

**The Influence of Childhood Adversity on Emotional Reactivity to Daily Stress in
Adulthood: A Systematic Review**

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Abstract

Adverse childhood experiences (ACEs), such as abuse, neglect, and household dysfunction, are prevalent and have been linked to psychopathology in adulthood, including depression and anxiety. This review posits that heightened emotional reactivity is a potential mediator between childhood adversity and adult psychopathology, by exploring the effect of adversity on the relationship between daily stressors and negative affect response. Ten studies that make use of ambulatory measurements were gathered to summarise the current evidence on the topic and observe patterns. Findings indicated that individuals with a history of childhood adversity can exhibit heightened emotional reactivity, characterised by increased negative affect in response to daily stressors. However, inconsistencies were also highlighted, and further moderating factors such as the type and timing of adversity, age, and the presence of supportive relationships were found. These factors contribute to the variability in emotional reactivity and underscore the need for further research to understand these complexities. Overall, from a theoretical standpoint, this systematic review highlights the need for reaching a consensus on the operationalisation of emotional reactivity. From a practical one, it emphasises the importance of addressing childhood adversity in clinical practice and developing interventions to mitigate the long-term effects of early trauma on emotional reactivity.

Keywords: Childhood adversity, emotional reactivity, stress, ambulatory measures, systematic review

The Influence of Childhood Adversity on Emotional Reactivity to Daily Stress in Adulthood: A Systematic Review

The idea that traumatic experiences in childhood have far-reaching impacts on mental health in adulthood is foundational in theories regarding life course development (Kong et al., 2021). Adverse childhood experiences (ACEs) are traumatic events that occur to children under the age of 18, including factors such as abuse, neglect, poverty and other household challenges (Karatekin & Hill, 2019). Such experiences are widespread, with approximately 60% of adults in the US alone reporting some form of ACE (Kong et al., 2021). The relationship between ACEs and various psychopathologies, most commonly depression, is well documented (e.g., Lardinois et al., 2010; Wichers et al., 2008; Yaroslavsky et al., 2020), with some studies even finding a dose-response relationship (Thompson et al., 2018, as cited in Kong et al., 2021). Further adverse effects can be seen in the areas of academic achievement, employment and social relationships (Yaroslavsky et al., 2020). However, less is known about the pathways and mechanisms through which childhood adversity exerts its influence on a day-to-day basis. One possible pathway, which is explored in the present paper, is through its effects on emotional reactivity to daily stressors. Research suggests that emotion regulation deficits, such as emotional reactivity, can act as the mediator between childhood adversity and psychopathology, such that it plays a critical role in determining whether someone with childhood adversity will develop a disorder (Hopfinger et al., 2016).

Emotional Reactivity in Response to Stress

Emotional reactivity has many different conceptualisations in literature. Terms such as emotional reactivity (Glaser et al., 2006), stress-sensitivity (Kong et al., 2021), and stress reactivity (Weltz et al., 2016) are often used interchangeably, describing similar phenomenon. In this paper, the term emotional reactivity will be used to describe levels of negative affect (NA) in response to daily stressors (as done in Glaser et al., 2006). Heightened emotional

reactivity can be seen as a type of emotion dysregulation (Weltz, 2016), and follows the idea that exposure to adversity makes individuals increasingly sensitive to stressors (Lardinois et al., 2010). This can be operationalised in a variety of ways, but each following the basic premise of increased NA in response to less severe stressors, such as daily hassles (e.g., Kong et al., 2021). This heightened reactivity can influence stress perception and response as a whole, making it a crucial area of study in understanding mental health.

Daily emotional reactivity can significantly disrupt an individual's ability to function and manage life's daily stressors, thereby affecting their overall quality of life. Furthermore, increased emotional reactivity to daily stressors and hassles has been linked to chronic health problems, affective disorders, and greater depressive symptoms (Kong et al., 2021). However, less is known about what factors impact emotional reactivity and cause it to become heightened in the first place.

Childhood Adversity and Emotional Reactivity

From a developmental perspective, childhood adversity can be seen as a risk factor that alters the typical trajectory of emotional and behavioural development (Nelson et al., 2020). Early stressful experiences can disrupt development during critical periods for learning emotional control and regulation (Espelata et al., 2018). Not developing the necessary skills early on can lead to lifelong dysfunction in stress and emotional responses, such as heightened emotional reactivity. The Stress Sensitization Model explains how early life adversity can increase sensitivity to stress, leading to greater emotional reactivity in adulthood (Stroud, 2018). Therefore, subsequent stressors, which might be manageable for others, can have a more severe impact individuals who experienced early life adversity.

Childhood adversity has also been associated with long-term dysfunction in hypothalamic-pituitary-adrenal (HPA) axis functioning, leading to dysregulated cortisol output and disruption of the stress response system (Kong et al., 2021). Other hormones that

have been associated with childhood trauma and emotional reactivity include serotonin, dopamine, and norepinephrine (Read et al., 2001). Research in psychosis patients with a history of childhood trauma has also shown brain abnormalities, such as hippocampal alterations, cerebral atrophy, and reversed cerebral asymmetry. These structural and physiological changes can lead to heightened emotional reactions and stress responses.

Although much research has found support for the hypothesis of childhood adversity increasing emotional reactivity, there is also inconsistency. Regarding HPA axis functioning, research has shown possible hyperactivity (Heim et al., 2000) and hypoactivity (Schär et al., 2022), with blunted and elevated cortisol activity in response to stress. Furthermore, work by Schweizer et al. (2015) even showed enhanced emotion regulation capabilities in those exposed to moderate childhood adversity. With inconsistency like this, possible influencing factors might be at play. Furthermore, factors like resilience (Poole et al., 2017) and support (McLaughlin et al., 2020) could attenuate effects of childhood adversity on reactivity, further complexifying the relationship. An exploration of such influencing factors could aid in understanding the nuances of the relationship.

Daily Analysis of Emotional Reactivity

Most studies of childhood adversity and emotional reactivity take a more traditional approach of capturing emotional responses to stress at a single point, most commonly through questionnaires (e.g., Hopfinger et al., 2016) or physiological responses in lab-induced stressors (e.g., Heim et al., 2000). However, increasingly more research is adopting the use of ambulatory measures, such as ecological momentary assessment (EMA) and experience sampling methods (ESM), to capture daily emotional regulation and stress responses. Emotions can vary significantly from day to day. Thus, by assessing emotional reactivity daily, researchers can better understand the immediate impact of stressors on emotional responses (Scollon et al., 2000). Such approaches allow researchers to capture fluctuations in

emotional reactivity that might be missed in cross-sectional studies (Bolger et al., 2003). Furthermore, it can aid in identifying patterns and mechanisms, which could help explore the inconsistencies in the knowledge base of this topic. Daily assessments are also more ecologically valid measures of emotional reactivity, limiting recall bias and improving accuracy (Scollon et al., 2000). Therefore, to truly understand the phenomenon, one must investigate the dynamic temporal processes as they unfold in everyday life (Weltz et al., 2016).

The Present Systematic Review

The present study focuses on daily measures of emotional reactivity in response to stress in participants who have experienced some form of childhood adversity. To the authors knowledge, there is no systematic review of the existing research, suggesting a possible opportunity to summarise the current knowledge. This could help identify gaps and inconsistencies in the research, and provide a more holistic understanding of the topic, thus contributing to overall advancement the field. Additionally, systematic reviews can provide a solid evidence base to influence clinical practice and policymaking (Haddaway & Pullin, 2014).

Therefore, the present study looks to investigate how childhood adversity can play a role in daily emotional reactivity, through summarising the current research on the topic in order to derive data and observe patterns. It is hypothesised that childhood adversity will act as a moderator to the association between daily stress and negative affect, that is, it heightens daily emotional reactivity to stress.

Methods

The present study is part of a larger project titled Stress in Action (Weverling, 2023). This project is a collaboration between multiple universities, focussed on reviewing research on daily measures of stress dynamics with the overarching goal of creating a more stress-

resilient population. It was designed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) statement (Moher et al., 2009) and was also pre-registered (see <https://osf.io/24auc>).

Eligibility criteria

To be included in the study, the articles needed to meet a set of eligibility criteria. Firstly, only studies involving human participants were considered eligible for inclusion. However, studies incorporating animals as intervention agents, such as those investigating the impact of canine companionship on daily mental distress among humans, were also included, given the focus on human participants. Additionally, single-participant case studies (N=1) were excluded from consideration. Secondly, only empirical studies were included, while non-empirical sources such as dissertations, reviews, comments, opinion articles, books (chapters), and similar publications are excluded. Nevertheless, protocols detailing the methodologies of empirical studies were included to optimise selection of relevant articles. Thirdly, selected studies had to incorporate daily measures that are recorded at least once a day for several consecutive days (≥ 2 days in a row). These measures could be subjective self-reports, reported by others, or objective measures of physiology or activity. However, studies reporting daily treatments without accompanying measures, Intensive Care Diaries (ICD) documenting the status and treatments of unconscious patients in intensive care units, or daily measures unrelated to human experiences, such as emotional word searches or crime reports, were excluded.

Search strategy and information sources

The search was conducted in Web of Science with Core Collection and MEDLINE searched and PsycINFO (through EBSCOhost) on December 15th, 2023. For these electronic databases, the search string was developed on three core components: a) stress concept (context); AND b) mental health outcome; AND c) the design of the study (daily

measurements). The search was conducted in the title or abstract. The first component “stress concept” used: a) stress* or “life event*” or “negative event*” or hassles or trauma* or abuse or neglect or "child* maltreatment" or "child* experiences" or violence or disaster*. The second component used: b) psychopathol* or "mental disorder*" or anxiet* or depress* or "CIDI" or "DSM" or phobia* or "ptsd" or "panic disorder*" or "GAD" or "MDD" or “MDE”. The last component used: c) diary or daily or "time series" or "time-series" or "experience sampling" or "ESM" or "ecological momentary assessment*" or "EMA" or "intensive longitudinal" or ambulatory or “micro-longitudinal”.

Selection process

A preparation stage was conducted, in addition to a pilot screening of 1200 hits, an update on selection criteria and continuation of work on screening, pilot extraction, extraction and synthesis stage. After removing duplicates using RStudio and Rayyan, abstract screening was conducted using ASReview available at <https://asreview.nl/> (van de Schoot et al., 2021). This software uses active learning to prioritise abstracts based on the similarity of included articles. The software was trained using 400 records as signifiers of articles that should be included or excluded (200 each). The prioritized records were then screened by four individuals, each looking at a different subset of abstracts. Only the title and abstract of the record were displayed on the screen with two decision options (relevant/irrelevant). The screening process continued until fifty records in a row were marked as irrelevant, after which, the criteria was met to stop semiautomatic screening, the remaining articles were not included and not seen by reviewers. Another round of screening of the excluded records was done by a different reviewer to ensure quality, also using ASReview.

Data collection process and items

A data extraction sheet in Excel was set up to be used for the primary data extraction phase. Twelve extractors were given instructions on how to code the articles, with each of

them coding approximately 100 articles in five weeks. The coding was supervised and assisted by one of the project leaders, to ensure extraction reliability. From the included articles, the following data was extracted regarding the population characteristics: year of publication, sample country, sample size, mean age, population, physical health, and mental health diagnosis. The data extraction sheet was separated into two blocks: for ambulatory measurements and cross-sectional measures. Sampling frequency per day, as well as type of report (subjective, objective, or mixed) was collected for the ambulatory measurements part, and the following variables were extracted when measured either ambulatory or cross-sectionally: stress response (stressor, stress, affect/emotions, cognitions, physiology, behaviour), and mental health symptoms (coping, mental health concept, measurement). Additionally, there was an 'other' column, where variables that do not fit into the other categories could be coded. Each study was coded as either including an intervention (1) or not (0). Information that could not be obtained was referred to as not available (N/A).

Formulation of the Research Question

The research question was formulated according to the PEO guidelines in order to understand the aetiology of heightened emotional reactivity (Kolaski et al., 2023). The exposure variable is adverse childhood experiences. The outcome variable is daily emotional reactivity, as defined and operationalised in the introduction. The population is adults to study long-term effects. Taken together the question is, "What is the evidence of the relationship between childhood adversity and heightened emotional reactivity in response to daily stress in adult populations?"

Study Selection from the Database

In order to find studies that can answer this research question, the database described above was used and filtered through. Firstly, in the cross-sectional stressor and stress variable, the terms such as "child", "youth", "early" and "history" were searched for. Through using

such general search terms, many possible “synonyms” for childhood adversity and trauma were found (the full list of terms is presented in Appendix). In addition to these, ‘N/A’ options were removed from daily measures of affect, stress, and stressors. That is, all possible measures of these variables were included in the initial search. Finally, to ensure that there were only adult populations, the population column was filtered through, removing the term ‘adolescent.’ A separate filter was also created where the same childhood adversity terms were searched in the cross-sectional ‘other’ column, with the same filters for population and daily emotions, stress and stressors, to ensure nothing was missed.

Eligibility criteria included (a) measures for childhood adversity, (b) daily emotions and daily stress or stressors, and (c) at least one result that focussed solely on the effect of childhood trauma and adversity on the interaction between negative affect and stress. For example, articles that only studied the effect of stress-reactivity on a mental health variable, using childhood trauma and adversity as a moderator, were excluded. Intervention studies were excluded to create uniformity in the selection.

To ensure a more comprehensive analysis, a minimum of ten articles were to be included in the review. Therefore, the snowballing technique was used, consisting of additional searches through the references of the selected articles to find more potential articles. The newly found articles were then screened, using the same criteria mentioned above.

Data Extraction and Synthesis

From the selection of articles, data regarding population characteristics, stress and emotion measures, and childhood adversity measures was extracted. Furthermore, data analysis methods and outcome data were also extracted. Outcome data includes the regression coefficients (b and β), p-values, and measures of uncertainty (standard errors and confidence intervals). Synthesis and interpretation of results occurred through tabulation of the extracted

information and engaging in narrative description of patterns and outcomes. Other potential influencing factors present in the studies were explored post-hoc through narrative description. Regarding interpretation of effect size, ambulatory measurements typically yield smaller effect sizes, and thus it is up to the researchers to explain why small effects sizes are still practically important (Gabriel et al., 2018). Therefore, coefficients were used to report effect size, while theoretical and practical meaningfulness were also discussed and interpreted based on the context.

Results

Article Selection

A summary of the article selection process can be seen in Figure 1. The 1159 articles in the database were filtered through, yielding a total of 21 potential articles. After full-text screening of the articles, five were included. Through snowballing, more potential articles were found, but only five met the criteria once screened. Thus, through the database and snowballing, a final total of ten articles were selected to be part of the review.

Sample Characteristics

Table 1 provides an overview of the characteristics of the ten studies included in the present review and their samples. Six of the articles had a USA-based sample (Infurna et al., 2015; Kong et al., 2019; Kong et al., 2021; Poon & Knight, 2012; Weltz et al., 2016; Yaroslavsky et al., 2020), while the remaining four were from Belgium and the Netherlands (Glaser et al., 2006; Lardinois et al., 2011; van Nierop et al., 2018; Wichers et al., 2008). Thus, all were from Western developed countries. Most of the studies (6/10) were published within the last 10 years (Infurna et al., 2015; Kong et al., 2019; Kong et al., 2021; van Nierop et al., 2018; Weltz et al., 2016; Yaroslavsky et al., 2020), while the oldest is from 2006. The sample sizes ranged from 50 to 2022 participants. The age of participants varies significantly, from university students to older adults (average age range is 19 to 58). Half of the studies

have a balanced gender distribution (Infurna et al., 2015; Kong et al., 2019; Kong et al., 2021; Poon & Knight, 2012; Weltz et al., 2016), while four studies had majority female (Glaser et al., 2006; Yaroslavsky et al., 2020) with two of them being entirely female (van Nierop et al., 2018; Wichers et al., 2008). Only one of the studies had predominantly male participants (Lardinois et al., 2011). Thus, overall, the participants are mostly female. Most of the samples are from the general population, with only one having a clinical population of people with non-affective psychotic disorder (Lardinois et al., 2011).

Study Characteristics

There were six different measures for childhood trauma or adversity. The Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994) was the most commonly used (4/10; Infurna et al., 2015; Lardinois et al., 2011; van Nierop et al., 2018; Wichers et al., 2008). Other scales used were Risky Families Questionnaire (RFQ; Felitti et al., 1998; Taylor et al., 2004), Traumatic Events Screening Inventory-Youth/Self Report (TESI-Y/SR; Ford et al., 2000), and Conflict Tactics Scale (Straus, Hamby, Boney-McCoy, & Sugarman, 1996). The study by Kong et al. (2021) measured ACEs through seven categories, namely parental divorce, living with a household member with a substance use issue, sexual assault, emotional abuse, physical abuse, emotional neglect, and financial distress.

For measures of daily stress, six studies used a measure of daily stressors or perceived stress only, all of which were single items (Infurna et al., 2015; Kong et al., 2021; Poon & Knight, 2012; van Nierop et al., 2018; Yaroslavsky et al., 2020). Four studies used both: a measure of stressors and a measure of perceived stress, to measure how much stress the stressor provoked (Glaser et al., 2006; Kong et al., 2019; Lardinois et al., 2011; Weltz et al., 2016; Wichers et al., 2008). Some questionnaires that were used to measure daily stressors include the Daily Inventory of Stressful Events (DISE; Almeida et al., 2002) and the Life Events Scale for Students (LESS; Clements & Turpin, 1996; Linden, 1984). Half of the

articles used the Positive and Negative Affect Schedule (PANAS; Watson et al., 1998) to measure daily emotions (Infurna et al., 2015; Kong et al., 2019; Kong et al., 2021; Weltz et al., 2016; Yaroslavsky et al., 2020), while four used at least one item to measure negative affect (Glaser et al., 2006; Lardinois et al., 2011; van Nierop et al., 2018; Wichers et al., 2008). One of the articles measured emotional distress (Poon & Knight, 2012). Half of the studies measured stress and emotion only once a day (Infurna et al., 2015; Kong et al., 2019; Kong et al., 2021; Poon & Knight, 2012; Weltz et al., 2016), while most of the remaining studies (4/10) measured the variables ten times a day (Glaser et al., 2006; Lardinois et al., 2011; van Nierop et al., 2018, Wichers et al., 2008).

Effect of Childhood Adversity on Emotional-Reactivity

Table 2 provides the outcomes for each study. All of the studies used some form of multilevel regression analysis. Most of the studies (9/10) estimated at least some effect between childhood adversity and emotional reactivity (Glaser et al., 2006; Infurna et al., 2015; Kong et al., 2019; Kong et al., 2021; Lardinois et al., 2011; van Nierop et al., 2018; Weltz et al., 2016; Wichers et al., 2008; Yaroslavsky et al., 2020), while one failed to show any significant findings for the relationship (Poon & Knight, 2012). Effect sizes were typically small (below 0.1), while two had higher effect sizes than this (Lardinois et al., 2011; Yaroslavsky et al., 2020).

Figure 1

Flow chart of literature search (adapted from PRISMA guidelines [Moher et al., 2009])

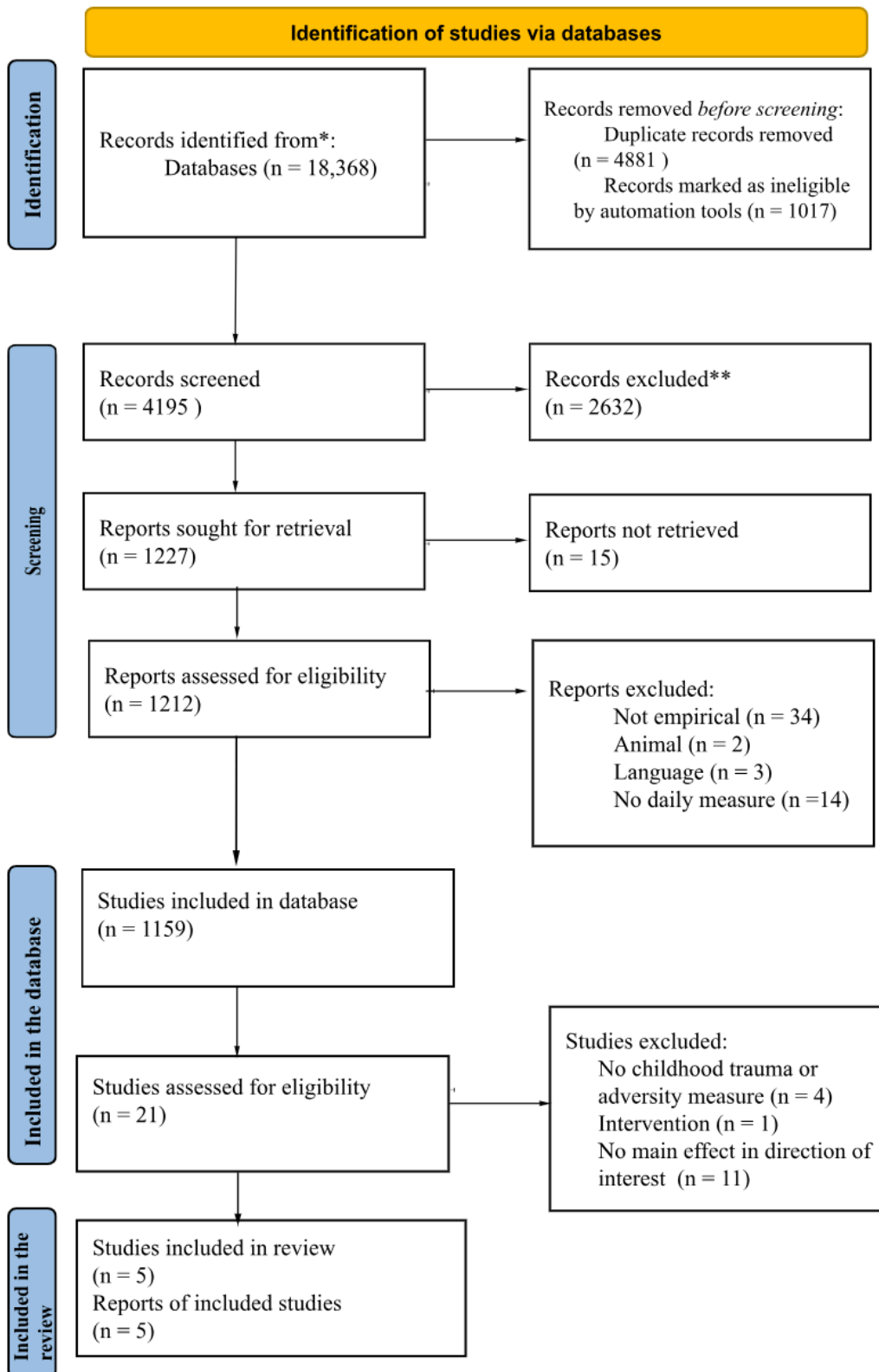


Table 1
Sample Characteristics

Author (year)	Population					Measures				
	Country	N	Age, mean	Female, %	Source of Participants	Measurement Frequency	Childhood Trauma or Adversity	Daily Stressors	Daily Stress	Daily Emotion
Weltz et al. (2016)	USA	1634	19	54	general	1	TESI-Y/SR for non-interpersonal trauma; RFQ for interpersonal trauma	LESS	one item "overall, how stressful was today?"	PANAS
van Nierop et al. (2018)	Belgium	621	28	100	general	10	CTQ	–	event stress; activity stress; social stress	negative affect
Kong et al. (2021)	USA	2022	56	57	general	1	ACEs	DISE	–	PANAS
Wichers et al. (2008)	Belgium	621	28	100	general	10	CTQ	Interview for Recent Life Events	one item "rate the most important event that occurred between the current and the previous beep"	negative affect
Yaroslavsky et al. (2020)	USA	142	27	76	general	5	CSA	–	one item "how stressed do you feel at this moment?"	PANAS
Lardinois et al. (2011)	Netherlands; Belgium	50	26	30	clinical	10	CTQ	N/A	event stress; activity stress	negative affect

Note. LESS: life events scale for students, TESI-Y/SR: Traumatic Events Screening Inventory-Youth/Self Report, RFQ: Risky Families questionnaire, DISE: Daily Inventory of Stressful Events, PANAS: Positive and Negative Affect Schedule, CTQ: Childhood Trauma Questionnaire

Table 1 Continued

Author (year)	Population					Measures				
	Country	N	Age, mean	Female, %	Source of Participants	Measurement Frequency	Childhood Trauma or Adversity	Daily Stressors	Daily Stress	Daily Emotions
Glaser et al. (2006)	Netherlands	90	36	61	general	10	childhood trauma	–	event stress; activity stress	negative affect
Infurna et al. (2015)	USA	191	54	54	general	1	CTQ	negative and positive events	–	PANAS
Poon & Knight (2012)	USA	787	58	55	general	1	Conflict Tactics Scale; parental emotional abuse; parental physical abuse	network stress	network stress	emotional distress
Kong et al. (2019)	USA	2022	56	57	general	1	Conflict Tactics Scale; parental emotional abuse; parental physical abuse	DISE	one item "how stressful was this for you?"	PANAS

Table 2
Analysis and Outcome Data

Author (year)	Outcomes				
	Data Analysis	Type of Measure	Other Variables in Model	Emotional Reactivity Main Outcome	Significant Results
Weltz et al. (2016)	Multilevel regression analyses	Interaction coefficient (b) of Type of Abuse x Daily Stress, with NA as the outcome	Neuroticism: 0.03 (SE = 0.00, $p < 0.001$) Major life events: 0.00 (SE = 0.00, $p < 0.001$) Sexual abuse: 0.01 (SE = 0.01, $p = 0.126$) Physical abuse: -0.02 (SE = 0.00, $p = 0.134$) Non-interpersonal trauma: 0.00 (SE = 0.00, $p = 0.743$)	Emotional abuse: 0.02 (SE = 0.00, $p < 0.001$) Neglect: -0.02 (SE = 0.00, $p = 0.696$)	Mixed
van Nierop et al. (2018)	Multilevel linear regression analyses	Association (b) of trauma with stress sensitivity in individuals with and without mixed phenotype	Event stress with mixed phenotype: 0.04 ($p = 0.338$, 95% CI [-0.04, 0.11]) Activity stress with mixed phenotype: 0.04 ($p = 0.022$, 95% CI [0.01–0.07]) Social Stress with mixed phenotype: 0.05 ($p = 0.019$, 95% CI [0.01, 0.09])	Event stress without mixed phenotype: 0.06 ($p = 0.112$, 95% CI [-0.14, 0.14]) Activity stress without mixed phenotype: 0.01 ($p = 0.551$, 95% CI [-0.02, 0.05]) Social stress without mixed phenotype: 0.03 ($p = 0.146$, 95% CI [-0.01, 0.07])	Contingent upon phenotype
Kong et al. (2021)	Multilevel structural equation modelling	Interaction coefficient (b) of ACEs x Daily Stressors (Within-Person), with NA as the outcome	Demographics; BMI; M2 chronic health conditions	0.02 (SE = 0.00, $p < 0.001$)	Significant

Note. NA = negative affect; CT = childhood trauma; b = unstandardised regression coefficient; beta = standardised regression coefficient

Table 2 Continued

Author (year)	Outcomes				
	Data Analysis	Type of Measure	Other Variables and Outcomes	Emotional Reactivity Main Outcome	Significant Results
Wichers et al. (2008)	Multilevel linear regression analyses	Interaction coefficient (beta) of Childhood Adversity x Daily Stress, with NA as the outcome	Birthweight, adult negative life events	0.047 ($p < 0.001$) $\chi^2(1) = 57.4$	Significant
Yaroslavsky et al. (2020)	Multilevel regression analyses	Level 3 unstandardised interaction coefficient (γ) of CSA x Stress, with NA as the outcome	Age, sex	0.41 (SE = 0.12, $p < .001$)	Significant
Lardinois et al. (2011)	Multilevel linear random regression analyses	Interaction coefficient (beta) of High CT x Stress, with NA as the outcome	–	Event stress: 0.12 (SE = 0.02, $p < 0.001$) Activity stress: 0.17 (SE = 0.03, $p < 0.001$)	Significant
Glaser et al. (2006)	Multilevel linear random regression analyses	Interaction coefficient (b) of CT x Daily Stress, with NA as the outcome	CT before the age of 10: 0.16 ($p < 0.001$, 95% CI [0.13, 0.19]) CT after the age of 10: 0.01 ($p = 0.001$, 95% CI [0.02, 0.09])	Activity stress: 0.03 (SE = 0.01, $p < 0.05$) Event stress: 0.02 (SE = 0.01, $p < 0.05$)	Significant
Infurna et al. (2015)	Multilevel linear regression analyses	Level 2 standardised interaction coefficient (γ) of CT x Negative Event, with NA as the outcome	Positive events	0.03 (SE = 0.01, $p < 0.05$)	Significant

Table 2 Continued

Author (year)	Outcomes				Significant Results
	Data Analysis	Type of Measure	Other Variables and Outcomes	Emotional Reactivity Main Outcome	
Poon & Knight (2012)	Multigroup multilevel analyses	Interaction coefficient (b) of Network Stress x Parental Abuse, with NA as the outcome	Paternal support	<p>Maternal emotional abuse for males: 0.04 (SE = 0.03, $p > 0.05$)</p> <p>Paternal emotional abuse for males: -0.08 (SE = 0.04, $p > 0.05$)</p> <p>Paternal physical abuse for males; -0.03 (SE = 0.04, $p > 0.05$)</p> <p>Maternal physical abuse for males: 0.05 (SE = 0.05, $p > 0.05$)</p> <p>Maternal emotional abuse for females: -0.04 (SE = 0.04, $p > 0.05$)</p> <p>Paternal emotional abuse for females: -0.05 (SE = 0.04, $p > 0.05$)</p> <p>Paternal physical abuse for females; 0.05 (SE = 0.04, $p > 0.05$)</p> <p>Maternal physical abuse for females: -0.03 (SE = 0.03, $p > 0.05$)</p>	Not significant
Kong et al. (2019)	Multilevel linear regression analyses	Level 2 unstandardised interaction coefficient (γ) of Daily Stressor x Parental Childhood Abuse, with NA as the outcome	Demographics, stressor severity (insignificant)	<p>Maternal abuse: 0.03 (SE = 0.01, $p < 0.05$)</p> <p>Paternal abuse: 0.01 (SE = 0.01, $p > 0.05$)</p>	Mixed

Types of adversity

Weltz et al. (2016) investigated the differences between different types of abuse and found a significant result for emotional abuse but not neglect. Sexual abuse was also found to be significant before controlling for neuroticism and major negative life events ($b = 0.02$, $SE = 0.01$, $p = 0.02$). However, when adding neuroticism and major negative life events to the model, the findings for emotional abuse became only marginally significant, and those for sexual abuse non-significant. On the other hand, Poon and Knight (2012) also investigated emotional abuse but did not find any significant effects. Kong et al. (2021) took the approach of looking at the total count of ACEs instead of only focussing on abuse and found a significant interaction between total adversity and emotional reactivity.

Types of stress

Operationalisation of stress also differed in the studies. Some common operationalisations were event stress, activity stress, and social stress. Event stress is the stress appraisal of the most unpleasant event of the day. Activity stress is the appraisal of the participants current activity. Social stress is the stress appraisal for when the participant is in the company of other people. Van Nierop et al. (2018) found significant effects for activity and social stress, but the results were non-significant for event stress. Glaser et al., (2006) and Lardinois et al. (2011) used the similar operationalisations of event and activity stress and found significant results for both. Additionally, some articles investigated negative affect in response to daily stressors (i.e., events), while some investigated it in response to daily perceived stress (i.e., feeling stressed). Of the three studies that focused on stressors, one showed mixed results (Kong et al., 2019), and two found significant effects (Infurna et al., 2015; Kong et al., 2021). Of the remaining seven that looked at stress, four showed only significant results (Glaser et al., 2006; Lardinois et al., 2011; Wichers et al., 2008;

Yaroslavsky et al., 2020), two had mixed results (van Nierop et al., 2018; Weltz et al., 2016), and one had insignificant results (Poon & Knight, 2012).

Poon and Knight (2012) studied how childhood trauma could influence emotional reactivity to network stress, that is, an interpersonal stressor involving bad things happening to members in one's social network. They did not find any significant associations for this, regardless of gender of participant or whether the abuse was paternal or maternal. An interesting finding, however, was that maternal emotional support attenuated the influence of CT on negative affect in response to network stress among daughters ($b = -.11$, $SE = 0.04$, $p = .004$).

Post-hoc Analysis

Beyond the main analysis, other potential influencing factors were investigated post-hoc to have a comprehensive and nuanced analysis of the interaction. Age of adversity was found to play a moderating role in one of the studies (Glaser et al., 2006), such that those who experiences trauma before the age of ten showed a stronger relationship between childhood trauma and emotional reactivity than those who experienced trauma after the age of 10. Another study showed that a difference was found depending on whether one experiences maternal or paternal abuse, such that only maternal abuse showed a significant effect in moderating the relationship between stress and negative affect (Kong et al., 2019). Furthermore, van Nierop et al. (2018) investigated the interaction in participants with a mixed phenotype of psychopathology, defined as affective, psychotic, and anxiety symptoms cutting across diagnostic boundaries, and those without. Only for the group with a mixed phenotype was trauma exposure was associated with a heightened reactivity to stress. An interesting finding by Infurna et al. (2015) was that reporting more childhood trauma was additionally associated with stronger increases in positive affect in response to positive events ($\gamma = 0.11$, $SE = 0.02$, $p < .05$).

Discussion

This systematic review summarises the evidence of ten studies regarding the effect of childhood adversity on emotional reactivity to daily stress in adulthood. In the included studies, many different operationalisations of the variables were identified. Overall, the findings indicate that individuals with a history of childhood adversity tend to show heightened emotional reactivity to daily stressors, supporting the hypothesis that childhood adversity acts as a moderator between daily stress and negative affect. Previous research has consistently shown that childhood adversity is associated with psychopathology, and that this relationship could be partly mediated by emotion regulation deficits such as heightened emotional reactivity (e.g., Hopfinger et al., 2016). This review not only corroborates these findings but extends them by emphasising the impact of daily stressors, which are more ecologically valid and representative of real-life stress than laboratory-induced stressors or questionnaires at a single point in time (Scollon et al., 2000).

Although the effect is found in most of the studies, there are still some inconsistencies and nuances that were observed. Poon and Knight (2012) were not able to observe any significant effect between childhood adversity and emotional reactivity to network stress. There are multiple potential explanations for this finding. Firstly, this article specifically studied network stress, which differs from all of the other measures of stress included in this review. The findings by van Nierop and colleagues (2018) indicated that the operationalisation of stress (i.e., activity, event or social stress) influenced whether a significant effect would be found in relation to childhood adversity and emotional reactivity. This idea is further supported by Bolger and colleagues (1989), who showed that interpersonal conflicts, a social stressor, had the greatest impact on mood from the daily stressors included in the study. This supports why van Nierop and colleagues (2018) found significant results for social stress, but not event stress. Overall, the findings from the review,

combined with previous research like this, suggest that different domains and operationalisations of stress could influence the relationship between childhood adversity and emotional reactivity. It is important to differentiate between measures of stress in future studies to gain more refined knowledge on how childhood adversity contributes to emotional reactivity.

Another possibility is that the average age of the participants could have had an influence. The sample in this study has the highest average age compared to the other studies in the review, and in the general literature there have been inconsistent findings regarding the effect of age on emotional reactivity. For example, a study by Charles and colleagues (2010) found that emotional reactivity to interpersonal conflict decreases in old age, whereas Stawski and colleagues (2008) found no significant difference comparing young and old age groups with regard to emotional reactivity to daily stressors. Furthermore, Brose and colleagues (2013) discuss how emotional stability increases with old age, a concept marked by decreased affective reactivity. Thus, age is a factor that would need to be further explored and expanded on.

Beyond the work by Poon and Knight (2012), potential influencing factors were observed in the other studies too. For example, age of adversity (Glaser et al., 2006), psychopathology (van Nierop et al., 2018), maternal versus paternal abuse (Kong et al., 2019), and type of abuse (Weltz et al., 2016) were all shown to influence the relationship between childhood adversity and emotional reactivity, highlighting the complexity of the interaction. These findings were only shown in limited studies but is further supported by literature. For example, Dunn and colleagues (2017) also showed that experiencing adversity at a younger age has a greater impact on well-being compared to older ages. Additionally, the dimensional model of early adverse experiences (McLaughlin et al., 2021) proposes that effects of adversity differ based on whether it is classified as a threat (e.g., abuse) or as

deprivation (e.g., neglect). Thus, type and classification of adversity can impact the relationship between childhood adversity and emotional reactivity (LoPilato et al., 2020).

Considering so many influencing factors were found in a selection of only 10 studies, it indicates that there are many more possibly at play, explaining the inconsistency in the research on this topic. Nonetheless, the majority of studies show that childhood adversity can at least in part explain heightened emotional reactivity in adulthood.

Theories and Mechanisms

These findings align with theories on stress responses and emotion regulation discussed in the Introduction, such as the Stress Sensitisation Model (Stroud, 2018), developmental perspectives (Espelata et al., 2018; Nelson et al., 2020) and theories regarding HPA-axis dysfunction (Kong et al., 2021). An interesting finding by Infurna et al. (2015) provides support for the differential susceptibility hypothesis (Belsky et al., 2007), positing that not only is reporting more childhood trauma associated with stronger increases in negative affect in response to negative events, but also increased positive affect in response to positive events. This theory expands on the Stress Sensitisation Model by positing that individuals who experience childhood adversity not only become more sensitive to negative events in adulthood, but positive ones too. That is, when placed in a supportive and adaptive environment, individuals with such sensitivity experience greater strives (Belsky et al., 2007). The implications of this finding are profound in improving and tailoring interventions.

Causality

In order to determine causality, certain criteria need to be met. For one, an association must be found consistently and with large effect sizes (Duckworth et al., 2010; Lardinois et al., 2010). The findings of the review show reasonable consistency, but small effect sizes. However, the effect sizes found have been comparable to those typically seen in daily research, such as ESM protocols, due to the variability and sensitivity of such measures

(Lardinois et al., 2010). Thus, considering the contexts of the studies and the potential cumulative significance for overall well-being, they can be considered sufficient (Glaser et al., 2006). Additionally, the association must be temporal, such that the exposure is preceding the outcome (Duckworth et al., 2010). In this case, childhood adversity does precede emotional reactivity in adulthood. Although, it is possible that heightened emotional reactivity can potentially lead to overreporting of traumatic events (Weltz et al., 2016). Finally, there must be a dose-response relationship, such that there are no third variables accounting for the relationship (Duckworth et al., 2010). The review showed that there are many factors and variables at play that influence the relationship, some even determining whether a significant effect will be found. Thus, a dose-response relationship cannot yet be established until there is a better understanding of these variables and possible mediation.

Limitations

The review and its findings also come with limitations. Firstly, all of the studies in the review used retrospective self-report to measure childhood adversity. This is a method that has been shown to have inconsistencies (Baldwin, 2019), easily falling prey to recall errors and leading to unreliable or simply a lack of specific details, such as the timing and duration of adversity. The self-report could be corroborated by additional documentation and evidence to account for this limitation.

Generalisability to other groups could also be questioned. The sample was predominantly female, Western and educated. For example, three of the studies derived samples from the National Survey of Midlife in the United States (MIDUS), which was shown to have higher retention rates among White, married women, as well as those with better health and higher levels of education. Thus, the results may not be generalisable to men, or those from less privileged positions. Additionally, childhood adverse experiences can include factors such as poverty, incarcerated family members, and familial substance abuse,

which samples from lower socioeconomic status are more likely to experience (Font & Maquire-Jack, 2016). However, there is a lack of participants from lower socioeconomic status in the sample, thus not capturing an important part of childhood adversity. Finally, only one of the studies had a clinical sample, despite the strong associations between adversity, emotional reactivity and psychopathology. Therefore, this limits the generalisability interpretation of the findings.

While the review aimed to cover different forms of childhood adversity, a majority of the studies were focussed on parental abuse. The limited amount of adversity types may not have captured the full range of experiences, potentially overlooking important nuances and complexities in how different adversities impact emotional reactivity, or how they can interact with one another. For example, parental abuse often coincides with other forms of childhood adversity (Kong et al., 2019). This represents an overall limitation with specificity models of childhood adversity (McLaughlin et al., 2021). Thus, future studies should focus on a wider variety of types of adversity and follow McLaughlin and colleagues in conceptualising adversity using dimensional models.

There was also significant heterogeneity in the measures used to assess emotional reactivity across the studies. As discussed, there were some measures that would focus on emotional reactivity to stressors, while some to stress responses. Conceptual differences between stress measures remain unclear. However, it has been found that subjective stress is associated with poorer health outcomes than objective measures of stressors (Shields et al., 2023), suggesting that these different measures are not capturing the same mechanisms or phenomena. Thus, it is possible that different operationalisations and measurement tools could have led to variability in findings, making it challenging to draw consistent conclusions and comparison across studies.

Finally, as is the case with any systematic review, there is a risk of publication bias influencing the results. That is, that studies with significant findings are more likely to be published than those with null results (Knobloch et al., 2011). This bias could have skewed the overall findings, leading to an overestimation of the relationship between childhood adversity and emotional reactivity. Furthermore, the review was limited to studies included in the database described in the Methods. By conducting a proper search, where search terms relevant to this exact topic are included, more studies could be part of the review. This would allow for stronger conclusions and higher certainty.

Future Directions and Conclusion

Despite the limitations, the consistency in the findings and their alignment with previous research and theory indicates that childhood adversity can impact emotion regulation, such as heightened reactivity. However, although there is an effect observed, there are apparent complexities and interacting factors that need to be further investigated, such as age, type of adversity, and type of stress. Additionally, future research should focus on addressing the limitations identified in this review, such as generalisability and inconsistent definitions. There needs to be consensus on how to measure emotional reactivity in order to create more consistency in the future research, thus allowing for a clearer picture.

Considering the association to psychopathology, the findings have important implications for clinical practice. The findings by Infurna and colleagues (2015) regarding differential susceptibility and those by Poon and Knight (2012) regarding parental support suggest that children experiencing adversity will likely be more responsive to early adaptive and supportive interventions, potentially mitigating the effect it will have on emotion regulation in adulthood. Furthermore, the findings from this review suggest that screening for childhood adversity should be a routine part of mental health assessments, in order to determine if emotional regulation is an area of potential treatment. Relatedly, interventions

aimed at improving emotion regulation skills and reducing reactivity in individuals with a history of childhood adversity could be beneficial.

In conclusion, the findings of this systematic review indicate that childhood adversity can act as a moderator in the association between daily stress and negative affect, such that it has potential to cause heightened emotional reactivity. However, there are many other variables that can influence the strength of the relationship, and whether the relationship even exists at all. This study highlights the need to further explore these factors, in order to ensure the best outcomes for people who experienced adversity in their childhood.

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Note: References marked with an asterisk (*) are studies that were included in the systematic review.

Appendix

Terms in the Database

Childhood Adversity	Affect	Stress/Stressors	'Other' Columns
childhood trauma	PANAS	one item stress	childhood adversity
CTQ	negative affect	life stress	
adverse childhood experiences	PA and NA	perceived stress	
trauma	dream affect	threat appraisal	
history sexual abuse	mDES	Perceived Stress Scale	
early trauma	emotions	PSS-10	
youth trauma		activity stress	
Child Abuse and Trauma Scale		social stress	
		event stress	
		positive events	
		daily stressor exposure	
		important events	
		daily stressful events	
		Adapted Life Event Scale	
		DISE	