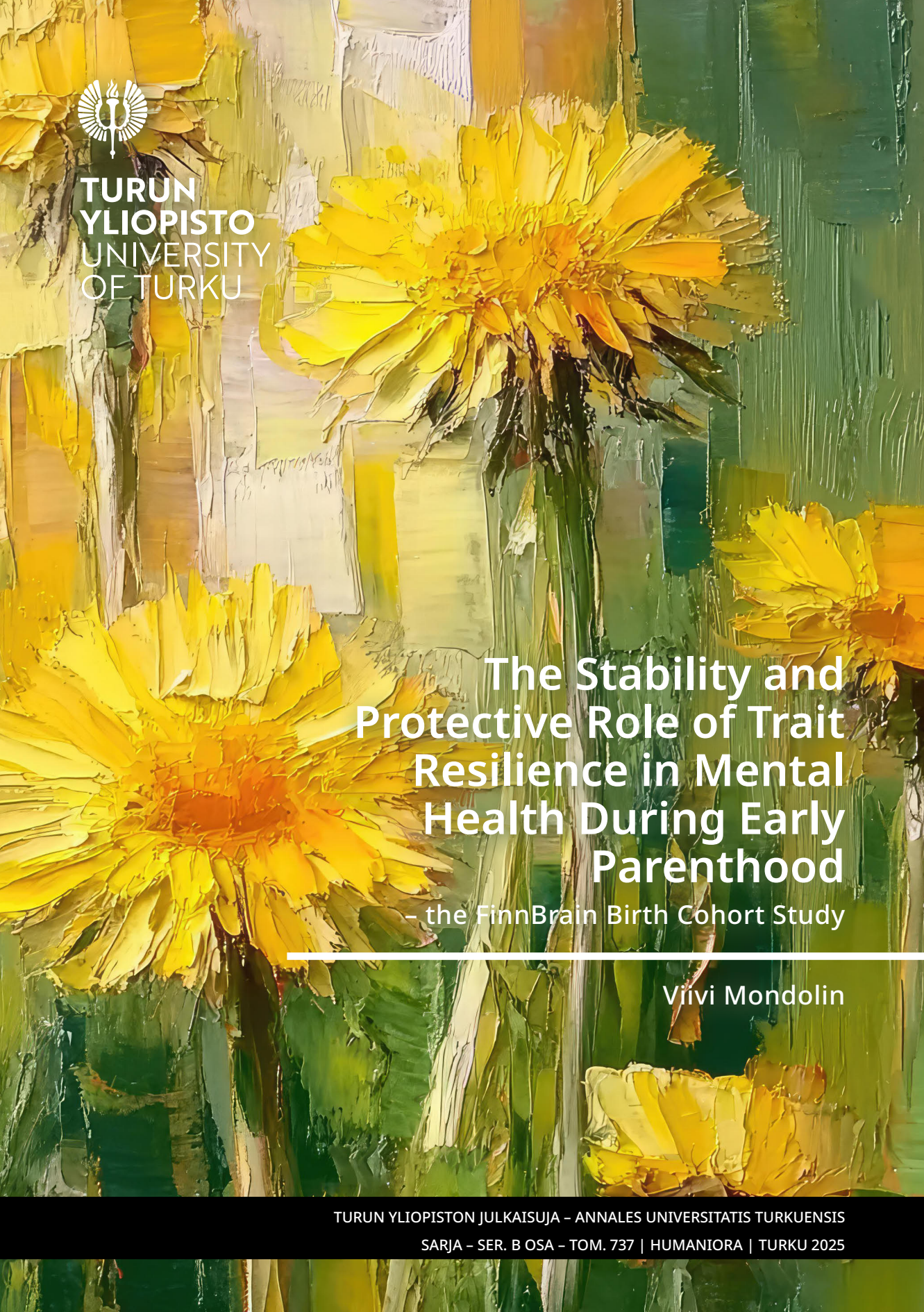

TURUN YLIOPISTO
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The Stability and Protective Role of Trait Resilience in Mental Health During Early Parenthood

– the FinnBrain Birth Cohort Study

Viivi Mondolin

TURUN YLIOPISTON JULKAISUJA – ANNALES UNIVERSITATIS TURKUENSIS
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To the memory of my mother,
whose love laid the foundation of my resilience.

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ABSTRACT

Trait resilience refers to a characteristic that enables individuals to navigate challenges and overcome adversities. There is limited research on the nature of trait resilience, for example regarding its stability over time. Instead, substantial evidence indicates that trait resilience is associated with better mental health. An increasing number of studies have focused on parents' resilience, particularly in mothers, while research on fathers remains limited.

This thesis examines, in mothers and fathers, the associations between trait resilience and mental health, the stability of trait resilience, and its associations with a biological factor related to distress symptoms, namely telomeres. The sample was drawn from the FinnBrain Birth Cohort Study with sample sizes ranging from 700 to 5000 parents across three separate studies. The aims were to investigate: 1) the associations between trait resilience, adverse childhood experiences (ACEs), and distress symptoms (Study I); 2) whether telomere length is associated with trait resilience, ACEs, or distress symptoms (Study II); and 3) the stability of trait resilience over a six-year period and its associations with stressful life events (Study III).

The results showed that trait resilience was consistently associated with lower levels of depressive and anxiety symptoms regardless of ACEs or stressful life events. Furthermore, trait resilience demonstrated stability from pregnancy to five years postpartum, while also showing some susceptibility to change. Stressful life events during this period did not moderate this association and were not associated with trait resilience. Additionally, no associations were found between trait resilience and telomere length, ACEs, or depressive and anxiety symptoms.

Trait resilience may play a significant role in the mental health of both mothers and fathers that offers protection against depressive and anxiety symptoms. Its persistent nature, and, on the other hand, its susceptibility to change make it a valuable target for support and development. Utilizing trait resilience in mental health work with parents may support a more holistic approach to their care and support.

KEYWORDS: trait resilience, resilience, mothers, fathers, early parenthood, distress symptoms, ACE, stressful life events, telomere

TURUN YLIOPISTO
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TIIVISTELMÄ

Piirreresilienssillä viitataan ominaisuuteen, joka auttaa yksilöä kohtaamaan ja selviytymään vastoinkäymisistä. Piirreresilienssin on havaittu olevan johdonmukaisesti yhteydessä parempaan mielenterveyteen. Sen sijaan sen luonnetta, kuten sen pysyvyyttä, koskeva tutkimus on vasta lisääntymässä. Raskausaika ja varhainen vanhemmuus ovat muutosten ja haasteiden aikaa, mikä tekee niistä kiinnostavan ajanjakson piirreresilienssin tarkastelulle. Viime vuosina näihin ajanjaksoihin kohdistuva resilienssitutkimus on lisääntynyt, joskin isät ovat jääneet vähälle huomiolle.

Tässä väitöskirjassa tutkittiin äitien ja isien piirreresilienssin ja mielenterveyden välisiä yhteyksiä, piirreresilienssin pysyvyyttä sekä sen yhteyksiä stressioireiluun yhdistettyyn biologiseen tekijään, telomeereihin. Väitöstyön tutkimusotos oli osa FinnBrain-syntymäkohorttitutkimusta, ja otoskoot eri osatutkimuksissa vaihtelivat 700-5000 vanhemman välillä. Tavoitteina oli tutkia 1) piirreresilienssin, psyykkisen oireilun (masennus- ja ahdistusoireiden) ja varhaisten haitallisten kokemusten (ACE-kokemusten) välisiä yhteyksiä (tutkimus I), 2) telomeerien pituuden yhteyksiä piirreresilienssiin, psyykkiseen oireiluun ja ACE-kokemuksiin (tutkimus II), sekä 3) piirreresilienssin pysyvyyttä kuuden vuoden seurannassa, sekä sen yhteyksiä kuormittaviin elämäntapahtumiin ja psyykkiseen oireiluun (tutkimus III).

Tulokset osoittivat, että piirreresilienssi oli systemaattisesti yhteydessä vähäisempään masennus- ja ahdistusoireiluun riippumatta ACE-kokemuksista tai kuormittavista elämäntapahtumista. Piirreresilienssi osoitti kuuden vuoden seurannassa merkittävää pysyvyyttä, mutta myös alttiutta muutokselle. Kuormittavat elämäntapahtumat eivät vaikuttaneet piirreresilienssin pysyvyyteen. Vastoin hypoteeseja telomeerien pituus ei ollut yhteydessä piirreresilienssiin, ACE-kokemuksiin eikä psyykkiseen oireiluun.

Piirreresilienssin merkitys sekä äitien että isien mielenterveydessä näyttää vakuuttavalta sen ollessa yhteydessä vähäisempään masennus- ja ahdistusoireiluun. Sen mahdollinen pysyvyys tekee siitä tavoittelemisen arvoisen ominaisuuden, ja toisaalta muutosalttius kiinnostavan kohteen mielenterveystyössä. Piirreresilienssin huomioiminen voi edistää vanhempien kokonaisvaltaista kohtaamista ja tukemista.

ASIASANAT: piirreresilienssi, resilienssi, äidit, isät, varhainen vanhemmuus, psyykkiset oireet, ACE, kuormittavat elämäntapahtumat, telomeeri

Acknowledgements

At the beginning of my PhD journey, my choice of a dissertation position was guided by the topic itself, as I wished to gain a deeper understanding of resilience. I first contacted my alma mater, only to learn that there was no research on this topic being conducted there at the time. After that, I approached a well-known professor at the University of Turku – Hasse Karlsson – to ask whether he happened to know of any research groups with an interest in resilience. As it turned out, his own research group, the FinnBrain Birth Cohort Study, happened to be interested in the topic. Next, I met with my prospective supervisors, Emeritus Professor Hasse Karlsson and Adjunct Professor Eeva-Leena Kataja. They asked me whether I would like to come and play with them. I absolutely did and so the journey began.

So, to begin with, my deepest gratitude to you two, Hasse and Eeva-Leena, for creating such a safe and warm environment in which to begin this work. And thank you for your patience; it took me two years to properly get started with the research. Eeva-Leena, thank you for everything, including your guidance, warmth, and steady support. Your analytical eye and thoughtful feedback have strengthened this work in countless ways. Thank you, Hasse, for all your wisdom, skepticism, and (bad) humor. It has been both an honor and a joy to have you as my supervisor.

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within FinnBrain is of high quality, and it has been an honor to be part of it. Most importantly, there would be no FinnBrain without our valued FinnBrain families: the children and parents who make up the entire dataset. My heartfelt thanks to you for your time, participation, and commitment to supporting this important research.

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Adolescent psychiatry holds a special place in both my career and my heart, and my work at HUS Adolescent Psychiatry has played an important role in my development as a specialist. One of the reasons why I chose to study resilience stems from this work in adolescent mental health work is that hope and resilience play a

unique and powerful role, and I wanted to deepen my understanding to better serve it. Over the years, I have had the privilege of working with many colleagues, and there are far too many to name individually. So, to all of you with whom I have worked in adolescent psychiatry, I wish to you a heartfelt thank you. A few individuals, however, deserve special mention. Thank you to Professor Klaus Ranta and Adjunct Professor Niklas Granö for believing in me from the early stages of my career. Professor Anu Raevuori, thank you for all your support and guidance.

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what an extraordinary mother you were, and how profoundly grateful I am for everything she gave me. I carry your love with me. Thank you, Mom.

When I started writing this Acknowledgements section, my first question was: how long can it be? I believe it has turned out to be quite long, and still, there are so many to whom I would like to express my gratitude. To everyone who has offered kind words, thoughtful gestures, and everyday support, thank you, my friends, colleagues, and acquaintances. Thank you, life.

At the heart of it all, there is still one person to whom I owe my deepest gratitude: my husband, Rami. We have been together for more than half of our lives, and I am still having the time of my life with you. You are truly amazing, and one of my greatest joys is knowing that you are happy with me. You have been an incredible source of support throughout this entire project, and I am so grateful for that. Thank you for giving me the time and space to see this through. I love you.

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Töölö, 30 June 2025
Viivi Mondolin

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List of Original Publications

This dissertation is based on the following original publications, which are referred to in the text by their Roman numerals:

I Mondolin, V., Karlsson, H., Tuulari, J. J., Pelto, J., Karlsson, L., Nordenswan, E., & Kataja, E. L. (2024). Childhood maltreatment, trait resilience and prenatal distress among expecting mothers and fathers in the FinnBrain Birth Cohort Study. Journal of Affective Disorders, 344, 41–47. https://doi.org/10.1016/j.jad.2023.10.026

II Mondolin, V., Karlsson, H., Perasto, L., Paunio, T., Vitikainen, E., Dries, S. M., Karlsson, L., Tuulari, J. J. & Kataja, E. (2024). Associations of Leukocyte Telomere Length with Trait Resilience, ACEs, and Psychological Distress among Expecting Parents in the FinnBrain Birth Cohort. Biological Psychiatry Global Open Science. https://doi.org/10.1016/j.bpsgos.2025.100498

III Mondolin, V., Karlsson, H., Perasto, L., Tuulari, J. J., Karlsson, L., & Kataja, E. (2024). Understanding Resilience in Parents: Longitudinal Examination of Trait Resilience, Stressful Life Events, and Psychological Distress Symptoms—Insights from the FinnBrain Study. Stress and Health, e3516. https://doi.org/10.1002/smi.3516

1 Introduction

Pregnancy and the early years of parenthood present significant changes and challenges as well as opportunities. Child development progresses rapidly, and parents must continuously adapt to new situations, which may at times be challenging. Parenting brings stressors, such as role overload, parenting guilt, and negative child behavior, that associate with elevated levels of depression, anxiety, and stress in mothers (Luthar & Ciciolla, 2015). Furthermore, recent research indicates that Finnish parents exhibit higher levels of burnout compared to parents in many other countries worldwide (Roskam et al., 2021). In general, parental mental illnesses, including mood and anxiety disorders and posttraumatic stress disorder, are relatively common with estimates ranging between 10% and 38%, respectively (Ertel et al., 2011; Reupert & Maybery, 2016; van Santvoort et al., 2015).

In addition to the stressors related to parenting, parents face various stressful life events (SLEs) and adversities in other domains of their life that can lead to distress and even mental disorders (Bjorndal et al., 2023; Ding et al., 2023; Kendler et al., 2010). Furthermore, parents' adverse childhood experiences (ACEs) may have an influence on the mental health of parents, as ACEs associate with an increased risk of mental health disorders (Kessler et al., 2010). In addition to individual parental mental health problems, ACEs associate with dysfunctional parent-child relationships (Christie et al., 2017; Souch et al., 2022).

Mental health and and its treatment are often discussed in terms of disorders and symptoms, even though numerous protective factors should be considered. These protective factors play a major role in preventing mental health imbalances but also in well-being and recovery. A more balanced approach that acknowledges both risk and protective factors can foster a more comprehensive understanding of mental health and developing effective interventions. Encouragingly, research on resilience has steadily expanded. Studies examining resilience during the perinatal period have also increased substantially, particularly in recent years (Hannon et al., 2022).

The term resilience comes from the Latin verb *resilire*, which means to bounce back or rebound. Resilience refers to the ability to maintain functionality in the face of adversity and to recover to the state before the adversity with the possible adoption of new, positive characteristics after the adversity (Connor & Davidson, 2003;

Fletcher & Sarkar, 2013; Masten, 2018). In the 1970s, pioneering psychologists and psychiatrists began studying resilience in children who were at risk of developing a psychopathology (Masten, 2001). They suggested that understanding resilient children could improve guidelines for psychopathology diagnosis and treatment. Initially, resilience was perceived to be an extraordinary trait with resilient children described as invulnerable or invincible. However, it soon became clear that resilience is a natural and widespread phenomenon rather than an exceptional ability (Masten, 2001).

Since then, recently, resilience research has gained increasing attention. However, this field has faced several challenges. A key challenge lies in the varied and sometimes ambiguous operationalization of resilience, which has limited the collective agreement and application, such as those supporting mental health work (Hu et al., 2015). One explanation for these diverse definitions and operationalizations is the inherent complexity of resilience itself. For example, Ungar and Theron (2020) support a multisystemic approach emphasizing that resilience is best understood as a dynamic process involving the interaction of multiple biological, psychological, social, and ecological systems. These systems work together to help individuals recover, maintain, or even enhance their mental well-being when facing challenges (Ungar & Theron, 2020).

As research has progressed, the understanding of resilience has evolved significantly with definitions and operationalizations becoming increasingly clearer. Despite the challenges, resilience research has yielded critically important insights, particularly in its association with mental health. Resilience is linked to fewer symptoms of psychological distress, a lower risk of mental health disorders, and greater well-being (Hu et al., 2015; Watters et al., 2023). These findings support the potential of resilience as a protective factor in mental health and as a foundation for interventions aimed at promoting psychological strength and recovery.

In summary, the vague operationalization of resilience has posed a significant challenge in resilience research. This thesis addresses this issue by adopting a clear and focused approach to its operationalization, specifically examining a characteristic called trait resilience as a distinct component of the broader concept. Another reason for the decision to investigate trait resilience is its' possible value in clinical work, as it is used in different clinical settings (Connor & Davidson, 2003; Dai et al., 2024). This thesis aims to deepen the understanding of trait resilience within parental and resilience science with a focus on its protective role in mental health, its biological underpinnings, and its stability.

1.1 The Definition and Operationalization of Resilience

A frequently utilized conceptualization of resilience is that it is a dynamic process involving positive adaptation within the context of significant adversity (Fletcher & Sarkar, 2013; Luthar, Cichetti & Becker, 2000). The aforementioned theory of Ungar & Theron (2020) provides an example of how multiple factors can be related to and affect resilience. Furthermore, it is a common research approach to define resilience as an outcome. This is where resilience is defined as a function or behavioral outcome that enables individuals to effectively overcome and recover from adversities (Hu et al., 2015; Nishimi et al., 2020). This perspective states that two conditions must be met for resilience to exist: there must be an observable risk factor and a positive outcome (Luthar et al. 2000; Masten, 2001). Consequently, resilience is often measured or defined in research by examining individuals who have experienced adversity and then determining their resilience based on their post-adversity condition. As an example, if a person shows no signs of mental health problems after adversity, they would be classified as resilient. Although there is general agreement on those two propositions, the specific factors themselves remain undefined. In particular, the definition of what is considered a positive outcome may vary from one study to another (Luthar et al., 2000; Masten, 2001).

Another prevalent conceptualization of resilience is as a personal trait that enables individuals to effectively cope with challenges and achieve positive adaptation (Connor & Davidson, 2003; Hu et al., 2015). Those who espouse this perspective regard resilience as a protective factor that enables individuals to endure and navigate adversities or traumatic experiences (Connor & Davidson, 2003; Ong et al., 2006). This trait encompasses qualities such as toughness and perseverance, which are primarily evaluated through self-report questionnaires (Campbell-Sills & Stein, 2007; Connor & Davidson, 2003). These assessments quantify an individual's capacity to adapt to changes, cope with unexpected events or illnesses, and recover from setbacks, thereby enabling them to overcome these challenges (Campbell-Sills & Stein, 2007). The trait resilience is utilized in clinical settings to provide a quantifiable and measurable score that can be tracked and operationalized (Connor & Davidson, 2003; Dai et al., 2024). Furthermore, the concept of resilience as a trait is a subject of debate and criticism. A significant point of disagreement is the implication that resilience is a fixed trait (Luthar et al. 2000; Windle, 2011). Additionally, some suggest that the absence of trait resilience could be perceived as a deficit or failure of the individual (Windle, 2011).

In this study, the conceptualization of trait resilience is used due to its significant relevance to mental health issues, as will be discussed, and the availability of a well-established measurement tool and its potential clinical applications. Unlike some critics of trait resilience who argue that it is considered fixed, trait resilience is not

assumed to be a fixed entity in this work. While it is typical of traits to exhibit some degree of stability, evidence also suggests that trait resilience can be modified (Dai et al., 2024; Davidson et al., 2008). However, it is expected that resilience will remain stable to a certain extent. This question about the stability of trait resilience is one of the main focuses of the thesis. In addition, trait resilience is only one aspect of the broader concept of resilience, as illustrated by the multi-system approach proposed by Ungar & Theron (2020).

1.2 Development of Resilience

Psychological resilience research is rooted in studies of children who grew up in highly adverse environments yet managed to cope as well as those raised in more favorable conditions (Masten, 2001, 2018; Werner, 1993). These findings suggest that humans possess a natural capacity for resilience, which begins to take shape and exert influence in childhood. In the seminal Kauai Longitudinal Study, several protective factors were identified among high-risk children who demonstrated positive adaptation in adulthood—that is, those considered resilient (Werner, 1993). One such factor was temperament. Resilient individuals were more likely to have temperamental characteristics that elicited positive responses from those around them. Notably, differences in temperament between resilient and non-resilient individuals were observable as early as infancy, and those later classified as resilient were often described as "easy" babies (Werner, 1993). Werner (1993) observed that "interactional continuity" was present suggesting that an individual's behavior or disposition evokes reinforcing responses from others that sustain and amplify the original behavior pattern (Caspi et al., 1989). It should be emphasized, however, that the finding regarding "easy babies" is an example, as resilience develops primarily through the interaction with the environment and can emerge in a wide range of temperamental dispositions.

There are various factors associated with the development of trait resilience. These include social support, particularly parental care and support in childhood (Werner, 1993; Masten, 2001), problem-solving skills, self-regulation, hope, and a sense of self-efficacy (Masten, 2018). In general, many of the factors associated with the development of resilience are protective factors that support a child's overall development (Masten, 2001). As Masten (2001) summarizes: "Resilience appears to be a common phenomenon arising from ordinary human adaptive processes."

In the context of resilience, adaptation refers specifically to the adjustment in the face of burdensome or adverse circumstances that induce stress. Although stress is a well-established predictor of potential mental and physical health problems (Shonkoff et al., 2009), not all stress is inherently harmful. Shonkoff and colleagues (2009) have distinguished between three types of stress. Positive stress involves

mild, short-term physiological responses to everyday challenges, such as frustration. This type of stress is a normal part of healthy development. Tolerable stress involves stronger responses but remains manageable when buffered by supportive relationships and coping mechanisms. Examples include the death of a loved one or natural disasters. In contrast, toxic stress results from prolonged or intense stress without adequate protection potentially causing lasting harm to brain function and increasing the risk of stress-related health problems (Sonkoff et al., 2009).

However, resilience research highlights the challenge of determining which stressors are tolerable or intolerable for different individuals. As Bonanno et al. (2023) suggests, even though we can estimate roughly what proportion of a population may show resilience, we still lack the ability to predict which individuals will be resilient and which will not. This may be explained by the fact that resilience, as an outcome, can emerge through multiple distinct pathways. Given the current lack of longitudinal research on trait resilience, it remains an open question whether its assessment could contribute to resolving the challenge of predicting individual resilience outcomes.

Stress is not only embedded in the concept of resilience but is also closely linked to its development. Resilience tends to be strengthened through the experience of adversity (Shonkoff et al., 2009). From a psychological perspective, this has been conceptualized by Rutter (2012, 2013) as the "steeling effect" and refers to the idea that exposure to moderate or manageable levels of stress can enhance an individual's capacity to cope with future stressors (Rutter, 2012). Conversely, avoiding such experiences or lacking exposure to them may hinder the development of resilience potentially resulting in excessive stress responses when facing adversity. A conceptually related idea has also been proposed from a biological perspective, known as stress inoculation (Feder et al., 2019; Kalisch et al., 2024). This inoculation effect will be discussed in more detail, here, in the subchapter 1.5.2 Biological Mechanisms of Resilience.

Although the foundation of resilience is built in childhood, it can also develop in adulthood. For example, self-reported resilience increases following interventions (Liao et al. 2025). Similarly, Rutter (2013) refers to "turning points," which are life events that "knife off" the past and give new direction to one's life. In addition, as many researchers emphasize that resilience is better understood as a process rather than a fixed trait, this process-oriented view implies that resilience involves intentional effort from the individual and can also be strengthened through external factors (Bonnano et al. 2023). If resilience emerges through such a process, then it is strongly influenced by external conditions, such as social support and problem-solving skills, that, in turn, can also be developed in adulthood, thereby enhancing an individual's resilience. However, a process orientation, per se, does not exclude the possibility that resilience may also include trait-like characteristics.

In summary, most research on the development of resilience has been conducted with children. A central finding is that humans appear to possess a fundamental capacity for resilience. There are likely some differences between individuals based on certain characteristics that influence the emergence of resilience, but resilience is also strongly shaped through one's interaction with the environment. One key factor supporting the development of resilience in childhood is the presence of supportive and secure close relationships. One key pathway in the development of resilience may involve successful experiences of overcoming adversity with first, the support of others and later internalized as a personal resource.

1.3 Trait Resilience and Mental Health

Trait resilience frequently associates with lower levels of stress, depression, and anxiety in different age groups (Anyan & Hjemdal, 2016; Cheng et al., 2020; García-León et al., 2019; Hu et al., 2015; Laird et al., 2019). Watters et al. (2023) conducted a multivariate meta-analysis to examine the associations between trait resilience, childhood trauma, and depression. The meta-analysis included a total of 18,732 participants with an age range of 12 to 92 years and an average age of 25.65 years. The study supported previous findings that traumatic experiences are pivotal for the onset of depression, and that trait resilience significantly correlates with both trauma and mental health. The largest observed weighted correlation was between depression and trait resilience with a value of -0.39. The weighted correlation between trauma and depression was 0.26 and between trauma and trait resilience being 0.19. The results indicated that trauma predicted lower trait resilience and higher depression, while trait resilience predicted decreased depression (Watters et al. 2023). Furthermore, trait resilience acted as a partial mediator between trauma and depression (Watters et al. 2023).

In another meta-analysis, Hu et al. (2015) examined the relationship between trait resilience and mental health. In their study, mental health was assessed using a range of indicators, including positive outcomes such as satisfaction with life and positive affect as well as negative indicators such as depression, anxiety, and negative affect. The meta-analysis included 60 studies and a total of 68,720 participants. Of the effect sizes employed, 76 (68%) were correlations between negative indicators and trait resilience, while 35 (32%) were correlations of positive indicators and trait resilience. The mean r effect size of the correlation between trait resilience and negative indicators was -0.36, while the mean r effect size of the correlation between trait resilience and positive indicators was 0.50. Overall, their findings emphasized that higher levels of trait resilience were associated with fewer symptoms of anxiety, depression, and negative affect as well as more positive outcomes such as greater life satisfaction and increased positive affect.

1.3.1 Trait Resilience and ACEs

ACEs encompass a broad spectrum of adverse experiences, including maltreatment and other potentially traumatic events that occur before the age of 18 (Felitti et al., 1998). ACEs are relatively common, although determining their exact prevalence remains challenging. A meta-analysis assessing data from 206 studies that included half a million adults found that 39.9% of individuals reported no ACEs, whereas the pooled prevalence of experiencing at least one ACE was 60.1% (Madigan et al., 2023). This suggests that experiencing at least some ACEs is more typical than having none. Moreover, ACE prevalence differed across populations with particularly high rates observed among, for example, individuals with a history of mental health conditions or substance abuse and those from low-income households (Madigan et al. 2023).

A substantial body of research shows that ACEs elevate the risk of developing mental health disorders (Kessler et al., 2010, Madigan et al. 2023). Studies have investigated the role of trait resilience in mitigating the negative effects of ACEs on mental health with growing evidence highlighting its protective impact particularly against depression (Liu et al., 2020; Watters et al., 2023; Wingo et al., 2010; Youssef et al., 2017). In addition to its primary effects, trait resilience also moderates the association between ACEs and psychiatric symptoms (Sexton et al., 2015; Youssef et al., 2017; Campbell-Sills & Stein, 2007). Youssef et al. (2017) found that trait resilience mitigated the impact of ACEs on depression in young adults. Likewise, Campbell-Sills and Stein (2007) found similar results in their validation study of the CD-RISC-10 in which they found that trait resilience moderated the association between childhood maltreatment and psychiatric symptoms among undergraduate students.

1.3.2 Trait Resilience and Stressful Life Events

Stressful life events (SLEs) are a variety of events and experiences that may cause harm or threat to an individual, e.g., death of a spouse, losing a job, having an injury or illness, or getting divorced (Cohen et al., 2019). There is a broad consensus that SLEs are associated with many types of problems, including psychological distress symptoms and psychiatric disorders (Cohen et al., 2019; Hjemdal et al., 2006; Kendler et al., 2010; Sheerin et al., 2018). The significance of SLEs is supported by research findings, which indicate that individuals who experience depression are 2.5 to 9.4 times more prone to having encountered a major stressful life event preceding their first depression episode (Cohen et al., 2019).

The pathways through which stressful life events affect mental health are diverse. It is widely accepted that such events can increase the risk of illness by affecting an individual's emotions, behavior, and physiology (Cohen et al., 2019).

However, although the connection between SLEs and mental health problems is well-established, most people do not develop mental illness when facing adversity (Bonanno et al., 2023). While the exact mechanisms by which SLEs lead to illness are not fully understood, there appear to be some key factors that may protect against the negative outcomes of SLEs.

One such key factor might be trait resilience. There are limited studies on SLEs and mental health that use trait resilience measures. However, one study found that low-trait resilience participants reported significantly higher levels of perceived stress, psychopathological symptoms, and even a greater number and intensity of current SLEs (García-León et al., 2019). Other similar studies have employed alternative approaches to operationalize resilience. In a study by Hjemdal et al. (2006), self-reported resilience was found to buffer against psychiatric symptoms in the context of SLEs. The study used the Resilience Scale for Adults (RSA), which differs from the trait resilience measure by emphasizing not only individual characteristics but also social and environmental factors. In another study with a 5-year follow-up period, individuals with high levels of resilience were less likely to develop a major depressive disorder or generalized anxiety disorder even when experiencing a high frequency of SLEs in the past year (Sheerin et al., 2018). Notably, resilience in that study was operationalized as a composite of psychological distress symptoms and the number of SLEs. It assessed resilience relative to the adversity faced and the symptoms reported that made it different from the trait resilience approach, which focuses on stable individual characteristics.

1.3.3 Trait Resilience and Mental Health in Early Parenthood

In both the pregnancy and postpartum periods, low levels of trait resilience associate with an increased prevalence of depressive symptoms, depressive and anxiety disorders, and post-traumatic stress disorder (Kinser et al., 2021; Sexton et al., 2015; Young-Wolff et al., 2019). Sexton et al. (2015) explored the role of trait resilience in postpartum maternal mental health and family functioning and found that higher trait resilience corresponded with lower levels of PTSD and depression as well as better overall family functioning and greater maternal confidence in parenting. Similarly, Young-Wolff et al. (2019) investigated trait resilience in prenatal mental and behavioral health reporting that greater trait resilience was linked to a lower prevalence of anxiety and depressive disorders, fewer depressive symptoms, and even a reduced likelihood of experiencing intimate partner violence. However, trait resilience did not significantly buffer against prenatal substance use. Kinser et al. (2021) examined the relationship between mental health and trait resilience among pregnant and postpartum women during the early phase of the COVID-19 pandemic

and found that higher trait resilience was associated with lower levels of depression, anxiety, and PTSD symptoms. Kinser et al. (2021) suggests that resilience may serve as a protective factor against psychological distress particularly in times of heightened stress.

Trait resilience also provides protection from the harmful effects of ACEs among mothers (Sexton et al., 2015; Young-Wolff et al., 2019). In the study conducted by Sexton et al. (2015), mothers with the lowest levels of trait resilience and a high proportion of childhood maltreatment experiences were more likely to have PTSD or major depressive disorder (MDD). Conversely, mothers with a high proportion of childhood maltreatment but coupled with the highest level of trait resilience evidenced low rates of PTSD and an absence of MDD (Sexton et al 2015). In addition, trait resilience moderated the association between mothers' childhood trauma and postpartum PTSD and depression serving to buffer against these outcomes (Sexton et al. 2015). A study by Young-Wolff et al. (2019) yielded comparable findings on the main associations between trait resilience, depression, and anxiety. Greater trait resilience gave protection for mothers with elevated ACEs, whereas those with low resilience exhibited more perinatal mental health symptoms when they had endured higher proportion of childhood trauma (Young-Wolff et al. 2019).

While the mental health and well-being of fathers are crucial for the entire family, research focusing on fathers during the perinatal period remains limited. During the perinatal period or early parenthood, limited research exists specifically on examining fathers' mental health and trait resilience or even on resilience as defined in other ways. In some studies, both parents have been included, although mothers typically dominate the samples. One such study examined factors predicting trait resilience among parents of autistic children including 15 fathers and 35 mothers (Schwartzman et al., 2022). Mothers' and fathers' responses were analyzed together, and the results showed that stress and anxiety negatively predicted trait resilience, while optimism and self-compassion were positive predictors of trait resilience. Another study examined resilience and its connection to parental burnout during the COVID-19 pandemic (Sorkkila & Aunola, 2022). The study included 1,105 Finnish parents of whom 972 were mothers and 133 were fathers. Resilience was assessed using the Brief Resilience Scale, which focuses on the individual's ability to recover from adversity and emphasizes its functional dimension. Their study highlighted that resilience serves as a crucial protective factor against parental burnout (Sorkkila & Aunola, 2022).

1.4 The Stability of Trait Resilience

Despite the growing body of research on trait resilience and its acknowledged significance for mental health, questions remain about its fundamental characteristics such as its stability over time. While often perceived as an enduring characteristic, implying its lasting nature, trait resilience may also exhibit susceptibility to change. Although trait resilience is part of several longitudinal studies, its stability per se has not been the central focus of these investigations (Perry et al., 2021; Sumner et al., 2023; Wang et al., 2022).

An exception to this is the study by Ollis et al. (2022) that examined whether resilience should be conceptualized as a stable trait or a dynamic state utilizing latent state-trait modeling to assess its stability and variability over time. Their aim was to evaluate the invariance and change in resilience across a six-month period using two established resilience measures being the Connor-Davidson Resilience Scale 10 (CD-RISC-10), which is also employed in the present thesis, and the Resilience Scale for Adults (RSA), which assesses protective factors such as social competence and family cohesion. While both scales captured both trait and state components of resilience, CD-RISC-10 exhibited stronger trait-like stability suggesting it primarily measures the lasting aspects of resilience. In contrast, RSA demonstrated greater variability over time reflecting its emphasis on external, dynamic protective factors such as social support and adaptability. As Ollis et al. (2022) suggest, these differences indicate that, while resilience encompasses both stable and fluctuating elements, the extent to which it appears fixed or malleable depends on the specific aspects being measured. However, the findings also acknowledge that situational factors can introduce some degree of variability and highlight that resilience, while lasting, is not entirely static (Ollis et al., 2022).

In the study by Ollis et al (2022), across a six-month period, resilience scores remained stable with no significant mean changes, and correlations between time points were high ($r = 0.70$). Findings from other longitudinal studies on trait resilience, although not their primary focus, align to some extent with these results. For instance, a study on medical students found relative stability in trait resilience over a 20-month period with a correlation of $r = 0.54$ (Wang et al., 2022), while Ríos-Risquez et al. (2018) observed a correlation of $r = 0.66$ after an 18-month follow-up. However, findings on mean changes in trait resilience over time remain unsettled. A two-year follow-up study conducted during and after the COVID-19 pandemic observed a slight decrease in trait resilience over time (Sumner et al., 2023). Similarly, a four-year follow-up of resident physicians found a decline in trait resilience among women but not among men (Perry et al., 2021). Moreover, at least one cross-sectional study suggests that trait resilience may increase with age that adds another layer of complexity to its developmental trajectory (Lundman et al., 2007).

Nevertheless, as highlighted in a systematic review by Cosco et al. (2017), there remains a lack of comprehensive longitudinal studies that specifically investigate resilience as a primary outcome. Moreover, existing studies have not fully examined how resilience changes and interacts with life events and behaviors (Cosco et al., 2017). The present study aims to address, to some extent, this gap in the current literature. The perinatal period and early parenthood provide an optimal setting for investigating the stability of trait resilience, as this time is characterized by change and challenges.

1.5 Biological Factors and Resilience

1.5.1 The Heritability of Resilience

Given that one of the key aims of this thesis concerns the stability of resilience, a short overview of its heritability is provided to offer context for its long-term patterns and the biological factors underlying resilience. Studies report moderate heritability estimates for resilience though the approaches used to operationalize resilience have varied considerably (Amstadter et al., 2014; Waaktaar & Torgersen, 2012; Wolf et al., 2018). For example, Amstadter et al. (2014) conducted a longitudinal twin study involving 7,500 twins to examine genetic and environmental influences on resilience with a focus on its heritability and stability over time. Participants were assessed at two time points approximately five years apart with resilience operationalized as the difference between expected and actual levels of internalizing symptoms (e.g., anxiety and depression) based on exposure to stressful life events. Their findings demonstrated that resilience is moderately heritable (~31%) with genetic factors accounting for a major portion of individual differences. After adjusting for measurement error, the heritability estimate increased to ~50% suggesting that resilience has a strong genetic basis. Furthermore, resilience remained largely stable over time with a high genetic correlation ($r = 0.88$) between the two assessment waves (Amstadter et al. 2014). This indicates that the same genetic influences contributed to resilience at both time points reinforcing the idea that resilience is a relatively enduring trait, although environmental factors also contribute to short-term variability (Amstadter et al. 2014). These findings indicate that resilience is not only shaped by life experiences but also has a biological basis with genetic factors contributing to its stability over time.

1.5.2 Biological Mechanisms of Resilience

Research on the biological mechanisms of resilience lags behind psychological resilience research, but it has grown rapidly in recent years (Kalisch et al., 2024).

The scope of biological research in this area is broad. In a recent review, Kalisch et al. (2024) outlines a wide range of resilience-related factors, such as the function of the hippocampus, prefrontal cortex, and reward system, and describes how these are supported by broader biological processes such as neuroplasticity, immune regulation, and gut-microbiome balance. Likewise, in a comprehensive review of the biological mechanisms underlying resilience, Feder et al. (2019) highlight that stress response systems, including the hypothalamic-pituitary-adrenal axis, amygdala, prefrontal cortex, and sympathetic nervous system, play a central role in resilience, which aligns with previous evidence on the role of stress systems in resilience.

Although the biological factors mentioned above and the broader stress response system lie outside the central scope of this dissertation, one concept presented in both reviews warrants attention and that is the concept of stress inoculation. This refers to the idea that moderate stressful experiences can enhance an individual's later ability to cope with stress. Animal studies have provided evidence supporting this effect, which is linked to prefrontal cortical plasticity (Feder et al., 2019; Kalisch et al., 2024). Similar findings have also been reported in children, where moderate adverse experiences associate with more robust cortisol responses compared to children with either no adversity or high levels of adversity (Feder et al., 2019). Moreover, some studies in adults likewise suggest that moderate lifetime adversity may have a "steeling effect" (Feder et al., 2019). In addition, Feder et al. (2019) emphasize that a core feature of resilience involves stress responses that are sufficient but not excessive along with rapid and efficient psychobiological recovery following stress. In addition, trait resilience associates with a faster recovery of cardiovascular reactivity after stress (Feder et al. 2019). Kalisch et al. (2024) further suggest that stress inoculation and experiences of mastery and control, often arising in the context of moderate stress exposure, may strengthen what they describe as a general resilience factor. This concept of stress inoculation is closely aligned with the previously described "steeling effect."

1.5.2. Trait Resilience and Cellular Aging

Given that many biological factors involved in stress response systems associate with resilience, it is not surprising that research on telomeres, which are recognized as a potential indicator of cumulative stress exposure, has been increasing. Telomeres are repetitive DNA sequences located at the ends of chromosomes, which serve as protective caps that prevent chromosomal deterioration (Blackburn, 1991). Telomere length naturally shortens as cell division occurs, and once shortened sufficiently, their protective function diminishes and triggers cellular stress (Yu et al., 2024). Through progressive shortening or direct telomere damage, cells eventually enter a state of cellular senescence, where they cease to function optimally (Yu et al., 2024).

This phenomenon is linked to aging and age-related diseases (Yu et al. 2024). Telomere length declines with age and is predictive of mortality (e.g., Cawthon et al., 2003) making it a wide indicator of biological aging. In addition to the effects of aging, shorter telomere length associates with various health conditions, including somatic diseases, psychiatric disorders, and psychosocial stress (Price et al., 2013). Research evidence also suggests an association between ACEs and shorter telomere length (Nelles-McGee et al., 2022; Price et al., 2013; Ridout et al., 2018; Zhou et al., 2023). As it appears ACEs may accelerate cellular aging, this may serve as one mechanism through which the negative effects of ACEs on mental health are conveyed (Klopack et al., 2022). However, findings in this remain heterogeneous with some studies showing no association between telomere length and ACEs (Bürgin et al., 2019; Kuehl et al., 2022; Nelles-McGee et al., 2022).

A few central mechanisms may explain the association between ACEs and telomere shortening. Telomerase, an enzyme that maintains telomere length, plays a central role in regulating telomere dynamics. Elevated cortisol levels are consistently associated with stress, and in turn, with reduced telomerase activity (Ridout et al. 2015). When telomerase activity is reduced, telomeres are not maintained in the same way, which leads to their shortening. Another proposed mechanism involves increased oxidative stress, which is also closely linked to elevated cortisol levels. Animal models support the idea that oxidative stress can shorten telomeres (Ridout et al., 2015). These mechanisms, however, lie beyond the scope of this dissertation and are not examined in greater depth.

The association between trait resilience and telomere length merits further investigation because of the associations between telomere length and ACEs and psychiatric symptoms that all correlate with lower trait resilience. The limited number of studies that have examined the relationship between psychological resilience and telomere length have used varying definitions of resilience. In one study, resilience was operationalized as the sum of various aspects, including optimism, trait positive affect, active coping, and low perceived stress (Johnson et al. 2019). The study found that resilience was associated with longer telomeres (Johnson et al., 2019). In addition, a multifaceted resilience, which encompasses decreased emotional suppression, increased social connectedness, increased physical activity, and improved sleep quality, was found to work as a moderating factor in the relationship between major depressive disorder and telomere length (Puterman & Epel, 2012). Furthermore, Schutte et al. (2016) conducted a study exploring resilience-related characteristics by examining the relationship between positive psychological traits and telomere length. They investigated factors such as trait positive affect, life satisfaction, mindfulness, trait emotional intelligence, self-efficacy, and optimism. The study revealed that these positive dispositional characteristics collectively accounted for variations in telomere length. At the

individual level, higher levels of optimism and emotional intelligence were found to be linked to longer telomeres (Schutte et al., 2016).

Bergquist et al. (2022) showed that business executives, who experience chronic stress, have high trait resilience, as measured with CD-RISC, appeared to protect against the effects of stress on biological aging, as measured by the GrimAge. GrimAge is a so-called epigenetic clock, a model designed to estimate biological age differences among individuals with the same chronological age (Berquist et al. 2022). GrimAge is not directly comparable with telomere length, but both serve as biomarkers of biological aging and are influenced by stress-related processes and make it plausible that trait resilience could also play a protective role in preserving telomere length. Investigating this potential link could provide deeper insights into the mechanisms through which resilience mitigates the biological impact of stress.

Only a few perinatal studies have investigated the associations between telomeres and depression, anxiety symptoms, or ACEs. One recent study identified a correlation between peripartum depression (PPD) and shorter telomeres in pregnant women (Vrettou et al., 2024). Furthermore, this study found that as the number of ACEs increased, individuals presenting with PPD symptoms exhibited shorter telomeres. In contrast, among individuals without PPD symptoms, higher ACE exposure was associated with longer telomeres (Vrettou et al., 2024). As previously mentioned, studies show positive associations between resilience and improved mental health during the perinatal period (Osofsky et al., 2021; Sexton et al., 2015; Vrettou et al., 2024; Young-Wolff et al., 2019). However, based on existing research, the relationship between resilience and telomere length in parents during the perinatal period remains unexplored. Addressing this gap is one of the aims of the present thesis. In this thesis, leukocyte telomere length (LTL) is utilized, as it is a commonly used measure in research due to the accessibility of peripheral blood, which is easier to obtain than most other tissues (Price et al., 2013).

2 Aims of the Study

To the family, the perinatal period and the first years of a child's life are important. Parents encounter many changes and joys as well as challenges. Parental mental health and well-being are directly related to the well-being of the child. Most studies on parental mental health focus on mothers and tend to be symptom and problem oriented. However, fathers have a major impact on the lives of both the child and the mother, and understanding fathers' mental health issues is essential. It is important to consider mental health issues, but this should not be the sole investigative focus. In order to balance this problem-oriented approach, the factors that protect and support mental health must be considered.

Research on resilience has increased significantly in recent decades, but there is still much to be discovered. In particular, the conceptualization of resilience is vague, although there is research progresss. The aim of the current thesis was to explore the concept of trait resilience in parents, particularly its relevance to their mental health from pregnancy to the first five years of their child's life. The associations of trait resilience with depressive and anxiety symptoms, ACEs, and stressful life events were examined. In addition, the associations between a biological marker of aging, i.e., telomere length, and trait resilience as well as ACEs and distress symptoms were investigated. To better understand the nature of trait resilience, the stability of the trait was assessed. Please see Figure 1 of the main associations investigated. Existing research indicates that this is one of the few studies to examine trait resilience in fathers during the perinatal period and during early fatherhood, the first to investigate the association between trait resilience and telomere length, and one of the most comprehensive longitudinal studies to assess the stability of trait resilience.

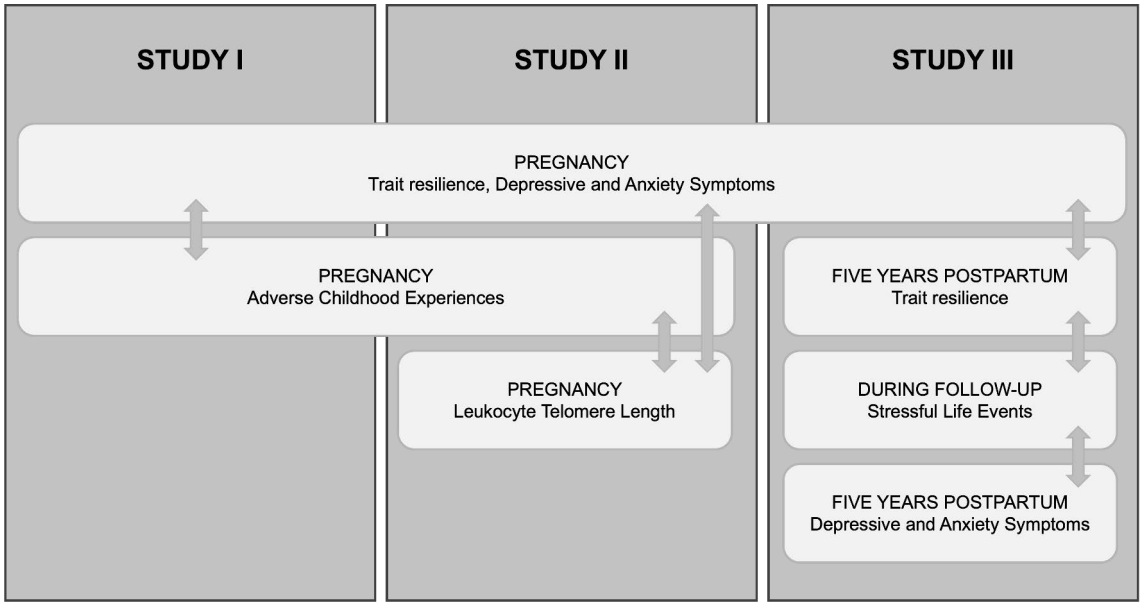

Figure 1. The main variables and associations investigated in Studies I-III.

The specific aims were:

1. To examine the associations between trait resilience, ACEs, and depressive and anxiety symptoms in mothers and fathers and to assess whether trait resilience moderates the associations between ACEs and depressive and anxiety symptoms. (Study I)
2. To investigate whether leukocyte telomere length is associated with trait resilience, ACEs, or depressive and anxiety symptoms in expecting mothers and fathers, and whether it mediates the associations between ACEs and these symptoms. (Study II)
3. To examine the stability of trait resilience during early parenthood over a six-year period and its associations with stressful life events, depressive symptoms, and anxiety symptoms. (Study III)

3 Materials and Methods

3.1 Study Design and Participants

This study is a part of the ongoing FinnBrain Birth Cohort Study (www.finnbrain.fi), which aims to investigate the effects of early life stress, including prenatal distress, on the development of a child's brain and health in a prospective manner. Participants were recruited during their first ultrasound appointment at 12-week gestation (gwk) at three maternal welfare clinics in southwestern Finland between December 2011 and April 2015. The cohort study's inclusion criteria required a sufficient command of either Finnish or Swedish, which are the official languages of Finland as well as a normal ultrasound screening result. After receiving information on the study's aims and procedures, parents provided written consent. Initially 3,808 mothers and 2,623 fathers agreed to participate in the study. The study cohort consisted mainly of ethnically homogeneous white individuals and was broadly representative of the expectant parent population in Southwest Finland (Karlsson et al., 2018).

3.1.1 Study Samples and Attritions

In the present study, questionnaires served as the primary source of data with blood samples used in one of the studies. 3,091 mothers and 2,003 fathers returned the first pregnancy questionnaire at gwk 14, which included the main questionnaire of the present study being the assessment of trait resilience. The measurements will be described in detail later in this section. The sample sizes differed across the three studies due to the varying research questions being investigated. In particular, the sample size of Study II differed from the others due to the inclusion of biological data. Figure 2 represents the flow chart of the sample sizes.

In Study I, the inclusion criteria required participants to have completed both the Connor-Davidson Resilience Scale 10 (CD-RISC-10) and the Trauma Distress Scale (TADS), which were included in the first pregnancy questionnaire at gwk 14. The total sample in the Study included 3,016 mothers and 1,934 fathers. A total of 75 mothers and 69 fathers returned the questionnaire without completing both the CD-RISC-10 and TADS and were therefore excluded from the study. The mean age of

non-responding mothers was nearly a year younger. No significant differences were observed between respondents and non-respondents with respect to education or income. It is noteworthy that most of the excluded mothers and fathers also did not complete the depression and anxiety questionnaires.

In Study II, the sample consisted of parents who had provided a blood sample at gwk 24. In addition to the blood sample, participants were required to complete the CD-RISC-10 at gwk 14. The total sample for Study II included 342 mothers and 339 fathers. An attrition analysis was conducted to compare parents included in the present study with those in the original cohort, examining age, education, income, trait resilience, depressive and anxiety symptoms, and ACEs for both mothers and fathers. Only fathers' depressive and anxiety symptoms showed significant differences. Fathers in the original cohort reported higher depressive symptoms compared to those in the present study. Similarly, fathers' anxiety symptoms were higher in the original cohort than in the present study. However, these differences were minor and not clinically significant.

In Study III, the inclusion criteria required participants to have completed the CD-RISC-10 twice being the first (T1) at gwk 14 and the second time (T2) approximately five years after the birth of their child. A total of 1,388 mothers and 657 fathers completed both questionnaires that formed the study sample for this research. Compared to Study I, 1,682 mothers and 1,277 fathers did not return the 5-year questionnaire and were therefore excluded from Study III. Again, an attrition analysis was conducted to compare the group of participants who responded at both T1 and T2 with the group of participants who responded only at T1. Among mothers, those who did not respond were younger and had lower educational attainment and lower income levels compared to the responding mothers. Furthermore, mothers who did not respond exhibited lower trait resilience and higher levels of depressive symptoms and anxiety symptoms in T1. Among fathers, non-respondents were younger, had lower education levels, and reported higher levels of depressive symptoms. However, these differences in depressive symptoms in both parents and differences in anxiety among mothers were not clinically significant. Despite these differences, due to the high attrition rates observed, which exceeded over 50% for both mothers and fathers, missing data were not imputed. Though the attrition analysis yielded statistically significant discrepancies, these differences were relatively minor when the descriptive statistics were examined.

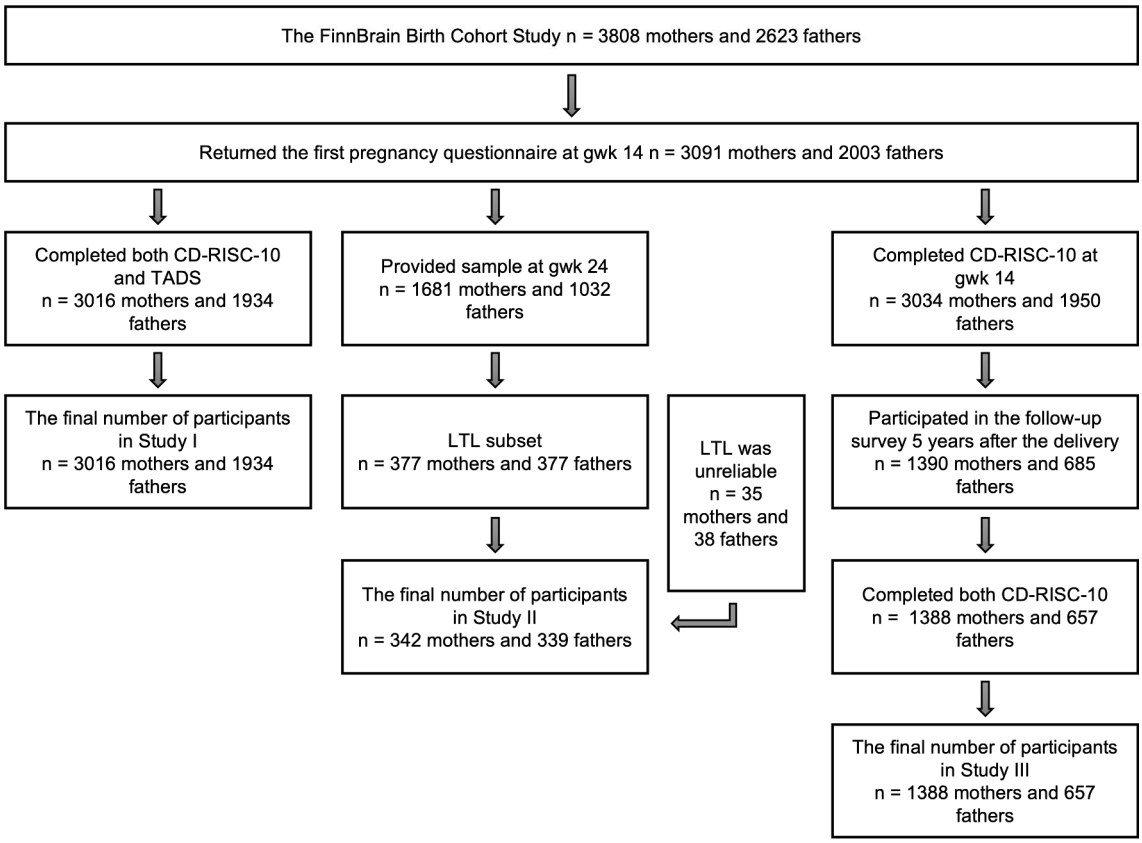

Figure 1. Samples of the Studies I-III.

3.1.2 Participant Characteristics

Table 1 presents the demographic characteristics and key variables of the study sample. On average, mothers were 30 years old, while fathers were 32 years old. Over 60% of mothers and approximately 50% of fathers had completed at least upper-secondary education. Importantly, many participants were also in the process of completing a higher level of education at the time of participation with the most common being the next educational degree. Additionally, 60% of mothers and 80% of fathers reported a net monthly income of at least 1,500 €. For comparison, the median net monthly income for 25- to 34-year-olds in Finland was approximately 2,000 €.

Table 1 displays the mean scores for trait resilience, depressive symptoms, anxiety symptoms, ACEs, stressful life events, and telomere length. The mean trait resilience score was 28 points for mothers and 29 points for fathers during pregnancy. At the follow-up, the trait resilience score increased by approximately one point for mothers reaching 29 points and by slightly less than one point for

fathers reaching 30 points. The depressive and anxiety symptoms were not clinically significant on average, which is to be expected given that the sample consists of the general population.

While the ACE assessment tool (TADS) is presented in detail in the Measures section, importantly, the instrument departs from the conventional categorical (yes/no) assessment of ACEs instead of measuring individual ACEs dimensionally, as degrees of severity, and produces a cumulative score. The overall ACE score in the study sample was relatively moderate. In Salokangas' (2020) dissertation, the reported mean TADS score for the general population sample was 28.47. In contrast, the mean TADS scores in the present study sample were substantially lower at 10.10 for mothers and 9.4 for fathers suggesting that the overall level of ACEs in the sample was considerably lower (Study I). The most common ACEs in the sample were emotional and physical neglect. At least one response other than "never," including options such as "rarely," on the emotional neglect items was given by 79% of mothers and 82% of fathers, and on the physical neglect items by 73% and 80%, respectively. Additionally, emotional abuse was indicated by 56% of mothers and 54% of fathers; physical abuse by 43% and 51%; and sexual abuse by 14% and 4%, respectively (Study I).

Regarding stressful life events (SLEs) during the approximately five-year period after delivery, during the follow-up, 47% of mothers and 60% of fathers reported experiencing none of the listed SLEs. Additionally, 26% of mothers and 23% of fathers reported experiencing one SLE, while 27% of mothers and 17% of fathers reported two or more SLEs. The most reported SLE among parents was a decline in their family's financial situation. Other frequently reported events included unemployment, a serious illness of the child's grandparent, and the death of a child's grandparent.

Table 1. Sample characteristics.

		Mothers			Fathers		
		Study I	**Study II**	**Study III**	**Study I**	**Study II**	**Study III**
N		3016	342	1388	1934	339	657
Age, mean (SD;range)		30.04 (4.5;17–46)	30.4 (4.4; 19-42)	30.9 (4.2; 18-45)	32.1 (5.3; 17–60)	32.4 (5.9; 20–60)	32.5 (5.2; 21–57)
Education (%)	< 12 years	37.8	32.6	28.7	49.2	44.6	34.8
	12-15 years	29.1	31.8	30.2	26.2	29.4	32.2
	15 < years	33.1	35.6	41.1	24.6	26.0	33.1
Net income, €/month (%)	≤ 1500	39.2	36.3	34.7	19.4	20.2	19.3
	1501–2500	51.2	55.1	54.4	55.2	56.6	54.2
	2501–3500	8.1	7.4	9.3	20.6	17.4	22.1
	> 3500	1.5	1.2	1.7	4.7	5.8	4.4
Main variables, score (SD; range)							
Trait resilience (T1)		27.9 (5.1; 4–40)	28.1 (4.6; 15–39)	28.3 (4.9; 5–40)	29.4 (5.1; 9-40)	29.3 (5.1; 12-40)	29.3 (5.2; 10-40)
Trait resilience (T2)		-	-	29.1. (6.0; 0-40)	-	-	29.8 (5.2; 4-40)
Depressive symptoms (T1)		5.1 (3.6; 0-25)	4.9 (3.6; 0-19)	4.8 (3.9; 0-27)	3.6 (3.1; 0-19)	3.2 (2.8; 0-16)	3.5 (3.3; 0-22)
Depressive symptoms (T2)		-	-	5.0 (4.5; 0-26)	-	-	4.1 (4.1; 0-23)
Anxiety symptoms (T1)		3.5 (3.6; 0-28)	3.7 (3.6; 0-20)	3.1 (3.8; 0-33)	2.4 (3.2; 0-32)	2.2 (2.8; 0-15)	2.4 (3.2; 0-22)
Anxiety symptoms (T2)		-	-	4.2 (5.0; 0-37)	-	-	3.0 (3.9; 0-29)
ACEs		10.0 (10.9; 0-86)	10.8 (11.9; 0-86)	-	9.4 (8.7; 0-67)	9.9 (9.2; 0-51)	-
Stressful life events		-	-	1.1 (1.4; 0-9)	-		0.7 (1.1; 0-9)
Telomere length		-	0.85 (0.2;0.45-1.77)	-	-	0.87 (0.2; 0.47-1.72)	-

*Note: Age, education, and income are gathered at measurement point 1 (T1)

3.2 Measures

The study measures were collected over a follow-up period of approximately six years spanning from pregnancy to five years postpartum. Trait resilience was assessed using the Connor-Davidson Resilience Scale 10 (CD-RISC-10), ACEs with the Trauma Distress Scale (TADS), depressive symptoms with the Edinburgh Postnatal Depression Scale (EPDS), and anxiety symptoms with the anxiety subscale of the Symptom Checklist-90 (SCL). Additionally, blood samples were collected at gwk 24 from which telomere length was analyzed. After delivery, data on stressful life events (SLEs) were collected through questionnaires at six months, one year, and at two, four, and five years. The follow-up period concluded five years after delivery, at which point trait resilience, depressive symptoms, and anxiety symptoms were reassessed. Figure 3 illustrates the data collection process. More detailed descriptions of the measures are provided in the following sections.

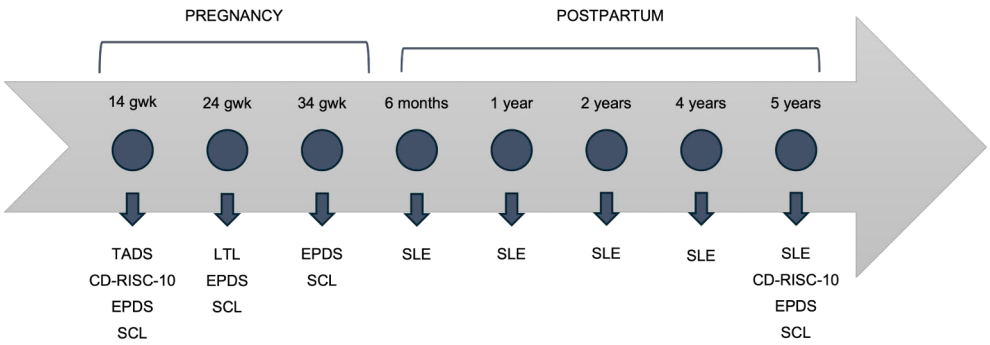

Figure 2. Illustration of the data collection process. TADS = ACEs, CD-RISC-10 = trait resilience, EPDS = depressive symptoms, SCL = anxiety symptoms, LTL = leukocyte telomere length, SLE = stressful life events.

3.2.1 Trait resilience

Resilience was assessed using the CD-RISC-10 (Connor & Davidson, 2003), which is a self-report instrument with broad psychometric properties (Cheng et al., 2020; Connor & Davidson, 2003; Wang et al., 2010). The CD-RISC-10 assesses an individual's perception of their ability to navigate and cope with adversity. It is comprised of 10 items, such as the ability to adapt to change, responses to difficulties, recovery after illness or injury, and persistence in the face of failure. The scale employs a 5-point Likert scale (ranging from 0, "not at all true," to 4, "true almost all of the time") to generate a composite score between 0 and 40, whereby higher scores indicate greater resilience. The internal consistency of the CD-RISC-

10 was strong across all three studies with a Cronbach's alpha ranging from 0.83 to 0.90 for mothers and from 0.85 to 0.88 for fathers.

3.2.2 Psychological Distress

The level of psychological distress experienced by mothers and fathers was assessed using questionnaires measuring symptoms of depression and anxiety. These were administered three times during pregnancy at gwks 14, 24, and 34 with a follow-up assessment given five years postpartum. The distress symptom measures were used differently across the three subset studies. In Studies I and II, a composite score was calculated by averaging the three distress symptom scores from pregnancy. In Study III, only the first pregnancy measure (gwk 14) and the follow-up assessment at five years postpartum were used.

Depressive symptoms were evaluated using the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987), which is a validated tool designed to detect both pre- and antenatal depression (Matijasevich et al., 2015; Rubertsson et al., 2011). Although the EPDS was originally developed to detect depression in mothers during the perinatal period, it is applicable for use with fathers and beyond the immediate postpartum phase (Edmondson et al., 2010; O'Connor et al., 2016). The EPDS does not include pregnancy-specific questions. The scale was developed to include somatic symptoms with traditional depression measures that may be common and normative experiences during the postpartum period and may limit the accuracy of such measures in this context (Cox et al., 1987). The questionnaire comprises 10 questions scored on a 4-point Likert scale (0, 1, 2, or 3) with total scores ranging from 0 to 30. The EPDS demonstrated adequate internal consistency across all studies with a Cronbach's alpha ranging from 0.80 to 0.86 for mothers and from 0.78 to 0.85 for fathers.

Anxiety symptoms were assessed using the Symptom Checklist-90, specifically the anxiety subscale consisting of 10 items (Derogatis et al., 1973), hereafter referred to as SCL. Participants rated these items on a 5-point Likert scale ranging from 0 to 4 points resulting in total scores ranging from 0 to 40 points. The reliability of the subscale has been confirmed in the Finnish population (Holi et al., 1998). Across all three studies, the SCL anxiety subscale demonstrated satisfactory internal consistency with Cronbach's alpha ranging from 0.83 to 0.86 for mothers and from 0.80 to 0.84 for fathers.

3.2.3 Adverse Childhood Experiences (ACEs)

The exposure of parents to ACEs was evaluated using the Trauma Distress Scale (TADS). TADS was developed with the objective of evaluating a range of childhood

trauma and distressing experiences (Salokangas et al., 2016). The questionnaire is designed to elicit retrospective accounts of emotional or physical abuse, sexual abuse, and emotional or physical neglect (Salokangas et al., 2016). TADS comprises 43 items with the frequency of exposure to maltreatment rated on a five-point Likert scale ranging from "never" (0) to "almost always" (4). The questionnaire includes items such as: “When I was young, I felt safe and protected by someone” (reverse scored), “When I was young, I was hit so hard that it left marks, cuts, or bruises,” and “I have experienced the loss of someone who was very important to me.” A complete list of items can be found in the study by Salokangas et al. (2016). TADS was conducted at gwk 14. Its internal consistency was found to be good with Cronbach’s alpha values of 0.92 (Study I) and 0.91 (Study II) for mothers and 0.88 (Study I) and 0.89 (Study II) for fathers.

TADS does not directly measure individual adverse events, as, for instance, one point does not correspond to a single ACE. The TADS scoring method aligns with that of the widely used Childhood Trauma Questionnaire (Bernstein et al., 1994), which also generates a cumulative score.

3.2.4 Stressful Life Events (SLEs)

To assess SLEs, 9 items were selected from a questionnaire of 17 life events, which were administered at five different time points (see Figure 3). The questions were derived from previous studies conducted in Finland (Vahtera et al., 2007), with adaptations made to better fit the specific focus on parents during pregnancy and the early years of parenthood. Certain elements of the questionnaire were modified, and additional questions related to parenthood were included, such as supplementary items on childcare and related factors. In summary, the assessment of SLEs comprises 9 items: death of the child's parents, divorce/separation of the child's parents, serious illness of the child, death of the child's grandparent, residential separation of the child’s parents, parental unemployment, serious illness of the child’s grandparent, and deterioration in the family's financial situation. Data on life events were collected at five different time points with participants responding to whether they had experienced any of the events within the past year (or within the last six months for the 6-month questionnaire). Responses were recorded as either "yes" or "no" for each item at each time point, and a total frequency score was calculated for each participant by summing these responses across the entire follow-up period.

3.2.5 Leukocyte Telomere Length (LTL)

Blood samples were collected at gwk 24. DNA was extracted using Chemagen and Puregene DNA extraction methods. The average relative LTL was measured using a modified singleplex quantitative polymerase chain reaction (qPCR) method adapted from Cawthon, 2002 and 2009. All samples were measured in triplicates, and the average relative LTL was calculated using qBasePlus 2.0 software and expressed as a calibrated normalized relative quantity (CNRQ). PCR efficiency was evaluated with standard curves, and the average efficiencies were 103% for T reactions and 95% for S reactions, with $R^2 > 0.99$ for all standard curves. The intraclass correlation coefficient (ICC) for triplicate T/S ratios was 0.97 with a coefficient of variation (CV) of 5.26%.

3.2.6 Background Factors and Covariates

Background variables, including age, educational level, and monthly net income, were derived from the questionnaires completed at 14 gwks. The participants' educational attainment was classified into three categories in accordance with the Finnish school system. The categories were defined as follows: less than 12 years represents basic education, 12–15 years corresponds to secondary education, and any level of education beyond that is classified as higher education. Monthly net income was divided into four categories for the purpose of facilitating interpretation: <1,500 €, 1,501–2,500 €, 2,501–3,500 €, and over 3,500 €.

In some of the studies, analyses with different covariates were also conducted, and sensitivity investigations were performed. Information on nulliparity and multiparity was obtained from registry data and supplemented with questionnaire data. The questionnaires included an open-ended question about medication use (at gwks 14 and 34) from which data on SSRI medication and corticosteroid use were gathered for this study. Information on parental smoking was similarly derived from registry data and supplemented with questionnaire data collected at gwks 14 and 34.

3.3 Statistical analysis

3.3.1 Study I

The main associations of trait resilience, ACEs, and depressive and anxiety symptoms as well as the moderation analyses were analyzed using linear regression models. All the variables were standardized for the analyses. As the distributions of the response variables, i.e., EPDS and SCL, were skewed and bias-corrected and accelerated bootstrap (BCa) confidence intervals (Efron, 1987) were also calculated

for the regression parameters. BCa confidence intervals were used as they do not assume normality for the residuals. The mother's analyses were also performed separately for nullipara and multipara mothers. In addition, a sensitivity analysis was performed regarding education and income levels. Furthermore, as part of a sensitivity analysis, the analyses were repeated after excluding parents who had taken SSRIs during pregnancy. In the supplementary analyses examining resilience groups and their associations with income and education, ANOVA was employed. Given that the data did not meet the assumptions of normality and homogeneity of variances essential for standard ANOVA, as determined by the Levene's test and normality test, Welch ANOVA was used, and Games–Howell post hoc comparisons were conducted. To address multiple comparisons, the Bonferroni correction was applied to the p-values.

3.3.2 Study II

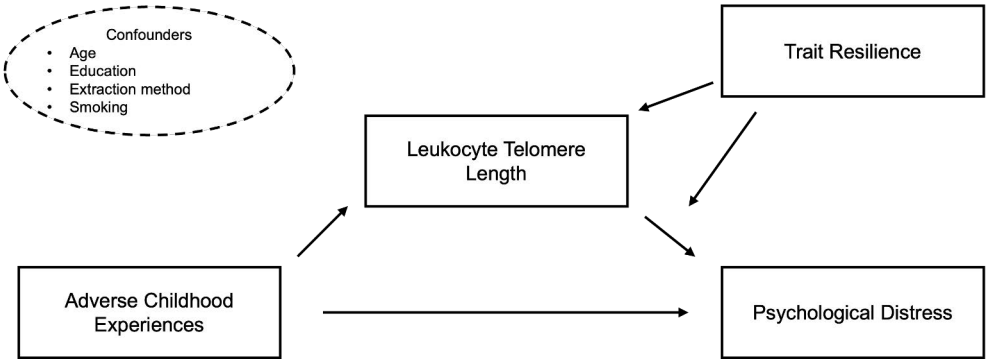

Figure 3. Investigated associations of the main variables and the confounders in the analyses. Adverse Childhood Experiences refer to the TADS score, Psychological Distress refers to either the EPDS or SCL score, and Trait Resilience refers to the CD-RISC-10 score.

Figure 4 presents an overview of the associations investigated. Beta coefficients (b), marginal R2, 95% confidence intervals (CI), and 95% bootstrap confidence intervals (BS CI) were calculated, as the distribution of models' residuals were skewed. BCa confidence intervals (based on 1000 bootstrap samples) were used for standard linear models, while percentile confidence intervals (based on 1000 bootstrap samples) were used for mixed effects models. Mediation analysis was conducted to analyze how LTL mediates the effect of ACEs on parental distress. Missing values were replaced with the available sum scores. Education and smoking were included as control variables, and the DNA extraction method was a random factor in models where LTL was the dependent.

Moderation analysis was conducted to examine the association between resilience and LTL, including education, smoking, and age as covariates, and the DNA extraction method as a random factor. Next, the main effects of LTL and resilience were examined using a linear model. Moderation analysis was formulated by adding the interaction term between LTL and resilience to model M3.

Furthermore, the association between selected covariates (i.e., LTL storage time, maternal body mass index at the beginning of pregnancy, maternal and paternal age at the child's birth, multiparity) and LTL was investigated using a mixed-effects model with the extraction method as a random factor. No associations were found. As a sensitivity analysis, non-linear associations between LTL and age, ACEs, resilience, and distress were examined using a piecewise linear function allowing for breaks at the lower and upper quartiles as well as the median values for each variable. No significant results appeared. Additionally, a sensitivity analysis of participants who did not report taking SSRI or corticosteroid medication at gwk 14 showed qualitatively similar results.

3.3.3 Study III

Correlations between continuous resilience scores were first examined using the paired Wilcoxon signed-rank test. Resilience scores were divided into quarters following a similar approach to previous studies (Davidson, 2021). The quarterly division was based on the distribution of resilience scores at the initial measurement point (T1). Cross-tabulation and the Chi-Square test were used to examine the stability of the categorized resilience scores at two time points. The SLE was divided into three categories, as the distribution was found to be skewed when treated as a continuous variable. First, the main effects of resilience in T1 and SLEs were examined using a linear model that included as covariates education, age, and depressive symptoms. Next moderation analysis was formulated by adding the interaction term between resilience T1 and SLEs to Model 1. As a sensitivity analysis, SCL in T2 was also included in the models. The assumptions of linear models were assessed visually and using the Shapiro-Wilk test. The distribution of model's residuals was skewed so the BCa bootstrap confidence intervals and bias-corrected estimates were also calculated (based on 5000 bootstrap samples).

All analyses were done separately for mothers and fathers. P-values (two-tailed) smaller than 0.05 were statistically significant. The beta coefficients (b) and 95% confidence intervals (CI) and partial Eta Squared ($\eta 2$) were calculated. In addition, the bootstrap confidence intervals (BCa CI) and bias-corrected estimates (bBC) were calculated where necessary. Finally, to provide an overview of the data, gender differences between mothers and fathers were examined using independent samples

t-tests. Welch's correction was applied when the assumption of homogeneity of variances was not met.

3.3.4 Software Information

STUDY I: The data analyses were performed with SPSS Statistics version 27 and with R 4.0.5 (R Core Team, 2021). The missing values in the TADS items were imputed using missForest.

STUDY II: Regression analyses were performed using R (4.2.2, 2022), libraries boot, lme4, and ggplot2 were used.

STUDY III: The analyses were performed using R (4.2.2, 2022). Bootstrap was calculated using the library boot and figures were made using the libraries ggplot2, ggeffects, and ggalluvial.

3.4 Ethical Considerations

The study protocols of the FinnBrain Birth Cohort Study an all its sub-studies have been approved by the Ethics Committee of the Hospital District of Southwest Finland. The study was conducted in full compliance with the Helsinki Declaration. After receiving information on the study's aims and procedures, the participating parents provided written consent.

4 Results

4.1 The Associations of Trait Resilience and Psychological Distress Symptoms

Higher trait resilience was consistently and systematically associated with lower levels of depressive and anxiety symptoms, while lower trait resilience was associated with higher symptom levels in both mothers and fathers (Studies I, II, III). Higher trait resilience assessed during pregnancy predicted lower levels of depressive and anxiety symptoms six years later (Study III). This association remained significant for mothers even after controlling for depressive and anxiety symptoms during pregnancy but did not remain significant for fathers.

4.1.1 The Associations with ACEs

As expected, depressive and anxiety symptoms were positively associated with ACEs (Study I & II). The models incorporating trait resilience and ACEs accounted for approximately 23% of the variance in depressive symptoms among mothers and 26% among fathers (Study I). For anxiety symptoms, the explained variance was 19% in mothers and 20% in fathers.

In examining the interaction effects of trait resilience, distinct patterns emerged (Study I). Among mothers, the association between ACEs and depressive symptoms was not influenced by trait resilience. In fathers, however, a significant interaction was identified being that the association between ACEs and depressive symptoms was stronger in less resilient fathers than in their more resilient counterparts. For anxiety, the results indicated that among mothers, the association between ACEs and anxiety was weaker in those with higher resilience compared to those with lower resilience, but the effect size was close to zero despite its statistical significance. In fathers, the ACE-anxiety association was stronger in less resilient fathers than in more resilient ones. These associations are illustrated in Figure 5, and the results of the regression analyses are presented in Table 2.

Although no clear moderation effect was found in mothers, meaning that a "buffering effect" of trait resilience could not be identified, a protective effect of trait resilience can still be observed. This means that, despite the number of ACEs, trait

resilience appears to protect mental health as reflected in lower levels of depressive and anxiety symptoms as shown in Figure 5.

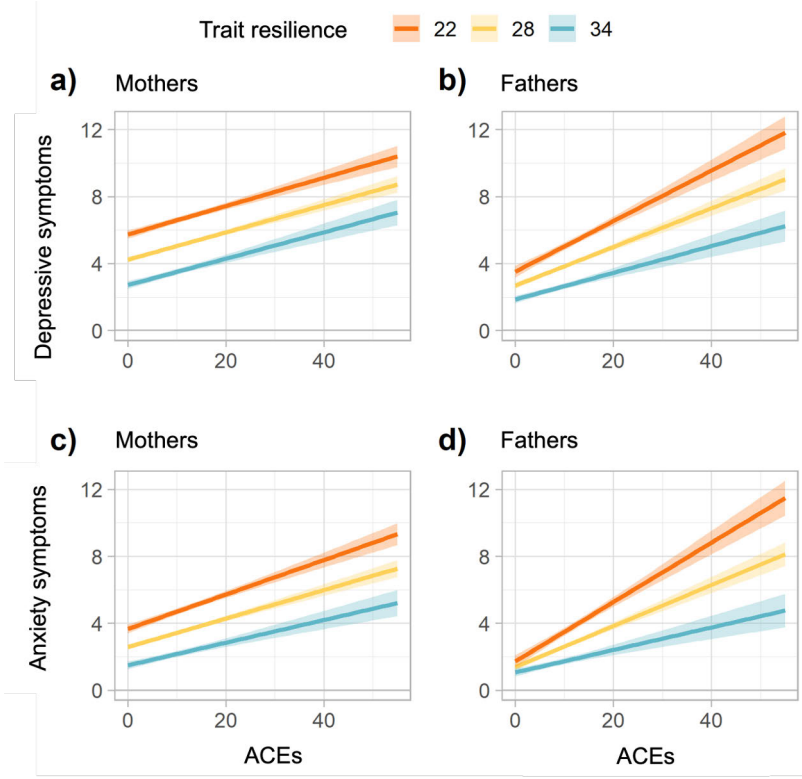

Figure 5. Estimated associations between ACEs, depressive, and anxiety symptoms in mothers and fathers based on interaction models with non-standardized variables. The associations are illustrated at three trait resilience levels: 22 (low), 28 (mid), and 34 (high) representing the 10%, 50%, and 90% quantiles, respectively. These specific values were selected for visualization. Shaded areas indicate pointwise 95% confidence intervals.

Table 2. The results of the regression models. All variables were standardized in the analyses.

Mothers, EPDS					
	b	95% CI	95% BCa CI	p value	η2
Intercept	0.00	[-0.03; 0.03]	[-0.03; 0.03]	.936	
ACE	0.25	[0.22; 0.28]	[0.21; 0.29]	< .001	0.059
Resilience	-0.36	[-0.40; -0.33]	[-0.40; -0.33]	< .001	0.127
ACE x Resilience	-0.01	[-0.04; 0.02]	[-0.05; 0.04]	.599	< .001
R^2 = 0.226					
Adjusted R^2 = 0.225					
Fathers, EPDS					
	b	95% CI	95% BCa CI	p value	η2
Intercept	-0.02	[-0.06; 0.02]	[-0.06; 0.02]	.342	
ACE	0.30	[0.26; 0.34]	[0.25; 0.34]	< .001	.083
Resilience	-0.32	[-0.36; -0.28]	[-0.36; -0.28]	< .001	.096
ACE x Resilience	-0.08	[-0.12; -0.05]	[-0.12; -0.04]	< .001	.008
R^2 = 0.258					
Adjusted R^2 = 0.257					
Mothers, SCL					
	b	95% CI	95% BCa CI	p value	η2
Intercept	-0.01	[-0.04; 0.02	[-0.04; 0.02]	.646	
ACE	0.26	[0.23; 0.29]	[0.22; 0.30]	< .001	.064
Resilience	-0.3	[-0.33; -0.26]	[-0.34; -0.26]	< .001	.085
ACE x Resilience	-0.04	[-0.07; -0.02]	[-0.09; -0.01]	.003	.002
R^2 = 0.191					
Adjusted R^2 = 0.19					
Fathers, SCL					
	b	95% CI	95% BCa CI	p value	η2
Intercept	-0.03	[-0.07; 0.01]	[-0.07; 0.01]	.173	
ACE	0.29	[0.25; 0.33]	[0.25; 0.35]	< .001	.08
Resilience	-0.22	[-0.27; -0.18]	[-0.27; -0.18]	< .001	.047
ACE x Resilience	-0.13	[-0.16; -0.09]	[-0.18; -0.07]	< .001	.018
R^2 = 0.203					
Adjusted R^2 = 0.202					

4.1.2 Differences in Trait Resilience Groups

Although the CD-RISC manual (Davidson, 2021) provides mean and median values for trait resilience across different countries, no universal cut-off points exist to define strong or weak resilience. To better interpret the results within the study population, resilience was analyzed across quartiles (Study I & III) following an approach used in trait resilience research (Davidson, 2021).

Depressive symptoms varied significantly among all resilience groups in both parents. Among mothers, all resilience groups differed in anxiety symptoms, whereas among fathers, only those in the lowest resilience group differed from the others. For ACEs, significant differences were found in most resilience group

comparisons among mothers except between the two highest resilience groups, whereas among fathers, only the lowest resilience group differed significantly from the others. Table 3 presents the distribution of resilience groups, along with means and standard deviations for trait resilience, depressive and anxiety symptoms, and ACEs.

Table 3. Participants' CD-RISC-10 score distribution in quartiles and means of distress symptoms and ACEs in different resilience groups (Q1 = quartile 1, Q2 = quartile 2, Q3 = quartile 3 and Q4 = quartile 4).

Mothers, M (SD)					
	N (%)	Trait resilience	Depressive symptoms	Anxiety symptoms	ACEs
Q1	850 (28)	21.86 (3.31)	6.89 (3.86)	5.13 (4.36)	12.60 (11.48)
Q2	772 (26)	28.02 (0.83)	5.27 (3.29)	3.51 (3.35)	10.28 (10.93)
Q3	682 (23)	29.90 (0.78)	4.22 (3.14)	2.74 (2.86)	8.11 (9.42)
Q4	712 (24)	34.34 (2.22)	3.47 (2.89)	2.15 (2.60)	8.61 (10.89)
Total	3016 (100)	27.94 (5.07)	5.06 (3.59)	3.47 (3.60)	10.05 (10.90)
Fathers, M (SD)					
	N (%)	Trait resilience	Depressive symptoms	Anxiety symptoms	ACEs
Q1	498 (26)	22.74 (3.11)	5.30 (3.63)	3.83 (4.37)	12.23 (9.05)
Q2	472 (24)	28.11 (0.84)	3.60 (2.78)	2.41 (2.78)	9.67 (8.43)
Q3	543 (28)	31.30 (1.14)	2.99 (2.62)	1.95 (2.61)	8.29 (8.14)
Q4	421 (22)	36.06 (1.86)	2.21 (2.39)	1.49 (2.21)	7.35 (8.07)
Total	1934 (100)	29.36 (5.13)	3.57 (3.12)	2.45 (3.24)	9.44 (8.63)

4.1.3 The Associations with Stressful Life Events

A greater number of SLEs was associated with higher levels of depressive and anxiety symptoms (Study III). In mothers, even the presence of one SLE was associated with an increased prevalence of depressive and anxiety symptoms, whereas among fathers, only the presence of two or more SLEs increased symptoms (Table 4).

Furthermore, whether trait resilience could moderate the negative impact of SLEs on mental health by providing a buffering effect was tested. However, contrary to this, resilience did not moderate the relationship between SLEs and distress symptoms. In other words, the effect of trait resilience on depressive and anxiety symptoms remained consistent and appeared to provide an equal positive impact regardless of whether a person had experienced or had not experienced SLEs. Figure 6 presents the associations between SLEs, trait resilience, and depressive and anxiety

symptoms. For illustrative purposes, SLEs are categorized into three groups: 0 events, 1 event, or 2 or more events.

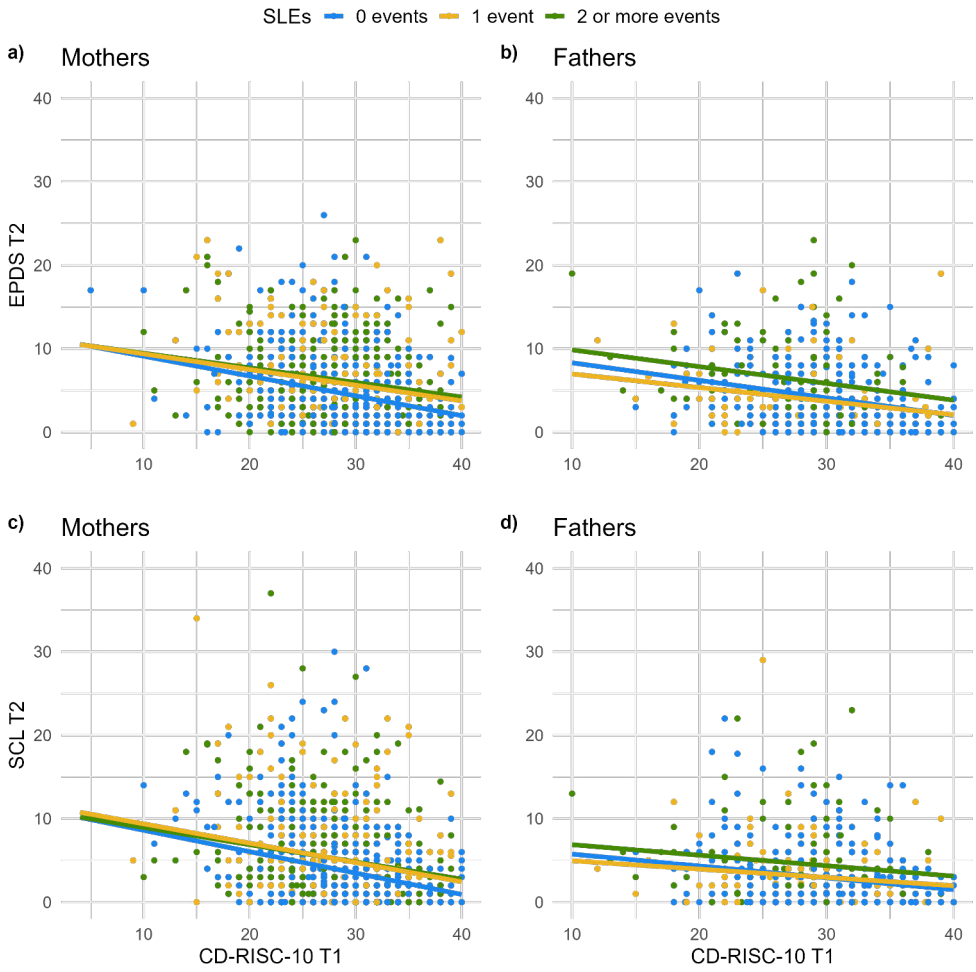

Figure 6. Associations between trait resilience (CD-RISC-10) at time point 1 (T1), the stressful life events (SLEs) score accumulated over the entire follow-up period, and depressive symptoms (EPDS and anxiety symptoms (SCL) at the end of the follow-up period (time point 2, T2)) in mothers and fathers based on the interaction models.

4.2 Stability of Trait Resilience

The stability of trait resilience was investigated using multiple approaches (Study III). The mean trait resilience score increased slightly but statistically significantly over the six-year follow-up period from 28.3 to 29.3 in mothers and from 29.1 to 29.8 in fathers. Correlational analyses revealed moderate to strong positive

associations between trait resilience in T1 and T2 for mothers (rs = 0.54) and fathers (rs = 0.63).

When examined by quartile, individuals exhibited more variability than stability in resilience: 43% of all mothers (N = 597) and 47% of all fathers (N = 306) remained in the same quartile. However, quartile-specific analyses revealed disparities between categories: in the highest quartile (Q4), 66% of mothers and 64% of fathers remained; while in the lowest quartile (Q1), 50% of mothers and 56% of fathers remained. In contrast, in the middle quartiles, the remaining percentages were 27% in Q2 and 28% in Q3 for mothers and 28% in Q2 and 40% in Q3 for fathers. Overall, the highest and lowest resilience groups demonstrated greater stability compared to the middle categories. The stability percentages for each quartile are presented in Figure 6.

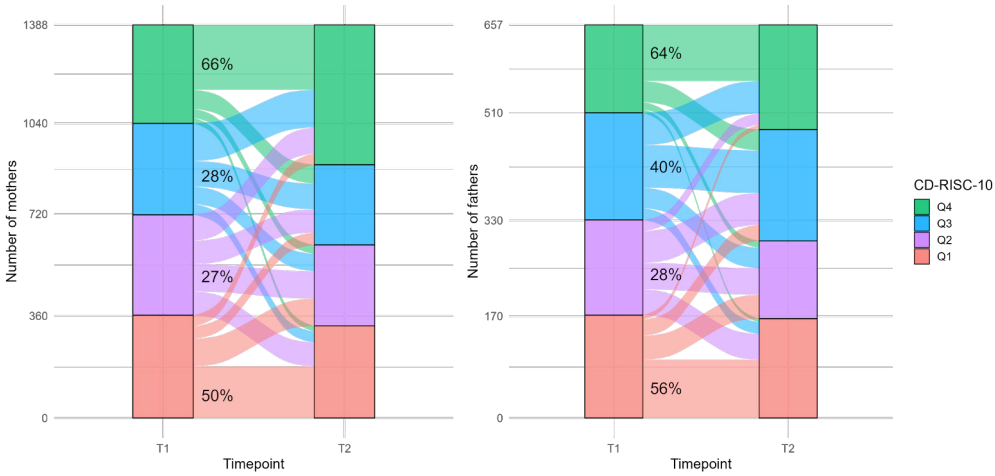

Figure 7. The stability percentages for trait resilience are presented by quarter with Q1 indicating the lowest and Q4 indicating the highest. The percentages represent the number of individuals who remained in the same quarter at the six-year follow-up point.

Linear regression analysis revealed a significant association between T1 and T2 trait resilience scores for both mothers and fathers with adjusting for depressive and anxiety symptoms, education, and age. Trait resilience during pregnancy accounted for approximately 26% of the variance in trait resilience six years later among mothers, whereas the predictive value was even higher among fathers at 37%. The results of the regression analyses are presented in Table 4.

Table 4 The regression models of trait resilience during pregnancy and trait resilience six years after with an interaction analysis of stressful life events.

	MOTHERS				FATHERS			
	b	95% CI	p-value	η^2	b	95% CI	p-value	η^2
Main effects:								
(Intercept)	15.02	12.80;17.24	<.001		14.83	12.09;17.56	<.001	
Resilience T1	0.55	0.50;0.60	<.001	0.255	0.62	0.55;0.68	<.001	0.372
SLEs (1 event)[a]	-0.09	-0.67;0.50	.768	0.001	-0.18	-0.93;0.58	.648	0.001
SLEs (≥ 2 events)[a]	0.46	-0.11;1.04	.115		0.12	-0.74;0.98	.785	
Education (mid)[b]	0.01	-0.62;0.64	.974	0.001	0.11	-0.64;0.87	.766	<0.001
Education (high)[b]	-0.34	-0.94;0.27	.275		-0.01	-0.77;0.74	.973	
Age	0.04	-0.02;0.10	.189	0.001	-0.04	-0.10;0.02	.225	0.002
EPDS T2	-0.53	-0.58; -0.47	<.001	0.207	-0.46	-0.54; -0.38	<.001	0.164
Moderation:								
Resilience T1 x SLEs (1 event)[a]	0.01	-0.11;0.13	.897	<0.001	-0.01	-0.16;0.14	.893	<0.001
Resilience T1 x SLEs (≥ 2 events)[a]	-0.04	-0.15;0.08	.508		-0.01	-0.16;0.14	.877	

* [a]The reference level is 0 events. [b]The reference level is low. The table only displays estimates for the interaction term in the moderation analysis. The moderation analysis included the same variables as the main effects model.

4.3 Trait Resilience and Leukocyte Telomere Length (LTL)

The associations of LTL with depressive and anxiety symptoms and ACEs were investigated using linear regression analyses (Study II). Interestingly, no association was found between LTL and distress symptoms. Similarly, no significant association was found between LTL and ACEs. As predicted, ACEs and distress symptoms did correlate. One of our initial hypotheses assumed that LTL could mediate the negative effect of ACEs into distress symptoms, however, as LTL was not found to be associated with depressive or anxiety symptoms, this association could not exist. The ACE subscales were explored comparing individuals with one or more ACEs to those with no ACEs within each subscale. One significant finding emerged among mothers being that those who reported one score of emotional neglect had longer telomeres compared to those with no emotional neglect experience. However, this association did not persist when emotional neglect was treated as a continuous variable.

A mixed-effects model was used to examine whether trait resilience was associated with LTL. Specifically, it was investigated whether there was a main association and whether trait resilience moderates the relationship between LTL and symptoms of depression or anxiety. None of these associations were confirmed, and no significant main effects or moderating influences were found.

5 Discussion

This dissertation's purpose was to deepen the understanding of trait resilience in the context of parental mental health. Specifically, this work was motivated by questions such as whether trait resilience plays a role in relation to parents' psychological distress, and whether it is a characteristic worth identifying and fostering during this life stage. More broadly, this work explored how trait resilience manifests over time, how stable it is, and how it relates to telomere length associated with psychological distress.

5.1 Trait Resilience and Parents' Mental Health

Higher trait resilience was systematically associated with lower depressive and anxiety symptoms, while lower trait resilience was linked to greater symptom severity. This finding aligns with previous research showing that lower trait resilience is associated with depression and anxiety (Hu et al., 2015; Watters et al., 2023). Overall, although the associations between trait resilience and distress symptoms were evident, depressive and anxiety symptom levels varied across the different trait resilience groups. When examined by quartiles, all group comparisons for depressive symptoms differed significantly in both mothers and fathers. For anxiety, the same pattern was observed in mothers, whereas in fathers, only those with the lowest trait resilience exhibited significantly higher anxiety symptoms. This may suggest that among fathers, those with very low trait resilience are particularly vulnerable to anxiety symptoms. This observation is in line with the observed interaction effect between ACEs and trait resilience on depressive and anxiety symptoms in fathers.

The moderating effect of trait resilience aligns with existing research, although this effect has been primarily studied in relation to depressive symptoms (Sexton et al., 2015; Wingo et al., 2010; Youssef et al., 2017). However, the absence of a moderating effect among mothers contradicts previous research. One possible explanation for this could be the relatively small number of individuals in the study sample with a high burden of ACEs. Although, the differences in ACE exposure between mothers and fathers were not substantial. Additionally, prior studies have focused on more severe distress symptoms, such as major depressive disorder,

whereas the present sample had mild symptoms overall. However, the presence of a moderating effect among fathers challenges this explanation, as symptom levels did not significantly differ between mothers and fathers.

Despite the absence of a moderating effect in mothers, the protective role of resilience in mitigating distress symptoms among parents was still evident even in the context of ACEs. In other words, regardless of ACE exposure, higher trait resilience was associated with lower levels of depressive and anxiety symptoms. Interestingly, trait resilience predicted depressive and anxiety symptoms even after six years. Among mothers, the association remained even after the baseline distress symptoms were controlled, which is particularly interesting because prior distress symptoms are known to be one of the strongest predictors for future distress symptoms (Jokela et al., 2011; Joshanloo, 2023).

SLEs were primarily investigated in the context of assessing the stability of trait resilience, but their associations with trait resilience as well as depressive and anxiety symptoms were also explored. For mothers, even a single SLE was associated with higher depressive and anxiety symptoms, whereas for fathers, this association was observed with two or more SLEs. Trait resilience may moderate this association, as suggested by previous findings (Hjemdal et al. 2006; Sheerin et al. 2008). However, this was not confirmed in this study. Instead, the positive impact of trait resilience on distress symptoms remained consistent, regardless of whether an individual had experienced stressful life events or not. Previous studies differed from this study particularly in the conceptualization of resilience and in examining more severe mental health problems. The buffering effect of trait resilience may be more pronounced in populations with more severe symptoms or a higher number of stressful life events. Furthermore, the present study differs from the two aforementioned studies due to its focus on parents of young children. This raises the question of whether parenting-related stressors or protective factors may have influenced the findings. Indeed, research suggests that trait resilience can help guard against parental burnout (Sorkkila & Aunola, 2022). The pronounced role of trait resilience as a protective factor throughout early parenthood may hide the more nuanced interaction effects.

In any case, in this study, the fact that trait resilience did not appear to provide any additional protection in the context of SLEs, although the SLEs themselves increased distress symptoms, raises questions about the nature of trait resilience. In resilience research, as a response to this type of adversity, resilience is manifested. Could it be that trait resilience, as measured by the CD-RISC-10, captures something that remains stable and exerts an influence both in the face of major difficulties and in more everyday challenges? Figure 8 summarizes the key findings on the associations between trait resilience and mental health.

Key Findings on Trait Resilience and Mental Health In Mothers and Fathers

- Higher trait resilience → Lower depressive and anxiety symptoms in both parents
- Lower trait resilience → Higher depressive and anxiety symptoms in both parents
- In fathers, trait resilience moderated the associations between ACEs and depressive and anxiety symptoms, providing additional support in the context of higher ACE exposure.
- Trait resilience was a stronger predictor of mental health than ACEs.
- Trait resilience did not moderate the associations between distress symptoms and stressful life events.

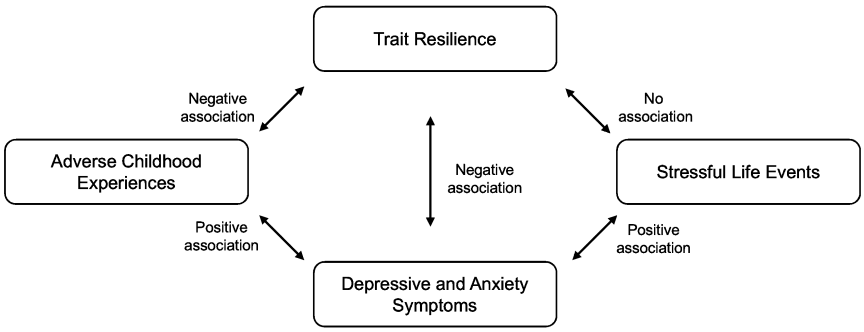

Figure 8. A summary of the key findings on trait resilience, depressive and anxiety symptoms (also referred to as distress symptoms), ACEs, and stressful life events. The diagram illustrates the main associations identified in the study.

5.2 Stability of Trait Resilience

One of the main aims of this thesis was to gain a deeper understanding of the nature of trait resilience, particularly its stability over time. Notwithstanding the changes, challenges, and potential adversities of early parenthood, parents' trait resilience demonstrated a certain degree of stability over time and across various life events. The correlation of trait resilience between the two time points was moderate for mothers and fathers, which is comparable to previous studies (Ríos-Risquez et al., 2018; Wang et al., 2022) and can be considered moderate to relatively strong correlations in behavioral sciences. Trait resilience during pregnancy predicted one-fourth of mothers' trait resilience six years later. For fathers, this proportion was higher exceeding one-third of their trait resilience over the follow-up period. Considering the long follow-up period and the use of a single predictor, these findings reflect temporal stability.

The stability of trait resilience was pronounced among parents with the lowest or highest levels of trait resilience, as a larger proportion of them demonstrated consistent resilience levels at the six-year follow-up. Notably, this pattern was not limited to a narrowly defined subgroup, such as the lowest or highest five

percentiles, but emerged in the lowest and highest quartiles and together represented half of the entire study population. In contrast, the middle groups exhibited greater variability with resilience levels fluctuating over time rather than remaining at consistent levels. This suggests that moderate levels of trait resilience may be more susceptible to external influences or individual life circumstances over the six-year period. These findings raise the question of whether certain thresholds or underlying factors help sustain trait resilience at its lowest and highest levels and potentially reinforce its stability over time. This pattern may also reflect the interactional continuity previously discussed in relation to the Kauai Longitudinal Study (Werner, 1993). Figure 9 provides an overview of the key findings on the stability of trait resilience.

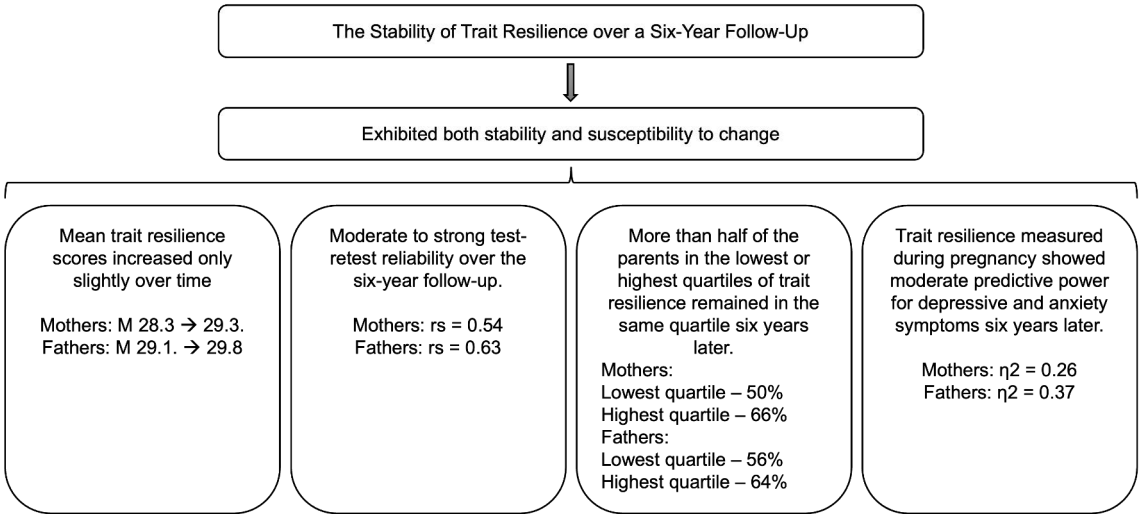

Figure 9. An overview of the findings on the stability of trait resilience.

The finding that SLEs did not moderate the association between trait resilience during pregnancy and six years later contrasts with the initial hypothesis that these events might weaken the association, but it reinforces the notion of trait resilience as a stable characteristic. Furthermore, the observation that SLEs were associated with distress symptoms but not with trait resilience further reinforces the lasting nature of trait resilience. In addition, the follow-up period in this study had pregnancy and early parenthood, which are phases marked by significant changes and challenges that demand active adaptation from parents. Finnish parents experience relatively high levels of burnout (Roskam et al., 2021), which is likely reflected to some extent in the depressive and anxiety symptoms assessed in this study. Nevertheless, this critical period underscores the significance of the

observed stability in trait resilience, despite the natural transitions and potential stressful life events encountered during this time.

5.3 Trait Resilience and Cellular Aging

Because of past studies linking resilience with several stress-related factors (Feder et al., 2019), this study aimed to investigate one biological marker associated with cumulative stress being telomere length. Previous research demonstrates associations between shorter telomere length and ACEs, psychiatric disorders, and psychosocial stress (Darrow et al., 2016; Price et al., 2013). As described in this thesis, these factors are also closely associated with trait resilience. Furthermore, a couple of previous studies show an association between shorter telomere length with lower resilience (Johnson et al., 2019; Puterman et al., 2013), and one study demonstrates a relation between trait resilience and epigenetic aging (Bergquist et al., 2022).

Interestingly, no associations were found between telomere length and depressive or anxiety symptoms. Moreover, no connection was found between ACEs and telomere length. The discrepancy between the present findings and those of previous studies may be explained by several factors. First, pregnancy and the associated hormonal changes may influence telomere length, although the relationship is not straightforward (Houminer-Klepar et al., 2023; Kresovich et al., 2018). This potential effect was addressed by conducting separate analyses for fathers, in whom, such hormonal changes are not expected. In addition, many technical and methodological factors may have affected the results and the extent to which they can be compared across studies. For example, the quantitative polymerase chain reaction (qPCR) method used in the present study can have variability from various sources, particularly related to preanalytical factors (Lin et al., 2019). One such key factor is the choice of a reference gene, which can significantly influence the results and should be taken into account when comparing findings across studies that have also used the qPCR method (Lin et al., 2019; Yu et al., 2024).

Lastly, differences in sample characteristics may also contribute to inconsistencies across studies. Previous studies focus on populations with more severe symptoms and clinical disorders, whereas the present sample had relatively low frequencies of ACEs and mild levels of depression and anxiety. This may partially explain the lack of observed association, as evidence suggests that the cumulative impact of ACEs may play a role in shorter telomere length (Zhou et al., 2023). Although there is convincing evidence linking psychological symptoms, ACEs, and shorter telomeres, conflicting findings, like those of the present study, also exist. A recent study examining telomere length in individuals with and without

major depression and ACEs found no associations (Kuehl et al., 2022). One potential explanation for the null findings was the relatively good physical health of their participants (Kuehl et al., 2022).

Furthermore, this study did not find any significant association between trait resilience and telomere length. Trait resilience could moderate the relationship between telomere length and distress symptoms, but this was not confirmed. Existing research on resilience and telomeres has focused on older populations compared to this study, which may affect the results. Additionally, the operationalization of resilience in those studies has differed from trait resilience (Johnson et al., 2019; Puterman et al., 2013). These factors may partly explain the contrasting findings.

While it has been proposed that the adverse effects of ACEs might be mediated by shortened telomere length (Klopack et al., 2022; Li et al., 2017), this was not supported in the present study. This outcome could suggest that adverse experiences encountered during childhood do not necessarily lead to telomere shortening. In fact, other factors, such as poorer health behaviors, may contribute to telomere attrition (Lin et al., 2012; Shalev et al., 2013). ACEs associate with alcohol use, smoking, poor diet, and obesity (Campbell et al., 2016; Gavrieli et al., 2015; Patten et al., 2016; Windle et al., 2018; Wiss & Brewerton, 2020), which may mediate the effect of ACEs on telomeres. In the present study, the participants represented a population with good socioeconomic status, which can facilitate healthier behaviors and even reduce chronic stress, potentially partly explaining the contrasting findings compared to previous studies. Although no significant associations with telomere length were identified, the effects of trait resilience might be more pronounced in populations with higher levels of distress or a greater burden of ACEs.

5.4 Gender Differences

Although the present study did not aim to explore gender differences, some of the findings related to these research questions are original. Moreover, research on these topics remains inconsistent, and studies focusing on fathers are scarce. For these reasons, the analyses were conducted, and the results were presented separately for mothers and fathers without directly focusing on or systematically testing differences between the two groups. A brief summary is provided of the main observed differences.

On average, mothers exhibited slightly lower resilience than fathers. Furthermore, they reported higher levels of depressive and anxiety symptoms as well as more experiences of SLEs. Among mothers, even one SLE was associated with heightened psychological distress, whereas among fathers, this association emerged only with two or more SLEs. Additionally, among fathers, trait resilience moderated

the relationship between ACEs and distress symptoms, a pattern that was not observed in mothers. Furthermore, among mothers, trait resilience during pregnancy predicted approximately 25% of the variance in trait resilience six years later, whereas among fathers, the proportion was 37%.

In summary, while the overall trends in trait resilience were largely similar for mothers and fathers, the results suggest that the role and relevance of trait resilience may differ between the groups. Trait resilience was associated with lower psychological distress in both mothers and fathers. However, among fathers, this association was moderated by childhood adversity such that the protective effect of trait resilience was stronger at higher levels of ACEs. Among mothers, the association was more consistent across different levels of ACEs.

In addition, trait resilience measured during pregnancy accounted for a greater proportion of the variance in resilience six years later among fathers compared to mothers. This may suggest greater temporal stability of resilience in men. This could reflect structural differences in personality stability, differential exposure to change-inducing life circumstances, or a lower susceptibility of fathers' resilience to contextual factors. In contrast, the comparatively lower predictability among mothers may imply greater plasticity or responsiveness of trait resilience in the face of changing life demands, such as caregiving and role transitions. However, as previously noted, this issue was not explored in depth in the current thesis and warrants further investigation in future studies.

5.5 Strengths and Limitations

Given the multifaceted nature of resilience and the challenges posed by its diverse definitions in resilience research field, the present study takes a structured approach to operationalizing trait resilience. It employs a validated instrument to measure this construct and situates it within a broader resilience framework that facilitate comparisons with other related studies.

While resilience research has expanded and evolved considerably, longitudinal studies on trait resilience remain scarce. The present study, in its detail, is among the first to examine trait resilience over an extended follow-up period. Furthermore, it provides novel insights into the associations between trait resilience and mental health, particularly in fathers, which is an area that has received limited attention in previous research.

Psychological distress symptoms were assessed using two validated instruments allowing for a detailed examination of distress beyond single-factor measures, such as depression or anxiety alone. Moreover, this study is based on an original and extensive sample that includes both mothers and fathers. By incorporating a diverse participant group and employing broad methodological

approaches, this study offers valuable new perspectives on the role of trait resilience in mental well-being.

This study also has certain limitations that should be considered. The reliance on self-reported data introduces the possibility of bias, which may affect the accuracy and reliability of the results. For example, participants might overestimate or underestimate their trait resilience, underreport psychological distress, or experience shifts in how they interpret the survey questions over time. Notably, future research would greatly benefit from exploring the relationship between trait resilience and outcome-operationalized resilience, as this could provide a comprehensive understanding of resilience and trait resilience.

The instrument used to assess SLEs was not formally validated. However, since the focus was on reporting events, including relatively recent ones, rather than, for example, individual traits or symptoms, this was not considered a significant concern. Nonetheless, a more detailed examination of the specific effects of different types of stressful life events on both trait resilience and psychological distress could offer valuable insights, as different types of events may vary in their impact. Considering ACEs, ACEs examined in this study do not cover all possible adverse childhood experiences. In addition to physical and emotional neglect and abuse, and sexual abuse, household dysfunction is also considered an ACE. This includes substance abuse or mental illness in the household, intimate partner violence, or the incarceration of a family member (Felitti et al., 1998). Yet, the TADS used in this study is a valid and reliable instrument for assessing childhood traumatization (Salokangas et al., 2016).

Furthermore, the study population exhibited mild symptom severity overall, which may influence both the results and their generalizability. For instance, the role of trait resilience may function differently in populations with more severe symptoms. Additionally, the limited representation of parents with high levels of ACEs or SLEs restricts the generalizability of the findings to populations with greater exposure to these factors. The low prevalence of such cases may also have affected the results, in particular, the absence of moderation effects.

The homogeneity of the sample, being predominantly white, limits the generalizability of the findings to more diverse populations. For instance, access to resources for managing stressful life events or psychological distress as well as opportunities for enhancing resilience may vary for some populations. Additionally, the sample's socioeconomic status, which was on average relatively high, may further impact generalizability. Socioeconomic factors can influence both exposure to stressors and access to resilience-building resources potentially shaping the associations observed in this study. These considerations are important when interpreting the average levels of the variables and the overall findings. Future research should be conducted in more diverse populations that consider both

ethnic backgrounds and socioeconomic statuses. Employing a more heterogeneous samples would improve the generalizability and applicability of the findings.

6 Conclusion and Clinical Implications

This dissertation examined the role and nature of trait resilience in mental health of parents during pregnancy and the early years of parenthood. Across studies, trait resilience has emerged as a meaningful individual characteristic and was associated with lower levels of depressive and anxiety symptoms.

The results of this dissertation support the well-established association between ACEs and increased levels of psychological distress. In addition, stressful life events encountered during early parenthood were associated with higher distress levels. Regardless of exposure to ACEs or recent stressors, trait resilience provided protection and was associated with lower psychological distress. Among fathers, trait resilience even appeared to offer additional protection in the context of a higher number of ACEs. These findings underscore the importance of identifying parents with such adverse experiences, and, particularly, when combined with low levels of trait resilience, as a potentially vulnerable group.

An unexpected finding was that trait resilience predicted mothers' depressive symptoms even six years later despite accounting for baseline levels of depression and anxiety. This is a noteworthy finding considering the strong association typically observed between baseline and later symptom levels. This finding highlight the potential significance of trait resilience in the prevention of psychological distress among mothers.

Another unexpected finding was that telomere length was not associated with any of the variables examined including trait resilience. Previous studies show consistent associations between shorter telomeres and both ACEs and mental health problems, such as depression. However, such associations were not observed in the present sample, which may be due to several explanatory factors as discussed earlier. Previous research has not examined the relationship between trait resilience and telomere length. Therefore, no strong conclusions can be drawn from this single finding.

Interestingly, trait resilience showed relative resistance to change over a six-year follow-up period, even as participants navigated the challenges of early parenthood and other stressful life events. However, the findings also suggest that trait resilience

may be susceptible to change under certain conditions. This interpretation is supported by the observation that the highest temporal stability was found in the lowest and highest quartiles of trait resilience and implies that individuals with moderate levels may show greater variation over time.

The question of resilience's "true nature," particularly in terms of its stability across time and contexts, remains, in the literature, controversial. The trait-based approach, which conceptualizes resilience as a relatively stable personal characteristic, is criticized for its assumed fixedness. However, the findings of this study suggest the existence of a resilience characteristic that tends to remain stable over time, at least in some situations. However, trait resilience is not equivalent to "resilience" in all contexts or situations. As mentioned, trait resilience is positioned within a broader conceptual framework of resilience that encompasses multiple interacting influences and is referred to as a multisystem resilience context (Ungar & Theron, 2020). Accordingly, in resilience research, defining and operationalizing resilience are important.

The findings of this dissertation suggest that trait resilience may be different than the so-called "outcome resilience," which is typically tied to positive adaptation following adversity. In this study, trait resilience did not provide additional protection specifically in the context of SLEs but rather appeared to offer a more general form of protection, regardless of SLE exposure. Trait resilience most likely contributes to outcome resilience yet may not be conceptually or functionally identical to it. Yet, as noted earlier, a lack of longitudinal studies examining the interaction between trait resilience and stressful life events. Given that SLEs represent a broad and heterogeneous category of experiences, this topic warrants further research.

While trait resilience may show temporal stability, some change was also observed in this study. This is consistent with the broader understanding in the behavioral sciences that psychological characteristics do not remain entirely stable over time. Even personality traits, which are typically considered relatively stable, undergo changes across the lifespan (e.g., Roberts et al., 2006). Given the limited availability of long-term longitudinal studies on trait resilience, no definitive conclusions can be drawn from a single study. Nevertheless, the present findings, when considered alongside previous research, including studies in genetics, offer additional support for the idea of trait resilience as a relatively lasting individual characteristic. Importantly, it should be viewed as only one facet of resilience that likely interacts with various systemic and individual-level protective factors including biological ones.

Although the present study did not explore the development or clinical applications of trait resilience, some perspectives on how it might be addressed in work with parents can still be considered. As suggested by the concepts of the

"steeling effect" and stress inoculation, resilience, including trait resilience, may develop through successful experiences that may initially require external support or the practice of specific skills that forms into an internal personal resource. Since trait resilience can be developed and sustained through multiple pathways, strategies to enhance it may also vary. But as a general starting point, recognizing the overall level of parents' trait resilience is an important first step. Second, if there are concerns, it may be helpful to explore parents' past experiences in order to identify the strategies they have previously used to cope with adversity. Third, support should be available, when necessary, to help identify and enhance resources that may be beneficial in fostering experiences of coping and success in the face of adversity. For some individuals, strengthening relationships and social support may be particularly valuable, while others might benefit more from specific cognitive strategies or behavioral approaches.

A validated measure of trait resilience, such as the CD-RISC-10, could be beneficial when working with families. However, even in the absence of a standardized assessment, it remains essential to recognize trait resilience characteristics in parents. Incorporating an assessment of trait resilience into the comprehensive evaluation of parents could provide valuable insights and help identify areas of support needs that might otherwise go unrecognized. Parents with low trait resilience represent a particularly vulnerable group. In general and especially during periods of heightened stress or adversity, it is crucial for professionals working with parents to identify these individuals and ensure they receive appropriate support.

Trait resilience emerges as a multifaceted concept that may be utilized in various ways, including its recognition as a protective factor, support for its development, and its use in informing preventive mental health efforts and therapeutic applications. Its relative stability and consistent association with lower psychological distress make it a promotable and clinically relevant target in mental health contexts. In the field of psychiatry, trait resilience offers a welcome counterbalance to the predominant focus on symptoms and disorders. Continued efforts to recognize, support, and better understand trait resilience during early parenthood may contribute to more focused and effective responses to the mental health needs of parents.

Abbreviations

ACE	Adverse Childhood Experience
ANOVA	Analyses of Variance
CD-RISC-10	Connor-Davidson Resilience Scale 10
EPDS	Edinburgh Postnatal Depression Scale
gwk	gestational week
LTL	Leukocyte Telomere Length
qPCR	Quantitative Polymerase Chain Reaction
SCL	Symptom Checklist-90, anxiety subscale
SLE	Stressful Life Event
TADS	Trauma Distress Scale
T1	Timepoint one
T2	Timepoint two

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