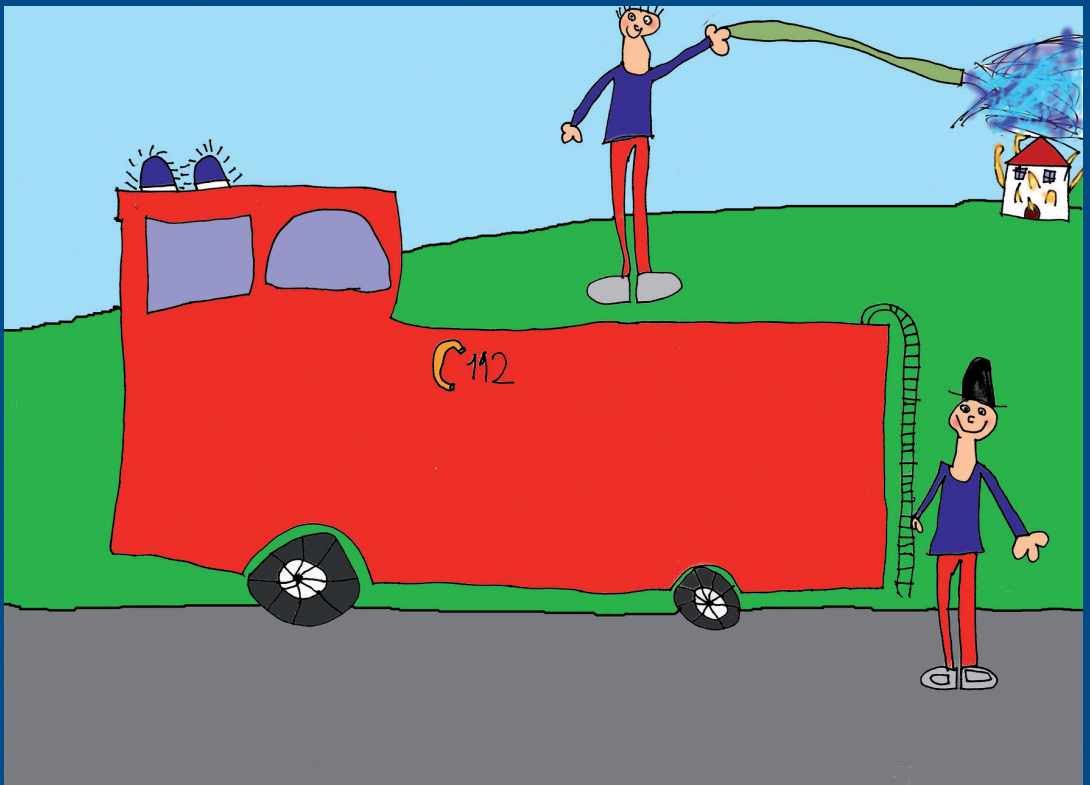


Auli Airila

Work characteristics, personal resources, and employee well-being: A longitudinal study among Finnish firefighters



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ABBREVIATIONS

AIC	Akeike's information criteria
BaB	Broaden-and-Build theory
BIC	Bayesian information criterion
BMI	Body mass index
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence interval
COR	Conservation of Resources theory
DPS	Depressive symptoms
EFA	Exploratory factor analysis
ERI	Effort-Reward Imbalance model
JDC	Job Demand-Control model
JD-R	Job Demands-Resources model
MLE	Maximum-likelihood estimation
MSP	Multisite musculoskeletal pain
LCGM	Latent class growth modeling
OR	Odds ratio
POMS	Profile of mood states
RMSEA	Root mean square error of approximation
SDT	Self-determination theory
SEM	Structural equation modeling
SRH	Self-rated health
TLI	Tucker-Lewis index
T1	Time 1 (1996)
T2	Time 2 (1999)
T3	Time 3 (2009)
UWES	Utrecht work engagement scale
WAI	Work ability index
WHO	World Health Organization

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- II Airila, A., Hakanen, J. J., Schaufeli, W. B., Luukkonen, R., Punakallio, A., & Lusa, S. (2014). Are job and personal resources associated with work ability 10 years later? The mediating role of work engagement. *Work & Stress*, 28, 87–105.
- III Airila, A., Hakanen, J. J., Luukkonen, R., Lusa, S., & Punakallio, A. (2013). Positive and negative mood trajectories and their relationship to work ability, self-rated health and life satisfaction: A 13-year follow-up study. *Journal of Occupational and Environmental Medicine*, 55, 779–785.
- IV Airila, A., Hakanen, J. J., Luukkonen, R., Lusa, S., Punakallio, A., & Leino-Arjas, P. (2014). Developmental trajectories of multisite musculoskeletal pain and depressive symptoms – the effects of job demands and resources and individual factors. *Psychology & Health*, 29, 1421–1441.

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Auli Airila

ABSTRACT

In today's dynamic work life, employees are expected not only to be healthy and able to work efficiently, but also to be highly engaged and motivated. However, at the same time, the prevalence of mental health disorders and diseases of the musculoskeletal systems is also high. Therefore, understanding and enhancing employee well-being as a whole is essential.

The aim of this thesis was to examine the longitudinal effects of work characteristics (i.e., job demands and resources), personal resources, and lifestyle on employee well-being by applying three theoretical frameworks – Job Demands-Resources (JD-R) model, Conservation of Resources (COR) theory, and Broaden-and-Build (BaB) theory. These theoretical frameworks were chosen as they offer theoretical explanations for the underlying psychological processes between the antecedents and well-being outcomes. In this thesis, employee well-being was understood as a multidimensional construct covering affective, cognitive, and health-related components. Through this conceptualization, both positive and negative aspects as well as job-related and context-free indicators of well-being were acknowledged and studied.

More specifically, this study aimed to extend current knowledge, firstly, by examining the relationship between the affective-emotional state of work engagement and work ability and its sub-dimensions. As such, this study contributed to current occupational health psychology by examining the role of work engagement in relation to work ability beyond lifestyle factors and work characteristics. Secondly, this study added new contribution by investigating the role of work ability in the motivational process of the JD-R model. In addition, the developmental paths in positive (i.e., vigor) and negative (i.e., fatigue) affective states and their

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relation to well-being, as well as intra-individual change trajectories in multisite musculoskeletal pain and depressive symptoms and the related antecedents were investigated. By applying a person-centered approach, this study was able to identify individual developmental paths over time.

The data was collected with questionnaires among Finnish firefighters during a 13-year period with three measurement points (i.e., 1996, 1999, and 2009). Two slightly different datasets were used in the four sub-studies. Dataset 1 (Studies I–II) consisted of firefighters who responded to the questionnaires in both 1999 (T2) and in 2009 (T3), and were still employed in their profession in 2009 ($n = 403$). Dataset 2 (Studies III–IV) included those firefighters who responded to the questionnaires at each measurement point, and were still employed in their profession in 2009 ($n = 360$). Several validated measures of work characteristics, personal resources, lifestyle and well-being were applied.

The study showed that a positive state of work engagement consisting of vigour, dedication, and absorption was significantly associated with work ability even after adjusting for various individual and work characteristics. Furthermore, lifestyle factors, work characteristics and work engagement were more strongly related to the subjective work ability dimensions than the two more objective sub-dimensions (i.e., number of diseases and sick leave). The second major finding and a theoretical contribution of the study was that the motivational process of the JD-R model also has health-related properties. More precisely, job and personal resources had long-term effects on work engagement and consequently on work ability, thus expanding the potential positive outcomes of the motivational process included in the JD-R model. Thus, the dual role of work ability both as a predictor (i.e., health-related resource) that may foster engagement, and as an outcome of the motivational process was found.

In addition, this study showed that different developmental paths in positive (i.e., vigor) and negative (i.e., fatigue) affective states are possible. Typically, a rather high level of vigor and low level of fatigue was observed. However, other combinations of positive and negative affective states also existed, for example, a trajectory with high but decreasing level of vigor and high level of fatigue. These results suggest that the positive and negative affect may not always be direct opposites or independent either. In addition, although both vigor and fatigue were rather stable over

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time, some changes occurred over the 13-year follow-up period. More precisely, a decline in positive mood and an increase in negative mood were apparent between 1996 and 1999 whereas the changes were rather minimal during the following ten-year period. Moreover, developmental paths of affective states were differentially related to well-being. Therefore, the results suggest both the possibility and need to foster positive developmental paths in affective states, i.e., to increase vigor and prevent fatigue at work, in order to maintain and improve employee well-being. Similarly, different developmental paths in multisite musculoskeletal pain and depressive symptoms were observed, and changes over time proved to be possible. The results also indicated that job demands, job and personal resources as well as lifestyle were partly differently related to pain-depression trajectories. This needs to be acknowledged when planning interventions for preventing musculoskeletal pain and depressive symptoms.

To conclude, the beneficial role of job resources and personal resources, and similarly the detrimental effect of job demands in explaining employee well-being were shown in this longitudinal study, and thus, proving further support for the assumptions of the JD-R model, COR theory, and BaB theory. Evidently, the findings suggest that a motivated and energetic worker, who has resourceful job and not too high mental and physical demands has better well-being than a co-worker who is less engaged and experiences a more unfavourable situation in terms of demands and resources. Moreover, a good level of self-esteem, an optimistic view of the future and healthy lifestyle habits may increase the likelihood of being healthy and happy. Overall, these results suggest that work characteristics may play a more crucial role than lifestyle in enhancing employee well-being. As such, work organizations have good opportunities to reinforce and maintain well-being of their employees, and consequently prevent ill-health and promote long work careers.

TIIVISTELMÄ

Jatkuvasti muuttuva työelämä asettaa työntekijöille yhä enemmän vaatimuksia. Hyvä terveys ja työkyky eivät yksinään riitä, vaan työntekijöiden oletetaan olevan myös entistä sitoutuneempia ja motivoituneempia työhönsä. Samanaikaisesti mielenterveysongelmat sekä tuki- ja liikuntaelinvaivat ovat yhä suurempia ongelmia työikäisten keskuudessa. Siksi työntekijöiden hyvinvoinnin kokonaisvaltainen ymmärtäminen ja edistäminen ovat entistä tärkeämpiä.

Tämän tutkimuksen tavoitteena oli selvittää työhön liittyvien tekijöiden, yksilöllisten voimavarojen ja elintapojen yhteyttä työntekijöiden hyvinvointiin. Työhön liittyvinä tekijöinä tutkittiin työn vaatimuksia ja työn voimavaroja (esimiestuki, työntekijöiden väliset suhteet, työtehtävään liittyvät voimavarat). Tutkimuksessa hyödynnettiin kolmea teoreettista viitekehystä, jotka ovat työn vaatimusten-työn voimavarojen (TV-TV) malli, voimavarojen säilyttämisen teoria ja positiivisten tunteiden laajentumis- ja rakentumisteoria. Nämä kolme teoreettista viitekehystä valittiin, koska niiden avulla oli mahdollista tarkastella voimavarojen, elintapojen ja hyvinvoinnin välisiä yhteyksiä. Työntekijöiden hyvinvointi on tässä tutkimuksessa ymmärretty moniulotteisena kokonaisuutena, jossa otetaan huomioon hyvinvoinnin affektiiviset, terveyteen sekä kognitiiviset (kuten elämään tyytyväisyyteen) liittyvät osa-alueet. Työntekijöiden hyvinvointia on tarkasteltu myönteisestä ja kielteisestä näkökulmasta. Siksi on selvitetty sekä työn imua ja työkykyä että tuki- ja liikuntaelinten kipuoireita ja masennusoireita.

Tutkimus laajensi nykyistä tietämystä selvittämällä työn imun yhteyttä työkykyyn ja sen eri osa-alueisiin. Samalla se selkeytti työkyvyn roolia TV-TV-mallin motivaatiopolulla, jonka on aiemmin ajateltu sisältävän ainoastaan myönteisiä *organisatorisia* seurauksia, kuten hyvän työstä suo-

riutumisen. Lisäksi tutkimuksessa selvitettiin myönteisten (tarmokkuus) ja kielteisten (väsymys) mielialojen kehityspolkuja ja niiden yhteyttä hyvinvointiin sekä tuki- ja liikuntaelinten kivun ja masennusoireiden kehityspolkuja ja niitä ennustavia tekijöitä. Yksilökeskeinen lähestymistapa mahdollisti yksilöllisten kehityskulkujen paikallistamisen.

Tutkimusaineistona oli suomalaisille palomiehille tehty kyselytutkimus. Aineisto koottiin 13 vuoden aikana kolmella kyselyllä vuosina 1996, 1999 ja 2009. Neljässä tutkimuksen osatutkimuksessa käytettiin kahta hieman erilaista aineistoa. Aineisto 1 (osatutkimukset I–II) koostui niiden palomiesten vastauksista, jotka osallistuivat kyselyyn vuosina 1999 (T2) ja 2009 (T3) ja työskentelivät edelleen ammatissaan vuonna 2009 ($n = 403$). Aineisto 2 (osatutkimukset III–IV) kattoi niiden palomiesten vastaukset, jotka osallistuivat kyselyyn jokaisella kolmella mittauskerralla ja jotka työskentelivät edelleen ammatissaan vuonna 2009 ($n = 360$). Tutkimuksessa käytettiin useita valideja mittareita, joilla tutkittiin työn vaatimuksia ja voimavaroja sekä yksilö- ja elintapatekijöitä.

Tutkimus osoitti, että työn imu eli myönteinen tunne- ja motivaatio-tila, joka muodostuu tarmokkuudesta, omistautumisesta ja uppoutumisesta, oli merkitsevästi yhteydessä työkykyyn senkin jälkeen kun useat yksilöön ja työhön liittyvät tekijät oli vakioitu. Lisäksi tutkimus osoitti, että elintapoihin ja työhön liittyvät tekijät sekä työn imu olivat vahvemmin yhteydessä työkyvyn subjektiivisiin ulottuvuuksiin kuin sen objektiivisiin ulottuvuuksiin, kuten tautien määrään ja sairauspoissaoloihin.

Toinen tutkimuksen keskeinen havainto ja teoriaa kehittävä tulos oli se, että TV-TV-mallin motivaatiopolkuun sisältyy terveyteen liittyviä ominaisuuksia. Toisin sanoen työhön ja yksilöön liittyvillä voimavara-tekijöillä oli pitkän aikavälin vaikutuksia työn imuun, joka edelleen oli yhteydessä työkykyyn. Näin ollen tutkimus osoitti, että TV-TV-mallin motivaatiopolku voi johtaa myös parempaan hyvinvointiin ja terveyteen. Samalla työkyvyn kaksoisrooli sai tukea: työkyky on motivaatiopolulla sekä selittäjä (eli terveyteen liittyvä yksilön voimavara), joka edistää työn imua, että motivaatiopolun myönteinen terveyteen liittyvä lopputulema.

Tutkimus osoitti lisäksi, että erilaiset tarmokkuuden ja väsymyksen kehityspolut ovat mahdollisia. Useimmiten palomiehillä oli korkea tarmokkuuden ja matala väsymyksen tila, mutta muitakin myönteisten ja kielteisten mielialojen yhdistelmiä esiintyi. Tulokset osoittivat, että kielteinen ja myönteinen mieliala eivät ole selkeästi vastakkaisia tai pääl-

lekkäisiä. Vaikka myönteiset ja kielteiset mielialat osoittautuivat varsin pysyviksi, joitakin muutoksiakin tapahtui 13 vuodessa. Esimerkiksi vuosien 1996 ja 1999 välillä tarmokkuus laski vastaavasti väsymyksen kasvaessa, kun taas seuraavan kymmenen vuoden aikana muutokset mielialoissa olivat varsin vähäisiä. Tutkimus osoitti myös, että tarmokkuuden ja väsymyksen erilaiset kehityspolut olivat eri tavalla yhteydessä hyvinvointiin. Tutkimus osoittikin, että myönteisten mielialojen kehittäminen on mahdollista, sillä tarmokkuuden edistäminen ja väsymyksen torjuminen myötävaikuttavat työntekijöiden hyvinvointiin.

Lisäksi tutkimus osoitti, että tuki- ja liikuntaelinten kipuoireet ja masennusoireet voivat kehittyä eri tavoin. Myös työn vaatimukset, työhön ja yksilöön liittyvät voimavarat sekä elintapatekijät ovat eri tavalla yhteydessä erilaisiin kipu-masennus-kehityspolkuihin. Tämä on syytä huomioida, kun kipu- ja masennusoireita pyritään vähentämään.

Tutkimus osoitti, että työn voimavarat, yksilön voimavarat ja työn vaatimukset vaikuttavat työntekijöiden hyvinvointiin hyvin pitkälläkin aikavälillä. Näin ollen tutkimus vahvistaa TV-TV-mallin, voimavarojen säilyttämisen teorian sekä positiivisten tunteiden laajentumis- ja rakentumisteorian oletuksia. Tutkimuksen tulokset osoittavat, että motivoitunut ja energinen työntekijä, jolla on useita voimavaroja sisältävä työ sekä alhaiset työn henkiset ja fyysiset vaatimukset, voi paremmin ja on terveempi kuin työntekijä, joka on vähemmän sitoutunut työhönsä ja jolla on epäsuotuisammat olosuhteet työn vaatimusten ja voimavarojen suhteen. Myös hyvä itsetunto, optimistinen suhtautuminen tulevaisuuteen sekä terveelliset elintavat voivat myötävaikuttaa työntekijän hyvinvointiin.

Tulokset viittaavat siihen, että työolotekijät voivat olla elintapatekijöitä tärkeämpiä työntekijöiden hyvinvoinnin edistämisessä. Näihin tekijöihin myös työpaikat voivat vaikuttaa, ja siten edistää työntekijöiden hyvinvointia ja myötävaikuttaa myös työurien pidentymiseen.

1 INTRODUCTION

Promoting employee health and well-being is essential in our ever-changing work life in which, for example, a growth of information technology is producing new requirements for employees. Therefore, employees are expected to be healthy, productive, proactive, energized, highly committed, and have a good work ability in order to perform efficiently (e.g., Leiter & Bakker, 2010). Thus, both health-related and affective qualifications of employees are required: being healthy and able to work is not sufficient. In addition, high levels of motivation and engagement are needed. However, simultaneously, every year over 20 000 people in Finland retire on disability pensions, most often because of mental disorders and diseases of the musculoskeletal systems (Finnish Centre for Pensions, 2013). Thus, evidently, understanding and enhancing employee well-being in its entirety is essential: how to build a healthy work life that allows employees to use their full capabilities at work and simultaneously enjoy good health and well-being?

Traditionally, employee well-being has been viewed from a negative perspective, that is, as occupational stress, disease, mental illness, weakness, and symptoms. Thus, understanding the causes and consequences of ill-health was the main focus of occupational health studies throughout the decades (e.g., Cooper, 1998; Cooper & Marshall, 1976; Dewe, O'Driscoll, & Cooper, 2010; Karasek & Theorell, 1990; Lazarus & Folkman, 1984). From the beginning of the millennium, the rise of positive psychology (Seligman & Csikszentmihalyi, 2000; Snyder & Lopez, 2002) has prompted interest in positive aspects of well-being. The focus has therefore gradually shifted from stress and illness to social psychological processes that contribute to and enhance well-being. In particular, this change has resulted in a rapid increase in studies of positive

1 INTRODUCTION

organizational behaviour, such as work engagement (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Schaufeli, Salanova, González-Romá, & Bakker, 2002), and psychological capital (Luthans, Youssef, & Avolio, 2007). The increasing amount of research on work engagement and other positive affective well-being states is not surprising as the benefits of such affective states on both employees and organizations are widely acknowledged. Indeed, previous studies indicate that engaged employees perform better, are proactive and more committed to their jobs, have fewer sickness absences, and are more willing to continue their job (for a review, see Halbesleben, 2010). Thus, in order to benefit from the favourable consequences, it is crucial to understand the drivers (e.g., job resources and personal resources) of such positive affective work-related states.

The idea of positive psychology was not to replace traditional view of psychology focusing on ill-health and health problems, rather, it was to complement and enlarge the field. Therefore, current research on social psychological health studies tries to find a balance between positive and negative aspects of employee well-being, and aims to understand the entire range of well-being, not just the positive or negative side of it (e.g., Schaufeli et al., 2002; Schaufeli & Bakker, 2004). Overall, in health psychology, health is understood as a product of not only biological processes, but also of psychological, behavioral, organizational, and social processes (e.g., Engel, 1977; Houdmont & Leka, 2010; Odgen, 2012). Similarly, this study aims to frame a comprehensive view of employee well-being, in taking an individual and organizational perspective, and in examining both positive well-being (e.g., work engagement, work ability and life satisfaction) as well as negative aspects of health, such as symptoms of depression and musculoskeletal pain. In particular, the focus of this study is on the psychosocial processes related to employee well-being, specially, on the mechanisms linking motivational (i.e., work engagement), situational (i.e., job resources and job demands), and individual (i.e., personal resources and lifestyle) characteristics on employee well-being. These mechanisms linking motivational, situational and individual characteristics on well-being were examined using data from a 13-year follow-up period on a sample of Finnish firefighters.

Apparently, firefighters experience both positive and negative aspects of well-being. Work as a firefighter can be highly motivating as the job

includes a wide variety of tasks which enables the use of one's knowledge and competence, as well as supportive team work. However, at the same time, firefighters are found to have several health problems, such as musculoskeletal disorders, sleeping problems, post-traumatic stress disorder, depression and even work disability (e.g., Fullerton, Ursano, & Wang, 2004; Haslam & Mallon, 2003; Punakallio, Lusa, Luukkonen, Airila, & Leino-Arjas, 2014; Regehr, Hill, Knott, & Sault, 2003). It is clear that health-protecting job resources and personal resources, as well as job demands that may reduce well-being, form part of the job of firefighters. However, so far, previous studies on firefighters' well-being have mainly focused on the negative side, such as risk factors of the job, risk behavior, and health problems, instead of positive aspects of well-being.

Thus, this study aims to fill in the gaps in current literature by providing a comprehensive perspective of firefighters' well-being through investigating both the positive and negative aspects of well-being and the related demands and resources by using a longitudinal data. Moreover, by applying a person-centered approach in examining employee well-being in the long term this study brings novel information about the developmental paths at individual level about positive and negative affective states, as well as with regard to multisite musculoskeletal pain and depressive symptoms. Theoretically, this study aims to expand on previous research by focusing on how motivational characteristics (i.e., work engagement) may predict health-related well-being (i.e., work ability), and how work ability itself may be considered a health-related resource that may have a beneficial effect on well-being in the long term. Despite using a data of a single occupation, this study has a strong theoretical basis, and it is therefore assumed that the models and results can largely be generalized to other occupations as well.

1.1 Conceptualization of employee well-being

A wide variety of constructs have been used to describe well-being (see for example, Ryan & Deci, 2001). As outlined, in occupational health psychology, well-being has frequently been distinguished by positive and negative perspectives (e.g., Mäkikangas, Schaufeli, Tolvanen, & Feldt, 2013; Schaufeli et al., 2002). In addition, concepts such as affective

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well-being (Warr, 1990, 2007), subjective well-being (Diener, 1984, 2000), and psychological well-being (Ryff & Keyes, 1995) have been applied. In addition, a distinction between job-related and non-job related well-being has been made (Warr, 1990). Compared to the model of affective well-being (Warr, 1990) – which is based on the dimensions of pleasure and arousal – subjective well-being (Diener, 1984, 2000) and psychological well-being (Ryff & Keyes, 1995) offer a somewhat more comprehensive view of well-being. First, subjective well-being refers the extent to which people feel and think that their life is going well. As such, subjective well-being includes both affective dimensions (i.e., moods and emotions) as well as a cognitive evaluation of one's satisfaction in general (i.e., life satisfaction) (e.g., Diener, 2000; Diener, Suh, Lucas, & Smith, 1999). Psychological well-being, on the other hand, includes not only affective and cognitive components, but also behavioural and motivational aspects of well-being (Ryff & Keyes, 1995). To sum up, several constructions – partly overlapping – of well-being exist, and at the moment no single agreed-upon definition of employee well-being exists (Salanova, Del Líbano, Llorens, & Schaufeli, 2014).

In this study, employee well-being is understood as a multidimensional construct covering affective, cognitive, and health-related aspects of well-being. This study combines elements from models by Warr (1990), Diener (1984, 2000), and Ryff and Keyes (1995), with health-related views about well-being. As such, three dimensions of well-being are studied: *affective well-being* (i.e., work engagement, and positive and negative affective states), *health-related well-being* (i.e., work ability, self-rated health, and multisite musculoskeletal pain), and *cognitive* component of subjective well-being (i.e., life satisfaction). Under this classification, both positive and negative sides as well as job-related and context-free indicators of well-being are acknowledged. In that sense, this study is following the line of occupational health psychology research that emphasizes the holistic view of employee well-being (e.g., Schaufeli et al., 2002; Schaufeli & Bakker, 2004; van Horn, Taris, Schaufeli, & Schreurs, 2004). Next, these three dimensions – affective, health-related, and cognitive – are presented in detail.

1.1.1 Affective well-being

As a theoretical approach to affective well-being, a typology of affective well-being by Peter Warr (1990) has been applied. In Warr's (1990) typology, affective well-being is comprised of two orthogonal dimensions: pleasure and arousal (see also Russell, 1980). In his model, any level of pleasure may be accompanied by high or low levels of arousal, and similarly, a particular level of arousal may be either pleasurable or unpleasurable. To measure affective well-being, three axes are used: discontented-contented, anxiety-comfort, and depression-enthusiasm. Thus, the model acknowledges both positive and negative aspects of well-being which both are of interest in the current study. From Warr's model, the focus of this study is in the third axis, i.e., depression-enthusiasm, in which positive feelings such as enthusiasm and positive motivation are situated opposite feelings of depression and sadness. More precisely, four affective well-being indicators are examined that can be included in the depression-enthusiasm axis of Warr's typology (1990): work engagement, vigor, fatigue, and depressive symptoms, respectively. In terms of Warr's model, *work engagement* and *vigor* refer to energetic and activated states, and positive pleasure filled with enthusiasm, and thus, they can be located at the positive end of the depression-enthusiasm axis. Whereas, feelings of *fatigue* and *depressive symptoms* are located at the negative pole of the same axis. Hereafter, the conceptualization of four affective well-being indicators of this study will be presented in more detail.

Work engagement

Work engagement has emerged as an affective well-being construct to measure the positive work-related state of mind (e.g., Bakker, Schaufeli, Leiter, & Taris, 2008). Research on engagement at work has grown considerably during the last 20 years; however, a comprehensive and common understanding of work engagement as an academic concept does not yet exist. Instead, there are diverse, and partly contradictory, conceptualizations of the work-related engagement.

Personal engagement. The first conceptualization of engagement at work was made by Kahn (1990) who defined personal engagement as "harnessing of organization members' selves to their work roles: in en-

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agement, people employ and express themselves physically, cognitively, emotionally and mentally during role performances (p. 694)". As such, engagement is simultaneous self-expression and self-employment by employees in role performances, that is, employees both drive personal energies into work roles (i.e., self-employment), and display self within the role (i.e., self-expression). In other words, engaged employees bring their personal selves into their work as they identify with it. Despite presenting a comprehensive theoretical model of engagement, Kahn has not proposed an operationalization of the model (Schaufeli et al., 2002). In addition, only a few empirical studies based on the Kahn's model exist (e.g., May, Gilson, & Harter, 2004; Rothbard, 2001; Saks, 2006).

Job engagement. According to Maslach and Leiter (1997) – the pioneers of burnout research – job engagement can be characterized as a positive antithesis of burnout. To them, engagement is characterized by energy, involvement and efficacy, which are the direct opposites of the three burnout dimensions (i.e., exhaustion, cynicism, and reduced professional efficacy). Therefore, engagement and burnout are considered to exist on the same underlying continuum, with job engagement at one end and burnout at the other. As such, this conceptualization limits the opportunity to examine engagement in its own right (see Seligman, 2002; Seligman & Csikszentmihalyi, 2000) as an independent, distinct concept of burnout. In addition, defining engagement and burnout as direct opposites disables the investigation of the relationship between these two concepts (Schaufeli et al., 2002).

Work engagement. A third – and the most cited and studied – definition of engagement considers work engagement as independent positive construct, although negatively related to burnout (Schaufeli et al., 2002). Consequently, work engagement is defined as a positive, fulfilling, affective-motivational state of work-related well-being, characterised by vigor, dedication, and absorption (Schaufeli et al., 2002). *Vigor* refers to high levels of energy and mental resilience while working and the willingness to invest effort in one's work, and persistence even in the face of difficulties. *Dedication* is characterized by being strongly involved in one's work, and experiencing a sense of significance, enthusiasm, inspiration, pride, and challenge. *Absorption* refers to being fully concentrated and happily engrossed in one's work, whereby having a sense of time passing quickly and difficulties detaching oneself from work. As such,

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work engagement is a multidimensional construct including behavioural-energetic (vigor), emotional (dedication), and cognitive (absorption) components. Most scholars agree that engagement includes dimensions of vigor and dedication, however, the significance of the third indicator of work engagement (i.e., absorption) is less unanimous (Bakker et al., 2008). In addition, the distinction of work engagement from burnout is supported by a vast amount of empirical evidence (for a meta-analysis, see Halbesleben, 2010). Due to the independence of work engagement, it is possible, to some extent, to be engaged and burn-out simultaneously, that is, to have both positive and negative affective states at the same time. Similarly, research has shown that work engagement is independent of several related constructs, such as flow (Csikszentmihalyi, 1990; Schaufeli & Bakker, 2010), job involvement (Lodahl & Kejner, 1965; Salanova, Agut, & Peiró, 2005), job satisfaction (e.g., Hackman & Oldman, 1976; Herzberg, 1959; Schaufeli & Bakker, 2010), and workaholism (e.g., Mäkikangas et al., 2013; Schaufeli, Taris, & Bakker, 2008). Thus, despite a partial overlap, the concept of work engagement has an added value over these related concepts and must therefore be distinguished from them (see also Schaufeli & Bakker, 2010).

Previous studies on work engagement have consistently shown that job resources (e.g., autonomy, social support, skill variety, and performance feedback) and personal resources (e.g., self-efficacy, optimism, and self-esteem) facilitate engagement (e.g., Christian, Garza, & Slaughter, 2011; Crawford, LePine, & Rich, 2010; Halbesleben, 2010; Simpson, 2009; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2007), and consequently, engagement is found to be related to positive outcomes at work, including organizational commitment (e.g., Hakanen, Bakker, & Schaufeli, 2006), job performance (Salanova et al., 2005), and work-unit innovativeness (Hakanen, Perhoniemi, & Toppinen-Tanner, 2008a). However, evidence of the relationship between engagement and health is still scarce (Bakker et al., 2008; Bakker & Leiter, 2010), and therefore, this study aims to enlarge current knowledge by examining the relationship between engagement and health-related well-being, i.e., work ability.

Positive and negative affective states

As outlined, work engagement refers to a positive *work-related* affective state. However, affective states can also be conceptualized as *context-free* dispositional constructs, such as positive and negative affect (e.g., Watson, Clark, & Tellegen, 1988; Weiss & Cropanzano, 1996). By definition, affect can be distinguished by moods and emotions. Moods are regarded as more stable affective states than emotions, which are considered more intense and short-lived (Brief & Weiss, 2002; Cropanzano, Weiss, Hale, & Reb, 2003).

Positive affect refers to feelings like energetic, active, alert, inspired, and enthusiastic, which are, in fact, closely related to the vigor dimension of work engagement. In contrast, negative affect refers to affective states such as being distressed, upset, nervous, or afraid. (Watson et al., 1988.) Both positive and negative affects can be conceptualized as state or trait: with state affect referring to one's feelings at a given point in time, whereas trait represents more stable individual differences in the level of affect (e.g., Pressman & Cohen, 2005). Several scales to measure positive and negative affective states exist; the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), and the Profile of Mood States (POMS; McNair, Lorr, & Droppelman, 1971) among others.

There is no consistent view as to whether positive and negative affect are bipolar opposites (e.g., Russell & Carroll, 1999) or independent of each other (e.g., Watson & Tellegen, 1999). The discussion has similarities with the aforementioned discussion between work engagement and burnout (e.g., Maslach & Leiter, 1997; Schaufeli et al., 2002). The independence of positive and negative affect would mean that an increase in one does not necessitate a decrease in the other (Cropanzano et al., 2003), and thus, people could have both positive and negative feelings at the same time (e.g., Cacioppo & Berntson, 1994; Larsen & McGraw, 2011; Larsen, McGraw, & Cacioppo, 2001). In contrast, the bipolar view assumes that positive and negative affect are opposite ends of a bipolar continuum, and people cannot have positive and negative feelings simultaneously (e.g., Green, Goldman, & Salovey, 1993; Russell & Carroll, 1999). In this study, the focus is on three affective states which represent both positive (i.e., vigor) and negative (i.e., fatigue and depression) poles of affect. Moreover, both the independence and bipolar view of the affective states will be examined.

Most of the conceptualizations of *vigor* share the idea that vigor is a positive affective state that is characterized by high levels of energy and vitality. For example, Ryan and Frederick (1997) have defined vigor as an individual's subjective feeling of energy and liveliness. In the work context, vigor has been defined as a set of interrelated affective states experienced at work, and as such, is characterized by feelings of physical strength, emotional energy, and cognitive liveliness (Shirom, 2010). As already noted, vigor has also been defined as a core component of work engagement (Schaufeli & Bakker, 2010). Hence, vigor is defined as high levels of energy, mental resilience, and willingness to invest effort in one's work. In this study, vigor is viewed as a positive affective state characterized by e.g., activity, energy, cheerfulness, and liveliness. Hence, vigor can be situated at the positive pole of depression-enthusiasm axis in Warr's (1990) affective well-being model. Previous studies, albeit thus far mainly based on cross-sectional data, suggest that vigor is positively related to well-being. For example, vitality – one component of vigor – was found to be related to physical and psychological health (Ryan & Frederick, 1997). Moreover, Shirom, Toker, Berliner, Shapira, and Melamed (2006) found that high levels of vigor were negatively correlated with several inflammation biomarkers. However, there is a paucity of longitudinal research investigating the effect of vigor on employee well-being, and in particular, the possible co-occurrence with fatigue, thus, this study aims to answer these shortcomings identified in previous research.

Fatigue – an aspect of negative affect – is related to a person's energy level in a similar way to vigor. In the work context, fatigue can be conceptualized as an exhaustion component of burnout (Maslach & Leiter, 1997). Exhaustion is defined as the draining of emotional resources and feelings of chronic fatigue (Maslach & Leiter, 1997), and as such, it directly refers to a person's reduced energy level (see also Schaufeli & Buunk, 2003). Following Warr's (1990) typology, fatigue can be situated at the negative pole of the depression-enthusiasm axis. In this study, fatigue is viewed as a negative affective state that is characterized by reduced emotional resources. Previous evidence shows that fatigue is related to work-related stress reactions, psychosocial overload, subjective health complaints (Sluiter, de Croon, Meijman, & Frings-Dresen, 2003), and even decreased work ability (de Croon et al., 2005). Similarly, exhaustion – a severe form of fatigue – has been found to be related to life satisfac-

tion (e.g., Demerouti, Bakker, & Schaufeli, 2005), and self-rated health (Hakanen et al., 2006). However, the joint effects of affective states (i.e., fatigue and vigor) are largely unknown, as well as their relationship to employee well-being in the long term. Therefore, this study contributes to current knowledge by examining the links between these affective states and their relationship to well-being during a 13-year period.

Similarly, *depression* can be defined as a negative affective state. As such, depression is characterized e.g., by sadness, irritability, hopelessness, feelings of failure, and social withdrawal (e.g., Beck, Steer, & Garbin, 1988). Hence, depression refers to a way of reacting to challenges that are perceived as impossible, a melancholic mood or to a clinical mental disorder (Gruenberg & Goldstein, 2003). Following Warr's (1990) typology, depression can be situated at the negative pole of the depression-enthusiasm axis. In this study, depressive symptoms such as feeling miserable, sad, hopeless, and lonely were examined. Consistent evidence indicates that high job demands are related to depression (Bonde, 2008; Netterstrøm et al., 2008), and similarly, the protective effects of work-related psychosocial factors, such as social support, are largely evident (for reviews, see Netterstrøm et al., 2008; Stansfeld & Candy, 2006). In addition, lifestyle factors such as alcohol consumption, exercise, and sleeping problems have been found to be associated with depression (e.g., Lopresti, Hood, & Drummond, 2013). However, the relationship between depressive symptoms and musculoskeletal pain is largely unknown despite the fact that both cause an enormous amount of health-related problems. Hence, this study aims to broaden current knowledge by examining the longitudinal development paths of both depressive symptoms and musculoskeletal pain, and the antecedents related to these paths.

1.1.2 Health-related well-being

In addition to affective well-being, this study aims to examine health-related aspects of employee well-being. Apparently, health as a construct is complex, and several conceptualizations of health exist. For example, health can have medical, physical, mental, and social components (e.g., see World Health Organization, 1986). Traditionally, biomedical models of health define health as the absence of disease or disability, and focuses

on the causes of diseases, prevention and cure (see e.g., Engel, 1977; Larson, 1999). In addition, health may be defined as an absence of physical disability, psychological disability or pain (Brown, Kazi, Spitz, Gertman, Fries, & Meehan, 1984). In this study, health is viewed from a broad perspective, that is, covering both ill-health and symptoms of pain, physical and mental (dis)ability, and subject's own evaluations of his/her mental and physical state, and thus, as health-related well-being indicators, *work ability*, *self-rated health*, and *multisite musculoskeletal pain* are investigated.

Work ability

In Finnish work life, the concept of work ability has been used for several decades. However, there is no clear consensus on what work ability is or how it should be defined. Different practitioners, such as health care professionals, pension and rehabilitation authorities, and researchers may have different perceptions and definitions of work ability. In addition, the conceptualization of work ability has changed as work life, and the demands related to it, has changed. (Gould, Ilmarinen, Järvisalo, & Koskinen, 2008.) Previously, work ability was simply defined as a balance between the demands of work and the resources of the individual, following the idea of a stress-strain model (e.g., Rohmert, 1986). Therefore, Ilmarinen, Tuomi and Klockars (1997) have postulated that work ability refers to employee's ability to carry out his/her work in relation to the demands of the work and his/her health and mental resources. As such, impaired work ability is believed to result from an imbalance between job demands and individual resources. Later, a multidimensional view of work ability has been adopted in which job-related resources and micro and macro environments outside work life have been incorporated in addition to that of job demands and individual resources (e.g., Ilmarinen, Tuomi, & Seitsamo, 2005; Järvikoski, Härkäpää, & Mannila, 2001). Two different work ability concepts applying a multidimensional view exist: a multidimensional work ability model (Järvikoski et al., 2001), and a holistic work ability model (Ilmarinen et al., 2005). In this study, the holistic work ability model has been applied as it is the most employed framework for examining work ability (e.g., van den Berg, Elders, Zwart, & Burdorf, 2009).

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In the holistic work ability model, developed by Ilmarinen et al. (2005), work ability is described as a multidimensional construct consisting of both the resources of the individual and factors related to work and working, and the environment outside of work. The dimensions of work ability are often depicted in the form of a “Work ability house” (Ilmarinen, Gould, Järvikoski, & Järvisalo, 2008). The first three “floors” of the house are formed by individual resources: health and functional capacity; knowledge and skills; and values, attitudes, and motivation. The fourth “floor” is that of work, consisting of working conditions; work content and demands; work community and organization; and supervisory work and management. In addition, family, close community, and society are included as part of the macro environment of work ability. Basically, all “floors” play a role in creating significant prerequisites for work ability, although, the balance between individual resources and work is the core of the holistic model.

A wide range of predictors and consequences of work ability has been examined. In particular, individual characteristics and work-related risk factors have been extensively examined as antecedents of work ability (for a review, see van den Berg et al., 2009). For example, individual lifestyle factors¹ such as alcohol consumption, exercise, and sleep (e.g., Ilmarinen et al., 1997; Pohjonen, 2001), and work-related factors such as mental and physical work demands, and management (e.g., Pohjonen, 2001; Tuomi et al., 1991) have been found to be associated with work ability. However, so far, the motivational aspects of human resources have not been examined with the same intensity as biographical, lifestyle, or work-related factors, despite the fact that affective-motivational factors – such as work engagement – are considered essential factors related to work ability (e.g., Ilmarinen, 2009). Moreover, health-related indicators, such as work ability, may themselves be important resources that boost positive affective states, such as work engagement, and consequently further improve health and well-being. In fact, The World Health Organization (WHO) defines health as a positive construct including physical, mental and social well-being, that is, “a resource for everyday life” rather than

¹ As poor health behaviors (e.g., smoking, alcohol consumption, and lack of exercise) may have serious health consequences (e.g., Odgen, 2012), lifestyle factors were included in the present study. However, the emphasis of this study was on the psychosocial processes that link job resources, personal resources and employee well-being.

the objective of living (WHO, 1986). Thus, health can be conceptualized as a kind of capital in which individuals may invest in order to achieve positive future health outcomes (Williamson & Carr, 2009). In a similar vein, it can be argued that work ability is a health-related resource that is likely to be related to future well-being. Therefore, this study aims to broaden current knowledge, by firstly, examining the relationship between work engagement and work ability, and secondly, investigating work ability as a health-related resource.

Self-rated health

Similar to that of work ability, self-rated health can be conceptualized as an indicator of health-related well-being. Conceptually, self-rated health (SRH) is defined as a person's global assessment of his/her general state of health (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006). Although reflecting individual's own perception of his/her general health, SRH can be regarded as a valid indicator of one's overall health status because several meta-analyses have shown that SRH is predictive of morbidity and various objective health indicators, even mortality (e.g., DeSalvo et al., 2006; Idler & Benyamini, 1997). As such, self-rated health is an important indicator of well-being that may influence individual's quality of life, as well as motivation toward work, and therefore, relevant factor to be taken into account in the current work life.

In fact, antecedents of SRH have been widely examined. For example, evidence on the detrimental effect of negative affect, such as depressive symptoms, on self-rated health exists (e.g., Barger, 2006; Idler & Benyamini, 1997). In a similar way, psychosocial work-related factors such as social support (Barger, 2006; Idler & Benyamini, 1997), as well as job variety, job control, and decision authority (Laaksonen, Rahkonen, Martikainen, & Lahelma, 2006; Niedhammer & Chea, 2003; Pikhart et al., 2001) have been found to be associated with good SRH. Nevertheless, for example, an understanding the relationship between positive affect and SRH is still deficient (e.g., Shirom, Toker, Berliner, Shapira, & Melamed, 2008). Moreover, the longitudinal relationship between the joint-effect of affective states and SRH still remains largely unknown. Therefore, this study aims to fill in these gaps in the literature.

Musculoskeletal pain

Among working population, musculoskeletal pain is a common health problem, and in fact, musculoskeletal disorders constitute the most frequently reported health complaint in Europe (Hauke, Flintrop, Brun, & Rugulies, 2011). Pain in the back, shoulder, and neck are found to be the most common musculoskeletal pain symptoms among employees (e.g., Weevers, van der Beek, Anema, van der Wal, & van Mechelen, 2005), and cause a vast number of sickness absences (Munce, Stansfeld, Blackmore, & Stewart, 2007), and more drastically, work disability (Kamaleri, Natvig, Ihlebaek, & Bruusgaard, 2009; Miranda et al., 2010). Moreover, pain in multiple sites has been found to be even more harmful than pain in a single site (e.g., Haukka et al., 2013; Øverland, Harvey, Knudsen, Mykletun, & Hotopf, 2012), and therefore, understanding the mechanisms causing multisite musculoskeletal pain is essential.

Recently, the study on multisite musculoskeletal pain (MSP) and its determinants has gained more attention, and several work characteristics and lifestyle factors have been found to be related to MSP (for a review see Hauke et al., 2011; Shiri, Karppinen, Leino-Arjas, Solovieva, & Viikari-Juntura, 2010). For example, low social support, high job demands, low job control, low decision-making authority, and low skill discretion were related to musculoskeletal disorders in a meta-analysis including 54 longitudinal studies (Hauke et al., 2011). Indeed, in several explanatory models of musculoskeletal pain it is assumed that high job demands and low social support lead to psychosocial stress which in its turn is related to musculoskeletal disorders (e.g., Bongers, de Winter, Kompier, & Hildebrandt, 1993; Hauke et al., 2011; Melin & Lundberg, 1997). Some evidence indicates that multisite musculoskeletal pain and depressive symptoms may develop together (e.g., Bair, Robinson, Katon, & Kroenke, 2003; Demyttenaere et al., 2007). However, pain and depression do not always co-exist (e.g., Magni, Moreschi, Rigatti-Luchini, & Merskey, 1994), and thus, they might also have different developmental paths over time. Nevertheless, the longitudinal evidence is still scarce, and thus, in this study, the longitudinal relationship between multisite musculoskeletal pain and depressive symptoms, and the related demands and resources, are examined.

1.1.3 Life Satisfaction

Life satisfaction is defined as a key indicator of positive subjective well-being (Erdogan, Bauer, Truxillo, & Mansfield, 2012; Pavot & Diener, 2008) that refers to a cognitive, global evaluation of the quality of one's life as a whole (McDowell, 2010; Pavot & Diener, 1993). Hence, it assess an individual's conscious global judgment of his/her life by using the person's own criteria, that is, individuals may evaluate and emphasize the different domains of life differentially. Therefore, as a cognitive construct, life satisfaction can be discriminated from affective components of well-being, such as pleasant affect. Moreover, affective reactions often respond to immediate factors and those of a short duration, whereas life satisfaction may reflect a long-term perspective. (Pavot & Diener, 1993.) Nevertheless, both cognitive and affective components of well-being are needed to capture a comprehensive picture of employee well-being. Therefore, beside affective and health-related indicators of employee well-being, a cognitive indicator of subjective well-being (i.e., life satisfaction) was also included in the current study.

As a context-free indicator of well-being, life satisfaction can develop in any domain of life. Apparently, personality traits, culture, and life circumstances are related to life satisfaction, but also psychological processes such as goals and coping strategies may influence life satisfaction (Diener et al., 1999; Steel, Schmidt, & Shultz, 2008). In addition, several work-related antecedents of life satisfaction have been identified (for a review, see Erdogan et al., 2012). Moreover, it has been shown recently that people report more life satisfaction in countries where positive emotions are highly valued (Bastian, Kuppens, De Roover, & Diener, 2014). In addition, life satisfaction is found to be related to several health related outcomes, such as a low level of sleep complaints (Brand, Beck, Hatzinger, Harbaugh, Ruch, & Holsboer-Trachsler, 2010), and reduced cardiovascular mortality (Chida & Steptoe, 2008) which also illustrates the importance of examining life satisfaction in work life context. However, such evidence is more or less lacking, as is also the case for longitudinal relationships between affective states and life satisfaction, and thus, this study aims to provide answers for these shortcomings. More specifically, this study contributes to current literature by examining the relationships between developmental paths of positive (i.e., vigor) and negative (i.e., fatigue) affect and life satisfaction over time.

1.2 Theoretical frameworks for explaining employee well-being

A wide variety of work-related factors, psychosocial processes, sociocultural factors as well as physiological factors are found to be related to employee well-being. The importance of working conditions on employee well-being is emphasized in the leading work stress models, that is, Job Demands-Control (JDC) model (Karasek, 1979), and the Job Demands-Resources (JD-R) model (Demerouti et al., 2001; Schaufeli & Bakker, 2004). In this study, the JD-R model is used as the main conceptual framework for examining employee well-being and its predictors. As such, the JD-R model is a descriptive model that specifies the relationships between work characteristics (i.e., job demands and job resources), personal resources, and employee well-being. However, it is not sufficient to explain the underlying psychological processes between the antecedents and well-being outcomes. Thus, additional theoretical frameworks are needed. (Schaufeli & Taris, 2014.) In particular, the Conservation of Resources (COR) theory (Hobfoll, 1989, 2001), and Broaden-and-Build (BaB) theory of positive emotions (Fredrickson, 2001) that have frequently been applied as explanatory theoretical frameworks in the field of occupational health psychology offer more exact predictions for the links between resources and well-being. In this study, along with the JD-R model, COR and BaB theories have also been used as main theoretical frameworks to guide theoretical reasoning in explaining the relationship between work characteristics, personal resources, and employee well-being. These frameworks are presented in more detail in the following sections.

1.2.1 Job Demands-Resources model

Job Demands-Resources (JD-R) model (Demerouti et al., 2001) is a conceptual framework that has often been used to investigate the antecedents of employee well-being, such as work engagement and burnout. The JD-R model can be characterized as a comprehensive model that simultaneously aims to predict both ill-health and motivation at work. Roots of the model can be found in the balance models of job stress, such as JDC model (Karasek, 1979) and Effort-Reward Imbalance (ERI) model (Siegrist, 1996).

The JD-R model proposes that diverse work characteristics, such as job demands and job resources, have either positive or negative effects on well-being. In the JD-R model, *job demands* are defined as “those physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs” (Demerouti et al., 2001, 501). Examples of job demands are physical demands, time pressure, work overload, and role conflict. In this study, physical and mental demands of the job were examined. In turn, *job resources* refer to “those physical, psychological, social, or organizational aspects of the job that may do any of the following: (a) be functional in achieving work goals; (b) reduce job demands and the associated physiological and psychological costs; (c) stimulate personal growth and development” (Demerouti et al., 2001, 501). Examples of job resources are autonomy, social support from colleagues and supervisor, skill utilization, and participating in decision making. In this study, supervisory relations, interpersonal relations, and task resources were examined as indicators of job resources.

The basic assumption of the JD-R model is that two distinct psychological processes – the health-impairment process and the motivational process – are differently related to well-being. Firstly, the *health-impairment process* assumes that high job demands and low job resources lead to burnout, and consequently to ill-health (e.g., depression, cardiovascular disease, and psychosomatic complaints). Thus, burnout acts as a mediator between job demands and ill-health. Secondly, the *motivational process* assumes that job resources lead to work engagement, which, in turn, has a positive effect on organizational outcomes, such as commitment and performance. In this process, work engagement acts as a mediator between job resources and positive organizational outcomes. (e.g., Bakker & Demerouti, 2007; Bakker et al., 2008.)

According to the later formulations of the JD-R model, personal resources have been added to the model, as they may have similar motivational potential to that of job resources and may be positively related to work engagement, and consequently to positive work-related outcomes (Xanthopoulou et al., 2007). By definition, personal resources are positive self-evaluations that are linked to resiliency, and refer to an individual’s sense of ability to successfully control and impact on his/her environment (Hobfoll, Johnson, Ennis, & Jackson, 2003). In this study,

self-esteem (see Janssen, Schaufeli, & Houkes, 1999; Rosenberg, 1965; Rosenberg, Schooler, Schoenbach, & Rosenberg, 1995) and optimism (see Scheier & Carver, 1985, 1992) have been investigated as indicators of personal resources.

Empirical evidence largely supports the assumptions of the two related processes suggested in the JD-R model (for overviews, see Bakker & Demerouti, 2007; Hakanen & Roodt, 2010; Schaufeli & Taris, 2014). Most of the studies are based on a cross-sectional design; however, some longitudinal evidence of the JD-R model exists, as well. For example, a 3-year follow-up among Finnish dentists (Hakanen, Schaufeli, & Ahola, 2008b) supported both the health-impairment and the motivational process. More precisely, job demands predicted burnout over time, which in turn predicted future depression; and job resources were related to future work engagement which in turn, predicted organizational commitment. In addition, a 1-year follow-up study among Dutch managers confirmed both processes proposed by the model (Schaufeli, Bakker, & Van Rhenen, 2009).

The advantage of the JD-R model is the option to simultaneously investigate both negative (i.e., health-impairment) and positive (i.e., motivational) processes. In addition, the wide variety of job demands, resources, and outcomes included in the model adds the model's flexibility, that is, the model does not restrict itself to a specific job demand or job resource, instead any demand and any resource may affect employee well-being. Consequently, this increases the model's availability and usability in diverse work contexts and organizations. (Schaufeli & Taris, 2014.) Hence, the JD-R model can be applied in various occupational fields as the model considers the specific demands and resources of each job. Indeed, the model has been tested among a wide variety of occupations in diverse countries. For example, evidence exists among industrial workers (e.g., Bakker, Demerouti, de Boer, & Schaufeli, 2003; Schaufeli & Bakker, 2004), white collar workers (e.g., Hakanen et al., 2006, 2008a, 2008b; Korunka, Kubicek, Schaufeli, & Hoonaaker, 2009; Schaufeli & Bakker, 2004), blue collar workers (e.g., Hansez & Chmiel, 2010; Hu, Schaufeli, & Taris, 2011), and even among volunteers (e.g., Lewig, Xanthopoulou, Bakker, Dollard, & Metzger, 2007), and family-owned business workers (e.g., Hu & Schaufeli, 2011). The evidence indicates that the model can be reliably used in diverse work environ-

ments. However, studies have mainly been conducted among white collar workers instead of more physically demanding jobs, such as firefighting. Nevertheless, demands and resources and their consequences also need to be examined in physically demanding jobs in order to examine the model's usefulness in such a context.

One limitation of the JD-R model has been its neglect to elucidate the relationship between job and personal resources and health-related outcomes. Research has emphasized the effect of work engagement on organizational commitment and job performance although work engagement could also be related to health-related outcomes. For example, organizational outcomes such as customer loyalty (Salanova et al., 2005), organizational commitment (Hakanen et al., 2008b), innovativeness (Hakanen et al., 2008a), and work-family enrichment (Hakanen, Peeters, & Perhoniemi, 2011) have been examined. In other words, in the JD-R model, health-related indicators are considered outcomes of the health-impairment process resulting from high levels of job demands, rather than an outcome of the motivational process. However, some evidence exists of the relationship between work engagement and health outcomes (Hakanen & Schaufeli 2012, Seppälä et al., 2012). Nevertheless, the longitudinal path from job resources via work engagement to work ability has not previously been investigated. Moreover, health-related indicators may also be important resources that boost work engagement and consequently further improve employee well-being. Therefore, this study examines the role of work ability in the motivational process of the JD-R model.

1.2.2 Conservation of Resources theory

Hobfoll's (2001) Conservation of Resources (COR) theory is a stress and motivational theory that considers the acquisition and accumulation of resources a pivotal drive to initiate and maintain people's behaviour, and consequently, enhance well-being. The basic tenet of COR theory is that people strive to obtain, retain, foster, protect, and build resources that they value. Resources are defined as "those entities that either are centrally valued in their own right, or act as means to obtain centrally valued ends" (Hobfoll, 2002, p. 307). Four broad categories of resources are distinguished: objects (e.g., home, food, tools, and socioeconomic status); conditions (e.g., job resources, such as social support and job

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control); personal characteristics (e.g., personal resources, such as skills and self-efficacy); and energies (e.g., time, money, and knowledge). Practically, COR theory assumes that people strive to maintain and accumulate diverse resources, and consequently, these resources may prevent them from health problems. Accordingly, stress is likely to occur when resources are threatened or lost, or when individuals invest in resources without receiving the expected level of benefits. In other words, a gain in resources results in well-being. (Hobfoll, 2002, see also Salanova, Schaufeli, Xanthopoulou, & Bakker, 2010.)

COR theory has two key principals. Firstly, people need to invest their resources in order to deal with stressful conditions and avoid negative consequences. For example, social support from colleagues as a resource may prevent stress, and consequently, also prevent negative health outcomes. Therefore, those with greater resources are less vulnerable to stress than those with fewer resources. Secondly, people must invest resources in order to protect against future resource loss, and gain new resources. Accordingly, those with greater resources are more capable of future resource gain, and thus, constituting “gain spirals”. Consequently, in the long term, the accumulation of resources results in positive outcomes, such as better coping, adaptation, and well-being. On the contrary, those who lack resources are more likely to have further resource loss, and consequently, suffer from health problems. Thus, COR theory proposes that resources and well-being affect each other reciprocally (i.e., gain or loss spirals). (Hobfoll, 2002, see also Salanova et al., 2010.)

Recently, COR theory has frequently been applied as a theoretical framework in studies of employee well-being, and empirical evidence largely supports the assumptions of the theory. For example, in a 3-year longitudinal study among Finnish dentists (Hakanen et al., 2008a) positive and reciprocal cross-lagged associations were found between job resources and work engagement (i.e., indicator of employee well-being), and between work engagement and personal initiative, which in turn had a positive effect on work-unit innovativeness over time. Similarly, gain spirals between personal and job resources and well-being were found in a longitudinal study among teachers (Salanova, Bakker, & Llorens, 2006). More recently, further empirical support for COR theory was found in a three-year longitudinal study that observed gain spirals between job and home resources and well-being (Hakanen et al., 2011).

To summarize, COR theory, alongside the JD-R model, assumes that high levels of resources can be beneficial for employee well-being in the long term. The resource gain of COR theory can be related to motivational process of the JD-R model as both emphasize the positive effect of resources on well-being. Similarly, the resource loss of COR theory has similarities with the health-impairment process of the JD-R model as both result in negative health outcomes. Therefore, in this study, COR theory is applied as a theoretical framework to examine whether job resources and personal resources (i.e., self-esteem) predict work ability in the long term.

1.2.3 Broaden-and-Build theory

The Broaden-and-Build (BaB) theory (Fredrickson, 2001) emphasizes the importance of positive emotions in the development of other resources, and consequently, positive health outcomes. As such, BaB theory provides a possible theoretical explanation for the mechanism that links positive affective states and employee well-being. According to BaB theory, positive emotions such as happiness, joy, and love, broaden people's thought-action repertoires, build their enduring physical, intellectual, social, and psychological resources, and consequently lead to better well-being. More precisely, the *broaden hypothesis* assumes that positive emotions broaden people's awareness and thinking which helps them to draw on a wider range of new ideas. For example, joy broadens people's thinking and action by encouraging the urge to play and be creative. Over time, this broadening of thoughts and attention leads to discovering and building new personal resources (i.e., *build hypothesis*) and, consequently, to improved well-being. On the other hand, negative emotions narrow people's momentary thoughts and actions. In addition, positive emotions are assumed to "correct" or "undo" the after effects of negative emotions. The theory not only assumes that positive emotions signal flourishing, but more importantly, that positive emotions also produce flourishing, even in the long term. Hence, similar to COR theory, BaB theory proposes that emotions and well-being affect each other reciprocally (i.e., gain spirals).

A wealth of research supports the proposals of the BaB theory. For example, Fredrickson and Joiner (2002) showed that positive affect and broad-minded coping reciprocally enhanced one another, initiating

upward spirals of enhanced well-being. Similarly, in an experimental study among college students, higher activation state of amusement broadened the scope of attention and thought-action repertoires (Fredrickson & Branigan, 2005), thus supporting the assumptions of BaB theory. In addition, empirical evidence indicates that positive emotions are associated with fewer symptoms, less illness, less pain and injury, and better health, even in the long term (for reviews see, Lyubomirsky, King, & Diener, 2005; Pressman & Cohen, 2005). For example, work engagement – as an affective well-being state – had a positive effect on life satisfaction in a seven-year follow-up study among dentists (Hakanen et al., 2006). Similarly, vitality – another indicator of affective well-being – was found to be related to physical and psychological health (Ryan & Frederick, 1997). Taken together, these findings, albeit thus far mainly based on cross-sectional studies, suggest that positive affective states are positively related to employee well-being. Similarly, evidence exists on the detrimental effect of negative affect on well-being (e.g., Billings, Folkman, Acree, & Moskowitz, 2000). In summary, for the purposes of this study, BaB offers a plausible explanation in examining the relationship between work engagement and work ability as well as the effects of positive affective states on employee well-being.

1.2.4 Comparison of the theoretical frameworks

To conclude, the JD-R model in particular, COR theory and to some extent BaB theory all emphasize the importance of resources in maintaining and increasing employee well-being, and thus, they are applied in the present study. However, some differences in the conceptualization of resources between the models exist and need to be mentioned. For the JD-R model, resources are related to the specific job in question, whereas COR defines resources on a general level covering resources from object to energies, and from conditions to personal characteristics. In turn, BaB focuses on positive emotions as a resource, for this reason therefore, the JD-R model and COR are more widely applicable, and have consequently been used more extensively in this study as well. Similarly to COR and BaB, there is an assumption of the gain spirals over time, that is, accumulation of resources results in resource gain or upward spirals in long term, and consequently, better well-being. Likewise, JD-R model discusses the positive links between job and personal resources and em-

ployee well-being. Therefore, for the purposes of this study, which aims to examine the long-term relationships between job and personal resources and employee well-being, these theoretical frameworks provide important perspectives on the subject. As stated, a vast amount of empirical evidence of all three models exists. However, strictly speaking only limited evidence of long-term relationships between resources and well-being exists (see also Salanova et al., 2010), and thus, further research is needed.

1.3 Study context: Rescue services

As indicated, the JD-R model (Demerouti et al., 2001) proposes that job demands, and job and personal resources are related employee well-being. More importantly, these demands and resources may differ between occupations, and thus, understanding the work context is important in examining employee well-being. The context of this study is rescue services in Finland, and in particular, operational firefighters within the rescue services. Therefore, in order to understand the particular job demands, job resources, and personal resources, and their relationships to well-being, it is essential to have an overview of the operational firefighters' job and their work environment.

In Finland, there are 22 rescue service regions that carry out the duties of rescue services in their respective regions. Municipalities are jointly responsible for rescue services in Finland. In addition, the Ministry of the Interior directs and steers rescue services and oversees their coverage and quality. There are approximately 360 full-time fire brigades with around 4,300 permanent full-time employees of which approximately 3,500 work in operational rescue tasks and medical first aid services (e.g., as firefighters, sub-officers, and fire chiefs). In addition, volunteer, institutional, industrial, and military fire brigades (i.e., contract fire brigades) participate in performing rescue services duties by agreement between the fire brigades and the regional rescue services. Overall, in approximately 520 fire brigades, there are about 13,400 persons employed by contract fire brigades. (Pelastusopisto, 2014.)

Work in rescue services includes diverse tasks and work environments. According to the Rescue Act (379/2011), the rescue departments are responsible for guidance, education, and provision of advice aimed at preventing fires and other accidents, preparing for the combating

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of accidents and taking appropriate action in accidents and dangerous situations, and in the limiting of the consequences of accidents, and supervisory duties of rescue services. In addition, tasks include, for example, warning the population of accidents and dangerous situations as well as tasks carried out as part of rescue operations. In 2013, Finnish rescue service regions conducted approximately 105 000 rescue tasks, comprising of 13 500 fires, 16 000 other accidents (e.g., traffic accidents, tasks related to hazardous substances), and around 75 500 other rescue tasks (such as testing smoke alarms, rescuing people and animals, and first response). (Pelastusopisto, 2014.)

In addition, fire brigades are allowed to carry out tasks belonging to emergency medical care services in joint-operation with the municipal board of the hospital district. Emergency medical care services include, for example, urgent treatment of patients who have suffered an injury or a sudden onset of an illness primarily outside of health care treatment facilities; transport of patients to the treatment unit with the most appropriate medical services; and referral of patients, relatives of patients, and other individuals involved in incidents to psychosocial support services, where necessary (Health Care Act 1326/2010). In 2013, fire brigades had nearly 500 000 emergency medical care tasks. At present, emergency medical care tasks represent the majority of all tasks within the rescue service regions.

Diverse tasks from fire and rescue services to emergency medical care tasks set high requirements for firefighters. Indeed, firefighting is a physically, mentally, and socially demanding job. Smoke diving, fire and rescue operations, working in the roofs, and cleaning up the incident sites (e.g., in fire and road accidents) are physically most demanding tasks of firefighting (Lusa, Louhevaara, & Kinnunen, 1994). In addition, good physical health is needed in emergency medical care tasks, e.g., with patient transportation. On the other hand, being constantly alert, working long hours in unpredictable work environments, and occasionally severe time pressure increase the mental work load of firefighters. Moreover, good mental health is needed in managing a demanding job that also includes rescuing human lives, and even facing death. (e.g., Beaton, Murphy, Johnson, Pike, & Corneil, 1998; Haslam & Mallon, 2003.) Socially, firefighting requires good communication skills (e.g., Beaton, Murphy, Pike, & Corneil, 1997). More precisely, work requires

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constant interaction with partners, such as colleagues and supervisors, customers, other public authorities, and public media. In particular, working in a 24-hour shift in closely co-ordinated teams necessitates good relationships between the co-workers. Practically, firefighters eat, sleep, and exercise together, and often their social activities tend to occur in the company of other firefighters (Beaton et al., 1997; Mankkinen, 2011). In addition, in dangerous work situations firefighters have to be able to fully trust their work mates, and thus, good social relationships between co-workers are extremely important. Furthermore, good supervisory relations are essential, and are in fact found to be related to a decreased level of mental work load among firefighters (Lusa, Punakallio, Luukkonen, & Louhevaara, 2006). In addition to requirements of good social relationships within the working community, emotionally highly demanding customers, for example angry, anxious, or impatient patients, or demanding and threatening patients and their relatives, may be challenging for firefighters, and increase the mental pressure of work.

Apparently, high job demands – physical, mental, and social – are part of the firefighters’ daily work tasks. However, at the same time, firefighting may include several job resources that help to reduce job demands and the related physiological and psychological costs, and stimulate personal growth and development (see Demerouti et al., 2001). Job resources of firefighters’ may include, for example, good relationships between co-workers (e.g., Pillai & Williams, 2004), supervisory support (e.g., Mitani, Fujita, Nakata, & Shirakawa, 2006), and the fair distribution of work tasks (e.g., Lusa et al., 2006). In addition, personal resources may act as a positive resource for firefighters. For instance, some evidence exists of the positive effect of self-esteem on firefighters’ well-being and job satisfaction (Saijo, Ueno, & Hashimoto, 2008).

Obviously, physical, mental, and social demands of the job may be related to firefighters’ well-being, as also suggested by the JD-R model. Indeed, previous studies indicate that firefighters suffer from several health problems, including, for example, sleep problems (Haslam & Mallon, 2003), hazardous drinking (Boxer & Wild, 1993), musculoskeletal problems (Bos, Mol, Visser, & Frings-Dresen, 2004; Sluiter & Frings-Dresen, 2007), and depressive symptoms (Carey, Al-Zaiti, Dean, Sessanna, & Finnell, 2011; Fullerton et al., 2004; Plat, Frings-Dresen, & Sluiter, 2012). In Finland, about 40% of the permanent operative

Finnish firefighters are not able to work until their normal retirement age. In 2000–2013, musculoskeletal disorders (44%), cardiovascular diseases (13%) and mental disorders (12%) were the most common reasons for early retirement among Finnish firefighters. (Fors, Keva, personal communication, 2014.) Therefore, in order to maintain and improve health and well-being of Finnish firefighters, it is essential to understand the longitudinal relationships between work characteristics, personal resources, lifestyle, and well-being.

1.4 Aims of the study

The aim of this study was to extend understanding of the relationships between work characteristics (i.e., job demands and job resources), personal resources, and lifestyle on employee well-being using data from a 13-year follow-up period on Finnish firefighters.

Firstly, the aim was to examine the role of affective-motivational state of work engagement in relation to work ability. Secondly, this study examined the role of work ability in the JD-R model both as a health-related resource (i.e., predictor) that is likely to influence work engagement, and as an outcome of the motivational process. Thirdly, the developmental paths in positive (i.e., vigor) and negative (i.e., fatigue) affective states and their relationship to well-being were investigated, as well as intra-individual change trajectories in multisite musculoskeletal pain and depressive symptoms and the related antecedents (i.e., work characteristics, personal resources, and lifestyle). Methodologically, this study aimed to extend the current knowledge by applying a person-centered approach (i.e., latent class growth modeling) along with a variable-based approach (e.g., multivariate analysis and structural equation modeling). Hence, several predictors, indicators of employee well-being, and methodologies have been used. The research questions by sub-studies were as follows:

1. Does work engagement relate to work ability even after adjusting for age, lifestyle factors, and work characteristics? Are age, lifestyle factors, work characteristics, and particularly work engagement associated with different dimensions of work ability? (Study I)
2. Does work engagement mediate the relationship between job resources and future work ability? Does work engagement mediate

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the relationship between personal resources (i.e., self-esteem) and future work ability? Does work engagement mediate the impact of work ability in 1999 on work ability in 2009? (Study II)

The specific hypotheses were:

H1: Job resources in 1999 will be positively related to work-ability in 2009 through work engagement in 2009.

H2: Self-esteem in 1999 will be positively related to work ability in 2009 through work engagement in 2009.

H3: Work ability in 1999 will be positively related to work engagement in 2009, which in its turn will be positively related to subsequent work ability in 2009.

3. Are there different developmental paths based on positive (vigor) and negative (fatigue) affect? Do these developmental paths change or remain stable over time? Are these developmental trajectories differently associated with well-being (i.e., work ability, self-rated health, and life satisfaction) during the 13-year follow-up period? (Study III)
4. Are there different developmental paths of multisite musculoskeletal pain and depressive symptoms during the 13-year follow-up period? Do job demands, job resources, personal resources, and lifestyle predict belonging to a particular pain-depression developmental path? (Study IV)

The specific hypotheses were:

H1a: A one large trajectory with low levels of both symptoms (*Low Symptoms*) will emerge.

H1b: A smaller trajectory with a high level of depressive symptoms (*High Depression*) will emerge.

H1c: A smaller trajectory with a high level of musculoskeletal pain (*High Pain*) will emerge.

H1d: A trajectory group with high levels of both symptoms (*High Symptoms*) will emerge.

H2: High levels of job demands and low levels of job resources and optimism at baseline predict belonging to the trajectory groups with high levels of pain and depressive symptoms.

The research framework and the relationships between the study variables are presented in Figure 1.

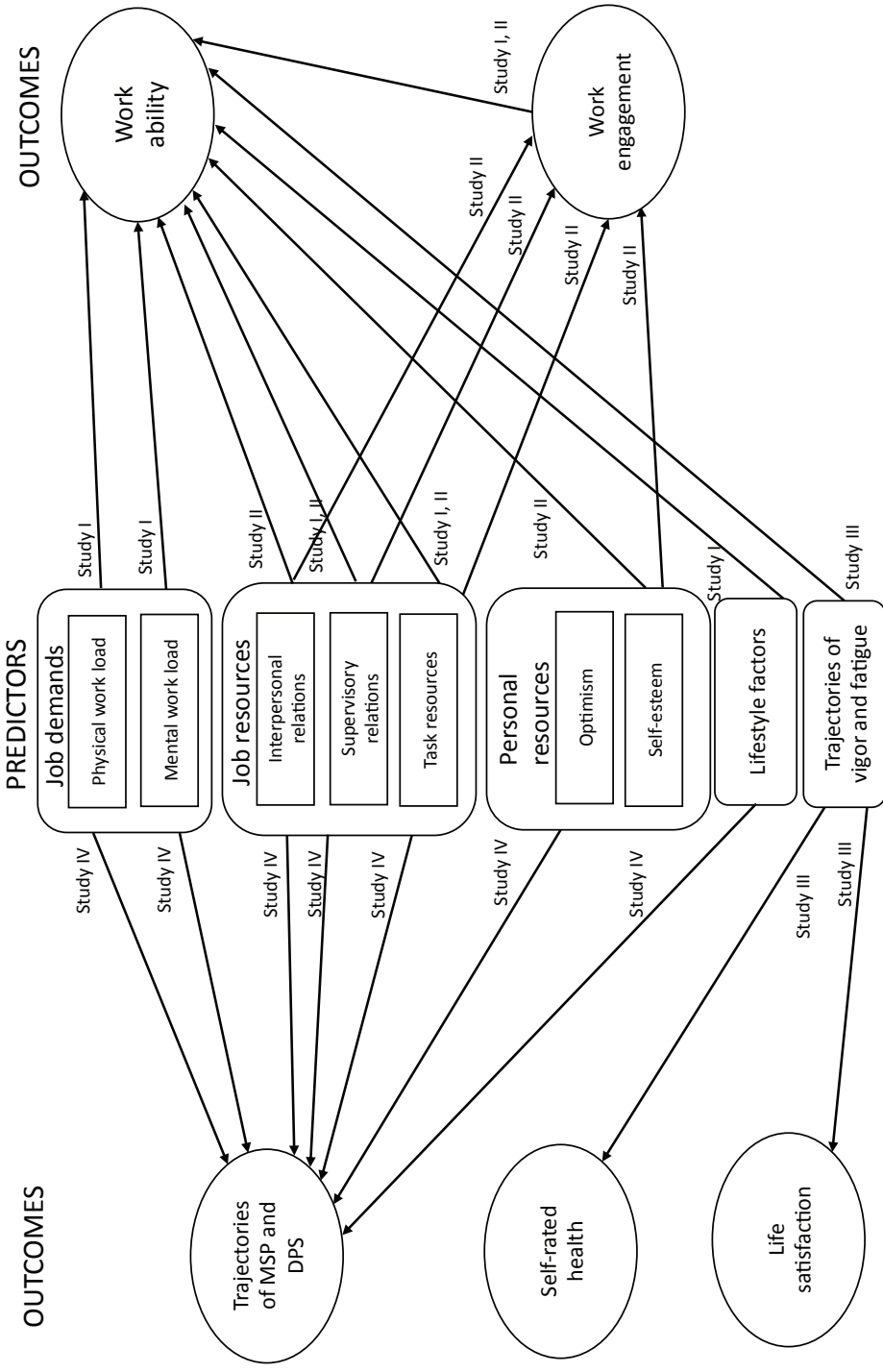


Figure 1. The research framework of the study.

2 METHODS

2.1 Participants

The data of this study is part of a questionnaire study among Finnish firefighters conducted by the Finnish Institute of Occupational Health in 1996 (T1), 1999 (T2), and 2009 (T3). The study was approved by the Ethics Committee of the HUS Hospital District, and was performed according to the Helsinki Declaration. Each subject gave written informed consent before participation. The questionnaires are available in Finnish (Lusa-Moser et al., 1996; Punakallio & Lusa-Moser, 1999; Punakallio & Lusa, 2011). The approval letter from the Ethics Committee and the letter of intent to the participants are available from the author on request.

In 1995, a stratified sampling of all permanent Finnish operative male firefighters ($n = 3512$) was conducted based on registers of the three trade unions of Finnish firefighters. The sampling was stratified according to the number of firefighters in the area and their age. At baseline, in 1996, a questionnaire was sent to 1,124 professional operative firefighters in Finland. The sample consisted of operating personnel in rescue services, which is mainly responsible for daily firefighting, rescue and medical emergencies, and medical emergency service operations. In the first phase, 76% ($N = 849$) returned the questionnaire. Of the respondents, 14 were excluded because of change of job, sick leave, or not being professional firefighter, thus the final sample size was 835. In 1999, a follow-up questionnaire was sent to 1,106 participants of the sample selected in 1996 who had or had not responded. The response rate was 72% ($N = 794$), and 67 were excluded, so the final sample was 727. In 2009, 1,061 questionnaires were sent to firefighters regardless of previous response status, and 68% returned the questionnaire ($N = 721$), and 270 were excluded (final sample $N = 451$). Figure 2 illustrates the process of data collection.

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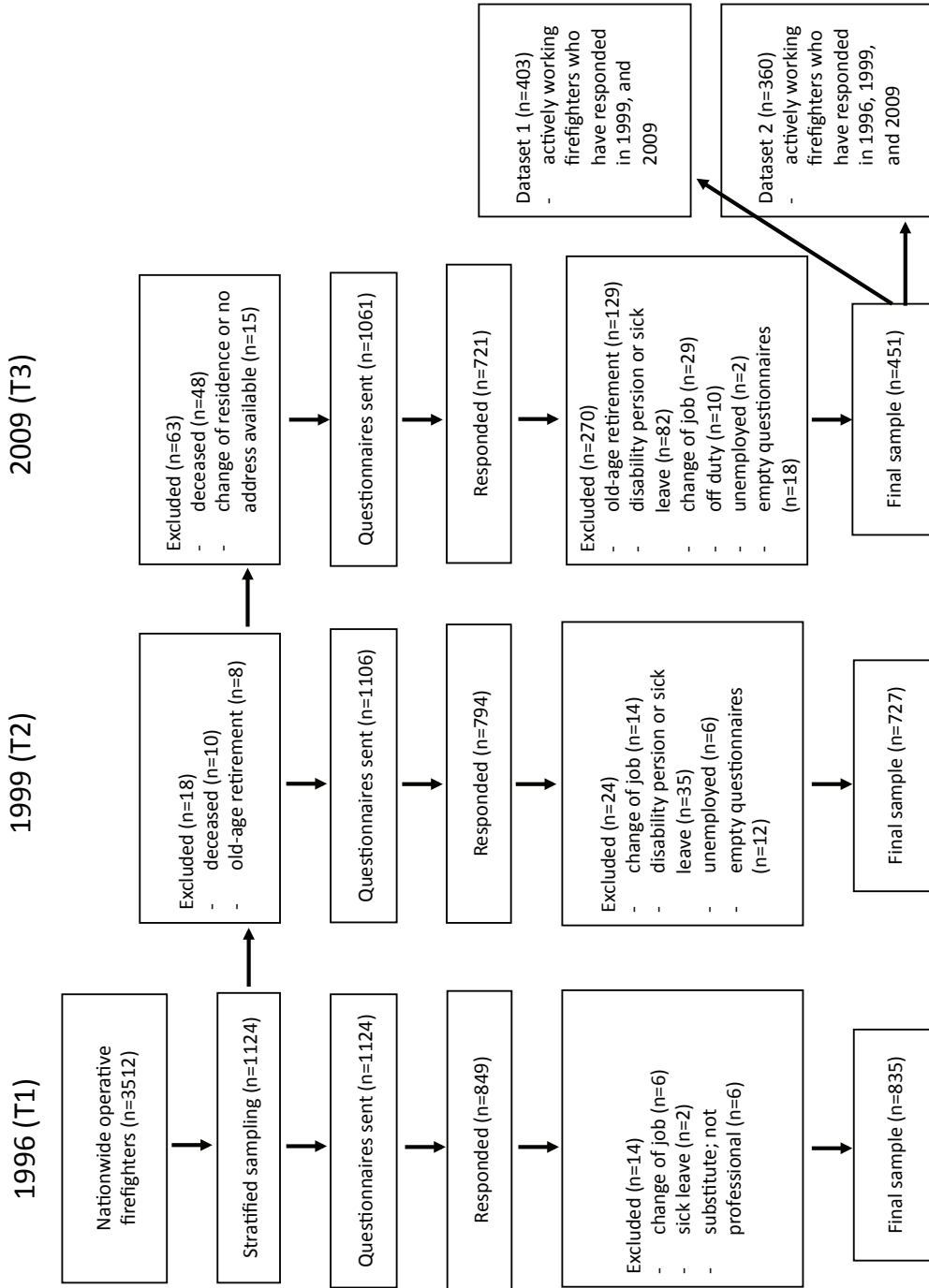


Figure 2. Collection of the data.

2 METHODS

Two slightly different datasets have been used in the four sub-studies. *Dataset 1* consisted of firefighters who responded to the questionnaires in both 1999 (T2) and in 2009 (T3), and were still employed in their profession ($n = 403$). This dataset has been used in Studies I and II. *Dataset 2* included those firefighters who responded to the questionnaires at each measurement point (T1, T2, and T3), and were still employed in their profession ($n = 360$). This dataset has been used in Studies III and IV. As some of the study variables were measured only at T2 (e.g., self-esteem), these two datasets were used. The characteristics of these two datasets are presented in Table 1.

Of Dataset 1, a total of 148 of the respondents from 1999 did not answer in 2009. The drop-outs were older, had lower education, smoked more often, and had lower work ability than those who responded on both occasions, indicating slightly better lifestyle and work ability among the sample of this study. However, when the age difference was taken into account there were no differences between the two groups. Moreover, the drop-outs and the participants did not significantly differ in relation to self-esteem and job resources. Of Dataset 2, a total of 475 respondents from 1996 did not participate in 2009. Statistical tests revealed that the drop-outs were significantly older, had lower education, and slightly poorer well-being in terms of work ability, depressive symptoms, and self-rated health. In addition, the drop-outs had higher mental work load, poorer lifestyle habits, and lower optimism than those who responded at all three times. In contrast, the drop-outs and the participants did not significantly differ in relation to life satisfaction, vigor, fatigue, musculoskeletal pain, physical work load, job resources, and alcohol consumption. To sum up, there were some differences between the participants and the drop-outs, however these were for the most part minor. The attrition analyses are described in detail in the original articles.

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Table 1. Descriptive characteristics of the study samples.

Characteristics	Dataset 1 (Studies I–II)	Dataset 2 (Studies III–IV)
Sample size	403	360
Average age at T3	48.5 (range 35–62, <i>SD</i> = 5.4)	48.7 (range 35–62, <i>SD</i> = 5.4)
Basic education		
<i>Primary or elementary school education</i>	80.9% (<i>n</i> = 321)	81.0% (<i>n</i> = 288)
<i>Secondary school education</i>	19.1% (<i>n</i> = 76)	19.2% (<i>n</i> = 69)
Vocational education		
<i>Firefighter</i>	87.7% (<i>n</i> = 315)	87.5% (<i>n</i> = 281)
<i>Sub-officer</i>	29.4% (<i>n</i> = 105)	30.4% (<i>n</i> = 97)
<i>Fire chief</i>	9.8% (<i>n</i> = 35)	9.4% (<i>n</i> = 30)
Mean work experience, in years	25.3 (<i>SD</i> = 5.8)	25.5 (<i>SD</i> = 5.7)
Shift work	84.3% (<i>n</i> = 337)	84.1% (<i>n</i> = 301)

2.2 Measures

2.2.1 Employee well-being

Affective well-being

Work engagement (Studies I–II) was measured by using the short version of the Utrecht Work Engagement Scale, the UWES-9 (Hakanen 2002, 2009; Schaufeli, Bakker, & Salanova, 2006). The UWES-9 is validated and the most widely used measure for work engagement (Bakker et al., 2008; Seppälä et al., 2009), consisting of nine items. The measure has been translated into 21 languages and used among various occupational groups. The instrument has three sub-scales: vigor (e.g., “At my work, I feel bursting with energy”), dedication (e.g., “My job inspires me”), and absorption (e.g., “I am immersed in my work”). Each of the sub-

dimensions was assessed using three items. The items were rated on a seven-point frequency-based scale (0 = never, 6 = daily). The scale was highly reliable (T3 Cronbach's $\alpha = 0.95$; for vigor $\alpha = 0.89$; dedication $\alpha = 0.90$; absorption $\alpha = 0.90$).

Vigor (Study III), *fatigue* (Study III) and *depressive symptoms* (Study IV) were measured using the Finnish version of the Profile of Mood States (POMS) (Hänninen, 1989; McNair et al., 1971) including 38 items that reflect both positive and negative affective states. Respondents were asked to indicate how the specific items describe their state during the last week rated on a five-point frequency-scale (0 = *not at all*, 4 = *very much*). The construct validity of the scale is satisfactory (Peterson & Seligman, 2004). POMS has been widely used in empirical studies, for example, in sports psychology and studies on cancer patients (see for example Beedie, Terry, & Lane, 2000; Cella, Tross, Orav, Holland, Silberfarb, & Rafla, 1989). POMS has also been used in some organizational psychology settings (e.g., Sonnentag & Niessen, 2008). *The vigor subscale* consisted of six items: active, energetic, cheerful, vigorous, lively, and alert (T1 $\alpha = 0.94$, T2 $\alpha = 0.95$, T3 $\alpha = 0.94$). *The fatigue subscale* consisted of three items: exhausted, fatigued, and weary (T1 $\alpha = 0.82$, T2 $\alpha = 0.86$, T3 $\alpha = 0.87$). And finally, *the depression subscale* consisted of seven items: miserable, sad, depressed, hopeless, blue, lonely, and distressed (T1 $\alpha = 0.87$, T2 $\alpha = 0.92$, T3 $\alpha = 0.89$).

Health-related well-being

Work ability (Studies I–III) was measured by the Work Ability Index (WAI) questionnaire (Tuomi, Ilmarinen, Jahkola, Katajarinne, & Tulkki, 1998). The index consists of seven dimensions, namely: (i) the subjective estimation of current work ability compared with lifetime best (0–10 points); (ii) subjective work ability in relation to job demands (2–10 points); (iii) the number of current diseases diagnosed by a physician (1–7 points); (iv) the subjective estimation of work impairment due to diseases (1–6 points); (v) sick leave during the past year (1–5 points); (vi) own prognosis of work ability two years from now (1, 4 or 7 points); and (vii) psychological resources (1–4 points). The WAI index ranges from 7 to 49 points, and a higher score indicates better work ability. The WAI is the most widely used questionnaire on work ability and a validated

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measure of work ability (van den Berg et al., 2009). Furthermore, satisfactory test-retest reliability of the index has been observed (de Zwart, Frings-Dresen, & van Duivenbooden, 2002).

In Studies I and III, the total index of WAI was used. However, due to the large amount of missing data ($n = 174\text{--}199$) in estimated work impairment due to diseases (sub-dimension 4), this item was excluded from all the analyses. Therefore the slightly modified WAI index had a range from 6 to 43 points ($\alpha = 0.70\text{--}0.78$, for more detail see the original papers). The continuous sum score of the WAI was used in Studies I and III. In addition, in Study I, the sub-dimensions of the WAI – i.e., the individual items – were used as separate dependent variables.

In Study II, work ability was measured by a single-item of the index, namely the subjective estimation of current work ability compared with lifetime best with a scale from 0 to 10: “Assume that your work ability at its best has had a value of 10. How many points would you give your current work ability? (0 means that currently you cannot work at all)”. The single-item question of work ability was used because the total work ability index cannot be regarded as a factor in which its seven dimensions would load similarly into a single factor. Therefore the index could not be used in the SEM model. Prior studies have indicated a strong association ($r = .87$) between the total WAI-score and the single-item indicator (e.g., Ahlstrom, Grimby-Ekman, Hagberg, & Dellve, 2010). In addition, both the total WAI and the single-item question have shown similar patterns of associations with diverse health-related outcomes (e.g., Ahlstrom et al., 2010). Thus, a single-item question of work ability is a good alternative to the total WAI-index, and has been widely used in Finnish work life and health surveys (e.g., Kauppinen et al., 2010).

Self-rated health (Study III) was measured by a single-item question by asking “How do you rate your health compared with your age peers?” with a five-point scale (1 = much worse, 5 = much better). The reliability of the SRH question is found to be as good as or even better than that of most of the more specific questions on health (Lundberg & Manderbacka, 1996). Moreover, the question is closely related to objective measures of health and even mortality (Chida & Steptoe, 2008).

Multisite musculoskeletal pain (MSP) (Study IV) was measured using seven items adapted from a validated Nordic Musculoskeletal Questionnaire (Björkstén, Boquist, Talbäck, & Edling, 1999; Kuorinka et al.,

1987). Pain was measured in neck, shoulders, forearms/hands, hips, knees, and radiating, and local pain in low back. The question was: “Estimate how many days altogether you have had ... (i.e., neck) pain during preceding 12 months?” All items were rated on a five-point scale (1 = never, 2 = 1–7 days, 3 = 8–30 days, 4 = over 30 days, 5 = daily). The variable was categorized into two categories: ‘0 = no pain’ (pain on 0–7 days), ‘1 = pain’ (pain more than 7 days). Finally, all seven dichotomized variables were summed and the sum score of MSP at all sites was calculated (0 = no pain, 7 = pain in seven sites).

Life satisfaction

Life satisfaction (Study III) was a single-item question “How satisfied are you at present with your life?”. The item was rated with a five-point scale from 1 (very unsatisfied) to 5 (very satisfied). Single-item measures of life satisfaction have previously been effectively used (Lucas & Donnellan, 2012, see also Wanous, Reichers, & Hudy, 1997).

2.2.2 Job demands

Job demands were measured with physical and mental work load (Studies I and IV). *Physical workload* was measured using four items adapted from Viikari-Juntura et al. (1996). Physical workload was covered by questions on the frequency of working in four difficult work postures: (i) working on one’s knees, crouched, or crawling; (ii) postures in which the back is bent; (iii) postures in which the back is twisted; and (iv) working with a hand or hands above neck-shoulder level. All items were rated on a four-point scale (for example, 1 = not at all, 4 = over an hour during the shift). (For datasets 1/2: T1 $\alpha = 0.73/0.73$, T2 $\alpha = 0.74/0.72$, T3 $\alpha = 0.79/0.78$). *Mental work load*² (e.g., Tuomi, Toikkanen et al., 1991) consisted of three items: Excessive demands of the job; responsibility of the job; and fear of failure and mistakes at work. Items were rated on a five-point scale (0 = not at all, 4 = very much) (for both datasets: T1 $\alpha = 0.77$; T2 $\alpha = 0.79$, T3 $\alpha = 0.75$).

² NB. In the original paper of the Study I, the term “job demands” has been used instead of mental work load.

2.2.3 Job resources

Three diverse job resources were examined. According to the JD-R model (Demerouti et al., 2001), each job has its own job resources that are relevant in terms of employee well-being. Thus, the applied job resources were selected according to prior studies that have identified these resources to be important for firefighters: (1) *supervisory support* (e.g., Haslam & Mallon, 2003; Mitani et al., 2006); (2) *supportive interpersonal relations* (e.g., Saijo, Ueno, & Hashimoto, 2007); and (3) *task resources* (e.g., Lusa et al., 2006). The three job resources – supervisory relations, interpersonal relations, and task resources – were adapted from the Occupational Stress Questionnaire (OSQ) (Elo, Leppänen, Lindström, & Ropponen, 1992). The OSQ measures the perceived work environment and its effects. It is well-validated in Finland and has been used among several occupational groups (Elo et al., 1992).

Supervisory relations (Studies I–II, IV) included five items covering supervisory support, supervisory control, and relationships between employees and supervisors (for datasets 1/2: T1 $\alpha = 0.81/0.81$, T2 $\alpha = 0.80/0.82$, T3 $\alpha = 0.84/0.83$). An example item is “Do you get support and help from your supervisor when needed?” *Interpersonal relations* (Studies II and IV) consisted of four items: conflicts between employees, conflicts between younger and older workers, cooperation in one’s work-unit, and relationships between employees (for both datasets: T1 $\alpha = 0.74$; T2 $\alpha = 0.72$, T3 $\alpha = 0.77$). An example item is “What kind of are the relations between co-workers in your workplace?” *Task resources* (Studies I–II, and IV) included three items: decision-making on issues concerning one’s tasks, opportunities to use one’s knowledge and skills at work, and feedback on success in work tasks (for datasets 1/2: T1 $\alpha = 0.67/0.67$, T2 $\alpha = 0.68/0.67$, T3 $\alpha = 0.72/0.72$). An example item is “Can you use your knowledge and skills at work?” All job resource items were rated on a five-point scale (e.g., 1 = not at all/practically never, 5 = very much). In Studies I and II a continuous sum scores of the job resources were used, whereas in Study IV, the sum scores were dichotomized at their median to create high and low groups of job resources.

2.2.4 Personal resources

Self-esteem (Study II) was measured by the Rosenberg Self-Esteem Scale (Rosenberg, 1965) consisting of 10 items. Rosenberg's self-report scale is a valid, reliable, and the most widely used measure of self-esteem (Gray-Little, Williams, & Hancock, 1997; Marsh, 1996). It includes both positive (e.g., "On the whole, I am satisfied with myself"), and negative (e.g., "At times I think I am no good at all") items. All items were rated on a four-point scale ranging from 1 = strongly disagree to 4 = strongly agree ($T2 \alpha = 0.81$).

Optimism (Study IV) was a single-item question from the validated Work Ability Index Questionnaire (Tuomi et al., 1998): "Have you recently felt yourself to be full of hope for the future?" The original five-point scale (0 = never, 4 = often) was categorized into low (<3) and high (≥ 3) levels of optimism.

2.2.5 Lifestyle factors

Alcohol consumption, body mass index (BMI), smoking, physical exercise, and sleep problems were studied as indicative of lifestyle (Studies I and IV). *Alcohol consumption* was measured using a single-item question on the frequency of alcohol consumption with an eight-point scale (1 = never, 8 = daily or almost daily). In Study I, a continuous variable was used. In Study IV, the variable was categorized into low (<6) and high (≥ 6) alcohol consumption. *BMI* (Study I) was calculated by dividing body weight (kilograms) by the square of body height (metres). *Smoking* habits were elicited using a dichotomous (yes-no) question on current smoking. *Physical exercise* was assessed through a single-item question on the frequency of leisure-time exercise activity, using a three-point scale (1 = not at all, 2 = occasionally, 3 = frequently). In Study IV, the variable was categorized into low (<3) and high (3) physical activity. Finally, a four-item scale of *sleep problems* was derived from the Basic Nordic Sleep Questionnaire (Partinen & Gislason, 1995): Difficulties in falling asleep during the past three months; sleeping well during the past three months; awaking too early in the morning and not being able to fall back asleep during the past three months; and extreme tiredness during daytime. All the items were rated on a five-point scale (1 = not

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at all, 5 = daily/almost daily) except sleeping well, which was measured with a three-point scale (1 = well, 3 = moderately, 5 = poorly) (for datasets 1/2: T1 $\alpha = 0.76/0.76$, T2 $\alpha = 0.79/0.78$, T3 $\alpha = 0.79/0.80$). In Study IV, the sum score was dichotomized using median to create low (<8) and high (≥ 8) sleeping problems. Table 2 summarizes the variables used in the sub-studies.

Table 2. Variables used in the sub-studies.

Variables	Study I	Study II	Study III	Study IV
Affective well-being				
<i>Work engagement</i>	x	x		
<i>Vigor</i>			x	
<i>Fatigue</i>			x	
<i>Depressive symptoms</i>				x
Health-related well-being				
<i>Work ability</i>				
Work ability index	x		x	
Single-item		x		
<i>Musculoskeletal pain</i>				x
<i>Self-rated health</i>			x	
Life satisfaction				
			x	
Job demands				
<i>Physical work load</i>	x			x
<i>Mental work load</i>	x			x
Job resources				
<i>Supervisory relations</i>	x	x		x
<i>Interpersonal relations</i>		x		x
<i>Task resources</i>	x	x		x
Personal resources				
<i>Self-esteem</i>		x		
<i>Optimism</i>				x
Lifestyle factors				
<i>Alcohol consumption</i>	x			x
<i>BMI</i>	x			
<i>Smoking</i>	x			x
<i>Physical exercise</i>	x			x
<i>Sleeping problems</i>	x			x

2.3 Statistical Analyses

Multiple statistical analyses were used in this study. Linear regression analysis was used in Study I, structural equation modeling in Study II, latent class growth modeling in Studies III–IV, mixed linear models in Study III, and multinomial regression analysis in Study IV. Continuous variables were applied in Studies I, II, and III, whereas due to the study design, categorized variables were applied in Study IV. Analyses were conducted using PASW Statistics 18 for Windows (Study I), AMOS 18.0 software package (Study II), and SAS (version 9.2) software (Studies III–IV).

In Study I, exploratory factor analysis (EFA) was used to examine whether the different scales of job demands and job resources could be distinguished from each other. Multicollinearity was checked, and found no collinearity problems in the data (see Myers, 1990). To examine whether lifestyle, job demands, job resources, and work engagement were related to the WAI or its six sub-dimensions in 2009, linear regression analysis was used. The baseline WAI and the sub-dimensions of the WAI ten years earlier were controlled. Thus, in total seven different models were analysed.

In Study II, structural equation modeling (SEM) techniques were used to test the role of work engagement as a mediator between job and personal resources on the one hand and work ability on the other. SEM was chosen due to several advantages. Firstly, it takes a confirmatory (i.e., hypothesis-testing) rather than exploratory approach to the data analysis. Secondly, SEM provides explicit estimates of error variance parameters, that is, by using latent variables it is possible to assess and correct measurement errors, which allows more reliable tests of the study models. Thirdly, both unobserved (i.e., latent) and observed variables can be incorporated in SEM procedure. Fourthly, SEM allows for the possibility of testing models against each other. Finally, SEM allows reliable methods to test indirect effects. (For more details, see Byrne, 2010.) In the first phase, the measurement model (confirmatory factor analyses, CFA) that defines relations between the observed and unobserved variables was tested (see Mulaik & James, 1995). After testing the measurement model, structural equation models were tested. Model fit was evaluated using goodness-of-fit indices (i.e., Chi-square χ^2 test, the Root Mean Square Error of Approximation, the Comparative Fit

Index, and the Tucker-Lewis Index), and conventional rules of thumb for their cut-offs (see Browne & Cudeck, 1993; Byrne, 2010). In addition, to compare the different models, Akeike's Information Criterion (AIC) was used. Finally, a bootstrapping on 2,000 subsamples from the original data using the ML estimator with bias-corrected 95% confidence intervals for each of the parameter bootstrap estimates was conducted in order to examine whether job resources, self-esteem, and work ability at T1 yielded an indirect effect via work engagement on work ability at T2 (see e.g., Hayes, 2009).

In Study III, a latent class growth modeling (LCGM) (Jones & Nagin, 2007; Nagin, 1999) to identify latent mood (i.e., vigor and fatigue) trajectories was used. LCGM is a semi-parametric statistical technique used to identify distinct subgroups of individuals following a similar pattern of change over time in a variable of interest (Andruff, Carraro, Thompson, Gaudreau, & Louvet, 2009). The parameters of the multitrajectory models were estimated by maximum likelihood estimation, and the censored normal model distribution was used. To decide on the adequate number of latent classes, different criteria were used: (i) The Bayesian Information Criterion (BIC) statistics; (ii) The AIC statistics; (iii) the posterior probabilities; and (iv) the usefulness and clarity of the latent classes in practice. In order to investigate the relationship between the latent mood classes and employee well-being, the mixed linear models were used. Moreover, the t-tests with Bonferroni correction were carried out to investigate whether differences existed on the levels of work ability, self-rated health, and life satisfaction between the different latent classes. Age was adjusted in each model.

In Study IV, the effects of job demands, job resources, personal resources, and lifestyle on pain-depression trajectories were analysed using the LCGM in a similar way to Study III. In order to investigate the relationship between the latent classes and antecedents in 1996, multinomial logistic regression analyses were conducted. The associations were presented as odd ratios (OR) and their 95% confidence intervals (95% CI). All models were adjusted with age, and finally, all significant predictors were put into the same model in order to examine their independent effects. In the final model, variables that were not significant at the critical level 0.05 in relation to either of the examined trajectories were eliminated.

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A more detailed description of the statistical analyses is provided in the original articles. Table 3 summarizes the study type, sample, main variables, and data analyses of each sub-study.

Table 3. Study type, sample, main variables, and statistical analysis of the Studies I–IV.

Study	Study type	Sample	Main variables	Data analysis
Study I The relationship between work engagement and work ability	Cross-sectional	n=403	Job demands; job resources; lifestyle factors; work engagement; work ability	Exploratory factor analysis (EFA); linear regression analysis
Study II The mediating role of work engagement; the role of work ability in the motivational process of the JD-R model	Longitudinal sample with two waves	n=403	Job resources; personal resources (self-esteem); work engagement; work ability	Confirmatory factor analysis (CFA); structural equation modeling (SEM); bootstrapping using the MLE
Study III The co-development of vigor and fatigue, and their relationship with well-being	Longitudinal sample with three waves	n=360	Vigor; fatigue; life satisfaction; self-rated health; work ability	Latent class growth modeling (LCGM); mixed linear models
Study IV The co-development of musculoskeletal pain and depressive symptoms, and their antecedents	Longitudinal sample with three waves	n=360	Job demands; job resources; personal resources (optimism), lifestyle factors; depressive symptoms; multisite musculoskeletal pain	Latent class growth modeling (LCGM); multinomial logistic regression

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The results are presented by sub-studies. Firstly, the relationship between work engagement and work ability is investigated (Study I). Secondly, the role of work ability in the motivational process of the JD-R model is examined (Study II). Thirdly, the co-development of vigor and fatigue and their relationship to employee well-being will be presented (Study III). Fourthly and finally, the results of the developmental paths of multisite musculoskeletal pain and depressive symptoms, and the antecedents related to particular trajectory groups will be presented (Study IV). Detailed analyses of sub-studies are presented in the original papers.

3.1 Relationship between work engagement and work ability (Study I)

Study I investigated whether work engagement is related to work ability after controlling for age, lifestyle, work characteristics, and work ability ten years earlier. Both work ability index (WAI) and its sub-dimensions were examined. Table 4 shows the results of the stepwise regression analyses related to total WAI. Age was negatively related to WAI. The lifestyle factors included in step 2 significantly improved the regression model. More specifically, sleep problems were negatively and physical exercise positively related to work ability. In contrast, alcohol consumption, BMI and smoking were not related to the total WAI score. Adding work characteristics (step 3) to the model further significantly improved the regression model. However, only physical workload was significantly related to the WAI. Finally, work engagement was added to the model (step 4). The results showed a positive relationship between work engagement and work ability. The final model explained 53% of the variance of the WAI.

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Table 4. Associations of age, lifestyle factors, work characteristics, and work engagement with work ability index (WAI) in 2009 (n = 403).

Explanatory variables	Work ability index			
	b	95% CI	ΔR^2	R^2
Step 1			.39***	.39
WAI 1999	.53	[.36, .70]		
Age	-.14	[-.26, -.03]		
Step 2: Lifestyle factors			.09***	.48
Alcohol consumption	-.01	[-.38, .35]		
BMI	-.16	[-.38, .06]		
Smoking	-1.38	[-2.79, .04]		
Physical exercise	1.74	[.43, 3.04]		
Sleep problems	-.28	[-.46, -.10]		
Step 3: Work characteristics			.04**	.52
Mental workload	-.73	[-1.51, .06]		
Physical workload	-1.32	[-2.40, -.23]		
Supervisory relations	-.01	[-.80, .78]		
Task resources	.32	[-.81, 1.44]		
Step 4: Work engagement			.01*	.53
Work engagement	.61	[.09, 1.13]		

Note. b = unstandardized beta-coefficient from the final step; CI = confidence interval; ΔR^2 = change in explanation rate; R^2 = explanation rate.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

The second aim of the Study I was to examine whether age, lifestyle, job demands and resources, and work engagement were associated with the sub-dimensions of the WAI. Results indicated that all independent variables, except BMI and alcohol consumption, were associated with at least one sub-dimension of the WAI after controlling the baseline WAI. Age was negatively correlated to the two WAI sub-dimensions, namely current work ability and own prognosis of work ability. Of lifestyle factors, frequent sleep problems were negatively related to current work ability, work ability in relations to job demands, and psychological resources. In turn, frequent physical exercise was positively associated

with current work ability and work ability in relation to job demands, and negatively with sick leave. Smoking was negatively related to work ability in relation to job demands. Work characteristics were associated with five sub-dimensions of the WAI. More specifically, high mental workload was negatively related to work ability in relation to job demands and psychological resources. High physical workload in turn was positively associated with a higher frequency of diseases and sick leave. In addition, task resources were positively related to own prognosis of work ability, whereas supervisory relations were not related to any of the sub-dimensions of the WAI. Work engagement was positively related to three sub-dimensions of WAI: good current work ability, good work ability in relation to job demands, and a higher level of psychological resources. Of the different sub-dimensions, the highest explained variances of the study models concerned work ability in relation to job demands (48%) and psychological resources (45%). In contrast, the lowest explained variances concerned sick leave (20%) and number of diseases (24%). More detailed results are presented in the original paper of the Study I.

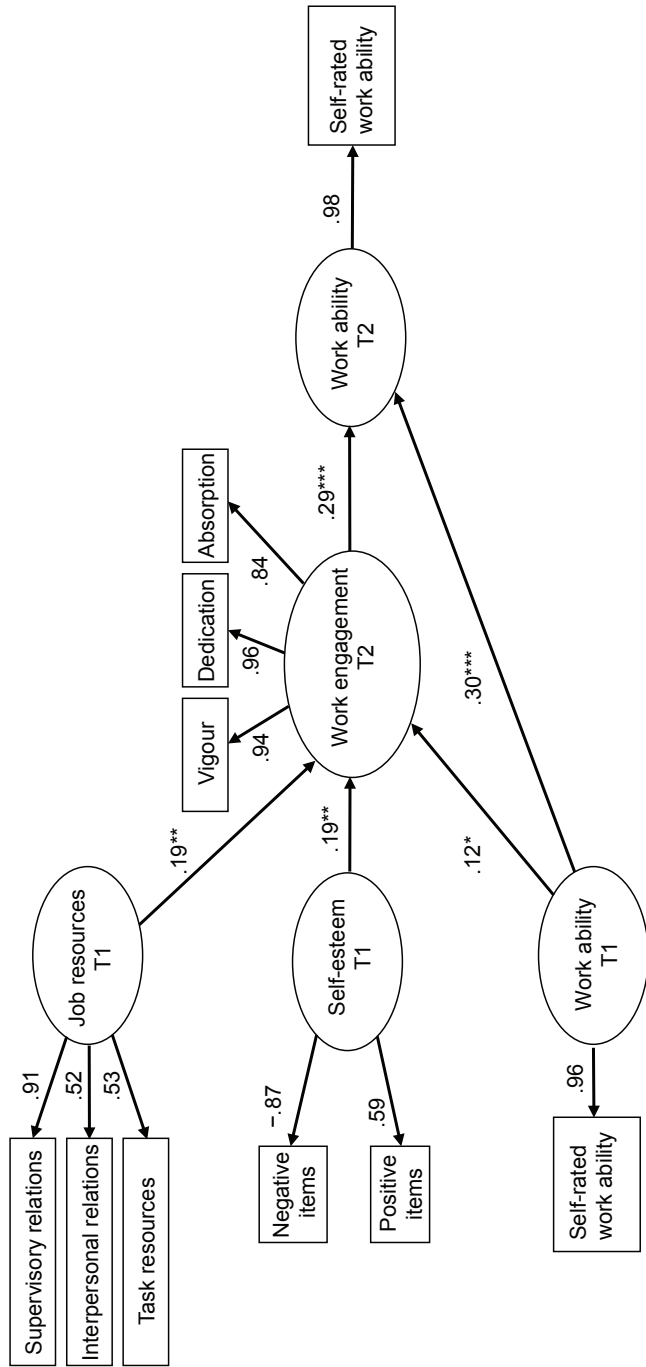
3.2 Work engagement as a mediator between job resources, personal resources, and work ability (Study II)

Study II examined the mediating role of work engagement between job resources and personal resources and work ability, and the role of work ability in the motivational process of the JD-R model. The measurement model produced an acceptable fit to the data. Of the structural equation models, the hypothesized mediation model fitted well to the data and significantly better than any of the other four tested models (for fit indices and chi-square difference tests of the five tested models, please see the original publication of the Study II). In the best-fitting model, displayed in Figure 3, both job resources at T1³ ($\beta = .19, p < .01$) and self-esteem at T1 ($\beta = .19, p < .01$) were positively related to work engagement at T2. Furthermore, work engagement at T2 was positively

³ NB. Here T1 refers to 1999 and T2 to 2009 in a similar way as in the original paper of the Study II.

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related to work ability at T2 ($\beta = .29, p < .001$). Work ability at T1 also predicted work ability at T2 10 years later ($\beta = .30, p < .001$), as well as work engagement at T2 ($\beta = .12, p < .05$). The hypothesized model explained 12% of the variance in work engagement at T2 and 21% of the variance in work ability at T2. Finally, bootstrapping was used to test whether job resources, self-esteem, and work ability at T1 yielded an indirect effect via work engagement on work ability at T2. All indirect effects were confirmed (please see the original publication of Study II for detailed bootstrapping analyses), thus supporting the mediating role of work engagement between job resources and work ability (Hypothesis 1), and between self-esteem and work ability (Hypothesis 2), respectively. In addition, work ability at T1 had an indirect effect on work ability at T2, via work engagement, and thus, supporting Hypothesis 3.



Note. *** $p < .001$; ** $p < .01$; * $p < .05$.
 (Airila, Hakanen, Schaufeli, Luukkonen, Punakallio, & Lusa, 2013).

Figure 3. Final model of the mediating role of work engagement between job resources, self-esteem, and work ability ($n = 403$).

3.3 Mood trajectories and their relationship to work ability, self-rated health, and life satisfaction (Study III)

Study III investigated the latent mood trajectories (i.e., vigor and fatigue) and their relationships to employee well-being (i.e., work ability, self-rated health, and life satisfaction) during a 13-year follow-up period. Altogether, trajectory models with 1–5 trajectories were tested. The BIC statistics revealed that a four-trajectory model was the best fitting model with acceptable posterior probabilities for all four groups ranging from .78 to .88 (for detail information about the fit criteria of the tested trajectories, please see the original publication of Study III). Thus, four distinct trajectories that differed from each other in their mean levels and changes were identified: (a) high positive ($n = 149$, 41%), (b) high positive but decreasing ($n = 106$, 29%), (c) moderately positive ($n = 79$, 22%), and (d) high negative ($n = 26$, 7%). The *high positive* trajectory consisted of those participants who had a high level of vigor and low level of fatigue across time. In this group, the level of vigor remained stable throughout the 13-year follow-up, whereas the feelings of fatigue slightly increased between T1 and T2, and remained stable thereafter. The *high positive but decreasing* trajectory consisted of participants who had a high but decreasing level of vigor and high level of fatigue. At baseline, the levels of vigor and fatigue differed from each other substantially. However, these two affective states were closer to each other by T2 and remained rather stable thereafter. The latent group labelled *moderately positive* was characterized by a moderate and stable level of vigor and a moderate level of fatigue, which slightly increased between T2 and T3. In this group, feelings of vigor were at a higher level than the feelings of fatigue throughout the study period. The trajectory labelled *high negative* was characterized by a high level of fatigue and low level of vigor, and both feelings remained stable over time. The trajectories are presented in Figure 4.

In terms of well-being, members of the *high positive* trajectory had better well-being than the members of other latent mood trajectories. In contrast, members of the *high negative* group had considerably lower work ability, SRH and life satisfaction than the members of the other latent groups. In all well-being outcomes, the differences between *high positive but decreasing* and *moderately positive* latent groups were non-significant. The detailed analyses are presented in the original publication of the Study III.

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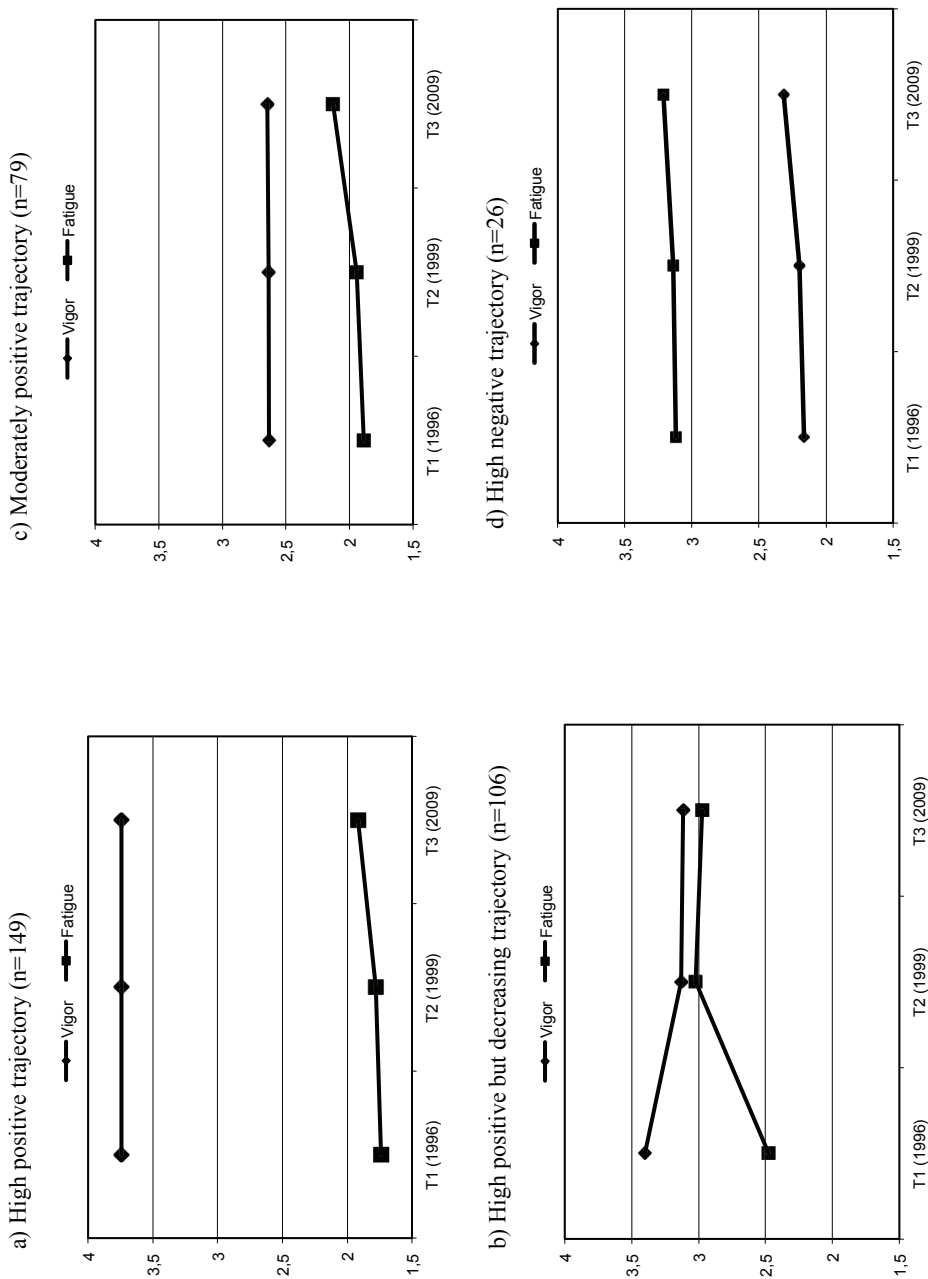


Figure 4. Estimated developmental trajectories for vigor and fatigue ($n = 360$). (Airila, Hakanen, Luukkonen, Lusa, & Punakallio, 2013).

3.4 Pain-depression trajectories, work characteristics, and individual factors (Study IV)

Study IV investigated the development of multisite musculoskeletal pain and depressive symptoms during a 13-year follow-up period; and whether the belonging to a particular trajectory group would be associated with baseline work characteristics, personal resources, and lifestyle. Three distinct trajectories that differed from each other in their mean levels and changes in multisite musculoskeletal pain and depressive symptoms were identified: (a) Low Symptoms ($n = 179$, 49%), (b) High Pain ($n = 115$, 32%), and (c) High Depression ($n = 66$, 19%). The fit criteria of the trajectories with the different number of latent classes are displayed in the original publication of the Study IV.

The *Low Symptoms* trajectory consisted of those participants who had low levels of both symptoms. In this group, the feelings of depression remained stable throughout the 13-year follow-up period, whereas the level of musculoskeletal pain slightly increased between T2 and T3. The *High Pain* trajectory consisted of participants who had a high and increasing level of musculoskeletal pain and low level of depressive symptoms. The latent group labelled *High Depression* was characterized by a high level of depressive symptoms and a moderate level of musculoskeletal pain. In this group, the level of depressive symptoms increased drastically between T1 and T2, and decreased thereafter, however still remaining at a high level. (See Figures 5 and 6.) Taken together, hypotheses 1a–1c were supported, as both trajectory groups with low symptoms (H1a), high pain (H1b), and high depressive symptoms (H1c) were found. Instead, no trajectory with high levels of both symptoms emerged, and thus Hypothesis 1d was not supported.

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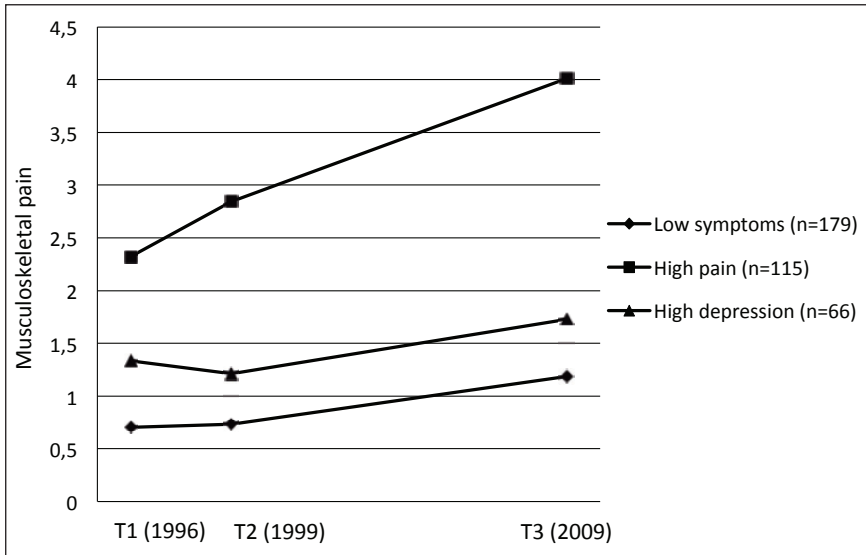


Figure 5. Mean profiles for musculoskeletal pain ($n = 360$). (Airila, Hakanen, Luukkonen, Punakallio, Lusa, & Leino-Arjas, 2014).

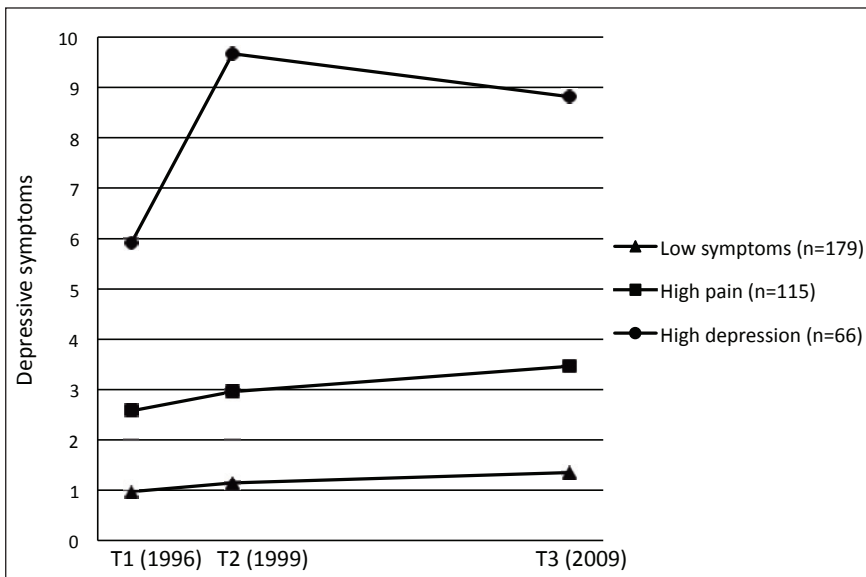


Figure 6. Mean profiles for depressive symptoms ($n = 360$). (Airila et al., 2014).

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This study examined also the effects of job demands and resources, lifestyle, and optimism on the pain-depression trajectories. Firstly, the independent effect of each predictor on the pain-depression trajectories was examined. When the High Depression was contrasted with the Low Symptoms trajectory, high mental work load predicted belonging to the former group (OR 4.48, CI: 2.45–8.18) when age was included in the model. The finding was similar when contrasting High Pain and Low Symptoms, however, the association was minor (OR 1.80, CI: 1.09–2.94) compared to that of High Depression. Physical work load was not a significant predictor in both contrasts. Again, with the Low Symptoms trajectory as reference, poor interpersonal relations predicted belonging to High Pain (OR 1.72, CI: 1.06–2.79) and High Depression (OR 3.61, CI: 1.99–6.57). Similarly, poor supervisory relations (OR 2.76, CI: 1.52–5.01) and low task resources (OR 2.56, CI: 1.42–4.61) predicted belonging to the High Depression. However, they were not significant when High Pain was contrasted with Low Symptoms. Of lifestyle factors, alcohol consumption predicted belonging to High Pain (OR 2.40, CI: 1.45–4.00), whereas smoking and physical exercise were non-significant predictors in both contrasts. Sleeping problems predicted belonging both to High Pain (OR 2.41, CI: 1.47–3.95) and High Depression (OR 3.76, CI: 2.07–6.81) when contrasted with Low Symptoms. Similarly, low levels of optimism predicted group membership in High Depression (OR 2.68, CI: 1.49–4.83) but not in High Pain.

Table 5 shows the age-adjusted results of the final model in which all antecedents of pain-depression trajectories were analysed at the same time. With the Low Symptoms as reference, high mental work load and sleeping problems, poor interpersonal relations, and low level of optimism predicted belonging to High Depression. Contrasting High Pain with Low Symptoms, alcohol consumption and sleeping problems were significant predictors. Thus, Hypothesis 2 was partly supported: high levels of job demands and low levels of job resources and personal resources at baseline predicted belonging to the trajectory groups of High Pain and High Depression. However, after including all the significant predictor variables in the same model, High Pain trajectory was not anymore predicted by any of the JDs or JRs.

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Table 5. Predicting of membership in pain-depression trajectories; final multivariable model. Multinomial regression analysis; odds ratios (OR) and their 95% confidence intervals (CI), (n = 360).

	High Pain vs Low Symptoms		High Depression vs Low Symptoms	
	OR	95% CI	OR	95% CI
<i>Age</i>	1.02	[.98, 1.07]	1.02	[.96, 1.08]
<i>Mental work load</i>				
Low	1.00		1.00	
High	1.39	[.81, 2.38]	2.87	[1.51, 5.45]
<i>Interpersonal relations</i>				
Good	1.00		1.00	
Poor	1.40	[.83, 2.34]	2.63	[1.39, 4.97]
<i>Alcohol consumption</i>				
Low	1.00		1.00	
High	2.42	[1.43, 4.11]	1.42	[.75, 2.70]
<i>Sleeping problems</i>				
Low	1.00		1.00	
High	2.13	[1.27, 3.59]	2.72	[1.44, 5.15]
<i>Optimism</i>				
High	1.00		1.00	
Low	1.23	[.73, 2.06]	1.97	[1.04, 3.72]

4 DISCUSSION

The aim of this study was to examine the effects of work characteristics, personal resources, and lifestyle on employee well-being, as well as developmental paths of affective states, and multisite musculoskeletal pain and depressive symptoms among Finnish firefighters using a longitudinal data. The study aimed to provide a comprehensive view of employee well-being by examining affective, health-related, and cognitive aspects of employee well-being applying three complementary theoretical frameworks – JD-R model, COR theory, and BaB theory. Theoretically, this study extended previous knowledge by bringing new input both to work engagement, as well as to work ability literature. Firstly, this study provided evidence for the motivational potential of work engagement in explaining work ability. Secondly, this study found support for the health-related properties of the motivational process of the JD-R model, and particularly, the role of work ability in it. Moreover, applying a person-centered approach in examining employee well-being over a 13-year follow-up period, this study provided new information on individual developmental paths in positive and negative affective states as well as in multisite musculoskeletal pain and depressive symptoms. To conclude, longitudinal linkages between work characteristics, personal resources, lifestyle, and employee well-being were found. Next, the main findings of the study are discussed in more detail.

4.1 Motivational state of work engagement associated with work ability

A vast number of studies exist on the associations between individual lifestyle, work characteristics, and work ability (van den Berg et al., 2009).

However, thus far the role of motivational aspects – here work engagement – has been neglected in explaining work ability, despite the fact that motivational factors are considered essential factors related to work ability (e.g., Ilmarinen, 2009). Moreover, the contribution of work engagement for health and work ability beyond lifestyle and work characteristics has rarely been examined (for exception, see Rongen, Robroek, Schaufeli, & Burdorf, 2014). The results of this study indicated that the positive state of work engagement consisting of vigour, dedication, and absorption was significantly associated with work ability. In fact, work engagement was related both to the total score of the WAI and to its three sub-dimensions even after adjusting for various individual and work characteristics. More specifically, this study showed that a motivated and energetic worker, who strongly identifies with his/her work, is more likely to have better work ability than his/her less engaged co-worker. This finding is in line with a study of Finnish teachers (Hakanen et al., 2006) in which work engagement was positively correlated with self-rated work ability measured with a one-item indicator. In addition to work engagement, other key factors promoting work ability among firefighters were good sleep, frequent exercise, not too high physical workload or mental workload, and good task resources. Similar findings exist on the effects of work characteristics (e.g., Fischer et al., 2006; Pohjonen, 2001; Tuomi et al., 1991) and lifestyle (e.g., Kaleta, Makowiec-Dabrowska, & Jegier, 2006; Lusa, Häkkänen, Luukkonen, & Viikari-Juntura, 2002; Rongen et al., 2014) on work ability.

Lifestyle may be related to employee well-being through several psychological pathways. For example, evidence indicates that exercise may increase self-esteem, positive affect, and self-efficacy (Biddle & Mutrie, 2008; Elavsky et al., 2005), which consequently may increase health and well-being. Similarly, a healthy lifestyle has been related to lower levels of fatigue, tension, depression, and anxiety (Biddle & Mutrie, 2008), and consequently, better health.

This study added new knowledge also by examining the antecedents of different sub-dimensions of the WAI separately, instead of a total index. In fact, knowledge on the relationships between the sub-dimensions of the WAI and individual and work characteristics are essential in order to improve work ability and apply properly focused interventions in workplaces. Indeed, the different sub-dimensions of the WAI had partly different antecedents. Furthermore, lifestyle, work characteristics, and

work engagement were more strongly related to the subjective WAI dimensions (i.e., current work ability, work ability in relation to job demands, own prognosis of work ability, and psychological resources) than to the two more objective (i.e., number of diseases and sick leave) WAI sub-dimensions. Generally, moderate association between work engagement and physiological health indicators have been found (e.g., Bakker & Leiter, 2010; Langelaan, Bakker, Schaufeli, Van Rhenen, & Van Doornen, 2006). In their study on construction workers, Alavinia, de Boer, van Duivenbooden, Frings-Dresen, and Burdorf (2009) found that work-related risk factors were more strongly associated with the subjective work ability sub-dimensions than with the health-related sub-dimensions. As regards sick leave, one study found that among Dutch managers, work engagement predicted absence frequency but not absence duration (Schaufeli et al., 2009). The WAI instrument does not differentiate between frequency and duration of sick leave, but simply measures the number of absence days. This may explain why in this study an association between work engagement and sick leave was not found. Conceptually, it has recently been suggested that the one-factor model of work ability should be dismissed (Martus, Jakob, Rose, Seibt, & Freude, 2010), and replaced with a two-dimensional instrument covering subjectively estimated work ability and objective health status. This study further gave support for such a distinction. Therefore, future studies should further investigate the dimensionality of the WAI and the importance of the different sub-dimensions within the total score.

To conclude, these findings contribute to the previous research on work ability by adding a motivational, work-related well-being construct of work engagement as a potentially important antecedent of work ability and its sub-dimensions. Theoretically, these findings support the basic idea of the JD-R model of the detrimental effect of job demands, and health-enhancing effects of job resources. Practically, these results suggest that by improving lifestyle, work-related factors, and work engagement, it may be possible to improve work ability, and especially its subjective dimensions, i.e., self-rated current work ability, work ability in relation to job demands, and psychological resources. Thus, not only promoting lifestyle or working conditions, but also fostering a positive and motivational state of work engagement is likely to be valuable in maintaining work ability.

4.2 Motivational process and its health-related properties

4.2.1 Longitudinal evidence of the importance of job and personal resources

Supporting all study hypothesis, sub-study II showed that job resources had motivational potential as they were related to future work engagement, and consequently to work ability over a 10-year study period. Thus, the beneficial role of job resources and personal resources in the motivational process of the JD-R model gained further support from this longitudinal study. As indicated by this study, jobs characterized by supportive conditions such as autonomous tasks, positive interactions between co-workers, and support and positive feedback from one's supervisor, may even in the long-term foster flourishing and engaged employees who enjoy good work ability. The long-term impacts of job and personal resources on well-being support the assumption of COR theory of slow positive accumulation processes resulting in long term resource gains. In addition, these results support self-determination theory (SDT; Deci & Ryan, 2000), which emphasizes the importance of social-contextual conditions that either enhance or hinder motivation at work. Empirically, the results of this study are line with previous studies that suggest positive associations between job resources and/or work engagement and health-related outcomes (e.g., Hakanen & Schaufeli, 2012; Langelan et al., 2006; Parzefall & Hakanen, 2010; Seppälä et al., 2012).

In addition, the present study revealed that self-esteem as a personal resource plays a significant role in shaping work engagement and also work ability in the long-term via engagement, even when the impacts of baseline work ability and job resources were controlled. In other words, the way in which people evaluate themselves is likely to influence how engaged they are and how they assess their work ability. This result is in line with previous studies on the positive relationship between self-esteem and well-being (for a review, see Baumeister, Campbell, Krueger, & Vohs, 2003, see also DeNeve & Cooper, 1998; Mäkikangas, Kinnunen, & Feldt, 2004; Schimmack & Diener, 2003). Moreover, this finding is consistent with the basic assumption of the JD-R model that highlights the relationships between personal resources, work engagement, and positive

outcomes. In a similar vein, the result supports both self-enhancement theory (Jones, 1973) and BaB theory (Fredrickson, 2001) that highlight the importance of personal resources (e.g., self-esteem) in maintaining and enhancing well-being. Tentatively, the results of the present study also lend support to the COR theory's assumption of resources caravans (Hobfoll, 1989, 2001), that is, increasing resources (i.e., job resources and self-esteem) tend to generate new resources (i.e., work engagement and work ability), and thus form resource caravans.

Several mechanisms may possibly link personality factors (e.g., self-esteem) and employee well-being. For example, individuals with a high level of self-esteem may be more likely to use proactive coping strategies to handle stressful situations (e.g., Antonovsky, 1987; Hobfoll, 1989). As such, positive personality factors act as buffers that protect well-being against various stressors (e.g., Kivimäki et al., 2005; Mäkikangas & Kinnunen, 2003). Personality and well-being may also be linked through health behavior or physiological mechanism (Antonovsky, 1987; Williams, Smith, & Cribbet, 2008). Evidence indicates, for example, that optimism is related to a healthy lifestyle (e.g., Giltay, Geleijnse, Zitman, Buijsse, & Kromhout, 2007) and to physical symptoms (Scheier & Carver, 1985). Genetic individual differences may act as a third variable in the relationship between personality and health (e.g., Friedman & Booth-Kewley, 2003; Williams et al., 2008), as well. As the focus of this study was on the social psychological determinants of employee well-being, it did not examine physiological, genetic, and environmental factors.

4.2.2 Health resources as drivers and outcomes of the motivational process in the JD-R model

The basic assumption of the JD-R model (Demerouti et al., 2001) is that the motivational process initiated by job and personal resources through work engagement may have several positive *organizational* outcomes, such as organizational commitment, job performance, and proactive behaviour (e.g., Hakanen & Roodt, 2010). However, this longitudinal study showed that the motivational process of the JD-R model may also have *health-related* properties. More precisely, this study showed that work engagement fully mediated the relationship between job resources and personal resources (i.e., self-esteem) on work ability 10 years later, thus

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expanding the potential outcomes of the motivational process included in the JD-R model. Moreover, these findings contribute to the work ability literature, which has mostly neglected motivational aspects. In other words, work engagement, supported by resourceful job and high self-esteem, plays an important role in maintaining and promoting work ability. Hence, a positive affective work-related state of mind – i.e., work engagement – can be beneficial in terms of health, not only in terms of motivational benefits.

In addition to the role of work ability as a health-related *outcome* of the motivational process of the JD-R model, this study showed that work ability may be an important health-related *resource* itself that boosts work engagement and consequently predicts not only directly but also indirectly future work ability. Thus, the dual role of work ability was observed: both as a predictor (i.e., health-related resource) and as a health-related outcome of the motivational process. As such, this study is one of the first on work ability that focuses not only on the antecedents of work ability but also on the positive consequences it may have (see also Feldt, Hyvönen, Mäkikangas, Kinnunen, & Kokko, 2009). Hence, work ability can be considered a health-related resource that may have beneficial effects on employee well-being also in the long term, thus supporting the build hypothesis of Fredrickson's (2001) BaB theory. In other words, work ability seems to, via work engagement, build well-being, i.e., work ability, over time.

The role of work ability as a health-related resource that has beneficial effects on employee well-being also in the long term has been acknowledged in some previous studies as well. For example, Seitsamo et al. (2011) showed that work ability was a strong predictor of later-life health in a 28-year longitudinal study among Finnish municipal workers. Similarly, Ahlstrom et al. (2010) found that work ability predicted future health among women working in human service organizations, with follow-ups at 6 and 12 months. In turn, in their 10-year follow-up study, Feldt et al. (2009) showed that work ability of Finnish managers was related to job involvement and organizational commitment – both constructs that are closely related to work engagement.

However, it should be noted that in this study it was not possible to directly test the positive gain cycle hypothesis between work engagement and work ability as suggested by both BaB theory and COR theory be-

cause work engagement could not be measured at both time points (see also Salanova et al., 2010). However, these results suggest the possibility of such positive reciprocal relationships evolving over time.

4.3 Mood trajectories were differentially related to well-being

This study applied a person-centered approach to examine the long-term changes in positive and negative affective states. By doing this, it was possible to identify individual developmental paths and their importance for employee well-being. These individual developmental trajectories do not become visible when using variable-based approaches, and therefore, the person-centered approach was chosen. Moreover, this study examined the joint-effects of affective states (i.e., vigor and fatigue), and thus, added new knowledge.

The results indicated that different developmental paths in vigor and fatigue are possible. More specifically, four distinct subgroups of individuals that differed from each other in their levels of positive and negative mood were found. Typically, firefighters had a rather high level of vigor and low level of fatigue. As such, these results indicate that having a positive affective state is more common than experiencing negative feelings (see also Diener & Diener, 1996). However, other combinations of positive and negative affective states also existed. These findings give partial support to both the independence and bipolar hypotheses of affect. On the one hand, vigor and fatigue seem to develop in tandem (Caccioppo & Berntson, 1994). More precisely, the co-occurrence of vigor and fatigue was particularly apparent among the members of the high positive but decreasing trajectory in which vigor and fatigue were almost at the same level between T2 and T3. This is in line with the independence hypothesis, which argues that an increase in one affect does not necessitate a decrease in the other (Cropanzano et al., 2003; Mäkikangas, Feldt, Kinnunen, & Tolvanen, 2012). On the other hand, the bipolar view of affect as opposite ends of the same continuum (e.g., Russell & Carroll, 1999) also found some support. In particular, in the most typical trajectory, i.e., the high positive, vigor and fatigue apparently represented opposite trends; that is, members of this latent group had

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the highest level of vigor and the lowest level of fatigue of all trajectories, therefore suggesting bipolarity of positive and negative affective states. These results suggest that positive and negative affective states may not always be direct opposites or independent either. In fact, present knowledge suggests that both approaches – independence and bipolar – may be valid as both of them found some empirical support, and thus there may be no need to make an “either-or” conclusion between them (Reich, Zautra, & Davis, 2003).

According to the results of this study, affective states were moderately stable over time; however, some changes were identified. In the high positive but decreasing trajectory in particular, moods changed significantly between the two first measurement points. In fact, in all mood trajectories, changes – mostly negative – were more obvious between 1996 and 1999. More precisely, a decline in positive mood and an increase in negative mood were apparent during this three-year period. In contrast, changes between 1999 and 2009 were rather minimal, as all trajectories followed a relatively stable line during this ten-year period. Speculatively, one reason for the increase in negative mood during the first three years and the persistent pattern thereafter might be found in the Finnish fire and rescue services’ situation at that time, namely the strikes in the spring of 1995 and winter of 1997–1998. These strikes had a considerable and long-reaching effect on fire departments’ work communities (see Mankkinen, 2011), and consequently, presumably also on employees’ affective states. Nevertheless, the overall changes in mood trajectories during the 13-year follow-up period were rather minimal. At least partly, the stability of mood states over time can be explained by the trait-nature of moods. As a trait, mood is regarded as a stable affect that does not change over time. Therefore, these findings support the idea of moods as rather lasting and enduring affective states (Brief & Weiss, 2002; Cropanzano et al., 2003). The rather high stability of mood states may also be explained by personality factors. For example, temperament traits (i.e., relatively stable aspects of personality, e.g., Thompson, Winer, & Goodvin, 2011) have found to be related to affective states, such as moods and emotions (Bates, Goodnight, & Fite, 2008; Goldsmith, 1993). Therefore, changes in moods may be expected to be minimal over time. Moreover, as emotional regulation increases with age (e.g., Gross et al., 1997), this could also explain the increased stability of mood states

among firefighters. Moreover, the result of relatively little changes in vigor and fatigue over a 13-year follow-up period is in line with previous studies that have shown rather high stability in affective states over time (e.g., Hakanen et al., 2008b; Seppälä et al., 2009).

By examining the relationships between mood trajectories and well-being, this study showed that those with a high level of positive mood (i.e., vigor) and low level of negative mood (i.e., fatigue) had better well-being than those with a high level of negative affectivity. Theoretically, this result is in line with Fredrickson's (2001) BaB theory, which suggests that positive emotions are related to increased well-being, even over time. Overall, these results highlight the importance of affects in predicting work ability, life satisfaction, and self-rated health. Empirically, these findings are in line with previous studies that have shown the positive relationship between vigor and health-related outcomes (e.g., Shirom et al., 2008), and the detrimental effect of negative affective states on health (e.g., Salovey, Rothman, Detweiler, & Stewart, 2000).

Taken together, it seems that different developmental paths and changes in positive and negative mood states are possible over time. Therefore, the results suggest both the possibility and need to foster positive developmental paths in affective states, i.e., to increase vigor and prevent fatigue at work, in order to maintain and improve employee well-being.

4.4 Developmental paths in musculoskeletal pain and depressive symptoms, and health-enhancing effects of job resources and individual factors

Although the antecedents of musculoskeletal pain and depressive symptoms are largely known, the knowledge regarding the developmental paths of MSP and DPS over long term is limited, as well as the effects of job-related demands and resources, personal resources, and lifestyle on the co-development of these symptoms. This study revealed that different developmental paths in multisite musculoskeletal pain and depressive symptoms are possible. Three distinct pain-depressive symptom trajectories were identified, i.e., Low Symptoms, High Pain, and High

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Depression, thus supporting the hypotheses. However, the hypothesis concerning a trajectory with high levels of both symptoms was not supported. It is likely that firefighters with high levels of MSP and DPS dropped out from work and thus the available data.

Both signs of stability and change in MSP and DPS were observed. The different developmental paths in musculoskeletal pain and depressive symptoms were most evident in High Depression. In this trajectory, changes in DPS were evident, whereas the level of MSP remained rather stable throughout the follow-up, suggesting separate developments of these symptoms. As such, these results are in line with prior assumptions of distinct development of musculoskeletal pain and depressive symptoms (e.g., Magni et al., 1994). In contrast, in the High Pain trajectory, increases in both MSP and DPS were obvious throughout the study period, indicating a parallel development of these symptoms. Overall, instead of changes in DPS in the High Depression group, rather high stability in musculoskeletal pain and depressive symptoms were observed.

The results indicated that job demands, job and personal resources, and lifestyle were partly differently related to pain-depression trajectories. Both job demands (i.e., mental workload) and all investigated job resources (i.e., supervisory relations, interpersonal relations, and task resources) as well as personal resources (i.e., optimism), and lifestyle (i.e., sleeping problems) were related to High Depression, whereas only some of these factors predicted belonging to the High Pain trajectory. However, solely High Pain was predicted by alcohol consumption. These findings argue a partly different mechanism in the etiology of musculoskeletal pain and depressive symptoms. Consistent with these findings, some previous findings indicate that pain and depression have at least partly different risk factors (e.g., Linton & Bergbom, 2011; Miller & Cano, 2009). The results also showed that the antecedents were more strongly related to High Depression than High Pain as the risk estimates were notably higher for High Depression. This indicates that improving job resources and individual factors may be more likely to have an effect on decreasing depressive symptoms rather than on musculoskeletal pain.

The findings of this study are in line with the JD-R model (Demerouti et al., 2001) that emphasizes the detrimental effect of job demands on employee well-being. Obviously, high job demands, such as a heavy mental work load, may act as psychosocial stressors at work that cause

psychosocial stress reactions, and consequently, an increase in depressive symptoms. Similarly, a high mental work load may lead to constant overload and eventually increase musculoskeletal pain. However, contrary to hypothesis and prior findings (e.g., Christensen & Knardahl, 2010; Haukka, Ojajärvi, Takala, Viikari-Juntura, & Leino-Arjas, 2012; Neupane, Miranda, Virtanen, Siukola, & Nygård, 2013) a high physical workload was not significantly related to pain-depression trajectories in this sample. This could at least be explained in part by the rather similar work tasks of the participants: difficult work postures were part of the job for all firefighters. Also health-based selection from employment, and hence from the data, may have weakened the associations, thereby leading to the underestimation of the actual effects.

Similarly, this longitudinal study gives more support to the assumptions of the JD-R model (Demerouti et al., 2001) of the enhancing effects of job resources and personal resources on employee well-being. Indeed, supporting hypothesis, job resources were significant predictors of pain-depression trajectories and this was particularly apparent in relation to High Depression. More precisely, in investigating the predictors separately, a lack of all examined job resources was related to High Depression, whereas only poor interpersonal relations were related to High Pain. In the final model, however, interpersonal relations was the only significant predictor among job resources, and furthermore, solely in relation to High Depression. Indeed, convincing health-promoting effects of social relationships and social support have previously been shown in social psychological studies on health and well-being (for reviews, see, Cohen, 1988; Uchino, 2004). Similarly, several longitudinal studies suggest that low social support from co-workers may be an important antecedent of depression (e.g., Paterniti, Niedhammer, Lang, & Consoli, 2002; Stoetzer et al., 2009, see also Hakanen et al., 2008b; Haukka et al., 2011). Along with these results, the findings of the current study suggest that good relationships between co-workers can positively influence employee well-being, even in the long term. Good interpersonal relations are highly valued in firefighting, in which employees work long hours together in closely coordinated teams (see also Pillai & Williams, 2004). On the other hand, the importance of supervisory relations may remain less influential because of the highly valued good relations between co-workers.

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According to this study, personal resources are also important in explaining employee well-being, as a lack of optimism predicted belonging to the High Depression trajectory. Similar findings are shown in previous studies, however, often with a shorter time lag, on the importance of personal factors in explaining well-being (e.g., Cannella, Lobel, Glass, Lokshina, & Graham, 2007; Scheier & Carver, 1992; Xanthopoulou et al., 2007). Optimism may enhance employee well-being via several pathways. First, a person's view of the world – here, optimistic – may be related to the likelihood of experiencing certain physiological responses when confronted by environmental challenges, and thus be directly related to health (Friedman & Booth-Kewley, 2003); in this case, to low levels of depressive symptoms. Second, optimism may act as a buffer. More precisely, optimists are likely to experience positive feelings, and when confronted by stressful events, are likely to be confident and persistent, which is protective of health. In contrast, pessimists are more likely to be doubtful and hesitant, which may lead to health risks, and consequently to ill-health. (Carver & Scheier, 2009.)

In addition to the importance of work characteristics and personal resources, the results of this study suggest that also good sleep is essential for employee well-being in terms of positive development in MSP and DPS. Similarly, in previous studies the importance of good sleep in preventing pain (Kamaleri, Natvig, Ihlebaek, Benth, & Bruusgaard, 2008) and depression (Baglioni et al., 2011) have been found. In particular, among firefighters who work long hours, adequate sleep is essential for maintaining good physical and mental health. Of the other lifestyle factors, only high alcohol consumption was a significant predictor of a high level of multisite musculoskeletal pain. In contrast, none of the examined lifestyle factors, except sleep problems, predicted belonging to the trajectory with a high level of depressive symptoms. Nevertheless, similar findings of no effects of lifestyle on pain and depression have been found previously (e.g., Haukka et al., 2012; Hölzel, Härter, Reese, & Kriston, 2011; Lebouef-Yde, 1999).

To conclude, in the present study, job-related demands and resources were found to be more important than lifestyle for employee well-being. Thus, decreasing demands and increasing resources is worthwhile in preventing the development of multisite musculoskeletal pain and depressive symptoms.

4.5 Methodological considerations

This study has both strengths and limitations that need to be considered. The main strengths of the study lie in the longitudinal design and the use of various sophisticated statistical analyses. The longitudinal dataset with three waves and a 13-year time lag was used. The longitudinal dataset enabled, for example, studying the developmental paths over time, and claiming for causality (Studies III–IV). In addition, applying a wide variety of statistical methods (i.e., linear regression analysis, structural equation modeling, latent class growth modeling, mixed linear models, and multinomial regression analysis) can be seen as another strength. In particular, the use of a fairly new method to study intra-individual changes in employee well-being (i.e., latent class growth modeling) over time can be considered as valuable. By applying the person-centered approach, the heterogeneity in positive and negative affective states, as well as in multisite musculoskeletal pain and depressive symptoms, could be identified, and thus capture the development of intra-individual trajectories over the 13-year follow-up period. Finally, this study focused on several important work characteristics and individual factors and their relationship to diverse well-being outcomes with validated measures.

Nevertheless, this study has some limitations that should be noted. First of all, the study was based on self-report measures, which may cause systematic measurement errors (common methods variance). However, the longitudinal design used in the current study may diminish the risk for common method bias (Doty & Glick, 1998). Also in Study I, which was cross-sectional, it was possible to control for baseline work ability, and thus, diminish the risk of common method bias. Nevertheless, future research would benefit from applying more objective indicators of work characteristics, individual factors, as well as well-being outcomes.

Secondly, the study design regarding psychosocial factors in the questionnaire had some limitations. For example, self-esteem and work engagement were measured only once. Thus, no causal relationship between variables could be determined. Obviously, in the case of work engagement, measuring it earlier was not possible as the measure was developed only after the two first measurement points (Schaufeli & Bakker, 2003; Schaufeli et al., 2002). Nevertheless, future research should apply a full panel design including all job and personal resources measured longitudinally.

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Thirdly, the conceptualization of some of the measures may be considered a shortcoming. For example, optimism and life satisfaction were both measured with a single-item indicator which may diminish their reliability and validity. In previous studies, however, single-item indicators of both optimism and life satisfaction have been used and found nearly as good as indicators with several items (e.g., Carver et al., 1994; Lucas & Donnellan, 2012). In addition, the measure of depressive symptoms (i.e., POMS depression subscale) captured solely the emotional symptoms, not cognitive or physical symptoms of depression. Moreover, only depressive symptoms, not depression as such, were assessed. However, depressive symptoms measured by POMS are strongly correlated with the well-established Beck Depression Inventory (Griffith et al., 2005), and therefore, a plausible measure to use. In addition, it would be difficult to measure trajectories of objectively measured depression.

Fourthly, the 3 and 10-year time lags used in this study may not be optimal for investigating the relationships between work characteristics, personal resources, lifestyle, and well-being, as other processes such as organizational changes may have influenced the effect of independent variables on the outcomes. In general, such long time lags may lead to an underestimation of the true causal relationship between study variables (Zapf, Dormann, & Frese, 1996). However, despite the changes in the organizational structure in Finnish fire departments, the work environments and colleagues for the most part remained the same. Moreover, organizations are in fact in several ways trying to pursue the stability against the changes within the organization (Leana & Barry, 2000). In relation to the fourth limitation, the effect sizes were relatively small. For example, in Study II, the explained variance in work engagement was 12% and in work ability 21%, respectively. Nevertheless, these effects are in line with prior studies (e.g., Mauno, Kinnunen, & Ruokolainen, 2007; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009). In addition, even relatively small effect sizes may be salient in predicting health and well-being of employees (Ford, Woolridge, Vipanchi, Kakar, & Strahan, 2014). Furthermore, work characteristics, personal resources and lifestyle are only one of the many variables accounting for employee well-being. Physiological, genetic, and environmental factors are also related to health and well-being. Moreover, non-work characteristics such as family, close community, and society are assumed to be related

to work ability (Ilmarinen, 2006). However, because of the relatively homogenous group of firefighters, for example, socio-economic and cultural factors were not examined. Nevertheless, in order to increase the explained variance, more factors should be included in the research models. For example, examining the work-family interaction or home resources among firefighters could be examined. On the other hand, the significant relationships between the study variables even over the rather long follow-up period are, in fact, indicative of the robustness of the findings. Nevertheless, in future studies, a shorter time lag and a full panel design should be used.

Fifthly, the rather high number of drop-outs may be considered a limitation. However, the differences between the participants and the drop-outs were either non-significant or rather minimal in every sub-study. For the most part, the drop-out was probably due to retirement as a result of the low retirement age (55 years) among Finnish firefighters during the study period and early retirement schemes and personal early retirement arrangements (under 55 years of age) which are still possible routes for retirement. An incremental increase in actual retirement age has only recently occurred. Therefore, the drop-out from the sample can be regarded as normal and not causing any particular bias to the results.

Sixth, the healthy worker effect (e.g., Li & Sung, 1999) may have biased the results, especially, as good mental and physical health is required of firefighters. Therefore, the null association found in this study between alcohol consumption and work ability, for example, may be at least partly explained by the healthy worker effect; that is, heavy drinkers with low work ability may have dropped out of the sample. However, the participants of the present study did in fact have lower work ability than Finnish male employees in general (Airila, Hakanen, Punakallio, Lusa, & Luukkonen, 2012), and thus it can be assumed that no considerable healthy worker effect existed.

Finally, this study focused on one profession only – firefighters – albeit a representative sample at baseline, which may potentially threaten the generalizability of the findings to other occupational groups. Moreover, all the participating firefighters were men, and this may possibly have affected the findings. Obviously, gender affects, for example, personality characteristics (e.g., Costa, Terracciano, & McCrae, 2001; Feingold, 1994; Mäkikangas & Kinnunen, 2003) and well-being (e.g., Fujita,

Diener, & Sandvik, 1991; Hakanen, 2009). However, the aim of the present study was to test theoretical models and examine the relationships between demands, resources, lifestyle, and well-being, and in this case, there is no reason to assume that the models would work differently according to gender. Although some caution is needed, I believe that the results can also be extended to other occupational sectors. In fact, similar evidence of the relationships between work characteristics, individual factors, and well-being exists in various occupation sectors and countries (e.g., Hakanen et al., 2006; Salanova & Schaufeli, 2008). Moreover, as job and personal resources were significantly related to employee well-being even in a highly physically demanding job, i.e., firefighting, it is plausible that the same effects are also likely to be found in other occupational sectors. Of course, this remains to be tested.

4.6 Implications for future research

Theoretically, the current study largely supported the assumptions of the JD-R model, COR theory, and BaB theory. At the same time, however, this study extended current knowledge by including the health-related outcome – i.e., work ability – to the motivational process of the JD-R model, as well as found support for the link between work engagement and work ability. In future studies, however, other health-related variables, in particular physiological health, should be examined as endpoints of the motivational process using a longitudinal data (see also Bakker & Leiter, 2010). In addition, objective measures of employee well-being, such as sickness absence, and health-related registers (e.g., National Hospital Discharge Register, National Prescription Register), could be used instead, or alongside, self-reports of well-being.

Furthermore, rather than focusing only on the individual level, employee well-being should be examined at team level, too. Indeed, team work has a crucial role in employee health and well-being (e.g., Wilson, DeJoy, Vandenberg, Richardson, & McGrath, 2004), which also became apparent in this study which found supervisory relations and interpersonal relations to be related to well-being of firefighters. There is already some evidence, although mostly cross-sectional, that work engagement acts as a collective psychosocial construct that emerges from the interaction and shared experiences of the members of a work

team (Salanova, Llorens, Cifre, Martínez, & Schaufeli, 2003), and which may have positive organizational consequences, such as increased task performance (Salanova et al., 2005), collective positive affective state, and collective efficacy beliefs (Salanova, Llorens, & Schaufeli, 2011). By examining employee well-being as a team-level process, it is possible to identify team-based resources that are essential in terms of health and well-being. For example, in firefighting, which requires good team work and supportive interpersonal relations, identifying team-level resources that may promote well-being would be valuable. Therefore, the role of the team in employee well-being should be investigated further, particularly using longitudinal data that allows the possibility to claim for causality.

As described earlier, the JD-R model can be considered a flexible model that includes a wide variety of job demands, resources and outcomes, and thus, is suitable and usable in diverse work contexts. Nevertheless, from a methodological point of view, changes in work life in terms of, for example, networking, flexibility, internationalization, and mobility, set new requirements for the definitions of demands and resources. For example, in a study among volunteer firefighters, camaraderie – i.e., feelings of belonging, a sense of shared identity, reciprocal trust, and positive bonds that exist within cohesive work groups – has been found to be a resource that may enhance their health and well-being (Tuckey & Hayward, 2011). Hence, in order to capture the features of a particular work environment in the constantly changing and fragmented world of work, the conceptualizations of demands and resources used in particular occupational sectors should be considered further.

Moreover, the role of the personal resources in the JD-R model needs to be studied further. In addition to the role of personal resources as directly impacting well-being, personal resources have been integrated into the JD-R model as mediators, moderators, “third variables”, and antecedents of job demands and resources, or another combination of these (for more details, see Schaufeli & Taris, 2014). In the present study only the direct links between personal resources and well-being were examined (i.e., from self-esteem to work ability via work engagement and from optimism to pain-depression trajectories). The results revealed that the strength of the association between personal resources (i.e., self-esteem) and well-being (i.e., work ability) was of a similar size to that of job resources, whereas the effect of optimism on well-being (i.e.,

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pain-depression trajectories) was somewhat weaker compared to that of job resources. Generally, previous studies have found more support for the importance of job resources in explaining employee well-being (e.g., Rodríguez-Sánchez, Hakanen, Perhoniemi, & Salanova, 2013; Schaufeli & Janczur, 1994), however, in some circumstances personal resources may play a more significant role. For example, Hakanen and Lindbohm (2008) found that optimism as a personal resource was more important for cancer survivors' well-being than that of job resources, whereas for their referents the effect of job resources was more crucial. Obviously, the importance of personal resources in explaining employee well-being, and on the whole, the role of personal resources in the JD-R model, needs to be examined more systematically using longitudinal data. Moreover, it is noteworthy that of the wide variety of personality traits (e.g., DeNeve & Cooper, 1998), only two personal resources – self-esteem and optimism – were examined in this study. Therefore, the importance of other personal resources, such as self-efficacy, on well-being among firefighters should be examined. Some previous findings indicate that high self-efficacy is a protective factor of stress and depressive symptoms among firefighters (Regehr et al., 2003), however, the relationship between self-efficacy and work ability remains unknown.

In addition, the role of job demands in the JD-R model remains somewhat unclear. Recent research has discussed the redefinition of job demands and distinguishing between challenge demands (e.g., work load, time urgency, mental demands, and responsibility) and hindrance demands (e.g., role ambiguity, job insecurity, and constraints) (Crawford et al., 2010; van den Broek, De Cuyper, De Witte, & Vansteenkiste, 2010; Webster, Beehr, & Christiansen, 2010). It is suggested that challenge demands have a motivational potential and are actually promoting well-being rather than diminishing it. Contrastingly, hindrance demands are more likely to thwart personal growth, learning and goal-attainment, and thus, be negatively related to employee well-being. (Lepine, LePine, & Jackson, 2004; Podsakoff, LePine, & LePine, 2007.) Based on this distinction, the indicators of job demands (i.e., mental and physical work load) of the present study could be determined as challenge demands that would be likely to increase work engagement but also stress and other negative indicators of well-being. Thus, in the future, the distinction between challenge and hindrance demands of the firefighters could

be examined in order to find out whether certain demands could have motivational functions. Nevertheless, defining demands as hindrances and challenges is not simple as individuals may evaluate demands differently: for some physical or mental work load may be a challenge whereas for others a real hindrance. Moreover, hindrances and challenges may have a different meaning in diverse work contexts. Nevertheless, this remains to be studied.

The current study has viewed employee well-being as a multidimensional construct covering affective, health-related, and cognitive (i.e., life satisfaction) aspects. As such, both positive and negative sides as well as job-related and context-free aspects of well-being were able to capture, and thus, following the previous theoretical conceptualizations of employee well-being (e.g., Diener et al., 1999; Schaufeli et al., 2002; Schaufeli & Bakker, 2004; van Horn et al., 2004). However, future studies should further develop the construct of employee well-being that comprehensively captures physical, mental, and social aspects of employee health and well-being.

4.7 Practical implications

The results of this study indicate that job demands, job and personal resources, and lifestyle are related to employee well-being even over the long term. Therefore, workplace interventions aiming at improving working conditions, interpersonal relations, as well as interventions targeted on individuals could be beneficial in order to maintain and improve employee well-being.

At the workplace level, interventions aimed at improving both the physical and psychosocial work environment could be applied. There is some prior evidence indicating the effectiveness of workplace interventions on employee health and well-being. For example, interventions targeting psychosocial work characteristics are found to be effective in preventing employee health problems (e.g., Bourbonnais, Brisson, Vinet, Vézina, Abdous, & Gaudet, 2006), increasing job satisfaction and decreasing absenteeism (Parks & Steelman, 2008), as well as increasing autonomy, strengthening social ties, and reducing interpersonal conflict (McLeroy, Gottlieb, & Heaney, 2002). Some evidence on effective work-

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place interventions in fire departments also exists. For example, team-based interventions and motivational interviewing had positive effects on firefighters' nutrition behavior, BMI, and physical activity one year after interventions among firefighters in the United States (MacKinnon et al., 2010). Similarly, previous worksite health promotion interventions among the same study population increased co-worker cohesion, exercise habits, and health behaviors among firefighters, and reduced their feelings of depression (Elliot et al., 2004). Also in the United States, action research has shown to be a potential mechanism for reducing burnout among firefighters (Halbesleben, Osburn, & Mumford, 2006). However, a recent review of the health effects of wellness programs at police and firefighter workplaces indicated mixed results regarding health and well-being outcomes (Rachele, Heesch, & Washington, 2014). Thus, the researchers concluded that empirical evidence for effective health interventions among firefighters remain scarce, and therefore, further research is needed.

For example, interventions targeting interpersonal relations by improving communication skills, training sessions on team work and team support, increasing communication between employees, or increasing employees' participation in the decision making process could be implemented. Similarly, interventions to decrease job demands, improve supervisory/follower relationships and increase task-related resources could be performed. Obviously, active involvement of both employees and managers needs to be ensured (Nielsen & Abildgaard, 2013). In addition, employees may also themselves redesign and customize their working conditions, that is to say, "craft" their jobs, to better fit their motives, strengths, and passions. As such, job crafting refers to self-initiated changes that employees make in their own job demands and resources in order to attain and/or optimize their personal goals. By job crafting, it becomes possible to seek resources and challenges and reduce demands. (Tims, Bakker, & Derks, 2012.) Crafting one's job may include changing task, relational, or cognitive boundaries of the work (Wrzesniewski & Dutton, 2001). Therefore, firefighters could according to their own needs, for example to some extent, expand or diminish the scope of their tasks, change the social relationships at work, alter the way to perceive their tasks, or change how to perform their tasks in cases which allows variation. However, not necessarily in rescue and fire situations which

are highly instructed and controlled. Empirical evidence shows that job crafting both at individual and team levels has a positive impact on employee well-being and performance (Bakker, Tims, & Derks, 2012; Tims, Bakker, Derks, & Van Rhenen, 2013), and therefore, more effort on launching bottom-up workplace interventions is essential.

As findings from this study indicate, personal resources and individual lifestyle are also related to employee well-being. Thus, promoting self-esteem, self-knowledge, optimism, and a healthy lifestyle among firefighters are also important and possible targets for interventions. Moreover, as this study identified several individual developmental paths both in terms of affective states and in musculoskeletal pain and depressive symptoms, in order to increase efficiency in interventions, it could be beneficial to identify groups of people that have similar situation in question and target interventions to them.

To sum up, in workplace interventions, both health-impairment and motivational processes of the JD-R model should be influenced, that is, decreasing ill-health and increasing well-being by applying tools for both to decrease demands and increase resources. However, features of the job need to be considered, in this case the characteristics of rescue services. Indeed, enhancing employee well-being in rescue services with multiple (i.e., physical, mental and social) demands and special features of organizational culture and structure (i.e., working in a 24-hour shifts in a highly hierarchical organization), and the unpredictable nature of work, may be rather challenging.

4.8 Conclusions

The purpose of this study was to examine the effects of work characteristics, personal resources, and lifestyle on employee well-being using longitudinal data. The beneficial role of job resources and personal resources in explaining employee well-being gained further support from this longitudinal study, and thus, supported the assumptions of the JD-R model, COR theory, and BaB theory. Adding a new contribution, this study examined the relationship between work engagement and work ability, and found that work engagement – as a positive work-related affective state – is associated with work ability. Moreover, work ability

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had a dual role in the motivational process of the JD-R model: first, as a health-related outcome, and secondly, as a health-related resource that may boost work engagement and consequently predict not only directly but also indirectly future work ability. Hence, the present study found long-term evidence for the health-related properties of the motivational process of the JD-R model.

Furthermore, using the person-centered approach in examining employee well-being over a 13-year follow-up period, this study provided new information on individual developmental paths in positive and negative affective states as well as in multisite musculoskeletal pain and depressive symptoms. Firstly, different developmental paths in vigor and fatigue were found, and consequently, those with a high positive affective state had better well-being in terms of work ability, self-rated health, and life satisfaction than those with a lower level of positive affective state. Secondly, different developmental paths in multisite musculoskeletal pain and depressive symptoms were observed, and as assumed, high job demands, low job and personal resources and poor lifestyle habits were related to the high levels of these symptoms.

Finally, this study aimed to offer a balanced view of employee well-being, examining it from several perspectives. Obviously, not only preventing ill-health (e.g., musculoskeletal pain, depressive symptoms) is sufficient, but also enhancing positive well-being (e.g., work engagement, life satisfaction) is needed: both are dimensions of employee well-being and thus essential when examining the antecedents of well-being. Similarly, several work characteristics and individual factors need to be considered in improving employee well-being. Evidently, the findings of the present study suggest that a motivated and energetic worker, who has resourceful job and low mental and physical demands, has better well-being than a co-worker who is less engaged and has more unfavourable situation in terms of demands and resources. Moreover, a good level of self-esteem, an optimistic view of the future, and healthy lifestyle habits may increase the likelihood of being healthy and happier. Hence, by focusing on, but of course not only limited to, improving work characteristics, personal resources, and lifestyle, employee well-being may be promoted. As such, work organizations have good opportunities to reinforce and maintain the health and well-being of their employees and consequently prevent ill-health and promote long work careers.

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In today's dynamic work life, employees are expected not only to be healthy and able to work efficiently, but also to be highly engaged and motivated. However, at the same time, the prevalence of mental health disorders and diseases of the musculoskeletal systems is also high. Therefore, understanding and enhancing employee well-being as a whole is essential. The present study examined the longitudinal effects of work characteristics (i.e., job demands and resources), personal resources and lifestyle on employee well-being, using data on Finnish firefighters.

This study showed that job demands, job resources, personal resources, and lifestyle all affect employee well-being over time. It offers new information for researchers, policy-makers, HRM at workplaces, and occupational health services about possibilities to enhance employee well-being, particularly work engagement, and consequently prevent ill-health and promote long working careers.

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