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Child maltreatment and whole person health: Investigation of psychosocial buffers using structural equation modeling

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Abstract

Objective: The purpose of this study was to investigate psychosocial factors that may modify associations between child maltreatment and whole person health (i.e., depressive symptoms, chronic health conditions, psychological well-being, inflammation).

Methods: Data were drawn from a subsample (N = 1,255) of Midlife in the United States (MIDUS) study, a national longitudinal study of health and well-being. Structural equation modeling was applied to test hypotheses.

Results: Child maltreatment was associated with more depressive symptoms (standardized β = 0.29, $p < .001$), more chronic health conditions (β = 0.24, $p < .001$), poorer psychological well-being (β = -0.25, $p < .001$), and elevated C-reactive protein (β = 0.06, p = .041), but not with interleukin-6 (β = 0.06, p = .055). There were significant interaction effects between child maltreatment and psychological resources on depressive symptoms (unstandardized b = -0.009, SE = 0.005, p = .045) and interleukin-6 (b = -0.001, SE = 0.000, p = .042). Specifically, there were stronger relationships between child maltreatment and more depressive symptoms and elevated interleukin-6 at low levels of psychological resources than at high levels of psychological resources. There were no statistically significant interaction effects between child maltreatment and social resources on any health outcomes.

Conclusions: High levels of psychological resources significantly mitigate the long-term effects of child maltreatment on depressive symptoms and inflammation among middle-aged and older adults.

Keywords: Biopsychosocial model; child maltreatment; whole person health; psychological resources; social resources; inflammation

Abbreviations:

ACE = Adverse Childhood Experiences

CTI = Comparative fit index

CRP = C-reactive protein

CTQ = Childhood Trauma Questionnaire

DMN = Default mode network

HPA = hypothalamic–pituitary–adrenal axis

IL-6 = Interleukin-6

MIDUS = Midlife in the United States

PTSD = Post-traumatic stress disorder

RMSEA = Root mean square error of approximation

SD = Standard Deviation

SEM = Structural Equation Modeling

Introduction

Well-being is a multi-faceted construct that is directly related to the balance between an individual's resource pool and the psychological, social, and environmental contextual factors (e.g., adverse stressful events) that may impact health (1). However, the majority of social science research and practice continues to operationalize well-being as the absence of mental illness (e.g., depression) (2). It is critical to redefine well-being beyond the absence of mental illness and explore multilevel mechanisms that foster overall health. This shift to a more salutogenic approach and aligns with a focus on whole person health, and consideration of how psychological (e.g., optimism) and social (e.g., social support) factors may buffer the experience of adverse stressful events, fostering mental and physical health and overall well-being (3, 4).

Child maltreatment, encompassing physical, emotional, and sexual abuse, as well as neglect (5, 6), is a critical issue with profound implications for whole person health (7-9). Globally, the prevalence of child maltreatment is alarming, with nearly 3 in 4 children aged 2-4 years experiencing physical punishment or psychological violence (10). The health impacts of child maltreatment are immediate and long-lasting (11). Findings from the Adverse Childhood Experiences (ACE) study revealed an individuals' risk of developing mental and physical health conditions increased in a graded dose-response manner as the types of childhood adversity experienced increased (12). Since the initial ACE study, studies have continued to find that exposure to child maltreatment increases the risk for mental health problems, as well as increases the risk for myriad physical health conditions and diseases (13-17).

According to the stress sensitization hypothesis, early life adversity, such as child maltreatment, can result in individuals having greater vulnerability to subsequent stressors, which in turn increases their risk for mental health problems such as depression in adulthood (18). When applied to the biological embedding of early life adversity, the stress sensitization hypothesis suggests individuals who experience child maltreatment are at increased risk for subsequent health problems as a result of the structural and functional changes to the brain and biological systems caused by environmental stressors (19). Specifically, child maltreatment experiences impact neurobiological processing pathways related to stress response, emotion processing, and self-referential processing (20). Studies have identified alterations in the patterns of resting-state functional connectivity between these regions of the brain and between resting-state networks and revealed associations between psychopathology (e.g., depression, post-traumatic stress disorder [PTSD]) and impaired functioning in these resting-state networks among those with child maltreatment histories (21, 22). In particular, growing evidence suggests child maltreatment may negatively impact the default mode network (DMN), which in turn leads to psychopathological symptoms and, particularly, those related to self-referential processing (23). The DMN, sometimes referred to as the task negative network, is involved in many high-level functions, including attention, self-related processes, and inhibitory control, and has an inverse relationship with the task positive network (24). Evidence suggests that child maltreatment experiences also impact the salience network, which processes attention, anticipation, or “alarm” and plays a crucial role in switching between the DMN and task positive network (25). Individuals with trauma histories and PTSD have been found to have an overactive system that disproportionately assigns threats to stimuli (25).

Studies suggest that changes in the stress response system, particularly the hypothalamic–pituitary–adrenal (HPA) axis, and inflammatory processes due to chronic stress exposure drive the relationship between child maltreatment and long-term health outcomes (26). Perceived stress activates the HPA axis, resulting in a cascade of responses, including the secretion of stress hormones, which increase inflammation. While initially adaptive, over time this repeated or chronic activation of the stress response adversely affects HPA axis functioning and inflammatory processes (27). In recent years, there has been a growing number of studies assessing associations between child maltreatment and inflammation, and recent systematic reviews and meta-analyses have helped to synthesize findings (28-30). However, the authors caution that methodological issues relating to the construct of child maltreatment, variations in analytic methods, and differences concerning consideration of confounding and mediating variables make it difficult to draw firm conclusions. These limitations notwithstanding, individuals with more severe child maltreatment histories tend to exhibit elevated inflammatory markers compared to those with less severe histories, and C-reactive protein (CRP) and Interleukin-6 (IL-6) have emerged as markers most frequently assessed (28, 30). Inflammation plays a key role in many mental and physical health conditions and is considered both a consequence of child maltreatment and a risk factor for adverse health outcomes. Consequently, inflammation may be a key mechanism through which child maltreatment ‘gets under the skin’ to affect long-term mental and physical health outcomes (31). In addition, although there is a well-established association between individuals with Major Depressive Disorder and elevated inflammation, inter-individual heterogeneity has been identified, leading some to assert elevated inflammatory markers may only be present for a subgroup of individuals with Major Depressive Disorder, such as those who have experienced early life adversities (32).

Despite increased understanding of the health-related consequences of child maltreatment, questions remain related to the pathways through which these experiences affect health, and how variations in the type of child maltreatment may differentially affect these processes and outcomes. While some studies have found maltreatment experiences involving threat (e.g., physical abuse, sexual abuse, psychological abuse) have worse impacts on health outcomes compared to experiences involving deprivation (e.g., physical neglect, emotional neglect) (33, 34), other studies have found significant relationships between health outcomes and experiences of threat or deprivation (35, 36), making additional inquiry necessary.

Importantly, the potential factors that might protect against adverse health outcomes associated with child maltreatment are not well understood yet. The stress-buffering hypothesis posits how psychosocial resources may mitigate the adverse effects of stress on individuals (37). This hypothesis is crucial for developing interventions aimed at reducing stress-related health issues (38, 39). The biopsychosocial model, which integrates biological, psychological, and social factors, provides a comprehensive framework for understanding health and illness, particularly in the context of stress (40).

Psychological resources may mitigate maltreatment experienced in early life by contributing to positive mental dispositions and cognitive habits that are beneficial for well-being (41). Self-esteem shapes individuals' health by influencing psychological, physical, and social well-being. Higher self-esteem is a psychological resource that helps individuals cope with adversity by regulating responses to the threat of stressors and thus supporting health (42). A study by Dogan et al. determined that there were significant and positive relationships between both self-esteem and self-efficacy and psychological well-being (43). Sense of control is another important psychological resource that has been shown to promote well-being, with individuals

who have high self-control reporting more positive affect, life satisfaction, and happiness (44). In addition, optimism is a frequently investigated psychological resource that promotes health and overall well-being. Higher optimism has been related prospectively to higher subjective well-being in times of adversity through greater engagement coping and less avoidance coping behaviors (45). Moreover, a systematic review found that greater optimism was associated with increased engagement in health-promoting behaviors (46). Collectively, these psychological resources may moderate associations between child maltreatment and whole person health through promoting adaptive coping processes.

Greater social resources are also generally associated with more positive health outcomes (47, 48), and include consideration of three related but distinct constructs: social support, social strain, and social integration. Social support describes the perceived availability and quality of an individual's social support network, whereas social strain captures the perceived strain resulting from the demands of others (e.g., partner, children, friends). Social integration, on the other hand, refers to the objective frequency of an individual's social interactions with high levels of contact (i.e., integration) on one end of the spectrum and low levels of contact (i.e., isolation) on the other. This is in line with prior literature, which has found that having larger social networks and higher quality of relationships–characterized by high support and low strain –are associated with better mental health (49, 50) and physical health outcomes (47, 48), as well as well-being (51-53). However, studies have tended to evaluate these social resources separately, and few have investigated relationships between the combined effects of social resources on the relationship between child maltreatment and health outcomes, overlooking the fact that these factors are largely overlapping and strongly correlated with each other (51).

The stress-buffering hypothesis helps clarify the ways in which social resources may moderate associations between child maltreatment and health outcomes (37). First, if individuals perceive they have others who will provide support in the aftermath of a stressful event, they may perceive the event as less stressful. Second, the availability of social support in the immediate aftermath of the event and longer term (e.g., adulthood) may serve as a buffer between the event and the development of subsequent problems by providing individuals with resources (e.g., emotional support) to more adaptively cope and potentially offset adverse impacts on the stress response system (i.e. HPA axis) and inflammatory processes (15, 26). Safe and supportive relationships may be especially important for those who have experienced child maltreatment, as prior studies indicate maltreated youth are at elevated risk for exposure to other forms of violence (54, 55). In line with the stress-buffering hypothesis, social support has been found to buffer associations between stressful events and adverse mental health (53, 56), physical health (48, 57), and well-being outcomes (52). To date, it remains unclear how collective psychosocial resources may buffer against the deleterious effects of child maltreatment on mental health, physical health, well-being, and inflammation.

Social and economic consequences of child maltreatment are significant. Victims often face lower academic performance and reduced job prospects, contributing to an economic burden on society through increased healthcare costs and loss of productivity (9). Addressing these issues requires a whole person health approach, which integrates care for physical, mental, and psychological well-being (9). In an attempt to fill this gap, the current study employed structural equation modeling using nationally representative data from the Midlife in the United States (MIDUS 2) study to investigate psychological (i.e., sense of control, self-esteem, optimism) and social (i.e., social integration, perceived social support, low social strain) factors that may buffer

associations between child maltreatment and whole person health (i.e., depressive symptoms, chronic health conditions, psychological well-being, inflammation). We hypothesized that child treatment was associated with poorer whole person health, and such an association was more evident among individuals with lower levels of psychological and social resources.

Methods

Participants

A subsample of participants (N = 1,255) who participated in the biomarker project and completed the survey assessment at the second wave of the Midlife in the United States (MIDUS 2) study 2004-2009 were included in our analyses (58). The MIDUS study is an ongoing cohort study on the well-being and health of non-institutional adults with publicly available study protocol and datasets (accessed at https://www.icpsr.umich.edu/web/ICPSR/series/203). The biomarker project included a 24-hour stay at one of the three clinical research centers and the collection of fasting blood, saliva, and urine samples. The biomarker subsample reported higher levels of educational attainment and was less likely to smoke compared to the larger MIDUS 2 survey sample (59). However, the biomarker subsample was comparable to the larger MIDUS 2 sample in terms of most key sociodemographic characteristics (e.g., sex, age, race, marital status, income, chronic conditions). Written consent was obtained from all participants, and the Institutional Review Boards at the University of Wisconsin–Madison, Georgetown University, and the University of California, Los Angeles approved the study.

Measures

Child maltreatment. Child maltreatment (the independent variable) was measured using the 28-item Childhood Trauma Questionnaire (CTQ) on a 5-point scale from 1 = never true to 5 =

always true (60). The CTQ is a validated measure of child maltreatment, consisting of the experience of emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. Of the 28 items, three validity items assessing minimization/denial were dropped from the analysis. Following previous MIDUS studies (61), scores on each item were summed to create a composite, with higher scores reflecting higher levels of child maltreatment severity. In addition, two sum scores were created to reflect two distinct dimensions of child maltreatment: threat (i.e., sum score of emotional, physical, and sexual abuse) and deprivation (i.e., sum score of physical and emotional neglect) (62).

Psychological resources. The psychological resource latent factor (the moderator) was composed of three indicators: sense of control, self-esteem, and optimism. Sense of control was measured using a 12-item questionnaire (63) assessing personal mastery and perceived constraints on a 7-point scale from 1 = strongly agree to 7 = strongly disagree. A composite score was created by averaging responses on the 12 items, with higher scores reflecting higher levels of perceived control (Cronbach's alpha = 0.86). Self-esteem was assessed using the 7-item version of the Rosenberg Self-Esteem Scale (64) on a 7-point scale from 1 = strongly agree to 7 = strongly disagree. A sum score was calculated, with higher scores reflecting higher levels of self-esteem (Cronbach's alpha = 0.77). Optimism was measured using the 6-item Life Orientation Test (65) on a 5-point scale from 1 = a lot agree to 5 = a lot disagree. A sum score was created, with higher scores reflecting higher levels of optimism (Cronbach's alpha = 0.80).

*Social resources***.** Three indicators were used to assess social resources (the moderator): social integration, social strain, and perceived social support. Following a similar approach adopted by previous MIDUS studies (66), social integration was measured using six indicators: (1) married or not living alone; (2) weekly or more frequent contact with at least one family member; (3)

weekly or more frequent contact with at least one friend; (4) weekly or more frequent contact with at least one neighborhood member; (5) monthly or more frequent attendance of church/temple activities; and (6) monthly or more frequent attendance of meetings of other social groups. Responses were summed to create a composite (range 0-6), with higher scores reflecting higher levels of social integration. Social strain was measured using a 4-item scale asking participants' perception of strain (e.g., making too many demands) from spouse/partner, family members, and friends, respectively (67). Response options ranged from 1 = often to 4 = never. A mean score was calculated, with higher scores reflecting lower levels of social strain (Cronbach's alpha = 0.82). Social support was measured using four items asking about their perceptions of support (e.g., relying on for help) from spouse/partner, family members, and friends, respectively, on a 4-point scale from 1 = a lot and 4 = not at all (67). Responses were reversely coded and averaged to create a composite, with higher scores reflecting higher levels of social support (Cronbach's alpha = 0.84).

*Chronic health conditions***.** Chronic health conditions (dependent variable) were assessed by asking participants about the presence of each medical condition out of a list of 30 conditions (e.g., cancer, diabetes) during the 12 months. A total count of the presence of each health condition was calculated, with higher scores reflecting more health conditions. Due to a skewed distribution, scores on chronic health conditions were log-transformed after adding a constant value of 1.

Depressive symptoms. Depressive symptoms (dependent variable) were assessed using the 20-item Center for Epidemiological Studies Depression Scale on a 4-point scale from 0 = rarely or none of the time to 3 = most or all of the time (68). Responses were summed to create a

composite score, with higher scores reflecting more depressive symptoms (Cronbach's alpha = 0.89).

Psychological well-being. Following Ryff's theoretical framework (69), psychological well-being (dependent variable) was indexed by six domains: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. Each domain was measured using seven items, with response options ranging from 1 = strongly agree to 7 = strongly disagree. Responses on each set of items were summed to create a composite for each corresponding domain, with higher scores reflecting higher levels of psychological well-being subdomains (Cronbach's alphas = 0.66-0.84) (70).

Inflammation. Inflammation was indexed by CRP and IL-6 (dependent variables). CRP was determined using fasting blood via the BNII nephelometer (Dade Behring, inc., Deerfield, IL) by a particle enhanced immunonepholometric assay (58). For blood samples with undetectable CRP values, those samples were re-assayed using a high-sensitivity kit (Meso Scale Diagnostics, #K151STG) by immunoelectrochemiluminescence. The inter- and intra-assay coefficients of variability (CVs) ranged from 2.1 to 5.7%. IL-6 was determined using the Quantikine high-sensitivity enzyme linked immunosorbent assay (ELISA) kit (R&D Systems, Minneapolis, MN). The inter- and intra-assay CVs, respectively, were 12.3% and 3.3%. Due to the skewed distribution, CRP and IL-6 were log-transformed for analyses.

Covariates. Several key covariates were included in the analyses due to their potential effects on child maltreatment and health outcomes (71, 72). Covariates included sex (0 = male, 1 = female), race (0 = White, 1 = others), age, socioeconomic status, having physical activity for at least 20 mins or more 3 times a week (0 = no, 1 = yes), alcohol use (0 = non-regular use [<3 days a week], 1 = regular use [<= 3 days per week]), and smoking (0 = never smoked, 1 = current or

ever regular smoker). Socioeconomic status was operationalized by averaging z-scored highest levels of educational attainment (1 = no schooling/some grade schooling, 12= doctoral and professional degree) and household-adjusted income. For models without the inclusion of social relationships, marital status (0 = others, 1 = married) was included as a covariate in the analysis.

Statistical Analyses

Descriptive analyses were performed using SPSS 29.0. We used structural equation modeling (SEM) to test our hypotheses in Mplus 7.0 using Maximum likelihood with robust standard errors (73). First, a measurement model (Model 0) was performed to examine how well each observed indicator loaded on corresponding latent variables (i.e., psychological well-being, psychological resources, social resources). The model fit would be considered acceptable if the comparative fit index (CFI) is no smaller than 0.90 and the root mean square error of approximation (RMSEA) is no larger than 0.08 (74). CRP and IL-6 were treated as two individual inflammatory markers in the analyses due to their distinct biological roles (75). Child maltreatment severity, chronic health conditions, and depressive symptoms were also treated as observed variables in the SEM. Second, SEM (Model 1) was performed by simultaneously testing the effect of child maltreatment on health outcomes (i.e., depressive symptoms, psychological well-being, chronic health conditions, CRP, IL-6) to minimize the inflation of type 2 errors. Finally, to test the moderating effect of psychological and social resources (Model 2), psychological resources (or social resources) and the interaction term between child maltreatment and psychological resources (or social resources) were computed using the XWITH function and included in Model 1. The moderating analyses were performed separately to minimize multicollinearity. Simple slope analyses were performed to further interpret significant moderation effects. Finally, we performed two sets of sensitivity analyses to examine

whether the examined relationships might differ by different dimensions of child maltreatment. Specifically, we reran Models 1 and 2 by treating threat and deprivation as independent variables in the analyses. Given the high correlation between threat and deprivation (r = 0.65), we ran analyses by including threat and deprivation separately in the models. All models were performed by adjusting for covariates. Missing data were handled using the full information maximum likelihood, an efficient and robust approach to handling missing data in the SEM models (76).

Results

Table 1 displays the characteristics of the sample. The mean age of the sample was 54.52 ± 11.72 years. Over half of the sample (56.8%) were female, and the majority (77.2%) were white participants. Supplemental Digital Content Table S1, http://links.lww.com/PSYMED/B88 displays the bivariate correlations between observed variables of interest. Child maltreatment severity was negatively associated with each indicator of psychological and social resources, as well as indicators of psychological well-being (ps < .05). Also, there were positive correlations between child maltreatment and chronic health conditions, CRP, IL-6, and depressive symptoms (ps < .01).

The measurement model (Model 0) showed an acceptable model fit Satorra-Bentler χ^2 (51) = 624.92, CFI = 0.91, RMSEA = 0.08. Each observed indicator was significantly loaded on its corresponding latent variable (ps < .001), with factor loading values ranging from 0.43 to 0.86. Model 1, testing the main health effects of child maltreatment severity, showed that child maltreatment severity was associated with more depressive symptoms (standardized β = 0.29, p < .001), more chronic health conditions (β = 0.24, p < .001), poorer psychological well-being (β = -0.25, p < .001), and elevated CRP (β = 0.06, p = .041), but not with IL-6 (β = 0.06, p = .055),

after adjusting for covariates (also see Supplemental Digital Content Figure S1, http://links.lww.com/PSYMED/B88).

Moderation analyses (Model 2) for psychological resources showed that there were significant interaction effects between child maltreatment severity and psychological resources on depressive symptoms (unstandardized b = -0.009, SE = 0.005, p = .045) and IL-6 (b = -0.001, SE = 0.000, p = .042). Simple slope analyses showed that there was a stronger relationship between child maltreatment severity and depressive symptoms at low levels of psychological resources (-1 standard deviation [SD], b = 0.118, SE = 0.023, p < .001) than at high levels of psychological resources (1 *SD*, b = 0.054, SE = 0.022, p = .013). Also, there was a significant relationship between child maltreatment severity and elevated IL-6 at low (b = 0.004, SE = 0.002, p = .014) but not high (b = -0.001, SE = 0.002, p = .77) levels of psychological resources. However, psychological resources did not moderate the relationship between child maltreatment severity and psychological well-being, chronic health conditions, or CRP (see Table 2). There were no statistically significant interaction effects between child maltreatment severity and social resources on any health outcomes (see Table 3).

Sensitivity Analyses

Similar to the results reported above, threat and deprivation were associated with more depressive symptoms, more chronic health conditions, and poorer psychological well-being (ps < .001). Threat, but not deprivation, was associated with elevated CRP (β = 0.07, p = .021; β = 0.04, p = .22; respectively) and IL-6 (β = 0.06, p = .039; β = 0.04, p = .19; respectively). To examine whether threat and deprivation might have unique effects on these health outcomes, we included threat and deprivation simultaneously in Model 1. Results showed that both threat and deprivation were associated with depressive symptoms (β = 0.09, p = .030; β = 0.23, p < .001;

respectively). Threat, but not deprivation, was uniquely associated with chronic health conditions (β = 0.23, p < .001; β = 0.03, p = .44; respectively) and CRP (β = 0.07, p = .050; β = -0.01, p = .75; respectively). Deprivation, but not threat, was uniquely associated with psychological well-being (β = -0.28, p < .001; β = 0.00, p > .99; respectively). Neither threat nor deprivation was associated with IL-6 (β = 0.06, p = .11; β = -0.00, p = .98; respectively).

Sensitivity analyses for Model 2 showed that psychological resources moderated the relationship between threat and depressive symptoms (b = -0.015, SE = 0.008, p = .041) and the relationships between deprivation and psychological well-being (b = 0.007, SE = 0.003, p = .038) and IL-6 (b = -0.002, SE = 0.001, p = .019). Simple slope analyses showed that threat was associated with depressive symptoms at low but not at high levels of psychological resources (b = 0.157, SE = 0.037, p < .001; b = 0.049, SE = 0.036, p = .18; respectively). Similarly, deprivation was associated with psychological well-being and IL-6 at low but not at high levels of psychological resources (psychological well-being: b = -0.060, SE = 0.014, p < .001; b = -0.010, SE = 0.020, p = .62, respectively; IL-6: b = 0.009, SE = 0.004, p = .032; b = -0.005, SE = 0.005, p = .28, respectively). Social resources did not interact with threat or deprivation to affect health outcomes (ps > .05).

Discussion

This study applied the biopsychosocial model to investigate how psychosocial resources may buffer associations between child maltreatment severity and whole person health in a nationally representative sample. Our findings suggest that child maltreatment was associated with more chronic health conditions, elevated inflammation, more depressive symptoms, and poorer psychological well-being. Moderation analyses indicated that though social resources did

not significantly moderate these associations, psychological resources mitigated the impact of child maltreatment on depressive symptoms and inflammation (i.e., IL-6).

Among this sample, child maltreatment was positively associated with elevated CRP in adulthood. This result is consistent with Baumeister et al.'s (28) meta-analysis, showing a relationship between more severe child maltreatment histories and elevated CRP. Interestingly, our result did not support a significant relationship between child maltreatment severity and IL-6, though existing literature has shown elevated IL-6 among those who had experienced child maltreatment (77). These results seem to suggest that compared to IL-6, CRP might be more sensitive to the long-term effects of early life experiences, including child maltreatment (30).

We also found that child maltreatment was associated with more chronic health conditions and depressive symptoms, as well as worse psychological well-being. These findings align with prior research indicating that child maltreatment can lead to chronic emotional dysregulation and heightened vulnerability to physical and mental illness in adulthood (78-80). In addition, our sensitivity analyses found that when threat and deprivation were included in the same model, threat was associated with CRP and chronic health conditions, and deprivation was associated with psychological well-being. These results, together with existing literature (62), highlight the need to consider the distinct dimensions of child maltreatment and their potential impact on health.

Notably, our moderation analyses showed that psychological resources, including optimism, self-esteem, and sense of control, buffered the impact of child maltreatment severity on depressive symptoms and IL-6. Specifically, the associations between child maltreatment severity and depressive symptoms and IL-6 were stronger at low levels of psychological resources than at high levels of psychological resources. This finding indicates that

psychological resources may help mitigate the emotional and biological toll of child maltreatment (79), although its protective effects may be limited in the context of more pervasive physical and psychological harm. These results align with a previous study that identified self-esteem as a psychological resource buffering the adverse effect of childhood victimization on mental health in adulthood (81). Alternative research identified optimism as a psychological resource that mediated associations between child maltreatment and depression and highlighted the need for additional studies examining multilevel resources as moderators of mental health outcomes (82).

A particularly novel finding of this study is the buffering effect of psychological resources on inflammation. While limited research has explored collective psychological resources in this context, mixed findings have emerged in the examination of sense of control as a moderator of trauma-related inflammation, reporting buffering effects (21) or null findings (83). Our results corroborate the buffering effects of psychosocial resources, indicating that psychological resources play a protective role in buffering against the adverse effects of child maltreatment severity on inflammation, specifically by moderating the relationship with IL-6. This result suggests that individuals with greater psychological resources may experience reduced inflammatory responses linked to IL-6, potentially helping to mitigate the long-term health consequences of child maltreatment. However, the lack of moderation in the relationship between child maltreatment and CRP suggests that different inflammatory markers may be influenced by distinct mechanisms. Future research should examine the pathways through which psychological resources impact inflammatory responses and identify additional factors that may help build psychological resources in individuals with a history of child maltreatment.

Surprisingly, we found that social resources did not alleviate the negative consequences of child maltreatment on any health outcomes. Several factors, including the timing of social support, the embedding of the stress response, maladaptive coping mechanisms, and the participants' demographics, could explain these results. The timing of social support could be a crucial factor influencing our study results. For instance, social support and integration may be less effective when introduced later in life than continuous support from a younger age. If participants did not experience supportive relationships early in life to counterbalance the effects of maltreatment, it might be harder for them to benefit from such resources later on. This is supported by a recent study that underscores the importance of consistent early intervention, including social support and psychoeducational interventions, continuing into adulthood (84). Notably, the ability to form supportive relationships can be impaired by child maltreatment, making individuals less likely to utilize available social resources effectively. Greater levels of child maltreatment may predict higher avoidance in close relationships (85).

The biological embedding of stress responses due to child maltreatment might have impacted the results in the current study. Chronic exposure to stress due to child maltreatment can make it difficult for individuals to receive social support. This finding aligns with past research that found children from highly distressed households are less likely to develop the social and emotional skills necessary for forming supportive close relationships in adulthood (86). Also, maladaptive coping mechanisms could have a significant influence on our study results. Participants with a history of child maltreatment may develop maladaptive coping mechanisms (e.g., substance abuse, social withdrawal) that persist into adulthood and can undermine the benefits of social support. For example, participants with low social support and a diminished sense of belonging may be more susceptible to substance use (87). Mental health

disorders such as depression, which are often outcomes of child maltreatment, can interfere with the ability to form and maintain supportive social relationships, thus limiting the buffering effect of social support. Germane to this point, past research suggests a significant indirect effect of child maltreatment on depression, mediated by insecure attachment and perceived social support (85).

Limitations

A few limitations should be acknowledged when interpreting the findings of this study. First, although the CTQ is a commonly used, valid assessment for child maltreatment, reporting bias might occur in the retrospective self-report of child maltreatment experiences, resulting in overestimating or underestimating the health effects of child maltreatment. Existing studies have shown a moderate correlation between retrospective and prospective reports of child maltreatment and stronger relationships between retrospective reports of child maltreatment and mental health than prospective reports of child maltreatment (88, 89). Future studies are needed to validate our findings using prospective reports of child maltreatment. Also, this study solely relied on self-reports of child maltreatment. Contamination (e.g., overreporting child maltreatment) may occur to obscure the reported relationship between child maltreatment severity and health (90). Although Coehlo et al. (29) noted in their systematic review that the CTQ stands out as one of the more comprehensive measures of childhood trauma with strong psychometric properties, future studies might consider using multiple sources of reports on child maltreatment (e.g., official case reports). Second, the cross-sectional nature of the data collection limits the ability to draw definitive conclusions about the causal relationships in this study. Third, differences in some characteristics (e.g., educational attainment) between the biomarker subsample and the MIDUS survey sample might indicate the existence of a selection bias in our

analytic sample that could affect the reported estimates. Fourth, social resource variables were not assessed during childhood when maltreatment occurred, but rather decades later, which precludes us from evaluating whether or how social resources in childhood might have influenced long-term health outcomes. Fifth, we used depressive symptoms to represent mental health within our biopsychosocial model, and future studies should consider other mental health symptoms and disorders. Lastly, the analytic sample was predominantly white, which limits our ability to examine any meaningful racial differences in the relationships examined in this study.

Implications

Despite these limitations, this study contributes additional information to understanding how child maltreatment affects health outcomes and provides novel insight into the protective role of psychological resources in mitigating the adverse effects of child maltreatment on whole-person health. Findings from this study advance current understanding of factors that may protect against the deleterious consequences of child maltreatment and hold implications for public health, particularly in the areas of prevention and intervention related to child maltreatment and whole-person health. The negative effects of child maltreatment on whole person health in adulthood reported in this study highlight the importance of early intervention and support for individuals who experienced child maltreatment to reduce these adverse long-term health outcomes. For example, assessing the experience of child maltreatment should be considered as a routine screening for primary care, enabling early intervention and offering immediate support (78, 91). Moreover, this study shows that psychological resources (e.g., self-esteem, sense of control) mitigated the adverse effects of child maltreatment on mental and immune function, suggesting that enhancing psychological resilience (e.g., through cognitive behavioral therapy) could be a possible effective intervention for improving the mental and biological health of those

with a history of child maltreatment. The finding that psychological resources buffered the effects of child maltreatment on depressive symptoms and inflammation, but not on overall psychological well-being or chronic health conditions suggests these resources may be more effective in reducing depressive symptoms and inflammatory responses as opposed to improving physical health or well-being. In addition, the absence of significant interaction effects between social resources (e.g., social support) and child maltreatment on health outcomes does not necessarily imply a less critical role of positive social relationships and social integration in fostering whole-person health than psychological resources. Our findings appear to suggest that social resources may not contribute to better health by protecting against the adverse health effects of child maltreatment. Instead, social resources might directly relate to better health outcomes, regardless of the presence of exposure to child maltreatment.

Conclusion

In summary, this study provided important empirical evidence to support the protective effect of psychological resources in maintaining mental and biological health following exposure to child maltreatment. Findings from this study suggest that interventions designed to enhance psychological resources might be a potentially effective strategy to promote health for middle-aged and older adults who experience child maltreatment.

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Table 1. Characteristics of the study sample.

Variables	Mean	SD
Independent variable		
Child maltreatment severity	38.28	14.52
Threat	21.61	9.27
Deprivation	16.67	6.66
Moderators		
Social resources:		
Social connectedness	4.34	1.23
Social strain	2.96	0.48
Social support	3.44	0.49
Psychological resources:		
Optimism	23.62	4.80
Sense of control	5.59	0.99
Self-esteem	38.01	7.48
Dependent variables		
Chronic health conditions	2.47	2.48
C-reactive protein (ug/mL)	3.02	4.78
Interleukin-6 (pg/mL)	3.04	3.04
Depressive symptoms	8.73	8.19
Psychological well-being:		
Autonomy	37.34	6.69
Environmental mastery	38.24	7.70
Personal growth	39.44	6.76
Positive relations with others	40.50	7.23
Purpose in Life	39.39	6.69
Self acceptance	37.50	30.48
Covariates		
Regular physical activity (N, %)	960	76.5%
Regular alcohol use (N, %)	237	18.9%
Smoking (N, %)	597	47.6%
Race (Others; N, %)	286	22.8%
Female (N, %)	713	56.8%
Age	54.52	11.72
Household-adjusted income	$36,380.4	$31,928.7
Educational attainment	7.47	2.53

Table 2. The moderating effect of psychological resources.

Variables	Psychological well-being		Depressive symptoms		Chronic health conditions		C-reactive protein		Interleukin-6	
	B(SE)	*p*	*B(SE)*	*p*	*B(SE)*	*p*	*B(SE)*	*p*	*B(SE)*	*p*
Child maltreatment severity (CMS)	-0.01(0.01)	.095	0.09(0.02)	<.001	0.01(0.00)	<.001	0.01(0.00)	.032	0.00(0.00)	.27
Psychological resources (PR)	0.91(0.08)	<.001	-0.78(0.18)	<.001	-0.05(0.01)	<.001	0.04(0.03)	.15	0.02(0.02)	.17
CMS × PR	0.00(0.00)	.19	-0.01(0.01)	.045	0.00(0.00)	.99	-0.00(0.00)	.32	-0.00(0.00)	.042
Regular physical activity	-0.26(0.16)	.11	-0.76(0.49)	.12	-0.02(0.04)	.58	-0.44(0.08)	<.001	-0.27(0.05)	<.001
Regular alcohol use	0.02(0.20)	.93	0.83(0.56)	.14	-0.05(0.05)	.27	-0.07(0.08)	.44	-0.04(0.05)	.47
Smoking	-0.14(0.14)	.30	1.12(0.10)	.005	0.09(0.04)	.012	0.05(0.07)	.42	0.07(0.04)	.076
Race (Others)	0.02(0.18)	.90	1.57(0.50)	.002	0.15(0.05)	.003	0.23(0.09)	.011	0.24(0.06)	<.001
Female	0.39(0.14)	.006	0.04(0.40)	.92	0.18(0.04)	<.001	0.33(0.07)	<.001	0.06(0.04)	.19
Age	0.02(0.01)	.001	-0.03(0.02)	.090	0.01(0.00)	<.001	0.00(0.00)	.51	0.01(0.00)	<.001
Socioeconomic status	-0.02(0.07)	.79	0.12(0.25)	.64	0.01(0.02)	.59	-0.11(0.04)	.008	-0.06(0.03)	.022
Marital status	0.18(0.14)	.19	-1.39(0.44)	.002	0.02(0.04)	.72	0.06(0.08)	.42	-0.07(0.04)	.099

Table 3. The moderating effect of social resources.

Variables	Psychological well-being		Depressive symptoms		Chronic health conditions		C-reactive protein		Interleukin-6	
	B(SE)	*p*	*B(SE)*	*p*	*B(SE)*	*p*	*B(SE)*	*p*	*B(SE)*	*p*
Child maltreatment severity (CMS)	-0.02(0.01)	.091	0.10(0.02)	<.001	0.01(0.00)	<.001	0.01(0.00)	.043	0.00(0.00)	.21
Social resources (SR)	3.58(0.79)	<.001	-4.30(1.59)	.007	-0.07(0.11)	.52	0.24(0.21)	.24	0.13(0.12)	.28
CM × SR	0.02(0.02)	.49	-0.03(0.05)	.50	-0.00(0.00)	.44	-0.00(0.00)	.43	-0.00(0.00)	.17
Regular physical activity	-0.08(0.24)	.75	-1.18(0.51)	.021	-0.05(0.04)	.31	-0.43(0.08)	<.001	-0.28(0.05)	<.001
Regular alcohol use	-0.20(0.27)	.47	1.15(0.60)	.054	0.04(0.05)	.38	-0.07(0.08)	.44	-0.03(0.05)	.50
Smoking	0.04(0.20)	.84	0.93(0.43)	.029	0.08(0.04)	.029	0.05(0.07)	.42	0.08(0.04)	.061
Race (Others)	0.58(0.28)	.041	1.28(0.56)	.023	0.13(0.05)	.012	0.23(0.09)	.011	0.26(0.05)	<.001
Female	0.21(0.20)	.30	0.48(0.44)	.27	0.18(0.04)	<.001	0.31(0.07)	<.001	0.06(0.04)	.13
Age	-0.04(0.01)	<.001	-0.05(0.02)	.002	-0.01(0.00)	<.001	-0.00(0.00)	.46	-0.01(0.00)	<.001
Socioeconomic status	-0.67(0.12)	<.001	-0.74(0.26)	.004	-0.02(0.02)	.39	-0.10(0.04)	.016	-0.07(0.03)	.009