Early Life Adversity and Blunted Cardiovascular Reactivity to Acute Psychological Stress: The Role of Current Depressive Symptoms

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ABSTRACT

Objective: The pathways underlying the early life adversity and cardiovascular reactivity association remain unclear. The current study examined the role of current depressive symptoms on this relationship.

Methods: Mediation analyses were conducted using data from 639 participants drawn from the Midlife Development in the United States 2 Biomarker Project. Responses were derived from the Childhood Trauma Questionnaire and Center for Epidemiologic Studies Depression Scale. Participants had their systolic and diastolic blood pressure (SBP, DBP) and heart rate monitored throughout a standardized stress testing protocol.

Results: The association between early life adversity and reactivity was mediated by current depressive symptoms; all adversity factors were linked to higher levels of current depressive symptoms, which, in turn, were associated with lower cardiovascular reactivity. For emotional abuse, this was noted for SBP ($\beta = -0.06$ [95% confidence interval {CI}, −0.13 to −0.01]) and DBP ($\beta = -0.04$ [−0.07 to −0.01]), physical abuse (SBP: $\beta = -0.05$ [−0.11 to −0.01]; DBP: $\beta = -0.03$ [−0.06 to −0.01]), sexual abuse (SBP: $\beta = -0.04$ [−0.09 to −0.01]; DBP: $\beta = -0.02$ [−0.05 to −0.01]), emotional neglect (SBP: $\beta = -0.04$ [−0.09 to −0.01]; DBP: $\beta = -0.02$ [−0.05 to −0.01]), physical neglect (SBP: $\beta = -0.09$ [−0.17 to −0.02]; DBP: $\beta = -0.05$ [−0.09 to −0.02]), and total Childhood Trauma Questionnaire score (SBP: $\beta = -0.02$ [−0.03 to −0.00]; DBP: $\beta = -0.01$ [−0.02 to −0.00]).

Conclusions: The present findings extend research and demonstrate that depression is an underlying mechanism linking early life adversity and blunted cardiovascular reactivity.

Key words: cardiovascular reactivity, blunted reactivity, early life adversity, depression, mediation.

INTRODUCTION

Coronary heart disease (CHD) is the leading cause of global deaths annually and has been in the United States for more than 90 years (1). Since 2007, there has been a 21.1% mortality increase attributable to cardiovascular disease (CVD), and an estimated 82.6 million Americans are living with cardiac-related illnesses (2). The focus in research is moving beyond conventional risk factors such as family history, physical inactivity, obesity, and smoking (3–5), to examining psychological factors such as depression. Hopelessness, a core symptom of depression, is associated with atherosclerosis (6) and is an established risk factor for CHD (7). Prospective studies suggest depression is predictive of subsequent hypertension (8), associated with an increased risk of CHD (9), and mortality (10). Furthermore, greater depressive symptoms predict stroke in men (11), with the risk of having a stroke increasing twofold to fourfold, even after controlling for confounds (12).

Stress is proposed to link depression and CVD (13), with maladaptive cardiovascular responses indicating adverse outcomes (7,14). Specifically, the cardiovascular reactivity (CVR) hypothesis suggests exaggerated responses to stress signify a vulnerability to disease, such as hypertension (15), atherosclerosis (16), and mortality (17). Blunted cardiovascular reactions, often considered to be protective, also lead to poorer outcomes, for instance, addiction (7,14), eating disorders (18), and depression (19). Studies indicate depression is associated with increased systemic vascular resistance (20) and heightened stress responses (21), whereas others report no relationship (22,23). In contrast, depression was found to be associated with blunted heart rate (HR) reactivity 5 years later (19), with several studies reporting an inverse relationship (19,24–29). Moreover, a recent systematic review found hypo-stress reactivity to be a hallmark of depression (30).

Stressful life events, be it proximal (recent events) or distal (early life adversity; ELA), have been identified as a pathway potentially related to dysfunctional stress responses (29,31,32). Chronic exposure to ELA during critical periods when physiological systems

CESD = Center for Epidemiologic Studies Depression Scale, **CHD** = coronary heart disease, **CTQ** = Childhood Trauma Questionnaire, **CTQ-SF** = Childhood Trauma Questionnaire–Short Form, **CVD** = cardiovascular disease, **CVR** = cardiovascular reactivity, **DBP** = diastolic blood pressure, **EA** = emotional abuse, **ECG** = electrocardiogram, **ELA** = early life adversity, **EN** = emotional neglect, **HR** = heart rate, **MATH** = Morgan and Turner Hewitt, **MBSR** = mindfulness-based stress reduction, **MIDUS** = Midlife Development in the United States, **PA** = physical abuse, **PN** = physical neglect, **SA** = sexual abuse, **SBP** = systolic blood pressure

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are developing can result in alterations in stress response systems implicated in blunted CVR (33). For example, studies found blunted reactivity was associated with greater ELA (31), in women exposed to ELA (34), and in those with greater experience to emotional adversity before the age of 15 years (35).

There are also a number of proximal and distal factors that influence the probability of developing depression (36). A longitudinal study of twins reported that recent life events (previous 12 months) were associated with symptom severity and may be the strongest determinant of the disorder (36). In contrast, it is well documented that ELA increases the risk of depression (37) and is related to earlier onset, symptom severity, duration, more episodes, and impairment (38–40). ELA is attributed to more than 30% of mental disorders in the United States (41), with emotional abuse (EA) and emotional neglect (EN) increasing the risk of lifetime depression (42,43), and more reliable than physical abuse (PA) or sexual abuse (SA; (44)). EA has been linked to low self-esteem, depression, and eating disorders (45). In addition, the prevalence estimate for EA (36%) is considerably higher than PA (8%) and for SA (2%) (46,47). Furthermore, there is a significant association between ELA and adult depression, even when controlling for mediating factors (48,49).

Although depression, be it historical, current, or clinically diagnostic, confers the risk of cardiac events and mortality (26) and may be the strongest psychosocial risk factor for CVD (50), the mechanistic association is still poorly understood. The majority of studies on depression and blunted reactivity focus on current depressive symptoms. Furthermore, ELA is reportedly a source of variation in reactivity among those with depression (51). Therefore, it is plausible that depression, given its links with blunted reactivity (28) and ELA (43,52), mediates the ELA-CVR relationship.

Therefore, based on the aforementioned evidence and using data from the Midlife Development in the United States 2 (MIDUS II), the aim of the present study was to identify if current depression influenced the relationship between ELA and CVR. In line with previous research, we hypothesized that individuals with depression would exhibit blunted reactivity to stress. Based on theoretical and empirical reports linking ELA with depression and CVR, we predicted that those with greater ELA would also report higher symptoms of depression and exhibit a blunted cardiovascular response to the stress task.

METHODS

Participants

Data were drawn from the 1255 respondents who completed the MIDUS II Biomarker Project, which consisted of 1054 from the longitudinal survey sample and 201 from the Milwaukee sample. At the time of the clinic visit, participants ranged in age from 35 to 86 years (mean [standard deviation], or M [SD] = 57.32 [11.55] years), with 56.8% females (n = 713) in the sample. A decision was made a priori to exclude the total number of twins in the sample (n = 388), because of genetic determinants of reactivity (53) and considerations of the assumption of independence in analyses. Furthermore, an additional 16 participants were excluded because they had completed an extended version of the stress task (54), with an additional 26 outliers, 7 who had pacemakers, and an additional 179 participants who were missing data on study variables. This left a total of 639 participants, and demographic information for the sample can be found in Table 1. There were no differences in reactivity or ELA because of socioeconomic status (all p values > .05). Furthermore, no association was observed for participants who reported taking medication for depression (n = 55) and CVR. More than two-thirds (70.1%) of the sample reported taking prescription medication of some kind. Given taking prescription medication was in effect normative for this sample, these participants were included and controlled for as a covariate in all mediation analyses. The Biomarker Project ran from 2004 to 2009, and data collection took place during a 24-hour stay at a clinical research center. Informed consent was obtained before beginning study procedures.

TABLE 1. Participant Characteristics and Demographics

Items	n	Mean (SD)	Range
Age, y	639	56.00 (11.10)	35–85
Body mass index, kg/m^2	639	30.28 (6.81)	
Sex			
Male	279	56.39 (11.34)	
Female	360	55.70 (10.91)	
Ethnicity			
White	429		
African American	153		
Native American	3		
Asian/Pacific Islander	1		
Multiracial	7		
Other	12		
Employment status			
Employed	332		
Unemployed	152		
Education level			
High school	121		
College (attending)	106		
Associate's degree	35		
Bachelor's degree	121		
Some graduate school	18		
Masters	64		
PhD	20		

SD = standard deviation.

For sex, age, and body mass index, n = 639; for ethnicity, n = 605; for socioeconomic measures, and education level, n = 485; and for employment status, n = 484.

Procedure

Participants from the original MIDUS survey study were invited to complete the MIDUS II Project 1 phone interview and self-administered questionnaire. Upon completion, those who were not part of the city oversamples and who lived in the United States were eligible for participation in the Biomarker Project. Participants underwent a comprehensive biological assessment and completed a standardized laboratory-based stress task, where indicators of beat-to-beat blood pressure and HR were obtained. To enhance self-reported data collected in Project 1, participants completed a medical history and self-administered questionnaires for psychosocial assessment.

Measures

Depression Measure

Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D; (55)). It comprises 20 items pooled from previously validated scales to measure current state of depressive symptomatology (55). Seven items measure depressive affect, four items measure

TABLE 2. Descriptive Statistics and Correlational Analysis for Study Variables

	Mean (SD)	Range	CES-D DA	CTQ-EA	CTQ-PA	CTQ-SA	CTQ-EN	CTQ-PN	CTQ-Total	SBP	DBP	HR
1. CES-D DA	2.1 (3.24)	0–20	—	0.326**	0.210**	0.193**	0.253**	0.282**	0.319**	−0.187**	−0.218**	−0.090**
2. CTQ-EA	8.4 (4.4)	5–25	—	—	0.728**	0.470**	0.669**	0.547**	0.870**	−0.156**	−0.134**	−0.066
3. CTQ-PA	7.2 (3.4)	5–25	—	—	—	0.521**	0.541**	0.534**	0.826**	−0.158**	−0.140**	−0.059
4. CTQ-SA	6.8 (4.4)	5–25	—	—	—	—	0.326**	0.385**	0.690**	−0.089*	−0.093*	−0.093*
5. CTQ-EN	10.1 (4.8)	5–25	—	—	—	—	—	0.643**	0.816**	−0.155**	−0.167**	−0.054
6. CTQ-PN	7.1 (3.1)	5–21	—	—	—	—	—	—	0.758**	−0.097*	−0.100*	−0.055
7. CTQ total	39.7 (15.9)	25–114	—	—	—	—	—	—	—	−0.167**	−0.163**	−0.083*
8. SBP reactivity	11.8 (11.5)	—	—	—	—	—	—	—	—	—	0.824**	0.161**
9. DBP reactivity	5.8 (4.3)	—	—	—	—	—	—	—	—	—	—	0.260**
10. HR reactivity	3.5 (3.3)	—	—	—	—	—	—	—	—	—	—	—

DA = Depressive Affect; CESD-DA Center for Epidemiologic Studies Depression Scale - Depressive Affect Subscale; SD = standard deviation; CES-D = Center for Epidemiologic Studies Depression Scale; CTQ = Childhood Trauma Questionnaire; EA = emotional abuse; PA = physical abuse; SA = sexual abuse; EN = emotional neglect; PN = physical neglect; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate.

The sample size was $n = 639$ on all measures except CES-D depressive affect ($n = 638$).

*$p < .05$.

**$p < .01$.

positive affect, seven items measure somatic complaints, and two items are an interpersonal subscale. Items are scored from 0 (*rarely or none of the time*) to 3 (*most or all of the time*), and responses are based on occurrence in the past week. Higher scores indicate higher symptoms of depression. The CES-D has excellent concurrent validity and acceptable psychometric properties (55). Only the depressive affect subscale was used in the present study, as it has been previously reported to hold the highest proportion of variance (55,56) and, in the current study, yielded a Cronbach α of .85. It is also reported that the CES-D can be reduced in size with low impact on reliability and validity (57,58).

Early Life Adversity

The original Childhood Trauma Questionnaire (CTQ) is a 70-item retrospective tool that assesses childhood abuse and neglect (59). A short form of the scale (CTQ-SF) was developed to reduce participant burden, and this 28-item self-report questionnaire contains five clinical scales that measure occurrence of EA, PA, SA, EN, and physical neglect (PN), with an additional three item minimization-denial scale to detect underreporting of abuse (60). Items are rated on a 5-point Likert scale, with response options ranging from 1 (*never true*) to 5 (*very often true*). The CTQ has good psychometric properties and is a validated tool for psychiatric populations (61–63). For this study, both the total score and the five clinical scales were analyzed. The total CTQ scale achieved an overall α (.62), and the Cronbach α for the each of the five scales exceeded .73.

Cardiovascular Assessment

Beat-to-beat systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured using a Finometer monitor (Finapres Medical Systems, Amsterdam, the Netherlands). Stemming from the volume-clamp method (64), measurements of finger arterial pressure were obtained through an inflatable finger cuff, which adjusts to increases in arterial pressure, reflecting changes in blood pressure (65). The Finometer accurately measures continuous blood pressure and detects minor changes in cardiovascular function (66). It is a widely used apparatus for measuring cardiac function in CVR research (4). HR was recorded using electrocardiogram (ECG) signals digitized at 500 Hz and installed in a microcomputer. With ECG waveforms submitted to detection software to identify R waves, MIDUS research staff then visually reviewed all ECG waveforms to amend software errors in identifying normal R waves. HR was calculated from the resulting series of normal R-R intervals and converted to beats per minute (54).

Stress Task

The stress tasks consisted of the Stroop color/word task and the Morgan and Turner Hewitt (MATH; (67)) mental arithmetic task, which were presented in random order, each at 6 minutes in duration. The laboratory stress session ran for approximately 90 minutes and is described in detail elsewhere (54,65). In brief, for the Stroop interference task, one of four color name words were presented in a font that was either congruent or incongruent to the name on a computer screen (e.g., the word blue was written in blue font), and participants used one of four keys on a keypad that corresponded to the color of the letters but not the color name. The rate of presentation was based on task performance, with greater accuracy leading to faster presentation rates.

For the MATH task, participants were required to complete a series of addition and subtraction mental arithmetic tasks. The problem was presented on the computer screen for 2.0 seconds, followed by the word equals for 1.5 seconds and then the answer that was displayed for 1.0 seconds.

TABLE 3. Mean (SD) Values of SBP, DBP, and HR, During Baseline, in Response to Stress Task and Recovery by Sex

	Male	Female
SBP, mm Hg		
Baseline	127.25 (16.63)	121.38 (17.67)
Task	140.26 (20.16)	132.35 (20.06)
Recovery	129.36 (17.42)	122.46 (17.56)
DBP, mm Hg		
Baseline	62.51 (10.43)	59.75 (10.43)
Task	68.46 (10.86)	65.49 (10.81)
Recovery	64.21 (10.71)	61.55 (10.72)
HR, bpm		
Baseline	70.55 (10.53)	74.59 (10.22)
Task	73.88 (10.73)	78.28 (10.57)
Recovery	71.32 (10.46)	74.99 (10.21)

SD = standard deviation; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; bpm = beats per minute.

Number of males ($n = 274$) and females ($n = 349$) on all cardiovascular measures.

Using the keypad, participants pressed one of two keys that corresponded to yes or no to indicate whether the answer presented to the problem was correct. Problem difficulty varied across five levels, from level 1 (1-digit ± 1-digit numbers) to level 5 (3-digit ± 3-digit numbers), and difficulty level was determined by response accuracy to each trial.

Participants completed practice trials for the stress task, after which a formal 11-minute resting baseline period began. They then completed the first of two cognitive stress tasks. A 6-minute recovery period followed, after which the second cognitive task began. Stressor measures for cardiovascular variables are averaged across the two stress tasks (Stroop and MATH), as previously reported elsewhere (65).

Statistical Analyses

Data were screened for outliers and assumption of fit before analyses. Mean levels of SBP, DBP, and HR were computed for baseline, task, and recovery. Given that our a priori hypothesis was concerned with ELA and CVR, we only examined this and not recovery. Reactivity scores were calculated by subtracting the mean baseline levels from the mean task levels. Independent *t* tests were conducted to test for differences in reactivity values, because of potential confounds of sex and smoking. A series of repeated-measures analyses of variance were used to determine if the task was successful in eliciting a stress response; partial η^2 is reported for the effect size.

Correlational analyses evaluated the association between ELA, current depressive symptoms, and cardiovascular outcomes. Simple mediation analyses (model 4) examined whether the relationship between ELA and CVR was mediated by current depression, using the overall total from the CTQ and then specifically investigating each individual subscale (EA, PA, SA, EN, and PN), while controlling for the covariates mentioned previously, along with body mass index, taking of prescription medication, hypertension, and baseline cardiovascular measures. The data were analyzed using the PROCESS macro (v3.1) in IBM SPSS Statistics version 25.0 (68).

RESULTS

Descriptive Statistics

The descriptive statistics and correlational analysis of study variables can be seen in Table 2.

Manipulation Check

Results from a series of repeated-measures (baseline, task) analyses of variance confirmed an increase in baseline to task on each cardiovascular measure for SBP ($F(2,1248) = 517.84$, $p < .001$, $\eta_p^2 = 0.45$), DBP ($F(2,1248) = 822.56$, $p < .001$, $\eta_p^2 = 0.57$), and HR ($F(2,1266) = 555.80$, $p < .001$, $\eta_p^2 = 0.47$), demonstrating that the task was physiologically stressful (Table 3). Furthermore, independent *t* tests revealed differences in reactivity due to sex for SBP ($t(637) = 2.40$, $p = .017$), with higher SBP responses in males (M [SD] = 13.00 [11.85]) compared with females (M [SD] = 10.81 [11.10]), and a similar pattern observed for HR ($t(637) = 6.29$, $p < .001$). In addition, analyses revealed differences in reactivity due to smoking, with smokers exhibiting lower SBP and DBP reactivity compared with nonsmokers (*p* values < .001). These potential confounds were also associated with baseline cardiovascular measures. Thus, these were controlled for in our main analyses.

Associations Between ELA, Depressive Symptoms, and CVR

As can be seen in Table 2, there were significant associations between exposure to ELA and current depressive symptoms, such that those scoring higher on all measures of abuse and neglect scored higher

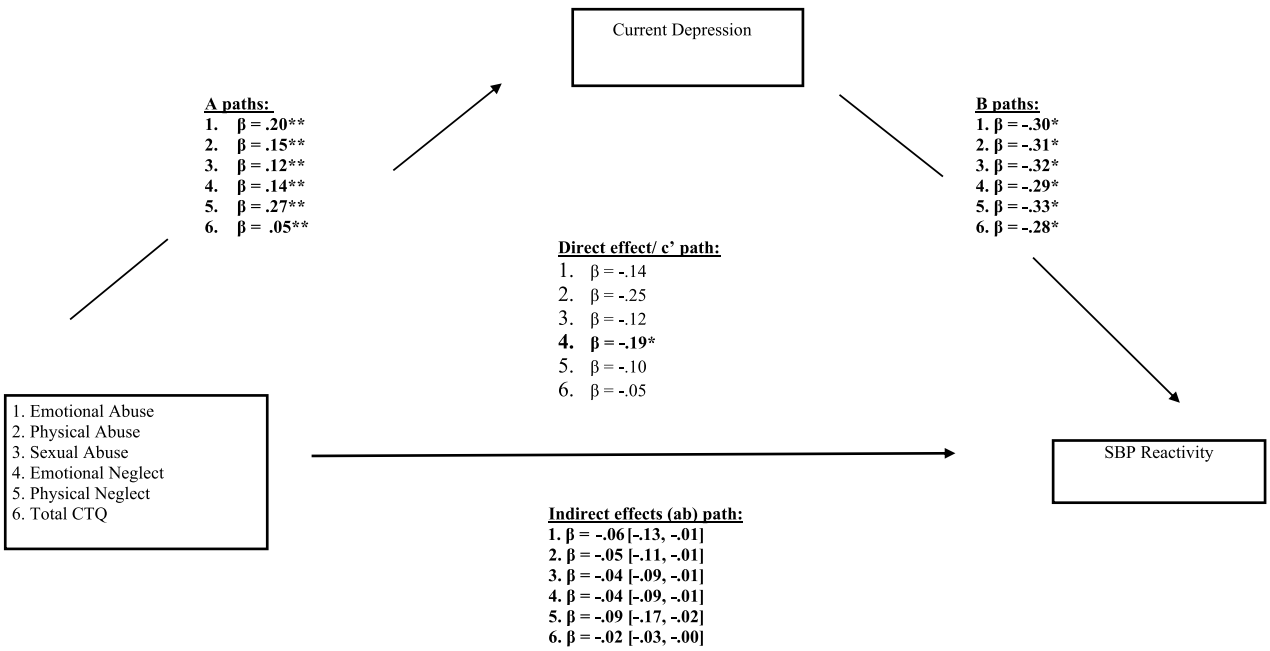

FIGURE 1. Mediation path diagram: early life adversity and SBP reactivity. Each mediation analysis includes sex, age, smoking, taking prescription medication, and baseline SBP as covariates. Statistics refer to unstandardized β values and 95% confidence intervals at the lower and upper limits for indirect effects. The *A* path represents the association between each independent variable and the mediator. Path *B* reflects the association between the mediator and SBP reactivity. Path *C′* represents the direct effect between each independent variable and SBP reactivity while holding the mediator and covariates constant. Finally, Path *ab* represents the indirect effect of each independent variable on SBP reactivity through current depressive symptoms. Significant effects are highlighted in bold text. * $p < .05$, ** $p < .01$. SBP = systolic blood pressure; CTQ = Childhood Trauma Questionnaire.

on depression. Furthermore, as expected for CVR, depression was negatively associated with reactivity values; those with higher depressive symptoms had blunted SBP, DBP, and HR responses to stress. Lastly, ELA factors were also associated in a negative manner with CVR variables, such that those scoring higher on total CTQ, EA, PA, SA, EN, and PN displayed blunted SBP and DBP responses to stress. Those who had a greater number of total CTQ and greater experiences of SA also exhibited blunted HR reactivity.

Mediation Analyses

Our overall analyses aimed to test if current depression (past week) was mediating the relationship between ELA and CVR. A simple mediation analysis was conducted while controlling for confounds sex, age, smoking, prescription medication, body mass index, hypertension, and baseline cardiovascular measures. Ordinary least square path analysis and 10,000 bootstrap samples were used to examine whether the effect of ELA factors on CVR was mediated by current depressive symptoms. In our mediation analyses, no total, direct, or indirect effects were observed for HR reactivity. Therefore, this is excluded from further reporting.

We observed several associations between ELA and SBP reactivity (please refer to Figure 1). Higher EA was significantly related to blunted SBP reactivity, with a total effect ($\beta = -0.20$, $t(631) = -2.00$, $p = .04$, 95% confidence interval [CI], −0.40 to −0.00]) being detected. EA was also related to greater depressive symptoms ($a = 0.20$, $p < .001$, 95% CI = 0.15 to 0.26). A 95% bias-corrected CI based on 10,000 bootstrap samples indicated that the indirect effect ($ab = -0.06$) was entirely below zero (−0.13 to −0.01). EA is indirectly related to blunted SBP reactivity through its relationship with current depression. A similar pattern emerged for EN.

We also observed several associations for ELA factors and DBP (Figure 2). Higher EN was significantly related to blunted DBP reactivity, with a direct effect ($\beta = -0.08$, $t(631) = -2.40$, $p = .02$, 95% CI = −0.15 to −0.01) being observed. EN was also related to higher levels of depression ($a = 0.14$, $p < .001$, 95% CI = 0.09 to 0.19). A 95% bias-corrected CI based on 10,000 bootstrap samples indicated that the indirect effect ($ab = -0.02$) was entirely below zero (−0.05 to −0.01).

As can be seen in Table 4, a broadly analogous pattern emerged for SBP and DBP reactivity, with total and indirect effects observed for total CTQ and PA, and with total, direct, and indirect effects for EN. These outcome variables only differed on EA, with total and indirect effects observed for SBP and only indirect effects for DBP. The relationship between ELA factors (childhood SA and PN), and blunted SBP and DBP reactivity only existed through the mediating role of current depression (Figures 3A, B).

DISCUSSION

The present study sought to examine associations between ELA, depression, and CVR to acute stress. As predicted, an inverse relationship was observed between depression and CVR; those reporting higher depressive symptoms displayed blunted responses to stress. The findings are in line with previous research reporting a negative relationship between depression and CVR (19,25–27). More importantly, and in line with our own expectations, depression mediated the association between ELA and blunted reactivity. These findings were evident for SBP and DBP reactivity and

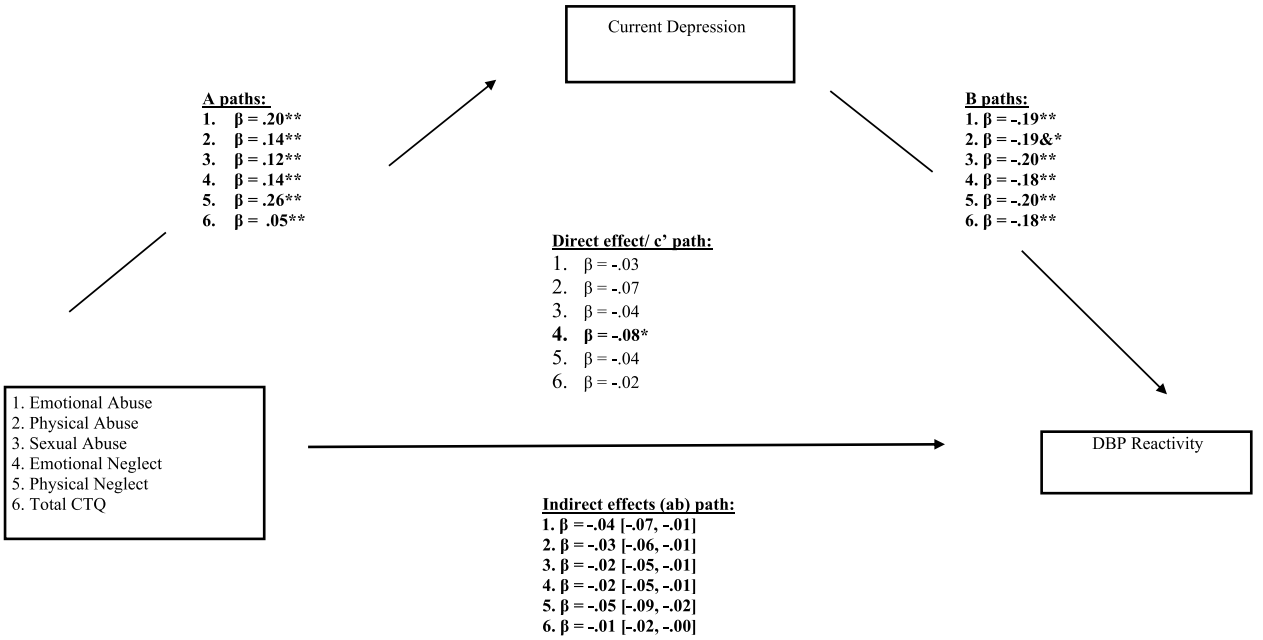

FIGURE 2. Mediation path diagram: early life adversity and DBP reactivity. Each mediation analysis includes age, smoking, body mass index, and baseline DBP as covariates. Statistics refer to unstandardized β values and 95% confidence intervals at the lower and upper limits for indirect effects. The *A* path represents the association between each independent variable and the mediator. Path *B* reflects the association between the mediator and DBP reactivity. Path *C′* represents the direct effect between each independent variable and DBP reactivity while holding the mediator and covariates constant. Finally, path *ab* represents the indirect effect of each independent variable on DBP reactivity through current depressive symptoms. Significant effects are highlighted in bold text. * $p < .05$, ** $p < .01$. DBP = diastolic blood pressure; CTQ = Childhood Trauma Questionnaire.

TABLE 4. Mediational Pathways on Cardiovascular Variables

	SBP Reactivity								BP Reactivity								HR Reactivity							
	Total Effect (*c*)			Direct Effect (*c*′)			Indirect Effect (*ab*)		Total Effect (c)			Direct Effect (*c*′)			Indirect Effect (*ab*)		Total Effect (c)			Direct Effect (*c*′)			Indirect Effect (*ab*)	
	β	*p*	95% CI	*β*	*p*	95% CI	*β*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI	*β*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI	*β*	95% CI
EA	−0.20	.05*	−0.40 to −0.00	−0.14	.176	−0.34 to 0.06	−0.06	−0.13 to −0.01	−0.07	.067	−0.15 to 0.00	−0.03	.429	−0.11 to 0.05	−0.04	−0.07 to −0.01	−0.10	.313	−0.29 to 0.09	−0.06	.582	−0.26 to 0.14	−0.04	−0.11 to 0.01
PA	−0.30	.02*	−0.55 to −0.05	−0.25	.053	−0.50 to 0.00	−0.05	−0.11 to −0.01	−0.10	.04*	−0.20 to −0.00	−0.07	.139	−0.17 to 0.02	−0.03	−0.06 to −0.01	−0.17	.184	−0.42 to 0.08	−0.14	.285	−0.39 to 0.11	−0.03	−0.09 to 0.01
SA	−0.16	.116	−0.35 to 0.04	−0.12	.248	−0.31 to 0.08	−0.04	−0.09 to −0.01	−0.07	.078	−0.14 to 0.01	−0.04	.260	−0.12 to 0.03	−0.02	−0.05 to −0.01	−0.10	.278	−0.30 to 0.08	−0.08	.429	−0.27 to 0.11	−0.03	−0.07 to 0.01
EN	−0.24	.009*	−0.41 to −0.06	−0.19	.03*	−0.38 to −0.01	−0.04	−0.09 to −0.01	−0.11	.002**	−0.18 to −0.04	−0.08	.02*	−0.15 to −0.01	−0.02	−0.05 to −0.01	−0.07	.446	−0.25 to 0.11	−0.04	.691	−0.22 to 0.14	−0.03	−0.08 to 0.01
PN	−0.19	.187	−0.46 to 0.09	−0.10	.495	−0.38 to 0.19	−0.09	−0.17 to −0.02	−0.09	.092	−0.20 to 0.01	−0.04	.478	−0.15 to 0.07	−0.05	−0.09 to −0.02	−0.06	.663	−0.34 to 0.21	−0.002	.991	−0.28 to 0.28	−0.06	−0.15 to 0.01
Total CTQ	−0.07	.01*	−0.12 to −0.02	−0.05	.056	−0.11 to 0.00	−0.02	−0.03 to −0.00	−0.03	.006	−0.05 to −0.01	−0.02	.081	−0.04 to 0.00	−0.01	−0.02 to −0.00	−0.03	234	−0.09 to 0.02	−0.02	.463	−0.08 to 0.03	−0.01	−0.03 to 0.00

SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; EA = emotional abuse; PA = physical abuse; SA = sexual abuse; EN = emotional neglect; PN = physical neglect; CTQ = Childhood Trauma Questionnaire; ELA = early life adversity; CVR = cardiovascular reactivity.

Path *a* represents the pathway from ELA factors to depression in the mediation model, whereas path *b* represents the pathway from depression to CVR parameters. The indirect pathway (*ab*) represents the effects of ELA on CVR through current depressive symptoms and was significant for SBP and DBP reactivity, as it does not pass through zero.

*$p < 0.05$.

**$p < 0.01$.

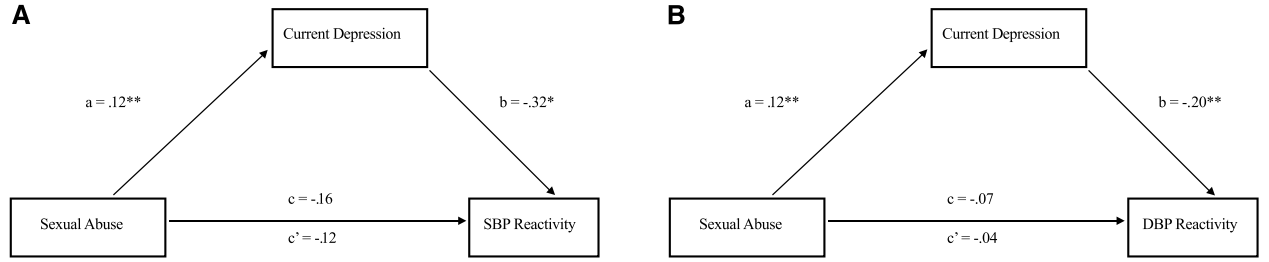

FIGURE 3. Simple mediation diagram. Current depressive symptoms as a mediator between ELA (sexual abuse) and SBP reactivity (A) and DBP reactivity (B). * $p < .05$ level. ** $p < .01$ level. ELA = early life adversity; SBP = systolic blood pressure; DBP = diastolic blood pressure.

withstood adjustment for several confounding factors, providing support for research reporting blunted SBP and DBP in patients with MDD (69). Although no significant interaction was observed for HR, associations were observed in our regression models. Moreover, it is worth noting that not all studies find depressed participants have alterations in HR (70).

This study extends knowledge on the ELA-CVR relationship and supports the proposition that ELA increases susceptibility to depression and influences stress regulation (29). Carroll et al. (29) proposed that the association between ELA and blunted reactivity was linked to motivational factors and that blunted reactivity may potentially be a marker of motivation dysregulation, implying that motivation may be a key mediating pathway. Our findings extend on this work by suggesting the ELA–blunted reactivity relationship is mediated by current depression; this association became less pronounced through the mediational pathway. More importantly, it may be that external factors like ELA interact with motivational factors and depression to influence blunted stress responses. For example, ELA influences physiological responses that result in changes to stress response systems associated with depression and motivated behavior (71,72). Furthermore, repeated or enduring exposure to ELA can have a long-lasting impact on brain systems responsible for stress regulation and mood (29,30). Thus, together, these studies offer some support for this notion that ELA may influence both depression and motivated behavior, which affects our physiological response to stress, a combination that could be examined in future studies.

Moreover, our study is in keeping with emerging evidence that supports the importance of preventative and intervention care. In fact, it is worth noting that a recent study found women with ELA in a mindfulness-based stress reduction (MBSR) group displayed improved cortisol responses and reduced depression relative to those in the control group (73). In addition, another study reported that MBSR reduced depressive symptoms over a 2-month period in adults who reported childhood SA (74,75). Considering the present findings suggest that the relationship between ELA and blunted reactivity is mediated through current depression, future research may benefit from cultivating MBSR in samples with a history of ELA to reduce depression and somatic complaints (74) and improve mental and physical outcomes (75).

There are several limitations to the present study. First, because of the cross-sectional nature and reliance on self-report measures, inferences about causality and pathology cannot be drawn (76). Although the CES-D is a valid and reliable measure of depression, it only measures symptom severity experienced in the past week (55,77). Second, because of the age of the sample, the majority of participants had at least one chronic health condition that may be comorbid with depression, albeit we did control for these, and the effects were still evident. Furthermore, retrospective assessment of ELA does not capture the effects of stress during critical periods of development (78,79) and is subject to recall bias and issues of underreporting (80,81). Future research may benefit by adding a measure of age of occurrence; this may offer a more comprehensive assessment on the critical periods of stress during sensitive developmental epochs. Nevertheless, the severity of events makes bias unlikely, and evidence suggests that recollection of ELA in adulthood is relatively reliable (82) and strongly associated with adult depression (83) and blunted reactivity (84,85). Finally, multiple comparisons were analyzed, and as such, future research should replicate our findings. Strengths of the present study are its relatively large sample size and inclusion of several covariates. Considering the wealth of research that shows blunted reactivity predicts the development of depression (19), an alternative avenue of investigation is that blunted reactivity and higher experiences of ELA may predict the development of depression. Although this was beyond the scope of the current article, it may prove useful for future research.

To conclude, the present study provides confirmation that ELA is associated with blunted CVR. In addition, it provides empirical demonstration that depression is a key factor in this story; in particular, we have found that the magnitude of the ELA–blunted reactivity relationship became less pronounced through the mediational pathway of current depression. Although SA and PA have reportedly lower prevalence estimates (46,47), with both EA and EN considered more reliable risk factors for depression (42,43), it is interesting that our findings suggest that those with greater exposure to childhood adversity, irrespective of type, are more susceptible to depression in adulthood. Given that ELA signifies a vulnerability to depression in adulthood (86), raises the frequency of depressive symptoms (48,87,88), and is reportedly a source of variation in reactivity among those with depression, it is not surprising that those reporting greater exposure to adversity in childhood had higher symptoms of current depression and blunted cardiovascular responses to stress. Considering the negative health implications associated with blunted CVR, ELA, and depression, our findings have important implications for tailored and targeted interventions. Although there is no consistent evidence to suggest that one particular type of ELA induces exaggerated or blunted reactivity, or has a differential impact in later life (35), it is clear that the harmful effects of ELA persist long into adulthood (89) and are linked to mental health issues (90).

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