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Adverse Childhood Experiences and Adult Distress:

The Role of Type and Timing of Exposure

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Adverse childhood experiences (ACEs), such as different forms of abuse and neglect, are linked to different psychopathologies, including depression and anxiety. It is widely known that the risk for negative health outcomes increases with the number of ACEs, but more studies are needed to examine the role of type and timing.

The present study examined the connection between ACEs and adulthood depression and anxiety and sought to find out whether there is a difference in adulthood distress based on the type and the timing of exposure to ACEs.

The sample (N=4966) comprised of mothers and fathers recruited for the ongoing FinnBrain Cohort Study, which this study is a part of. The data were collected using self-report questionnaires, including TADS, EPDS and SCL-90. The ACE types in this study were emotional and physical abuse and neglect, as well as sexual abuse. According to the timing of exposure, three time periods were defined: ACEs occurring prior to age 6, between ages 7 and 12 or between ages 13 and 18. The Relative Weight Analysis (RWA) was conducted to examine the predictive role of ACE type and timing of exposure.

ACEs were associated with increased symptoms of depression and anxiety, and ACEs during adolescence showed to have the most significant impact. Emotional abuse played a central role in predicting paternal anxiety and depression as well as maternal anxiety. Emotional neglect had the most significant impact on maternal depression. The predictive role of other ACE types was significantly lower.

Key words: adverse childhood experiences (ACEs), ACE type, timing of exposure, distress, depression, anxiety

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1   Introduction

Childhood adversity, including exposure to different forms of abuse and neglect, is a global problem significantly affecting the public health. It is now widely recognized that exposure to adverse childhood experiences increases the risk for multiple neural, behavioral, and psychological consequences, and these effects seem to be long-lasting throughout the lifespan (Gabard-Durnam & Nelson, 2020). The prolonged activation of the stress response systems (i.e., toxic stress response) due to adversity in childhood can alter the development and functioning of the brain and increase the risk for different kinds of diseases and psychiatric disorders (e.g. depression and PTSD), other emotional and behavioral problems (e.g. aggressive behavior, risk taking and violence) as well as to deficits in cognitive and executive functions (Nelson et al., 2020).

Child's genetics (Luoni et al., 2018) and individual traits (Nelson et al., 2020) are shown to affect the vulnerability to adverse health consequences, and environmental factors can alter this vulnerability by affecting the child's resilience. For instance, a positive adult relationship can act as a buffer against the negative effects of adversities (Gilgoff, et al., 2020). Without these so-called buffers, the adverse childhood experiences can lead to a toxic stress reaction and further to adverse health outcomes in later life (Nelson et al., 2020).

The increased vulnerability for different psychopathologies following the adverse childhood experiences persists into adulthood (Green et al., 2010). Kessler et al. (2010) found a significant connection between retrospectively reported ACEs and adulthood mental health disorders in their study including 21 countries. The data was collected via World Mental Health (WMH) surveys from a large sample including 51 945 participants. According to their study, approximately one-third of all mental disorders globally are associated with adverse childhood experiences. Adverse experiences in childhood, specifically maladaptive family functioning (e.g. physical or sexual abuse and neglect) showed to increase the risk for mental health disorders, including depression and anxiety, across all countries. The strength of Kessler et al. (2010) study was a large sample size (N=51 945) that included participants from multiple countries. Yet, the heterogenous sample causes limitations due to the variation across surveys in different languages. In addition, concerns were raised regarding potential differences in interpretations and attitudes across different countries, that might affect to the results. (Kessler et al., 2010)

Other studies show, how adverse childhood experiences increase risk for depression with odd ratios (ORs) of 2.7 (Chapman et al., 2004), pooled odds ratio of 2.03 (Li et al., 2016), and anxiety with pooled odds ratio of 2.70 (Li et al., 2016). According to Chapman et al. (2004) study (N=9460), especially emotional abuse in childhood increases the risk for depressive disorders in adulthood. The data was gathered as part of the ACE study via self-report questionnaires, and the different forms of adversities in the study were emotional, physical, and sexual abuse as well as multiple forms of household dysfunction (Chapman et al. 2004). According to the meta-analysis conducted by Li et al. (2016), sexual abuse had the strongest association with depression and anxiety disorders in later life. While Chapman et al. (2004) study used a retrospective method, the meta-analysis conducted by Li et al. (2016) consisted of longitudinal studies with externally reported ACEs to avoid the issue of recall bias.

1.1 Adverse childhood experiences (ACEs) and cumulative risk model

Adverse childhood experiences (ACEs) are potentially traumatic events – such as physical, sexual, or emotional abuse and neglect - that children experience before age 18. The term ACE arose from the publication of the Adverse Childhood Experiences study (ACE study) in 1998. In their study, Fellitti et al. discovered not only the high prevalence of ACEs among participants but the graded relationship of ACEs with negative health outcomes. According to the ACE study, children who experience multiple adverse experiences are two or three times more likely to suffer depression in adulthood, and the risk increases as a function of the amount of these experiences (Felitti et al., 1998). According to a large meta-analysis (N=253 719) conducted by Hughes et al. (2017), those who experienced at least four ACEs were at higher risk for negative health outcomes, such as depression and anxiety, in comparison with individuals with no ACEs. The cumulative risk model, according to which accumulation of adverse experiences increases the risk for adverse health consequences, is a dominant model explaining the negative health outcomes in the ACEs framework literature (LaNoue et al., 2020). Generally, the significantly heightened risk for adverse outcomes is linked to having four or more ACEs (Fellitti et al. 2018; Hughes et al. 2017).

1.2 Other factors explaining the adverse health outcomes

It has been shown that individuals with the same primary psychiatric diagnoses exhibit differences in clinical, neurobiological and genetic aspects based on whether they have experienced maltreatment or not (Teicher et al. 2016). The cumulative risk model assumes

that all adverse experiences have equal impact on negative health outcomes and have therefore been criticized of being overly simplistic (Hagan et al., 2016; O'Donnell et al., 2017). When it comes to the risk for adverse outcomes, other predictors have also been studied, such as the type and the timing of exposure to ACEs.

1.2.1 ACE type

Different forms of adversities are shown to have different kinds of outcomes, depending both on the type and the severity of the adverse experience. Out of all the domains of adversity in their study (emotional neglect and abuse, physical abuse and neglect, and sexual abuse), Salokangas (2020) found that the physical and emotional neglect had the strongest association with adult psychiatric disorders. Their study included different samples from general population (N=692), primary care (N=250) and psychiatric outpatient care (N=245). The study examined the associations between diagnostic categories and ACE domains evaluated by TADS in primary and psychiatric care. In general population, depressive symptoms and negative attitudes towards others were assessed using depression screening instrument DEPS. Their findings suggest that both physical abuse and neglect can lead to distrusting attitude towards other people by violating the youth's basic needs of safety and love as well as their self-esteem. Negative attitudes appeared to have stronger mediative role between ACEs and depressive symptoms in males. Gender was showed to be a central factor moderating the connection between ACEs and mental health. (Salokangas 2020)

Interestingly, Teicher et al. (2018) found that there were variations between males and females in how they responded to abuse compared to neglect. The sample consisted of 336 participants and the adverse experiences were assessed using a retrospective self-report questionnaire called Maltreatment and Abuse Chronology of Exposure (MACE) as well as interview. The participants were asked whether they have experienced a given event regarding different types of maltreatment across childhood (including abuse and neglect). Regarding female participants in their study, abuse appeared to be associated with hippocampal abnormalities that are usually linked to psychiatric disorders, including major depression. In contrast, male hippocampal alterations were associated with neglect, but not abuse. (Teicher et al. 2018). Similar to other studies, a limitation of Teicher et al. (2018) study was the reliance on retrospective self-report. However, the additional information from neuroimaging studies that supported their findings, can be considered as a major strength of their study (Teicher et al. 2018).

Even though the different types of adverse experiences have unique effects on development, most of them co-occur, which sometimes makes it hard to distinguish the effects of a specific event. For instance, poverty has been linked to multiple other risk factors for mental health, such as increased likelihood of exposure to neighborhood violence or higher degree of family stress (Zeanah, 2019). The findings of sex-dependent connections between specific ACE types and mental health outcomes make this association even more complex (Teicher et al. 2018; Salokangas 2020).

1.2.2 Timing of exposure

Emerging studies show how adverse experiences become biologically embedded in the brain during different stages of neurodevelopment and this is usually explained through sensitive periods. According to sensitive period model, there are specific time windows, sensitive periods, in development when adverse experiences are most influential (Knudsen, 2004; Dunn et al., 2019; Gabard-Durnam & Nelson, 2020). During a sensitive period, the plasticity and vulnerability of the brain is heightened for a certain amount of time, and experiences during this time can cause lasting effects on brain function and behavior by altering the neurodevelopment (Knudsen, 2004; Gabard-Durnam & Nelson, 2020). Neurodevelopmental changes caused by adverse experiences in childhood are thought to be linked to increased risk for multiple psychopathologies, including major depressive disorder (Heim & Binder, 2012).

Dunn et al. (2019) found the developmental timing of exposure to be the most important factor explaining the epigenetic alterations caused by adversity. Their study (N=774) investigated the association between adverse experiences and DNA methylation patterns at the age of 7. These DNA methylation patterns have been linked to adversity and known to be associated with increased risk for psychopathologies. The aim of their study was to investigate the sensitive period hypothesis in comparison with the cumulative model and recency model, according to which the effect of adversity is stronger for more proximal events. The developmental timing showed to be the most important factor explaining the DNA methylation patterns. According to the results of their study, compared to later exposure (3-5 years or 6-7 years of age), the first three years of life are specifically vulnerable to these alterations. (Dunn et al. 2019) Yet it is important to emphasize that differing from the current study, Dunn et al (2019) didn't investigate the role of adolescence at all. In comparison, the

meta-analysis (N=665) conducted by Lussier et al. (2023) found that the most significant epigenetic alterations appeared when children were exposed to ACEs between ages 3 and 5 years. Their study investigated the association between the ACEs from birth to 11 years of age and DNA methylation at the age of 15 years. Although their study included the examination of adolescence as a potential sensitive period, the primary emphasis of their study focused on examining the adverse health outcomes during adolescence rather than adulthood. (Lussier et al. 2023)

ACEs during the early years of life have been found to increase the risk for depression (Dunn et al. 2013). Dunn et al. (2013) investigated the connection between both physical and sexual abuse and depression as well as suicidal ideation in a large longitudinal study including 15 701 participants. Age periods were divided into early childhood (0-5 years), middle childhood (6-10 years) and adolescence (14-17 years). Depression was assessed using the Center for Epidemiological Studies of Depression Scale (CES-D) and the age of participants varied from 18 to 32 years. Their results indicated that physical abuse in early childhood increased the risk for suicidal ideation, and sexual abuse increased the risk for depression in later life. Differing from the current study, the other forms of ACEs were not investigated. Yet, regarding the timing of exposure, the results emphasize the role of early childhood. (Dunn et al. 2013)

The foundational sculpting of the brain structure occurs in the first years of life (Dunn et al. 2019), and this time consist of multiple sensitive periods (Gabard-Durnam & Nelson 2020). Sensitive periods in the development of the brain occur not only in early childhood. For example, brain regions that regulate the stress response (via the hypothalamic-pituitary-adrenal axis) develop and mature at different ages, which may highlight the role of timing of exposure even more (Lupien et al., 2009). Maturation of the HPA axis occurs during puberty, and this window of development is considered as particularly sensitive to stress exposure (Herbinson et al., 2017). The vulnerability to adverse outcomes during puberty might be extremely high not only due to the maturation of stress regulating region, but also to the lack of adequate amount of stress in earlier life. Some studies show that children who never learned how to respond stress may be more sensitive to the negative outcomes of exposure to stress in later life, especially during puberty (Seery et al., 2013; Herbinson et al., 2017).

Growing evidence indicates that the timing of sensitive periods may also be sex dependent (Dunn et al. 2023; Teicher 2018). In their study (N=3474) Dunn et al. (2023) investigated the

association between ACEs (occurring at 3, 5 and 9 years of age) and psychopathology symptoms at the age of 15 years. ACEs were assessed using Parent-Child Conflict Tactics Scales (CTS-PC), where parents were asked about their parenting styles including maltreatment. Psychopathology symptoms were assessed by parental report using Child Behavior Checklist (CBL/6-18). They were able to identify sensitive periods for harsh physical discipline, and the sensitive period showed to be 9 years of age for girls and 5 years of age for boys. (Dunn et al. 2023)

Overall, the negative health outcomes are usually result of complex interactions between different dimensions of adversity, and no single model explains the whole range of its effects. Regarding sensitive periods for adverse health outcomes, some studies emphasize the role of very early childhood (Dunn et al. 2019), when other findings indicate that the middle childhood would be the most crucial (Lussier et al. 2023). Fewer studies included the investigation of adolescence as a sensitive period. Yet, this specific time window in development is particularly sensitive time for stress exposure especially due to the maturation of the HPA axis (Herbinson et al. 2017).

1.2.3 Research Questions and Hypotheses

The purpose of this study is to investigate the association between ACEs and adult depressive and anxiety symptoms. This study uses the word "distress" to describe these symptoms. The research questions are:

1. Are the ACEs linked to adult distress? The associations of ACEs and depressive symptoms (EPDS) as well as anxiety symptoms (SCL-90) will be investigated. Based on the previous research, ACEs are connected to different psychopathologies, including depression and anxiety (Green et al. 2010; Kessler et al. 2010; Chapman et al. 2004; Li et al. 2015; Heim & Binder, 2012; Dunn et al. 2019; Teicher et al 2018).

2. Is there a sensitive period for these adverse experiences? This study examines and compares three different time periods: adverse experiences prior to age 6, between ages 7 and 12, and between ages 13 and 18. The existing studies predominantly focus and emphasize the role of an early childhood (Gabard-Durnam & Nelson, 2020), indicating that the most crucial time periods would wither be the first years of life (Dunn et al. 2019) or from 3 to 5 years of

age (Lussier et al. 2023). According to Schalisnki et al. (2016) study, specifically emotional neglect at age 8-9 would increase the risk for depression. This study uniquely focuses on ACEs across a large age range (ACEs occurring from birth to adolescence) as well as multiple forms of adversities (physical and emotional neglect and abuse as well as sexual abuse). The long-lasting outcomes until adulthood will be investigated. The aim of this study is to find out whether the earlier or later exposures are more deleterious.

3. Is there a difference in adult depression and anxiety based on the type of adversity? Existing evidence indicates that different forms of adversities are connected to different kinds of outcomes, and these connections might also be sex dependent (Teicher et al. 2018; Salokangas, 2020). Physical abuse and neglect have shown to lead to depressive symptoms by creating a negative attitude towards others and self (Salokangas, 2020). According to Teicher et al (2018) study, abuse appeared to be associated with hippocampal abnormalities in females, while male hippocampal alterations were associated with neglect. The aim of this study is to better understand the unique connections between different ACE types and adult distress. While this study doesn't primarily focus on sex dependent connections, female and male participants will be investigated separately.

Further knowledge of the role of type and timing of exposure would provide a deeper understanding of the overall relationship between ACEs and adult distress. This understanding is essential for effectively recognizing and supporting individuals at risk for adverse health outcomes.

2 Methods

The current study was conducted as a part of the ongoing Finnbrain Birth Cohort Study (www.finnbrain.fi) that was established to study the influences of environmental and genetic factors on child brain development and health.

2.1 Participants

The study sample (N=4954) comprises of mothers and fathers who were recruited for the Finnbrain Birth Cohort Study from maternal welfare clinics in the South-Western Hospital District and the Åland Islands in Finland between December 2011 and April 2015. Participants were recruited at their first ultrasound visit in gestational week (gwk) 12, and the inclusion criteria was having a normal result in the ultrasound as well as a sufficient knowledge in either Finnish or Swedish. After receiving a written informed consent from the participants, data were collected using questionnaire research during pregnancy. The full study cohort consisted of 3808 mothers and 2623 fathers who agreed to participate in the study. The participants were representative of the source-population of expecting parents in Southwest Finland, creating ethnically homogenous (Scandinavian-Caucasian) sample. (Mondolin et al. 2024).

Only 3091 mothers and 2003 fathers returned the first pregnancy questionnaire at gwk 14 (Mondolin et al. 2024). Participants who completed the Trauma Distress Scale (TADS) at gwk 14 were included in this study, creating a sample of 3020 mothers and 1934 fathers.

The data for this study was collected in three different time points. Data from TADS was collected during gwk 14, while Edinburgh Postnatal Depression Scale (EPDS) and Symptom Checklist (SCL-90), measures were conducted at gwk 14, gwk 24 and gwk 34. Background information (age, education level, and monthly income) were collected in gwk 14 through a self-reported questionnaire. The study protocol was approved by The Ethics Committee of the Hospital District of Southwest Finland.

2.2   Measures

2.2.1   EPDS and SCL-90

The symptoms of depression were assessed using the Edinburgh Postnatal Depression Scale (EPDS) which is a 10-item self-report questionnaire (Cox et al., 1987). Parents were asked whether she or he has experienced the symptoms during the last two weeks using a 4-point Likert Scale. General anxiety was assessed using the Symptom Checklist (SCL-90), the anxiety subscale consisting of 10 items rated from 0 to 5 (Derogatis et al., 1973). Both EPDS and SCL-90 were used to evaluate the symptoms of both parents at gestational weeks 14, 24, and 34. The internal consistency was good for all measurement points and for both parents (α = 0.88 for EPDS and α = 0.87 – 0.88 for SCL-90).

2.2.2   TADS

Traumatic experiences were evaluated in both parents using the Trauma and Distress Scale (TADS) at the beginning of the FinnBrain Birth Cohort Study. The TADS is a 43-item self-report questionnaire assessing childhood maltreatment retrospectively using a five-point scale ranging from 0="never" to 4="almost always" (Salokangas et al., 2016). It includes five categories of adverse experiences: emotional and physical abuse, sexual abuse, as well as emotional and physical neglect. The timing of exposure to adversity in childhood is divided into three different time windows: adverse childhood experiences occurring prior to age 6, between ages 7 and 12 or between ages 13 and 18. The internal consistency of TADS was high, α = 0.92 for mothers and α = 0.93 for fathers.

2.3   Statistical Methods

To investigate the predictive role of the type and timing on anxiety and depression this study used Relative Weights Analysis (RWA). RWA Analysis were performed using R (4.2.2, 2022) with package rwa (Chan, 2020). Relative Weight Analysis can be used to calculate the relative importance of these predictive factors by breaking down the total variance predicted by the regression model into weights that indicate the proportional influence of each factor (Tonidandel & LeBreton, 2015).

3 Results

3.1 Descriptive statistics and correlations

The characteristics of the sample are presented in Table 1, and the characteristics of TADS are presented in Table 2.

The correlations between distress (EPDS depression and SCL-90 anxiety) and traumatic experiences (TADS) are presented in Table 3. Table 4 includes the correlations between distress and TADS subscales separately (emotional neglect, emotional abuse, physical neglect, physical abuse and sexual abuse) for mothers and Table 5 for fathers.

Table 1

Descriptive of the sample characteristics

		Mothers	Fathers
Age at the due date, M(SD)		30.43 (4.54)	32.10 (5.38)
Education (%)	mid/low	37.9	49.2
	high/voc	29.1	26.3
	high	33	24.5
Monthly income (%)	≤ 1500	39.3	19.6
	1501 – 2500	51.1	55.1
	2501 – 3500	8.1	20.5
	> 3500	1.5	4.9
Early life adversity (TADS)	0-6 Y	10.85(10.88)	11.93(9.36)
	7-12 Y	14.86(13.38)	15.72(11.17)
	13-18 Y	17.49(14.56)	18.07(12.19)
Depression, M(SD) (EPDS sum)	Gwk 14	5.17(4.03)	3.74(3.42)
	Gwk 24	4.95(4.10)	3.48(3.48)
	Gwk 34	4.86(4.05)	3.13(3.39)
General anxiety, M(SD) (SCL-90 sum)			
	Gwk 14	3.31(3.93)	2.50(3.48)
	Gwk 24	3.89(4.24)	2.66(3.80)
	Gwk 34	3.19(3.93)	1.93(3.19)

Table 2

Descriptives of TADS categories

	Timing	Range of Scores	Minimum and Maximum Score (Mothers)	Mean (Standard Deviation) Mothers	Minimum and Maximum Score (Fathers)	Mean (Standard Deviation) Mothers
Em. neg.	0-6 Y	0-20	0, 19	2.71 (3.04)	0, 19	3.06 (2.989)
	7-12 Y	0-20	0, 19	3.14 (3.323)	0, 18	3.31 (3.132)
	13-18 Y	0-20	0, 19	3.68 (3.631)	0, 19	3.71 (3.382)
Em. ab.	0-6 Y	0-20	0, 18	1.03 (2.01)	0, 16	0.92 (1.634)
	7-12 Y	0-20	0, 18	1.61 (2.68)	0, 16	1.29 (2.092)
	13-18 Y	0-20	0, 18	2.05 (3.098)	0, 17	1.46 (2.309)
Phys. neg.	0-6 Y	0-12	0, 11	1.11 (1.536)	0, 10	1.34 (1.505)
	7-12 Y	0-14	0, 14	1.63 (1.995)	0, 12	1.89 (1.918)
	13-18 Y	0-14	0, 14	2.00 (2.147)	0, 13	2.32 (2.104)
Phys. ab.	0-6 Y	0-20	0, 20	0.54 (1.525)	0, 15	0.48 (1.288)
	7-12 Y	0-20	0, 18	0.79 (1.79)	0, 15	0.75 (1.548)
	13-18 Y	0-20	0, 17	0.89 (1.812)	0, 17	1.01 (1.707)
Sex. ab.	0-6 Y	0-20	0, 20	0.14 (1.065)	0, 8	0.04 (0.363)
	7-12 Y	0-20	0, 20	0.22 (1.179)	0, 6	0.03 (0.318)
	13-18 Y	0-20	0, 20	0.30 (1.383)	0, 6	0.06 (0.406)

Table 3

Correlations between ACEs and distress

		Mothers			Fathers		
		Early life adversity (TADS)			Early life adversity (TADS)		
		0–6 Y	7–12 Y	13–18 Y	0–6 Y	7–12 Y	13–18 Y
Depression (EDPS sum)	Gwk 14	.332**	.342**	.373**	.399**	.394**	.398**
	Gwk 24	.283**	.305**	.319**	.389**	.398**	.410**
	Gwk 34	.254**	.280**	.299**	.380**	.379**	.384**
General anxiety (SCL-90 sum)	Gwk 14	.312**	.333**	.363**	.367**	.365**	.386**
	Gwk 24	.291**	.311**	.336**	.332**	.341**	.365**
	Gwk 34	.260**	.277**	.311**	.319**	.316**	.328**

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 4

Correlations between different ACE types and maternal distress

		General anxiety (SCL-90 sum)			Depression (EPDS sum)		
		Gwk 14	Gwk 24	Gwk 34	Gwk 14	Gwk 24	Gwk 34
TADS Em. neg.	0-6 Y	0.241**	0.226**	0.200**	0.289**	0.245**	0.222**
	7-12 Y	0.255**	0.237**	0.210**	0.294**	0.260**	0.238**
	13-18 Y	0.276**	0.254**	0.231**	0.317**	0.269**	0.254**
Em. ab.	0-6 Y	0.255**	0.231**	0.200**	0.269**	0.224**	0.199**
	7-12 Y	0.284**	0.269**	0.231**	0.281**	0.250**	0.223**
	13-18 Y	0.301**	0.275**	0.245**	0.302**	0.252**	0.244**
Phys.neg.	0-6 Y	0.147**	0.143**	0.140**	0.158**	0.146**	0.130**
	7-12 Y	0.172**	0.176**	0.162**	0.179**	0.180**	0.156**
	13-18 Y	0.187**	0.175**	0.159**	0.192**	0.178**	0.153**
Phys. ab.	0-6 Y	0.146**	0.130**	0.107**	0.134**	0.094**	0.077**
	7-12 Y	0.176**	0.159**	0.129**	0.159**	0.123**	0.106**
	13-18 Y	0.206**	0.177**	0.171**	0.197**	0.132**	0.144**
	0-6 Y	0.110**	0.076**	0.042*	0.105**	0.080**	0.070**

		General anxiety (SCL-90 sum)			Depression (EPDS sum)		
Sex. ab.	7-12 Y	0.117**	0.076**	0.038	0.090**	0.064**	0.062**
	13-18 Y	0.187**	0.165**	0.120**	0.134**	0.128**	0.062**

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 5

Correlations between different ACE types and paternal distress

		General anxiety (SCL-90 sum)			Depression (EDPS)		
		Gwk 14	Gwk 24	Gwk 34	Gwk 14	Gwk 24	Gwk 34
TADS	0-6 Y	0.275**	0.235**	0.214**	0.318**	0.308**	0.265**
Em. neg.	7-12 Y	0.273**	0.231**	0.208**	0.307**	0.302**	0.258**
	13-18 Y	0.275**	0.233**	0.224**	0.307**	0.300**	0.276**
	0-6 Y	0.325**	0.308**	0.292**	0.346**	0.323**	0.337**
Em. ab.	7-12 Y	0.310**	0.294**	0.290**	0.332**	0.315**	0.335**
	13-18 Y	0.313**	0.301**	0.284**	0.312**	0.309**	0.314**
	0-6 Y	0.151**	0.166**	0.158**	0.175**	0.182**	0.188**
Phys.neg.	7-12 Y	0.175**	0.202**	0.164**	0.205**	0.225**	0.219**
	13-18 Y	0.191**	0.210**	0.171**	0.220**	0.246**	0.220**
	0-6 Y	0.167**	0.123**	0.196**	0.144**	0.127**	0.213**
Phys. ab.	7-12 Y	0.208**	0.173**	0.192**	0.179**	0.163**	0.198**
	13-18 Y	0.230**	0.224**	0.199**	0.180**	0.193**	0.222**
	0-6 Y	0.117**	0.025	0.062*	0.048*	0.014	0.032
Sex. ab.	7-12 Y	0.046*	0.062*	0.037	0.065**	0.060*	0.074**
	13-18 Y	0.057*	0.032	0.034	0.044	0.029	0.040

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

The correlations between the overall TADS scores and EPDS and SCL-90 were all statistically significant (see Table 3). Examining the different categories and time windows

separately, the correlations to EPDS and SCL-90 were statistically significant in most of the cases. Differing from other categories, reported sexual abuse occurring in some specific time periods wasn't significantly correlated to distress (See Table 4 and 5).

3.2   Prevalence of ACEs

It is worth emphasizing that this study classified every other answer than zero as having an adverse experience. The occurrence of reported adverse experiences varied among different types of adversities. Regarding emotional abuse and physical abuse, nearly half of all responses (55,2% for emotional abuse and 46,3% for physical abuse) reported some incidents. In contrast, the figures were notably higher for emotional and physical neglect, with 80,5% and 75,7% of responses reporting incidents, respectively. Sexual abuse was the least frequently reported category across all domains, with 10.1% of responses indicating incidents.

Across the specific time windows in this study, the reported adverse experiences were distributed more evenly. However, the highest number of reported adversities still fell within the age range of 13 to 18.

3.3   Relative Weights Analysis

Relative Weights Analysis was conducted to investigate the predictive role of ACE type and timing of exposure. Table 6 and 7 includes the results of the Relative Weights Analysis (mothers and fathers respectively).

Table 6

Relative Weights Analysis of Maternal Depression, Anxiety and ACE type and timing

Dependent variable	Predictor		RRW (Raw Relative Weight)			RRW-Rescaled (Rescaled Relative Weight)		
			Gwk 14	Gwk 24	Gwk 34	Gwk 14	Gwk 24	Gwk 34
Depression (EDPS)	Timing (TADS)	0-6Y	0.022	0.015	0.011	21.384	19.968	17.654
		7-12Y	0.028	0.024	0.020	27.249	31.631	30.245
		13-18Y	**0.053**	**0.037**	**0.034**	**51.368**	**48.402**	**52.101**
Anxiety (SCL-90)	Timing (TADS)	0-6Y	0.020	0.016	0.012	19.745	18.899	17.839
		7-12Y	0.028	0.024	0.018	28.573	28.850	25.473
		13-18Y	**0.051**	**0.044**	**0.039**	**51.682**	**52.251**	**56.689**
Depression (EDPS)	Type (TADS)	Em. ab	0.038	0.030	0.027	32.816	33.779	36.083
		Phys. ab	0.010	0.006	0.006	9.065	6.991	7.903
		Sex. ab	0.007	0.007	0.002	6.322	7.669	2.552
		Em. neg	**0.048**	**0.036**	**0.032**	**42.110**	**40.361**	**43.798**
		Phys. neg	0.011	0.010	0.007	9.687	11.201	9.664
Anxiety (SCL-90)	Type (TADS)	**Em. ab**	**0.037**	**0.032**	**0.027**	**34.714**	**37.637**	**40.545**
		Phys. ab	0.012	0.010	0.008	11.072	11.133	11.544
		Sex. ab	0.018	0.011	0.003	16.594	13.263	5.255
		Em. neg	0.030	0.024	0.021	28.269	28.095	31.940
		Phys. neg	0.010	0.009	0.007	9.351	9.873	10.716

The strongest predictors are highlighted

Table 7

Relative Weights Analysis of Paternal Depression, Anxiety and ACE type and timing

Dependent variable	Predictor		RRW (Raw Relative Weight)			RRW-Rescaled (Rescaled Relative Weight)		
			Gwk 14	Gwk 24	Gwk 34	Gwk 14	Gwk 24	Gwk 34
Depression (EDPS)	Timing (TADS)	0-6Y	0.043	0.037	0.043	33.231	27.436	33.089
		7-12Y	0.037	0.039	0.037	28.774	29.077	28.200
		13-18Y	**0.049**	**0.058**	**0.050**	**37.995**	**43.487**	**38.711**
Anxiety (SCL-90)	Timing (TADS)	0-6Y	0.032	0.024	0.031	28.908	23.579	32.519
		7-12Y	0.030	0.028	0.026	26.491	28.225	27.098
		13-18Y	**0.050**	**0.048**	**0.039**	**44.601**	**48.196**	**40.383**
Depression (EDPS)	Type (TADS)	**Em. ab**	**0.049**	**0.043**	**0.049**	**38.517**	**34.779**	**38.850**
		Phys. ab	0.017	0.021	0.031	13.380	16.861	24.513
		Sex. ab	0.002	0.0003	0.002	1.881	0.284	1.411
		Em. neg	0.045	0.0426	0.031	35.622	34.211	25.101
		Phys. neg	0.013	0.017	0.013	10.599	13.865	10.125
Anxiety (SCL-90)	Type (TADS)	**Em. ab**	**0.046**	**0.043**	**0.041**	**35.980**	**41.985**	**41.612**
		Phys. ab	0.030	0.025	0.026	22.944	24.039	26.432
		Sex. ab	0.009	0.001	0.002	6.919	1.250	1.568
		Em. neg	0.034	0.019	0.021	26.612	18.502	21.115
		Phys. neg	0.010	0.015	0.009	7.545	14.225	9.273

The strongest predictors are highlighted

An examination of the relative weights demonstrated that compared to various forms of adversity, emotional neglect played a central role in predicting maternal depression in gestational week 14 (RRW=0.048), 24 (RRW=0.036) and 34 (RRW=0.032), while emotional abuse was the primary factor associated with maternal anxiety in gestational week 14

(RRW=0.037), 24 (RRW=0.032), and 34 (RRW=0.027) (see Table 6). Similarly, emotional abuse was found to have the most significant impact on paternal anxiety in gestational week 14 (RRW=0.046), 24 (RRW=0.043) and 34 (RRW=0.041), but also on paternal depression in gestational week 14 (RRW=0.049) 24 (RRW=0.043) and 34 (RRW=0.049) (see Table 7).

According to the results of RWA, among the specified time periods (prior to age 6, between ages 7 and 12, and between ages 13 and 18), it was found that adversity experienced between ages 13 and 18 had the most significant impact on negative outcomes. This specific time window was the most important explaining maternal depression in gestational week 14 (RRW=0.053), 24 (RRW=0.037) and 34 (RRW=0.034), and maternal anxiety in gestational week 14 (RRW=0.0513), 24 (RRW=0.044) and 34 (RRW=0.039). Similarly, adverse experiences occurring between ages 13 and 18 emerged as the most influential time window explaining paternal depression in gestational week 14 (RRW=0.049), 24 (RRW=0.058) and 34 (RRW=0.050), and paternal anxiety in gestational week 14 (RRW=0.050), 24 (RRW=0.048) and 34 (RRW=0.039).

4 Discussion

The aim of this study was to investigate the association between ACEs and adult distress. Further, to find out whether the ACE type and timing of exposure affect this association. Approximately 55% participants reported having some experiences of emotional abuse. The same numbers were 46% for physical abuse, 81% for emotional neglect, 76% for physical neglect and 10% for sexual abuse. The highest number of reported adversities fell within the age range of 13 to 18. Emotional neglect played a central role in predicting the maternal depression, while emotional abuse was the most strongly associated with maternal anxiety, as well as paternal depression and anxiety.

As expected, reported ACEs were associated with increased adult distress (See Table 3, 4 and 5). While the correlations indicate that the ACEs might increase the risk for adult distress, it is crucial to acknowledge the possibility of reverse causation. Emotions at the time of memory retrieval can influence the information recalled (Holland & Kensinger, 2010). It is possible, that the respondents emotional state affects how they recall and report the ACEs in this study. For instance, if an individual is experiencing distress, they might selectively recall more negative memories from childhood rather than positive ones. Conversely, a stable emotional state might have the opposite effect of what is remembered.

Regarding the role of the timing of exposure, it appears that ACEs occurring in adolescence have the most significant impact on negative health outcomes compared to the other time periods in this study (See Table 6 and 7). While there is not a clear understanding in the ACE framework literature whether earlier or later exposures are more deleterious, most of the existing studies focus and emphasize the role of the early childhood (Dunn et al. 2019; Gabard-Durnam & Nelson, 2020). Therefore, the results of this study not only emphasize the importance of the timing of exposure, but also suggest that the adolescence could be a sensitive period for adverse outcomes.

As discussed, the timing of exposure might be an important predictor due to the sensitive periods in development. ACEs during a specific time can disrupt the mechanisms that are typical to that specific developmental stage. Surprisingly, early childhood in this study didn't seem to be as crucial period compared to later exposure, and this unique finding is not in line with previous studies. Yet, it is important to note, that the frequency of reported ACEs in this

study was the lowest in early childhood, which might affect to this finding. The results emphasizing the role of adolescence might also be due to the mechanisms occurring at this stage of development. For example, adolescence is considered being particularly sensitive period for stress exposure due to the maturation of the HPA axis during puberty (Herbinson et al., 2017). In addition, Teicher et al. (2018) found that timing of exposure was the most important factor predicting the inadequate development of hippocampus, which is seen particularly sensitive to early life stress. Their study emphasized the important role of adolescence indicating, that abuse during adolescence was found to be the most important predictor of hippocampal alterations in female participants (Teicher et al., 2018). Interestingly, the sensitive periods seemed to be not only sex dependent but also type dependent, indicating, that there might be different sensitive periods for different types of adversities (Teicher et al. 2018).

This study is not equipped to make interpretations regarding type- nor sex-specific sensitive periods, but similarly to Teicher et al. (2018) study, there seemed to be differences between maternal and paternal outcomes due to a specific type of adversity. The results of this study indicated, that among all the ACE types, emotional abuse was the most important predictor of paternal depression and anxiety as well as maternal anxiety, where emotional neglect, on the other hand seemed to predict maternal depression. The unique predictive role of emotional abuse on anxiety has also been found in previous studies (Al-Fayez et al. 2012; Mills et al. 2013). The finding of the predictive role of emotional neglect on depressive symptoms in adulthood is also in line with previous studies (Salokangas, 2020; Kajanoja 2019; Lee et al. 2018). It might be, that emotional neglect (i.e. parental unavailability), could enhance depressive style through experiences where individual's needs are not being met and the feeling of being important and loved is lacking. Emotional abuse, on the other hand, is an experience that activates the stress response or threat detection systems (Teicher et al. 2018) and could therefore predispose to symptoms of anxiety through learning to constantly be alert and aware of the surroundings. These might be possible reasons why emotional neglect was associated with depression and emotional abuse with anxiety in this study.

Overall, the results of this study emphasize the role of timing of exposure, shedding light to the importance of adolescence as a sensitive period for adverse outcomes. In addition, the results support the previous understanding, that different types of ACEs seem to be connected to different forms of distress.

4.1 Strengths and limitations

The present study has few major strengths and limitations. The major strength of this study is the large population sample size (N=4966). Regarding the source-population of expecting parents in Southwest Finland, the participants were largely representative (Karlsson et al., 2018).

There are few limitations considering the possible conclusions that can be drawn about the prevalence of ACEs in general as well as in this sample. First, the sample of this study is ethnically homogenous, Scandinavian-Caucasian. Second, it is worth noticing that this study classified every other answer than zero as having an adverse experience. Simply this means that the reported adverse experiences for example in the Emotional Neglect category, which had the highest rate of 80,6% reporting instances, includes a large scale of answers from mild to severe experiences. Most of the answers in every category fell within the mildest experiences.

The variation of reported adverse experiences between different ACE subtypes and time windows might affect to the results. Among the categories in this study, Sexual abuse had the lowest rate of reported instances, with 10,1% indicating instances. The low prevalence of this subtype might affect to the results, where sexual abuse didn't have much of a predictive role on adulthood distress. It is also important to note that among all the time windows in this study, the adolescence had the highest rate of reported adversities. This might be because adverse experiences in adolescence tend to be more vividly recalled compared to those in early childhood. Regardless of the cause, this could influence the findings that highlight the crucial role of adolescence over other time periods.

Relying on the retrospective self-report can be considered as a limitation of this study. The results rely on the respondent's ability to recall experiences from the early years of life. The memories and associated narratives are subject to alteration with the passage of time, and certain experiences may eventually fade from memory.

It is also important to bring up the ethical concerns regarding this study. Identifying individuals who have histories of traumatic experiences and experience symptoms related to

these experiences is a prevention strategy, which requires to be followed by an appropriate treatment plan (Substance Abuse and Mental Health Services Administration, 2014). In this study, the participants were asked about ACEs without the ability to provide adequate support to those who may need it. However, the participants whose EPDS scores were above a certain cutoff point were contacted to confirm their need for futher support.

4.2   Conclusions and future studies

The findings of this study support the widely recognized influence of adverse childhood experiences on mental health. Moreover, the results draw attention to the role of type and timing as factors affecting to this association. In line with previous studies, the specific ACE types seem to be connected to different forms of distress. Adolescence appears to be an important sensitive period for negative health outcomes due to ACEs, and this understanding was in line with the results of this study. Surprisingly, early childhood in this study didn't seem to be as crucial period compared to later exposure.

Most of the existing studies regarding ACEs, as well as the present study, rely on the self-report either by asking the participants about their experiences retrospectively (Chapman et al. 2004; Kessler et al. 2010; Teicher et al. 2018) or via parental reports (Dunn et al. 2023). While retrospective self-reports are prone to the recall bias, relying on parental reports might also be problematic given the potential for answers that might show the respondent in better light as a parent. Long-term prospective studies are needed to resolve these problems. Long-term prospective studies would provide more accurate information not only about the existence of adverse experiences, but also the specific timing of these experiences. The previous findings of sex-dependent connections between ACE types and adult distress emphasize the need for future studies to focus on potential sex-dependent sensitive periods. Future studies should also focus on detailed measures of multiple dimensions of ACEs, such as severity, duration, and chronicity. Thus, the effects of the timing of exposure can be separated from other characteristics of ACEs as well as the individual factors. A better understanding of the role of both ACE type and timing is essential for effectively recognizing and supporting individuals at risk for adverse health outcomes. This understanding can help to develop more targeted interventions and early preventive approaches, ultimately leading to improvements in overall population health.

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