	.01	-.06 (-.20, .09)	-.03	<.01	.17 (-.03, .37)	.09	.01
Income	.01 (-.01, .04)	.05	<.01	-.02 (-.05, .01)	-.06	<.01	-.04 (-.08, .00)	-.10*	.01
Education level	-.01 (-.06, .03)	-.04	<.01	-.01 (-.05, .04)	-.02	<.01	.02 (-.04, .08)	.01	<.01
	$R^2 = .01$			$R^2 = .10^*$			$R^2 = .04^*$		
Step 2									
Constant	2.24 (1.94, 2.53)			2.63 (2.36, 3.90)			2.17 (1.79, 2.54)		
Emotional Abuse	.02 (<-.01, .03)	.13	<.01	.03 (.01, .05)	.24*	.02	.03 (.01, .06)	.18*	.01
Physical Abuse	-.01 (-.03, .02)	-.03	<.01	.01 (-.01, .03)	.05	0	.00 (-.03, .03)	-.02	<.01
Sexual Abuse	.01 (<-.01, .02)	.07	<.01	.01 (<-.01, .02)	.07	.01	.03 (.01, .05)	.14*	.02
Emotional Neglect	<.01 (-.02, .02)	.01	<.01	<-.01 (-.03, .02)	-.03	0	.01 (-.02, .04)	.05	<.01
Physical Neglect	-.01 (-.03, .02)	-.05	<.01	-.02 (-.05, <.01)	-.11	.01	-.02 (-.06, .01)	-.08	<.01
	$\Delta R^2 = .02$			$\Delta R^2 = .05^*$			$\Delta R^2 = .06^*$		

Note. Gender reference category = Male. ΔR^2 = change in R^2 . sr^2 = Squared semi partial correlation. *B* = Unstandardized coefficients. β = Standardized coefficients. CI = Confidence intervals. * $p < .05$, ** $p < .01$

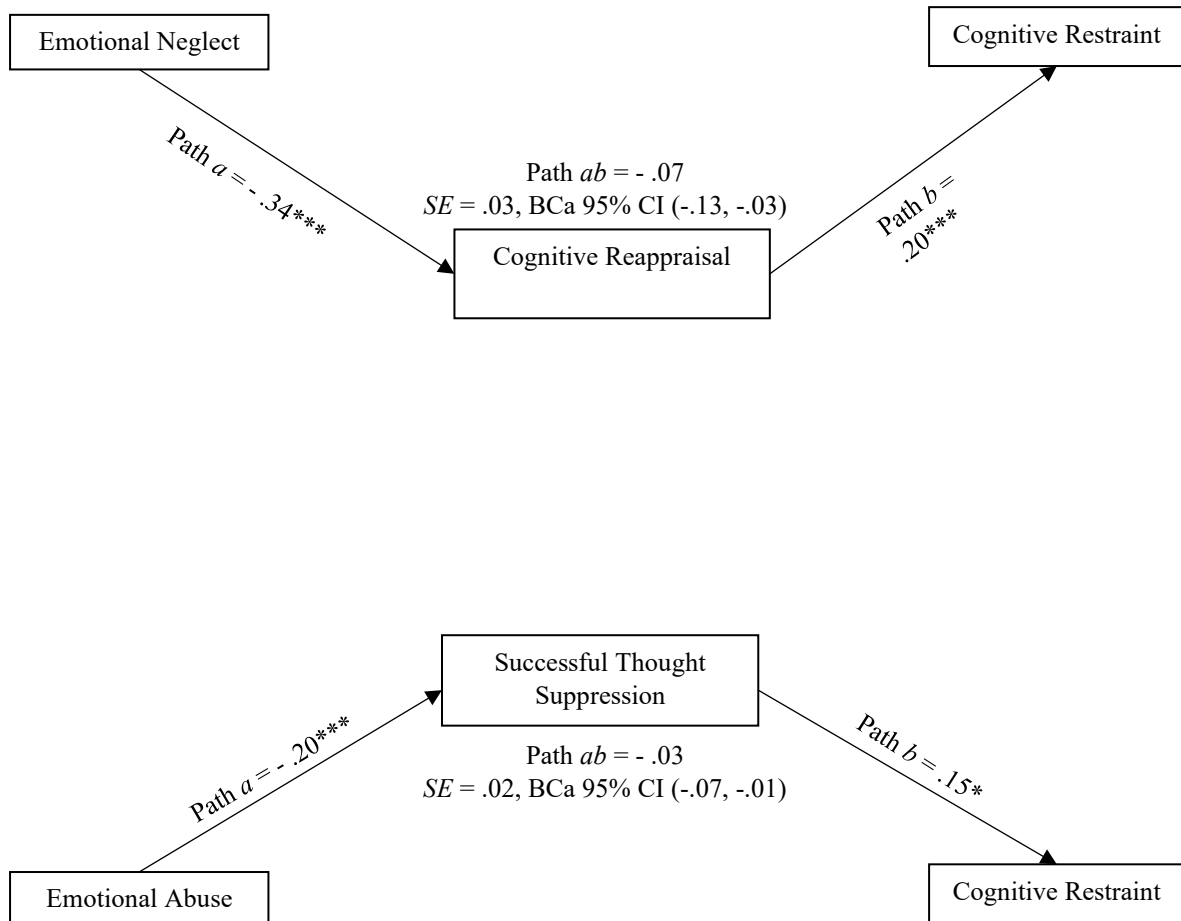


Figure 1. Significant indirect and direct pathways from childhood maltreatment to cognitive restraint. Standardised coefficients reported. BCa 95% CI = bias corrected and accelerated bootstrapped confidence intervals. Confidence intervals are based on 5,000 samples. $*p < .05$, $**p < .01$, $***p < .001$. All factors of child maltreatment were included as covariates.

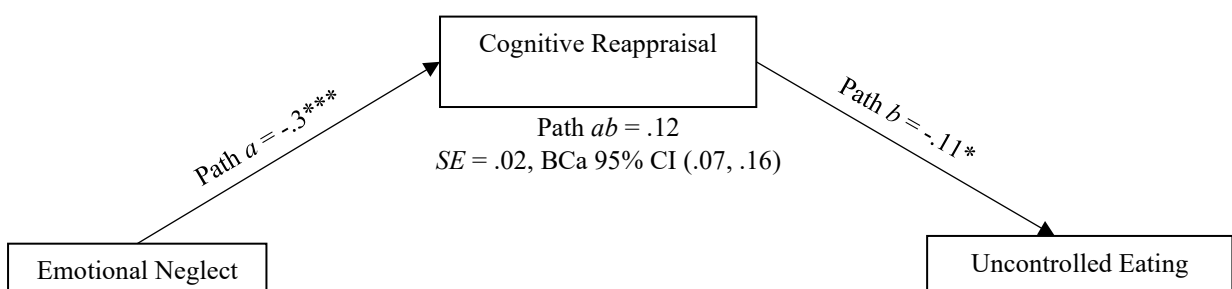
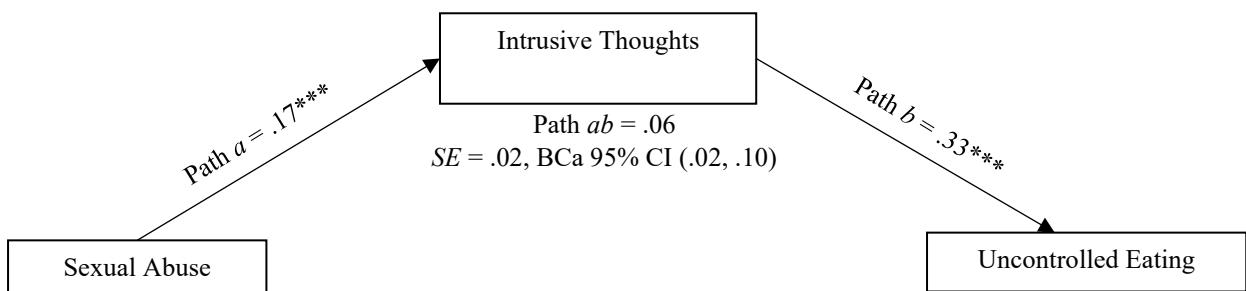
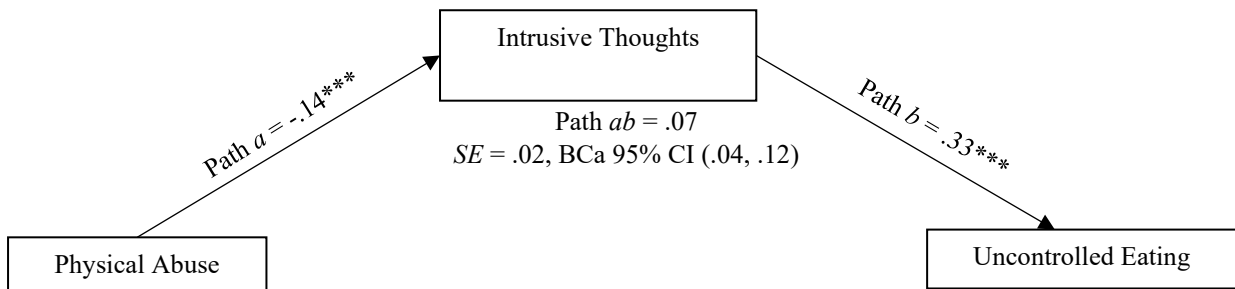
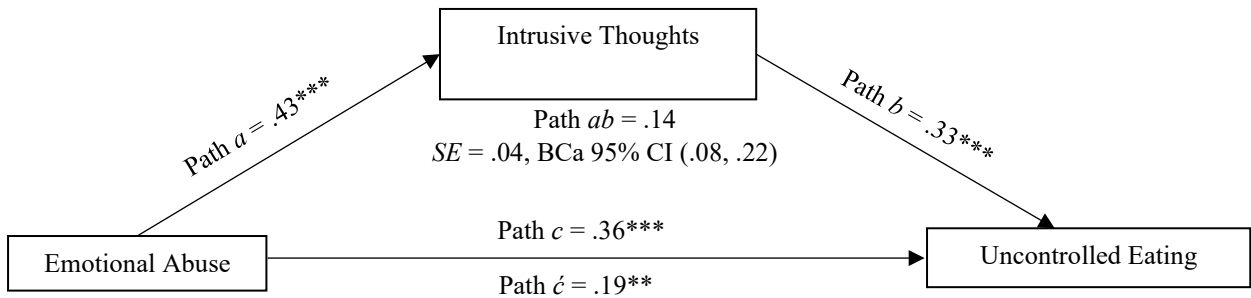
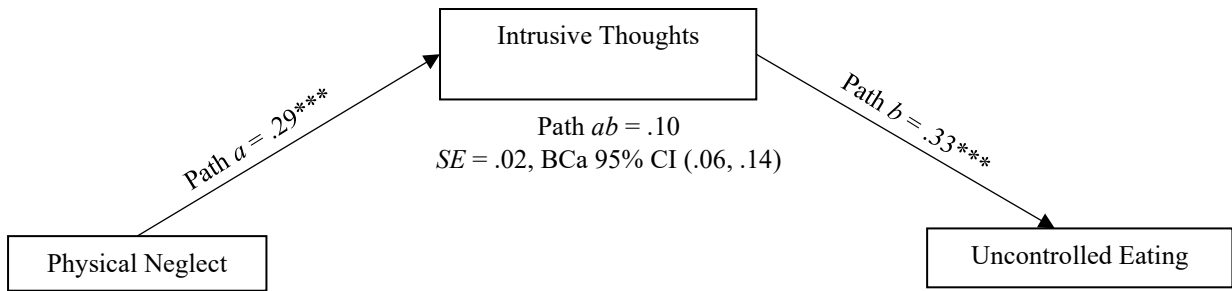


Figure 2. Significant direct and indirect pathways from childhood maltreatment to uncontrolled eating. Standardised coefficients reported. BCa 95% CI = bias corrected and accelerated bootstrapped confidence intervals. Confidence intervals are based on 5,000 samples. * $p < .05$, ** $p < .01$, *** $p < .001$. All factors of child maltreatment were included as covariates.

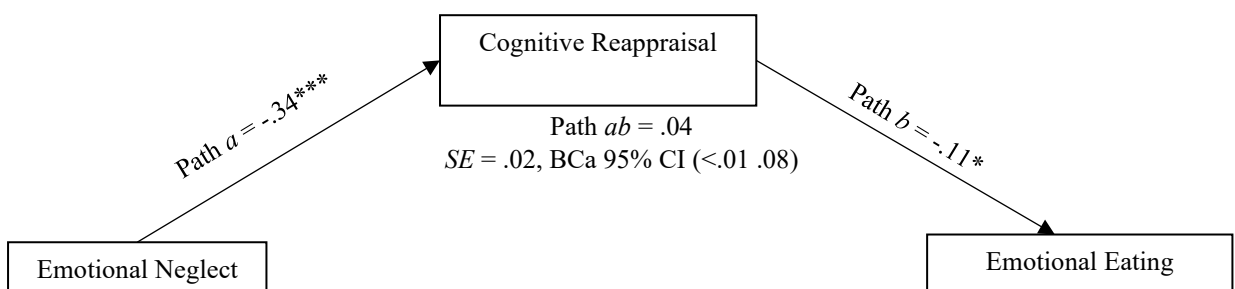
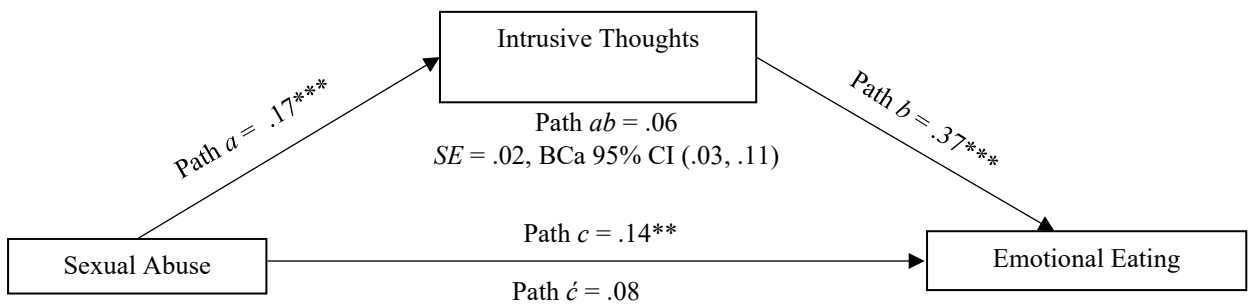
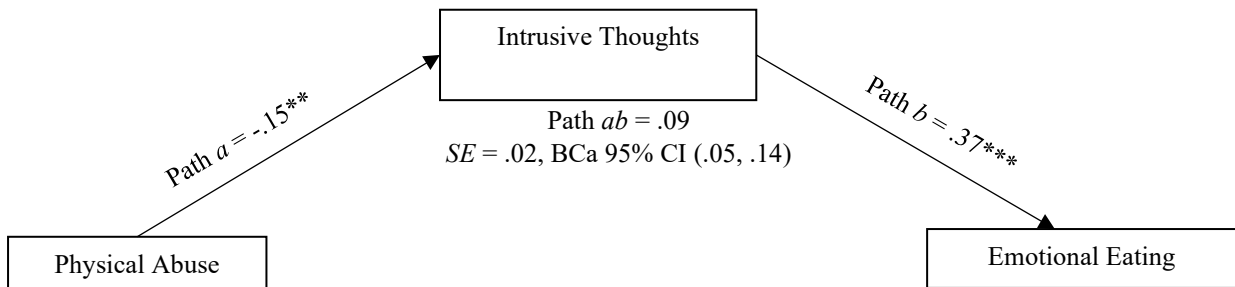
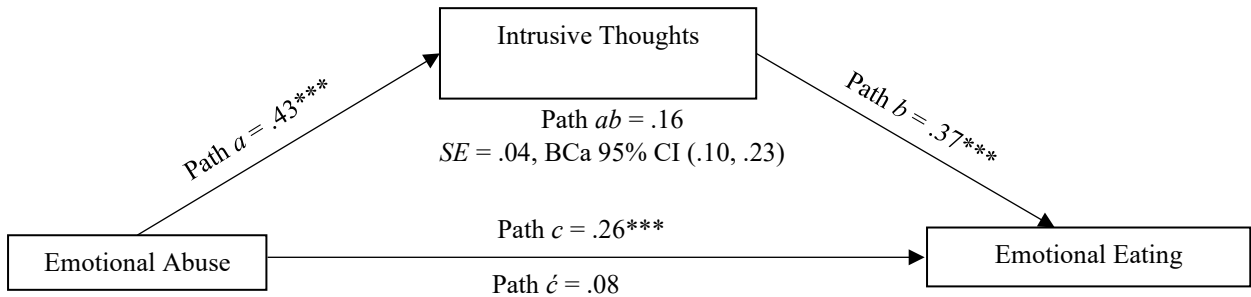


Figure 3. Significant direct and indirect pathways from childhood maltreatment to emotional eating. Standardised coefficients reported. BCa 95% CI = bias corrected and accelerated bootstrapped confidence intervals. Confidence intervals are based on 5,000 bootstrapped samples. * $p < .05$, ** $p < .01$, *** $p < .001$. All factors of child maltreatment were included as covariates.