



## Regular Article

# To what extent do social support and coping strategies mediate the relation between childhood maltreatment and major depressive disorder: A longitudinal community-based cohort

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### Abstract

This study aimed to articulate the roles of social support and coping strategies in the relation between childhood maltreatment (CM) and subsequent major depressive disorder (MDD) with a comprehensive exploration of potential factors in a longitudinal community-based cohort. Parallel and serial mediation analyses were applied to estimate the direct effect (DE) (from CM to MDD) and indirect effects (from CM to MDD through social support and coping strategies, simultaneously and sequentially). Sociodemographic characteristics and genetic predispositions of MDD were considered in the modeling process. A total of 902 participants were included in the analyses. CM was significantly associated with MDD (DE coefficient ( $\beta$ ) = 0.015, 95% confidence interval (CI) = 0.002~0.028). This relation was partially mediated by social support (indirect  $\beta$  = 0.004, 95% CI = 0.0001~0.008) and negative coping (indirect  $\beta$  = 0.013, 95% CI = 0.008~0.020), respectively. Social support, positive coping, and negative coping also influenced each other and collectively mediated the association between CM and MDD. This study provides robust evidence that although CM has a detrimental effect on later-on MDD, social support and coping strategies could be viable solutions to minimize the risk of MDD. Intervention and prevention programs should primarily focus on weakening negative coping strategies, then strengthening social support and positive coping strategies.

**Keywords:** childhood maltreatment; coping strategies; depression; resilience; social support

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Childhood maltreatment (CM) is a global issue with serious life-long consequences (Fang et al., 2015; Ferrara et al., 2015; Gilbert et al., 2009). Up to one billion children aged 2–17 years had experienced various types of CM, including physical, sexual, or emotional abuse or neglect (Hillis et al., 2016). CM substantially increases the likelihood of later-on mental health problems, for instance, it can increase the risk of depression by 2–3-fold (Chapman et al., 2004; Li et al., 2016).

Social support and coping strategies are the most frequently studied factors that are involved in the relation between CM and mental health outcomes (Runtz & Schallow, 1997; Vranceanu et al., 2007; Zhao et al., 2019). Social support refers to an individual's perception of being loved, cared for, respected, and valued by other members of

the community (Cobb, 1976). Coping strategies refer to psychological patterns that individuals use to manage thoughts, feelings, and actions (Franklin, 2014; Lazarus & Folkman, 1984) and are generally categorised into positive and negative coping (or adaptive and maladaptive coping) based on the outcomes that have been associated with these behaviors (Smedema & McKenzie, 2010). The associations between social support, coping strategies, and mental health outcomes are often made under the context of a stress coping framework (Chernomas, 2014). Reviews have consistently synthesized that both social support and positive coping strategies are associated with positive health outcomes in maltreated victims (Domhardt et al., 2015; Dufour et al., 2000; Meng et al., 2018; Su et al., 2020), whereas negative coping strategies are associated with more severe psychiatric problems, depressive symptoms, and life dissatisfaction (Gustems-Carnicer & Calderón, 2013; Hebert et al., 2009).

Studies have been conducted to explore the potential mechanisms of social support and coping strategies in the relation between CM and depression. Many cross-sectional studies have

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tested both moderating (Dale et al., 2015; Easton et al., 2017; Eisman et al., 2015) as well as mediating (Arslan, 2017; Lagdon et al., 2021; Massing-Schaffer et al., 2015; White Hughto et al., 2017) effects in the relation between CM and depression. The correlations between perceived social support and coping strategies have also been well-documented (Çevik & Yildiz, 2017; Fiksenbaum et al., 2006; Holahan, Valentiner, et al., 1995; Roohafza et al., 2014). Previous literature suggests that social support and coping strategies could act in a sequential manner to mediate different health outcomes. For instance, high social support predicted less subsequent depression in cardiac illness patients, and this relation was partially mediated by adaptive coping strategies (Holahan, Moos, et al., 1995). A more recent study discovered mediating effects of positive and negative coping strategies in the relation between social support and anxiety symptoms in Chinese medical staff during the COVID-19 pandemic (Zhu et al., 2020). Studies also suggested that social support may also mediate the relation between coping strategies and mental health outcomes. The mediating roles of three sources of social support (subjective support, family support, and counselor support) were found between cognitive coping and behavioral coping, and anxiety, respectively (Li & Peng, 2021). This finding could be partially explained by the fact that social support could serve as coping assistance (Thoits, 1986), and it could work with positive coping strategies to eliminate or alter problematic demands and control the feelings of anxiety or depression that are usually triggered by those demands.

Radell et al. (2021) suggested that different types of CM may have different etiological contributions relating to depression. For example, psychological abuse was often found to be strongly associated with depression later in life (Infurna et al., 2016; Powers et al., 2009; Shapero et al., 2014; Spertus et al., 2003) and depression severity (Nelson et al., 2017), whereas neglect was a stronger predictor of adult depression compared to physical and sexual abuse in childhood (Powers et al., 2009). The mediating effects of social support and coping strategies had also been separately examined in the relations between specific types of CM and depression (Berg et al., 2017; Zhang et al., 2020; Zhou et al., 2019). However, there is a lack of research conducted to compare the mediating effects of social support and coping strategies in the relations between various types of CM and depression.

Depression is moderately inheritable (probably 40%~50%) (Levinson & Nichols, 2022) and ample studies have recognized the joint contributing roles of genetic predispositions and CM in depression (Grabe et al., 2010; Li, Liu et al., 2020; Normann & Buttenschön, 2020). It is well accepted that CM interacts with genetic vulnerability to produce lasting effects on the neural structure or function and stress physiology (McEwen et al., 2015) and increases the risk of mental disorders (McEwen, 2007). For example, the polymorphisms of 5-HTTLPR which are involved in the regulation of serotonergic signaling and emotional behaviors and play an important role in brain development and function were found to interact with CM in determining the risk of adult depression (Brown et al., 2013; Caspi et al., 2003). Studies have also been conducted to investigate the genetic basis of stress coping which in turn related to the development of depression (Horwitz et al., 2018; Skapinakis et al., 2020). Met allele carriers of brain-derived neurotrophic factor reported higher levels of emotion-focused coping strategies compared to Val/Val individuals (Caldwell et al., 2013). A systematic review of genetic influences on stress coping strategies also discovered differential coping strategies among people with different genotypes of the serotonin

transporter (SLC64A) and the adrenergic receptor beta 2 (ADRB2) (Dunn & Conley, 2015). Because of the role of genetic predispositions in stress coping and to control its potential confounding in the relation between CM and depression, it is crucial to control for genetic predispositions while examining the roles of social support and coping strategies in the relation between CM and subsequent depression.

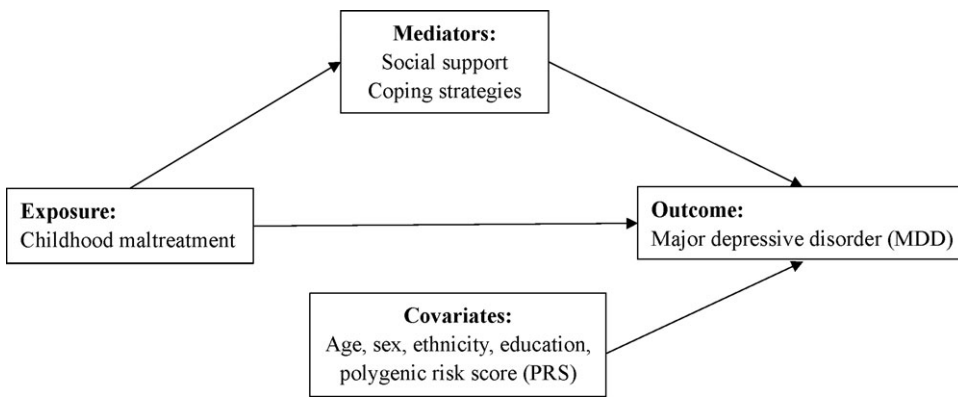
The literature highlights the importance of social support and coping strategies in the relation to CM and depression and has valuable attempts to identify their specific roles in this relation. An in-depth exploration of the sequential order of social support and coping strategies is needed to triangulate their roles in the relation between CM and depression. There are several limitations in the literature: (a) previous mediation studies were mainly cross-sectional without temporal order among studied variables (Lagdon et al., 2021; Li & Peng, 2021; Zhu et al., 2020). There is a lack of causal evidence on the mediating effects of social support and coping strategies in the relation between CM and depression. (b) Little is known about the sequential chains among social support and coping strategies as mediators in this relation. (c) A better understanding of how social support and coping strategies mediate the relations between different types of CM and major depressive disorder (MDD) can help to elucidate the differential effects of various stressors in MDD. (d) Other meaningful factors, such as sociodemographic characteristics and genetic predispositions, have not been comprehensively studied in previous mediation studies either.

To address the knowledge gap in the potential mediating effects of social support and coping strategies, the present study aimed to articulate their roles in the relation between CM and subsequent depression with a comprehensive exploration of other potential factors in a longitudinal cohort study. We hypothesized that social support and coping strategies not only simultaneously but also sequentially mediate the relation between CM and depression. Figure 1 presents the conceptual framework of the present study. This study also tested all the possible serial chains among social support and coping strategies to explore their potential mechanisms in the relation between CM and depression, which can (a) help to explain why maltreated individuals are more likely to develop depression in adulthood on average, and (b) direct intervention and prevention strategies and efforts for maximum payoff. We also compared the mediating effects of social support and coping strategies in the relations between different types of CM and depression and considered the genetic predispositions of depression and sociodemographic characteristics (age, sex, ethnicity, and education) that might also contribute to the different likelihood of depression onset.

## Method

### Study cohort

The Zone d'Épidémiologie Psychiatrique du Sud-Ouest de Montréal (ZEPSOM) cohort is a large-scale, longitudinal, community-based, population cohort from Southwest of Montreal, Canada. A total of 2,433 participants (aged 15–65) were randomly selected to represent a mixed Francophone and Anglophone population of 269,720 living in the five neighbourhoods of Montreal in 2007. Details of the ZEPSOM cohort and data collection procedure can be found in a previous study (Caron et al., 2012). A total of 1,351 participants having five data collections with genetic sequencing and psychosocial attributes in psychiatric disorders from 2007 to 2018 were eligible for this study. Of which, 902



**Figure 1.** The conceptual framework of the present study.

ZEPSOM participants aged 17 years and over provided complete information on the studied variables (CM at Wave V; MDD at Wave IV; social support, coping strategies, and all covariates at Wave III) and were included in this study. There was no significant difference between the study sample ( $N = 902$ ) and the total sample ( $N = 1,351$ ) in terms of age, sex, polygenic risk score ( $PRS_{MDD}$ ), education, and ethnicity (see Appendix 1).

## Measurements

### Major depressive disorder

MDD was assessed at Wave IV (2014–2015) by the Composite International Diagnostic Interview that is a structured diagnostic tool that generates psychiatric diagnoses according to the definitions and criteria of the ICD-10 and DSM-IV (Kessler et al., 2004; Kessler & Üstün, 2004). MDD diagnosis was derived from the interview using the algorithms provided by Statistics Canada.

### Childhood maltreatment

CM was assessed at Wave V (2017–2018) using the Childhood Trauma Questionnaire (CTQ). The CTQ retrospectively assesses experiences of abuse and neglect in childhood before 16 years of age, including physical, emotional, and sexual abuse, and physical and emotional neglect. It has demonstrated good reliability and validity in the initial evaluation study (Bernstein et al., 1994). The Cronbach's alpha value in this study was 0.92 for the total score, 0.85 for emotional abuse, 0.79 for physical abuse, 0.90 for sexual abuse, 0.84 for emotional neglect, and 0.63 for physical neglect.

### Social support

Social support was assessed at Wave III (2012–2013) using the Social Provision Scale (SPS) (Cutrona & Russell, 1987) which covers a wide range of measures, including attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance. SPS has demonstrated good psychometric properties and was translated and validated in French (Caron, 1996). The Cronbach's alpha value in this study was 0.91.

### Coping strategies

Coping strategies were evaluated at Wave III (2012–2013) from several items drawn from three scales including the Coping Strategies Index, the Ways of Coping-Revised, and COPE (Amirkhan, 1994; Carver et al., 1989; Clark et al., 1995; Vitaliano et al., 1985) used by the Canadian Community Health Survey Cycle 1.2 Mental Health (CCHS 1.2). Good psychometric qualities of these three instruments have been reported previously (Clark et al., 1995). Based on previous factor analytic work (Baetz &

Bowen, 2008; Graff et al., 2009), we used principal component analysis with varimax rotation to derive a two-factor solution specifying positive and negative coping strategies from the CCHS Coping scale (results are available upon request). An index variable was created to indicate positive coping strategies, including the following items: *trying to solve the problem*, *speaking to others*, *doing something enjoyable*, and *looking on the bright side*. An index variable for negative coping strategies was from the following items: *avoiding the company of others*, *sleeping more than usual*, *changing eating habits*, *alcohol consumption*, *drug consumption*, *blaming oneself*, and *magical thinking*. One item (*spiritual help*) did not load on any factor and was not used in the computation of the coping index variables. Two items (*physical exercise* and *more smoking*) were removed from the computation of the index variables since their removal significantly increased the reliabilities of the index variables for positive and negative coping strategies, respectively. Cronbach's alpha values in this study for the positive and negative coping items were acceptable (0.51 and 0.59, respectively).

### Covariates

Age, sex, ethnicity, and education measured at Wave III (2012–2013) were included in the models as time-invariant covariates. A PRS for major depression ( $PRS_{MDD}$ ) was also considered as a covariate in the analysis. PRS is a method of aggregation conceptualized as an indicator of the diathesis used to test the predictive power of multiple genetic variants simultaneously (International Schizophrenia Consortium, 2009).  $PRS_{MDD}$  was used as a summary genetic score to represent the contribution of genetic risk for MDD.  $PRS_{MDD}$  reflects the number of genetic variants (alleles) nominally associated with a trait, weighted by the odds ratio between a given variant and the presence of MDD, with a higher PRS indicating a greater genetic propensity for MDD (Howard et al., 2018). In the present study, the  $PRS_{MDD}$  was produced using the GWAS summary statistics of per single-nucleotide polymorphisms from the Psychiatric Genomics Consortium with the  $p$ -value threshold of 0.05.  $PRS_{MDD}$  was then calculated for each study participant. The detailed procedure of calculating PRS from raw genotyped data is presented in Appendix 2.

### Statistical Analyses

We conducted comparative analyses on demographic characteristics between the study sample ( $N = 902$ ) and the total sample ( $N = 1351$ ) by  $t$ -test and chi-square test. Descriptive analyses were used to explore the distribution of exposure (CM), mediators (social support, positive and negative coping strategies) and

covariates (age, sex, ethnicity, education, and  $PR_{MDD}$ ) by outcome (MDD).  $PR_{MDD}$  was standardized to explore potential variances. Univariate analyses were conducted to investigate potential associations between the studied variables and MDD. Logistic regression was used for the relation between  $PR_{MDD}$  and MDD, adjusting for population stratifications (principal component scores) which are major confounders when looking at the reproducibility of  $PR_{MDD}$ . Pearson's correlation coefficient tests were performed on CM, the three mediators, and continuous covariates to assess their predictive potentials in mediation models.

Both parallel (PMMs) and serial mediation models (SMMs) were applied to explore the direct effect (DE) of CM on MDD and the indirect effects (IEs) (through social support, positive and negative coping strategies, simultaneously as well as sequentially). PROCESS macro for SPSS developed by Hayes (2013) was used to fit mediation models by applying an ordinary least squares path analytic framework. For dichotomous outcome variables, logistic regression models were applied. PROCESS with the bootstrapping method was used to generate a bias-corrected bootstrap confidence interval (CI) based on 5,000 resamples from the data. As the PROCESS does not provide p values for IEs, the significance of IEs is assumed if the 95% CI does not include zero (Opel et al., 2019). Unstandardized regression coefficients and standard errors are presented for each effect. Covariates (age, sex, ethnicity, education, and  $PR_{MDD}$ ) were included in all the models. Subgroup PMMs analyses by types of CM (physical, emotional, and sexual abuse, and physical and emotional neglect) were also conducted. For SMMs, we tested all the potential sequential chains of social support and coping strategies to explore their potential temporal orders and their effects on CM and MDD.

To explore the potential confounding of the status of MDD (incident vs. prevalent MDD) in the results, sensitivity analyses were conducted to examine if there were differences between incident and prevalent MDD cases at Wave IV. Adult participants who never had MDD at Wave I and before were included in the analyses. Thus, the MDD cases in these analyses refer to new diagnoses from Wave II to Wave IV. Social support and coping strategies at Wave I were included as mediators. Any type of CM before 16 years of age was the exposure. In this way, mediation models were applied to explore the mediating effects of social support and coping strategies between CM and subsequent new incident MDD.

All analyses were performed in SPSS, version 24 (IBM Corp., Armonk, NY, USA). The PROCESS macro, version 3.5.2, model 4 was used for PMMs, and model 6 for SMMs.

## Results

Of the 902 participants, most were females ( $n = 586$ , 65.0%), had post-secondary degree or diploma ( $n = 624$ , 69.2%), being French-Caucasian ( $n = 430$ , 47.7%) or non-Caucasian ( $n = 381$ , 42.2%), and were not diagnosed with MDD at Wave IV ( $n = 676$ , 74.9%). Table 1 presents a summary of the study cohort stratified by MDD. Participants were more likely to be diagnosed with MDD if they were: not graduating from secondary schools, or French-Caucasian. MDD was positively associated with CM and its subtypes and negative coping but negatively associated with social support and positive coping. No significantly statistical differences were found in age, sex, and  $PR_{MDD}$  between participants with and without MDD.

Table 2 presents correlation tests among CM, social support, positive and negative coping strategies, age, and  $PR_{MDD}$ . CM was positively associated with negative coping and inversely

associated with both social support and positive coping. As expected, social support was positively associated with positive coping, whereas negatively associated with negative coping. Positive coping was negatively associated with negative coping. These results satisfied our criteria for testing potential mediation among these variables. In addition, age was positively correlated with CM and negatively correlated with social support.  $PR_{MDD}$  was positively associated with CM.

### Mediation effects of social support, positive and negative coping strategies

Both parallel and serial mediation analyses were used to explore the potential mediating mechanisms of the studied variables. A series of parallel mediation path analysis models were used to examine the DEs of CM (Figure 2), as well as its subtypes (Appendix 3), on subsequent MDD as well as any IEs potentially mediated by social support, positive and negative coping strategies. Table 3 presents the DEs, total indirect effects, IEs of each mediator, and ratios of IEs to the total effect. We present the results by different types of maltreatment.

#### Any CM and MDD

CM was directly and significantly associated with subsequent MDD ( $DE = 0.015$ ,  $SE = 0.007$ ,  $p = 0.027$ ). Significant IEs of social support ( $IE = 0.004$ ,  $Boot SE = 0.002$ ,  $Boot 95\% CI = 0.0001-0.008$ ) and negative coping ( $IE = 0.013$ ,  $Boot SE = 0.003$ ,  $Boot 95\% CI = 0.008-0.020$ ) on the association between CM and MDD were also noted. Their mediation effects accounted for 12.1% for social support, and 39.4% for negative coping, of the total effect on the association between CM and MDD. The ratio of the total IE to the total effect was 54.5%. No significant mediation effect of positive coping was found.

#### Subtypes of maltreatment and MDD

We also conducted subgroup analyses classified by different subtypes of CM. Significant DEs were found for the associations between emotional neglect ( $DE = 0.042$ ,  $SE = 0.021$ ,  $p = 0.042$ ) and physical neglect ( $DE = 0.081$ ,  $SE = 0.035$ ,  $p = 0.021$ ), respectively, and MDD. Negative coping strategies mediated the associations between all different types of maltreatment and MDD, with the mediation effects accounted for 31.0%–44.3% of total effects. Social support only mediated the associations between emotional abuse and physical abuse, respectively, and MDD, with the mediation effects accounted for 11.3% for emotional abuse and 15.6% for physical abuse.

#### Serial causal effects of social support, positive and negative coping

SMMs were performed to examine whether these mediators (social support, positive and negative coping strategies) sequentially mediating the impact of CM on MDD. Figure 3 illustrates an example of the six SMMs and coefficients of each path (CM→social support→positive coping→negative coping). The rest of the SMMs and coefficients are shown in Appendix 4. Table 4 presents the IEs of each path in these serial models and their ratios to the total effects of CM on MDD. These three mediators in all the six possible serial orders partially mediated the relation between CM and MDD (total  $IE = 0.018$ ,  $Boot SE = 0.004$ ,  $Boot 95\% CI = 0.012-0.026$ ). The DE of CM on MDD was 0.015 ( $SE = 0.007$ ,  $p = 0.027$ ,  $95\% CI = 0.002-0.028$ ), and the ratio of the total IE to the total effect

**Table 1.** Characteristics of the study cohort stratified by depression status (*N* = 902)

	No depression ( <i>n</i> = 676)		Depression ( <i>n</i> = 226)		Difference ( <i>p</i> value)
	<i>n</i> (%)	Mean ( <i>SD</i> )	<i>n</i> (%)	Mean ( <i>SD</i> )	
<b>Sex</b>					
Male	244 (36.1)		72 (31.9)		.248 <sup>a</sup>
Female	432 (63.9)		154 (68.1)		
<b>Education</b>					
< secondary	43 (6.4)		29 (12.8)		.021 <sup>a</sup>
Secondary graduate	67 (9.9)		20 (8.8)		
Some post-secondary	91 (13.5)		28 (12.4)		
Post-secondary degree/diploma	475 (70.3)		149 (65.9)		
<b>Ethnicity</b>					
French Caucasian	308 (45.6)		122 (54.0)		.002 <sup>a</sup>
English Caucasian	61 (9.0)		30 (13.3)		
Non-Caucasian	307 (45.4)		74 (32.7)		
Age at Wave III		44.7 (13.3)		46.8 (13.2)	.920 <sup>b</sup>
Age at Wave IV		46.4 (13.2)		48.6 (13.8)	.795 <sup>b</sup>
Age at Wave V		49.6 (13.2)		51.7 (13.1)	.978 <sup>b</sup>
Standardized PRS <sub>MDD</sub>		-0.04 (1.0)		0.04 (1.0)	.383 <sup>c</sup>
Any childhood maltreatment		36.0 (11.8)		41.2 (14.0)	.000 <sup>b</sup>
Physical abuse		6.4 (2.8)		6.9 (2.8)	.093 <sup>b</sup>
Sexual abuse		6.2 (3.0)		6.8 (3.4)	.000 <sup>b</sup>
Emotional abuse		7.5 (3.7)		9.0 (4.3)	.000 <sup>b</sup>
Physical neglect		6.4 (2.2)		7.3 (2.9)	.000 <sup>b</sup>
Emotional neglect		9.5 (4.0)		11.3(4.7)	.003 <sup>b</sup>
Social support		84.5 (8.6)		80.0 (10.3)	.003 <sup>b</sup>
<b>Coping strategies</b>					
Positive coping		14.3 (1.5)		13.7 (1.8)	.000 <sup>b</sup>
Negative coping		14.8 (2.9)		17.2 (3.5)	.004 <sup>b</sup>

Note. <sup>a</sup> $\chi^2$  tests. <sup>b</sup>t-tests. <sup>c</sup>Logistic regressions adjusted for principal component scores (pc1 to pc10). PRS, polygenic risk score.

**Table 2.** Pearson correlations among childhood maltreatment, social support, positive and negative coping strategies, age, and PRS<sub>MDD</sub>

Variables	1	2	3	4	5	6
1. Childhood maltreatment	-					
2. Social support	-0.28**	-				
3. Positive coping strategies	-0.13**	0.39**	-			
4. Negative coping strategies	0.23**	-0.29**	-0.21**	-		
5. Age	0.08*	-0.18**	-0.03	-0.06	-	
6. PRS <sub>MDD</sub>	0.10**	-0.05	-0.04	0.05	-0.01	-

Note. \**p* < 0.05; \*\**p* < 0.01.

was 0.545. The DE, total IE, and the ratio to the total effect, were the same as in the PMM for CM group.

When considering three mediators simultaneously in the relation between CM and MDD, all six models were compared in terms of the significant path created by each different order of the

mediators. All the models yielded three to six significant indirect paths out of the seven possible paths. Three of the six models yielded significant indirect paths involving all three mediators in a serial model with the equal ratio of indirect to total effect (0.030) (CM→SS→PC→NC→MDD (SMM1), CM→PC→NC→SS→MDD (SMM3), CM→PC→SS→NC→MDD (SMM4), and CM→NC→PC→SS→MDD (SMM5)). These results showed that exposure to CM led to the poor social support or increased negative coping strategies as well as reduced positive coping strategies, which in turn increased the risk of MDD.

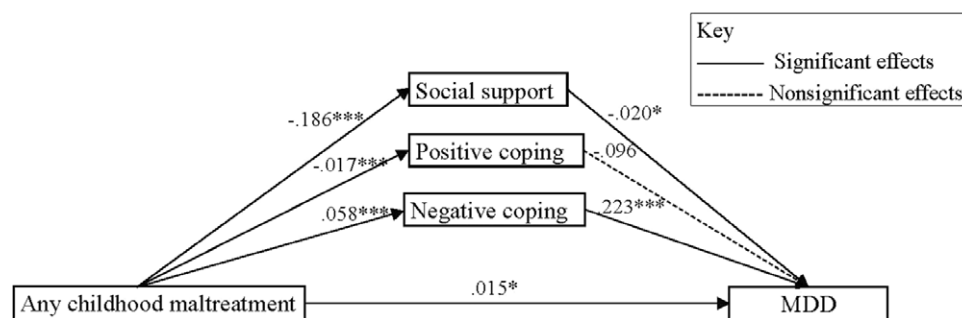
The indirect paths involving positive coping and negative coping/social support (one after the other and vice versa) were statistically significant in two out of the six SMMs, specifically in SMM3 and SMM4.

The indirect paths involving negative coping and social support (one after the other and vice versa) were statistically significant in all SMMs. This indicates that the exposure to CM increased negative coping (or decreased social support) which in turn decreased social support (or increased negative coping) resulting in an elevated risk of subsequent MDD. The serial mediating effects of these two mediators were significant in all the serial models.

**Table 3.** Direct and indirect effects and ratio of indirect to total effects for parallel mediation models (PMMs)

	Direct effect			Total indirect effect			Indirect effect			Ratio of indirect effect to total effect <sup>a</sup>
	$\beta$	LLCI	ULCI	$\beta$	Boot LLCI	Boot ULCI	$\beta$	Boot LLCI	Boot ULCI	
PMM1: CM→MDD	0.015*	0.002	0.028	0.018	0.012	0.026				
<b>M1. social support</b>							0.004	<0.001	0.008	0.121
M2. positive coping							0.002	<0.001	0.004	0.061
<b>M3. negative coping</b>							0.013	0.008	0.020	0.394
PMM2: EA→MDD	0.039	-0.002	0.080	0.058	0.040	0.082				
<b>M1. social support</b>							0.011	0.001	0.022	0.113
M2. positive coping							0.004	<0.001	0.011	0.041
<b>M3. negative coping</b>							0.043	0.028	0.064	0.443
PMM3: PA→MDD	0.029	-0.030	0.087	0.048	0.021	0.079				
<b>M1. social support</b>							0.012	0.001	0.025	0.156
M2. positive coping							0.003	-0.001	0.010	0.039
<b>M3. negative coping</b>							0.033	0.011	0.058	0.429
PMM4: SA→MDD	0.027	-0.023	0.077	0.030	0.011	0.056				
M1. social support							0.002	-0.003	0.009	0.035
M2. positive coping							0.002	-0.001	0.009	0.035
<b>M3. negative coping</b>							0.025	0.010	0.046	0.439
PMM5: EN→MDD	0.042*	0.002	0.082	0.053	0.035	0.076				
M1. social support							0.012	-0.001	0.025	0.126
M2. positive coping							0.006	-0.001	0.014	0.063
<b>M3. negative coping</b>							0.036	0.022	0.054	0.379
PMM6: PN→MDD	0.081*	0.012	0.149	0.074	0.041	0.115				
M1. social support							0.019	-0.001	0.043	0.123
M2. positive coping							0.007	-0.001	0.019	0.045
<b>M3. negative coping</b>							0.048	0.024	0.077	0.310

Notes. Table shows unstandardized direct effects and indirect effects with bootstrapped 95% confidence intervals. X, exposure. M, mediator. Mediators in bold indicate statistically significant indirect effects. LLCI, lower limit confidence interval; ULCI, upper limit confidence interval; CM, childhood maltreatment; MDD, major depressive disorder; EA, emotional abuse; PA, physical abuse; SA, sexual abuse; PN, physical neglect; EN, emotional neglect.  
<sup>a</sup>Ratio of indirect effect to total effect = indirect effect  $\beta$  / (direct effect  $\beta$  + total indirect effect  $\beta$ ).  
 \* $p < .05$ ; \*\* $p < .01$ .

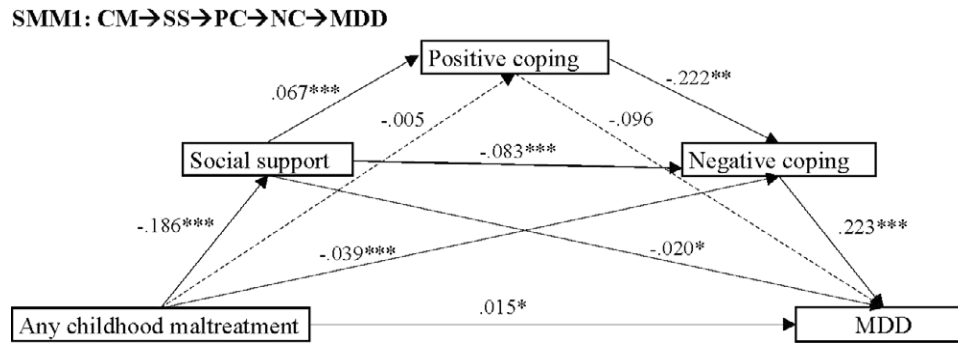


**Figure 2.** Parallel Mediation Model (PMM). Indirect effects of childhood maltreatment on major depressive disorder (MDD) through social support, positive coping, and negative coping, respectively. Models were controlled for age, sex, education, ethnicity, and PRS. Unstandardized effects are presented. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

**Sensitivity analyses**

To explore whether MDD status could influence the results, sensitivity analyses were conducted for those without MDD at Wave I. A total of 614 participants were included in the sensitivity analyses. Of which, 59 (9.6%) participants were firstly diagnosed with MDD from Wave II to Wave IV. Both parallel and serial mediation

analyses identified the similar results, with negative coping strategies being the significant mediator in the relation between CM and MDD. In the PMM, Significant IEs of negative coping (IE = 0.004, Boot SE = 0.003, Boot 95% CI = 0.003–0.011) was found in the relation between CM and MDD. The total IE was 0.0103 (Boot SE = 0.005, Boot 95% CI = 0.003–0.021). The



**Figure 3.** Serial Mediation Model (SMM). Indirect effects of childhood maltreatment on major depressive disorder (MDD) through serial chains of social support, positive coping, and negative coping. The model were controlled for age, sex, education, ethnicity, and PRS. Unstandardized effects are presented. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

mediation effect of negative coping accounted for 8.3% (0.0044/(0.042 + 0.0103)) of the total effect. No significant mediation effect of social support or positive coping was found. In the SMMs, the mediators partially mediated the relation between CM and MDD in the path  $CM \rightarrow positive\ coping \rightarrow social\ support \rightarrow negative\ coping \rightarrow MDD$  (IE = 0.0002, Boot SE = 0.0002, Boot 95% CI = 0.00002–0.001). This serial mediation effect accounted for 0.38% (0.0002/(0.042 + 0.0103)) of the total effect.

## Discussion

This present study provides one of the first pieces of evidence on the mediating effects of social support and coping strategies in the association between CM and subsequent MDD in a longitudinal community-based population cohort. CM, as well as its subtypes, significantly increased the risk of subsequent MDD. Social support and negative coping strategies simultaneously and sequentially mediated the relation between CM (and its subtypes) and MDD. Positive coping strategies were significantly correlated with social support and negative coping strategies and collectively mediated the relation between CM and MDD.

The mediating effect of social support in the relation between CM and depression or other psychiatric disorders has been reported in the previous literature (Brunton et al., 2020; Li, Zhao et al., 2020; Powers et al., 2009). Our findings on the mediating effect of negative coping strategies in the relation between CM (and its subtypes) and MDD are also consistent with previous psychopathology studies (Choi et al., 2015; Liu et al., 2020). Our findings not only provide robust evidence to support the stress-buffering model and the transactional model of stress and coping (Cohen & Wills, 1985; Fondacaro & Moos, 1987; Lazarus & Folkman, 1984), but also illustrate the potential mediating paths of social support and coping in the relation between CM and MDD. When an individual is struggling with adverse childhood experiences, which are often associated with feelings of fear, mistrust, and isolation (Kendall-Tackett, 2001), the perceived social support would enhance one's ability to cope positively (Lagdon et al., 2021). Social support serves as a stress mediator, minimizing the negative consequences of CM (Gurung, 2006; Southwick et al., 2016). Additionally, our finding on the mediating effects of negative coping in the relation between CM and MDD is also in line with previous studies (Bal et al., 2003; Calvete et al., 2008; Schuck & Widom, 2001). For example, Rayburn et al. (2005) applied a composite measure of various types of traumatic experiences and found it associated with depression through avoidance coping. Negative forms of coping, including avoidance, alcohol

and drugs, and self-destructive behaviors, may be more likely to be used when individuals feel overwhelmed by the emotions with which they are attempting to cope. Traumatic events may increase the likelihood that negative coping strategies are activated, which in turn increases emotional distress (Whiffen & MacIntosh, 2005).

Although we did not find direct evidence to support the mediating effect of positive coping strategies in the relation between CM on MDD, findings on the mediating role of positive coping strategies in the relation between CM and mental health outcomes have been inconclusive. Some studies reported the moderating/mediating role of positive coping strategies in positive mental health (Meng & D'Arcy, 2016; Miller Smedema et al., 2010), whereas a more recent Spanish study also found that positive (or adoptive) coping strategies did not independently mediate the effects of stress on depressive symptoms (Peláez-Fernández et al., 2021). They suggested that positive coping strategies played a more critical role in reducing autonomic arousal which is the central core of anxiety, rather than depression. The core component of depression is low positive affectivity (Gloria & Steinhardt, 2016). Self-system (for instance, self-worth and self-esteem) may mediate the effect of positive coping strategies on mental health and well-being (Miller Smedema et al., 2010; Peláez-Fernández et al., 2021).

We found sequential mediating effects of the three mediators in the relation between CM and MDD. Social support, negative coping, and positive coping strategies significantly influenced each other, and their combined effect determined the psychopathology of CM on MDD. Hirai et al. (2020) suggested that in their mediation study on posttraumatic stress symptoms severity among sexually victimized women, the path from perceived social support to maladaptive coping might be quickly established after the traumatic event and maintained longitudinally. On the other hand, negative coping responses might erode an individual's sources and ability to develop and maintain supportive social ties, while the ability to problem-solving and regulate emotions could result in more supportive relations (Fondacaro & Moos, 1987). However, we found that the serial mediating chains were not supported when positive coping was at the third place in the chain, for instance,  $CM \rightarrow SS \rightarrow NC \rightarrow PC \rightarrow MDD$  and  $CM \rightarrow NC \rightarrow SS \rightarrow PC \rightarrow MDD$ . This could be attributable to a lack of correlation between positive coping and MDD. Similar findings were found in a recent study on moderated SMMs, indicating that attachment predicted perceived social support, which then predicted negative religious coping and then depression; positive religious coping was not a mediator, but partially buffered detrimental effects of negative religious coping on depression (Klausli & Caudill, 2021). It is reasonable to propose that negative coping strategies and social support mediate the effect

**Table 4.** Indirect effects and ratio of indirect to total effects for the paths on the serial mediation models (SMMs)

	Indirect effect of CM on MDD			Ratio of indirect effect to total effect <sup>a</sup>
	$\beta$	Boot LLCI	Boot ULCI	
SMM1: CM→SS→PC→NC→MDD				
CM→SS→MDD	0.004	0.0001	0.008	0.121
CM→PC→MDD	0.0004	-0.0004	0.002	0.012
CM→NC→MDD	0.009	0.005	0.014	0.273
CM→SS→PC→MDD	0.001	-0.0001	0.003	0.030
CM→SS→NC→MDD	0.004	0.002	0.006	0.121
CM→PC→NC→MDD	0.0002	-0.0002	0.001	0.006
CM→SS→PC→NC→MDD	0.001	0.0002	0.001	0.030
SMM2: CM→SS→NC→PC→MDD				
CM→SS→MDD	0.004	0.0001	0.008	0.121
CM→NC→MDD	0.009	0.005	0.014	0.273
CM→PC→MDD	0.0002	-0.0006	0.001	0.006
CM→SS→NC→MDD	0.004	0.002	0.007	0.121
CM→SS→PC→MDD	0.001	-0.0001	0.003	0.030
CM→NC→PC→MDD	0.0002	0.0000	0.001	0.006
CM→SS→NC→PC→MDD	0.0001	0.0000	0.0003	0.003
SMM3: CM→PC→NC→SS→MDD				
CM→PC→MDD	0.002	-0.0002	0.004	0.061
CM→NC→MDD	0.012	0.007	0.018	0.364
CM→SS→MDD	0.002	0.0001	0.005	0.061
CM→PC→NC→MDD	0.002	0.001	0.003	0.061
CM→PC→SS→MDD	0.001	0.0001	0.001	0.030
CM→NC→SS→MDD	0.001	0.0001	0.001	0.030
CM→PC→NC→SS→MDD	0.001	0.0002	0.002	0.030
SMM4: CM→PC→SS→NC→MDD				
CM→PC→MDD	0.002	-0.0001	0.004	0.061
CM→SS→MDD	0.003	0.0001	0.007	0.091
CM→NC→MDD	0.009	0.005	0.014	0.273
CM→PC→SS→MDD	0.001	0.0001	0.002	0.030
CM→PC→NC→MDD	0.001	0.0002	0.002	0.030
CM→SS→NC→MDD	0.003	0.002	0.005	0.091
CM→PC→SS→NC→MDD	0.001	0.0003	0.001	0.030
SMM5: CMNCPCSSMDD				
CM→NC→MDD	0.013	0.008	0.019	0.394
CM→PC→MDD	0.001	-0.0002	0.003	0.030
CM→SS→MDD	0.002	0.0001	0.006	0.061
CM→NC→PC→MDD	0.001	-0.0001	0.001	0.030
CM→NC→SS→MDD	0.001	0.0001	0.002	0.030
CM→PC→SS→MDD	0.001	0.0003	0.002	0.030
CM→NC→PC→SS→MDD	0.001	0.0002	0.001	0.030
SMM6: CM→NC→SS→PC→MDD				
CM→NC→MDD	0.013	0.008	0.019	0.394
CM→SS→MDD	0.003	0.0001	0.006	0.091
CM→PC→MDD	0.0002	-0.001	0.001	0.006

(Continued)



**Table 4.** (Continued)

	Indirect effect of CM on MDD			Ratio of indirect effect to total effect <sup>a</sup>
	$\beta$	Boot LLCI	Boot ULCI	
<b>CM→NC→SS→MDD</b>	0.001	0.0001	0.002	0.030
CM→NC→PC→MDD	0.0003	0.0000	0.001	0.009
CM→SS→PC→MDD	0.001	-0.0001	0.002	0.030
CM→NC→SS→PC→MDD	0.0003	0.0000	0.001	0.009

Notes. Table shows unstandardized direct effects and indirect effects with bootstrapped 95% confidence intervals. Paths in bold indicate statistically significant indirect effects. LLCI, lower limit confidence interval; ULCI, upper limit confidence interval; CM, childhood maltreatment; MDD, major depressive disorder; SS, social support; PC, positive coping; NC, negative coping.

<sup>a</sup>Ratio of indirect effect to total effect = indirect effect  $\beta$  / (direct effect  $\beta$  (0.015) + total indirect effect  $\beta$  (0.018)).

of CM on depression, and positive coping strategies mediate CM, social support, and negative coping, and moderate the effect of negative coping strategies and social support in the association between CM and depression.

Our main analyses and sensitivity analyses identified the main mediating effects of negative coping strategies in the relation between CM and MDD. Compared to social support, negative coping strategies acted as the major indirect path from CM to MDD. Mahmoud et al. (2012) found similar processes and suggested that eliminating negative coping strategies might be one of the most valuable approaches to helping people cope with the challenges in life. It is reasonable to propose that negative coping strategies could be one of the factors involved in the etiopathogenesis of depression among those exposed to CM.

We did not observe a significant association between PRS<sub>MDD</sub> and the incidence of MDD. There is a small variance (ranging from 1.5% to 3.2%) in MDD explained by identified alleles (Howard et al., 2019). The findings of PRS<sub>MDD</sub> in MDD may be partially influenced by various measurements of depression phenotypes, the presence of depression clinical heterogeneity, different sample sizes that are closely related to the statistical power to identify small-effects genetic variations and request a larger sample size to control for random variations (Palla & Dudbridge, 2015; Peyrot et al., 2018; Wray et al., 2017). Furthermore, the present study had a large proportion of non-White participants (42.2%), which may limit the predictive value of PRS in MDD. This phenomenon has also been noted in other diverse population cohorts (Martin et al., 2019).

### Implications in public and population health

Our results provide robust evidence to support targeted and indicated prevention strategies focusing on both social support and coping strategies as they played important mediating roles in the relation between CM and depression. Preventing CM before it occurs should always be the primary choice for universal prevention and public health promotion. For those exposed to CM and its subtypes, prevention strategies on negative coping strategies could be the primary and the most effective solution to reduce depression. Social support could also be the target for mental health prevention with a focus on external resources and interpersonal relationships. These prevention strategies could be achieved by promoting positive parenting skill-based interventions (Moffitt, 2013; National Research Council, 1993). A multisectoral approach at the individual, familial as well as societal levels (schools, working settings, communities) should be considered to optimize the effectiveness of these targeted prevention and intervention programs. These preventive programs should be made widely accessible for

those exposed to CM from multiple sectors (health, education, social welfare, as well as occupation).

### Strengths and Limitations

The present study demonstrated the underlying mediating mechanisms of social support and coping strategies in the association between CM and MDD while comprehensively considering socio-demographic characteristics (age, sex, ethnicity, and education). The use of large and community-based samples and validated questionnaires of the studied variables facilitate the generalizability of the research findings in other population settings. As CM is a global public health issue, findings on mediating effects of social support and coping strategies not only provide robust evidence to highlight the importance of early interventions among CM victims but also shed light on developing effective prevention and intervention programs.

There are several limitations to be noted. First, significant but small effect sizes were found in some paths, which may affect the implementation of our findings in the practice. Second, we assume that CM occurs before MDD. As the measurement of CM collected adverse experiences before age of 16 and the measurement of MDD was for adulthood depression. It is likely that most of our participants developed MDD after exposure to CM. Also, data on the mediators (social support and coping strategies) were collected at the same time. Therefore, instead of running a definite SMM, we tested all the possible sequential orders of the studied variables. Third, the reliabilities of the positive and negative coping strategies scales were relatively low. It may suggest poor interrelatedness between items or heterogeneous constructs in the positive and negative coping strategies scales used (Tavakol & Dennick, 2011). Finally, the self-reported and retrospective measurement of CM may not accurately capture the maltreated experience because an individual's recall and memory may be influenced by the depressed state (Hardt & Rutter, 2004) and can be experimentally manipulated by mood induction (Cohen et al., 1988).

### Conclusion

Overall, CM, as well as its subtypes, significantly increased the risk of subsequent MDD, and both social support and coping strategies mediated the association between CM and MDD. Negative coping strategies played a major mediating role in the association. Multisectoral and multi-level intervention and prevention programs are suggested to target both social support and coping strategies with the primary focus on weakening negative coping strategies and strengthening social support and positive coping strategies.

**Supplementary material.** The supplementary material for this article can be found at <https://doi.org/10.1017/S0954579422000918>

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