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EXAMINING TRAIT COMPASSION

THE ASSOCIATIONS OF COMPASSION WITH JOB CHARACTERISTICS, SLEEP, AND BODY COMPOSITION

UNIVERSITY OF OULU GRADUATE SCHOOL;
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The associations of compassion with job characteristics, sleep, and body composition

Academic dissertation to be presented with the assent of the Doctoral Programme Committee of Human Sciences of the University of Oulu for public defence in the OP auditorium (L10), Linnanmaa, on 10 May 2024, at 12 noon

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Abstract

Compassion can be seen as part of civilized society, but compassion also supports personal well-being. However, not much is known of how compassion as a trait is connected to well-being. In contrast, there are indications that some fundamental adulthood well-being indicators may be on the decline. The current doctoral dissertation examined the uninvestigated temporal and longitudinal associations of trait compassion with job characteristics and sleep difficulties. Additionally, cross-sectional associations between compassion, self-compassion, and body composition were examined, a domain that has received limited investigation thus far.

Data of the dissertation was collected in two Finnish prospective studies: *Young Finns Study* (Study I, n = 723; Study II, n = 1,064) and *Northern Finland Birth Cohort 1986* (Study III, n = 789). Self-report questionnaires were used to measure compassion, self-compassion, job characteristics (Study I), sleep quantity and quality (Study II), whereas body composition was measured at a clinic (Study III). The analyses were adjusted for several known confounders, such as age, gender, socioeconomic factors in childhood and adulthood (Study I, II, III), as well as BMI, health behaviors, work conditions, and depressive symptoms (Study II). The data were analyzed using regressions, cross-lagged panel models, and multilevel models.

The results of Study I indicated that the direction of the temporal relationship was more likely to run from high compassion to fewer straining job characteristics, rather than in the opposite direction. A similar result was found in Study II: the direction of the temporal relationship was more likely to run from high compassion to fewer sleep difficulties. Moreover, high compassion predicted the development of several job characteristics and fewer sleep difficulties over the 11-year follow-ups, even after adjusting for all confounders. One exception was the association between compassion and sleep, which largely disappeared after being adjusted for depressive symptoms. Regarding body composition, compassion was cross-sectionally associated with three out of five body composition measurements. Specifically, high compassion was related to lower waist circumference, body fat percentage, and fat mass index, but not to body mass index or waist-to-hip ratio. These found relationships had been adjusted for sex and for childhood as well as adulthood socioeconomic position. Self-compassion was not associated with any of the body composition measurements.

According to the current results, trait compassion is associated with, and can even predict, a diverse group of well-being indicators. Moreover, the predictive relationships can last over a decade. Other-directed compassion thus appears to be a beneficial trait amongst the general population. In connection with this, it can also be suggested that it would be advantageous to strive to support compassion and its development.

Keywords: compassion, insomnia, obesity, personality, prospective, self-compassion, work stress

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Tiivistelmä

Myötätunto voidaan käsittää osana sivistystä, mutta myötätunto tukee myös yksilön hyvinvointia. Vielä ei kuitenkaan tiedetä kovinkaan paljoa siitä, miten myötätunto piirteenä on yhteydessä hyvinvointiin. Sen sijaan on merkkejä siitä, että jotkin tärkeät aikuisuuden hyvinvoinnin osatekijät saattavat olla heikentymässä. Tämän väitöskirjan tavoitteena oli tarkastella taipumuksellisen myötätunnon aiemmin tutkimattomia ajallisia ja pitkittäisiä yhteyksiä työn piirteisiin ja univaikeuksiin. Lisäksi tarkasteltiin myötätunnon ja itsemyötätunnon poikittaisia yhteyksiä kehon koostumukseen, joita on toistaiseksi tutkittu vähän.

Tutkimuksen aineistona käytettiin kahta suomalaista seurantatutkimusta: *Lasten Sepelvaltimotaudin Riskitekijät* (osajulkaisu I, n = 723; osajulkaisu II, n = 1 064) ja *Pohjois-Suomen Syntymäkohortti 1986* (osajulkaisu III, n = 789). Kyselyillä mitattiin myötätuntoa, itsemyötätuntoa, työn piirteitä (osajulkaisu I), unen määrää ja laatua (osajulkaisu II), kun taas kehon koostumusta mitattiin tutkimusklinikalla (osajulkaisu III). Tilastollisissa analyyseissä huomioitiin ikä, sukupuoli, lapsuuden ja aikuisuuden sosioekonominen asema (osajulkaisut I, II, III) sekä painoindeksi, terveyskäyttäytyminen, työolosuhteet ja masennusoireet (osajulkaisu II). Aineistojen analyyseissä hyödynnettiin regressioanalyysejä, rakennusyhtälömalleja ja monitasomalleja.

Osajulkaisun I tulokset osoittivat, että ajallinen yhteys kulki todennäköisemmin korkeasta myötätunnosta vähäisempiin kuormittaviin työn piirteisiin kuin vastakkaiseen suuntaan. Sama havaittiin osajulkaisussa II: ajallisen yhteyden suunta kulki todennäköisemmin korkeasta myötätunnosta vähäisempiin univaikeuksiin. Lisäksi korkea myötätunto ennusti usean työn piirteen sekä vähäisempien univaikeuksien kehittymistä 11 vuoden seurannassa. Nämä yhteydet eivät muuttuneet kontrolloitavien muuttujien lisäämisen myötä. Ainoana poikkeuksena oli myötätunnon ja unen yhteys, jotka suurilta osin katosi, kun analyyseissä huomioitiin masennusoireet. Kehon koostumuksen osalta taas havaittiin, että myötätunto oli poikittaisesti yhteydessä kolmeen kehon koostumuksen mittariin. Toisin sanoen, korkea myötätunto oli yhteydessä matalampaan vyötärön ympärykseen, rasvaprosenttiin ja rasvamassaindeksiin, mutta ei painoindeksiin tai vyötärö-lantiosuhteeseen. Näissä tuloksissa oli huomioitu sukupuoli sekä lapsuuden ja aikuisuuden sosioekonominen asema. Itsemyötätunto ei ollut yhteydessä kehon koostumuksen mittareihin.

Tämän tutkimuksen perusteella voidaan todeta, että korkea taipumuksellinen myötätunto on yhteydessä moninaisiin hyvinvoinnin osatekijöihin. Lisäksi myötätunto voi jopa ennustaa näitä hyvinvoinnin osatekijöitä yli vuosikymmenen ajan. Toisiin kohdistuva myötätunto näyttäisi siis olevan hyödyllinen piirre valtaväestössä. Tämän myötä voidaan myös ehdottaa, että olisi otollista pyrkiä tukemaan myötätuntoa ja sen kehitystä.

Asiasanat: itsemyötätunto, liikalihavuus, myötätunto, persoonallisuus, seurantatutkimus, työstressi, unettomuus

To Toivo, Lilja, and Tyyne

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I embarked on my doctoral research journey on the same day Finland entered COVID-19 lockdown, March 18, 2020. Doing one's doctoral dissertation is not the easiest task, and the pandemic did not make it any easier. Nevertheless, I have been fortunate and privileged to collaborate with various people who have supported me in my doctoral studies since day one.

First and foremost, my heartfelt thank you and appreciation go to my main supervisor Professor Mirka Hintsanen and supervisor Docent Aino Saarinen. First, Mirka did not only guide and teach me but also provided a timely and important research topic for me. Researching compassion has been enriching not only professionally but also personally, more so than I initially imagined. Furthermore, Mirka provided research data and funding, enabling me to focus on research full-time. Thus, Mirka's wisdom and resources were the starting point for the current dissertation as well as the condition for its continuation. Her compassion and willingness to help me through challenges were invaluable. As for Aino, she has shown me unwavering guidance, support, and knowledge throughout. She always had the most patient and kindest answers, even to my most obvious inquiries. Her enthusiasm about research was, and still is, infectious. This was crucial when I thought I was about to lose my momentum. Furthermore, Aino's elegant scientific writing always left me inspired to improve myself. I am deeply grateful to have had such excellent researchers as my supervisors. Thank you Mirka and Aino for your invaluable guidance!

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In Oulu, 21.3.2024 Iina Tolonen

Glossary

BF%	Body fat percentage
BMI	Body mass index
CI	Confidence interval
e.g.	Exempli gratia
ERI	Effort-reward imbalance model
FMI	Fat mass index
i.e.	Id est
JDC	Job demands-control model
NFBC1986	Northern Finland Birth Cohort 1986 Study
SEP	Socioeconomic position
YFS	The Young Finns Study
WC	Waist circumference
WHR	Waist-to-hip ratio

Publications

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

I Tolonen, I., Saarinen, A., Keltikangas-Järvinen, L., Siira, V., Kähönen, M., & Hintsanen, M. (2021). Rewards of Compassion: Dispositional Compassion Predicts Lower Job Strain and Effort-Reward Imbalance Over a 11-Year Follow-Up. *Frontiers in Psychology, 12,* 730188. https://doi.org/10.3389/fpsyg.2021.730188

II Tolonen, I., Saarinen, A., Puttonen, S., Kähönen, M., & Hintsanen, M. (2023). High compassion predicts fewer sleep difficulties: A general population study with an 11-year follow-up. *Brain and Behavior*, *13*(10), e3165. https://doi.org/10.1002/brb3.3165

III Tolonen, I., Saarinen, A., Sebert, S., & Hintsanen, M. (2024). Do compassion and self-compassion moderate the relationship between childhood socioeconomic position and adulthood body composition? *Psychology and Health.* Advance online publication. https://doi.org/10.1080/08870446.2024.2305133

Regarding the contributions, Tolonen, Saarinen, and Hintsanen designed Studies I, II, and III. Keltikangas-Järvinen designed and collected the data in Studies I and II. Data of Study III came from the Northern Finland Birth cohort 1986 Study. Tolonen analyzed the data, while Saarinen supervised the data analyzes in Studies I, II, and III. Tolonen made the initial interpretation of the results, and from thereon, Tolonen, Saarinen, and Hintsanen collaborated on the interpretation of the results. Tolonen wrote the first drafts of the manuscripts (Study I, II, III). Tolonen, Saarinen, and Hintsanen collaborated further in writing the manuscripts (Study I, II, III). All authors discussed the designs and results, took part in writing the manuscripts, and approved the final manuscripts of Studies I, II, and III.

Contents

1 Introduction

The world is increasingly becoming wealthier and more educated (Shorrocks et al., 2022; United Nations International Children's Emergency Fund, 2022). However, societies will face new kinds of challenges in the future, such as how to support healthy aging and mitigate societal polarization (Arora et al., 2022; Behr et al., 2023). As part of the human condition, humans will encounter personal suffering and the forms can be numerous. Personal suffering may consist of, for example, straining job characteristics, sleep difficulties, and unhealthy body composition. The prevalence of these three adverse well-being markers is relatively common in the general population and is possibly increasing (Koponen et al., 2018; Kronholm et al., 2016; Sääksjärvi et al., 2021).

The three proxies of well-being and health, i.e., job characteristics, sleep, and body composition, can be perceived as parts of the greater backbone of adulthood well-being. When high in quality or quantity, the proxies may become associated with, and even predict, positive consequences for both mental and physical health (Hirshkowitz et al., 2015; Kivimäki et al., 2006; World Health Organization, 2021 [WHO]). These positive outcomes range from a lowered risk for psychopathologies such as depression and anxiety (Alvaro et al., 2013; Preiss et al., 2013; Stansfeld et al., 2012) and lower risk of cardiovascular events (De Koning et al., 2007; Kivimäki et al., 2012; Sofi et al., 2014) to lower premature mortality (Hublin et al., 2007; Niedhammer et al., 2021; Prospective Studies Collaboration, 2009).

Well-being indicators are determined by a dynamic interaction between multiple internal and external factors such as genetics, environment, and psychosocial factors (Kocevska et al., 2021; W. D. Li et al., 2016; Reddon et al., 2016; Røysamb et al., 2002). Personality traits and dispositions, for instance, can dictate to some extent how thoughts and emotions are interpreted, how stress is handled, and what kind of action, if any, is taken when we feel unwell or threatened (Carver & Connor-Smith, 2010; Lazarus & Folkman, 1984). To demonstrate, it has been found that personality traits are associated with the said well-being indicators, namely one's perception of job characteristics, self-reported sleep, and body composition (Gerlach et al., 2015; Hintsanen et al., 2014; Törnroos et al., 2012).

Theoretical frameworks have emerged to explain why certain traits support well-being and its proxies. For example, the tend-and-befriend model suggests that social affiliations activate psychobiological mechanisms that can relieve stress (S. E. Taylor, 2012b; S. E. Taylor et al., 2000). Another theoretical framework, the social mentalities approach, argues that individuals have socially motivated

dispositions (Gilbert, 2005b, 2017). These dispositions are evolution-driven and, thus, subsequently, promote well-being and health (Gilbert, 2005b, 2017). One of these social mentalities is compassion (Gilbert, 2017).

Compassion is defined as the disposition to feel concern for others' suffering and a subsequent desire to alleviate the suffering (Goetz et al., 2010). Self-compassion, on the other hand, is directed at oneself, with three focal elements: self-kindness, common humanity, and mindfulness (Neff, 2003a, 2023). Consistent with the tend-and-befriend model and the social mentalities approach, empirical evidence has implicated high compassion and self-compassion with higher psychological well-being (Kirby et al., 2017; Zessin et al., 2015). To illustrate, the two traits are associated with lower stress and depressive symptoms, as well as higher positive affect and perception of social connections (Cosley et al., 2010; Dev et al., 2020; Galante et al., 2014; Kirby et al., 2017; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020; Saarinen, Keltikangas-Järvinen, Viding, et al., 2021; Wilson et al., 2020; Zessin et al., 2015).

Research on trait compassion is still, however, relatively scant. To demonstrate, compassion is often studied as a temporary state, not as a stable trait (e.g., Kirby et al., 2017). Hence, trait compassion has not yet been investigated with the previously mentioned markers of well-being, namely job characteristics, sleep, and body composition. Self-compassion, on the other hand, has been investigated together with some indicators of body composition, with mixed findings (Brenton-Peters et al., 2021). Furthermore, past compassion studies have also had a cross-sectional or an intervention design (e.g., A. Carter et al., 2021; Di Bello et al., 2020; Galante et al., 2014). Consequently, the temporal and longitudinal associations of trait compassion and well-being indicators remain largely uncharted. Lastly, many compassion studies have also focused on specific populations, such as healthcare workers (e.g., Scarlet et al., 2017; Weingartner et al., 2019), which means that less is known about the compassion of the general population.

The current study aimed to investigate trait compassion and self-compassion. Specifically, whether trait compassion is associated with the well-being indicators: job characteristics, sleep, and body composition. In addition, this study aimed to explore temporal and longitudinal associations. In other words, whether high trait compassion predicts the well-being proxies, or vice versa, whether high well-being proxies predict higher trait compassion. The cross-sectional association of trait self-compassion and body composition was also investigated. The participants came from prospective, population-based Finnish studies, namely the Young Finns Study

(Åkerblom et al., 1985; Raitakari et al., 2008) and the Northern Finland Birth Cohort 1986 Study (Järvelin et al., 1997; University of Oulu, 1986).

2 Literature review

2.1 Compassion: conceptualization

Whereas compassion is directed at others, self-compassion is directed at oneself (Goetz et al., 2010; Neff, 2003a). There has been discussion on whether compassion and self-compassion fall under the same construct, or whether they are two separate constructs (e.g., Strauss et al., 2016). Although compassion and self-compassion share some conceptual similarities, such as concern, they have a weak positive correlation (López et al., 2018; Neff & Pommier, 2013). Thus, compassion and self-compassion are treated as separate constructs in the current study.

2.1.1 Other-directed compassion

Compassion is defined as the disposition to experience concern for others' suffering and the subsequent desire to alleviate the perceived suffering (Goetz et al., 2010). Moreover, compassion has been described as a sign of developmental maturity (Cloninger et al., 1993). On a more specific level, compassion has been described to have five main components. Those five components are (1) recognizing the suffering, (2) seeing the suffering as a part of human experience, (3) emotional resonance with the suffering, (4) tolerating uncomfortable feelings (e.g., fear, distress, anger) in the face of suffering, and (5) being motivated to alleviate the suffering (Strauss et al., 2016). The inclusion of "tolerating uncomfortable feelings" may be unnecessary in the definition of compassion, according to a confirmatory factor analysis (Gu et al., 2017). For example, another conceptualization of compassion has four components: (1) awareness of suffering, (2) caring and concern for the suffering, (3) genuine wish to alleviate the suffering, (4) readiness to act and relieve suffering (Jazaieri et al., 2013; Jinpa, 2010). Although different in their wording, these definitions share a similarity: they include a cognitive (e.g., recognizing or awareness), affective (i.e., emotional resonance or concern), and behavioral motivation process (i.e., motivated to alleviate or readiness to act) (Kanov et al., 2004).

There are different views on whether compassion is a state, motivation, or trait (Goetz et al., 2010; Mascaro et al., 2020). The state view characterizes compassion as a short-term way of being in terms of feeling, thinking, and behaving, induced by internal or external factors (Goetz et al., 2010; Mascaro et al., 2020). In the past,

a majority of the studies have characterized compassion as a state (e.g., Kirby et al., 2017). The second way of conceptualizing compassion is the motivation view (Goetz & Simon-Thomas, 2017; Khoury, 2019). According to the motivation view, compassion is a reflex or a drive which motivates behavior similarly to, for example, self-defense (Goetz & Simon-Thomas, 2017). Interest in using the motivation conceptualization of compassion has been increasing over the past few years (Steindl et al., 2021).

As mentioned before, compassion can also be conceptualized as a trait. The trait view describes compassion as a stable characteristic that is relatively unchanged over time, has genetic components, and can dictate behavior to some degree (Goetz et al., 2010; Goetz & Simon-Thomas, 2017; Mascaro et al., 2020). For example, Cloninger's biopsychosocial model of personality characterizes personality as an adaptation to dynamic environments, which may be internal or external (Cloninger et al., 1993, 1994). Furthermore, personality is the outcome of complex interaction between genetic, psychological, social, cultural, and spiritual factors (Cloninger et al., 1993; Cloninger & Cloninger, 2011). Individuals are described to have temperament traits, which incline them to act in certain rudimentary ways, whereas character traits drive emotion regulation, motivation, and value expression (Cloninger & Cloninger, 2011). One of the main character traits is cooperativeness, which includes compassion as a subscale (Cloninger et al., 1994). According to the personality model, compassionate individuals are unconditionally kind to others and lack hostile or revengeful dispositions (Cloninger et al., 1993). The compassion subscale has shown within-individual stability (Josefsson et al., 2013) and has been used before to study compassion, although such research is still emerging (e.g., Hintsanen et al., 2019; Saarinen et al., 2019).

Whether defined as a state, trait, or motivation, the role of compassion in humanity is undeniable. Compassion has been described to have evolutionary roots and as a force driving societies forward (Gilbert, 2005b; Goetz et al., 2010). To illustrate, compassion has a role in sexual selection, offspring survival, kinship, and promotion of cooperation with non-kin individuals and groups (Goetz et al., 2010). As such, compassion has been called an evolved strategy in the promotion of survival and well-being (Gilbert, 2017, 2020). Besides evolutionary characteristics, compassion is a crucial part of our modern society. Compassion is imperative in organizations (Cameron, 2017), education (Jazaieri, 2018), justice (Hueston & Hutchins, 2018), and health care organizations (Sinclair et al., 2016); moreover,

compassion contributes to the maintenance of harmony in societies (Klimecki, 2019). Thus, compassion promotes cooperative and sustainable societies.

Moreover, as a construct, compassion is separated from empathy, sympathy, and pity (Goetz et al., 2010; Jazaieri, 2018). Empathy, for example, refers to identification with others' emotions and thoughts, whether positive or negative (Cuff et al., 2016). Sympathy, on the other hand, is "sharing the same feelings with the other, while having a positive attitude towards him" (Gelhaus, 2012, p. 399). Perhaps confusingly, compassion and sympathy have been used synonymously in past research (Wispé, 1986). Lastly, pity is feeling sorry for the sufferer and seeing the sufferer as somewhat inferior to oneself (Goetz et al., 2010). Crucially, what sets compassion apart from the above-mentioned constructs is that the core of compassion is within the perception of suffering and the subsequent motivation component. The intention to ease the suffering is not part of empathy, sympathy, or pity (Goetz et al., 2010; Klimecki & Singer, 2012; Singer & Klimecki, 2014).

Thus, the current study conceptualizes compassion as a trait (versus state versus motivation). More specifically, compassion is a disposition comparable to a personality trait and relatively stable in the within-individual variation over time (Eisenberg et al., 2002; Josefsson et al., 2013; Lee et al., 2021; Shiota et al., 2006). Compassion as a disposition has been found to have a distinguishable profile from other emotional dispositions such as love, joy, and content (Shiota et al., 2006). Furthermore, compassion and compassion-related traits have also demonstrated genetic components (Ando et al., 2004; Grühn et al., 2008; Knafo-Noam et al., 2015). Lastly, the current doctoral dissertation defines compassion as not necessarily needing to transform into action, but the motivational intention is critical (Goetz et al., 2010; Strauss et al., 2016).

2.1.2 Self-compassion

In the original research, self-compassion was described as having three different components, including self-kindness, common humanity, and mindfulness (Neff, 2003b). Today, self-compassion is more commonly described to include six components, as the above-mentioned components have their negative counterparts. These counterparts are self-judgement (versus self-kindness), isolation (versus common humanity), and over-identification (versus mindfulness) (Raes et al., 2011).

To further describe the components, first, self-compassion entails kindness and understanding towards oneself (Neff, 2003b). Rather than being self-judgmental,

self-kindness refers to having, for example, positive inner dialogue as well as accepting one's shortcomings and flaws. Self-kindness also entails engaging in things that are beneficial for one even if they might cause temporary discomfort, such as physical exercise (Neff, 2011). The next component is common humanity, meaning that one can perceive one's own experiences, even negative ones, as part of the common human experience (Neff, 2003b). In other words, one can appreciate that all individuals go through adversities, making one feel connected with, rather than isolated from, others (Neff, 2011). Lastly, mindfulness is the ability to hold and observe one's feelings and thoughts, even if they are uncomfortable (Neff, 2003b). One can objectively observe their inner (negative) experiences with curiosity, rather than overidentify with them. Thus, highly self-compassionate individuals are less likely to become consumed with their negative thoughts and feelings (Neff, 2003b).

Taken together, self-compassion is the caretaking mentality directed at oneself, and is not to be confused with egotism, passivity, self-pity, or self-indulgence (Neff, 2003b, 2011). Rather, self-compassion can be viewed as an antithesis to such negative self-relating and functioning. Higher self-compassion has been associated with various positive outcomes such as lower neuroticism and self-criticism (Neff et al., 2007; Raes, 2010; Wakelin et al., 2022), greater mastery goals, perceived competence, and motivation (Breines & Chen, 2012; Neff et al., 2005), and greater emotional resilience and health-related self-regulation (Sirois, 2015; Trompetter et al., 2017). Depending on the situation and needs of the individual, flexible self-compassion can take the form of self-soothing, for example, or the more active 'agentic' version, to motivate beneficial behaviors (Neff, 2023).

The current dissertation conceptualizes self-compassion as a trait, like other-directed compassion. The early literature did not explicitly characterize self-compassion as a trait, but rather as an attitude towards self (Neff, 2003a). Today, the dominant view is that self-compassion is a trait, as there are individual differences in self-compassion, and self-compassion is relatively stable over time (Raes et al., 2011; Svendsen et al., 2016; Waring & Kelly, 2019).

2.2 Compassion and well-being: theoretical frameworks

Although the value of compassion to personal well-being has been recognized for a few decades in psychological research (e.g., Eisenberg et al., 1989; Rein et al., 1995), the field has experienced a substantial re-emergence since the 2000s. Likewise, the study of self-compassion has experienced considerable growth since

its inception in the early 2000s. Consequently, several frameworks have been used to explain why such compassionate responses are associated with well-being indicators (e.g., broaden-and-build theory; Fredrickson, 2004; Fredrickson et al., 2008). Next, two prominent compassion frameworks, tend-and-befriend and social mentalities, are examined to dive further into the idea that compassion and self-compassion are associated with well-being indicators.

2.2.1 Tend-and-befriend model

A biobehavioral model called tend-and-befriend argues that prosocial and affiliative tendencies relieve stress (S. E. Taylor, 2006; S. E. Taylor et al., 2000). The 'tend' refers to caring and nurturing intentions and activities, whereas the 'befriend' means social affiliations. According to the model, stressful events elicit oxytocin production, which heightens social cues (Kucerova et al., 2023; S. E. Taylor, 2006). Consequently, the heightened social cues drive individuals to seek social interactions (S. E. Taylor, 2006, 2012b). Together, the increased oxytocin levels and (positive) social affiliation calm down the momentarily amplified sympathetic nervous system and the hypothalamic–pituitary–adrenal axis activity, resulting in attenuated stress (Heinrichs et al., 2003; Ito et al., 2019; Rodrigues et al., 2009). The initial tend-and-befriend research highlighted that 'tend and befriend' responses may be more common in women (S. E. Taylor et al., 2000). However, more recent research has shown that men can also exhibit 'tend and befriend' tendencies when their cortisol levels are high or when they experience social stressors (Berger et al., 2016; von Dawans et al., 2012).

Empirical findings have shown how caring and nurturing orientations are heightened in stressful situations. For example, sharing behaviors increase while self-beneficiary behaviors decrease in psychosocially stressful situations (Buchanan & Preston, 2014; Margittai et al., 2015). In a laboratory setting, it was found that after being exposed to psychosocial stress, the self-other distinction of the female participants increased, whereas their emotional egocentricity and reaction time in perspective taking decreased (Tomova et al., 2014). In other words, individuals become more other-orientated and less self-focused in stressful situations. Moreover, the readiness to take on risks is higher in social contexts compared to non-social contexts, possibly indicating greater stress regulation and greater agency in social situations (von Dawans et al., 2012).

Empirical evidence supports the idea that compassion aligns with the tend-and-befriend model. To illustrate, there is strong evidence that high compassion is associated with lower perceived stress. First, intervention studies have shown that training state compassion, meaning a short-term feeling of compassion, is associated with lower perceived stress (Brito-Pons et al., 2018; Matos et al., 2017; Totzeck et al., 2020) and greater acceptance in stressful situations (Austin et al., 2020; Jazaieri et al., 2018). Moreover, there is also longitudinal evidence showing that trait compassion, meaning a stable characteristic, predicts less vital exhaustion for over 15 years, rather than vice versa (Saarinen, Keltikangas-Järvinen, Viding, et al., 2021). Highly compassionate individuals are also more likely to show a higher tendency to upregulate positive affect, a sign of stress regulation (Engen & Singer, 2015; Förster & Kanske, 2022).

Furthermore, compassion has also been linked to the physiological markers of stress. For instance, training state compassion is associated with lower interleukin-6 levels, (i.e., pro-inflammatory cytokine) and lower cortisol levels (i.e., stress hormone) (Abelson et al., 2014; Pace et al., 2009). High compassion is also related to lower stress reactivity, including lower blood pressure reactivity, lower cortisol reactivity, and higher high-frequency heart rate variability (Cosley et al., 2010; Engert et al., 2016, 2017; Rockliff et al., 2008). In addition, compassion has been linked to increased levels of oxytocin, and possibly vasopressin, both being hormones associated with social behaviors and alleviated stress (for reviews, see C. S. Carter et al., 2017; Kucerova et al., 2023).

Like other-directed compassion, self-compassion is also associated with lower stress. To demonstrate, intervention studies have consistently shown that training state self-compassion is linked to lower stress, as shown by a recent meta-analysis (Han & Kim, 2023). Moreover, various groups seem to benefit from self-compassion, as lowered stress has been found in, for example, students, athletes, psychologists, and other healthcare professionals (Conversano et al., 2020; Dev et al., 2020; Finlay-Jones et al., 2015; Mosewich et al., 2013). These results agree with the physiological stress investigations. For example, intervention studies have shown that training state self-compassion is associated with lower cortisol, lower salivary alpha-amylase (i.e., a psychosocial stress biomarker), and increased salivary Immunoglobulin A (i.e., an immune function biomarker) (Arch et al., 2014; Martínez-Borrás et al., 2022).

2.2.2 Social mentalities approach

Another framework called 'social mentalities' is an evolutionary and biopsychological approach. The model argues that through evolution, humans are designed to detect safety and threat signals and to act accordingly (Gilbert, 1989, 2005b, 2005a). Individuals have social mentality archetypes with interpersonal agendas, such as care seeking, caregiving, co-operation, and competing. With the aid of these social mentalities, an individual can organize and coordinate emotions, motivations, and behaviors, and thus, survive and thrive (Gilbert, 1989).

One of the social mentalities is caregiving. According to the model, caring and nurturing behaviors activate the person's own 'soothing system', which promotes feelings of safety, trust, and calmness (Gilbert et al., 2008; Gilbert & Irons, 2005; Kirby & Gilbert, 2017). Such feelings, of course, aid in effective caretaking. On the other hand, according to the model, attacks, criticism, and shame activate another system, called the threat-defense system. The threat-defense system induces vigilance, defensiveness, and aggression externally (i.e., towards others) but also internally (i.e., towards self) (Gilbert, 2014).

The hypothesized location of the soothing system is in the parasympathetic nervous system, and the system is connected to the 10th cranial nerve, the vagus nerve (Di Bello et al., 2020; Stellar & Keltner, 2017). Essentially, the vagus nerve plays a critical role in relaxation and restoration, as indicated by slower heart and breathing rate, promotion of digestion, and regulation of inflammatory responses (Depue & Morrone-Strupinsky, 2005; Porges, 2001, 2007). The vagus nerve also serves an important role in the feelings of social connectedness, sharing, and caring, in addition to the equivalent facial expression and vocal tones (Depue & Morrone-Strupinsky, 2005; Porges, 2001, 2007).

Compassion, self-compassion, and social mentalities

In the case of other-directed compassion, compassion has been described to be one of the social mentalities, according to the framework creator (Gilbert, 2017). Indeed, as the definition of compassion includes concern for others and a subsequent motivation to care for others, compassion is clearly a form of the 'caregiving' archetype of the model. Moreover, research has shown that the concern and motivation to alleviate the suffering have been linked to higher vagus nerve activation (Bornemann et al., 2016; Di Bello et al., 2021; Stellar, Cohen, et al., 2015). In contrast, the simple perception of suffering, positive affect, or self-

interested motivations, such as norm conformity in the face of suffering, were not related to such biological response (Bornemann et al., 2016; Di Bello et al., 2021; Stellar, Cohen, et al., 2015).

Furthermore, neuroimaging studies support the compatibility of compassion and the social mentalities approach. For example, studies have shown that state compassion is associated with the activation of the limbic system, which is responsible for emotional and behavioral processes related to caring behaviors (J. J. Kim, Parker, et al., 2020; Novak et al., 2022). To illustrate, training state compassion has been associated with both increases and decreases in amygdala activity (Lutz et al., 2008; Weng et al., 2018). This seemingly contradictory finding is, however, a possible sign for both attentional preference for suffering and reduced aversive and emotional reactivity to the suffering (Lutz et al., 2008; Weng et al., 2018). Moreover, state compassion has also been linked to increased activation in the anterior cingulate and anterior insula, regions associated with empathic reactions and behaviors (Hou et al., 2017; Lutz et al., 2008). Another brain region associated with compassion is the prefrontal cortex, which is known for emotion regulation and executive functioning, among other functions (Engen et al., 2018; J. J. Kim, Cunnington, et al., 2020; J. J. Kim, Parker, et al., 2020).

Self-compassion and the social mentalities approach are also compatible. To demonstrate, when the soothing system is activated, one is more able to be self-soothing and self-forgiving, or in other words, more self-compassionate (Gilbert, 2005b). In an experiment, it was shown that highly self-compassionate individuals reported higher safeness and connectedness after facing a ruminative and self-critical task (Kirschner et al., 2019). In contrast, those with low self-compassion exhibit higher self-criticism, anxiety, and stress, which are possible signs of an activated defense-threat system (Brenner et al., 2018; Gilbert et al., 2011). Indeed, self-compassionate thoughts can increase the heart rate variability, a marker of vagus nerve activation, although the sample sizes in these studies have been relatively small (Luo et al., 2020; Petrocchi et al., 2017; Svendsen et al., 2016).

Additionally, neuroimaging studies have found that high self-compassion is associated with higher activity of the brain regions that are associated with the social mentalities approach. First, self-compassion training is associated with greater activation of the anterior cingulate, an area known for emotion processing (J. Lutz et al., 2020). Second, self-compassion may be associated with a specific pattern involving prefrontal cortex-amygdala connection, indicative of reduced sensitivity or reactivity to negative emotional experiences (Parrish et al., 2018).

Taken together, these findings suggest that high self-compassion is linked to the activation of the soothing system.

2.3 Well-being proxies: conceptualization

Well-being is not only about caregiving and social affiliations, as well-being is an umbrella term for a multifaceted condition. Moreover, the concept of well-being refers to a phenomenon that goes beyond hedonism and simple lack of sickness as, for instance, functioning adaptively is also an important facet of well-being (Diener et al., 2010; Huppert & So, 2013; Ruggeri et al., 2020; Ryan & Deci, 2001; WHO, 2001). Furthermore, well-being is a condition "that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community… underpins our individual and collective abilities to make decisions, build relationships and shape the world we live in" (WHO, 2001, 2022, para. 1).

For the sake of the current study, well-being is assessed through three different proxies: job characteristics, sleep, and body composition. When high in quality or quantity, all three factors have been associated with higher well-being and health outcomes (Cappuccio et al., 2010; Heikkilä et al., 2013; Madsen et al., 2017; Prospective Studies Collaboration, 2009; WHO Regional Office for Europe, 2022; Zhai et al., 2015). In addition to personal well-being, the high well-being proxies can have a positive impact on the economy, for example, through a smaller burden on the healthcare system (Goh et al., 2016; Streatfeild et al., 2021; Tremmel et al., 2017).

Worrisomely, the markers of adverse well-being, namely straining job characteristics, sleep difficulties, and unhealthy body composition, have all been shown to be relatively common in adults (Knutson et al., 2010; Milczarek et al., 2009; WHO Regional Office for Europe, 2022). In Finland, 36.7% of women and 28.0% of men report not having enough time at work to accomplish their tasks (Koponen et al., 2018). Furthermore, 21.0% of women and 13.8% of men report that they cannot make independent decisions regarding their work (Koponen et al., 2018). Similarly, 40.3–45.3% of the general Finnish population has occasional but recurring difficulties with sleep (Kronholm et al., 2016). Lastly, it has been estimated that 27.5% of women and 26.1% of men in Finland can be classified as having obesity (Koponen et al., 2018). The same report also estimated that 46.0% of women and 45.6% of men of the Finnish population have abdominal obesity

(Koponen et al., 2018). Thus, a significant amount of the population could be suffering from one or more of these proxies, making them topical areas to study.

2.3.1 Job characteristics

A job can have a meaningful impact on one's well-being. A compatible job can to a certain extent fulfill one's basic psychological needs of autonomy, competence, and relatedness (De Jonge et al., 2014). Moreover, the characteristics of a job have been linked to a variety of well-being and health outcomes (Bakker & Demerouti, 2017; Niedhammer et al., 2021). To demonstrate, less straining jobs are associated with, for example, an increase in quality of life (Foster et al., 2021), fewer psychopathologies such as major depressive disorder and anxiety (Jun et al., 2019; Stansfeld et al., 2012), and better cardiovascular health (Kuper & Marmot, 2003). Thus, a job can be a source of well-being and health, but also a risk factor for well-being and health.

Job characteristics have been studied to understand why some jobs are experienced as less straining while others are perceived as more straining (Bakker et al., 2023; Demerouti et al., 2001). Two models, namely job demands-control (Karasek, 1979; Karasek & Theorell, 1990) and effort-reward imbalance (Siegrist, 1996), have had a prominent presence in the field of work psychology. The job demands-control model postulates that individuals have both job demands and job control. Job demands refer to psychological, physical, social, and organizational burdens of the job. These can be, for example, workload, time constraints, and role conflicts, among others. Job control, on the other hand, is the opportunity to start and stop job tasks as one prefers, to have autonomy, and to control the work pace. While job demands place a burden on the individual, job control acts as a protective factor against the job demands (Karasek, 1979; Karasek & Theorell, 1990). To illustrate, if the job demands are high and the control is also high, the job strain may be buffered against. Indeed, lower job strain has been linked, among others, to a decreased risk for sleep difficulties (Magnusson Hanson et al., 2011), fewer sick leaves due to mental disorders (Amiri & Behnezhad, 2020), and decreased psychosomatic and health complaints such as back and chest pain (De Jonge et al., 2000).

Similarly, the effort-reward imbalance model proposes that all jobs require effort but also offer rewards (Siegrist, 1996; Siegrist et al., 2004). Effort refers to various demands and obligations included in the job description, but also to different situations where need for control is high. Rewards can also mean various

things, including esteem acquired through work success, promotions along the work career, and long-term job security. The model is transactional, as it is based on the core assumption of reciprocity between employees and employers (Siegrist, 1996). If the reciprocity principle is imbalanced, meaning the efforts outweigh the rewards, the individual will experience inherent dissonance (Siegrist, 1996). The dissonance is stressful and subsequently, increases the risks for adverse well-being and health (Dragano et al., 2017; Siegrist et al., 2004). To demonstrate, when effort-reward imbalance is low, the associated outcomes include a lower co-occurrence of risky health factors and behaviors such as being overweight, smoking, alcohol consumption, and physical inactivity (Kouvonen et al., 2006). Low effort-reward imbalance is also linked to lower musculoskeletal pain (Koch et al., 2014), and lower effort (a subcomponent) is associated with lower concentrations of C-reactive protein (i.e., a marker of inflammation) and cortisol (i.e., a stress hormone) (Izawa et al., 2016).

The principle of job demands-control and effort-reward imbalance is similar. While job demands and effort are straining, job control and reward are protective. Indeed, studies investigating job demands-control and effort-reward imbalance have yielded convergent results related to cardiovascular health, for example (Dragano et al., 2017; Kivimäki et al., 2012). However, the models do not compete; rather, they work as complementary to each other (Calnan et al., 2004; De Jonge et al., 2000; Jachens & Houdmont, 2019). The formula for calculating strain, for example, can differ between job demands-control (e.g., calculating subtraction) and effort-reward imbalance (e.g., calculating ratio) (Landsbergis et al., 2003; Siegrist et al., 2004).

As established before, job characteristics are associated with various indicators of well-being and health (Niedhammer et al., 2021). Therefore, it is concerning that there is an apparent decline in the well-being markers of the employees. To illustrate, while in 2014 25.0% of the European workers reported experiencing job strain, in 2022 the equivalent number had risen to 46% (Eurofound & EU-OSHA, 2014; Leclerc et al., 2022). In line with the above finding, other investigations have also found evidence of increasing job strain and its indicators in recent years (Rigó et al., 2021; Suutala et al., 2023). Moreover, a recent report of Finnish workers showed that work well-being indicators have kept declining in the past four years (Suutala et al., 2023).

2.3.2 Sleep

The restorative properties of sleep are essential for both optimal psychological and physical functioning (for a review, see Chattu et al., 2019). One of the ways to measure sleep is to assess the quantity and quality of sleep (Johnson & Czeisler, 2022). Sleep quantity refers to sleep duration or the lack/excess of sleep (Cappuccio et al., 2010). Both deficient and excessive sleep are unhealthy as the optimal amount of sleep is around 7–8 hours a day for an adult (Hublin et al., 2011; Kronholm et al., 2011). Individual's own perception of sleep deficiency (i.e., the actual sleep duration versus personal preference for sleep duration) is also an important aspect of sleep (Altman et al., 2012; Shankar et al., 2010). Sleep quality, on the other hand, can refer to difficulties with sleep. Sleep difficulties include, for example, difficulties falling asleep, not staying asleep during the night, waking up several times a night, and not feeling refreshed after a night's sleep (Jenkins et al., 1988).

Decent quality of sleep is an important matter as it has both short-term and chronic consequences. For example, having few acute sleep difficulties is associated with fewer headaches (Kelman & Rains, 2005), less worry and rumination (Clancy et al., 2020), and lowered proneness to accidents (Uehli et al., 2014). Having few chronic sleep difficulties, on the other hand, can have epidemiological consequences. To illustrate, having few sleep difficulties has been associated with a decreased risk for psychopathologies such as depression and anxiety (Bao et al., 2017; Cox & Olatunji, 2020; Zhai et al., 2015), obesity (Gangwisch et al., 2005), cardiovascular events (Hoevenaar-Blom et al., 2011; Sofi et al., 2014), and even decreased risk for mortality (Hublin et al., 2007; Kronholm et al., 2011).

There is evidence that poor sleep is increasing (Knutson et al., 2010; Kronholm et al., 2016; Léger et al., 2008). In contrast, other reports have shown that sleep deficiency, for example, has not increased in the past decades (Bin et al., 2012, 2013). These apparently mixed findings can be attributed to several factors. For one, the prevalence of long sleepers, meaning those who sleep more than 9 hours per day, has increased over the years (Bin et al., 2012). Increased sleep duration may possibly be due to growing numbers of depressive symptoms and other chronic illnesses (Bakour et al., 2022; Matricciani et al., 2017). Second, different countries demonstrate different patterns in sleep duration over time. A review showed that between the 1960s and 2000s, sleep duration had decreased in six countries (Austria, Belgium, Finland, Germany, Japan, Russia), increased in seven countries (Britain,

Bulgaria, Canada, France, South Korea, the Netherlands, Poland), while two countries showed inconclusive results (Sweden, the United States) (Bin et al., 2012). The changes in sleep duration between countries, however, did not seem to have a clear pattern (e.g., East versus West). Third, although sleep duration (i.e., sleep quantity) may not have changed over time, there might be a growing number of sleep difficulties (i.e., sleep quality) (Hoyos et al., 2015).

Regarding Finland specifically, there have been clear changes in sleep. For example, there has been a trend of decreasing sleep duration over the years (Bin et al., 2012). Interestingly, the number of long sleepers has also increased in Finland (Bin et al., 2013). As mentioned before, both deficit and excess of sleep are risk factors for health (Hublin et al., 2011; Kronholm et al., 2011). Furthermore, perceived sleep deficiency increased in the general Finnish population between 2011 and 2017 (Koponen et al., 2018). These findings are corroborated by other results. For instance, the prevalence of sick leaves due to sleep disorders increased from 2,427 individuals in 2010 to 9,448 individuals in 2022 (Perhoniemi & Blomgren, 2023). This increase might be attributable to an increasing prevalence of job strain and work disability (Perhoniemi & Blomgren, 2023).

2.3.3 Body composition

Body mass can be broken down into two rudimentary categories: fat mass (i.e., adipose cells) and fat-free mass (i.e., muscles, bones, organs, etc.). Fat mass can be further divided into essential and non-essential body fat. The essential fat serves important bodily functions, including the protection of internal organs, insulation, energy storage, and hormone regulation (Chidozie, 2011). In contrast, the non-essential fat resides underneath the skin and around major organs, serving as protection, energy deposit, and prevention against heat loss. When one gains weight by overfeeding, not due to fluids or increased muscle mass, it is usually in the form of non-essential fat (Lammert et al., 2000).

There are several ways to measure excess weight. Perhaps the most common method has been the measurement of body mass index (BMI), which evaluates the relation between weight and height (kg/m^2). A healthy BMI ranges between 18.5 and 25.0, while values over 25.0 indicate overweight and values over 30.0 indicate obesity (WHO, 2011). As such, BMI does not take into consideration gender or muscle mass, cannot assess the dangerous visceral fat, and may underestimate and overestimate overweight (Deurenberg et al., 2002; D. O. Okorodudu et al., 2010; Pasco et al., 2014; Romero-Corral et al., 2008). Thus, when studying body

composition, ideally, also other measurements are taken into consideration. Such alternatives can be waist circumference, waist-to-hip ratio, body fat percentage, and fat mass index (Cho et al., 2009; Czernichow et al., 2011; Janssen et al., 2004; Liu et al., 2013).

Regarding waist circumference, the recommended cut-off values are 80.0 centimeters for women and 94.0 centimeters for men (WHO, 2011). For waist-to-hip ratio, the recommended cut-off values are 0.85 for women and 0.90 for men (WHO, 2011). Ideal waist circumference and waist-to-hip ratio may also depend on the age, as the cut-off values may differ for older adults (Carr et al., 2023). Both indicators also are potentially prone to measurement variations, although there are established measurement protocols (WHO, 2011). Nevertheless, unlike BMI, waist circumference and waist-to-hip ratio can assess the undesirable abdominal fat with relative accuracy (WHO, 2011).

With non-invasive bioelectrical impedance testing it is possible to measure body fat more directly. Examples of these estimates are body fat percentage and fat mass index. As the name suggests, body fat percentage assesses the ratio between body fat and total body mass. Healthy body fat percentage ranges around 21–33% for women and 8–20% for men (Deurenberg et al., 1998; Gallagher et al., 2000; Macek et al., 2020). Obesity can be diagnosed in women with a body fat percentage over 37.1% and in men with over 25.8% (Deurenberg et al., 1998; Gallagher et al., 2000; Macek et al., 2020). These are not, however, strict cut-off values. Regarding fat mass index, the calculation is done by dividing fat mass in kilograms by height in meters squared (i.e., fat in kg/height in m^2). Thus, body fat index corrects the estimate for one's height, which body fat percentage does not do. Healthy fat mass index estimate for women is 5.0–9.0, while values over 13.0 indicate obesity (Bonikowske et al., 2019; T. L. Kelly et al., 2009). In men, healthy fat mass index is 3.0–6.0, while values over 9.0 suggest obesity (Bonikowske et al., 2019; T. L. Kelly et al., 2009). However, neither body fat percentage nor fat mass index considers differences between different ethnicity groups (Deurenberg et al., 1998; Jeong et al., 2023).

Body composition measurements in the healthy ranges have been associated with a variety of positive consequences (Kolb, 2022; Pischon et al., 2008; Srikanthan et al., 2016). Indicators of lower fat body composition, such as lower BMI, are associated with psychosocial factors, such as lowered risk for depression and anxiety (de Wit et al., 2022; Gariepy et al., 2010; Kalarchian et al., 2007) and increased quality of life (Kolotkin et al., 2001; Vesikansa et al., 2022). Physiological associations include a decreased risk for inflammation (Kolb, 2022;

Pischon et al., 2008; Srikanthan et al., 2016), metabolic syndrome (for a review, see Després & Lemieux, 2006), and risk of developing a cancer (Recalde et al., 2021). In contrast, unhealthy body composition can affect one's life span. A large-scale study, combining 57 prospective studies, found the overall mortality risk to increase by 30% when the participants had a body mass index (BMI) above 30 kg/m² (Prospective Studies Collaboration, 2009).

Due to various multiple associated outcomes, it is worrisome that unhealthy body composition has been described to have reached pandemic proportions (Swinburn et al., 2011). The prevalence of unhealthy body composition has almost tripled in four decades, as it was estimated that 13% of adults were obese worldwide in 2016, and the prevalence may still be increasing (Boutari & Mantzoros, 2022; WHO, 2021). The increasing prevalence of overweight and obesity has also been observed in Finland. The Finnish Institute for Health and Welfare has estimated that in 2018, 45.0% of women and 59.0% of men were either overweight or obese in Finland (Sääksjärvi et al., 2021). By 2020, the same estimates had increased by 4% in women and 6% in men (Sääksjärvi et al., 2021).

2.4 The empirical evidence on compassion, self-compassion, and well-being proxies

As established before, compassion and self-compassion may offer a perspective to study the etiology of well-being indicators (e.g., Gilbert, 1989, 2005a; S. E. Taylor et al., 2000). To understand effective methods to maintain healthy levels of the well-being proxies, and possibly suppress the found decline in the three well-being proxies (i.e., job characteristics, sleep, and body composition), it is important to study their etiology. Next, the empirical evidence on compassion and job characteristics, sleep, and body composition (as well as self-compassion and body composition) is examined.

2.4.1 Compassion and job characteristics

Many factors are associated with job strain, including but not limited to resources such as social support and ergonomics (Bakker & Demerouti, 2017; Demerouti et al., 2001) as well as leadership and other organizational structures (Bakker et al., 2023; Tummers & Bakker, 2021). Individual differences, such as personality traits, are also important to consider (Schaufeli & Salanova, 2014). Although dispositions can create an individual susceptible to strain, some dispositions may act as

protective factors (Hintsa, Hintsanen, et al., 2013; Sutin & Costa, 2010; Törnroos et al., 2013). For example, high agreeableness, a trait related to compassion, has been associated with lower perceived job strain and higher perceived job control (Di Fabio & Saklofske, 2021; Törnroos et al., 2013).

According to my current knowledge, there is no previous research on trait compassion and job characteristics. There are, however, indications that the association may exist. For example, training state compassion is linked with lower burnout symptoms such as (reduced) emotional exhaustion and (increased) personal accomplishment, although the study did not employ a control group (Orellana-Rios et al., 2017). A similar result was found in a survey study (n = 849) which found that compassion motivation toward patients is protective against burnout in a structural equation modeling analysis (Ropes & de Boer, 2021). In contrast, another intervention study combined qualitative and quantitative methods and found that state compassion training was linked to higher job satisfaction, but not to burnout (Scarlet et al., 2017). The study, however, did not have a control group, and second, the authors suggested that the null finding between compassion and burnout might have been due to low baseline burnout scores of the participants in the study (Scarlet et al., 2017).

There is also worth to consider the opposite, i.e., that the amount of job strain may predict compassion outcomes. For one, high job strain may predict lower compassion. To demonstrate, high job strain can hamper cognitive, affective, and behavioral processes (Bakker & de Vries, 2021). Prolonged work-related stress can lead to impaired executive functioning and attention, increased negative mood, and distancing behavior (Grossi et al., 2015; Leone et al., 2008; Schaufeli et al., 2009). As compassion includes similar cognitive, affective, and behavioral processes (Goetz et al., 2010; Mascaro et al., 2020; Strauss et al., 2016), such dysfunctions could be detrimental to the emergence of compassion. On the other hand, low job strain may predict higher compassion. For instance, if one's job includes considerable amounts of social support, there is protection against job strain (Bakker & Demerouti, 2017; Pan et al., 2019). Such a job environment may open opportunities to cultivate compassion. Interestingly, compassion-related behaviors such as helping are not only associated with lower stress, but they also spread effortlessly among social networks (Fowler & Christakis, 2010; Raposa et al., 2016).

2.4.2 Compassion and sleep

Sleep is a complex and overarching phenomenon, as it has been linked to health behaviors (Kredlow et al., 2015), working conditions (Drake et al., 2004; Rahim et al., 2021), psychological well-being (Chunnan et al., 2022), and physical health (Hoevenaar-Blom et al., 2011; Kronholm et al., 2011). Even personality traits are associated with sleep. Some cross-sectional results indicate that certain traits are linked to poorer sleep while others are associated with better sleep (Cellini et al., 2017; Gamaldo et al., 2020; Hintsanen et al., 2014; Randler, 2008). Some studies have found that high agreeableness, a trait related to compassion (Di Fabio & Saklofske, 2021), has been associated with longer sleep duration and fewer sleep difficulties (Cellini et al., 2017; Hintsanen et al., 2014).

The relationship between trait compassion and sleep, however, remains completely unexplored, according to my current knowledge. One quasi-experimental study (n = 180) investigated whether compassionate reappraisal versus rumination affected sleep outcomes (Witvliet et al., 2022). The results indicated that individuals in the compassionate reappraisal group reported fewer sleep disturbances and shorter sleep onset latency compared to the rumination group (Witvliet et al., 2022). However, the study in question did not assess any baselines and had only college students as participants. On the other hand, cross-sectional studies have discovered that compassion-related behaviors, such as high prosocial behaviors online (e.g., donating money, being kind) and low levels of cyberbullying, had significant, although weak, associations with higher sleep duration and fewer sleep difficulties (Kırcaburun & Tosuntaş, 2018; Melton et al., 2021). However, these studies used convenience sampling, and due to the cross-sectional design, the studies do not offer any information about the temporality of the associations (Kırcaburun & Tosuntaş, 2018; Melton et al., 2021).

The reverse causality should be taken into consideration, meaning that the direction of the predictive pathways may run from high sleep difficulties to lesser compassion. However, according my to current knowledge, there are no studies that have investigated this possibility. Past findings indicate, nevertheless, that sleep deficiency is closely connected with poorer emotional information processing (for a review, see Tempesta et al., 2018). This may mean that disruptions to sleep also impair the precursors to compassion such as empathy, but also compassion-related behavioral coping strategies such positive affect and action orientation (Guadagni et al., 2014; Killgore et al., 2008). Indeed, it has been found in experimental studies that high sleep deficiency predicts fewer compassion-related

prosocial behaviors, including giving out donations and voting behavior (Holbein et al., 2019).

2.4.3 Compassion, self-compassion, and body composition

The treatment of unhealthy body composition has been proven to be a challenging task as, for example, the treatment results are often not long-lasting after the initial success (Mann et al., 2007; Mauro et al., 2008). Therefore, investigations of (1) innovative targets for weight loss interventions and studies (2) to identify risk and protective factors for body composition have been of interest (Chen & Miller, 2012; Gerlach et al., 2015; D. E. Okorodudu et al., 2015; Olson & Emery, 2015). Recently, there has been a shift from the traditional strict and restrictive practices to lose and maintain weight. For example, trait agreeableness, which is related to compassion (Di Fabio & Saklofske, 2021), and BMI have been studied together, although with contradictory results (for a review, Gerlach et al., 2015). More recent studies have investigated the dispositions embracing acceptance and adopting self-care behaviors in terms of body composition (Brenton-Peters et al., 2021; Carter et al., 2023).

Regarding self-compassion, there is preliminary evidence that self-compassion may be associated with body composition (Brenton-Peters et al., 2021; Carter et al., 2023). To demonstrate, cross-sectional, intervention and prospective studies have found that self-compassion may be associated with healthier body composition, although the results have been mixed (Braun et al., 2012; Forbes & Donovan, 2019; Mantzios & Wilson, 2014, 2015; Palmeira et al., 2017; Pyykkö et al., 2022; Schnepper et al., 2020; Thøgersen-Ntoumani et al., 2021). Studies investigating trait self-compassion have often found non-significant results with BMI (e.g., Pyykkö et al., 2022; Thøgersen-Ntoumani et al., 2021) while state self-compassion studies have yielded mixed results concerning BMI (e.g., Carter et al., 2023). Some studies have studied self-compassion together with other body composition measurements (Horan & Taylor, 2018). Regarding these, high state self-compassion has been linked to lower abdomen circumference, but not to waist circumference, waist-to-hip ratio, or body fat percentage in intervention studies (Horan & Taylor, 2018; Palmeira et al., 2017). However, the cited intervention studies have some limitations, such as small sample sizes, all-female or female majority samples, short length (e.g., 5 weeks), and they have often not used a control group (e.g., Carter et al., 2023; Rahimi-Ardabili et al., 2020).

In the case of other-directed compassion and body composition, there have been fewer studies, according to my current knowledge. The preliminary findings have indicated, nevertheless, that cultivating state compassion is associated with slight decreases in BMI (Palmeira et al., 2019). The study, however, had a small sample size (n = 53), had only overweight or obese participants, and employed a variety of methods, including psychoeducation and mindfulness, in addition to loving-kindness meditation (Palmeira et al., 2019). Loving-kindness meditation is a commonly used method to cultivate compassion for others, but also for self (Hofmann et al., 2011). Thus, it is difficult to disentangle how compassion specifically was related to body composition in the study (Palmeira et al., 2019).

However, compassion and self-compassion have been shown to be associated with habits that support healthy body composition. Practicing loving-kindness meditation, for example, has been associated with less emotional eating (Palmeira et al., 2017, 2019). Moreover, high self-compassion is associated with health behaviors such as higher physical activity according to a meta-analysis (Brown et al., 2021; Wong et al., 2021). These health factors are correlates of healthier body composition, such as lower BMI (Cassidy et al., 2017; Gangwisch et al., 2005; Mertens & van Gaal, 2000; Traversy & Chaput, 2015).

2.5 Gaps and limitations in the literature

Although compassion research is increasingly popular, the research is nascent. There are, thus, gaps and limitations in the existing knowledge.

First, the majority of the compassion studies have investigated compassion as a state, not as a trait (gap I) (e.g., Kirby et al., 2017). As previously established, state compassion is short-lived and induced by internal or external factors (Goetz & Simon-Thomas, 2017). Trait compassion, on the other hand, is a relatively stable and enduring characteristic that can be prognostic of behavior (Goetz & Simon-Thomas, 2017). To understand whether compassion predicts change in the well-being indicators, or vice versa, the investigation of trait compassion may prove to be more useful compared to state compassion. It has been argued that traits are more useful for predicting trends and outcomes in the long term, whereas states may be more beneficial in the investigation of short-term changes (Fleeson, 2004). Moreover, by investigating compassion as a trait it is also possible to evaluate whether there is a long-term protective (versus risk) element in the compassion trait.

Second, research on compassion with job characteristics and sleep does not exist at all, while research on compassion and body composition is scarce (gap II).

Consequently, research on the temporal associations of compassion with the well-being indicators, such as job characteristics and sleep, does not exist, according to my current knowledge (gap III). Regarding the investigations of state compassion/self-compassion and body composition, they have often been intervention studies (Carter et al., 2023). These interventions have also included other components, including psychoeducation, mindfulness, even yoga, making it difficult to disentangle the effects of these factors on body composition (Braun et al., 2012; Carter et al., 2023). Moreover, self-compassion has mainly been studied with BMI, with a few and single studies on waist circumference, waist-to-hip ratio, and body fat percentage, but rarely together (Horan & Taylor, 2018; Palmeira et al., 2017; Rahimi-Ardabili et al., 2020).

Lastly, relatively little is known about the trait compassion of the general population (gap IV). Some general population studies on trait compassion have been conducted in recent years (e.g., Gluschkoff et al., 2019; A. Saarinen et al., 2019, 2021; A. Saarinen, Keltikangas-Järvinen, Hintsa, et al., 2020; A. Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020; A. I. L. Saarinen et al., 2020), but not on the current well-being proxies. Moreover, the majority of compassion studies have been conducted with specific populations such as healthcare professionals (e.g., Scarlet et al., 2017; Weingartner et al., 2019), clinical populations (Austin et al., 2020; Chapin et al., 2014), local communities (Cosley et al., 2010; Jazaieri et al., 2013; Lee et al., 2021), and students (Di Bello et al., 2021; Galante et al., 2014). Moreover, female-majority or female-only samples also are common in compassion studies (Carter et al., 2023; Galante et al., 2014; Kirby et al., 2017; Rahimi-Ardabili et al., 2020).

3 Aims of the current doctoral dissertation

In the current study, the aim is to examine compassion while addressing the four gaps in the literature.

First, the current study investigates trait compassion, rather than state compassion, which has been a more common topic to investigate (gap I) (Kirby et al., 2017). In the current study, trait compassion is assessed with self-reported questionnaires. The questionnaires have been used to measure trait compassion in the past and have received support for validity and reliability (Cloninger et al., 1994; Dixson et al., 2018; Hansenne et al., 2005; Lim & DeSteno, 2016; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020; Shiota et al., 2006; Stellar, John-Henderson, et al., 2015; Yaden et al., 2019). Self-compassion is also assessed as a trait with previously used, validated, and reliable questionnaires (Castilho et al., 2015; Raes et al., 2011; Uršič et al., 2019).

Second, the aim is to explore trait compassion together with well-being proxies that can be considered as integral parts of well-being (Cappuccio et al., 2010; Heikkilä et al., 2013; Madsen et al., 2017; Prospective Studies Collaboration, 2009; WHO Regional Office for Europe, 2022; Zhai et al., 2015), yet there is minimal to no research conducted on them with compassion (gap II). Moreover, the three well-being indicators – job characteristics, sleep, and body composition – were selected as topics of interest for other reasons as well. First, the three proxies represent a diverse group of well-being indicators, both psychological and physiological. Second, straining job characteristics, poor sleep, and unhealthy body composition are relatively common in the Finnish population (Koponen et al., 2018; Kronholm et al., 2016). Third, there are indications that perception of straining job characteristics, poor sleep, and unhealthy body composition may be increasing in the Finnish general population (Bin et al., 2012; Koponen et al., 2018; Sääksjärvi et al., 2021; Suutala et al., 2023).

The three well-being proxies, job characteristics, sleep, and body composition, are investigated with more than one measurement. An assortment of measurements allows to gain more in-depth insight into how trait compassion (and self-compassion) may relate to these proxies. Job characteristics (Study I) are assessed using two models, namely job demands-control and effort-reward imbalance as well as their subcomponents (i.e., job demands, job control, effort, reward). Sleep (Study II) is assessed with sleep duration, perceived sleep deficiency, and sleep difficulties. And lastly, body composition (Study III) is measured with five measurements: BMI, waist circumference, waist-to-hip ratio, body fat percentage,

and body fat index. Self-compassion is investigated only with body composition (Study III). The job characteristics and sleep data come from the Young Finns Study, which did not have data on self-compassion.

Third, the current study aims to investigate trait compassion with longitudinal designs (gap III) in addition to the cross-sectional ones. Previously, many compassion studies have examined cross-sectional associations or have used intervention designs in the longitudinal studies (e.g., Carter et al., 2023; Scarlet et al., 2017; Thøgersen-Ntoumani et al., 2021; Witvliet et al., 2022). Thus, first, Study I and II examine whether the direction of the temporal relationship runs from compassion to job characteristics (Study I) and sleep difficulties (Study II), or vice versa, from job characteristics and sleep difficulties to compassion. To paraphrase, the dissertation examines whether compassion is a protective factor for the well-being indicator, or rather the result of the well-being indicator. The aim is achieved by using longitudinal data from 2001 and 2012, and with the use of statistical analysis of cross-lagged panel models. Second, the current doctoral dissertation also investigates whether compassion can predict the development of job characteristics and sleep difficulties over a follow-up of 11 years. This is achieved with the use of multilevel models. As a final note, Study I did not include explicit investigation of the cross-sectional association between compassion and job characteristics, as such analyses are included in the cross-lagged panel models by default.

Lastly, the aim is to examine compassion with samples drawn from the Finnish general population (gap IV). The participants come from two large Finnish prospective studies, namely the *Young Finns Study* (Åkerblom et al., 1985; Raitakari et al., 2008) and the *Northern Finland Birth Cohort 1986* (University of Oulu, 1986). The data allows the adjustment of several known confounders such as age, gender, socioeconomic position in childhood and adulthood (i.e., job characteristics, sleep, body composition), as well as BMI, health behaviors, working conditions, and depressive symptoms (i.e., sleep).

3.1 Research questions

Figure 1 depicts the research questions to increase clarity.

3.1.1 Study I

1. Is there a temporal relationship between trait compassion and job characteristics (i.e., job demands-control, effort-reward imbalance, and their subcomponents)?
2. Does trait compassion predict the developmental trajectory of job characteristics (i.e., job demands-control, effort-reward imbalance, and their subcomponents) over an 11-year follow-up?

Hypotheses for Study I are the following: 1) the temporal relationship exists, and it is more likely to run from high trait compassion to fewer straining job characteristics, meaning lower job demands-control and lower effort-reward imbalance, than vice versa. No assumptions were made about the temporal association between trait compassion and the subcomponents, meaning job demands, job control, effort, and reward. 2) High trait compassion predicts the development of fewer straining job characteristics, namely lower job demands-control and lower effort reward imbalance over the 11-year follow-up. No assumptions were made about trait compassion predicting the subcomponents, meaning job demands, job control, effort, and reward, over the 11-year follow-up.

3.1.2 Study II

1. Is trait compassion cross-sectionally associated with sleep duration, perceived sleep deficiency, and sleep difficulties?
2. Is there a temporal relationship between trait compassion and sleep difficulties?
3. Does trait compassion predict the developmental trajectory of sleep difficulties over an 11-year follow-up?

Hypotheses for Study II are the following: 3) high trait compassion is associated with longer sleep duration, lower perceived sleep deficiency, and fewer sleep difficulties. 4) The temporal relationship exists, and it is more likely to run from high trait compassion to fewer sleep difficulties, than vice versa. 5) High trait compassion predicts the development of fewer sleep difficulties over the 11-year follow-up.

3.1.3 Study III

1. Is trait compassion cross-sectionally associated with body composition (i.e., body mass index, waist circumference, waist-to-hip ratio, body fat percentage, and body fat index)?
2. Is trait self-compassion cross-sectionally associated with body composition (i.e., body mass index, waist circumference, waist-to-hip ratio, body fat percentage, and body fat index)?

Hypotheses for Study III are the following: 6) high trait compassion is associated with lower body mass index, lower waist circumference, lower waist-to-hip ratio, lower body fat percentage, and lower body fat index. 7) High trait self-compassion is associated with lower body mass index, lower waist circumference, lower waist-to-hip ratio, lower body fat percentage, and lower body fat index.

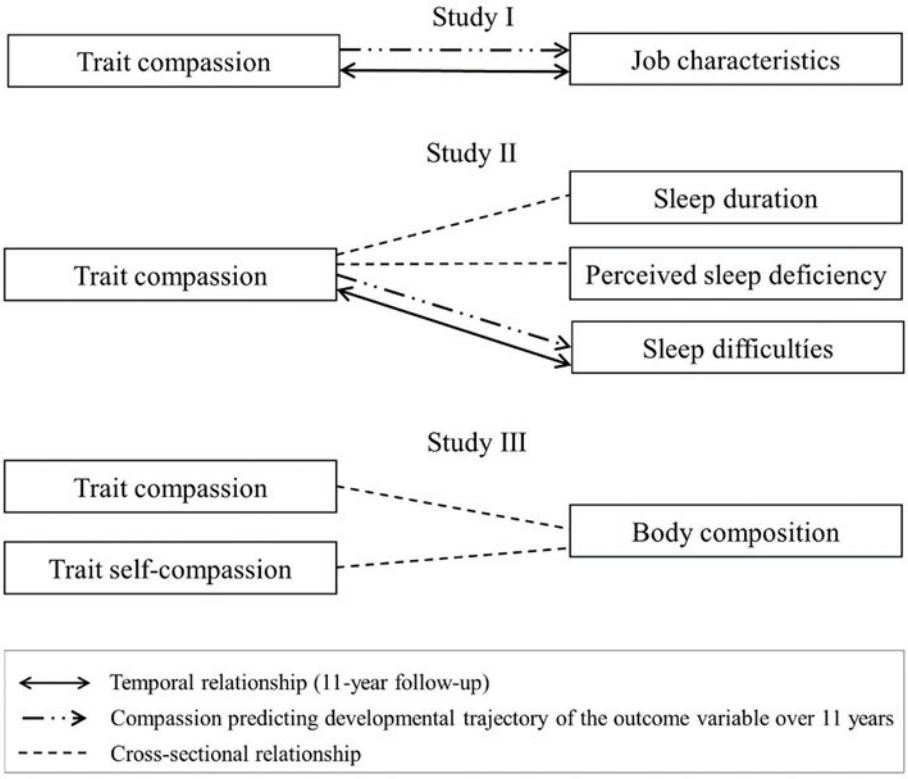


Fig. 1. Studies I, II, and III and their main study variables and examined relationships.

4 Methods

4.1 Participants

The participants are from two prospective studies called the Young Finns Study (Study I and II) and the Northern Finland Birth Cohort 1986 Study (Study III).

4.1.1 The Young Finns Study (Study I, II)

The Young Finns Study (YFS) is a prospective study investigating the cardiovascular risk of its population (Åkerblom et al., 1985; Raitakari et al., 2008). The aim has been to study Finnish children, who are representative of (1) female and male genders, (2) both cities and rural communities, and (3) western and eastern parts of Finland. The baseline measurement of YFS was conducted in 1980. The original sample included 3,596 participants, aged between 3 and 18 years (born in 1962, 1965, 1968, 1971, 1974, and 1977). Since then, participants have been followed for over 37 years, in 1983, 1986, 1989, 1992, 1997, 2001, 2007, 2012, and 2017.

Five Finnish universities with medical schools collaborated with the recruitment of the participants (i.e., Universities of Helsinki, Turku, Tampere, Oulu, and Kuopio). The potential participants were invited from the university cities (50%) and their close-by rural municipalities (50%). In choosing the rural municipalities, they needed to (1) be within 200 kilometers of the respective university city, (2) have similar industrial infrastructures with each other, and (3) have large enough child populations. Two rural municipalities were selected from the region of Helsinki (i.e., Vihti, Nurmijärvi), Turku (i.e., Loimaa, Mynämäki), and Tampere (i.e., Orivesi, Ruovesi) to represent the West. Two rural municipalities from Oulu (i.e., Haapavesi, Pudasjärvi) and four rural municipalities from the region of Kuopio (i.e., Ilomantsi, Juuka, Lapinlahti, Nilsiä) were selected to represent the East. The West and East distinction was established using the Nöteborg Peace Treaty borderline (Åkerblom et al., 1985; Vähämurto et al., 2019), which still reflects health differences between populations in the West and East (Vähämurto et al., 2019).

The next step was to identify the participants from the population register of the Social Insurance Institution. In practice, this meant girls and boys belonging to target age cohorts and having residency in target cities and rural municipalities. The

potential participants were then put in random order. Thereafter, the researchers invited 30 children from each sampling group (i.e., age cohort, sex, and place of residence, for example, *girls* born in *1965* in *Oulu*). In the end, out of the 4,320 invited children, 3,596 took part in the baseline study in 1980. The design and progression of the YFS are described in further detail elsewhere (Åkerblom et al., 1985; Raitakari et al., 2008).

Final analytical sample of Study I (compassion and job characteristics)

Study I used data from three follow-ups of the YFS: 2001 (n = 2,283), 2007 (n = 2,204), and 2012 (n = 2,060). Participants were included only if they were working full-time during the follow-ups in 2001, 2007, and 2011 (n = 918). Of these participants, those who did not have any missing data on the covariates, meaning age, gender, and childhood and adulthood socioeconomic factors, were included (n = 792). Lastly, those participants were included in the analyses who had data available on compassion in at least one of the follow-ups (either 2001 or 2012) (n = 724) and data on job characteristics in at least one of the follow-ups (either 2001, 2007, or 2012) (n = 723). Hence, the final number of participants in the analyses was 723.

Final analytical sample of Study II (compassion and sleep)

The data of Study II come from three measurement points of the YFS: 2001 (n = 2,283), 2007 (n = 2,204), and 2012 (n = 2,060). The participants were required to have full data on the covariates: age, gender, childhood (1980) and adulthood socioeconomic factors (2011), health behaviors (alcohol consumption, smoking, physical activity), BMI, working conditions (2011), and depressive symptoms (2012). Of these participants, those with full data on sleep duration, perceived sleep deficiency, and sleep problems (2012) as well as data on sleep difficulties (2001, 2007, and 2012) and compassion (2001, 2012) in at least one of the measurements years were included in the sample (n = 1,073). Since pregnancy is associated with increased sleep difficulties, pregnant participants and those who did not provide information about possible pregnancy were excluded (n = 9) (Sedov et al., 2018). Hence, the final sample size was 1,064.

4.1.2 Northern Finland Birth Cohort 1986 Study (Study III)

The Northern Finland Birth Cohort 1986 (NFBC1986) study is an ongoing, prospective epidemiological study investigating the well-being and health of its population (University of Oulu, 1986). In 1985–1986, the study recruited pregnant women (N = 9,362) and their children born in 1985–1986 (N = 9,479, still births n = 47) who were living in the provinces of Oulu and Lapland. The recruited baseline sample entailed approximately 99% of the children who were born in the target time period and region. After the baseline assessments in 1985–1986, there have been four follow-ups, at the ages of 1, 7–8, 15–16, and 33–35 years. In the follow-ups, a range of factors have been assessed including, but not limited to, prenatal and early life measurements, motor/social/psychological development in childhood and adolescence, as well as adulthood information on lifestyle, diagnosed diseases, psychiatric symptoms, occupational health, economy, and personality traits (University of Oulu, 1986). The study population has been described in more detail elsewhere (Järvelin et al., 1997).

Final analytical sample of Study III (compassion, self-compassion, and body composition)

The participants of Study III came from the measurement points of NFBC1986 in 1993 (n = 8,416) (Taanila et al., 2004) and 2019–2020 (n = 1,807–3,224) (University of Oulu, n.d.). Out of the original study population (N = 9,479), only 5,717 participants were invited to take part in the clinical part of the follow-up in 2019–2020. To be included in the analyses of the current study, the participants had to have full data on the body composition measurements in 2019–2020 (n = 1,770). Furthermore, participants were required to have at least 50% of responses available on compassion and self-compassion from the follow-up of 2019–2020 (n = 1,441). Of these participants, those who had data on the sex and full data on childhood (1993) and adulthood socioeconomic factors (2019–2020) were included (n = 967). Participants who were pregnant, or female participants who did not supply information about pregnancy, were excluded (n = 132). Participants with hypothyroidism (n = 46) were also excluded as the condition is associated with weight gain (Biondi, 2010). Thus, the final sample size was 789.

4.2 Measures

4.2.1 Compassion (Study I, II, III)

Study I and Study II

Trait compassion was assessed using Cloninger's Temperament and Character Inventory (Cloninger et al., 1994). More specifically, compassion was assessed with one of the five Cooperativeness subscales called Compassion versus Revengefulness (Cloninger et al., 1994). The assessments were done in 2001 and 2012. The compassion subscale consists of 10 items such as "*I hate to see anyone suffer*" or "*It gives me pleasure to see my enemies suffer*" (a reversed item). All the items were responded to on a 5-point scale ("1 = Completely disagree"; "5 = Completely agree"). The items were recorded so that higher scores reflected higher compassion. The mean score of the scale was calculated for all the participants who had responded to at least 50% of the items. The variable was treated as continuous.

The reliability of the scale is good. The internal consistency of the scale was high in both Study I (Cronbach's $\alpha = 0.86$ in 2001, $\alpha = 0.85$ in 2012) and in Study II ($\alpha = 0.87$ in 2001, $\alpha = 0.85$ in 2012). In addition, the test-retest correlations between the follow-ups were high in both Study I ($r = 0.69$, $p < 0.001$) and Study II ($r = 0.70$, $p < 0.001$). The reliability of the scale has been good in the past studies as well (Hansenne et al., 2005).

The scale also has good validity. For example, the scale has had support for its structural validity (Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020). In addition, the convergent validity of the scale has also been demonstrated, as a higher compassion score is associated with higher warmth and prosocial behaviors (García et al., 2012; Schmidt et al., 2003).

Study III

Trait compassion of Study III was assessed with the compassion subscale of Dispositional Positive Emotion Scales in 2019–2020 (Shiota et al., 2006). The subscale consists of five items, such as "*It's important to take care of people who are vulnerable*". There were no reverse items in the scale. The responses were given on a 7-point Likert scale ("1 = Strongly disagree"; "7 = Strongly agree"), meaning higher scores indicated higher compassion. The mean score was calculated if the

participant had at least 50% of the responses available. The variable was treated as a continuous one.

The scale has good reliability. The internal consistency was high in the current study (α = 0.84). Past studies have confirmed the reliability of the scale. For instance, the test-retest estimate has been good in the past (Shiota, 2003) and the internal consistency estimates have been strong (Stellar, John-Henderson, et al., 2015; Yaden et al., 2019).

Moreover, the validity of the scale is good. To illustrate, the structural validity of the scale has received support (Dixson et al., 2018). The scale has shown convergent validity too, as high score of compassion has been linked with more positive affect, prosocial behaviors, higher kindness, warmth, and cooperativeness (Dixson et al., 2018; Güsewell & Ruch, 2012; Lim & DeSteno, 2016; Shiota et al., 2006).

4.2.2 Self-compassion (Study III)

Trait self-compassion was assessed using the short-form version of the Self-Compassion Scale in 2019–2020 (Raes et al., 2011). The short-form version assesses global and overall self-compassion with 12 items. Items are such as "*When I'm going through a very hard time, I give myself the caring and tenderness I need*" and "*When I fail at something important to me I become consumed by feelings of inadequacy*" (a reverse item). The responses were given on a 5-point Likert scale ("1 = Almost never"; "5 = Almost always"). All items were coded so that higher scores referred to higher self-compassion. The mean score of self-compassion was calculated for those who had at least 50% of the data available. The variable was treated as a continuous one.

The reliability of the scale is sufficient. The internal consistency was acceptable in the current study (α = 0.70). The reliability of the scale has been acceptable in the past as well, as indicated by the estimates of internal consistency and test-retest (Alfonsson et al., 2023; Castilho et al., 2015; Uršič et al., 2019).

The scale has been validated before as, for example, the scale has shown acceptable model fits (Raes et al., 2011). Moreover, there is evidence for convergent validity as the current short-form and the original long-form scales have a very high correlation ($r \geq 0.97$), meaning the short form is representative of the long form (Raes et al., 2011). The scale also demonstrates convergent validity in other contexts, as high self-compassion has been associated with, for example, less psychopathology in the form of depression and anxiety (Alfonsson et al., 2023).

4.2.3 Job characteristics (Study I)

Job demands-control

Job demands-control was assessed in 2001, 2007, and 2012.

Job demands was assessed with three items from the Occupational Stress Questionnaire (Elo et al., 1992): "*Do you have to hurry to get your work done*?", "*Does your work have phases that are too difficult*?", and "*Is your work mentally strenuous?*". The responses ranged from 1 to 5 ("1 = Never"; "5 = "All the time").

Job control was assessed with nine items from the original Job Content Questionnaire (Karasek, 1985). The participants reported their answers using a 5-point Likert scale ("1 = Completely disagree"; "5 = Completely agree").

All items were recorded so that higher scores reflected higher *job demands* and higher *job control*. The mean score of *job demands* and *job control* was calculated for those participants who had at least 50% of the data available on each of these scales.

The reliability of the scales in the current study was acceptable. To examine the internal consistency of *job demands* and *job control*, the inter-item and corrected item-total correlations were carried out. For *job demands*, inter-item correlations were 0.23 (2001), 0.24 (2007), and 0.23 (2012), while the corrected item-total correlations were 0.68–0.78 (2001), 0.69–0.78 (2007), and 0.70–0.78 (2012). For *job control*, the inter-item correlation values were 0.42 (2001), 0.38 (2007), and 0.34 (2012), and the corrected item-total correlations were 0.51–0.75 (2001), 0.52–0.79 (2007), and 0.48–0.79 (2012). The test-retest correlation of 2001 and 2012 measurements was moderate for both *job demand* ($r = 0.45$, $p < 0.001$) and *job control* ($r = 0.55$, $p < 0.001$). Thus, the reliability of *job demands* and *job control* was within acceptable levels (Ferketich, 1991; Piedmont, 2014).

The scales have received support for their reliability. In the past, the Cronbach's alpha has been 0.60–0.87 for *job demands*, and for *job control* the same estimates have been 0.85–0.90 (Hintsanen et al., 2011; Rosenström et al., 2011; Törnroos et al., 2017).

The scales have also received support for their validity. The validity of the *job demands* scale was seen as satisfactory in a large sample of more than 25,000 workers representing a variety of occupations (Elo et al., 1992). The three *job demand* items were developed at the Finnish Institute of Occupational Health and are comparable to the original Job Content Questionnaire (Karasek, 1985). Moreover, both subscales have predictive validity. For example, higher *job*

demands predict higher depressive symptoms and higher *job control* predicts fewer sleep problems (Pulkki-Råback et al., 2016; Törnroos et al., 2017). In addition, high job strain is associated with approximately 50% excess risk of cardiovascular heart disease (Kivimäki et al., 2006).

Job demands-control can be calculated using several formulas. Past research has recommended considering the additive effects of *job demands* and *job control*. To paraphrase, job strain increases as job demands increase and job control decreases (Landsbergis et al., 1994; MacCallum et al., 2002). Thus, the current dissertation used the following formula: *job demands-control = job demands − job control*. The variable was treated as a continuous one.

Effort-reward imbalance (ERI)

Effort-reward imbalance was assessed in 2001, 2007, and 2012.

Effort was assessed with the same items as job demands, namely the three items from the validated Occupational Stress Questionnaire (Elo et al., 1992).

Reward items of the original scale were not available. Thus, *a reward proxy* was employed, which has been commonly used in the Finnish work stress studies (Hintsa et al., 2007, 2010; Hintsa, Määttänen, et al., 2013; Hintsanen et al., 2007, 2010, 2011). *Reward proxy* was assessed with three items from the Occupational Stress Questionnaire (Elo et al., 1992): "*Do you get help and support from your superior if needed?*" ("1 = Very little"; "5 = Very much"), "*How do your co-workers get along with each other at the workplace?*" (Their relationship is: "1 = Bad, tense, resentful, etc."; "5 = Very good"), and "*How satisfied are you with your current employment?*" ("1 = Very unsatisfied"; "5 = Very satisfied"). The *reward proxy* items are like those of the original reward subscale (Siegrist, 1996; Siegrist et al., 2004). Moreover, the *reward proxy* correlates with the original reward subscale ($r = 0.59$, $p < 0.001$) (Hintsanen et al., 2011). The *reward proxy* items also reflect the esteem component of the original scale (Siegrist et al., 2004). Higher *reward proxy* scores indicate higher perception of rewards.

The reliability of the reward scale was acceptable. Regarding internal consistency, inter-item correlations for *reward proxy* were $r = 0.25$ (2001), $r = 0.26$ (2007), and $r = 0.28$ (2012). The corrected item-total correlations for *reward proxy* were $r = 0.71$–0.79 (2001), $r = 0.67$–0.75 (2007), and $r = 0.69$–0.77 (2012). The test-retest correlation for *reward proxy* between 2001 and 2012 was weak ($r = 0.28$, $p < 0.001$). Taken together, the current *reward proxy* showed acceptable reliability (Ferketich, 1991; Piedmont, 2014).

Regarding reliability, in the past, the Cronbach's alpha of the *reward proxy* scale has been within the acceptable range, although at the lower end (α = 0.50-0.61) (Hintsa et al., 2007, 2010; Hintsa, Määttänen, et al., 2013; Hintsanen et al., 2007, 2010, 2011).

The *reward proxy* scale also has shown to be a valid measurement. For example, the scale has predictive validity as high *reward proxy* has been associated with higher heart rate variability and lower heart rate, which decrease the risk of cardiovascular events (Hillebrand et al., 2013; Hintsanen et al., 2007; D. Zhang et al., 2016).

To calculate *effort-reward imbalance*, it has been recommended that the mean score of *effort* be divided by the mean score of *reward* (Siegrist et al., 2004). Thus, the *effort-reward imbalance* was calculated using the following formula: *effort-reward imbalance = effort ÷ reward proxy*. The variable was treated as a continuous one.

4.2.4 Sleep (Study II)

Sleep was assessed with the following variables: *sleep duration*, *perceived sleep deficiency*, and *sleep difficulties*. *Sleep difficulties* were assessed with two questionnaires: *sleep difficulties* with sleep items from the Maastricht Vital Exhaustion Questionnaire (Appels et al., 1987) and *sleep problems* with Jenkins's Sleep Scale (Jenkins et al., 1988). The distinction between *sleep difficulties* and *sleep problems* was made as *sleep difficulties* were assessed with a longitudinal design, whereas *sleep problems* were assessed with a cross-sectional design.

Sleep duration was assessed in 2012. The participants reported their habitual sleep duration per night from 10 options: 5 hours or less, 6 hours, 6.5 hours, 7 hours, 7.5 hours, 8 hours, 8.5 hours, 9 hours, 9.5 hours, or 10 hours or more. Sleep duration was, thereafter, categorized into three groups: "1 = *Sleep duration 6.5 hours or less per night*", "2 = *Sleep duration between 7 and 8.5 hours per night*" (reference group), and "3 = *Sleep duration 9 hours or more per night*". Similar sleep duration groupings have been used in the past (Cappuccio et al., 2010). Sleep duration has good predictive validity as both deficit and excess of sleep predict a greater risk of coronary heart disease and stroke (Cappuccio et al., 2011). Sleep duration was treated as a categorical variable.

Perceived sleep deficiency was assessed in 2012. As with *sleep duration*, participants selected one option out of 10 possibilities for their *perceived sleep need* per night: 5 hours or less, 6 hours, 6.5 hours, 7 hours, 7.5 hours, 8 hours, 8.5 hours,

9 hours, 9.5 hours, or 10 hours or more. The following formula assessed *perceived sleep deficiency*: *perceived sleep deficiency = sleep duration − perceived need for sleep*. An identical formulation has been used in the past (Hintsanen et al., 2014; Talvitie et al., 2019). *Perceived sleep deficiency* also has good predictive validity as low *perceived sleep deficiency* is associated with a decreased risk for various health outcomes such as coronary heart disease and metabolic disorder (Altman et al., 2012; Shankar et al., 2010). *Perceived sleep deficiency* was treated as a continuous variable.

Sleep problems were assessed in 2012 with Jenkins's Sleep Scale (Jenkins et al., 1988). The four items assess problems falling asleep, problems remaining asleep, waking up several times during the night, and feeling tired after a usual amount of sleep at night (in the past four weeks). The participants gave their responses using a 6-point Likert scale ("1 = Never", "2 = 1–3 nights/month", "3 = Approximately 1 night/week", "4 = 2–4 nights/week", "5 = 5–6 nights/week", "6 = Every night"). The scale assesses the frequency of the most prevalent sleep complaints, and the items are close to the insomnia criteria in the Diagnostic and Statistics Manual of Mental Disorders Fourth Edition (American Psychiatric Association, 1994). For each participant, a sum score of *sleep problems* was calculated if they had responded to all items, meaning no missing values were allowed. Higher scores indicated greater *sleep problems*, and the variable was treated as a continuous variable.

The *sleep problems* scale has shown good reliability and validity. In the current study, the Jenkins's Sleep Scale showed good internal consistency ($\alpha = 0.78$). In the past, the internal consistency and structure of the scale has received support in a cohort study of 80,000 adults (Juhola et al., 2021). The scale also has good predictive validity as prospective studies have found that having few *sleep problems* predicts fewer depressive symptoms and cardiovascular events (Campbell et al., 2013; Jackowska & Steptoe, 2015).

Sleep difficulties were assessed in 2001, 2007, and 2012. Four sleep-related items from the Maastricht Vital Exhaustion Questionnaire (Appels et al., 1987) were used to assess sleep difficulties. These were "*Do you often feel tired?*", "*Do you often have trouble falling asleep?*", "*Do you wake up repeatedly during the night?*", "*Do you ever wake up with a feeling of exhaustion or fatigue?*". Possible responses were 0 ("No"), 1 ("I don't know"), and 2 ("Yes"). A summed value of *sleep difficulties* was calculated for each participant for each measurement year, and thus, no missing values were accepted. Higher scores referred to higher *sleep difficulties*. *Sleep difficulties* was treated as a continuous variable.

The *sleep difficulties* scale has shown reliability and validity within the acceptable limits. In the current study, the internal consistency of *sleep difficulty* items was examined using inter-item and item-total correlations. The inter-item correlations were $r = 0.18$, $r = 0.25$, and $r = 0.24$ in 2001, 2007, and 2012, respectively. The item-total correlations were $r = 0.62$-0.73 in 2001, $r = 0.67$-0.75 in 2007, and $r = 0.65$-0.75 in 2012. The test-retest for *sleep difficulties* in 2001 and 2012 was also examined ($r = 0.45$, $p < 0.001$). Taken together, the reliability of the *sleep difficulty* scale was acceptable in the current study (Ferketich, 1991; Piedmont, 2014). Past research has indicated that the Cronbach's alpha value of *sleep difficulties* has been acceptable in the past ($\alpha = 0.67$, Smith et al., 2009).

Past research has shown satisfactory validity for *sleep difficulties*. For example, regarding predictive validity, low scores on the sleep items of the Maastricht Vital Exhaustion Questionnaire are associated with fewer depressive symptoms, better health status, and decreased risk for cardiovascular disease incident (Balog et al., 2017; McGowan et al., 2004; Smith et al., 2009).

4.2.5 Body composition (Study III)

The *body composition* of the participants was measured at a clinic in 2019–2020. Body composition measurements were taken either (1) manually by a professional or (2) body composition was assessed by a professional with a bioelectrical impedance analysis device, InBody 770. In bioelectrical impedance analysis, a person stands on the device while a non-detectable low electrical current of different frequencies is sent through the body via hand and foot electrodes. As electrical currents react to water within the body, the device estimates the total body water content. Moreover, the electrical currents react differently to muscle and fat tissue, as they contain different amounts of water. Thereafter, algorithms estimate the different body composition measurements. InBody testing has received support for acceptable validity and reliability in the past (McLester et al., 2020; Schubert et al., 2019).

A total of five different body composition indicators were measured: *waist circumference*, *waist-to-hip ratio*, *body mass index* (*BMI*), *body fat percentage*, and *fat mass index*. *Waist circumference* (in centimeters) and *waist-to-hip ratio* (waist circumference in centimeters divided by hip circumference in centimeters, i.e., *waist cm ÷ hip cm*) were measured manually. *BMI*, *body fat percentage*, and *fat mass index* were evaluated by InBody testing. *BMI* is calculated as body weight in kilograms divided by height in meters squared (i.e., *weight in kg ÷ height in m²*).

Body fat percentage unit is a percentage (%). *Fat mass index* is calculated as dividing the body fat in kilograms by height in meters squared (i.e., *fat in kg ÷ height in* m^2). All body composition measurements were treated as continuous variables.

All five body composition measurements have good predictive validity, as their lower estimates are associated with decreased risk for metabolic disorder, cardiovascular events, and decreased risk for mortality (Bonikowske et al., 2019; Czernichow et al., 2011; De Koning et al., 2007; Després, 2012; Janssen et al., 2004; Liu et al., 2013; Sedlmeier et al., 2021).

Table 1 presents all the main study variables of Study I, Study II, and Study III, as well as their means, standard deviations, ranges, and frequencies.

Table 1. Means, standard deviations (*SD*), ranges, and frequencies of main study variables, in addition to age and gender, in the first follow-up measurement.

	Study I (*n* = 723)				Study II (*n* = 1,064)				Study III (*n* = 789)			
	Mean	*SD*	Range	Frequency	Mean	*SD*	Range	Frequency	Mean	*SD*	Range	Frequency
Age (in years)	32.7	4.9	24.0–39.0		32.0	5.0	24.0–39.0		34.0	0.7	32.9–36.1	
Gender (female)				344 (47.6%)				604 (56.8%)				411 (52.1%)
Job characteristics (I)												
Job demands-control	-0.98	0.87	-3.3–2.9									
Job demands	2.88	0.64	1.0–5.0									
Job control	3.86	0.70	1.0–5.0									
Effort-reward imbalance	0.78	0.28	0.2–3.3									
Reward	3.86	0.67	1.0–5.0									
Sleep (II)												
Sleep duration												
6.5 hours or less								219 (20.6%)				
Between 7.0–8.5 hours								801 (75.3%)				
9 hours or more								22 (4.1%)				
Perceived sleep deficiency					1.0	1.5	-4.0–9.0					
Sleep problems					9.3	4.1	4.0–24.0					
Sleep difficulties (2001)					2.7	2.3	0.0–8.0					
Body composition (III)												
BMI (kg/m^2)									26.0	4.7	15.0–49.1	
Waist circumference (cm)									88.5	12.6	61.0–145.5	
Waist-to-hip ratio									0.9	0.1	0.8–1.2	
Body fat percentage (%)									26.6	9.8	5.4–54.6	
Fat mass index (kg/m^2)									7.2	3.9	1.1-26.4	
Self-compassion									3.1	0.7	1.0-5.0	
Compassion	3.69	0.62	1.0–5.0		3.7	0.6	1.0–5.0		5.4	0.9	1.0-7.0	

4.2.6 Covariates

Study I (compassion and job characteristics)

Covariates of Study I included *age*, *gender* (female/male), and *socioeconomic factors in childhood* (1980) and *adulthood* (2011). Past studies investigating job characteristics have used similar factors as covariates (Hintsanen et al., 2011; Törnroos et al., 2013). Participants provided self-reported data regarding all covariates. **Table 2** presents the correlation coefficients between study variables and the covariates.

The socioeconomic position in childhood included three factors: parental occupation status, parental educational level, and annual family income. Parental occupational status consisted of three groups: 1 = manual, 2 = lower grade non-manual, and 3 = upper grade non-manual. Parental educational level was also categorized into three groups: 1 = comprehensive school, 2 = high school or vocational school, and 3 = academic level (i.e., university or university of applied sciences). Parents were asked to report their annual income by selecting one option of out eight: 1 = less than 15,000 Finnish marks/year; 8 = more than 100,000 Finnish marks/year.

The socioeconomic position in adulthood included three factors: occupational status, educational level, and annual income. Occupational status and educational level were categorized and labeled identically with parental occupational status and parental educational level, respectively. Participants reported their annual income on a 13-point scale: 1 = Less than €5,000/year; 13 = More than €60,000/year. Both parental and adulthood occupational statuses and educational levels were treated as categorical variables and income as a continuous variable.

Past studies have indicated that both high childhood and high adulthood socioeconomic position predict, for example, lower job strain and higher job control in adulthood (Elovainio et al., 2007; Hintsa et al., 2006; Landsbergis et al., 2003; Torén et al., 2014).

Table 2. The correlation coefficients between the study variables (2012) and covariates (2011) in Study I.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Compassion	1.0													
2. JDC	-0.21***	1.0												
3. Job demands[1]	0.011	0.65***	1.0											
4. Job control	0.26***	-0.67***	0.13**	1.0										
5. ERI	-0.19***	0.60***	0.65***	-0.14***	1.0									
6. Reward	0.27***	-0.40***	-0.17***	0.36***	-0.76***	1.0								
7. Age	0.11**	-0.08	-0.03	0.07	-0.05	0.03	1.0							
8. Gender	0.14***	0.11**	0.12**	-0.03	0.07	-0.001	0.11**	1.0						
9. AO	0.09*	-0.17***	0.14***	0.36***	0.04	0.08	-0.03	-0.10**	1.0					
10. AE	0.09*	-0.11**	0.14***	0.28***	0.03	0.09*	-0.11**	0.04	0.49***	1.0				
11. AI	0.04	-0.19***	0.13**	0.37***	-0.01	0.13***	-0.01	-0.29***	0.56***	0.40**'	1.0			
12. PO	0.04	-0.04	0.12**	0.17***	0.05	0.03	-0.13***	0.01	0.18***	0.16***	0.19***	1.0		
13. PE	-0.04	-0.07	0.06	0.15***	0.01	0.04	0.23***	-0.09*	0.22***	0.20***	0.16***	0.70***	1.0	
14. PI	0.03	-0.11**	0.07	0.22***	-0.01	0.11**	0.001	-0.002	0.22***	0.22***	0.20***	0.53***	0.48***	1.0

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$

[1]Job demands and effort were assessed with the same items.

JDC = Job demands-control, ERI = Effort-reward imbalance, AO = Adulthood occupational status, AE = Adulthood educational level, AI = Adulthood income, PO = Parental occupational status, PE = Parental educational level, PI = Parental income

Study II (compassion and sleep)

Covariates of Study II included *age*, *gender* (female/male), *socioeconomic position in childhood* (1980) and *adulthood* (2011), *BMI* (2012), *health behaviors* (2012), *working conditions* (2012), and *depressive symptoms* (2012). Identical or very similar covariates as in Study II, as listed above, have been used in previous sleep studies (Hintsanen et al., 2014; Talvitie et al., 2019; Törnroos et al., 2017). Participants provided self-reported data regarding all covariates. **Table 3** presents the correlation coefficients between study variables and the covariates.

Socioeconomic factors in childhood and adulthood in Study II were identical to Study I. In other words, the socioeconomic position in childhood included three factors: parental occupational status (three groups; manual, lower grade non-manual, upper grade non-manual), parental educational level (three groups; comprehensive school, high school or vocational school, academic level), and annual family income (eight groups). Similarly, *the socioeconomic position in adulthood* included three factors: occupational status (three groups; manual, lower grade non-manual, upper grade non-manual), educational level (three groups; comprehensive school, high school or vocational school, academic level), and annual income (13 groups). Occupational statuses and educational levels were treated as categorical variables and income as a continuous variable. High childhood and adulthood socioeconomic positions have been associated with better sleep outcomes, such as longer sleep duration and fewer sleep difficulties as adults (Etinde Sosso et al., 2021; Matthews et al., 2018; Tomfohr et al., 2010).

Health behaviors included (1) *smoking*, (2) *alcohol consumption*, and (3) *physical activity.* First, *smoking* was categorized as a dichotomous variable: 1 = daily smokers, 0 = others. *Smoking* was added as a covariate as non-smokers report better sleep quality and quantity in self-reports and in physiological measurements (Jaehne et al., 2012; Riedel et al., 2004).

Second, participants were asked about their *alcohol consumption* habits. In other words, how frequently they consume six portions of alcohol at a time on a 5-point scale: 1 = twice a week or more, 2 = once a week, 3 = 2–3 times a month, 4 = once a month, 5 = 2–6 times a year. One portion of alcohol equals 12 grams. *Alcohol consumption* was treated as a continuous variable. Alcohol has a dose-dependent and negative effect on sleep and consequent restoration (Pietilä et al., 2018; Zheng et al., 2021).

Third, *physical activity* was a composite (and continuous) variable, consisting of different dimensions. These dimensions were intensity, frequency, hours per week, average duration, and participation in structured sports activities. Higher *physical activity* index score indicated higher physical activity. A detailed description of the scoring and coding of the *physical activity* index can be found elsewhere (Telama et al., 1997). High *physical activity* has been found to improve sleep quality (Jurado-Fasoli et al., 2020; Kredlow et al., 2015).

Working conditions included (1) employment status, and (2) shift work. Employment status was a dichotomous variable: 0 = employed (i.e., working full-time), 1 = unemployed. Similarly, shift work was also a dichotomous variable: 0 = regular day job 1 = shift work (morning/evening, morning/evening/night, evening/night shifts, irregular shifts). Being employed and having a regular day job have been associated with better sleep outcomes (Mai et al., 2019; Rahim et al., 2021).

Depressive symptoms were assessed with Beck's Depression Inventory II (BDI-II) (Beck et al., 1996). The inventory has 21 items and participants responded to them on a 4-point scale (range: 0–3) ($\alpha = 0.91$). Higher scores signify more severe depressive symptoms. As a sum score is calculated for the *depressive symptoms*, no missing values are accepted. Past studies have indicated that having few *depressive symptoms* is associated with better sleep outcomes, and the relationship is potentially a bidirectional one (Chunnan et al., 2022; Dinis & Bragança, 2018). The adjustment of depressive symptoms by using BDI-II has been common in studies exploring sleep as an outcome (Hintsanen et al., 2014; Talvitie et al., 2019). As additional analysis, it was checked whether BDI-II without the sleep items would affect the association between compassion and sleep. After adjusting for the BDI-II without the sleep items, the findings were identical to the original results regarding compassion and perceived sleep deficiency, and compassion and sleep problems.

The reliability and validity of the BDI-II have been good in the past studies. For example, internal consistency estimates of the scale have been high ($\alpha = 0.84$-0.94) (for a review, Y. P. Wang & Gorenstein, 2013). BDI-II has also shown concurrent validity with, for example, other depression scales, anxiety, hopelessness, and suicide ideation (for a review, Y. P. Wang & Gorenstein, 2013).

Table 3. The correlation coefficients between the study variables (2012) and covariates (2011) in Study II.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. Comp.	1.0																			
2. SD	0.06*	1.0																		
3. PSD	-0.08*	-0.50‡	1.0																	
4. SP	0.12‡	0.19‡	0.44‡	1.0																
5.SD	0.15‡	0.14†	0.42‡	0.75‡	1.0															
6. Gend.	0.15‡	0.16‡	0.06	0.05*	0.07*	1.0														
7. Age	0.11‡	0.05	0.06	0.02	0.03	0.05	1.0													
8. AE	0.09†	0.06*	0.01	-0.06*	-0.05	0.08*	-0.19‡	1.0												
9. AO	0.04	-0.001	0.05	-0.03	-0.06	0.12‡	-0.03	0.43‡	1.0											
10. AI	0.04	0.07*	-0.004	-0.08*	-0.13‡	-0.29‡	0.004	0.29‡	0.49†	1.0										
11. PI	0.05	0.02	-0.02	-0.06	-0.10†	-0.01	-0.03	0.21‡	0.22‡	0.17‡	1.0									
12. PO	0.05	0.01	0.03	0.01	-0.04	-0.01	-0.13‡	0.25‡	0.22‡	0.17‡	0.52‡	1.0								
13. PE	0.01	0.0002	0.06	0.03	-0.03	-0.05	-0.28‡	0.26‡	0.21‡	0.14‡	0.48‡	0.70‡	1.0							
14. BMI	-0.10†	-0.06*	0.02	0.04	0.10†	-0.07*	0.12‡	-0.12‡	-0.07*	-0.03	-0.14‡	-0.12‡	-0.13†	1.0						
15. PA	0.06	0.001	-0.02	-0.06	-0.09*	0.08*	-0.04	0.13‡	0.09†	0.12‡	0.09†	0.07†	0.05	-0.12‡	1.0					
16. AC	-0.16‡	-0.05	-0.03	0.04	0.02	-0.32‡	0.03	-0.15‡	-0.03	0.06	-0.02	0.02	-0.01	0.12‡	-0.08†	1.0				
17. SMO	-0.05	-0.07*	0.03	0.004	0.02	-0.05	-0.0002	-0.16‡	-0.10†	0.06	-0.07	-0.09†	-0.10†	0.03	-0.14‡	0.21‡	1.0			
18. ES	0.02	-0.03	-0.004	-0.01	-0.02	-0.01	0.05	-0.001	-0.03	0.24‡	-0.06*	-0.08*	-0.07*	-0.05	0.07†	0.02	0.05	1.0		
19. WC	-0.02	0.01	0.03	0.04	0.06	-0.02	-0.05	-0.13‡	-0.21‡	-0.18‡	-0.03	-0.05	-0.05	0.03	-0.01	-0.01	0.05	-0.13‡	1.0	
20. DS	-0.18‡	-0.09†	0.32‡	0.50‡	0.54†	0.08†	0.002	-0.03	-0.003	-0.13‡	-0.05	0.02	0.03	0.11‡	-0.07*	-0.0002	0.01	-0.06*	0.03	1.0

*$p \leq 0.05$, †$p \leq 0.01$, ‡$p \leq 0.001$

Comp = Compassion, SD = Sleep duration, PSD = Perceived sleep deficiency, SP = Sleep problems, SD = Sleep difficulties, Gend. = Gender, AE = Adulthood educational level, AO = Adulthood occupational status, AI = Adulthood income, PI = Parental income, PO = Parental occupational status, PE = Parental educational level, BMI = Body mass index, PA = Physical activity, AC = Alcohol consumption, SMO = Smoking, ES = Employment status, WC = Working conditions, DS = Depressive symptoms

Study III (compassion, self-compassion, and body composition)

Covariates of Study III included *sex assigned at birth* (female/male) in 1985–1986, as well as *childhood and adulthood socioeconomic position* in 1993 and 2019–2020, respectively. Age was not added as a covariate as the sample was investigated as a single age cohort. Participants provided self-reported data regarding all covariates. **Table 4** presents the correlation coefficients between study variables and the covariates.

Childhood socioeconomic position was determined by three factors: parental occupational status, parental educational level, and parental employment status in 1993. The parental educational level and occupational status were categorized similarly to those in Studies I and II, meaning parental occupational status had three groups (1 = manual, 2 = lower grade non-manual, 3 = upper grade non-manual) and parental educational level had three groups (1 = comprehensive school, 2 = high school or vocational school, 3 = academic level). Parental employment was defined by three groups: 1 = both parents unemployed, 2 = one parent employed, and 3 = both parents employed.

The values of the three *childhood socioeconomic position* variables were summed together. Thus, we created a further continuous composite variable 'childhood socioeconomic score'. The childhood socioeconomic score ranged from 3 to 9, with higher values reflecting a higher socioeconomic position in childhood. The use of such composite socioeconomic variable has been done in the past (Lindberg et al., 2022; Saarinen, Keltner, Dobewall, et al., 2021).

Adulthood socioeconomic position included three factors: occupation status, educational level, and annual income.

Occupation status was categorized into two groups: 0 = manual labor or lower-grade non-manual labor, and 1 = upper-grade non-manual labor. Manual labor and lower-grade non-manual labor groups were combined, as only four participants reported manual labor as their occupation group. Occupational status was treated as a categorial variable.

There were also two educational level groupings: 0 = comprehensive school or high school/vocational school, 1 = academic level (university or university of applied sciences). Only four participants reported comprehensive school as their highest educational level, and thus these participants were added to the next highest group: the high school/vocational school group. Educational level was treated as a categorical variable.

Participants reported their annual income in euros (€). Annual income was asked with an open question: "*How high was your annual income last year (before taxes)?*." Income was treated as a continuous variable.

High childhood and adulthood socioeconomic positions have been either associated with, or even predicted, several body composition indicators, such as lower BMI, waist circumference, waist-to-hip ratio, and body fat indices in adulthood (Kivimäki, Davey Smith, et al., 2006; Laaksonen et al., 2004; Lowry et al., 2020; Newton et al., 2017; Poulsen et al., 2018; Ziol-Guest et al., 2009).

Table 4. The correlation coefficients between the study variables and covariates (2019-2020) in Study III.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Compassion	1.0													
2. Self-compassion	0.11**	1.0												
3. BMI	0.07	-0.05	1.0											
4. WC	-0.12***	-0.02	0.89***	1.0										
5. WHR	-0.05	-0.04	0.79***	0.79***	1.0									
6. BF%	0.05	-0.07	0.69***	0.50***	0.72***	1.0								
7. FMI	0.001	-0.06	0.87***	0.68***	0.78***	0.94***	1.0							
8. Gender	0.18***	-0.02	-0.07	-0.33***	-0.01	0.54***	0.35***	1.0						
9. AO	0.03	0.06	-0.16***	-0.19***	-0.18***	-0.02	-0.07*	0.17***	1.0					
10. AE	-0.04	0.08*	-0.18***	-0.20***	-0.21***	-0.06	-0.12**	0.15***	0.75***	1.0				
11. AI	-0.01	-0.03	-0.04	-0.01	-0.09*	-0.15***	-0.12***	-0.14***	0.03	0.03	1.0			
12. PO	-0.05	-0.003	-0.08*	-0.08*	-0.10**	-0.08*	-0.08*	-0.001	0.12***	0.20***	-0.02	1.0		
13. PES	0.03	-0.01	-0.09*	-0.07	-0.10**	-0.12**	-0.10**	-0.03	0.05	0.10**	-0.03	0.16***	1.0	
14. PE	-0.09*	-0.01	-0.01	0.01	-0.04	-0.05	-0.02	-0.05	0.13***	0.19***	-0.05	0.37***	0.11**	1.0

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$

BMI = Body mass index, WC = Waist circumference, WHR = Waist-to-hip ratio, BF% = Body fat percentage, FMI = Fat mass index, AO = Adulthood occupational status, AE = Adulthood educational level, AI = Adulthood income, PO = Parental occupational status, PES = Parental employment status, PE = Parental educational level

4.3 Statistical analyses

The statistical software STATA and its versions SE 16.1 (Study I, II) and BE 17.0 (Study III) were used to analyze the data. The statistical assumptions were checked and confirmed for all three studies and their respective analyses. To illustrate, there was a linear relationship between the study variables, the variables were distributed normally, there was little multicollinearity between the variables, the observations were independent of each other (i.e., random, no clustering), and there was homogeneity of variance between the variables (Berry & Feldman, 1985).

In addition, attrition analyses were done for the included and excluded (and dropped-out) participants: independent t-tests were used for continuous variables and chi-square tests for categorical variables.

4.3.1 Study I

The first aim was to investigate the temporal relationship of trait compassion with job characteristics. In other words, job demands-control, effort-reward imbalance, and their subcomponents job demands, job control, and reward. Effort was calculated with the same items as job demand. Compassion and job characteristics were measured in 2001 and 2012. Cross-lagged panel models were used to investigate the potential temporal relationships. Four models were created and estimated: (1) an autoregressive model (i.e., compassion and job characteristics were included in the model, but no predictive pathways were added), (2) the predictive pathway running from compassion to job characteristics, (3) the predictive pathway running from job characteristics to compassion (i.e., the opposite direction), and (4) bidirectional predictive pathways (i.e., both predictive pathways running from compassion to job characteristics, as well as predictive pathways running from job characteristics to compassion). Age, gender, and socioeconomic factors in childhood and adulthood were added as covariates. In addition, all models had covariances added between compassion and job characteristics in 2001 and 2012. It was assumed that the two variables would correlate with one another and adding covariances would thus improve the fit of the model.

To evaluate the statistical fits of the predictive models, the following estimates were examined: Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Bayesian Information Criterion (BIC), and χ^2 test

difference between Models 1–4. The cut-off values for good statistical fits are < 0.06 for RMSEA, > 0.95 for CFI, and lower scores of BIC and χ^2 indicate better fits (L. Hu & Bentler, 1999; Schreiber et al., 2006).

The second aim of Study I was to examine the longitudinal association of trait compassion with job demands-control, effort-reward imbalance, and their subcomponents. In other words, whether compassion measured in 2001 predicted the developmental trajectory of different job characteristics over an 11-year follow-up. This was done by examining growth curve models by using multilevel modeling with maximum likelihood estimation. Maximum likelihood estimation is used when the variables are continuous and normally distributed.

The growth curve models estimate both fixed effects and random effects. The fixed effects are interpreted as regression coefficients of the predictor variables. The random effect was the residual variance, or the random variation that occurs within individuals over the follow-up.

In practice, a model was created in which trait compassion measured in 2001 predicted job characteristics measured in 2001, 2007, and 2012. The fixed effects included intercept, compassion (2001), age, age squared (i.e., to test curvilinearity), gender, and socioeconomic factors in childhood and adulthood. Compassion and age interactions were also checked to see whether the effect of compassion was continuous over the follow-up. The age of the participants was centered to improve the interpretability of the results. In practice, this meant that the age of the participants was centered in 2001 (i.e., the first measurement year) to 24 years (i.e., the youngest age cohort).

4.3.2 Study II

The first aim of Study II was to examine the cross-sectional association between trait compassion and self-reported sleep. Multiple logistic regression analysis was carried out to see whether compassion predicted sleep duration, meaning short sleepers (i.e., 6.5 hours or less) versus long sleepers (i.e., 9 hours or more). Multiple linear regressions were used to see if compassion predicted perceived sleep deficiency, sleep problems, and sleep difficulties. Three models with each sleep indicator were created with different covariates. Model 1 included age and gender. Model 2 included age, gender, childhood and adulthood socioeconomic position, BMI, health behaviors (physical activity, alcohol consumption, smoking), and working conditions (shift work, employment). Model 3 included all the variables mentioned above and depressive symptoms.

Second, the temporal relationship of trait compassion with sleep difficulties was assessed with the measurements from 2001 and 2012. Four cross-lagged panel models were used for this investigative purpose. Model 1 included compassion and sleep difficulties, but there were no predictive pathways included (i.e., only autoregressive pathways), Model 2 included predictive pathways running from compassion to sleep difficulties, Model 3 had the predictive pathways running in the opposite direction (i.e., from sleep difficulties to compassion), and finally, Model 4 had predictive pathways running in both directions (i.e., from compassion to sleep difficulties, and from sleep difficulties to compassion). Age, gender, and childhood and adulthood socioeconomic positions were added as covariates. In addition, covariances were added between compassion and sleep difficulties at both measurement years. It was assumed that the two variables would correlate with one another and adding covariances would thus improve the fit of the model.

To evaluate the statistical fits of the predictive models, the following estimates were examined: Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Bayesian Information Criterion (BIC), and χ^2 test difference between Models 1–4. The cut-off values for good statistical fits are < 0.06 for RMSEA, > 0.95 for CFI, and lower scores of BIC and χ^2 indicate better fits (L. Hu & Bentler, 1999; Schreiber et al., 2006).

Third, it was examined whether trait compassion predicted the development of sleep difficulties over the 11-year follow-up. This aim was achieved with growth curve models, using multilevel modeling with maximum likelihood estimation. As mentioned before, multilevel models estimate fixed effects as regression coefficients, as well as random effects. In Study II, the random effects included the residual variance (i.e., the random variation within-individual over the follow-up) and variance of the intercept (i.e., the variation in the intercept between-individuals over the follow-up).

The multilevel models examined whether compassion measured in 2001 predicted the developmental trajectory of sleep difficulties measured in 2001, 2007, and 2012. For this analysis, three models were created. The fixed effects of Model 1 included intercept, compassion (2001), age, age-squared (i.e., to check curvilinearity), and gender. In addition to the above-mentioned variables, Model 2 was further adjusted for childhood and adulthood socioeconomic positions, BMI, health behaviors, and working conditions. Lastly, Model 3 was even further adjusted for depressive symptoms, in addition to the variables in Model 2. Compassion and age interactions were also checked to see whether the effect of compassion was continuous over the follow-up. The age of the participants was

centered on the age of 24 in 2001. In other words, age was centered on the youngest age cohort in the first measurement year to improve the readability of the results.

4.3.3 Study III

In Study III, the aim was to examine the cross-sectional relationship between trait compassion and body composition. The measurements were done in 2019–2020. Linear regression analyses were run to examine whether compassion predicted body composition (i.e., BMI, waist circumference, waist-to-hip ratio, body fat percentage, and fat mass index). Model 1 was unadjusted, Model 2 was adjusted for sex, and Model 3 was adjusted for sex as well as childhood socioeconomic score and adulthood socioeconomic position. The potential moderating effect of sex was checked with two-way interaction terms (i.e., compassion × sex). There was no evidence that sex moderated the relationship between compassion and body measurements. Thus, the analyses were run for the whole sample.

To investigate the cross-sectional relationship between self-compassion and body composition, linear regression analyses were also conducted. The measurements were carried out in 2019–2020. Model 1 was unadjusted, Model 2 was adjusted for sex, and Model 3 was adjusted for sex as well as childhood socioeconomic score and adulthood socioeconomic position. The potential moderating effect of sex was also checked with self-compassion, with two-way interaction terms (i.e., self-compassion × sex). As the interactions were not significant, the analyses were not run separately for women and men in the case of self-compassion either.

Table 5 displays Study I, II, and III, and their data source, measurement years, and statistical analyses in addition to the main study variables.

Table 5. Studies I, II, and III and their data source, study variables, measurement years, and statistical analyses.

	Data*		Measurement year				Statistical analysis		
	YFS	NFBC1986	2001	2007	2012	2019–2020	Linear regression	Cross-lagged panel model	Multilevel model
Study I	x							x	x
Job demands-control			x	x	x				
Effort-reward imbalance			x	x	x				
Compassion			x		x				
Study II	x						x	x	x
Sleep duration					x				
Perceived sleep deficiency					x				
Sleep problems					x				
Sleep difficulties			x	x	x				
Compassion			x		x				
Study III		x					x		
Body composition						x			
Compassion						x			
Self-compassion						x			

*YFS = Young Finns Study; NFBC1986 = Northern Finland Birth Cohort 1986

5 Results

5.1 Compassion and job characteristics (Study I)

5.1.1 Attrition analyses

Attrition analyses indicated that the included and excluded (or dropped out) participants did not differ in gender, job demands, childhood socioeconomic position factors, and adulthood occupational status. However, the included participants were older (M = 32.7 versus M = 31.1, $p < 0.001$), reported lower job demands-control (M = -0.98 versus M = -0.89, $p < 0.05$), higher job control (M = 3.86 versus M = 3.74, $p < 0.001$), lower effort-reward imbalance (M = 0.78 versus M = 0.82, $p < 0.01$), higher reward (M = 3.86 versus M = 3.70, $p < 0.001$), higher income in adulthood (M = 8.35 versus M = 6.79, $p < 0.001$) and were more likely to have academic educational level (40.4% versus 25.9%, $p < 0.001$) when compared to the excluded participants.

Taken together, there was some evidence of bias as, for example, included participants appeared to have slightly higher income and were more likely to have higher educational level. Other differences found were relatively small, regarding job characteristics, for instance.

5.1.2 The temporal relationship of compassion and job characteristics

Compassion and job demands-control

It was examined whether the predictive relationship was more likely to run from compassion to job demands-control, or from job demands-control to compassion. **Table 6** presents the exact numerical results. All analyses were adjusted for age, gender, and childhood and adulthood socioeconomic positions.

The results indicated that Models 1–4 concerning compassion and job demands-control had good statistical fit indices (e.g., RMSEA and CFI). According to the χ^2 difference test, there was no evidence for statistical difference between Model 1 (i.e., no predictive pathways), Model 2 (i.e., a predictive relationship from compassion to job demands-control), Model 3 (i.e., the predictive pathway from

job demands-control to compassion), and Model 4 (i.e., bidirectional predictive pathways).

Regarding the temporal relationships of compassion with job demands and job control (the subcomponents), Models 1–4 had good and adequate statistical fit indices, respectively (e.g., RMSEA, CFI). However, according to the χ^2 difference test, there was no evidence for statistical difference between Model 1 (i.e., no predictive pathways), Model 2 (i.e., a predictive relationship from compassion to job demands), Model 3 (i.e., the predictive pathway from job demands to compassion), and Model 4 (i.e., bidirectional predictive pathways). In the same fashion, Models 1–4 of compassion and job control did not differ from one another in the χ^2 difference tests.

The results indicated that there was no evidence for a temporal relationship between compassion and job demands-control, or compassion and the subcomponents, job demands and job control.

Compassion and effort-reward imbalance

It was investigated whether the predictive relationship was more likely to run from compassion to effort-reward imbalance, or vice versa. **Table 6** presents the exact numerical results regarding the predictive pathways between compassion and effort-reward imbalance. All models were adjusted for age, gender, and childhood and adulthood socioeconomic positions.

The results indicated that Models 1–4 concerning compassion and effort-reward imbalance had good statistical fit indices (e.g., RMSEA, CFI). According to the χ^2 difference test, Model 2 (i.e., a predictive relationship from compassion to effort-reward imbalance) had a better statistical fit than Model 1 (i.e., no predictive pathways) and Model 3 (i.e., the predictive pathway from effort-reward imbalance to compassion). However, Model 2 and Model 4 (i.e., bidirectional predictive pathways) did not differ from one another in the χ^2 difference test.

The results thus indicated that the direction of the temporal relationship was more likely to run from high compassion to lower effort-reward imbalance, rather than from low effort-reward imbalance to higher compassion.

Regarding the temporal relationships of compassion and reward (a subcomponent), Models 1–4 had good statistical fit indices (e.g., RMSEA, CFI). According to the χ^2 difference test, Model 2 (i.e., a predictive relationship from compassion to reward) had a better statistical fit than Model 1 (i.e., no predictive pathways) and Model 3 (i.e., the predictive pathway from reward to compassion).

However, Model 2 and Model 4 (i.e., bidirectional predictive pathways) did not differ from one another in the χ^2 difference test.

The results thus indicated that the direction of the temporal relationship was more likely to run from high compassion to higher reward, rather than from high reward to higher compassion. **Figure 2** depicts the temporal associations of compassion with effort-reward imbalance and reward.

Table 6. The statistical fit indices of the cross-lagged panel models, which estimate the temporal relationships between compassion and job characteristics.

	Statistical fit index*						Model 1-4 comparisons		
	RMSEA	CFI	BIC	χ^2 value	*df*	*p*	χ^2 difference test	*df*	*p*
JDC									
Model 1	0.035	0.979	16,466.617	29.799	18	0.039			
Model 2	0.036	0.979	16,471.906	28.801	17	0.036	χ^2 (2 versus 1) = 1.00	1	0.318
Model 3	0.037	0.977	16,472.875	29.770	17	0.028	χ^2 (3 versus 1) = 0.03	1	0.886
Model 4	0.039	0.977	16,478.149	28.758	16	0.026	χ^2 (4 versus 1) = 1.04	2	0.594
Job demands[1]									
Model 1	0.047	0.959	15,965.732	39.293	18	0.003			
Model 2	0.049	0.958	15,971.522	38.793	17	0.002	χ^2 (2 versus 1) = 0.50	1	0.479
Model 3	0.049	0.957	15,971.960	39.231	17	0.002	χ^2 (3 versus 1) = 0.06	1	0.803
Model 4	0.051	0.956	15,977.751	38.732	16	0.001	χ^2 (4 versus 1) = 0.56	2	0.755
Job control									
Model 1	0.073	0.930	15,791.427	69.374	18	< 0.001			
Model 2	0.074	0.933	15,795.042	66.704	17	< 0.001	χ^2 (2 versus 1) = 2.67	1	0.102
Model 3	0.076	0.929	15,797.711	69.373	17	< 0.001	χ^2 (3 versus 1) = 0.00	1	0.971
Model 4	0.077	0.931	15,801.327	66.703	16	< 0.001	χ^2 (4 versus 1) = 2.67	2	0.263
ERI									
Model 1	0.033	0.977	14,238.794	28.356	18	0.057			
Model 2	0.028	0.984	14,241.079	24.359	17	0.110	χ^2 (2 versus 1) = 4.00	1	**0.046**
Model 3	0.035	0.976	14,244.892	28.171	17	0.043	χ^2 (3 versus 1) = 0.18	1	0.668
Model 4	0.031	0.982	14,247.217	24.214	16	0.085	χ^2 (4 versus 1) = 4.14	2	0.126
							χ^2 (4 versus 2) = 0.14	1	0.704
Reward									
Model 1	0.045	0.959	16,063.770	37.327	18	0.005			
Model 2	0.028	0.985	16,056.802	24.077	17	0.117	χ^2 (2 versus 1) = 13.25	1	**<0.001**
Model 3	0.047	0.959	16,060.480	36.755	17	0.004	χ^2 (3 versus 1) = 0.57	1	0.450
Model 4	0.030	0.984	16,062.692	23.685	16	0.097	χ^2 (4 versus 1) = 13.64	2	**0.001**
							χ^2 (4 versus 2) = 0.39	1	0.531

*RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, BIC = Bayesian Information Criterion, JDC = Job demands-control model, ERI = Effort-reward imbalance model

[1]Job demand was measured with the same items as effort.

Model 1: No predictive cross-lagged pathways, only autoregressive pathways

Model 2: Predictive pathways from compassion to job characteristics

Model 3: Predictive pathways from job characteristics to compassion

Model 4: Bidirectional predictive pathways between compassion and job characteristics

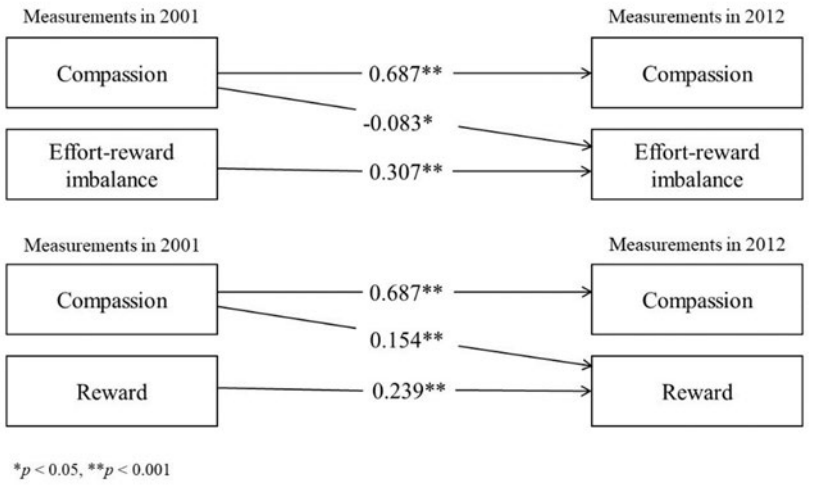


Fig. 2. Standardized regression pathways regarding the predictive pathways between compassion and effort-reward imbalance (Model 2) and between compassion and reward (Model 2) (adjusted for age, gender, and childhood and adulthood socioeconomic positions; covariances omitted for clarity).

5.1.3 The longitudinal effect of compassion on job characteristics over 11 years

Compassion and job demands-control

It was investigated whether compassion predicted the developmental trajectories of job demands-control and its subcomponents (job demands and job control) over the 11-year follow-up. The exact numerical results can be found in **Table 7**. All analyses were adjusted for age, gender, and childhood and adulthood socioeconomic positions.

The results indicated that high compassion predicted the development of lower job demands-control and higher job control. Compassion did not predict the development of job demands. Moreover, none of the compassion-age interactions were significant when predicting job demands-control or job control. This indicated that the effect of compassion on the trajectories of job demands-control and job control was evident over the entire 11-year follow-up. See **Figure 3** and **Figure 4**

for the depiction of high compassion predicting the development of lower job demands-control and higher job control over the 11 years of follow-up, respectively.

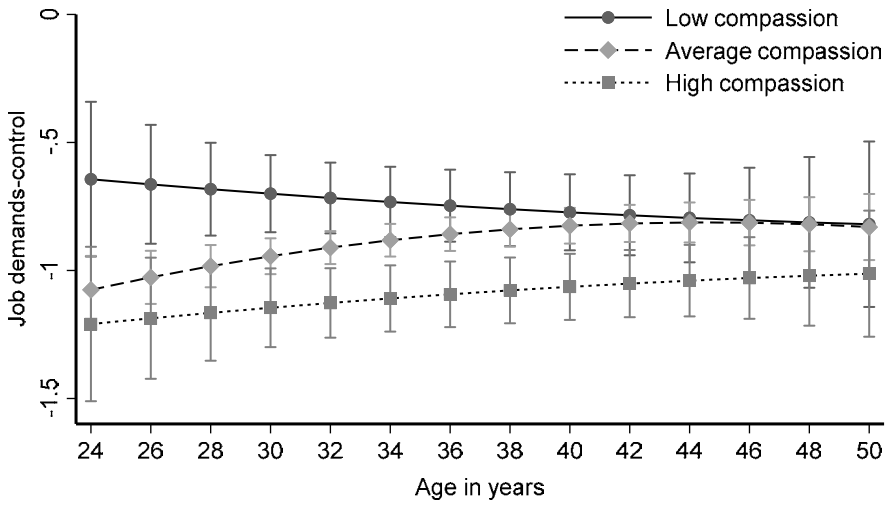
Table 7. Estimates (B) and 95% confidence intervals (CI) of compassion and age, when predicting job characteristics with growth curve models (i.e., multilevel models).

	Job demands-control			Job demands			Job control			Effort-reward imbalance			Reward		
	B	*p*	95% CI	*B*	*p*	95% CI	*B*	*p*	95% CI	*B*	*p*	95% CI	*B*	*p*	95% CI
Fixed effects															
Intercept	0.589	0.151	-0.214;1.391	2.566	**<0.001**	1.960;3.171	1.974	**<0.001**	1.374; 2.575	1.004	**<0.001**	0.787;1.220	2.626	**<0.001**	1.926;3.326
Age	-0.026	0.652	-0.138;0.087	0.042	0.332	-0.043;0.127	0.068	0.114	-0.016;0.153	0.007	0.276	-0.006;-0.010	0.006	0.912	-0.094;0.105
Com*×Age	0.010	0.516	-0.020;0.040	-0.006	0.607	-0.028;0.017	-0.016	0.165	-0.038;0.007	-0.001	0.606	-0.004;0.003	-0.008	0.541	-0.035;0.018
Com×Age×Age†	-0.0002	0.680	-0.001;0.001	0.0003	0.542	-0.001;0.001	0.001	0.241	-0.0003;0.001				0.0003	0.492	-0.001;0.001
Com	-0.292	**0.002**	-0.481;-0.104	-0.012	0.868	-0.155;0.130	0.282	**<0.001**	0.140; 0.423	-0.056	**0.017**	-0.102;-0.10	0.237	**0.006**	0.070;0.413
Random effects															
Residual variance	0.651	**<0.05**‡	0.624;0.679	0.492	**<0.05***	0.472;0.512	0.490	**<0.05***	0.469; 0.511	0.236	**<0.05***	0.226;0.246	0.582	**<0.05***	0.559;0.606

*Com = Compassion

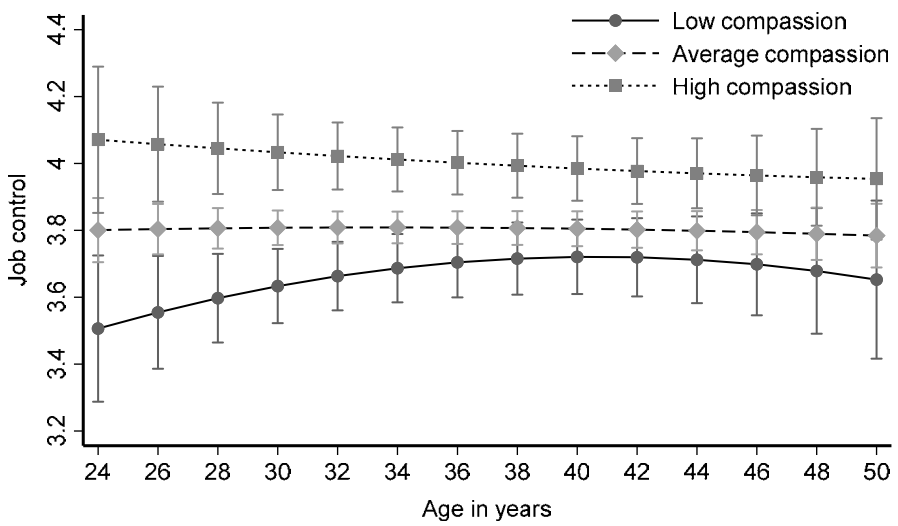
†When predicting effort-reward imbalance, there was no evidence for the compassion × age × age interaction, and thus, it was excluded from the model and the table.

‡The statistical software STATA does not supply exact p-values for random effects in the multilevel model estimate reports



Note. The figure illustrates the model-predicted values with 95% confidence intervals of job demands-control over participants' age. The values are shown separately for participants with low (-1 standard deviation), average, and high (+1 standard deviation) levels of compassion.

Fig. 3. The depiction of trait compassion predicting the development of job demands-control over an 11-year period.



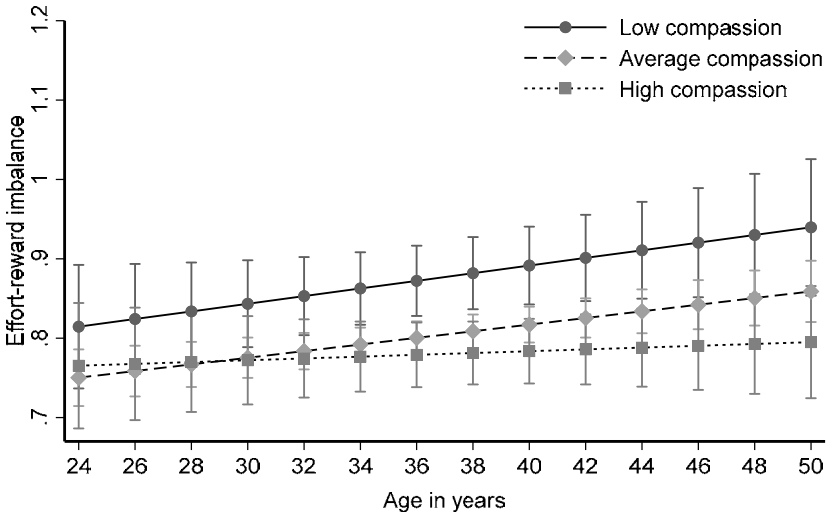
Note. The figure illustrates the model-predicted values with 95% confidence intervals of job control over participants' age. The values are shown separately for participants with low (-1 standard deviation), average, and high (+1 standard deviation) levels of compassion.

Fig. 4. The depiction of trait compassion predicting the development of job control over an 11-year period.

Compassion and effort-reward imbalance

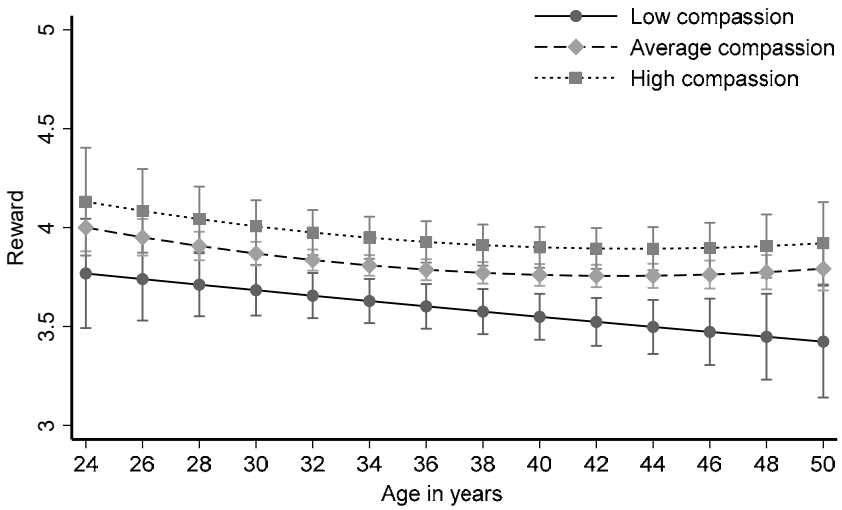
It was investigated whether compassion predicted the developmental trajectories of effort-reward imbalance and its subcomponent (reward) over the 11-year follow-up. The exact numerical results are presented in **Table 7.** All analyses were adjusted for age, gender as well as childhood and adulthood socioeconomic positions.

The results showed that high compassion predicted the development of lower effort-reward imbalance and higher reward over the 11-year follow-up. No evidence was found for the compassion-age interactions in effort-reward imbalance or reward analyses. These results indicated that the effect of compassion on these trajectories was evident throughout the 11 follow-ups. Depictions of high compassion predicting the development of lower effort-reward imbalance and higher reward are shown in **Figure 5** and **Figure 6**, respectively.



Note. The figure illustrates the model-predicted values with 95% confidence intervals of effort-reward imbalance over participants' age. The values are shown separately for participants with low (-1 standard deviation), average, and high (+1 standard deviation) levels of compassion.

Fig. 5. The depiction of trait compassion predicting the development of effort-reward imbalance over an 11-year period.



Note. The figure illustrates the model-predicted values with 95% confidence intervals of reward over participants' age. The values are shown separately for participants with low (-1 standard deviation), average, and high (+1 standard deviation) levels of compassion.

Fig. 6. The depiction of trait compassion predicting the development of reward over an 11-year period.

5.2 Compassion and sleep (Study II)

5.2.1 Attrition analyses

Attrition analyses showed that included and excluded (or dropped out) participants did not differ in compassion, sleep duration, perceived sleep deficiency, parental educational level or parental occupational status, or adulthood educational level or adulthood occupational status. However, included participants were more likely to report fewer sleep problems (M = 9.3 versus M = 9.9, $p < 0.05$) and fewer sleep difficulties (M = 2.7 versus M = 2.9, $p < 0.05$). Included participants were more likely to be women (32.9% versus 26.1%, $p < 0.05$), older (M = 32.0 versus M = 31.2 years, $p < 0.01$), have higher family income in childhood (M = 4.9 versus M = 4.8, $p < 0.05$) and higher income as adults (M = 7.7 versus M = 7.0, $p < 0.001$). Lastly, included participants reported fewer depressive symptoms (M = 4.4 versus M = 6.1, $p < 0.001$) than excluded participants.

To paraphrase, although differences emerged between included and excluded participants, the evidence of bias was weak. The found differences between included and excluded participants were relatively small (e.g., for sleep difficulties $M = 2.7$ [$SD = 0.08$] versus $M = 2.9$ [$SD = 0.07$]).

5.2.2 The cross-sectional relationship of compassion and sleep

It was investigated whether a cross-sectional relationship existed between compassion and sleep indicators (i.e., sleep duration, perceived sleep deficiency, sleep problems, and sleep difficulties). **Table 8** presents the exact numerical results.

The results indicated that in Model 1 (adjusted for age and gender), high compassion was associated with less perceived sleep deficiency, fewer sleep problems, and fewer sleep difficulties. In Model 2 (further adjusted for childhood and adulthood socioeconomic positions, BMI, health behaviors, and working conditions), the same associations remained significant. When adjusting even further for depressive symptoms (Model 3), high compassion continued to be associated only with sleep difficulties, but not with perceived sleep deficiency or sleep problems. Compassion was not associated with sleep duration (short versus long sleepers) in Model 1, 2, or 3.

Table 8. The cross-sectional associations between compassion and sleep duration, perceived sleep deficiency, sleep problems (Jenkins's Scale), and sleep difficulties (sleep items from Maastricht Vital Exhaustion Questionnaire).

	Model 1			Model 2			Model 3		
	B	*p*	95% CI	*B*	*p*	95% CI	*B*	*p*	95% CI
Sleep duration									
≤ 6.5h	-0.205	0.122	-0.464; 0.054	-0.173	0.207	-0.441; 0.096	-0.011	0.937	-0.292; 0.269
7.0–8.5h	Ref.*	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 9h	0.049	0.858	-0.049; 0.583	0.096	0.731	-0.451; 0.643	0.307	0.286	-0.257; 0.870
Sleep deficiency	-0.216	**0.007**	-0.374; -0.058	-0.222	**0.007**	-0.382; -0.062	-0.074	0.349	-0.230; 0.081
Sleep problems	-0.979	**<0.001**	-1.401; -0.556	-0.858	**<0.001**	-1.287; -0.428	-0.219	0.260	-0.600; 0.163
Sleep difficulties	-0.714	**<0.001**	-0.966; -0.461	-0.618	**<0.001**	-0.872; -0.364	-0.226	**0.046**	-0.447; -0.004

*Reference group

Model 1: Adjusted for age and gender.

Model 2: Adjusted for age, gender, childhood and adulthood socioeconomic positions, BMI, health behaviors, and working conditions.

Model 3: Adjusted for age, gender, childhood and adulthood socioeconomic positions, BMI, health behaviors, working conditions, and depressive symptoms.

5.2.3 The temporal relationship of compassion and sleep difficulties

It was investigated whether the predictive relationship was more likely to run from compassion to sleep difficulties, or vice versa. **Table 9** presents the exact numerical results regarding the predictive pathways between compassion and sleep difficulties. All models were adjusted for age, gender, and childhood and adulthood socioeconomic positions.

The results indicated that Models 1–4 concerning compassion and sleep difficulties had good statistical fit indices (e.g., RMSEA, CFI). According to the χ^2 difference test, Model 2 (i.e., a predictive relationship from compassion to sleep difficulties) had a better statistical fit than Model 1 (i.e., no predictive pathways) and Model 3 (i.e., the predictive pathway from sleep difficulties to compassion). However, Model 2 and Model 4 (i.e., bidirectional predictive pathways) did not differ from one another in the χ^2 difference test.

The results thus indicated that the direction of the temporal relationship was more likely to run from high compassion to fewer sleep difficulties, rather than from few sleep difficulties to higher compassion. **Figure 7** depicts the temporal association of compassion with sleep difficulties.

Table 9. The statistical fit indices of the cross-lagged panel models, which estimate the temporal relationship between compassion and job sleep difficulties.

	Statistical fit index*						Model 1-4 comparisons		
	RMSEA	CFI	BIC	χ^2 value	*df*	*p*	χ^2 difference test	*df*	*p*
Model 1	0.038	0.974	31,430.076	40.855	18	0.002			
Model 2	0.036	0.978	31,432.266	36.256	17	0.004	χ^2 (2 versus 1) = 4.60	1	**0.032**
Model 3	0.038	0.975	31,435.191	39.181	17	0.002	χ^2 (3 versus 1) = 1.67	1	0.196
Model 4	0.036	0.979	31,437.432	34.633	16	0.004	χ^2 (4 versus 1) = 6.22	2	**0.045**
							χ^2 (4 versus 2) = 1.62	2	0.203

*RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, BIC = Bayesian Information Criterion,

Model 1: No predictive cross-lagged pathways, only autoregressive pathways.

Model 2: Predictive pathways from compassion to job sleep difficulties.

Model 3: Predictive pathways from sleep difficulties to compassion.

Model 4: Bidirectional predictive pathways.

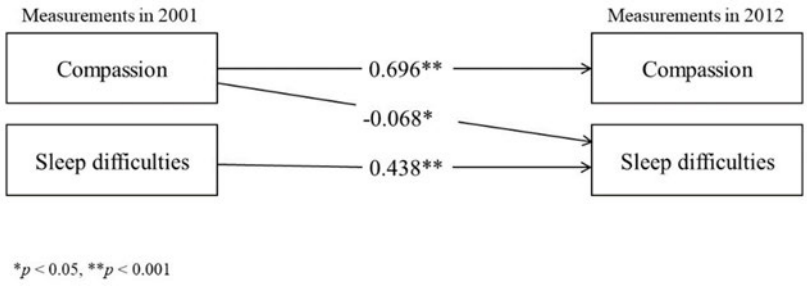


Fig. 7. Standardized regression pathways regarding the predictive pathways between compassion and sleep difficulties (Model 2; adjusted for age, gender, and childhood and adulthood socioeconomic positions; covariances omitted for clarity).

5.2.4 The longitudinal effect of compassion on sleep difficulties over 11-years

It was investigated whether compassion predicted the developmental trajectory of sleep difficulties over the 11-year follow-up. **Table 10** presents the exact numerical results.

The results showed that high compassion predicted the development of fewer sleep difficulties over the 11-year follow up. In Model 1 (adjusted for age and gender), high compassion predicted the development of fewer sleep difficulties over the follow-up of 11 years. In Model 2 (further adjusted for childhood and adulthood socioeconomic positions, BMI, health behaviors, and working conditions), high compassion continued to predict the development of fewer sleep difficulties over the 11 years. When adjusting even further for depressive symptoms (Model 3), the association between compassion and sleep difficulties disappeared. Compassion-age interactions were not significant in Model 1 and Model 2, meaning that compassion consistently predicted sleep difficulties over the follow-up of 11-years in these analyses. The depiction of high compassion predicting the development of fewer sleep difficulties is shown in **Figure 8** (Model 2).

Table 10. Estimates (B) and 95% confidence intervals (CI) of compassion and age, when predicting sleep difficulties using multilevel models.

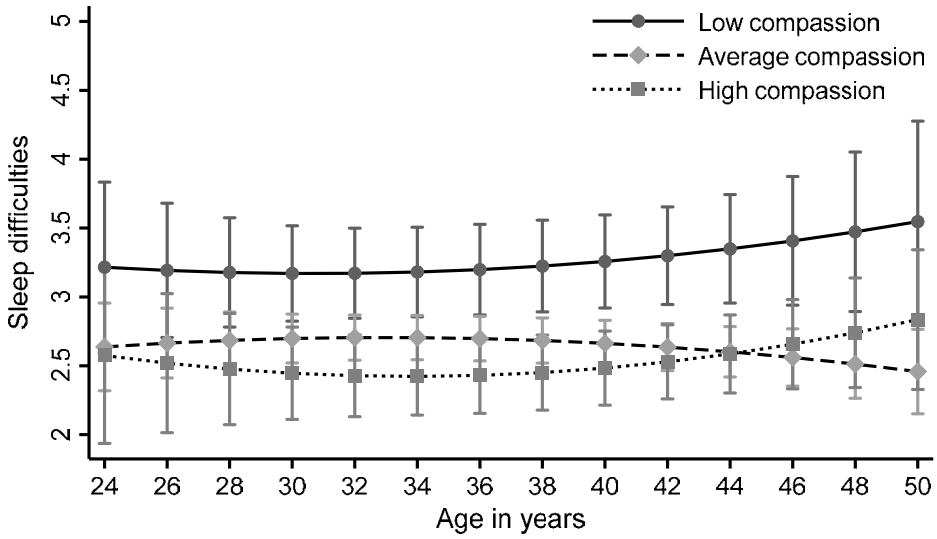
	Model 1			Model 2			Model 3		
	B	*p*	95% CI	*B*	*p*	95% CI	*B*	*p*	95% CI
Fixed effects									
Intercept	4.253	**<0.001**	2.768; 5.738	4.492	**<0.001**	2.495; 6.488	2.892	**0.003**	0.971; 4.812
Age	-0.026	0.814	-0.245; 0.192	-0.019	0.867	-0.238; 0.201	-0.011	0.921	-0.233; 0.210
Compassion×Age	0.009	0.766	-0.050; 0.067	0.007	0.814	-0.052; 0.066	0.005	0.860	-0.054; 0.065
Compassion×Age×Age	-0.001	0.566	-0.003; 0.002	-0.001	0.573	-0.003; 0.002	-0.001	0.532	-0.003; 0.002
Compassion	-0.520	**0.011**	-0.919; -0.119	-0.448	**0.030**	-0.853; 0.043	-0.187	0.373	-0.599; 0.225
Random effects									
Variance of intercept	1.277	**<0.05***	0.921; 1.771	1.299	**<0.05***	1.023; 1.648	1.067	**<0.05***	0.874; 1.302
Residual variance	1.688	**<0.05***	1.608; 1.771	1.689	**<0.05***	1.622; 1.759	1.695	**<0.05***	1.640; 1.752

Model 1: Adjusted for age and gender.

Model 2: Adjusted for age, gender, childhood and adulthood socioeconomic position, BMI, health behaviors, and working conditions.

Model 3: Adjusted for age, gender, childhood and adulthood socioeconomic position, BMI, health behaviors, working conditions, and depressive symptoms

*The statistical software STATA does not supply exact p-values for random effects in the multilevel model estimate report



Note. The figure illustrates the model-predicted values with 95% confidence intervals of sleep difficulties over participants' age. The values are shown separately for participants with low (-1 standard deviation), average, and high (+1 standard deviation) levels of compassion.

Fig. 8. The depiction of trait compassion predicting the development of sleep difficulties over an 11-year period (Model 2: adjusted for age, sex, childhood and adulthood socioeconomic positions, BMI, health behaviors, working conditions.

5.3 Compassion, self-compassion, and body composition (Study III)

5.3.1 Attrition analyses

The attrition analyses between the included and excluded (or dropped out) participants showed that there were no differences in sex, body mass index, waist circumference, waist-to-hip ratio, or fat mass index. Moreover, included and excluded participants did not differ in adulthood income, adulthood educational level, or childhood socioeconomic score. However, included participants reported lower compassion (M = 5.40 versus M = 5.50, $p < 0.05$), higher self-compassion (M = 3.14 versus M = 3.06, $p < 0.01$), and lower body fat percentage (M = 26.62 versus M = 27.96, $p < 0.01$) than excluded participants. Included participants were

also more likely to have manual or lower-grade non-manual as their occupational status compared to excluded participants (52.5% versus 46.1%, $p < 0.05$).

To sum up, there was some evidence of bias in Study III, concerning body fat percentage, for example. Other differences found between included and excluded participants were small (e.g., compassion and self-compassion).

5.3.2 The cross-sectional relationships of compassion and body composition

It was investigated whether a cross-sectional relationship existed between compassion and body composition measurements. **Table 11** presents the exact numerical results.

The results indicated that in Model 1 (unadjusted), high compassion was associated with lower waist circumference. In Model 2 (adjusted for sex) compassion was not associated with any of the body composition measurements. When the relationships were adjusted for sex and childhood and adulthood socioeconomic positions (Model 3), high compassion was associated with lower waist circumference, body fat percentage, and fat mass index, but not with body mass index or waist-to-hip ratio.

5.3.3 The cross-sectional relationship of self-compassion and body composition

It was investigated whether a cross-sectional relationship existed between self-compassion and body composition measurements. The exact results of self-compassion and body composition are presented in **Table 11.**

The results indicated that self-compassion was not associated with any of the body composition measurements in Model 1 (unadjusted), Model 2 (adjusted for sex), or Model 3 (adjusted for sex, and childhood adulthood socioeconomic positions).

Table 11. The results of linear regression analyses: compassion and self-compassion predicting body composition in 2019–2020. Estimates (*B*) with 95% confidence intervals (CI).

	Body mass index			Waist circumference			Waist-to-hip ratio			Body fat percentage			Fat mass index		
	B	*p*	CI 95%	*B*	*p*	CI 95%	*B*	*p*	CI 95%	*B*	*p*	CI 95%	*B*	*p*	CI 95%
Compassion															
Model 1	-0.341	0.062	-0.700; 0.017	-1.623	**0.001**	-2.576; -0.670	-0.004	0.198	-0.010; 0.002	0.476	0.206	-0.263; 1.215	0.006	0.970	-0.293; 0.305
Model 2	-0.291	0.118	-0.655; 0.074	-0.819	0.081	-1.737; 0.100	-0.004	0.210	-0.010; 0.002	-0.574	0.076	-1.207; 0.060	-0.275	0.058	-0.559; 0.009
Model 3	-0.349	0.058	-0.710; 0.012	-0.960	**0.039**	-1.870; -0.498	-0.005	0.093	-0.011; 0.001	-0.693	**0.030**	-1.317; -0.069	-0.325	**0.023**	-0.605; -0.044
Self-compassion															
Model 1	-0.343	0.180	-0.844; 0.159	-0.446	0.514	-1.787; 0.895	-0.005	0.274	-0.013; 0.004	-1.016	0.054	-2.047; 0.015	-0.364	0.087	-0.781; 0.053
Model 2	-0.353	0.167	-0.854; 0.148	-0.583	0.365	-1.845; 0.681	-0.001	0.271	-0.010; 0.008	-0.847	0.057	-1.717; 0.024	-0.319	0.109	-0.710; 0.071
Model 3	-0.275	0.277	-0.771; 0.221	-0.402	0.529	-1.656; 0.851	-0.003	0.444	-0.011; 0.005	-0.751	0.086	-1.610; 0.107	-0.264	0.181	-0.650; 0.012

M1 = Model 1: Unadjusted.

M2 = Model 2: Adjusted for sex.

M3 = Model 3: Adjusted for sex, and childhood and adulthood socioeconomic positions

6 Discussion

6.1 Main results

Regarding the research questions 1–7, the current results indicated that (1) the direction of the temporal relationship was more likely to run from high trait compassion to lower effort-reward imbalance and higher reward. No evidence was found for a temporal relationship between trait compassion and job demands-control, job demand, job control, or effort. Moreover, Study I found that (2) high trait compassion predicted the developmental trajectory of lower job demands-control, higher control, lower effort-reward imbalance, and higher reward over the follow-up of 11 years. Trait compassion did not predict the development of job demands or effort.

In Study II, it was found that (3) high trait compassion was cross-sectionally associated with lower perceived sleep deficiency, fewer sleep problems, and fewer sleep difficulties. Trait compassion was not associated with sleep duration. The cross-sectional associations disappeared when the relationships were adjusted for depressive symptoms, except for compassion and sleep difficulties. Moreover, the results also indicated that (4) the direction of the temporal relationship was more likely to run from high trait compassion to fewer sleep difficulties, rather than vice versa. Lastly, regarding Study II (5), high trait compassion predicted the development of fewer sleep difficulties over the follow-up of 11 years. However, this association disappeared when the depressive symptoms were included in the analyses.

The results of Study III indicated that (6) high trait compassion was cross-sectionally associated with three out of the five body composition measurements, namely lower waist circumference, lower body fat percentage, and lower body fat index. Trait compassion was not associated with body mass index or waist-to-hip ratio. These results were adjusted for sex and for socioeconomic position in childhood and adulthood. In the unadjusted and adjusted for sex analyses, however, most of the associations between compassion and body composition were not significant. Lastly, the results showed that (7) trait self-compassion was not cross-sectionally associated with any of the body composition measurements in the unadjusted or adjusted Models.

Figure 9 summarizes the main results of the current doctoral dissertation.

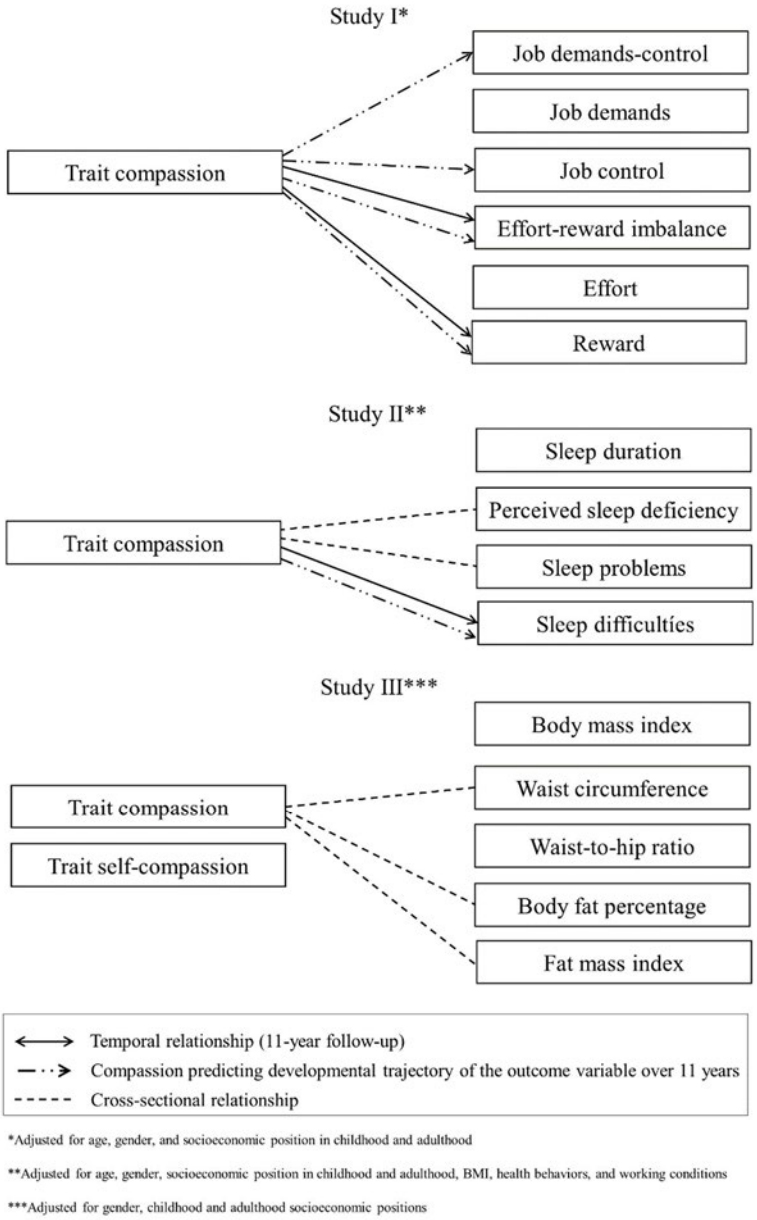


Fig. 9. The main results of Studies I, II, and III.

The first aim of the current doctoral dissertation was to examine compassion as a trait with well-being indicators. Past research had largely focused on compassion as a state (gap I) (e.g., Kirby et al., 2017). The current results indicated that the disposition to perceive suffering and wanting to alleviate such distress, in other words, trait compassion, was associated with several proxies of well-being. Previously, compassion-related frameworks such as tend-and-befriend and social mentalities (Gilbert, 1989, 2005b, 2017; S. E. Taylor, 2006; S. E. Taylor et al., 2000) had suggested that concerned and caring states and dispositions can support well-being and its indicators. The current results further support these assumptions. Taking into account past and current results together, compassion appears to be beneficial for the individuals themselves both as a state and as a trait (Kirby et al., 2017; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020).

The second aim of the current doctoral dissertation was to investigate the relationship between trait compassion and the uninvestigated well-being proxies of job characteristics, sleep, and body composition (gap II). Crucially, the dissertation found preliminary evidence for the extension of the scope of the benefits of compassion. These associated benefits include the perception of fewer straining job characteristics, fewer sleep difficulties, and potentially healthier body composition. Trait self-compassion was not associated with body composition measurements. The current results suggest, therefore, that other-directed compassion can be viewed as a rather far-reaching trait, as its associations range from psychological to health outcomes. Past studies have focused more on the prosocial outcomes, which has perhaps been the more traditional view of compassion and its benefits (Luberto et al., 2018).

The third aim of the current dissertation was to examine the temporality of the relationships. In other words, does trait compassion predict well-being proxies, or vice versa, do well-being proxies predict trait compassion (gap III)? The studies with longitudinal designs (Study I, II) indicated that the relationships were more likely to run from high trait compassion to higher well-being indicators, meaning less straining job characteristics and fewer sleep difficulties, rather than vice versa. One of the key messages of the dissertation is thus that compassion can be a protective trait for the well-being indicators, rather than the result of the well-being indicator. Moreover, according to the current results, compassion as a trait does not appear to be a draining disposition, but a protective one. Past evidence shows that trait compassion can be protective against, for example, depressive symptoms, negative affect, and vital exhaustion (Saarinen et al., 2019; Saarinen, Keltikangas-Järvinen, et al., 2021; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020).

Last, the dissertation aimed to investigate samples drawn from the general population (gap IV). This goal was achieved by using data from two Finnish prospective studies, the Young Finns Study and the Northern Finland Birth Cohort 1986 Study. The data sets of the Young Finns Study allowed the investigation of several age cohorts from several cities and municipalities in Finland. The Northern Finland Birth Cohort 1986, on the other hand, allowed the examination of two of the most northern provinces of Finland. Both data sets had participants who belonged to different socioeconomic groups as children and adults. This meant that the participants represented different educational level, occupational status, and income groups. The samples also contained relatively equal numbers of women and men. Moreover, several known confounders were adjusted in the analyses, such as health behaviors and working conditions in the study examining sleep. Thus, one of the contributions of the dissertation is the evidence that trait compassion can be beneficial among the general population, as shown with significant results in all three studies. Past compassion studies have often employed specific populations, such as healthcare workers (e.g., Scarlet et al., 2017; Weingartner et al., 2019). It is justified to investigate compassion in specific populations such as healthcare workers, who can use compassion as a work tool. The current evidence, however, suggests that also general population can benefit from compassion.

Next, the findings of Studies I, II, and III are discussed in more detail.

6.1.1 Compassion and job characteristics

Study I is the first investigation examining the relationship between trait compassion and job characteristics. The findings of Study I showed that high compassion predicted several job characteristics over a decade. More specifically, high compassion predicted the perception of fewer straining job characteristics. Although the relationship had previously been completely uninvestigated, according to my current knowledge, there are a few indirect past findings that are in accordance with the results from Study I. To illustrate, training state compassion has been found to be associated with lower burnout symptoms, such as lower emotional exhaustion and higher personal accomplishment (Orellana-Rios et al., 2017; Ropes & de Boer, 2021).

Although Study I found evidence for a temporal relationship between compassion and effort-reward imbalance, there was no evidence for a temporal relationship between compassion and job demands-control. Past studies have indicated that these two models are complementary to each other, not competitive

(Calnan et al., 2004; De Jonge et al., 2000; Jachens & Houdmont, 2019). The models are similar in the sense that job demands and effort are straining. The protective elements of the models, however, have slightly different emphases. To illustrate, job control refers more to internal protective resources such as perception of autonomy and control of work pace, although these could also be dictated from outside. On the other hand, rewards include more external protective resources given by the employer/workplace/colleagues, including esteem, security, and social support. It is perhaps unsurprising that compassion can be protective against some stressors (i.e., effort-reward imbalance), but not against others (i.e., job demands-control).

As already briefly mentioned, another finding was that high compassion predicted higher rewards. The reward items in Study I largely referred to social rewards in the workplace, such as social support from colleagues and supervisors. Compassion has previously been found to predict higher social support in a variety of studies, for example, high trait compassion predicting higher social support in a longitudinal study (Cosley et al., 2010; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020). Furthermore, social support is a well-established and potent stress reliever (S. E. Taylor, 2012a; S. E. Taylor et al., 2000). Compassionate individuals may have a lower threshold to perceive as well as seek social support. This could mean that they are more adept at establishing supportive social networks for themselves. Moreover, highly compassionate individuals may be more adept at mobilizing rewards, particularly social ones. Indeed, compassionate individuals are often described as warm, helpful, and kind (Goetz et al., 2010). Thus, compassionate individuals may be awarded with either informal or formal rewards due to their prosocial tendencies. It is noteworthy, however, that the reward items reflect the perceptions of rewards, not actualized rewards. Lastly, it should be noted that the goodness-of-fit indices of the model, which had bidirectional pathways, from compassion to reward as well as from reward to compassion, were also good. This could suggest, for example, that high compassion and reward may feed each other.

The past findings of neuroimaging studies can shed more light on why compassion can be protective against effort-reward imbalance through rewards. To illustrate, training compassion is associated with the activation of dopaminergic neural circuits, which are tightly linked with the experience of reward (Klimecki, 2015; Klimecki, Leiberg, Ricard, et al., 2013). Moreover, it has been suggested that compassionate responses may originate from the activation of these neural circuits, particularly those implicating oxytocin (Kucerova et al., 2023). Therefore,

compassion may be experienced as gratifying/rewarding, due to increased influx of oxytocin, increased perception of social affiliations, and increased positive affect (Favre et al., 2021; Novak et al., 2022; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020; Weng et al., 2013). Perhaps this above-described physiology of compassion also applies in work contexts, increasing the likelihood of perceiving rewards.

However, it also is important to consider that the results may be due to the possibility that highly compassionate individuals seek or are being selected for positions that offer more rewards. Temperament and personality traits are associated with certain career paths (Berings et al., 2004; Mullola et al., 2018; Viinikainen et al., 2017), but also with how much individuals tend to expose themselves to stress (Code & Langan-Fox, 2001; Williams et al., 2010). Moreover, as compassionate individuals are characterized as kind, warm, and cooperative (Goetz et al., 2010), these same individuals may also appeal to employers who are looking for team-oriented people, for instance. A well-functioning team is associated with various benefits for work well-being and performance (Bradley et al., 2012; Clausen et al., 2019; Viswesvaran et al., 1999).

Lastly, the longitudinal results showed that high compassion predicted the development of higher job control over the 11-year follow-up. Although compassion has not before been linked with the perception of control, there is some indirect preliminary evidence. For instance, an intervention study indicated that training compassion can be associated with higher self-regulation in distressing situations (i.e., calmer and less anxious) (Jazaieri et al., 2018). Moreover, as intent and motivation are core components of compassion, the definition implies that compassionate individuals may also have an optimistic expectation of themselves controlling and affecting a discomforting situation (Goetz et al., 2010; Strauss et al., 2016). Indeed, compassionate motivation, but not, for example, empathic concern, is associated with a decrease in burnout symptoms (Ropes & de Boer, 2021). However, it should be remembered that compassion and job control did not have a temporal relationship. In other words, high compassion was associated with the development of job control, but the direction of the relationship did not run from compassion to job control in the current data.

6.1.2 Compassion and sleep

Study II was the first of its kind, as it investigated the relationship between other-directed trait compassion and sleep. Although trait compassion and sleep had not

previously been examined together, according to my current knowledge, the current results agree with the indirect past findings. For example, in a recent quasi-experiment, compassionate reappraisal (versus rumination) before sleep was associated with reduced sleep disturbances and shorter sleep onset latency (Witvliet et al., 2022). In a similar fashion, the tendency to be warm and cooperative, a characteristic of compassion (Goetz et al., 2010), has been associated with better sleep, including less perceived sleep deficiency and sleep problems (Cellini et al., 2017; Hintsanen et al., 2014). The tendency to be warm and cooperative has also been associated with longer sleep duration (Hintsanen et al., 2014), but the current results did not find an association between compassion and sleep duration.

To continue with more detailed results of Study II, it is possible that compassion may affect sleep via depressive symptoms. It was shown that the inclusion of depressive symptoms caused many of the associations between compassion and sleep to disappear (i.e., perceived sleep deficiency and sleep problems in the cross-sectional analyses; sleep difficulties in the longitudinal investigation). There is strong evidence from cross-sectional, intervention, and longitudinal studies that high state and trait compassion predict fewer depressive symptoms, rather than vice versa (Catarino et al., 2014; Kirby et al., 2017; Saarinen et al., 2019). Moreover, high depressive symptoms have a well-established relationship with poorer sleep (Alvaro et al., 2013; Bao et al., 2017; Zhai et al., 2015). Major depressive disorder has been linked with, for instance, sleep deficiency as well as hypersomnia, difficulties falling asleep, and feeling unrested after a night's sleep (Pandi-Perumal et al., 2020; Soehner et al., 2014).

It can therefore be very tentatively suggested that trait compassion may lead to fewer depressive symptoms, and thus, better sleep. Whereas compassion is other-orientated and characterized by distress tolerance and acceptance (Austin et al., 2020; Goetz et al., 2010; Jazaieri et al., 2018; Orellana-Rios et al., 2017; Singer & Klimecki, 2014; Strauss et al., 2016), depression often includes maladaptive self-focus and rumination over past events (Strauman, 2002). Such negative orientation can induce wakefulness and interfere with relaxation at nighttime (Butz & Stahlberg, 2018; Y. Hu et al., 2018; Witvliet et al., 2022). Interestingly, practicing compassion has been associated with reduced rumination in depressed individuals and with increased acceptance in a non-clinical sample (Frostadottir & Dorjee, 2019; Jazaieri et al., 2018). Compassion may thus have some protective element against the turbulences of the mind that disrupt sleep.

6.1.3 Compassion, self-compassion, and body composition

Trait compassion and body composition had not been studied together before Study III, according to my current knowledge. However, past findings have been somewhat encouraging about the potential role of compassion in body composition, as practicing state compassion has been associated with slight decreases in weight in intervention studies (Carter et al., 2023; Palmeira et al., 2019). However, the effects of state compassion are difficult to disentangle in these past studies, as the intervention designs have also incorporated practices of psychoeducation, self-compassion, and mindfulness, among others (e.g., Palmeira et al., 2019). In contrast, the current study was able to investigate the role of compassion in body composition separately from other factors.

The current results showed that high trait compassion was associated with healthier body composition, meaning lower waist circumference and body fat indices. Waist circumference is a good indicator of, for example, the dangerous visceral fat (De Koning et al., 2007; Janssen et al., 2004; WHO, 2011). High body fat is undesirable as it encourages low-grade inflammation in the body (Kolb, 2022). Although acute inflammation is part of our normal immune system function, chronic low-grade inflammation can have detrimental effects, including an increased risk for metabolic diseases (Lasselin & Capuron, 2014). Interestingly, it has been previously found that training compassionate states has been associated with decreased low-grade inflammation, as shown by decreased interleukin-6 and C-reactive protein levels after an intervention (Pace et al., 2009, 2013). It should be remembered, however, that the current results are cross-sectional. The direction of the relationship between compassion and body composition cannot thus be determined at this time.

In contrast, the current study did not find an association between compassion and BMI or waist-to-hip ratio. Although perhaps most widely used, BMI has been criticized over the past years as it does not consider, for example, muscle mass, which is a correlate of positive health outcomes (Al-Ozairi et al., 2021; Janssen et al., 2004; Srikanthan et al., 2016). Moreover, there is evidence that other body composition markers besides BMI, such as waist-to-hip ratio, might be more accurate indicators of, for example, cardiovascular health (Myint et al., 2014). Although there is preliminary evidence that compassion can be associated with healthier body composition, the current results also suggest that the relationship may not be fully consistent across different body composition measurements.

In the case of self-compassion, the current non-significant results were partly corroborated by past research. Two recent literature reviews have indicated that approximately half of the studies found that self-compassion was not associated with BMI (Brenton-Peters et al., 2021; Carter et al., 2023). Non-significant results have also been found with self-compassion and other measurements, such as waist circumference and body fat percentage (for a review, see Horan & Taylor, 2018). However, these previous studies have mainly been intervention studies, investigating state self-compassion mixed with other components such as psychoeducation and yoga (Brenton-Peters et al., 2021; Carter et al., 2023). In addition, the same studies have had relatively small sample sizes, often female-only or female-majority samples, and have often used participants with overweight or obesity (Brenton-Peters et al., 2021; Carter et al., 2023). In contrast, the current study investigated trait self-compassion and several body composition measurements together, with a larger (n = 789) and population-based sample, investigated self-compassion separately from other predictors, and had an almost equal share of women and men (52.1% women).

The non-significant results were perhaps somewhat surprising, as self-compassion has previously been associated with various health indicators. These include but are not limited to lower stress and health-supporting behaviors, such as better sleep, higher physical activity, and more frequent mindful eating (Allen & Leary, 2010; Y. Hu et al., 2018; A. C. Kelly et al., 2014; Y. Li et al., 2020; Phillips & Hine, 2021; Schnepper et al., 2020; M. B. Taylor et al., 2015; Wong et al., 2021). Moreover, self-compassion has also been linked to better self-regulation of health behaviors and mastery goals (Breines & Chen, 2012; Neff et al., 2005; Sirois, 2015). This could suggest that self-compassionate individuals theoretically have the tools to achieve healthy body composition. Taken together, these findings beg the question why the results concerning self-compassion and body composition are somewhat mixed.

One possible explanation may be the flexible nature of self-compassion, leading to opposing forces and outcomes regarding body composition. It has been suggested that self-compassion may serve several functions and translate into different behaviors, depending on the context (Neff, 2003b, 2023). For example, individuals who score high on self-compassion may not impose harsh and strict exercise and diet regimes on themselves, a reflection of self-kindness. Yet, this tendency can lead to higher weight, for instance. Nevertheless, it has been highlighted that self-kindness does not mean self-indulgence (Neff, 2023). However, evidence shows that, in practice, individuals tend to mix self-kindness

and self-indulgence (Egan & Mantzios, 2018). Therefore, self-compassion may not have a straightforward relationship with body composition, as choosing the most optimal choice for an individual can vary depending on the context (Carter et al., 2023). Taken together, the relationship of self-compassion and body composition might be a complex one.

6.2 Potential mechanisms behind the associated benefits of compassion

Although the mechanisms have not been rigorously investigated, there are indications why compassion might be associated with a versatile group of well-being indicators. For instance, according to the tend-and-befriend and social mentality approach, compassion can be stress-relieving on both psychological and physiological level (Gilbert, 1989, 2005b, 2017; S. E. Taylor, 2006; S. E. Taylor et al., 2000). Moreover, training (state) compassion has been associated with changes in brain activity in regions such as amygdala, hippocampus, anterior insula, and prefrontal cortex, among others, which are involved in affective processing (Desbordes et al., 2012; Engen & Singer, 2015; Klimecki, Leiberg, Lamm, et al., 2013; Leung et al., 2013; A. Lutz et al., 2008; Weng et al., 2013). Thus, the potential mechanisms behind compassion and its associated benefits could be (1) stress regulation and (2) positive emotionality and emotion regulation.

6.2.1 Stress regulation

Previous literature has consistently found that state compassion is associated with, and that trait compassion can even predict, less stress, including lower perceived psychological stress (Brito-Pons et al., 2018; Matos et al., 2017; Saarinen, Keltikangas-Järvinen, Viding, et al., 2021) and lower physiological stress such as lower cortisol and interleukin-6 levels (Abelson et al., 2014; Pace et al., 2009). High state compassion is also associated with lower stress reactivity as indicated by lower blood pressure, lower high-frequency heart rate variability, and lower cortisol reactivity (Cosley et al., 2010; Engert et al., 2016, 2017; Rockliff et al., 2008). Even further, high state and trait compassion have been shown to predict higher stress-relieving resources, such as perception of higher social support, in experimental and longitudinal studies (Cosley et al., 2010; Heinrichs et al., 2003; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020).

In contrast, stress is a well-known associate of the current well-being indicators. First, high job demands and effort are by definition stressful in both the psychological and physiological sense, if not protected by job control and reward, respectively (Karasek, 1979; Siegrist, 1996). Studies have supported these assumptions with empirical evidence. The perception of less straining job characteristics has been associated with higher heart rate variability, higher physiological immunity, and lower low-grade inflammatory responses, among many other markers (Borchini et al., 2015; Eddy et al., 2016; Loerbroks et al., 2010; Shirom et al., 2008).

Next, it is a well-established finding that stress has an impact on sleep (Åkerstedt, 2006; C. J. Harvey et al., 2014; Sanford et al., 2015). High stress can promote sleep difficulties, as stress can induce arousal and wakefulness at nighttime. Wakefulness can lead to delayed onset of sleep and awakening during sleep, potentially resulting in sleep deficiency (Kalmbach et al., 2018; lo Martire et al., 2020). Stress can also affect one's sleep architecture, for example, changing the proportion of REM sleep (Suchecki et al., 2012; Wardle et al., 2011).

Regarding body composition, high stress has been shown to be a risk factor for higher body adiposity, according to a meta-analysis of longitudinal studies (Wardle et al., 2011). Stress can advance unhealthy body composition through various mechanisms. Stress can, for example, increase the influx of appetite-related hormones, or weaken executive functions that can translate into fewer health behaviors, such as lower physical activity and shorter sleep duration (for reviews, see O'Connor et al., 2021; Tomiyama, 2019).

Taken together, high compassion has been consistently found to predict lower stress (e.g., Abelson et al., 2014; Saarinen, Keltikangas-Järvinen, et al., 2021). The stress regulation of compassionate individuals may function as a mechanism to ameliorate straining job characteristics and poorer sleep, and possibly even support healthier body composition.

6.2.2 Positive emotionality and emotion regulation

Another possible mechanism between compassion and its associated benefits is positive emotionality and adaptive emotion regulation strategies. The preliminary evidence shows that training state compassion is associated with, for example, among other markers, higher positive affect, and higher acceptance (Engen & Singer, 2015; Förster & Kanske, 2022; Jazaieri et al., 2018; Klimecki, Leiberg, Lamm, et al., 2013). Higher compassion is also associated with less emotional

reactivity and lower risk to ruminate (Favre et al., 2021; Frostadottir & Dorjee, 2019; Jazaieri et al., 2014). Moreover, high trait compassion can also predict less negative emotionality (Saarinen, Keltikangas-Järvinen, et al., 2021), although feeling negative affect may also be a fundamental part of compassion (Condon & Barrett, 2013). Some have argued that it is the increased positive affect of compassion that functions as the protective element, not necessarily the decreased negative affect (Engen & Singer, 2015; Förster & Kanske, 2022).

As mentioned before, high compassion has been associated with adaptive emotion regulation strategies (e.g., Favre et al., 2021; Förster & Kanske, 2022; Saarinen, Keltikangas-Järvinen, Viding, et al., 2021). In contrast, emotional reactivity, hiding negative emotions, and feigning positive emotions, which are signs of non-adaptive emotion regulation, are linked to higher job strain and effort-reward imbalance (Hintsa, Hintsanen, et al., 2013; Too & Butterworth, 2018; Yin et al., 2018). Excessive negative emotionality can, for instance, limit one's perception in a stressful situation and make it challenging to find remedies for job strain (Bakker & de Vries, 2021; Fredrickson, 2004). Positive affect, on the other hand, appears to have the opposite effect. Positive affect broadens thought-action repertoires; thus, it builds up resources and resilience over time (Fredrickson, 2004; Fredrickson et al., 2021). Positive affect broadening and building one's resources may also occur in individuals practicing compassion (Kearney et al., 2014).

Second, individuals who have trained compassion show reduced tendency to ruminate, yet they exhibit greater acceptance (Austin et al., 2020; Frostadottir & Dorjee, 2019; Jazaieri et al., 2018). Rumination is a good example of dysregulation of emotions. Rumination entails a downward spiral of negative affect when passively dwelling on past events, among other characteristics (Nolen-Hoeksema, 1991; Nolen-Hoeksema et al., 2008). Perhaps unsurprisingly, high rumination can predict several sleep outcomes, such as lower sleep duration, independently of worry and negative affect (Carney et al., 2010; A. G. Harvey, 2002; Thomsen et al., 2003). As rumination often occurs before sleep, it may increase sleep onset latency and sleep disturbances, whereas compassion may be associated with the reverse (Witvliet et al., 2022).

Regarding body composition, studies have found that higher compassion is associated with less emotional eating and at-risk alcohol consumption, for example (Gluschkoff et al., 2019; Palmeira et al., 2019). Thus, when faced with a distressing situation, compassionate individuals may be less likely to engage in hedonic escapes (Gluschkoff et al., 2019; Palmeira et al., 2019) and are more likely to choose more constructive ways, such as perspective taking and acceptance (Jazaieri

et al., 2018; Lim & DeSteno, 2016). Indeed, both emotional eating and at-risk alcohol consumption can be potential signs of maladaptive emotion regulation or ways to suppress or divert attention from demanding and difficult emotions. Moreover, frequent emotional eating and heavy alcohol consumption can predict weight gain (Frayn & Knäuper, 2018; Golzarand et al., 2022).

Lastly, one also needs to consider the possibility that the current well-being indicators also influence one another. To demonstrate, the current dissertation showed that high trait compassion is protective against straining job characteristics. Previously, a different study using the same data found that straining job characteristics and poor sleep outcomes have a bidirectional relationship (Törnroos et al., 2017). Moreover, short sleep is associated with an increased risk for obesity (Cappuccio et al., 2008). Well-being and health are complex phenomena, and many of the relationships can be cyclical.

To sum up, there is possibly more than one mechanism behind compassion and the well-being proxies. Moreover, the mechanisms are likely to be complex, as the well-being proxies can also predict one another.

6.3 Methodological considerations

6.3.1 Limitations

To begin with the limitations, first regarding Study I, Study II, and Study III, the regression coefficients were unstandardized. Although unstandardized regression coefficients bear practical relevance for the interpretation of body composition results, the same is not true for the other study variables with their unique scales. In order to make more practical interpretations of the results, the scores of compassion, self-compassion, job characteristics, and sleep would have needed to be standardized (e.g., using z-scores). However, when using the statistical software STATA for multilevel modelling, STATA cannot print standardized regression coefficients due to technical reasons. Study III, however, which used regression analyses, could have benefited from compassion and self-compassion scores being standardized. Thus, in the future, standardized regression coefficients should also be investigated when relevant to the research questions and design.

Next, some of the reliability estimates of the outcome variables were within the lower end of acceptable range (i.e., Cronbach's alpha) in Studies I and II. However, other internal consistency indicators (i.e., inter-item and item-total

correlations) showed more satisfactory estimates for the outcome variables (Ferketich, 1991; Piedmont, 2014). For example, past studies using the same questionnaires for job demands and reward have had similar alpha values (e.g., Hintsanen et al., 2011; Törnroos et al., 2013). The low alpha values found here may be due to the small number of items, as job demands, reward, and sleep difficulties had only three or four items each. In addition, the test-retest was low for the reward subscale in Study I. However, the longitudinal changes in effort-reward imbalance scores are more likely due to changing perceptions of job characteristics (i.e., changes in work roles, personal life changes) rather than to instability of the construct of the scale (Törnroos et al., 2014).

To continue with Study I and Study II, the outcome variables were assessed three times over the 11-year period. Although the long follow-up is a considerable strength, it also meant that the short-term effect of compassion on job characteristics and sleep difficulties remains unknown for now. Short-term fluctuations in job strain and sleep difficulties can be common due to daily occurrences (Loerbroks et al., 2010; Vidal Bustamante et al., 2020), but also a result of more profound life changes, such as increasing or decreasing job complexity or starting a family. Capturing such life events was beyond the aims of the current study. Moreover, compassion was measured only twice, not three times like the outcome variables. Thus, some details in the long-term fluctuation may be lost.

Regarding Study II, there are some specific limitations. As mentioned before, sleep difficulties were measured three times, whereas sleep duration, perceived sleep deficiency, and sleep problems were measured once. Thus, the temporal and predictive relationship of compassion with these three sleep indicators cannot be determined. In addition to the cross-sectional data, the number of short and long sleepers was limited in Study II, particularly in the case of long sleepers (n = 22). As the statistical power was weak when examining the association between compassion and (long) sleep duration, no definite conclusions can be made about their relationship. A larger sample size and longitudinal data on sleep duration will help to clarify whether a relationship, and what kind of relationship, exists. Both short and long sleep have associations with health and potentially different effects on health as well (Irwin et al., 2016); it is thus important to investigate both short and long sleep.

Regarding Study III, the data on compassion and body measurements faced considerable attrition, as the participation rate in 2019–2020 ranged from 16.2% to 36.2%, depending on the follow-up phase (University of Oulu, n.d.). The high attrition may explain, for example, why self-compassion was not associated with

body composition as the employed sample was not fully representative of the original population. According to the attrition analyses of Study III, however, the results indicated that there were no great biases present. The included participants were slightly more self-compassionate and slightly less compassionate compared to excluded participants. The differences were quite small, however. Thus, the differences between included and excluded participants may not have a large practical effect.

Additionally, Study III employed a cross-sectional design. Thus, the direction of the relationship between compassion and body composition is open for discussion, meaning body composition may predict compassion. However, there is strong past evidence that traits dispose individuals to feel, think, and behave in certain ways (Carver & Connor-Smith, 2010; Hawkley & Cacioppo, 2003; Uchino et al., 2007; Williams et al., 2010). Therefore, traits are also likely to predict the development of obesity, rather than vice versa (Jokela et al., 2013; Pulkki-Råback et al., 2005; Sutin et al., 2011). Nevertheless, it has been suggested that personality traits and body composition interact in a complex fashion, mixed with genetic, environmental, and social factors (Cohen et al., 2006; Gerlach et al., 2015; Vainik et al., 2018). Therefore, the reverse causality should be considered as a possibility.

Lastly, regarding Study III, self-compassion has traditionally been assessed as one factor including six dimensions (Neff, 2003b, 2023). To paraphrase, self-compassion entails self-kindness versus self-judgement, common humanity versus isolation, and mindfulness versus over-identification (Neff, 2003b, 2023). Recently, however, there has been a discussion whether self-compassion might consist of two factors (i.e., self-compassion and self-coldness) (Muris & Otgaar, 2020; Neff, 2020). Some studies have not found evidence for the one-factor structure, but instead, have found support for the two-factor structure, in the full 26-item scale (Brenner et al., 2017; Kumlander et al., 2018). In terms of the presently used 12-item short-form scale, both one-factor and two-factor structure have received support (Babenko & Guo, 2019; Garcia-Campayo et al., 2014; Uršič et al., 2019). As the current study was an exploratory one, it was of interest to investigate the traditional global measure of self-compassion. In the future, however, the possible two-factor structure should be investigated with body composition.

Finally, one aspect to note is that the study variables were studied with self-reported questionnaires, except for body composition. Hence, there is a possibility of bias, such as common method bias (i.e., the use of the same method can cause spurious correlations) and social desirability bias (i.e., the participants respond in a way that makes them look good). To illustrate, compassion is often viewed as a

favorable trait to possess, and people may embellish their answers so as to be perceived as more socially acceptable. Such risks are higher in Study III, which has a cross-sectional design. However, the outcome of Study III was a physiological measurement, which may reduce common method bias. Moreover, Studies I and II had longitudinal designs. In these longitudinal studies, the predictive analyses controlled the starting level compassion, potentially also reducing the common method bias.

6.3.2 Strengths

First, the current doctoral dissertation used two large datasets from two prospective studies, the Young Finns Study (YFS) and the Northern Finland Birth Cohort 1986 (NFBC1986). The use of these data sets meant several advantages. For example, both data sets are population-based. In the investigation of compassion and job characteristics, the sample consisted of several different age groups and occupation groups, instead of focusing on one age group, occupation, or organization. Past compassion intervention studies have focused on healthcare workers (e.g., Scarlet et al., 2017; Weingartner et al., 2019). Moreover, many compassion intervention studies have also had female-majority samples (Carter et al., 2023), whereas all three current investigations had relatively equal gender ratios. Regarding the NFBC1986 study, approximately 99% of the children born in the target time period and region were recruited for the baseline assessment. Moreover, these participants have been followed since pregnancy. The NFBC1986 data thus provide unique and comprehensive data on Northern Finns born in the 1980s. Lastly, both data sets offered various known confounders such (e.g., gender, socioeconomic factors, health behaviors, working conditions, and depressive symptoms), and thus, enabled reducing noise in the statistical analyses. In the future, it might be of interest to also adjust for potential shared underlying genes, such as those related to oxytocin (Fang et al., 2020; Kucerova et al., 2023; Y. Li et al., 2023; Sun et al., 2019), as such analyses were not conducted in the current study.

Second, both studies have been running for several decades, since the 1980s. In the case of YFS, the data came from the follow-ups of 2001 and 2012, allowing the investigation of the direction of the temporal relationships. Previously, no study had investigated compassion with job characteristics and sleep or their temporal relationships, according to my current knowledge. Thus, the current studies entail the first preliminary findings of how compassion can predict the perception of fewer straining job characteristics (Study I) and fewer sleep difficulties (Study II).

Furthermore, the longitudinal data allowed to examine whether the relationship ran from well-being proxies to compassion, meaning the tentative test of reverse causation. The investigation of the direction of the temporal associations was done with cross-lagged panel models, which can be used to assess stability and the effects of study variables on one another (e.g., Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020).

Third, YFS also enabled the examination of whether compassion could predict the developmental trajectory of the well-being proxies over the follow-up of 11 years. This was possible as the outcome variables were measured three times over the 11 years in Study I and Study II. Thanks to the long follow-up time and several age cohorts, the examined time window ranged from early adulthood into middle age. Moreover, these adulthood trajectories were investigated with the statistical analysis of multilevel models as growth curves. Multilevel models allow the examination of both within-individual and between-individual variations, which cannot be achieved with regression analysis, for example.

Fourth, Study III investigated both compassion and self-compassion in relation to body composition. Studying compassion and self-compassion allowed the examination of the similarities and differences of the two traits. There has been a discussion whether compassion and self-compassion should be treated as one or two separate constructs (Strauss et al., 2016). However, there is evidence that highly compassionate and highly self-compassionate individuals differ from one another to some extent. Previous studies have shown, for example, that the demographics of compassionate and self-compassionate individuals can differ, such as gender and socioeconomic position (Lee et al., 2021; López et al., 2018). Moreover, the two traits correlate only weakly, the correlation coefficients ranging from 0.10 to 0.28, and the correlation has not always been significant in these studies (Lee et al., 2021; López et al., 2018; Neff & Pommier, 2013). The current results of Study III showed converging results as there was a weak, positive correlation between compassion and self-compassion. Moreover, the two traits appeared to have a different relationship to body composition according to the results in Study III.

Another strength of the study was that the current data came from studies using prospective designs, whereas many past longitudinal compassion studies have used intervention designs. To illustrate, compassion intervention studies commonly use the Buddhist-based loving-kindness meditation, which traditionally entails the practice of both compassion for self and others (Hofmann et al., 2011; Kirby, 2017; R. Wang et al., 2023). Thus, the effects of compassion and self-compassion may

often be entangled, whereas here, the associations of compassion and self-compassion were examined independently of each other regarding body composition, for example.

Lastly, all three studies included more than one measurement of the well-being proxy. In Study I, two different job characteristic models were employed with altogether three subcomponents. Study II had four different sleep indicators, which assessed both quantity and quality. Furthermore, Study III had five different body composition measurements that were not self-reported but taken by a professional. In Study III, body composition measurements included perhaps the most utilized body composition measurement, namely BMI, but also waist-circumference and waist-to-hip ratio, which are more adept at assessing the dangerous centralized fat (De Koning et al., 2007; Janssen et al., 2004). Additionally, body fat percentage and fat mass index were assessed with a bioelectrical impedance analysis device, InBody 770, which is commonly used among the general population. Thus, the current study was able to get a detailed look at how compassion and self-compassion were related to the well-being factors of interest.

6.4 Practical implications

The investigation of the temporal relationships between compassion and well-being indicators is imperative. For the past few decades, there has been a discussion about the "cost of caring", particularly in healthcare (Figley, 1995; Scheffer et al., 2022). According to PubMed, increasing numbers of studies with "compassion fatigue" in the title or abstract are published every year. Patient work in healthcare can indeed be straining (Dutheil et al., 2019). Labels such as "cost of caring" or "compassion fatigue" may, however, have created the false impression that compassion is a draining disposition (Gerard, 2017; Klimecki & Singer, 2012). The current results suggest the opposite: compassion can be a protective trait, for example, against effort-reward imbalance. The findings from the healthcare field seem to agree with the current results. Healthcare professionals have emphasized that lacking resources and unideal work environments (e.g., staff shortage, lack of breaks) were more pressing issues that needed addressing than the implementation of resilience training (Aiken et al., 2023). Thus, the popular term 'compassion fatigue', which refers to indirect exposure to trauma (usually) in the healthcare setting, could be referred to as 'secondary traumatic stress' or 'empathic distress fatigue' (Figley & Ludick, 2017; Klimecki & Singer, 2012). This relabeling of the construct could help to distinguish it from compassion.

Compassion may be beneficial in other domains of life. To demonstrate, the results of the current doctoral dissertation showed that high compassion predicts fewer straining job characteristics. The effect sizes in the multilevel models were, for example, 0.06 for effort-reward imbalance, and 0.24 for reward (i.e., unstandardized regression coefficients). The suggested theoretical cut-off value has been ≥ 1.0 for high effort-reward imbalance, for example (Siegrist et al., 2014). Such estimated cut-off values may not be directly comparable to other populations (Kurioka et al., 2013). However, the suggested cut-off value can give an indication that in the current data, compassion may have a small, but practical effect on job characteristics. The current results also indicated that compassion accounted for approximately 3–4% of the variance in the job characteristics in regression models adjusted for age and gender (estimated by adjusted R^2).

Thus, the incorporation of compassion in the work context may have some benefits. There has been an increasing prevalence of public discussion in Finland on how to support workers at their jobs (Hytönen & Pennanen, 2023; Vuolteenaho, 2022). A recent study has highlighted the importance of stable, personal resources as they can aid in regulating job strain (Bakker & de Vries, 2021). In addition to the current results, a recent meta-analysis showed that practicing state compassion is associated with improved mental well-being in a work context (R. Wang et al., 2023). As young professionals and individuals with lower educational level appear to be at particular risk for experiencing job strain (Koponen et al., 2018; Rigó et al., 2021; Suutala et al., 2023), they could be some of the target groups for compassion interventions. Compassion could be implemented as part of work well-being programs or as a tool for job crafting, for instance (Matos et al., 2022; Shanafelt et al., 2019; Tims et al., 2012). Of course, when addressing job strain, person-centered practices are not enough and they need to be supplemented with organization level actions, such as work redesign and sustainable human resource management (Lovejoy et al., 2021; Lu et al., 2022).

Similarly to straining job characteristics, sleep difficulties are also one of the plagues of our time. Reports show an increasing prevalence of sleep difficulties, while there also is a trend of decreasing sleep duration (Bin et al., 2012; Knutson et al., 2010). Moreover, sleep difficulties may be underdiagnosed, and thus, undertreated (Chattu et al., 2019; Ogeil et al., 2020). One solution to sleep difficulties has been the prescription of sleep medication, but they can have side-effects and may not be suitable for all populations (Pagel et al., 2018). There is thus a need for low-threshold practices to treat sleep difficulties, preferably before they escalate or become chronic.

The current data suggest that compassion could possibly be applied in sleep interventions. The current results indicated that the effect sizes in regression analyses were -0.86 for sleep problems, -0.62 for sleep difficulties, and -0.22 for sleep deficiency (i.e., unstandardized regression coefficients). In addition, compassion accounted for around 1–3% of the variance in the sleep indicators when adjusted for age and gender (estimated by adjusted R^2). Past research has found similar estimates for other personality traits, as a single Big Five personality trait can account for ~1–3% of the variance in a sleep indicator (Hintsanen et al., 2014). By comparison, the inclusion of all Big Five can account for ~12% of the variance in sleep quality (Cellini et al., 2017).

One of the most significant findings of Study II (sleep) was that the effects of compassion held even after controlling for age, gender, socioeconomic positions in childhood and adulthood, health behaviors (physical activity, alcohol consumption, smoking), and working conditions (employment status, shiftwork). Health behaviors and working conditions, for instance, are some of the most common associates of sleep issues (Lallukka et al., 2010; Magnusson Hanson et al., 2011; Törnroos et al., 2017). Thus, it is rather remarkable that the associations of compassion and sleep persisted after adjusting for these known confounders. Moreover, the current findings tentatively suggested that depression may be a mechanism behind the relationship between compassion and sleep. Therefore, compassion may prove to be a useful complementary sleep tool, for example, for those with mild work strain or mild depressive symptoms.

Third, compassion may function as a supportive element in healthy body composition. However, this is a very tentative suggestion as high compassion was associated with three out of the five body composition measurements in the fully adjusted model. Most of the analyses showed non-significant results. Regarding practical implications, the effect size for, for example, waist circumference was -0.96 (i.e., unstandardized regression coefficient). In practice, this result indicates that waist circumference was associated with an almost 1.0 centimeter reduction when there was a one-unit increase in compassion, while other variables remained constant. Past research has found that a 1.0 centimeter reduction in waist circumference is associated, for example, with small improvements in cardiorespiratory fitness, 4% reduction in visceral adipose tissue, and 2% reduction in risk of developing cardiovascular disease (De Koning et al., 2007; Dyrstad et al., 2019; Ross et al., 1996). Of course, the results of these studies are not comparable, and the relationships are likely to be more complex than implied here. Nevertheless,

together they can give references and indications of what the practical effects of compassion on body composition and health could potentially be.

To continue even further with the implications of Study III, it has been previously suggested that other-directed compassion may be associated with adaptive stress and emotion regulation tactics (e.g., Förster & Kanske, 2022). Therefore, compassion could be a sustainable means to support healthy body composition. To illustrate, when an individual, perhaps inevitably, faces relapses and setbacks in weight management, compassion may provide a tool to manage stress and difficult emotions and carry on despite the adversities (Cosley et al., 2010; Förster & Kanske, 2022; Saarinen, Keltikangas-Järvinen, Viding, et al., 2021). However, more research is needed on the topic as the current results were not significant across all tested Models. Moreover, the directionality of the relationship between compassion and body composition remains undiscovered. It is also unknown whether compassion is better suited as a complementary rather than an alternative tool to more traditional methods. Lastly, according to the current results, self-compassion cannot be recommended to be an intervention target for body composition in the general population. Self-compassion may be more beneficial in different areas of well-being. Previously, self-compassion been shown to have several other benefits for cognitive and psychological well-being, for example (Ewert et al., 2021; Wakelin et al., 2022; Zessin et al., 2015).

Although compassion is a relatively stable dispositional trait, research has also demonstrated the plasticity of compassion (Hofmann et al., 2011; Kirby, 2017; Klimecki, 2015). Compassion can be increased with relatively brief and light interventions, according to meta-analyses (Kirby et al., 2017; Luberto et al., 2018). Furthermore, compassion practices have several favorable qualities, making them attractive targets for interventions (Hofmann et al., 2011; Kirby, 2017). First, mindfulness-based compassion interventions are cost-effective (L. Zhang et al., 2022). After relatively brief initial training, compassion meditation practices can be done independently. Moreover, compassion meditations are accessible time- and setting-wise. Second, compassion-based meditations have been found to have moderate effects when practiced for seven minutes daily (Hutcherson et al., 2008). Practicing somewhat longer, around 15–20 minutes at a time, may be more common (Fredrickson et al., 2008; Zeng et al., 2022). The effects can be observed after two to three months (Galante et al., 2014; Kirby et al., 2017; Luberto et al., 2018). It is noteworthy that rather than the total amount of time spent practicing compassion at a time, consistency and quality in practicing appear to be more important for the effects (Gawrysiak et al., 2021; Zeng et al., 2022). Moreover,

although training a state can eventually result in increases in a trait, there is great variability in the individual trajectories (Kiken et al., 2015). Lastly, compassion practices can accommodate a variety of populations, as the practices vary from low to high intensity, from meditation to clinical therapy (Kirby, 2017; Kirby & Gilbert, 2017).

It is noteworthy, however, that not all individuals may be able to use compassion to promote well-being indicators (Gilbert et al., 2011; Kirby et al., 2021). For example, the exploration and cultivation of compassion can arouse strong emotions and memories, causing some individuals to experience resistance to compassionate thoughts and feelings (Gilbert et al., 2011). In addition, the motivations and attitudes individuals hold about compassion may also determine how useful and effective compassion can be for them (Catarino et al., 2014; Kirby et al., 2021). There are also psychosocial factors that may restrict compassion. Challenges to compassion are, for example, the perception of in-groups versus out-groups, the perception of cognitive costs or few resources, psychological and physical distance to the target of compassion, and the target of compassion being a larger group (versus an individual) (Klimecki, 2019; Scheffer et al., 2022; Vitaliano et al., 2003). Lastly, individuals at risk of psychosis may not be suitable candidates for compassion practices, as many of the compassion exercises are meditation-based (Kirby, 2017; Sharma et al., 2019). Meditation can act as a stressor in individuals with vulnerable conditions. To demonstrate, preliminary evidence has shown that some such individuals have reported symptoms of depersonalization, dissociation, and hallucinations after transcendental and concentrative meditation (Charan et al., 2022). Nevertheless, it is important to offer individuals a selection of tools, out of which the most suitable option is offered to them. Thus, compassion can be one of the many tools that can be offered to individuals to promote well-being and its indicators (Roca et al., 2021).

6.5 Recommendations for future research

This doctoral dissertation showed that compassion is associated with a variety of well-being indicators, i.e., factors as diverse as less straining job characteristics, better sleep, and possibly, healthier body composition. As high quality and quantity of these well-being proxies predicts a lower risk for mortality (Hublin et al., 2007; Niedhammer et al., 2021; Sedlmeier et al., 2021), it would be justified to also study whether compassion is associated with less morbidity and mortality and higher longevity, for example.

As the population pyramid is changing, society needs tools to promote and sustain healthy aging (Behr et al., 2023). Compassion may be such a tool, but research on compassion of older adults and health is scarce. Nevertheless, some benefits of compassion for older adults have been hypothesized (A. Lutz et al., 2021). Compassion could potentially support older adults from various points of view: protection against mental health problems such as depression (T. Hu et al., 2022; Saarinen et al., 2019), and possibly, physical health concerns such as high blood pressure (Gupta et al., 2020; Saarinen, Keltikangas-Järvinen, Hintsa, et al., 2020), but it could also promote social health by decreasing isolation and loneliness, for example (J. Hu et al., 2021; Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020).

In similar fashion, research on the development of trait compassion is still emerging. A few studies have shown that, for instance, warm parenting and preschool attendance at the age of 6 can predict the development of higher trait compassion in adulthood (Gluschkoff et al., 2018; Hintsanen et al., 2019). In contrast, more frequent somatic complaints can interfere with the development of compassion in adulthood (Saarinen, Keltikangas-Järvinen, Lehtimäki, et al., 2020). It is important to further disclose how to support the development of compassion. Large-scale studies have indicated that crucial components of compassion such as empathic concern and perspective-taking are on the decline (Konrath et al., 2011).

Supporting the development of trait compassion can possibly have implications for well-being, but it also functions as a compass to navigate challenging social situations. There are indications that some antisocial behaviors are on the rise, such as cyberbullying and juvenile delinquency (Danielsson, 2022; Kessel Schneider et al., 2015). Such antisocial behaviors are not only linked to harmful and long-lasting effects for other individuals (Danielsson, 2022; Lozano-Blasco et al., 2020; Zaborskis et al., 2019), but cyberbullying and juvenile delinquency are also associated with greater risk of developing depression and even serious health problems (J. Kim et al., 2020; Lozano-Blasco et al., 2020). Compassion may support not only one's personal well-being (Saarinen, Keltikangas-Järvinen, Pulkki-Råback, et al., 2020) but may also promote positive connections with others (Cosley et al., 2010; Don et al., 2022; Hutcherson et al., 2008) and aid in conflict management (Klimecki, 2019; Park et al., 2018). Therefore, supporting the development of trait compassion can potentially have positive implications for both individuals and their social groups.

6.6 Conclusion

Using data from two, large Finnish prospective studies, the current doctoral dissertation found that trait compassion is implicated in comprehensive well-being, as indicated by job characteristics, sleep, and body composition. Moreover, high compassion predicts two of these well-being proxies, fewer straining job characteristics and fewer sleep difficulties, rather than vice versa. These effects of compassion can be observable over a substantial time period spanning more than a decade. The findings may be of use, for example, in working life or in the promotion of sustainable well-being of the general population.

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III Tolonen, I., Saarinen, A., Sebert, S., & Hintsanen, M. (2024). Do compassion and self-compassion moderate the relationship between childhood socioeconomic position and adulthood body composition? *Psychology and Health.* Advance online publication. https://doi.org/10.1080/08870446.2024.2305133

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