Work ability in young adults

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Cover illustration: Young adults at work. © TOK, Tomas Karlsson, Illustratörscentrum

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Jag sitter på min plats på kontoret [..]. Att sitta här påminner mig om de första osäkra stegen in i arbetslivet, i tonåren. Att vara lägst i rangordningen. För naiv för att inse att man när som helst kan bli undanskuffad. [..] rädslan för att man ska bli påkommen med att inte kunna hantera det där allra mest grundläggande.

Emma, ung vuxen, i romanen Linjen
Elise Karlsson, 2015

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ABSTRACT

Young adults may need special attention in their shift from student life to working life, to guarantee work ability. Being new at the workplace, they may encounter high expectations, resulting in high job demands. Also, they can expect to have a long working life and therefore need to have good work ability when entering the labor market. The overall aim of this thesis is to understand work ability in young adults. Two prospective studies, one cross-sectional and one qualitative study, were included in the thesis. Young workers were examined using questionnaires and individual interviews, and students were investigated using questionnaires. The results showed that workers 25–30 years old experienced work ability as complex and as one's own responsibility. To be alert and have energy, to possess sufficient education, skills, and working life experience and to experience meaningfulness and engagement in work were perceived to be fundamental for work ability. Work circumstances and private life could reduce or improve work ability. Similarly, changes in the job control and in the negative influence of job demands on one's private life could reduce or improve work ability, and increased social support at work could improve work ability, among workers 21–25 years old. Opportunities for recovery at work, such as having varied work, were found to be associated with excellent work ability for male workers aged 18–29 years. Finally, widespread and long-lasting symptoms were established as possible risk factors for generally reduced productivity due to musculoskeletal pain or ache among students 18–25 years old. In sum, work ability can be seen as one's own responsibility and complex, including, besides occupational factors, private life, and work–life balance. Having varied work could promote excellent work ability for young men, while widespread and long-lasting musculoskeletal symptoms can reduce general productivity. This thesis can be used as a basis for prevention and promotion programs of work ability, including adapted introductory education and mentorship for young adults.

Keywords: sustainable work ability, working life, prevention, young workers

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SAMMANFATTNING PÅ SVENSKA

Unga vuxna kan behöva särskild uppmärksamhet i övergången från studentliv till arbetsliv för att behålla sin arbetsförmåga. De kan möta höga förväntningar från arbetsgivaren samtidigt som de har begränsad erfarenhet från arbetslivet, vilket kan ge dem höga krav i arbetet. Dessutom kommer sannolikt unga vuxna att arbeta under lång tid och behöver därför ha en hållbar arbetsförmåga från början av sitt arbetsliv.

Det övergripande syftet med denna avhandling är att bättre förstå arbetsförmåga hos unga vuxna. Avhandlingen består av fyra studier. En studie undersökte studenter över tid med frågeformulär. I två andra studier, en med 1–års design och en tvärsnittsstudie, svarade olika grupper av unga vuxna som arbetar på olika frågeformulär. Dessutom intervjuades unga i arbete i en studie.

Avhandlingen visar att arbetsförmåga upplevdes som ett eget ansvar för unga som arbetar i åldern 25–30 år. Att vara pigg och ha energi, ha kunskap, färdigheter och arbetslivserfarenhet, och att uppleva en meningsfullhet och engagemang i arbetet var grundläggande för att ha arbetsförmåga. Dessutom kunde arbetsförmågan minska eller öka på grund av olika förhållanden i arbetet och i privatlivet. På liknande sätt kunde en förändrad kontroll i arbetet och en förändrad negativ påverkan på privatlivet på grund av krav i arbetet minska eller öka arbetsförmågan för unga i arbete, 21–25 år. Ett ökat socialt stöd på arbetsplatsen kunde också öka arbetsförmågan. Avhandlingen visar även att återhämtningsmöjligheter i arbetet kan ha ett samband med utmärkt arbetsförmåga för unga vuxna i åldern 18–29 år. Detta gällde dels för män med ett varierat arbete och dels för män med höga krav i arbetet som kan bestämma när de skall utföra en arbetsuppgift. För kvinnor med utmärkt arbetsförmåga tycks det vara en återhämtningsmöjlighet att kunna bestämma över sina arbetstider. Slutligen pekar avhandlingen på att långvariga symptom i armar och utbredda symptom i nacke och armar kan ge en generellt nedsatt prestationsförmåga på grund av smärta eller värk. Detta gällde för studenter i åldern 18–25 år i studier, arbete eller på fritiden.

Sammanfattningsvis kan arbetsförmåga upplevas som ett eget ansvar bland unga vuxna i arbete. Arbetsförmåga kan dessutom påverkas av olika förhållanden i arbetet, i privatlivet och av balansen mellan arbete och fritid. Att ha ett varierat arbete kan vara en återhämtningsmöjlighet i arbetet som kan ge utmärkt arbetsförmåga för män, medan utbredda eller långvariga symptom kan ge en prestationsnedsättning för unga studenter. Denna avhandling kan utgöra en grund för anpassade introduktionsutbildningar och mentorskap för att främja god arbetsförmåga hos unga vuxna.

LIST OF PAPERS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

I. Boström M, Dellve L, Thomée S, Hagberg M. Risk factors for generally reduced productivity - a prospective cohort study of young adults with neck or upper-extremity musculoskeletal symptoms. *Scand J Work Environ Health* 2008; 34(2): 120-132.

II. Boström M, Sluiter J, Hagberg M. Changes in work situation and work ability in young female and male workers. A prospective cohort study. *BMC Public Health* 2012, 12:694.

III. Boström M, Holmgren K, Sluiter J, Hagberg M, Grimby-Ekman A. Experiences of work ability in young workers - an exploratory interview study. *Int Arch Occup Environ Health* 2016;89(4):629-640.

IV. Boström M, Sluiter J, Hagberg M, Grimby-Ekman A. Opportunities for recovery at work and excellent work ability - a cross-sectional population study among young workers. *BMC Public Health* (2016) 16:985.

CONTENT

ABBREVIATIONS

AMM	Arbets- och miljömedicin (Occupational and Environmental Medicine)
BMI	Body mass index
CI	Confidence interval
H24	Health 24 (cohort)
ICT	Information and communication technology
Md	Median
PR	Prevalence ratio
SD	Standard deviation
SEK	Swedish crowns
STC	Systematic text condensation
USD	United States dollars
WAI	The work ability index
WAS	The work ability score
WAYA	Work Ability Young Adults (cohort)
WHO	World Health Organization

1 INTRODUCTION

Young adults are a group in society that needs special attention to ensure work ability in their transition from student life to working life. They may encounter high expectations from employers because they are young, alert, and newly educated; at the same time, they have little experience of work circumstances, which can create high demands and influence work ability. Young adults can expect to work for many years, and consequently, they need good work ability from the beginning of their working life (Ilmarinen 2009). In general, specific knowledge about the working life of young adults is sparse, though research with a life course approach has been highlighted (Ilmarinen 2006). Traditional occupational research has focused on middle-aged and older workers, to ensure this group will be able to work until retirement. But, studies of newly exposed workers as young adults can contribute new insights in occupational epidemiology (Checkoway et al. 2007), as they are not earlier exposed for occupational factors. Additionally, young adults' values concerning the meaning of work (Twenge 2010), and therefore, possibly also their views of work ability, can differ from those of earlier generations, motivating research specific to this group.

The thesis has its focus on young adults in the span of 18–30 years old, engaged in studies or employment. It takes its beginning in risk factors due to pain that have possible influence on general productivity among students (Paper I), and continues with changes in work factors that can alter work ability (Paper II), experiences of work ability (Paper III), and opportunities for recovery at work associated with excellent work ability (Paper IV), all among young workers. The thesis describes young adults in a Swedish context who are students or who are able to work.

1.1 Young adults

The definition of young adults varies in different settings, from 18 years old up to 35 years old in the context of work ability (Gould et al. 2008; Pohjonen 2001). The World Health Organization (WHO) has defined young adults as 20–24 years old, while the United Nations has expressed the closely related concept, youth, as 15–24 years old, showing an overlap. However, WHO has in recent years used the term young adults to mean 15–29 years old in reports (http://www.who.int/mediacentre/factsheets/fs344/en/). This is probably due to the proposed extension of the period of emergence from adolescence into adulthood (Arnett 2000; Trondman 2003). Young people consider themselves to be adult when they have an education and a job, and earn their own living

with a wage that makes them autonomous, according to Trondman, who has suggested that those up to 30 years old be defined as young adults. The period from the late teens through the twenties is a distinct period, emerging adulthood, during which change, instability, and exploration are common, according to Arnett. As marriage and parenthood today are delayed, it is not normative to settle into an adult role with responsibility during this period (Arnett 2000; Sacker and Cable 2010). Arnett asserted that to "emerging adults", "accepting responsibility for one´s self", "making independent decisions", and "becoming financially independent" are more important for their conceptions of what it means to reach adulthood than to have a home, to have finished school and started to work, and to have been in a love relationship for a long time.

1.1.1 Health in young adults

Young adults may face several health problems, more common among young women, and declining working conditions may be one explanation (Lager et al. 2012). Young workers 15–34 years old in the Nordic countries have been found to have poorer mental health but better musculoskeletal health than older workers (Hanvold et al. 2016). This is in line with a Swedish public health report from 2012 among 16- to 24-year-olds (Lager et al. 2012), where the authors claim that the health of this group has not shown the same improvements compared to other age groups since the 1990s. Although their musculoskeletal health seems to be better than that of older workers, development of musculoskeletal complaints in the neck and shoulder among young adults just entering their working life has been presented in Norwegian studies (Hanvold et al. 2014; Hanvold et al. 2015). This is in concordance with a European study where the 1-year prevalence of back pain and neck/upper limb pain among 16- to 25-year-old employees and self-employed persons was 35% and 34%, respectively (Farioli et al. 2014). In Sweden, 29% of the men and 44% of the women, respectively, aged 16–29 years, reported pain in the neck after work at least one day per week (Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2016). Furthermore, a Finnish study found that one fourth of 18- to 29-year-olds had a chronic illness (Gould et al. 2008). All these figures must be regarded as notable in such a young group. So, in spite of their young age, young workers seem to have significant health problems.

1.1.2 Changing work attitudes among young adults

There are reasons to believe that young adults value work in a different way compared to earlier generations. In a global view, young adults aged 16–29 years from 11 countries seem to want a working life with personal development

and fair bosses, in contrast to jobs with high status (Kairos future 2013). This is in agreement with the empirical overview, mentioned earlier, of 18-year-old students who value interesting and developing work higher than the wage (Trondman 2003), and is also consistent with findings among young adults born in the 1980s, who want to have fun at work and to enjoy good opportunities for development and safe employment as well as finding personal fulfillment (Parment 2008). Parment predicts that young adults born in the 1990s want flexibility, appreciation at work, and meaningful work. Conversely, meaningless work has been found among young office employees (Paulsen 2013), who end up devoting half of their time to "empty work" such as private tasks or breaks. Finally, according to the review mentioned in the first paragraph (Twenge 2010), it is recommended that employers focus on work–life balance and flexible schedules in the recruitment of young workers from the generation called GenMe, as this generation rates work as less central in their lives and value leisure more than earlier generations.

1.2 A changing work life

Working life has altered to a great extent during the last 30 years, both in employment and how work is organized. Theories suggesting that work and health have changed places have been presented (van der Klink et al. 2016). In the past, when work was the foundation, health was a state that people struggled to preserve despite the burden of work. Today, health is the resource, and employment and work are the state that people want to maintain, sometimes despite impaired health, according to van der Klink. Further, the transition to the labor market has become prolonged, fragmented, diversified, and less linear for young people compared to previous generations (Walther and Plug 2006). The labor market for the young workforce is now characterized by the reduced work security of flexible employment, with lower numbers of full-time job opportunities and more temporary positions (Lager et al. 2012; Statistics Sweden (SCB) 2015). For the "new precariat" of whom a majority are young people, working life is characterized by less security (Standing 2013), which can pose a threat to health comparable to that of unemployment (Kim and von dem Knesebeck 2015).

Similarly, work itself has changed. A growing individualism has been seen in society and in the working sphere (Gillberg 2010), with an increased individual responsibility for work. In earlier generations of workers, the goals and results of work were the responsibility of the employer; in contrast, today more people are forced to plan, perform, and take responsibility for their own actions at work, according to Gillberg. Also, somewhat alarmingly, Nordic young

workers in the age group of 15–24 years seem to be unaware of their rights as employees and the work environment responsibility of the employer (Kines et al. 2013) ,which can increase their own responsibility. Work has become more boundless, with opportunities for many people to work wherever and whenever (Allvin and Aronsson 2013; MacEachen et al. 2008); meanwhile, the Swedish laws and regulation of a healthy workplace have to be fulfilled of the employer (Swedish Work Environment Authority (Arbetsmiljöverket) 2015b). Nevertheless, in the knowledge-intensive work of today there can be expectations of working more hours than the regulations stipulate, and working at a distance, for example from home, can be a solution to managing everyday life (MacEachen et al. 2008), which has been questioned as a sustainable solution (Trygg 2014). Further, in a Swedish context, 16- to 29-year-old young workers report more physically demanding work than older workers 50–64 years of age (Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2014; Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2016) also confirmed in the other Nordic countries (Hanvold et al. 2016). Finally, increasing computerization in many occupations, with nearly 25% of the Swedish workforce using the computer "nearly all the time," according to the same report, has changed the work demands, not least the psychological and cognitive demands.

1.3 Work ability

Work ability is a complex and multidimensional concept. Historically, it has been used in relation to individuals described as (approximately): "The frail and others, who, having an insufficient work ability, are incapable of earning their living" (The Swedish Academy (Svenska Akademin) 1901). Nowadays the concept of work ability often includes individual physical, mental, and social resources, and several aspects of work, such as organization, management, tasks, environment, and physical and mental demands, all set in a context of the family and society (Ilmarinen 2009). Three dimensions of the concept have been found: physical, psychological, and social work ability (Ludvigsson et al. 2006). There is, however, no consensus of the definition of work ability in the scientific literature of this research field (Fadyl et al. 2010). "A balance between persons' resources and work demands" has in a report been found to be the most widespread definition of work ability in Europe, though in the context of fibromyalgia (Palstam 2012). Certainly, there are other definitions of work ability. Two definitions have been suggested, one referring to the ability to perform jobs needing special education or training and one relating to easier jobs that anyone can manage after a short introduction

(Tengland 2011). This double definition is not so well-known or widely used, and has also been questioned (Nordenfelt 2008). Nordenfelt has another definition of work ability: the ability to fulfill the tasks and reach the goals of the actual job, by a person who has the competence, qualifications, and health required. This researcher has also emphasized the importance of including in the aspect of work ability the willingness to perform a task. Further, work ability has been found to be perceived as "the ability to perform work tasks as requested" (Stigmar et al. 2012). Another way to interpret the concept work ability is as a continuum from work inability to excellent work ability (Lindberg 2006).

In addition to the different definitions of work ability, there are several similar concepts used in the research field. Work capacity has been used synonymously (Hensing et al. 2013; Lundh et al. 2014), and also capacity to work (Bertilsson et al. 2015). However, in searching for studies of work capacity, results often show studies in the field of work physiology. Probably this term is used due to its correct semantic meaning as work ability. Another concept, work functioning, can include not only individual and occupational factors but also work participation (Sandqvist and Henriksson 2004), respectively, the capacity to work, quality of work performance, and recovery from work (Boezeman et al. 2015). In sum, several definitions and similar concepts are used for work ability, which could obstruct its understanding and assessment. However, as it is a complex concept, this is inevitable. In this thesis the concept of work ability as the balance between individual resources and work demands (Ilmarinen 2009) was used, mainly due to its immense scientific spread and understanding, at least in a European context.

1.3.1 WAI and WAS

The work ability index (WAI) was developed in the 1980s in Finland by Kaija Tuomi and Juhani Ilmarinen (Tuomi et al. 1991). It has been translated into 30 languages, established, used, and spread, both in the scientific area and in workplace health prevention. From clinical assessments and statistical analyses, they developed an instrument with questions indicating the work ability of an employee. The WAI, validated in different settings (de Zwart et al. 2002; Radkiewicz 2005) is a self-report instrument entailing seven dimensions derived from ten items whereby the individual estimates the dimensions of his or her work ability (Ilmarinen et al. 1997). The WAI has been used with young workers from 16 years of age (Gould et al. 2008; Pohjonen 2001) and has been found consistent among young employees aged of 31 years (Kujala et al. 2006). Still, a need for evaluation of its use with workers of different ages has been emphasized by Torgén (Torgén 2005), who

has investigated an entire working population, while finding WAI to be a useful tool.

Use of the first question in the WAI, the work ability score, WAS, has been rather frequent in epidemiological research (Ahlstrom et al. 2010; Boschman et al. 2015; Boschman et al. 2014; de Croon et al. 2005; El Fassi et al. 2013; Gould et al. 2008); it has also been used in an adapted version for a group of physicians (Ruitenburg et al. 2012). This single item for scoring work ability measures "current work ability compared with the lifetime best" and consists of a scale ranging from 0 "cannot work at all right now" to 10 "my work ability is at its best right now." WAS has been validated towards the WAI in different populations, such as in a random sample of the Swedish working population (Torgén 2005), among the nursing profession (Radkiewicz 2005), women on long-time sick leave (Ahlstrom et al. 2010), a working population of 40- to 65-year-olds (El Fassi et al. 2013), and male construction workers (Roelen et al. 2014). Although WAS has not been validated specifically for young workers, it is considered to be an age-neutral item (Ilmarinen 2009).

The house of work ability

The model house of work ability (Fig. 1) illustrates the complexity of the concept (Gould et al. 2008). The first three levels include individual resources: health and functional capacity; knowledge and skills; and values, attitudes, and motivation. The fourth level of the house shows different aspects of work. The house of work ability is in close interaction with private life and society outside the house. The balcony on the third level demonstrates the close interaction between the values of work and the surroundings. The levels in the house have been found to be of different rank, where the first level is considered to be the most important (Gould et al. 2008; Ludvigsson et al. 2006), and the second and third levels have been found to be less significant for work ability that the first and the fourth levels (Ilmarinen et al. 2005). Yet, it has been stressed that in applying work ability in an organization all four floors should be considered (Hasselhorn 2008).

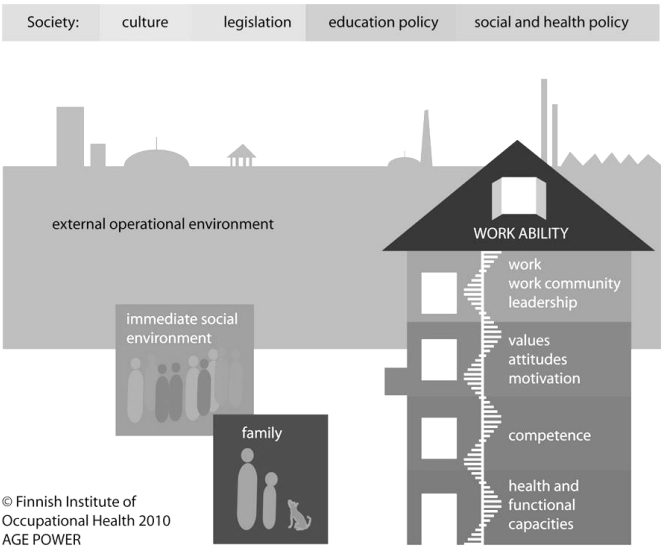

Figure 1. The house of work ability shows the balance between the individual resources (levels 1–3) and work (level 4) in the context of private life and society. (Finnish Institute of Occupational Health. Reprinted with permission from J Ilmarinen).

1.3.2 Determinants of work ability

Lack of leisure-time vigorous activity, poor musculoskeletal capacity, older age, obesity, high mental work demands, lack of autonomy, poor physical work environment, and high physical workload have been found to be associated with poor work ability as defined by the WAI (van den Berg et al. 2009), however, not specifically for young workers. The authors emphasize the multifactorial nature of work ability, including individual characteristics, lifestyle, work demands and physical work condition, important in health promotion interventions. Since this review, recent studies have found associations between poor work ability and frequent headache (Hedenrud et al. 2014) and common mental disorders (Boschman et al. 2014) among mostly adult workers. For young adults little is known in this field, shown in two cross-sectional studies. Health status, control, and ergonomic factors at work have been shown to predict the level of work ability in female home care workers aged 19–34 years (Pohjonen 2001). Further, poor basic education, high physical work demands, and mental strain at work have been found to relate to poor work ability for young adults 18–29 years old (Gould et al. 2008). In the same group, satisfaction with one's health, good perceived quality of life, good physical fitness, male gender, young age, and experiences of appreciation at work were shown to be the most important factors for experiencing excellent

work ability. To our knowledge, no new findings in this research area have been published specifically concerning young adults. Furthermore, no research on opportunities for recovery at work and work ability has been presented, either for young workers or for a working general population, to our knowledge.

1.4 Reduced productivity

A concept close to work ability is reduced productivity, although in a negative form. Reduced productivity can occur both before and after a period of sickness (Brouwer et al. 2002); it can be associated with high work demands such as computer use (Hagberg et al. 2002; Hagberg et al. 2007), and with psychosocial work factors (Alavinia et al. 2009), job strain, and physical loads at work (Martimo et al. 2009); it can cause a high, often hidden, cost (Collins et al. 2005; Goetzel et al. 2004; Loeppke et al. 2009). Synonymous terms for reduced productivity are productivity losses (Besen and Pransky 2014; Karlsson et al. 2010), productivity costs without absence (Koopmanschap et al. 2005), and lost work performance (Kessler et al. 2006). Further, the concept presenteeism (Burton et al. 2004; Schultz and Edington 2007) has been used in the same manner, and also as sickness presenteeism (Aronsson and Gustafsson 2005). All these different definitions illustrate the lack of consensus surrounding this term. In Paper I, the concept reduced productivity was chosen, as it had been utilized in earlier studies (Hagberg et al. 2002; Hagberg et al. 2007) and also validated by Hagberg in interviews with 50 students (unpublished data).

Despite the importance of valid measurements of reduced productivity, no instrument has been firmly established and validated (Mattke et al. 2007; Roy et al. 2011). Consequently, improvements in this research area have been suggested (Krol et al. 2013; Uegaki et al. 2011; Zhang et al. 2011). Established associations between musculoskeletal disorders and reduced productivity are sparse despite clear evidence of associations between arthritis and presenteeism (Schultz and Edington 2007). Still, some separate studies have shown associations between musculoskeletal pain and productivity loss (Bielecky et al. 2015; Hagberg et al. 2002; Hagberg et al. 2007; Lindegård et al. 2014; McDonald et al. 2011; van den Heuvel et al. 2007), however, not specific to young adults. For university students, depression has been shown to influence academic performance (Hysenbegasi et al. 2005), and an inequality in health-related performance between male and female college and university students has been found (Eriksson et al. 2007). Finally, in Japan, a presenteeism scale for college students has been presented (Matsushita et al.

2011). In sum, reduced productivity seems to be quite unexplored among young adults.

1.4.1 Productivity in relation to work ability

There is no consensus in the literature as to how productivity relates to work ability and no studies, to my knowledge, solely of young adults in this topic, as few studies have examined these concepts together. In a study from the Netherlands among 18- to 68-year-olds (van den Berg et al. 2011), job control was found to buffer the loss of productivity at work among workers with decreased work ability, however, no explicitly for young workers. Furthermore, chronic health problems have been shown to be associated with decreased work ability, but to a much lower extent to lower productivity at work, still among older employees (Leijten et al. 2014).

1.5 Gender aspects

In the horizontal segregation of the labor market men and women are found in different trades and occupations, with small changes during the last 30 years (Statistics Sweden (SCB) 2014). Of all women working in Sweden, 72% are in occupations dominated by women, and 68% of men are in male-dominated occupations. Many women are to be found in health care, education, social services, and administration, while men are more often occupied in sales, computer programming, transport, stocks, manufacturing, construction, and repair work. This segregation is also valid for young workers. Additionally, in the vertical segregation men have higher wages than women (Statistics Sweden (SCB) 2014), which is even obvious for young workers, despite having few years in the labor market.

Young women 16–29 years of age have reported poorer health, more bodily exhaustion after work, and more repetitive work tasks compared to young men over two years (Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2014; Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2016); meanwhile, young men reported more physically strenuous work and awkward postures during the same period. However, work tasks performed by women have been shown to be valued lower compared to work tasks performed by men, making prevention less important, which emphasizes the gender perspective in systematic work management (Swedish Work Environment Authority (Arbetsmiljöverket) 2015a). The Swedish Work Environment Authority stated in its report that the existing gender pattern of the male norm in society is also found in working life, which may be an explanation. The segregated labor market with different

work tasks and contexts for men and women can be another explanation for the difference in work-related health. Several independent steps have been presented to try to explain inequalities in work-related health (Lewis and Mathiassen 2013). Most important is the previously described segregated labor, but even when women and men have the same occupation, they may perform different work tasks, possibly related to attitudes of the employer and gender roles in the occupation (Abrahamsson 2009). This corresponds to a finding of gendered organization in job rotation among adult employees, resulting in more varied works for men (Johansson 2015).

No large variation has been seen among young women and men in the assessment of work ability level, but young men have been reported to have excellent work ability more often than young women (Seitsamo et al. 2008). This corresponds with a Swedish context among those 16–29 years of age, where 64% of the men assessed their work ability in 2015 as 9–10 on the WAS compared to 57% of the young women (Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2016). This is a decline compared to 2013 with corresponding numbers of 73% respectively 67%. (Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2014). Whether this possible higher valuation among young men can be detected in the working life or is a measure of self-confidence is unknown.

1.6 Working life research and models

In occupational health research the influence of physical environment on health has been in focus for many years. Traditionally, the physical load in manual handling, including lifting, strenuous work postures, and repetitive movements has been studied (Hagberg 1984; Kuorinka et al. 1995; Palmer and Smedley 2007; van Rijn et al. 2009; van Rijn et al. 2010). During the 1990s working life became more computerized, and computer use started to be observed as a risk for musculoskeletal disorders due to static low strain, as stated in several reviews (Andersen et al. 2011; Bongers et al. 2002; IJmker et al. 2007; Swedish Council on Health Technology Assessment and Assessment of Social Services (SBU - Statens Beredning for medicinsk utvärdering) 2012; Wahlström 2005); however, the evidence for a causal relationship remains limited (Andersen et al. 2011; Wærsted et al. 2010). The psychosocial work environment has begun to be of greater interest during the last decades, possibly affecting cardiovascular, mental, and musculoskeletal health. This is shown in several reviews with a focus on psychological health (Westerholm 2008); depression and burnout syndrome (Swedish Council on Health

Technology Assessment and Assessment of Social Services (SBU - Statens beredning för medicinsk utvärdering) 2014); heart disease (Swedish Council on Health Technology Assessment and Assessment of Social Services (SBU - Statens beredning för medicinsk och social utvärdering) 2015); and neck, shoulder, arm, and back pain (Swedish Council on Health Technology Assessment and Assessment of Social Services (SBU - Statens Beredning for medicinsk utvärdering) 2012; Swedish Council on Health Technology Assessment and Assessment of Social Services (SBU - Statens Beredning for medicinsk utvärdering) 2014; van Rijn et al. 2009; van Rijn et al. 2010).

Two models have been developed and are well used in this area. First, the well-established and validated job demand–control model (Karasek Jr 1979; Karasek and Theorell 1990) measures the joint effect of the level of job demands and job control, to which the effect of social support has also later been included (Johnson and Hall 1988). In this model job strain (high job demands and low job control) was found to be associated with occupational ill health. Second, the effort–reward imbalance model (Siegrist 1996; Siegrist et al. 2004) has played a large role in understanding occupational health. In this model the imbalance between the effort (job demands such as workload, time pressure, and overtime) and the reward (salary, esteem, and career opportunities) has shown to be associated with cardiovascular heart disease and mental ill health. Both these models have helped occupational researchers and practitioners to understand the complexity of the psychosocial work environment. Additionally, different reviews have shown that opportunities for recovery at work, such as offered by flexible schedules (Baltes et al. 1999), rest breaks (Tucker 2003), and work-time control (Nijp et al. 2012), can be related to performance and productivity, regardless of the effect on health (van Veldhoven and Sluiter 2009).

1.7 Thesis rationale

Young adults on their way from student life to working life have little work experience and can encounter high demands at work, which can influence work ability. Likewise, they have a long working life ahead, motivating a sustainable work ability. Further, possible changing attitudes to work have also to be taken into consideration. Consequently, young workers can define work ability differently from adult workers, which increases the importance of research studies involving solely this group. There is today an obvious gap in knowledge of work ability and productivity in young adults. They are included in many research studies of these topics but have not been investigated as a specific subgroup, which make it difficult to draw any conclusions about this

group alone. The studies included in this thesis were designed to increase the understanding of work ability and productivity specifically of young adults.

The separate studies are connected to work ability in different ways, which is shown in Figure 2, where a model of Ilmarinen and Liukkonen is used (Ilmarinen 2001). In this model, health, education and competence, human resources, and work can all together influence work ability, which is closely related to the organization and its economy. Paper I is related to health and work (in terms of studies) and leisure (not shown in the model) and reduced productivity, which is linked to the economy in the original model. Papers II and IV are connected to both work and work ability in this model, while work ability is explored in Paper III.

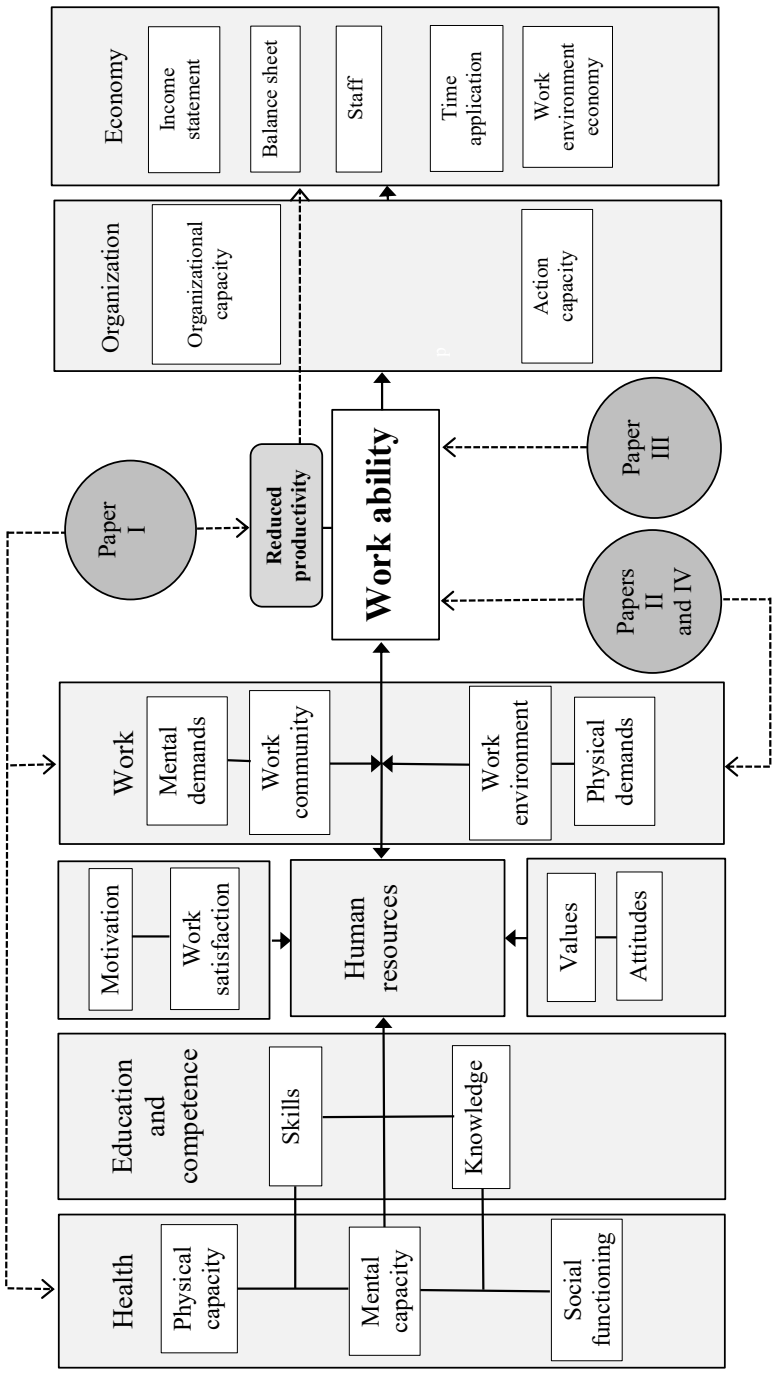

Figure 2. The thesis linked to a model of work ability, partly published (Ilmarien J, Occup Environ Med 2001 58(8):546), extended and used in lectures by Ilmarien J and Liukkonen P. Reprinted with permission from J Ilmarinen.

2 AIM

The overall aim of this thesis is to understand work ability in young adults.

The specific aims of the individual papers (Papers I–IV) were:

- To prospectively assess individual conditions (including lifestyle and symptoms) and computer use during school or work and leisure time as possible risk factors for self-reported generally reduced productivity due to musculoskeletal complaints among young adults with musculoskeletal symptoms from the upper back or neck or shoulders or arms (Paper I).
- To assess whether a change in self-reported work factors over time was associated with self-reported work ability among young workers (Paper II).
- To explore the experiences of and influences on work ability in young workers related to their work and life situation (Paper III).
- To investigate the association between opportunities for recovery at work and excellent work ability among young workers, especially for young workers with high work demands (Paper IV).

3 MATERIALS AND METHODS

Generally reduced productive and work ability among young adults were assessed by quantitative methods (Papers I, II, and IV), and work ability was also explored by a qualitative method (Paper III). An overview of these studies can be seen in Table 1. Different measurements were used for the outcomes. Generally reduced productivity was indicated by answering yes on a question about whether pain or ache in muscles or joints had affected the general productivity during the preceding month. A change in work ability was measured as a decrease or increase of two or more score levels on the WAS. Experiences of work ability were explored through interviews. Finally, a rank of 10 on the WAS was considered as excellent work ability.

Table 1. Overview of the study designs, data collections, study samples, and outcomes.

Paper	Study design	Data collection	Study sample	N	Age, years	Outcome
I	Prospective cohort study	Web-based questionnaire	Students	1051	18–25	Generally reduced productivity due to pain/ache
II	Cohort study with a longitudinal design	Postal and web-based questionnaire	Young workers	1311	21–25	Changed work ability over a year
III	Explorative interview study	Semi-structured interviews	Young workers	24	25–30	Experiences of work ability
IV	Cross-sectional population study	Register-based data; telephone interview and questionnaire	Young workers	2351	18–29	Excellent work ability

3.1 Study design and study sampling

3.1.1 The H24 cohort

The baseline and the 1-, 2-, and the 3-year follows-ups in this cohort were used for Paper I. The cohort was the basis for a prospective cohort study called Productivity, Health, and Creativity in Relation to the Use of Computers,

Telecommunication and Media – a 10-Year Cohort Study. The methodology of the baseline questionnaire (Herloff et al. 2003) and the follow-ups (Eriksson et al. 2005) have been described. The aim of the H24 cohort was to follow young students into their working life to identify risk and health effects of information and communication technology (ICT) use. The name of the cohort was later changed to H24 cohort, as the purpose was to recruit young adults up to 24 years old. However, 25 years of age ended up being the upper limit for the study group.

The questionnaire with 45 items was formulated from earlier questionnaires used in different research projects in Sweden, 1990–2001. Several of these projects, such as Epimus, MOA, and QPS Nordic, have been described in detail (Dallner et al. 2000; Hagman et al. 2001) and also validated (Härenstam et al. 1999; Härenstam et al. 2000). In the construction of the questionnaire by a large group of employees at Occupational and Environmental Medicine (AMM), Gothenburg University, several pilot studies were performed. First, after testing by three people employed at AMM, wording was changed. Second, an interview study was performed with 25 young students, 18–24 years old, who had completed the questionnaire. These were recruited by advertising in vocational schools, colleges, and universities. The aim of this pilot study was to obtain a deeper understanding of the concepts and attitudes among young adults in relation to their experiences of ICT use (Gustafsson et al. 2003). Third, a pilot study with eight young adults, 18–26 years old, relatives of employees at AMM, was performed to test the web version of the questionnaire, to assess the time needed to complete it, and to get feedback on the questions. Finally, the questionnaire underwent a validation by Statistics Sweden, resulting in better comprehensibility as a result of changes and streamlining. The baseline web-based questionnaire was first distributed in 2002 to the recruited group and also in 2004 to a newly recruited group, in each case with four reminders. These two recruitments together formed the baseline of the cohort. The 1-year follow-ups to the web version were therefore sent out in 2003 and 2005, respectively, with two reminders. At the time for the start of Paper I the first recruited group had also been followed up in 2004 (2-year follow-up) and 2005 (3-year follow-up), and the newly recruited group had been followed up in 2005 (1-year follow-up).

The young group of 18- to 25-year-old students was selected because they were, on the whole, unexposed to work. The total source population at baseline entailed 5786 college/university students and vocational school students recruited through enrollment lists from schools. Students with experiences of ICT use were selected in the first recruitment from medical schools in Göteborg, Lund, and Linköping, and from different information technology

programs at Gothenburg University, Chalmers University of Technology in Göteborg, and colleges in Borås and Skövde. In contrast, students from vocational schools such as engineering, motor mechanical, and health care were selected mainly from schools in the Västra Götaland County, Sweden. The new recruitment of students in 2004 was solely from universities or colleges: medical studies, information technology studies, and nursing studies. In total, 2914 individuals answered the questionnaire, a 50% response rate. However, the response rate at baseline differed between college/university and vocational school students. For students in information technology studies the response rate was 68%, in medical studies 71%, and in nursing studies 58%, in contrast to engineering including motor mechanical studies with 15%, and health care studies with a 27% response rate. In total the response rate was 87% for the 1-year follow-up and 75% for the first recruited group in the 2-year follow-up.

3.1.2 The WAYA cohort

This cohort with its baseline and 1-year follow-up was used for Paper II. For Paper III, the 5-year follow-up was used. The WAYA (Work Ability Young Adults) cohort was a prospective population study of young adults in Sweden created in 2007 (Ekman et al. 2008), with follow-ups in 2008 and 2012–13. The aim was to generate a cohort of young adults 20–24 years old, to be followed for 10 years, with the possibility of identifying factors important for good health and good physical and mental work ability. The aim was also to study systems that may be capable of changing the influences of the environment on the working life, with a focus on ICT use. A questionnaire with 78 items was used for the data collection. It was designed by an extensive research group at AMM, Gothenburg University. The questionnaire contained both validated and specific, newly designed questions concerning health, work, environmental factors, and work ability. First, four employees at AMM tested and developed both the postal and the web versions. This was followed by two pilot studies. The first concerned an arbitrary sample of 36 young adults, resulting in clearer formulation of questions. The second pilot study, including 31 young adults from a randomized group of 100 young adults, aimed to test reliability using two similar questionnaires with 11–20 days between administrations. This resulted in a change of the number of answer alternatives in some questions. Finally, Statistics Sweden performed an expert validation of the questionnaire.

The Swedish Tax Agency made a randomized selection of 20 000 youth born 1983–87, 10 000 women and 10 000 men, from the general population. Half of the women and men lived in the Västra Götaland county and the other in the

rest of Sweden. The questionnaire at baseline was sent via post to the selected sample. There was an option to either answer the pencil-and-paper questionnaire or respond to the questionnaire via the web. Those who had reported an interest in participating in following studies were invited after one year to complete an identical questionnaire, available only on the web. A lottery ticket valued at 10 SEK was used as compensation, included in each cover letter, which could be used whether participating or not. For the first questionnaire, two reminders were sent out by post, and in the second, three reminders were used, including a paper version of the questionnaire and two cinema tickets in the last reminder. At baseline 7125 (36%) individuals answered the questionnaire. Of these, 5734 (80%) wanted to be contacted again for continuing participation in the study. Further, of these, 4163 (73%) answered the questionnaire at 1-year follow-up. At the 5-year follow-up the response rate was 66% and included 2738 individuals.

3.1.3 The Work Environment Survey

For Paper IV, three different years of the Work Environment Survey were used. This survey has been conducted every second year since 1989 among a randomized large sample in Sweden, by Statistics Sweden on behalf of the Swedish Work Environment Authority. The aim of this survey is to describe the work environment of the employed population in the ages of 16–64 years. For each of the years 2009, 2011, and 2013 the randomized selected sample was about 10 000–16 000, of whom approximately 8100–12 400 answered the telephone interview and about 4800–7800 also answered the postal questionnaire. The survey consists of two parts: 24 additional questions at the end of a telephone interview and a questionnaire with 121 items. The telephone interview is performed for another survey, the Labour Force Survey, by the same authority and includes questions of comprehensive work environment and work ability. The questionnaire consists of detailed questions about work environment conditions, both physical and psychosocial, and attempts to provide an objective description of the work environment. The development and the validation of the method in both these surveys is well-described (Wikman 1991), and has also been developed further.

3.1.4 Paper I

This study was a prospective cohort study with a 1-year follow-up. However, initially, cross-sectional analyses were performed to describe baseline data and to show possible risk factors to be tested in the prospective analysis. A selection of young students with musculoskeletal pain or ache, 18–25 years old, was done from 2914 respondents. The response frequency at the baseline was 68%–75% for the college or university students and 15%–27% for the

vocational school students, due to the different study programs. In spite of this low response rate, the vocational school students were retained, as the aim was to obtain as large a study sample as possible, rather than comparing the different groups of students. The selection of the study group was made in several steps (Fig. 3). From the baseline, 684 students (200 + 484 students) were chosen. Additionally, 286 students (59 + 227 students) were chosen who had not reported pain at baseline but at the 1-year follow-up. Finally, a further 81 students (21 + 60 students) were chosen who had not reported pain at baseline or 1-year follow-up but at the 2-year follow-up. Altogether, N = 1051 were merged to create a new baseline for this study, and each participant was followed for 1 year. This was possible, as there also was a 3-year follow-up of the cohort. The inclusion criterion for the study sample was either current pain or ache in the upper back or neck; current pain or ache in the shoulders, arms, wrists, or hands; or current numbness or a tingling sensation in hand or fingers for ≥1 day. In the study group 80% were college or university students and 20% were vocational school students at baseline. At baseline 280 students reported generally reduced productivity due to pain or ache during the last month and were excluded from further analysis. The rest, 771 students, were followed for 1 year. At the 1-year follow-up 65 students reported generally reduced productivity due to musculoskeletal pain or ache, 518 did not, and the rest, 188 students, did not complete the questionnaire at the 1-year follow-up; response frequency was 76%. The 65 students were the cases, as they were defined from the inclusion criteria of having reported symptoms and had reported generally reduced productivity due to musculoskeletal pain or ache.

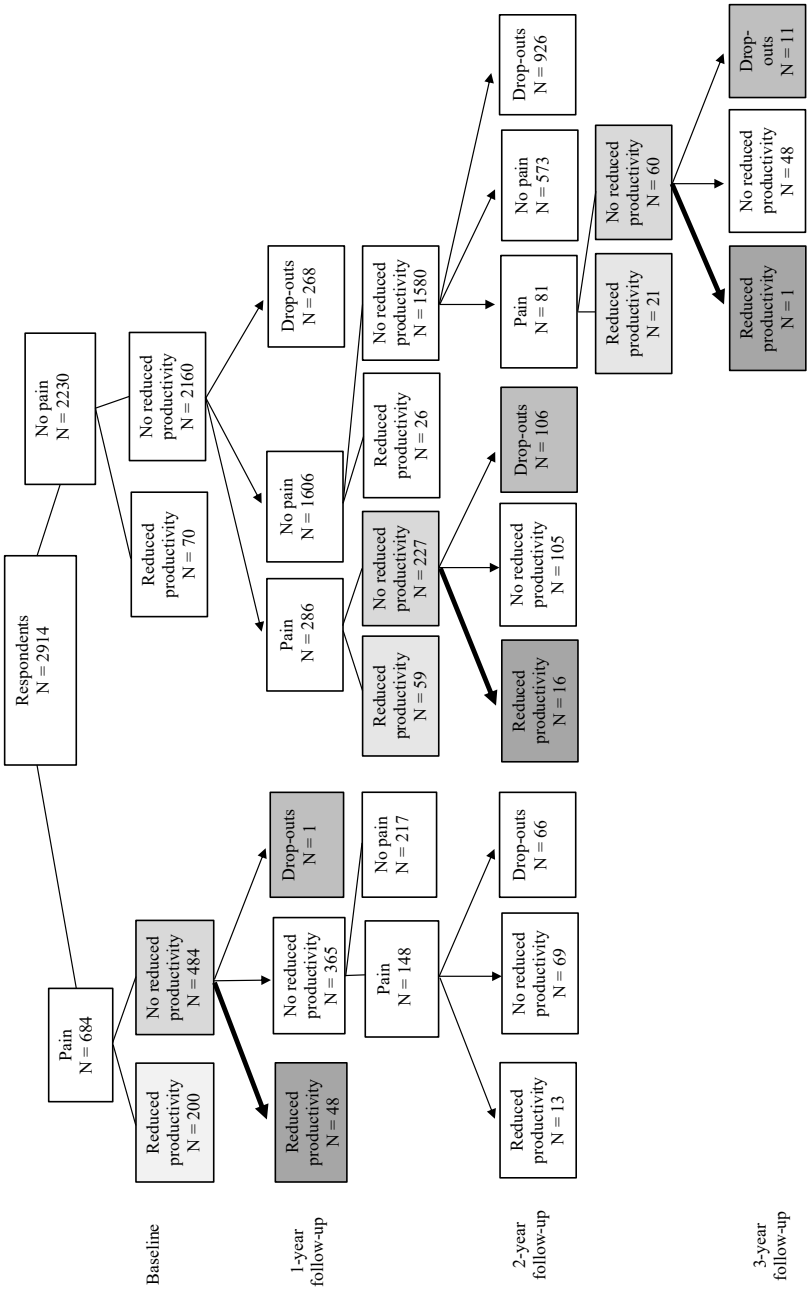

Figure 3. Sample selection for Paper I was performed from the baseline, the 1-year follow-up, and the 2-year follow-up.

3.1.5 Paper II

This study was a cohort study with a longitudinal design, using the WAYA cohort. The study sample consisted of 1311 young workers, derived from 4163 respondents at the 1-year follow-up (Fig. 4), 718 women and 593 men, aged 21–25 years. The inclusion criteria for this group were (i) had answered the WAS and (ii) were in salaried work, having both conditions fulfilled at the baseline and at the 1-year follow-up. Consequently, 1745 students were excluded. Furthermore, individuals on long-term sick leave/sickness benefit, on leave of absence/parental leave, or in search of work/in labor market measures (N = 121) were excluded. Also, 58 individuals were missing, and 352 were workers at baseline but not at the 1-year follow-up, and not included in the study sample. When forming the study sample from baseline to the 1-year follow-up, there was a drop-out of 1490 workers from the group of 1571 individuals and also a drop-out of 10 workers from the group of 576 individuals, in total 1500 workers, who were analyzed.

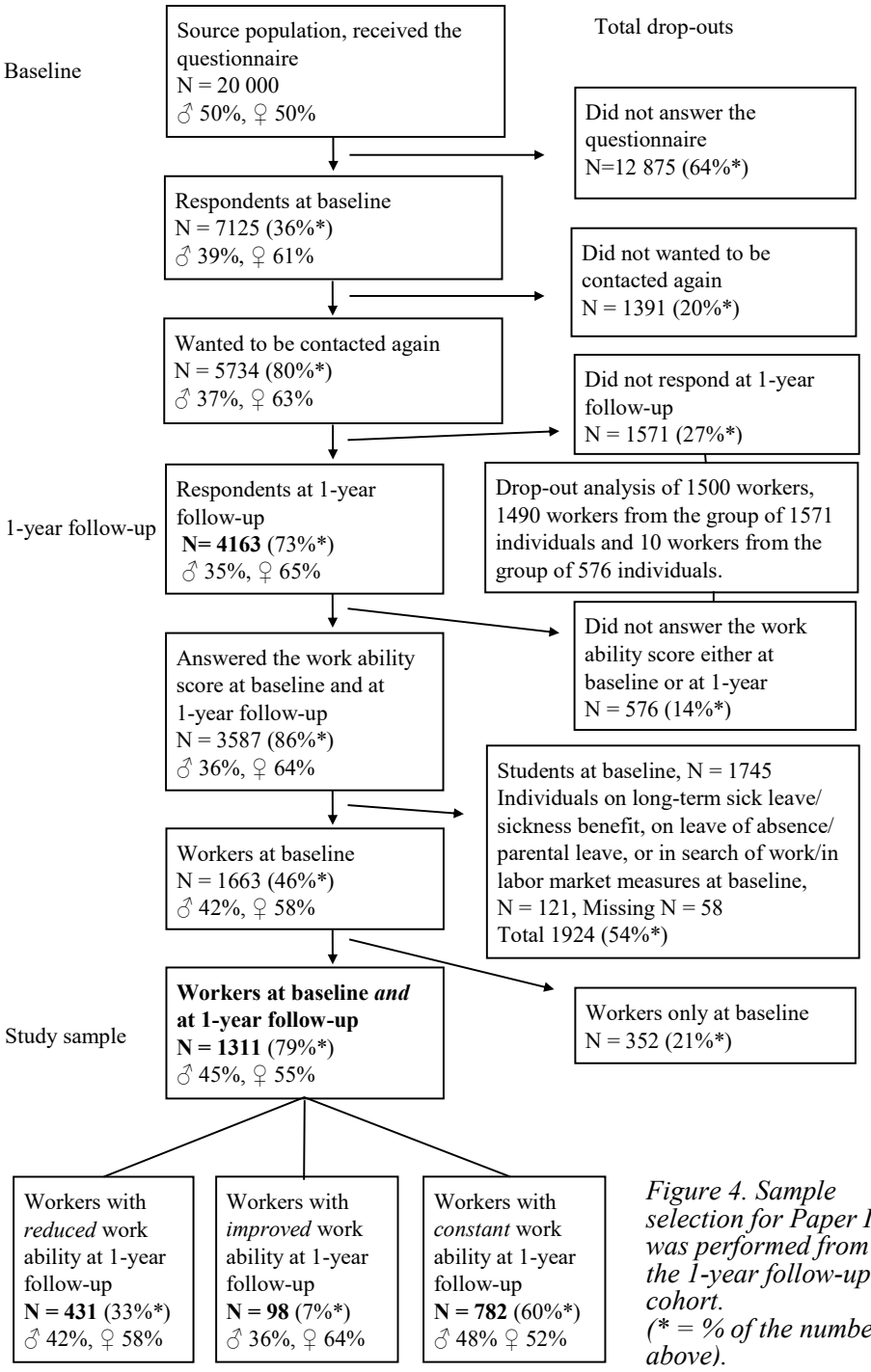

Figure 4. Sample selection for Paper II was performed from the 1-year follow-up cohort. (= % of the number above).*

3.1.6 Paper III

This study was an explorative interview study. The study group of 24 workers, 12 female and 12 male workers, aged 25–30 years, was selected in a strategic manner (Fig. 5). From the 5-year follow-up of the WAYA cohort a group was selected from three criteria: (i) living in the Västra Götaland County, (ii) in ongoing work or having recently left work, and (iii) having reported poor or excellent work ability, making a sample of 265 individuals. From this group, eight subgroups were constructed that differed by sex, work ability level, and education level. This selection method was chosen because a large variation in the study group is preferable in obtaining a sufficient variety of experiences (Malterud 2001). The two education levels were nine years of school or high school, and college or university. Work ability was measured by the WAS. Excellent work ability was defined as 10 on this 0- to 10-point scale, and poor work ability as ≤ 5. However, for two subgroups, due to having few individuals, the limit had to be changed to ≤ 6. The predetermined criteria of poor work ability could therefore not be reached, but is still in agreement with the definition of poor or moderate work ability (Gould et al. 2008). A total of 20–25 interviews was considered to be sufficient to obtain rich data (Dahlberg et al. 2008), but due to having eight subgroups, it was decided to conduct 24 interviews. These 24 young workers were randomly selected, three from each subgroup. An invitation letter was sent out, followed by an inquiry by telephone. If anyone declined participation or did not appear at the interview, additional participants were invited in the same way. In total, 64 letters were sent out and one to three telephone calls were performed per individual. In the telephone invitation, 24 individuals could not be reached, and 13 individuals did not want to participate due to lack of interest or time. In total, 27 individuals had to be contacted during a period of several months, as three of them did not show up to the interview, resulting in the predetermined number of 24 individuals who completed the interview.

Theoretical framework

The theoretical framework in this study was phenomenology, a philosophy used in science (Giorgi 2009). In phenomenology, objects—phenomena—are explored, presenting themselves to consciousness, according to Malterud (Malterud 2012), influenced by Giorgi (2009). To look at objects, the way they are experienced by humans in a conscious way, and to understand and describe these experiences, is central in phenomenology, according to Malterud. One way to understand humans is to explore the meanings of their experiences in daily life, which can be discovered, analyzed, clarified, understood, and described in science (Dahlberg et al. 2008). To reach this understanding, an

open mind is essential, not presuming to know the answer in advance. Bridling, a way for an individual to hold back what he or she believes is true and takes for granted, according to these authors, can be one strategy, as a bracketing of presuppositions can be difficult. Systematic text condensation (STC) has its origin in the descriptive phenomenological method by Giorgi (2009), but is elaborated in a pragmatic way by Malterud (2012). STC is a descriptive approach to the experiences of a phenomenon as described by the participants themselves, rather than an exploration of the possible underlying meaning of what was said, according to this author. This was applied in the current paper with results close to the raw data.

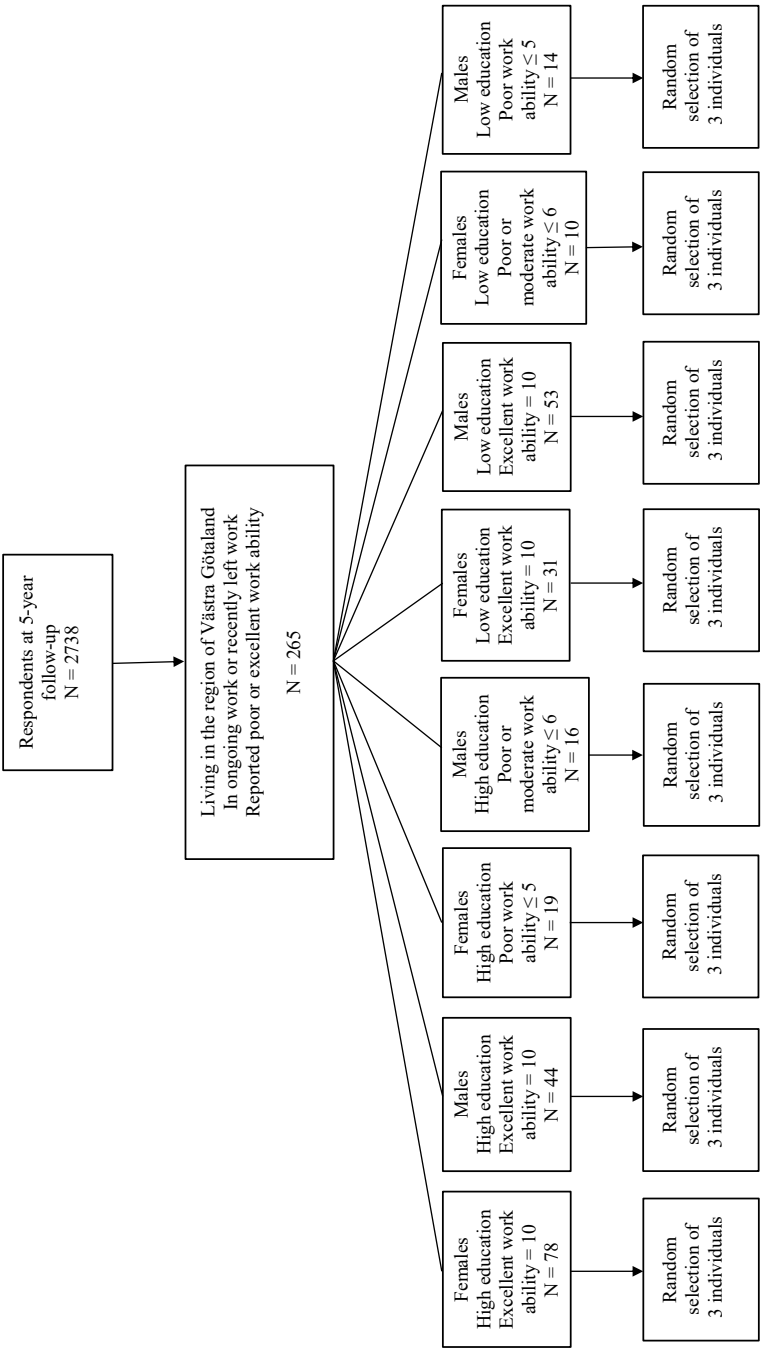

Figure 5. The sample selection for Paper III was performed from eight subgroups from the group which met the inclusion criteria.

3.1.7 Paper IV

This study was a cross-sectional population study, based on register data from The Work Environment Survey. Three surveys were used: 2009, 2011, and 2013, to obtain a large group to increase the power in the statistical analyses. There was no overlap of individuals in these years. For each of these years the randomized sample of 16- to 64-year-olds was in total about 10 000–16 000; approximately 8100–12 400 responded to the telephone interview, and about 4800–7800 also responded to the questionnaire. From a total group of 4949 individuals aged 18–29 years old who met the criterion of having answered the entire telephone interview, a study sample of 2351 individuals, 1295 women and 1056 men, was selected (Fig. 6). This group had responded to the questionnaire and also to the WAS, the other criterion, in the telephone interview. A subsample of young workers experiencing high work demands was chosen, with the criteria of having physically strenuous work to a large extent and/or having a high workload with quite too much to do to a large extent, ending up with 788 individuals, 439 women and 349 men. The selection of this subsample was chosen, as women and men with high work demands could have an increased need of opportunities for recovery at work (Geurts and Sonnentag 2006).

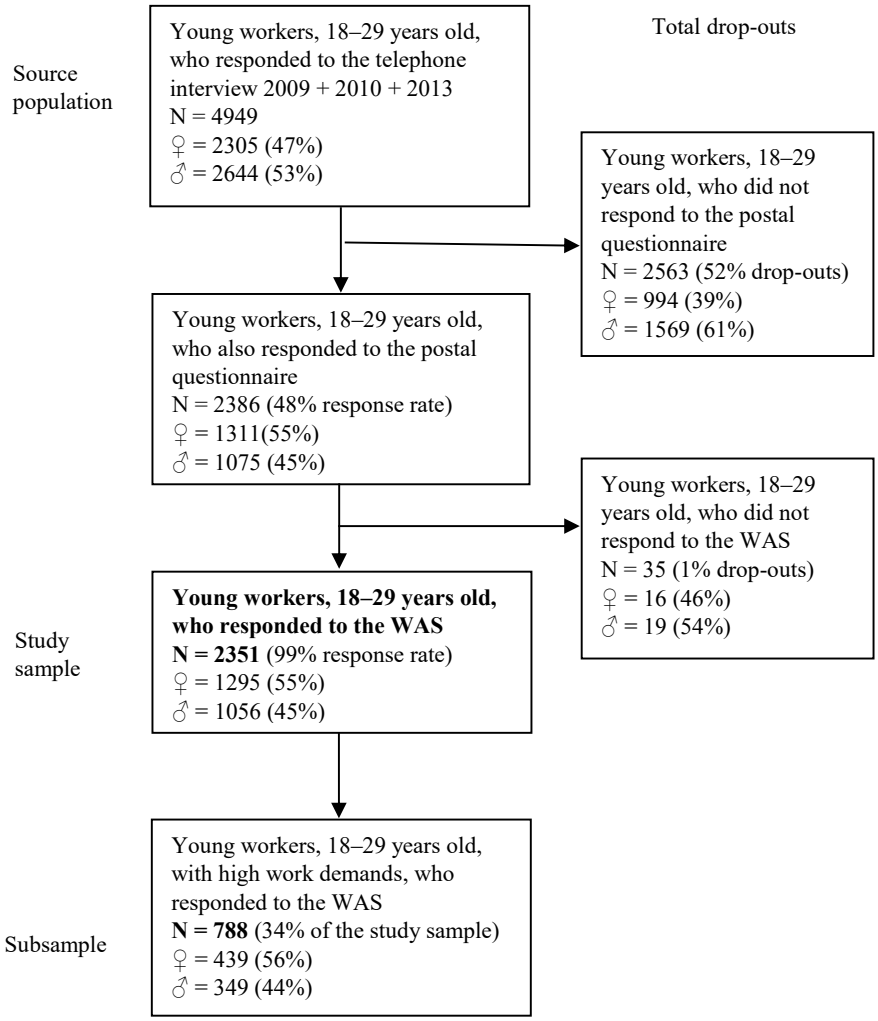

Figure 6. The study sample in Paper IV included workers who answered the telephone interview, the postal questionnaire, and also the work ability question ranked according to the work ability score, WAS.

3.2 Data collection

3.2.1 Outcome variables

The outcome variables differed between the three quantitative papers. In Paper I generally reduced productivity was the outcome and was measured by the single-item question:

> *Has pain or ache in muscles or joints affected your general productivity during the last 30 days?*

Also, the amount of generally reduced productivity, for descriptive purposes, was measured by asking:

> *If your productivity has decreased, please state how much in percentage compared to when you have no symptoms.*

These two items have been used and qualitatively validated among a group of 50 computer users (not published) and also tested among 16 young adults (not published) and found to be valid.

For Papers II and III, work ability was assessed by the WAS, which measures "current work ability compared with the lifetime best" and consists of a scale ranging from 0 "cannot work at all right now" to 10 "my work ability is at its best right now":

> *We assume that your work ability when it was as its best values with 10 points. Which point would you give your present work ability?*

In Paper II the WAS variable was used as a change in self-reported work ability. A real change in the WAS was defined as a decrease or increase of two or more score levels on WAS, based on a test/retest study of 29 young adults (Ekman et al. 2008). In this study the smallest detectable change of the WAS was calculated as 1.9. Excellent work ability measured by WAS = 10 was the outcome in Paper IV. However, in the telephone interview by Statistics Sweden a scale of 1–10 was used, due to a misunderstanding. As WAS = 10 was the outcome, and the variable was dichotomized, this fault probably did not influence the analyses.

3.2.2 Explanatory variables for Papers I, II, and IV

Individual, lifestyle, and symptoms variables were used in Paper I as explanatory variables that could influence productivity, due to pain or ache (Table 2). Further, several physical work variables were used in Papers I and II (Table 3), and numerous psychosocial work variables and recovery opportunity variables were used in Papers I, II, and IV (Table 4), which possibly explain the outcome. Some of the single-item psychosocial questions were derived from the job demand–control model (Karasek and Theorell 1990) (job demands, job control, support at work) and also from the effort–reward model (Siegrist et al. 2004). The explanatory variables were divided into two or three levels in Paper I, in contrast to Paper II, where an explanatory variable was used as a change between the answer alternatives. This change was defined as one or more steps among the three to five response alternatives between baseline and the 1-year follow-up. This simplified way to measure a change was chosen, although other methods of interpreting scales exist (Svensson 2003). The decision to use one step or more was based on the test/retest ((Ekman 2008), where the numbers of answer alternatives were changed from five to four for some questions to increase their reliability.

In Paper IV the explanatory variables about flextime and possibilities to take breaks were in line with questions in the recovery opportunity scale (van Veldhoven and Sluiter 2009). The variable "varied work" was selected, as it can contribute to increased possibilities of taking breaks (Geurts and Sonnentag 2006). According to Geurts and Sonnentag, varied work can also increase the possibilities for deciding the work pace, motivating inclusion of that variable. Finally, the possibility of deciding when to perform a work task was selected as being closely related to work pace, though included in the concept of work-time control (Geurts and Sonnentag 2006). All these variables were dichotomized either in a logical way or following the use of Statistics Sweden.

Table 2. Descriptions of individual, lifestyle and symptoms variable used in Paper I.

Concept	Description
Civil status	Civil status: cohabiting or married (low exposure) and single (high exposure)
BMI	Body mass index : < 25 kg/m² (low exposure) and ≥ 25 kg/m² (high exposure)
Breakfast habits	Eating breakfast/week: 0-7 times/week; 3-7 times/week (low exposure) and 0-2 times/week (high exposure)
Smoking	Daily or nearly daily smoking last week: no (low exposure) and yes (high exposure)
Snuff use	Daily or nearly daily snuff use last week: no (low exposure) and yes (high exposure)
Alcohol consumption	Being total abstainer (never drinking alcoholic): yes (low exposure) and no (high exposure)
Physical activity in leisure time	Time dedicated to exercise/training last week, assessed number of hours: > 4 hours/week (low exposure), 2-4 hours/week (moderate exposure) and < 2 hours/week (high exposure)
Current pain or ache in upper back or neck	Current pain or ache in upper back or neck: no (low exposure) and yes (high exposure)
Current pain or ache in shoulders, arms, wrists or hands	Current pain or ache in shoulders, arms, wrists or hands: no (low exposure) and yes (high exposure)
Current numbness or tingling sensation in hands or fingers	Current numbness or tingling sensation in hands or fingers: no (low exposure) and yes (high exposure)
Current symptom location or dimension	Merger of the three questions of current symptoms, divided into one (low exposure), two (moderate exposure) or three locations or dimensions (high exposure), more than one location or dimension= widespread symptoms
Duration of pain or ache in upper back or neck	Integrated question to current pain or ache in upper back or neck, assessment of days, months and years: 1-30 days (low exposure), 31-90 days (moderate exposure) and > 90 days (high exposure)
Duration of pain or ache in shoulders, arms, wrists or hands	Integrated question to current pain or ache in shoulders, arms, wrists or hands, assessment of days, months and years: 1-30 days (low exposure), 31-90 days (moderate exposure) and > 90 days (high exposure)
Duration of numbness or tingling sensation in hands or fingers	Integrated question to current numbness or tingling sensation in hands or fingers, assessment of days, months and years: 1-30 days (low exposure), 31-90 days (moderate exposure) and > 90 days (high exposure)

Concept	Description
Symptoms of depression last month	1) Little interest or pleasure in doing things last month: yes, or no, 2) Feeling low, depressed or hopeless last month: yes, or no. Neither of these two variables (low exposure), one variable (moderate exposure) and both variables (high exposure)
Difficulties falling asleep last half year	Difficulties falling asleep last half year: (i) never, or (ii) once or a few times a year (low exposure), (iii) once or a few times a month (moderate exposure), and (iiii) several times/week or (iiiii) daily (high exposure)
Current stress	A condition of tenseness, restlessness, or worry or having difficulties sleeping at night due to problem fixation: (i) not at all or (ii) slight (low exposure), (iii) responding to some extent (moderate, exposure) and (iiii) rather much or (iiiii) very much (high exposure).

Table 3. Descriptions of physical work variables used in Papers I and II.

Concept	Description	Paper			
		I	II	III	IV
Total computer use last week	Total time of computer use in school, work or leisure time last week assessed by hours and minutes, then divided into:1–9 hours/week (low exposure), 10–29 hours/week (moderate exposure), and ≥ 30 hours/week (high exposure)	*			
Total computer use last month	Total daily time spent at a computer in work and leisure last month: < 2 h/day , 2-4 h/day and > 4 h/day		*		
Computer use in leisure time last week	Total time of different use on the computer in leisure time last week assessed by hours and minutes for each activity, then divided into: 1-7 hours/week (low exposure), 8-14 h/week (moderate exposure) and ≥ 15 hours/week (high exposure)	*			
Breaks in computer use last week	Number of times during the last week using the computer > 4 hours without a break (> 10 minutes): (i) 0 time/week or (ii)1 time/week (low exposure), (iii) 2-4 times/week (moderate exposure) or (iiii) > 5 times /week (high exposure)	*			
Breaks in computer use last month	Computer use > 2 hours without a break (> 10 minutes) last month: never, once in a while, a couple of times per month, a couple of times per week and, most days		*		
Computer mouse use last week	Distribution of computer mouse use compared to keyboard use (computer mouse use in %): (i) 0% or (ii) 25 % (low exposure), (iii) 50% (moderate exposure), (iiii) 75% or (iiiii) 100% (high exposure)	*			
Image management last week	Image management/lay-out, graphics in leisure time last week: no (low exposure), yes (high exposure)	*			
Time with hands above shoulder level last month	Time per day working with the hands above shoulder level, most of the working days the last month: never, < 1 hour, 1-2 hours and > 2 hours		*		
Time with flexed or extended neck last month	Time per working day with flexed or extended neck, most of the working days the last month: never, < 3 hour, 3-5 hours and > 5 hours		*		

Concept	Description	Paper			
		I	II	III	IV
Time with flexed back last month	Time per working day with flexed back, most of the working days the last month: never, < 0,5 hour, 0,5-1 hour and > 1 hour		*		
Lifting last month	Number of times per day lifting a weight of 5-10 kg, 11-15 kg, 16-25 kg or > 25 kg, most of the working days the last month: 0-4 times/day, 5-15 times/day, 16-30 times/day and > 30 times/day.		*		
Forceful grip last month	Use of tools or equipment or other burden that requires a forceful grip (hard grip with one hand corresponding to a lift of 1 kg or more): seldom or never, several times per day, several times per hour and several times per minute		*		
Use of vibrating tools last year	Regularly use of vibrating hand-held machines at work: yes or no		*		

Table 4. Description of psychosocial work factors (Papers I and II) and opportunities for recovery at work (Paper IV).

Concept	Description	Paper			
		I	II	III	IV
Current productivity demands	Experience of productivity demands in the study or work situation divided into partly or entirely in agreement with "excessively low demands" (low exposure), partly or entirely in agreement with "neither excessively low nor excessively high demands" (moderate exposure) and partly or entirely in agreement with "excessively high demands" (high exposure)	*			
Job demands	Exposure to high demands and expectations at work with four answer alternatives: corresponds very poorly or corresponds somewhat poorly, corresponds fairly well and corresponds very well		*		
Job control	Having control over and the ability to deal with situations at work, with the same answer alternatives as for job demands		*		
Social support at work	Access to support and help at the workplace in the event of problems, with the same answer alternatives as for job demands		*		
Reward relative to effort	Reward deserved in relation to the effort extended and the actual production at work, with the same answer alternatives as for job demands		*		
Negative influence of job demands on private life	Demands at work negatively influence private life (leisure, home and family life), with five answer alternatives: very seldom, fairly seldom, sometimes, fairly often and very often		*		
Work outside the workplace last month	Work performed outside the workplace, for example at home, last month, with five answer alternatives: never, once in a while, a few times per month, a few times per week and, more or less daily		*		
Reachable by mobile phone out of work time last month	Forced to be reachable by mobile phone after working hours, with five answer alternatives: never, once in a while, a few times per month, a few times per week and, more or less daily		*		

Concept	Description	Paper			
		I	II	III	IV
Noise annoyance at the workplace last month	Noise annoyance (for example fan sound, music, traffic noise, talk) at the workplace last month, with five answer alternatives: never, once in a while, a few times per month, a few times per week and, more or less daily		*		
Overtime work last month	Daily work > 12 hours last month, with five answer alternatives: 0, 1-2, 3-8, 9-15 and > 15 times in the last month		*		
Possibility of deciding working hours	Possibility of, within some limits, deciding one's own working hours, with three answer alternatives: (i) yes, I can be on flexitime, (ii) yes, I have in other ways relatively free working hours (positive exposure), (iii) no, I cannot influence my working hours (negative exposure)				*
Possibility of deciding the work pace	Possibility of deciding the work pace, with six answer alternatives: nearly all the time, about 3/4 of the time (positive exposure), half the time, about ¼ of the time, a little (maybe 1/10 of the time), no, not at all (negative exposure)				*
Possibility of taking short breaks	Possibility of taking short breaks nearly whenever to talk, with six answer alternatives: nearly all time, about 3/4 of the time (positive exposure), half the time, about ¼ of the time, a little (maybe 1/10 of the time), no, not at all (negative exposure)				*
Possibility of deciding when to perform a work tasks	Possibility of partly deciding when to perform different work tasks (for example chose to work faster some days and take it more calmly other days), with four answer alternatives: always, mostly (positive exposure), mostly not, never (negative exposure)				*
Having mostly varied work	A scale 1-5 from 1= monotonous work, 3= neither nor, 5= varied work, 4-5 defined as positive exposure, 1-3 as negative exposure				*

3.2.3 Confounding

Age was generally not considered to be a possible confounder in the thesis, as a small age span was used. Instead of using sex as a confounder, the analyses were stratified by sex in all quantitative papers (Messing and Silverstein 2009). No confounders were tested in Papers I and II, but two possible confounders were considered for the latter: change in pain and in depressive symptoms. Owing to earlier research, it was decided that these factors probably were not confounders (Spector et al. 2000; Toomingas et al. 1997). For the qualitative Paper III a discussion of confounders was inappropriate, due to the selected strategy. Finally, in Paper IV, two confounders were considered. First, high work demand was seen as a possible confounder for the analyses of the total sample. This variable was also used for creating a subsample. High work demands can influence work ability (van den Berg et al. 2009) and have a negative association with opportunities for recovery at work (Geurts and Sonnentag 2006); high work demand was defined in terms of physically strenuous work to a large extent *and/or* high workload with far too much to do to a large extent. Second, education level was considered to be a possible confounder, as poor basic education has been shown to relate to poor work ability among young adults (Seitsamo et al. 2008). Education level was dichotomized into compulsory school or high school and post-gymnasium, college, or university. Shift work could also be a possible confounder in this paper but data unfortunately were not available.

3.2.4 Paper III

The data for this study were collected through 24 semi-structured interviews (Kvale and Brinkmann 2009) in May–September 2013. First, two pilot interviews were performed to test the selected research areas and to gain experience of the interview technique. Afterwards, the first author discussed these interviews with the more experienced second author. All interviews, except for one, were held at the Department of Occupational and Environmental Medicine in Gothenburg. One was held at the participant's home in Skövde, due to the inconvenience of the long travel time to Gothenburg. All interviews were performed in a calm environment aimed to create a trustful climate where the participants hopefully felt they could express themselves freely. Each interview began with friendly talk before the recorded interview, to help create a more open and trusting environment and to increase the possibility of gaining rich descriptions of the participant's experiences of his or her work ability, according to Kvale and Brinkmann. Initially, a question about a typical day was used to understand the participant's working life. After that the main question was expressed:

Can you tell me what it means for you to have work ability in your present work?

The other three interview topics concerned experiences of reduced, improved, and excellent work ability:

Can you tell me about your experiences when your work ability was decreased?

Can you tell me about your experiences when your work ability was increased?

Can you tell me about your experiences when your work ability was at its best?

The participants were encouraged to give examples of their experiences, by follow-up questions such as "Can you give an example?", "Do you remember an event when this occurred?", and the like. Nearly all of the participants described experiences related to work ability from their leisure time, but a few did not. These participants were asked an additional question: "Do you have any experiences outside your working life that have influenced your work ability?". The interviews were transcribed verbatim, the first five by the first author and the rest by Jenny Ström, assistant at the Västra Götaland Region Competence Center.

3.3 Quantitative analyses

In the three quantitative studies, Papers I, II, and IV, descriptive and analytic statistics were performed. SAS version 9.1 was used in the analyses in Papers I and II, and SAS version 7.11 was used for Paper IV (SAS Institute, Cary, NC, USA). SAS version 9.1 was also used for the characteristics in Paper III.

3.3.1 Paper I

Frequency analyses were performed to obtain descriptive statistics for the whole study group, and respectively, stratified for the group with generally reduced productivity due to musculoskeletal pain or ache. The Cox proportional hazard regression model was used to estimate adjusted prevalence ratios (PRs) in the cross-sectional and prospective analyses. The "proc phreg" in SAS was used with the time set to 1 (Deddens and Petersen 2008). The analyses performed for the whole study group were adjusted for sex, but separate analyses for women and men (Messing and Silverstein 2009) were

also done. The cross-sectional analysis was performed to obtain possible associations between different factors and the outcome as guidance for the prospective analysis. PRs were computed separately for the group that reported generally reduced productivity due to musculoskeletal pain or ache at baseline.

A supplementary analysis was performed, presented in this thesis, as an erratum in Table 1 was found after its publication. The classification of physical activity was inversely performed in the cross-sectional analysis. Correctly, physical activity > 4 hours/week should be the reference value with a PR set to 1.00, and < 2 hours/week as a possible risk factor for generally reduced productivity due to musculoskeletal pain or ache. This is now shown in Table 5. Fortunately, this did not change any results or conclusions of the study.

Table 5. New results in Paper I for the association between physical activity and generally reduced productivity due to musculoskeletal pain or ache.

Physical activity	All		No generally reduced productivity due to pain or ache		Generally reduced productivity due to pain or ache		PR	95% CI
	N	%	N	%	N	%		
> 4 h/week	334	31.8	236	30.6	98	35.0	1.00	..
2–4 h/week	402	38.2	303	39.3	99	35.4	0.84	0.64–1.11
< 2 h/week	315	30.0	232	30.1	83	29.6	0.90	0.67–1.20

Another additional analysis was performed to investigate the proportion of students and workers at the new common baseline. At the original baseline all were students, but as the construction of a new baseline included different years, some students could have started to work.

In the 1-year prospective analysis the group with generally reduced productivity due to musculoskeletal pain or ache at baseline (N = 280) was excluded, to assess risk factors for generally reduced productivity due to musculoskeletal pain or ache at the follow-up. Before the multiple analyses, also performed with the Cox proportional hazard regression model, multicollinearity among the risk factors was tested by Pearson correlation coefficient. All paired correlations were < 0.8, so no multicollinearity was found. However, the multiple analyses did not show any relationships between the possible risk factors and the outcome. Finally, a modified Cox proportional hazard regression model with univariate PRs was used to estimate a combination of the four main risk factors present at the same time.

Telephone interviews were performed with 27 vocational school students to examine the drop-outs from this group at the baseline of the H24 cohort (Herloff et al. 2003). The interviews showed that these non-participants had a lack of interest and a lack of experience of the web-designed questionnaire.

One drop-out analysis was performed for the baseline in the WAYA cohort. Chi-square tests were performed to assess differences between the drop-outs and the participants (Ekman et al. 2008), whereby women and Swedish-born workers were found to be overrepresented in this cohort. Further, for this paper a drop-out analysis with a test of proportions (Altman 1999) was performed for the students who did not complete the questionnaire at the 1-year follow-up (N = 188). This group showed no major differences in sex, number of symptom locations, or symptom duration compared to the participating group, N = 583 (518 + 65).

3.3.2 Paper II

For the descriptive statistics, mean, range, and standard deviation for work ability for male and female workers were presented. Associations between changes in work situation and changes in work ability were examined in the prospective analyses, univariate and multiple. The robust variance was used in the calculations of confidence interval (CI) (Deddens and Petersen 2008). When analyzing reduced work ability, the reference group consisted of both those that reported constant work ability (N = 782) and those that reported improved work ability (N = 98) at the 1-year follow-up. In the same manner, when analyzing improved work ability, the comparison was made with the group with either constant work ability (N = 782) or reduced work ability (N = 431) at the 1-year follow-up (Fig. 4). The work factor variables were coded so that a PR > 1 for reduced work ability meant that an increased negative exposure was hypothesized to have a negative effect on work ability. On the other hand, for improved work ability, a PR > 1 meant that a decreased negative exposure was hypothesized to have a positive effect on work ability. Finally, a multiple regression analysis was performed with a backward stepwise procedure. Only work factors with a p-value ≤ 0.2 in the univariate Cox proportional hazard regression analysis were selected for the multiple regression analysis. Spearman's rank correlation was chosen to calculate the multicollinearity for the selected work factors. All paired correlations were < 0.8, and therefore, no multicollinearity was found. In the backward stepwise multiple regression analysis, exclusion was performed of the variables with the highest p-values, one at a time in order. This procedure was finished when all variables had a p-value ≤ 0.05.

As there could be a possible effect of regression to the mean (Björk 2010) on the results, an additional Cox proportional hazard regression analysis was performed. A comparison was completed between the groups with an improvement of work ability from 7 to 10 and 8 to 10, respectively, on the WAS. A similar comparison was made between the groups that reduced their work ability from 10 to 8 and from 8 to 6, respectively, on the WAS. Also, a possible ceiling effect was assessed using the same analytical method with an exclusion of the individuals who reported work ability levels of 9 and 10, as these were not able to improve their work ability according to the definition of a change.

Two drop-out analyses were performed of the drop-outs of workers between the baseline and the 1-year follow-up. Of these, 1490 workers derived from the drop-out group of 1571 individuals, and 10 workers derived from the drop-outs of 576 individuals (Fig. 4). This group of 1500 workers was compared with the study sample of 1311 individuals. First, using the Mann-Whitney test, a statistically significant difference was seen for work ability, 0.1 score levels ($p = 0.047$). As this difference in work ability was small, it is probably clinically uninteresting. However, in the group of drop-outs, men constituted a larger proportion, and less daily computer use was found for the drop-outs as a whole. Second, the test of proportions (Altman 1999) showed no statistically significant differences for job control, social support at work, or negative influence of job demands on private life, between these two groups.

3.3.3 Paper IV

Descriptive statistics concerning work ability, age, and years in present occupation were calculated with the mean, range, and standard deviation. Logistic regression (proc genmod in SAS) was used for the univariate and multiple analyses, stratified for sex for the total study sample and a subsample. The effect measures obtained from these regressions were prevalence ratios (PRs) instead of the commonly used odd ratios (ORs), as the outcome being common and hence ORs cannot be interpreted as approximations of PRs. From the logistic regressions PRs were calculated as the effect of the exposure around the prevalence of 50%. The group with the lower degree of recovery opportunities at work was used as the reference category in the presented PRs. The 95% confidence intervals (CIs) for PRs was calculated using the delta method (Agresti 2002).

Model building for testing associations between opportunities for recovery and excellent work ability in multiple models was performed by following a guideline (Hosmer and Lemenshow 2000). Co-linearity was checked by examining pairwise correlations between all exposure variables, between all

exposure variables and the possible confounders of high work demands and educational level, and between the two confounders with cross-tables considering > 80% in a diagonal or any cells with no answers. Univariate logistic regression analyses were done to select variables for the multiple regression with the criteria of a p-value < 0.25. When forming the multiple models, the steps defined in the guideline were followed. These steps used criteria for variable inclusion based on a p-value < 0.25, changes in parameter estimates for exposure variables < 15%, and likelihood ratio tests between nested models. If an explanatory variable had $p \geq 0.25$, but changed parameter estimates for other explanatory variables when the models were considered with and without it, it was included as a confounder.

Statistics Sweden does not, to our knowledge, present any drop-out analyses of The Work Environment Survey, which was the basis for this paper.

3.4 Qualitative analyses

Descriptive statistics of sex, age, education level, years in present occupation, and work ability were performed. The guidelines for strategies in systematic text condensation, STC (Malterud 2012) were followed in the analysis, which started after the final interview had been held. A bridling of the process of preunderstanding was practiced through discussion and reflection between the two authors (MB, KH) during the analysis of the data (Dahlberg et al. 2008). The recommended steps in the STC were followed: (1) Preliminary themes connected to the phenomenon of having work ability were emerged; (2) Meaning units related to the phenomenon were identified in each interview and sorted into groups of themes and subthemes, representing different aspects of the participants' experiences of work ability; (3) The contents in each theme were manually condensed and abstracted into meanings of the phenomenon. In this third step, new terms for the themes and subthemes were also described; (4) The meanings were manually condensed, and descriptions and concepts were developed (Malterud 2012). The analysis was performed by the first author (MB) in close cooperation with the second author (KH).

During the analysis a back-and-forth process between the four steps in different sequences was performed several times, to guarantee the quality of the condensation of the contents, and the meanings were compared with those of the original interviews. In the first step, two of the authors (MB, KH) carefully listened to and read the interviews several times to obtain an overview of the participants' experiences of work ability. In this step 11 themes related to the phenomenon were found. In the ensuing discussions there were changes to five main themes with 10 subthemes. In the second step, the first author (MB)

identified approximately 750 meaning units which were organized using nVivo (Edhlund 2011). Discussions on this procedure were held with the second author (KH) for validation, and if any disagreement on the coding occurred, the procedure went on until they were agreed. The number of themes changed during this step to five themes and 12 subthemes. In the third step, condensation and abstraction of the content in the subthemes into meanings were done. In addition, the meanings from the subthemes were summarized in the five themes. In the fourth step, descriptions and concepts were discussed regarding how to present the participants' experiences of work ability. In this step, the number of themes was changed to four themes, still with 12 subthemes in total, since the fifth theme, work ability at its best, turned out to contain a summary. Throughout the analysis process, the notations for the themes and subthemes were adjusted to ensure they were distinctively descriptive. Finally, a workshop was held with two colleagues outside of the department with experience in phenomenology research, to discuss the process and the results in terms of intelligibility and credibility.

3.5 Ethics

The studies were approved by the Regional Ethics Review Board in Gothenburg, Sweden, with the following approval numbers: study I: Ö 491-01, study II: 144-08, study III: 797-12, and study IV: 221-15. In studies I and II informed consent was considered to be given by answering the questionnaires. In study III all participants gave their written consent to participate before the interview started. For study IV, through participating in the survey performed by Statistics Sweden, the individuals gave their informed consent automatically. All studies were performed following the ethical standards of the 1964 Declaration of Helsinki.

4 RESULTS

The main results in the four papers are presented in this section, as more detailed information can be found in the respective papers. Also, additional results from supplementary analyses are described.

4.1 Paper I

The study sample (N = 1051) consisted of more women, 60%. Half of the individuals reported symptoms ≥ 7 days. At baseline, 280 individuals of the study group reported generally reduced productivity due to musculoskeletal pain or ache. In this group 82% were college or university students, and the rest were vocational school students. In the group that reported no generally reduced productivity (N = 771) the corresponding number was 79%. Supplementary analysis showed for this group that all individuals were in ongoing studies, except for one individual who was in search of work.

The cumulative incidence of self-reported generally reduced productivity at the 1-year follow-up was 0.11: 65 cases out of 583 respondents (the group of 771 individuals minus the drop-outs, N = 188), 47 college or university students and 18 vocational school students, at baseline. Several risk factors for generally reduced productivity due to musculoskeletal pain or ache were found prospectively in the univariate analyses (Table 6). Long-term symptoms (> 90 days) in the shoulders, arms, wrists, or hands (PR 2.5, 95% CI 1.12–5.58) and widespread symptoms in the upper back or neck and in the shoulders, arms, wrists, or hands (PR 2.3, 95% CI 1.40–3.78) were found to prospectively relate to generally reduced productivity. Current symptoms in the arm also showed this relationship (PR 1.8, 95% CI 1.10–2.90). Likewise, computer use during leisure time (8–14 hours/week versus 0–7 hours) showed a relationship (PR 2.3, 95% CI 1.20–4.47). Finally, difficulties in falling asleep one or a few times per month were related to generally reduced productivity due to musculoskeletal pain or ache (PR 1.8, 95% CI 1.01–3.14). Specifically, for the female students (N = 352), widespread symptoms (PR 3.3, 95% CI 1.74–6.32) and current symptoms in shoulders, arms, wrists, or hands (PR 2.4, 95% CI 1.26–4.62) were found to relate to the outcome. In the multiple analyses no relationships were found. However, when three or four of the prospective risk factors were present at the same time at baseline, a relationship with generally reduced productivity due to musculoskeletal pain or ache at 1-year follow-up was established (PR 2.7, 95% CI 1.42–5.26 and PR 4.8, 95% CI 1.99–11.82, respectively), indicating the importance of combinations of several risk factors.

Table 6. Risk factors for self-reported generally reduced productivity at the follow-up for the study group in Paper I, adjusted for gender, and separately for female and male students [a].

	Generally reduced productivity due to musculoskeletal pain or ache at 1-year follow-up											
	All students (N = 583)				**Female students (N = 352)**				**Male students (N = 231)**			
Risk factors at baseline	Exposed (N)	Cases (N)	PR	95% CI	Exposed (N)	Cases (N)	PR	95% CI	Exposed (N)	Cases (N)	PR	95% CI
Current pain or ache in shoulders, arms, wrists and hands	222	34	**1.8**	**1.10-2.90**	124	21	**2.4**	**1.26-4.62**	98	13	1.2	0.56-2.47
Widespread symptoms in upper back or neck and in the shoulders, arms, wrists, or hands	131	26	**2.3**	**1.40-3.78**	85	19	**3.3**	**1.74-6.32**	46	7	1.3	0.57-3.15
Long-lasting symptoms in shoulders, arms, wrists and hands	106	23	**2.5**	**1.12-5.58**	59	14	2.4	0.87-6.72	47	9	2.6	0.71-9.67
Difficulties in falling asleep once or a few times per month	194	30	**1.8**	**1.01-3.14**	130	18	1.7	0.79-3.69	64	12	2.0	0.88-4.69
Computer use 8-14 h/w in leisure time	88	16	**2.3**	**1.20-4.47**	41	7	2.5	0.98-6.19	47	9	1.8	0.68-4.92

N = number of students
PR = prevalence ratios
95% CI = 95% confidence interval
[a]The figures in boldface were statistically significant (the lower limit of the 95% CI being ≥1.00).

4.2 Paper II

There were slightly more women in the study group, 55%. The work ability level was high, 8.7 on the WAS for the male workers and 8.5 for the females. In the study group, 89% had occupations where higher education was not necessary. Two main risk factors were found for reduced work ability in the multiple analyses (Table 7): decreased job control (PR 1.7, 95% CI 1.49–2.12) and increased negative influence of job demands on private life (PR 1.5, 95% CI 1.25–1.69). These associations were found for both female and male workers with relatively similar PRs. For female workers, social support at work (PR 2.4, 95% CI 1.43–3.95) was found to improve work ability (Table 8). Conversely, shown in the same table, increased job control (PR 2.3, 95% CI 1.21–4.54) and decreased negative influence of job demands on private life (PR 2.1, 95% CI 1.10–3.87) were associated with improved work ability for male workers. Additionally, for the total sample, decreased computer use in general was also associated with improved work ability (PR 1.8, 95% CI 1.15–2.76).

Table 7. Prospective relationships between changes in work factors and reduced *work ability in Paper II. All shown results were statistical significant.*

Changes in psychosocial work factors	**All workers N = 1311** **Multiple regression analysis [1]**				**Men N = 593 (45%)** **Multiple regression analysis [1]**				**Women N = 718 (55%)** **Multiple regression analysis [1]**			
	Exposed	Cases	PR	95% CI	Exposed	Cases	PR	95% CI	Exposed	Cases	PR	95% CI
Decreased job control	388	187	1.7	1.49-2.12	168	78	1.7	1.36-2.23	220	109	1.6	1.34-1.99
Decreased social support at work	420	173	1.2	1.00-1.38	179	75	1.4	1.06-1.74				
Increased negative influence of job demands on private life	411	180	1.5	1.25-1.69	172	71	1.5	1.20-1.91	239	109	1.4	1.15-1.71

N = number of workers
Cases = exposed individuals reported reduced work ability
[1] Backward stepwise analyses
PR = prevalence ratios
95% CI = 95% confidence interval

Table 8. Prospective relationships between changes in work factors and improved *work ability in Paper II. All shown results were statistical significant.*

Changes in psychosocial work factors	**All workers N = 1311** **Multiple regression analysis [1]**				**Men N = 593 (45%)** **Multiple regression analysis [1]**				**Women N = 718 (55%)** **Multiple regression analysis [1]**			
	Exposed	Cases	PR	95% CI	Exposed	Cases	PR	95% CI	Exposed	Cases	PR	95% CI
Decreased daily computer use in general	201	23	1.8	1.15-2.76								
Increased job control	199	29	1.8	1.18-2.83	90	11	2.3	1.21-4.54				
Increased social support at work	239	35	2.0	1.34-3.05					136	25	2.4	1.43-3.95
Increased reward relative to effort									193	28	1.7	1.03-2.82
Decreased negative influence of job demands on private life	349	41	1.7	1.13-2.43	149	15	2.1	1.10-3.87				

N = number of workers
Cases = exposed individuals reported reduced work ability
[1] Backward stepwise analyses
PR = prevalence ratios
95% CI = 95% confidence interval

4.3 Paper III

In the study group, 21 individuals were engaged in ongoing work, one had recently left work, and two persons had been on sick leave for no more than three months. The participants had worked 4–5 years (median) in academic and non-academic occupations involving school, health care, church, trading, restaurant, cleaning, and museum work (female workers), and in military, academy, engineering, administration, care, construction, assembly, delivery, and public transport job (male workers).

Work ability was experienced as complex, consisting of four themes, each with three subthemes (Fig. 7). The first theme, Work ability as the worker's own responsibility, was considered the core theme. Furthermore, the participants experienced that work ability could be influenced by the psychosocial work climate, the work organization, and private life. Optimal work ability was experienced when the core theme was optimal during a positive influence of the other three themes. The core theme consisted of three subthemes: to be alert and have energy; to possess sufficient education, skills, and working life experiences; and to experience meaningfulness and engagement in work. For all these subthemes the young workers took responsibility upon themselves. They experienced work ability when they were alert, had energy for the work task, felt well, and did not have any sickness or injuries. This state of good health was described as a base for having the functions and abilities that were needed for the specific work. Further, in the next subtheme, education was seen as a personal requirement to obtain specific work or be permitted to work in specific occupations. The importance of the professional role in work ability was described. In the third subtheme, the young workers experienced motivation, and a will to go to work, as a basis for work ability. Comfort and joy contributed to good work ability, such as doing well for someone and experiencing work as meaningful. The three other main themes, each consisting of three subthemes, could reduce or improve work ability (Fig. 7).

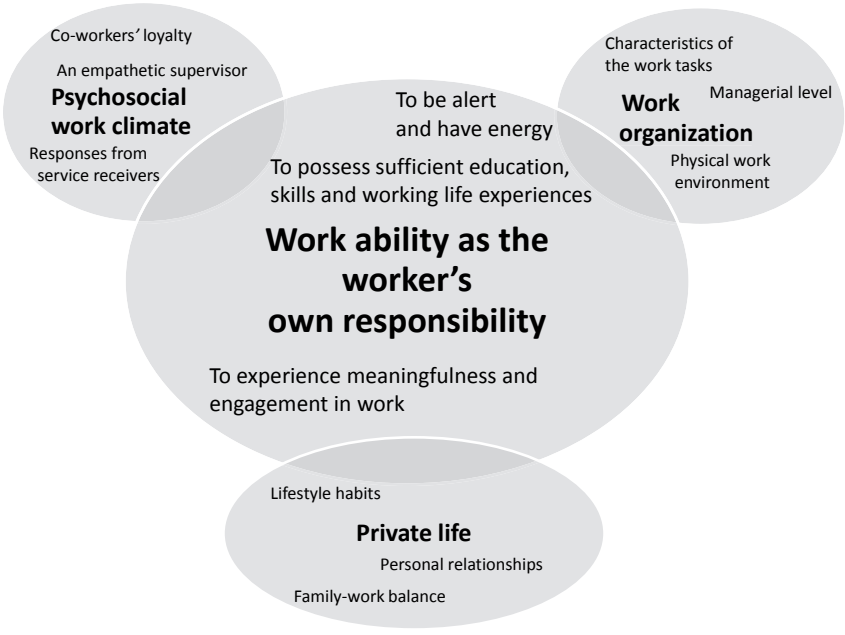

Figure 7. Experiences of work ability among young workers found in Paper III. The participants described work ability as being one's own responsibility, which could be influenced by the psychosocial work climate, the work organization and private life. The main themes are in bolded text and the subthemes to each theme are in plain text. The core theme is in the middle.

4.4 Paper IV

The study sample and the subsample consisted of slightly more women than men, 55% and 56%, respectively. Work ability was assessed at 9.2 (mean) on the WAS in both samples of women and men. The young workers had less than 4 years (mean) of working experiences in traditional gender-differentiated trades such as those in the service, care, and selling sectors for the women, and in construction and manufacturing enterprises for the men, especially those with high work demands. Up to slightly more than half of the study sample reported opportunities for recovery. Yet, women with high work demands seemed to report fewer recovery opportunities compared to the whole sample. Possibilities to decide working hours and having varied work appeared to be quite comparable for women and men.

Four multiple models were created, with different exposure variables included for women compared to men. For women, the variable *possibility of deciding working hours*, was included in the multiple models I and II with $p = 0.08$ and $p = 0.1$ respectively. *Possibility of deciding the work pace* was included in both these models only to adjust the models and should then be regarded as a confounder. In the multiple model III both *possibility of deciding working hours* and *possibility of deciding the work pace* were included, with $p = 0.1$ and $p = 0.2$, respectively. Finally, in the multiple model IV for women, only *possibility of deciding working hours* was included with $p = 0.046$.

Model I for the study sample of women included neither of the specified confounders (high work demands and educational level), but model II for the study sample of women included high work demands. Further, model III for the subsample of women did not include the educational confounder, but model IV for the subsample of women did.

For men, having reported *varied work* was included in all four models with *p*-values < 0.05. *Possibility of deciding when to perform a work task* was included in models I and III, with $p = 0.097$ and $p = 0.099$, respectively, and in model II with $p = 0.1$. In model IV the *p* of this variable was 0.049. *Possibility of deciding the work pace* was included in models I–III, with $p = 0.1$, $p = 0.1$, and $p = 0.2$, respectively, and finally, the variable *possibility of taking short breaks* was included in model I with $p = 0.2$. In model II this exposure variable was only included as a confounder to adjust the multiple model as *possibility of deciding the work pace* in model IV.

Similar to women, model I for the study sample of men included neither of the specified confounders (high work demands and educational level), and model II for the study sample of men included high work demands. Further, model III for the subsample of men did not include the educational confounder, but model IV for the subsample of men did, also in similarity with women.

The largest effect size of recovery opportunities was a PR of 1.3 for men who reported varied work (all models) and for men with high work demands who reported possibility of deciding when to perform a work task (Table 9). For women with high work demands who reported possibility of deciding working hours (models III and IV), the PR was 1.2 (Table 10).

Table 9. Prevalence ratios based on multiple regression models for associations between recovery opportunities at work and excellent work ability for young men in Paper IV.

	Men				Men with high work demands			
	N = 1025		N = 1025		N = 345		N = 345	
	Multiple model I [a]		Multiple model II [b]		Multiple model III [c]		Multiple model IV [d]	
Recovery opportunities at work	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)
Possibility of deciding working hours	.	.	.	.	.	.	.	.
Possibility of deciding the work pace	1.1	(0.96–1.29)	1.1	(0.96–1.29)	1.2	(0.90–1.49)	1.1 [e]	(0.85–1.42)
Possibility of taking short breaks	1.1	(0.95–1.26)	1.1 [e]	(0.93–1.24)	.	.	.	.
Possibility of deciding when to perform a work task	1.1	(0.97–1.30)	1.1	(0.96–1.29)	1.2	(0.93–1.52)	1.3	(0.96–1.60)
Having mostly varied work	1.3	(1.10–1.46)	1.3	(1.10–1.45)	1.3	(0.99–1.61)	1.3	(1.01–1.67)

N = number of workers included in the multiple analyses
PR = prevalence ratios
95% CI = 95% confidence interval
[a] Multiple model with no confounders.
[b] Multiple model with two confounders: high work demands and educational level.
[c] Multiple model for the subsample with no confounders.
[d] Multiple model for the subsample with one confounder: educational level.
[e] Variable included only to adjust the multiple model
. = the variable was not included in the multiple model

Table 10. Prevalence ratios based on multiple regression models for associations between recovery opportunities at work and excellent work ability for young women in Paper IV.

	Women				Women with high work demands			
	N = 1279		N = 1279		N = 434		N = 434	
	Multiple model I [a]		Multiple model II [b]		Multiple model III [c]		Multiple model IV [d]	
Recovery opportunities at work	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)
Possibility of deciding working hours	1.1	(0.98–1.24)	1.1	(0.96–1.22)	1.2	(0.94–1.41)	1.2	(0.98–1.46)
Possibility of deciding the work pace	1.1 [e]	(0.94–1.20)	1.0 [e]	(0.92–1.17)	1.2	(0.89–1.42)	.	.
Possibility of taking short breaks	.	.	.	.	.	.	.	.
Possibility of deciding when to perform a work task	.	.	.	.	.	.	.	.
Having mostly varied work	.	.	.	.	.	.	.	.

N = number of workers included in the multiple analyses
PR = prevalence ratios
95% CI = 95% confidence interval
[a] Multiple model with no confounders.
[b] Multiple model with two confounders: high work demands and educational level.
[c] Multiple model for the subsample with no confounders.
[d] Multiple model for the subsample with one confounder: educational level.
[e] Variable included only to adjust the multiple model.
. = the variable was not included in the multiple model

5 DISCUSSION

The overall aim of this thesis is to increase the understanding of work ability in young adults. The main findings in the separate papers are discussed below. Also, methodological aspects of the thesis are discussed.

5.1 Thesis findings

This thesis contributes some new findings of work ability for young adults. Work ability can be seen as one's own responsibility and as complex, including, besides occupational factors, private life and work–life balance. Above all, varied work can offer an opportunity for recovery at work that could promote excellent work ability among young men. Also, widespread and long-lasting symptoms can have an influence on work ability in the terms of reduced productivity among students, despite their young age. A schematic house of work ability for young adults formed from this thesis would include the private life inside the house, in comparison with the Finnish model (Gould et al. 2008) with its balcony connecting the private life outside. Also, the fourth level in the house, containing work, would take more space compared to this model and would also include recovery opportunities at work.

5.1.1 Risk factors for generally reduced productivity

As health-related productivity loss has been valued at more than double the associated medical and pharmaceutical costs (Loeppke et al. 2009), reduced productivity seems to be an important and hidden problem. One of the main findings in the first paper was that long-lasting (chronic) symptoms in the upper extremities were prospectively related to generally reduced productivity in studies, work or leisure due to musculoskeletal pain or ache, mainly among college/university students. This is in line with results of persistent symptoms in the neck or arm lasting at least 7 days among computer workers aged 20–65 years, associated with reduced productivity (Hagberg et al. 2002). Notably, reduced productivity was in that study more common among young women in the age spans of 18–24 and 25–34 years than in older computer users, yet not found in a later study by the same authors (Hagberg et al. 2007). Also, findings of neck disorders as the most important determinant of the work impairment level have been shown (Collins 2005), which is partly in agreement with the results in the present study. For young students, increased neck and shoulder pain in the transition from technical school into working life has been found (Hanvold et al. 2014), which, according to the current paper, could be a risk for reduced productivity later in their employment. As chronic pain has been found to be associated with high costs of lost productivity for workers aged

20–64 years (van Leeuwen et al. 2006), generally reduced productivity related to long-lasting pain has to be taken seriously.

Widespread symptoms in the neck and upper extremities was also prospectively associated with generally reduced productivity due to musculoskeletal pain or ache for primarily college/university students, not shown before, to our knowledge. These results are consistent with findings among adults. Widespread pain has been shown to be cross-sectionally associated with loss of productivity among computer workers (van den Heuvel et al. 2007) and predictive of both sickness absence among blue-collar workers (Morken et al. 2003) and work absenteeism (Haukka et al. 2013). Pain intensity was unfortunately not measured in the H24 cohort questionnaire, but has been found to be associated with productivity losses among 20- to 45-year-old workers (Martimo et al. 2009). In contrast to the main findings in the current paper, no associations between back/neck pain and productivity loss have been found among an Australian working population 18–70 years old (Holden et al. 2011). As well, no sure associations between musculoskeletal disorders and presenteeism has been stated (Schultz and Edington 2007). So, the results in this research topic are contradictory. With only a few studies concerning solely young adults, comparisons with earlier research have limitations. However, there have been attempts to develop presenteeism scales for students (Matsushita et al. 2011), which have been found to be useful.

Total computer time was, somewhat surprisingly, not found to be a risk factor for reduced productivity due to musculoskeletal pain or ache. This is in contrast to prospective associations found between computer use > 4 hours/day and reduced performance among young men (Thomée et al. 2012). Instead, moderate computer use in leisure, 8–14 hours/week was established to be a risk factor for generally reduced productivity due to musculoskeletal pain or ache. This is in line with findings of hobbies with static postures for the upper limb, as, for example, computer use, associated with neck or shoulder pain among youth 15–18 years old (Niemi et al. 1996). The result is also in agreement with findings of computer mouse use > 0.5 hours/day among adults with shoulder and forearm/hand symptoms prospectively associated with reduced productivity (Hagberg et al. 2007). As the result in the current study concerned, rather unexpectedly, moderate exposure, it is not further highlighted.

Finally, difficulties in falling asleep one or a few times per month were related to generally reduced productivity due to musculoskeletal pain or ache. Though this frequency of sleeping difficulties does not fit the criteria of insomnia, the result can indicate that sleep can be important for productivity and cannot be

disregarded. However, in the model of combined risk factors this result was not included, due to its moderate exposure.

5.1.2 Changes in work situation associated with work ability

The main findings in Paper II dealt with changes in different psychosocial aspects of work and changes in work–life balance related to changed work ability. In this study changes in physical factors did not turn out to be associated with changed work ability, somewhat in line with results for adults (Emberland and Knardahl 2015), but in contrast to previous research among young workers (Seitsamo et al. 2008) and adult workers (Tuomi et al. 1997; Tuomi et al. 2004), respectively. Perhaps physical demand did not influence work ability due to the low age in the study sample. As 24% of the participants in the study sample reported long-lasting pain, possibly the physical demands could affect health. However, about the time of the data collection (2008), only 8% of the individuals among those 16–24 years old reported severe ache (Statistics Sweden (SCB) 2013b). So, though slightly different measurements were used, this can indicate a less healthy study group due to the large drop-out, making this reasoning uncertain.

Decreased job control was found to be associated with reduced work ability, seen earlier in several studies among young workers (Pohjonen 2001) and adult workers (Feldt et al. 2009; Tuomi et al. 1997). Also, the importance of job control for adult workers with reduced work ability to sustain productivity has been stated (van den Berg et al. 2011). Furthermore, increased negative influence of job demands on private life was associated with reduced work ability for both young female and young male workers, which is in line with values among young adults (Twenge 2010). Young workers may have a greater wish to separate work and private life, as found in several attitude inquiries. Work–home interference has been found to influence well-being (Mostert et al. 2011), and consequences associated with work–family conflicts have been shown to have effects on general well-being and health (Allen et al. 2000) among adults. In these studies, though, work ability was not examined.

For improved work ability the strongest association was seen for increased social support at the workplace. This is in line with studies, among primarily adult workers, showing the importance of support from supervisors and high level of organizational support (Feldt et al. 2009; Tuomi et al. 2004). However, in these studies, changes were not assessed. Furthermore, increased job control was associated with improved work ability, in line with the studies above. Also, the work–home interference was also important for improved work

ability, which has not been previously shown to our knowledge. Finally, decreased computer use in general was found to be associated with improved work ability, though after additional analyses of a possible ceiling effect, the PR for this result had decreased from 1.8 to 1.3, and the confidence intervals then included 1 and were no longer statistically significant. Therefore, this result was not highlighted.

5.1.3 Experiences of work ability

The idea to interview young workers emerged during the work with Paper II, as understanding of how this group reasons about the WAS and how they experience work ability was scarce. A phenomenological approach was therefore selected, due to this research field being unexplored and to the aim being to explore experiences and not to generate a model of work ability.

Two main findings in the core theme were stated in this paper: that responsibility for work ability is one's own, and that work ability is complex. The experience of the individual's own responsibility can have different interpretations, such as a relation to the increased individualism in society (Twenge et al. 2004) and also in working life (Gillberg 2010). The young workers reported it was up to them to gain work ability through being alert and having energy for work; having the required education, skills, and working life experiences; and experiencing meaningfulness and engagement in work. They did not expect the nearest manager, the supervisor, or organizational structures to support these aspects. A lack of knowledge about organizations and the employer's responsibility as set out in the Occupational Safety and Health Act may be one explanation. This ignorance of a good work environment (Kines et al. 2013) seems to result in seeking individual solutions to the work situation. Furthermore, the importance of a professional role for experience work ability was highlighted in the current study, in line with findings among adult workers (Emberland and Knardahl 2015), where reducing role conflicts could prevent low work ability. Finding a professional role can be facilitated by an organizational system where experienced co-workers can guide new employees (Holte and Kjestveit 2012). Introduction, education, and mentorship for young workers have to be guaranteed, according to Nordic researchers (Kines et al. 2013).

The other main finding was that work ability was experienced as complex, and that all themes seemed to be interacting when optimal work ability was experienced. In the model house of work ability described earlier (Gould et al. 2008), a complexity of work ability was also emphasized. However, compared to this model, the findings in the current study are slightly different and seem

to have dissimilar weightings (Gould et al. 2008; Ilmarinen et al. 2005), which can be seen as a complement. Also, private life is more closely included, with a home-work interference, which can affect work ability for better or worse. This is consistent with results among adults of a negative influence on work performance due to family conflicts (Hancock and Page 2013). As well, work–life balance has been stated as one of five general categories of a healthy workplace, defined as workers' well-being combined with profit and productivity in the company (Grawitch et al. 2006). It is also in line with the greater wish to separate work and life outside of work due to young workers' valuing of a balance in life (Twenge 2010).

5.1.4 Opportunities for recovery at work and excellent work ability

This study was an attempt to examine cross-sectional associations between opportunities for recovery at work and excellent work ability among young workers. The main finding in the current study was that young men with varied work appeared most likely to experience excellent work ability. This was found both for men as a whole and for men with high work demands. Temporal variation (work interrupted by breaks) has been found to decrease muscle discomfort, according to a review (Luger et al. 2014), and a variation in work tasks with different exposure levels has been stated to reduce the risk of musculoskeletal complaints (Balogh et al. 2016). In addition, another review has shown that variation in physical workload has a significant effect on recovery in relation to musculoskeletal disorders (Swedish Work Environment Authority (Arbetsmiljöverket) 2016). So, varied work obviously seems to have an effect on musculoskeletal health. Further, having possibilities of taking breaks has been found to maintain performance among adult workers (Tucker 2003). This option, and also the possibility of deciding the work pace can probably increase with varied work, included in a theoretical framework of recovery (Geurts and Sonnentag 2006). Consequently, creating varied work content could probably contribute to promoting excellent work ability in young men, both with and without high work demands. Additionally, for men with high work demands, the possibility of deciding when to perform a work task was found to be associated with excellent work ability. This aspect is included in "global worktime control" which has been shown to have an association with job satisfaction but not performance or productivity among adult workers (Nijp et al. 2012). Thus, the result of work ability in the present study seems to be new.

For women with high work demands, the recovery opportunity of deciding one's working hours was associated with excellent work ability. This is to

some extent in agreement with previous studies in adult workers. Flextime has been shown to be associated with job satisfaction (Nijp et al. 2012) and to have a positive effect on productivity (Baltes et al. 1999), according to these reviews. In the latter, the authors presented the theory that flextime allows individuals to better use their own circadian rhythms and may decrease experienced stress, which could result in a higher agreement between the individual's abilities and the job requirements. This theory is in line with the common definition of work ability as the balance between an individual's resources and the work demands (Ilmarinen 2009).

5.1.5 Gender aspects

Though a gender focus not was the aim in this thesis, the findings have to be discussed from this aspect due to the segregated labor market (Statistics Sweden (SCB) 2014) and the potential differences in occupational health between women and men (Härenstam 2009; Messing and Silverstein 2009), which may influence work ability. In general, this thesis does not have the power to express new knowledge of gendered occupational patterns, but some results can be highlighted with caution.

Two risk factors for generally reduced productivity due to musculoskeletal pain or ache in Paper I were confirmed for female students: current symptoms in the upper extremities and widespread symptoms in neck and upper extremities. However, no comparison between the sexes was performed so a possible difference was not investigated. The result for female students is in line with previous research among adult female computer users with twice the incidence of reduced productivity due to similar symptoms (Hagberg et al. 2007). Also, gender differences in excellent performance, with disadvantage to the young women, have been seen (Eriksson et al. 2007), however, not compared to young men. As women report more musculoskeletal disorders than men (Strazdins and Bammer 2004) even in young age (Niemi et al. 1996), and sometimes with a complex symptomatology (Strömbäck 2014), the influence on productivity is not surprising.

Decreased job control associated with reduced work ability was seen in Paper II for both female and male workers, in accordance with a previous study (Nordander et al. 2008). Also, increased negative influence of job demands on private life was associated with reduced work ability, relevant for both sexes. This was somewhat consistent with the finding of home-work balance influencing work ability in Paper III, though reversed. These factors seem to be important to workers, independent of gender. To the contrary, increased social support at work was found in Paper II to be associated with improved

work ability only for young female workers. This is partly in contrast to Paper III, where the empathetic supervisor and co-workers' loyalty were important for both women and men, though included more than merely social support. One explanation could be that women need more social support in their occupations, mainly in the school, health care, and service sectors, which involve working closely with other people. A very hypothetical approach could be that men already experience support in their work, in line with findings of men in a typical male sector having managers with fewer employees, compared to a typical female sector, found in Swedish communities (Swedish Work Environment Authority (Arbetsmiljöverket) 2014).

In the qualitative study, Paper III, no gender differences emerged. Young female and male workers seemed to experience work ability in a similar way, notwithstanding that they were in different work contexts due to the segregated labor market, in contrast to paper II. In Paper IV, however, the multiple models indicated different results for young women and men, though these were not tested. Gender issues are seldom discussed in studies of recovery, though there are exceptions (Gommans et al. 2015), which makes a comparison with earlier research limited. As varied work, the main finding for men in the present study, is included in a theoretical framework of recovery (Geurts and Sonnentag 2006), this result solely among men raised questions. Slightly more women seemed to report varied work compared to men in the current study, which indicates that this possible small difference probably cannot be an explanation. The segregated labor market for men and women (Statistics Sweden (SCB) 2014), even in young age, can be one possible reason. In male occupations it may be possible that varied work creates a variation in work postures and work movements, regardless of the possibility of taking breaks and deciding the work pace. As most male employees in Paper IV were found in construction and manufacturing and most female employees in the service, care, and sales sectors, there may be a difference in the way the work yields this real variation that results in recovery. In female-dominated workplaces the different work tasks may be more similar in nature. Too, there have been presented theories suggesting that men can create more real variation in their work in a higher degree than women in the same occupation, due to gendered work tasks in working life (Abrahamsson 2009). This can also be a plausible explanation in the present study.

On the other hand, the finding that offering the possibility of deciding one's working hours could be a promising way to promote excellent work ability was valid for young women with high work demands but not for young men. Women report higher psychosocial strain at work than men (Lewis and Mathiassen 2013), yet this is not specific to young women, which could signal

a need for other types of opportunities for recovery at work. Further, as young women seem to take more responsibility in private life (Landstedt et al. 2009), and probably also for unpaid work (Statistics Sweden (SCB) 2014), their focus on work may be split by a focus on life outside work. Consequently, external recovery such as sleep and rest and relaxation between working days (Sonnentag 2003) could be more important for young women than for young men. In line with these arguments, the recovery opportunity of deciding on working hours might be a trap for young women to manage life, including work and private life, while maintaining excellent work ability. According to this reasoning, young men may have a larger focus on work compared to life outside work and could therefore benefit more from varied work to promote excellent work ability.

In conclusion, although there was no clear gender focus in this thesis, some possible gendered patterns could be seen. There seem to be different assumptions, possibilities, and expectations for women and men in working life (Abrahamsson 2009; Hooftman et al. 2004; Swedish Work Environment Authority (Arbetsmiljöverket) 2015a), but whether this is significant for work ability, this thesis cannot answer.

5.2 Methodological considerations

In every thesis there are strengths and limitations that need to be highlighted. This chapter is in divided into two parts, as the terms for these aspects differ for quantitative and qualitative research. Internal validity, reliability, and external validity are discussed for Papers I, II, and IV, and credibility and dependability, conformability, and transferability for Paper III.

5.2.1 Internal validity and reliability

A strength in Papers I, II, and IV is that they all use large cohorts; hence, the sample sizes are large. A prospective study design, used in Paper I, can be seen as a strength, while increasing the possibility of protecting against reversed causality, as cause precedes the outcome. In addition, in this paper a dose–response relationship can be assessed. Further, the majority of the questions in all papers have been validated. Finally, the stratified analysis of women and men, as recommended due to the segregated labor market (Messing and Silverstein 2009), is another advantage. Still, there are several limitations. Large drop-outs when forming the cohorts could lead to selection bias. Another form of error could occur due to recall bias. Lastly, confounding can be one form of systematic error, which was important to consider when interpreting the studies. The mentioned strengths and limitations are now discussed below.

Study design

As the explanatory variables and the outcome were measured at different time points in Paper I compared to Paper II, it was possible to assess a causal relationship in the first study, which is a strength. The study design for Paper II was chosen to assess changes in the work situation and in work ability during the year examined. As both the explanatory factors and the outcome were measured at the same time point, the results can be seen as cross-sectional, despite the longitudinal design. Still, this study design probably contributed more to the research in this field than a study with a cross-sectional design would do. But certainly, an inclusion of a later follow-up had been an advantage. On the contrary, in Paper IV, recovery opportunities at work are probably more important for excellent work ability at the moment and not a year or several years later. So, a cross-sectional design was suitable for that research questions. Also, if a lack of recovery opportunities at work associated with low work ability had been studied in this paper, other results might have been found. Furthermore, both Papers II and IV have a deliberately narrow focus on solely occupational factors as explanatory factors. This design was chosen not only because it was an unexplored research field but also because work-related factors are among the most important factors associated with work ability (Alavinia et al. 2007). This slim focus can be seen as a possible limitation, but probably gives a clearer focus on the research topics.

Sample selection

The merging of participants from different years in Papers I and IV needs to be discussed. The selection of participants from different "baselines" in Paper I (Fig. 3) could introduce a healthy workers effect, in spite of the fact that the drop-out analyses in Paper I did not show any differences for the group not analyzed at the follow-up. Whether the participants with musculoskeletal symptoms recruited from the follow-ups were healthier in other aspects compared to those who reported symptoms at baseline, is unknown, but it is possible. Fortunately, 63% of the study sample were recruited from the original baseline. Another possible selection bias in Paper I was the chosen limit of ≥ 1 day of musculoskeletal pain or ache in the inclusion criteria. Although there is a risk that pain lasting less than three days can be due to stiffness, this definition was used to obtain a sufficiently large study sample for the prospective analysis. About half of the study sample had had symptoms ≥ 7 days, which decreases this possible error.

The study sample in Paper IV was in conformity with Paper I, selected from three subsequent, alternate years, of the cohorts. This selection was chosen to

obtain a large enough study sample to stratify by sex and further divide into subsamples with high work demands, while still having enough power for the statistical analyses. Although the work environment changed for young workers during at least the last two years (Swedish Work Environment Authority by Statistics Sweden (Arbetsmiljöverket via SCB) 2014), there is no reason to believe that the examined possible associations should have changed substantially. Statistics Sweden took care to obtain large selections from the working population, and similar to Paper II, the inclusion criteria for the study sample were clear, which would diminish a selection bias.

Data collection

The definitions of some concepts measured in this thesis have to be emphasized. The term "generally reduced productivity" was used for individual assessments in Paper I. Opinions have been raised about reserving the term *productivity* for the output at the enterprise level, and at an individual level using the concept *performance* (Brooks et al. 2010). The term productivity can semantically be translated into performance, but not the other way around. Likewise, the term performance is widely used in other contexts as, for example, in theater, which can be confusing. Also, some researchers differentiate between the concepts *presenteeism* and *productivity loss* (Johns 2011), showing the lack of consensus in this field (Krol et al. 2013). Perhaps the term *reduced performance* would have been used if this paper had been written today, in line with this view. Furthermore, the term *excellent work ability* in Paper IV can be questioned. The level 10 in the WAS was chosen following previous research (El Fassi et al. 2013; Gould et al. 2008), in spite of 9–10 having been used for young workers (Seitsamo et al. 2008; von Bonsdorff et al. 2011). In these cases, choosing 10 had resulted in too few cases. In the cohort, the Work Environment Survey, the self-reported work ability was high, so the upper limit of 10 was considered suitable.

Internet-based questionnaires have been more common during the last 20 years. In the H24 cohort, the questionnaire was administered solely via the web, which was one of several reasons for the low response rate among the vocational school students. The baseline questionnaire in the WAYA cohort was instead sent out by post, and the 1- and 2-year follow-ups via the web. As web questionnaires have been found to be comparable to pencil-and-paper data (Ritter et al. 2004) and judged to be a possibly valid collection tool (Pettit 2002), both methods seem to be equal in validity.

Self-report questionnaires are a common form for gaining much information from a large group of individuals. Reproducibility and validity of self-reported

general physical work demands have been summarized in two reviews (Barrero et al. 2009; Stock et al. 2005). Self-reported duration of work demands showed good to excellent reproducibility in the first, and this was supported in the latter, but more validity testing research is inquired. Moderate to good validity (Deane et al. 1998), an overestimation (Douwes et al. 2007), and a misclassification (IJmker et al. 2008) have been found for self-report of computer use. This supports the caution in the interpretation of computer use in the first two papers. However, the changed design of this question in Paper II, with time-limited alternatives of computer use, can be seen as an advantage. On the other hand, self-reported productivity has been found to have good validity (Allen Jr and Bunn 2003). Though the recall period of one month has been questioned as being too long (Koopmanschap et al. 2005), the use of 4 weeks' recall period in Paper I can be justified, as no differences between 2- or 4-week recall of productivity have been found in another study (Stewart et al. 2004).

The measure of generally reduced productivity due to musculoskeletal pain or ache in Paper I was performed with one question. This single item was chosen, despite its possible limitation, as it was used before in similar settings of computer users (Hagberg et al. 2002; Hagberg et al. 2007), however, among adults. Conscious of the shortcoming of this type of question it was changed to have four answer alternatives in the WAYA cohort. On the other hand, the well-validated WAS from the established WAI in the other papers can be seen as a most likely reliable measurement instrument. One objection could be the possibility of assessing lifetime best work ability at the age of 18–30 years, with few work experiences. The WAS has been used for young adults, but its suitability for this group has also been questioned (Gould et al. 2008), as work ability can be about maintaining meaning in life and tolerating uncertainty in conditions where a lasting career cannot be predicted, according to this study. The WAS has been considered to be an age-free item (Ilmarinen 2009), and so far, no better measurement for young adults has been presented.

New single questions were constructed for the WAYA cohort, as there was an effort to confine the questionnaire. These were used in Paper II. The single questions of job demands, job control, and social support at work were developed from the job control–demand model (Karasek and Theorell 1990), by experienced psychologists at the department. Control was defined as a feeling of control and ability to handle work situations. This variable has showed limited validity with the original model in a report among 141 workers and students (Stefan et al. 2014). As the response rate was 13% in this report of workers 20–66 years old with high control, of whom about half had higher

education, a direct comparison has evident limitations. Hence, the validity of this question is uncertain.

The definition of a change in a work factor in Paper II as one step between the answer alternatives was based on a likely semantic difference. As the questions had been validated and also tested for reliability, and the answer alternatives had been examined and in some cases also reduced from five to four answer alternatives (Ekman et al. 2008), this simplified method was used. However, a comparison could have been made between individuals who changed their answers one step compared to two or more steps, clarifying the validity and reliability of the selected method.

Data analyses, confounding, and interpretation

Several different strategies were used when performing the multiple regression analyses. A multiple regression model to examine the effect of a combination of risk factors was tested in Paper I. In Paper II a backward stepwise regression procedure was used, and in Paper IV a purposeful model-building procedure was followed. Further, possible regression towards the mean and ceiling effect were analyzed in Paper II. These post hoc analyses increased the validity of this paper.

To include possible *confounders* in the analysis to avoid bias of the results is important. In Paper I, however, no confounders were included, as the study was explorative, and a large number of explanatory variables were tested. Nor were any confounders tested in Paper II, although two were discussed. A change in pain could be a confounder, but no associations where exposure would affect increase in pain were assumed, as earlier shown (Toomingas et al. 1997). Similarly, a change in depressive symptoms was considered to be a confounder. However, depressive symptoms have shown little influence of reported job strain (Spector et al. 2000). Both sleep difficulties and alcohol use could be possible confounders in Papers I and II, as they likely could influence the outcome. However, to be confounders, they also need to influence the exposure, which is not necessarily true here. It could as well be the case that the exposure affects these variables. In this case they would be mediators and should not be adjusted for. In Paper IV two confounders were considered, high work demands and education level, and were tested in the model building. High work demands were included in the multiple model II for both women and men, and education level was included in the multiple model IV for both women and men with high work demands.

Finally, when interpreting the results in this thesis, several factors can pose a restriction. One limitation for the first two papers is the difficulty in pronouncing anything about the latency period, as what happened between the measurements is not identified. In Paper I the frequency of the students who had started to work at the follow-up is unknown, and in Paper II there is no information about possible changes at the workplace, in work tasks or in leadership. Hence, repeated measurements during the year would have given more interesting information and more possibilities to interpret the findings for these studies. Also, young adults in general report high work ability. This can mute the contrast between exposed and unexposed groups and at least in part be a reason for the small effects that were found, especially in Paper IV.

5.2.2 External validity

The external validity in this thesis, the possibilities of generalizing the results, depends on both the representativeness of the study groups compared to the young population, and also the risk for over/underestimation of the results, due to drop-outs. The large numbers of drop-outs in all cohorts are a limitation. The response rates in the cohorts are in line with the generally decreased response rate from 2% drop-outs in 1970 to 28% drop-outs in 2012 (Statistics Sweden (SCB) 2013a). Also, younger age has specifically been found to be associated with decreased response rate (Lamers et al. 2012). In H24 there was a great drop-out of vocational school students, so the results in Paper I can only be generalized to college/university students, who had an acceptable response rate. No differences between the drop-outs and study group in this paper were found in the drop-out analyses between baseline and the 1-year follow-up, which supports this generalization. Furthermore, women and Swedish-born workers were overrepresented at the baseline in the WAYA cohort. So, there was a more representative basis for these groups, which increases the possibility of generalizing the results in Paper II for women and Swedish-born individuals. Last, for the Work Environment Survey, no drop-out analyses are presented, but as their sample selection was carefully performed (Statistics Sweden (SCB) 2013a), the possibility of generalizing the findings in Paper IV is increased.

A large number of drop-outs raises the risk for an over- or underestimation of which groups the results are valid for. Yet, combinations of either a high explanatory variable and a low outcome, or a low explanatory variable and a high outcome have to be more common among the drop-outs compared to the study sample to generate biased effect estimates. This was examined in Paper I, where no statistically significant differences were seen for the main findings, widespread symptoms and long-lasting symptoms, between the drop-outs at

the 1-year follow-up (N = 188) and the study group (N = 583). Similarly, no statistically significant differences were found for the main results in Paper II, changes in job control, social support at work, and negative influence of job demands on private life, between the baseline and the 1-year follow-up of the WAYA cohort. These results decrease the risk for an over- or underestimation of the thesis findings. Still, there is no information on the explanatory variables in combination with the outcomes for the WAYA cohort and the Work Environment Survey, which contributes to the uncertainty of possible over/underestimation of the results.

Important to remember is that the external validity in this thesis concerns different groups in society, from highly productive students in college and university (Paper I) to mainly blue-collar workers (Paper II), and further, to workers in both academic and non-academic professions (Papers III and IV). In general, the possibility of drawing firm conclusions is limited by the lack of similar previous research for this age group. Further studies among young adults may increase the external validity of the thesis. Finally, the thesis findings are in a Swedish context. In other countries in Europe, which may still be more authoritarian with probably less individualism, a similar thesis could have given other results.

5.2.3 Methodological considerations for Paper III

The standards for reporting qualitative studies were followed in agreement with the selected strategy (Tong et al. 2007) to present this paper scientifically. Credibility and dependability (internal validity), conformability (reliability), and transferability (generalizability) (Lincoln and Guba 1985) are discussed in this section.

Credibility and dependability

To assess trustworthiness, information on the research process is essential. In this study the researchers were familiar with the context of work ability, which is important for the whole research process. As only one of the researchers was acquainted with qualitative research (KH), a close cooperation between the first (MB) and the second (KH) authors was performed through the pilot interviews, and in the data collection phase and the analysis phase. Individual interviews were selected, as the purpose was to explore individual experiences in depth, in contrast to focus groups interviews, which exploring the collective understanding of the world (Ivanoff and Hultberg 2006). The selected strategy, STC, with its clear descriptions facilitates the assessment of the credibility and the dependability for the reader. As phenomenological analyses can be beyond

the scope of several of the students (Malterud 2012), STC was a pragmatic choice, since the strategy can be used by novices in qualitative research, according to Malterud.

Conformability

The preconception of the researchers can derange the objectivity in a study and can lead to expectations of specific findings that can drown the new knowledge gained by the empirical material. So, the researchers' mirror, the reflexivity (Malterud 2001) is essential. The professional background of the first author as a physiotherapist in primary health care and an ergonomist in occupation and environmental medicine has to be noted. To increase an unawareness of the preconceptions and reflexivity, repeated discussions with the second author (KH), with a different preunderstanding, were undertaken. Likewise, the practice of bridling of, for example, the model house of work ability, was useful. The selected strategy, STC, with open questions and follow-up questions, also increased the conformability and contributed to transparency. All these attempts increase the possibility of replicating this study in another context.

Transferability

As the possibility of transferring results from a qualitative study is mainly due to the variation in the study sample, which offers rich data (Hallberg 2013; Malterud 2001), the sample selection for this paper was performed strategically through the eight subgroups. Rich data were then likely obtained, owing to these selection procedures. Likewise, the use of open questions and the phenomenological approach with an open mind increased the likelihood of gaining thorough experiences of each research topic. All these aspects increase the possibility of transferring the results to similar contexts. However, the transferability to contexts with many young workers not born in Sweden is doubtful, as this group was already underrepresented in the cohort. Nonetheless, results from qualitative studies, based on information from a strategically selected study group, can be tried in other contexts in order to confirm the results (Hallberg 2013). This author also thinks it is possible to transfer results of a qualitative study to other similar groups that are characterized by the same selection criteria and circumstances as the study group. On the other hand, findings in qualitative studies are not valid for the population in general, but rather can be viewed as descriptions or theories applicable within a specific setting (Malterud 2001). So, in conclusion, the findings in the current study can possibly be transferred to similar contexts with young Swedish-born workers 25–30 years old.

5.3 Ethical considerations

There are various ethical difficulties in research. The sample recruitment, the handling of informed consent, the performance of interviews, and eventual wishes to discontinue in a study are some areas to be concerned about (Forsman 1997). For Papers I and II, one to four reminders were sent out in an effort to obtain large cohorts. As three reminders have been shown to have little effect on the response rate (Wenemark et al. 2010), maybe no more than two reminders should be considered in future studies. Also, care in respect to the respondents' integrity is important. Incentives in the form of cinema or lottery tickets can undermine motivation among adult respondents with already high intrinsic motivation to participate, as stated in this study. However, the young group in the current thesis was considered to possibly be more interested in participating if they received some incentives. In the interviews for Paper III, though, several of the participants reported that they would have had participated even without any incentives.

Informed consent was given when answering the questionnaires in both cohorts and in the survey performed by Statistics Sweden. Specifically, for Paper III, a formal information session with a professional atmosphere was held before the participants gave their written informed consent. Also, the sample selection for the interviews was performed in several steps, so the participants were prepared before being questioned about possible participation. If they declined, no attempts were made to convince them to join. In the interview situation, this professional attitude was important to perform the interview in an ethical way. Finally, for Paper III all participants received the published article, to obtain feedback on their participation.

5.4 Implications

The focus in this thesis on the unexplored group of young adults and the approach to work ability as a continuum (Lindberg 2006) from reduced productivity to excellent work ability generate suggestions for implications. The finding that work ability was experienced as complex can be a basis for constructing nuanced prevention and promotion programs that take private life into consideration, alongside the notion that work ability is one's own responsibility. The well-executed introduction and education of newly employed young workers can be of great importance in increasing their knowledge of the responsibility of the employer and how the organization can influence their work ability (Hanvold et al. 2016). In addition, mentorship by experienced colleagues at the workplace could be important. Furthermore, an organization that creates varied work with flexible working hours, and

possibilities of deciding when to perform a work task, could increase the opportunities for recovery at work, which could contribute to excellent work ability, probably for both young women and young men. Organizations that fulfill prerequisites for good job control and social support at work can probably both prevent reduced work ability and also promote improved work ability among young workers. Also, if, through good leadership, the work organization were to facilitate a balance between work and leisure by allowing workers to set limits between these areas, work ability could improve. Finally, to prevent generally reduced productivity, it seems important that personnel in student health centers and in primary health care take musculoskeletal complaints among young adults seriously. In sum, from this thesis there are several implications for both employers and health care givers to increase the possibilities of reaching sustainable work ability for young adults in their transition from student life to working life.

6 CONCLUSION

General conclusions

Work ability for young adults can be seen as one's own responsibility and as complex, including, besides occupational factors, private life and work–life balance. Widespread and long-lasting symptoms can reduce general productivity, while having varied work can be a recovery opportunity at work for young men, which could promote excellent work ability.

Specific conclusions

The main risk factors for generally reduced productivity due to musculoskeletal pain or ache among young students in this study were long-lasting (chronic) symptoms in the upper extremities and widespread symptoms in the neck and upper extremities *(Paper I)*.

Decreased job control and increased negative influence of job demands on private life over time seem to be the most important work factors associated with reduced work ability among young workers of both sexes. Increased social support at work, increased job control, and decreased negative influence of job demands on private life were also found to be the main work factors associated with improved work ability, although with possible gender differences *(Paper II)*.

Work ability was experienced as complex and as the worker's own responsibility that could be influenced by work circumstances and private life. To promote good work ability among young workers, work ability has to be understood in its specific work context. Whether the understanding of work ability found in this study is explicit for the group of young adults needs to be explored in a more general population in further research *(Paper III)*.

Having varied work can contribute to excellent work ability for young men. In addition, for men with high work demands, the possibility of deciding when to perform a work task may be favorable for excellent work ability. For young women with high work demands, the possibility of deciding one's working hours can contribute to excellent work ability. Employers could use these opportunities for recovery in promoting work ability among young workers *(Paper IV)*.

7 FUTURE PERSPECTIVES

This thesis contributes knowledge to the field of both prevention of low work ability and promotion of excellent work ability for young adults. Certainly, there is much more to do in this research area, including comparing different age groups to examine whether the results in this thesis solely concern young adults or are more generally applicable, independent of age. A clearer gender focus is also important to develop in this research topic.

To increase the possibility of answering questions about causality in the field of work ability among young adults, more prospective studies are desirable. These would increase the understanding of causal relationships between individual, lifestyle, and occupational factors and work ability. Furthermore, more qualitative studies in this research topic would definitely increase the understanding of work ability in this young group. For example, increased knowledge of employers' experiences of work ability (Jansson et al. 2015), including among young workers, and young workers' own experiences of opportunities for recovery at work and their influence on work ability, could be of great interest.

Traditionally, risk factors have been studied in occupational epidemiology. In the future, hopefully a larger focus will be aimed at positive factors at work. Multidimensional measurements of work ability have recently been developed to handle the challenges of promoting work ability (Ilmarinen et al. 2015), which can be seen as a promising start. Likewise, there is a great need of intervention studies to examine options to promote sustainable work ability among young adults.

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Släck lampan, lägg bort din bok
Du blir alldeles för klok
Det är på tok
För många ord
För en kväll som den här
På vår jord

Vit flagg
Nådens År
Ulf Lundell, 1978

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APPENDIX

The appendix tables for Paper II describes the subgroups of the study sample at baseline (Table A) respectively the work factors at baseline and the changes between baseline and 1-year follow-up for the study sample (Table B).

Table A. Descriptive characteristics of the subgroups of the study sample at baseline.

	The subgroup of workers with reduced work ability at the 1- year follow-up N = 431		Males (N = 181, 42%)		Females (N = 250, 58%)		The subgroup of workers with improved work ability at the 1- year follow-up N = 98		Males (N = 35, 36%)		Females (N = 63, 64%)		The subgroup of workers with constant work ability at the 1-year follow-up N = 782		Males (N = 377, 48%)		Females (N = 405, 52%)	
Work ability at baseline; mean (range) SD	9.2 (5-10) 1.0		9.3 (7-10) 0.9		9.1 (5-10) 1.1		6.1 (1-8) 1.7		6.5 (1-8) 1.8		5.8 (1-8) 1.8		8.6 (3-10) 1.3		8.7 (4-10) 1.3		8.5 (3-10) 1.3	
Individual factors at baseline	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Civil status																		
Cohabit/married/partnership	165	42	59	35	106	47	33	36	11	31	22	39	307	42	127	35	180	49
Girl-/boyfriend, not living together	90	22	37	22	53	23	25	27	11	31	14	24	139	19	67	19	72	19
Single	143	36	74	43	69	30	34	37	13	38	21	37	285	39	165	46	120	32
Educational level – highest finished																		
Compulsory school/high school	336	76	153	80	183	73	82	85	34	97	48	77	638	82	329	88	309	77
College/university	88	24	27	20	61	27	15	15	1	3	14	23	137	18	44	12	93	23
Occupation with demands of education at college/university level																		
Yes	50	12	15	8	35	14	7	8	1	3	6	10	89	12	28	8	61	16
No	373	88	163	92	210	86	86	92	33	97	53	90	673	88	342	92	331	84

Living area																		
City	176	41	62	34	114	46	54	55	21	60	33	52	302	39	139	37	163	40
Not city	255	59	119	66	136	54	44	45	14	40	30	48	480	61	238	63	242	60
Birth country																		
Sweden	404	94	167	92	237	95	91	93	32	91	59	94	742	95	360	96	382	94
Other	27	6	14	8	13	5	7	7	3	9	4	6	40	5	17	4	23	6
Smoking																		
No, not at all/seldom	373	87	162	90	211	85	75	77	32	91	43	68	675	86	335	89	340	84
Yes, daily/nearly daily	57	13	19	10	38	15	23	23	3	9	20	32	107	13	42	11	65	16
Body mass index																		
< 25 kg/m²	293	71	119	66	174	75	66	70	21	62	45	75	524	70	232	64	292	77
≥ 25 kg/m²	119	29	60	34	59	25	28	30	13	38	15	25	220	30	133	36	87	23
Physical activity in leisure time																		
Moderate exercise-hard training	354	83	147	82	207	84	82	84	29	83	53	84	652	85	306	84	341	86
Sedentary	72	17	32	18	40	16	16	16	6	17	10	16	117	15	61	16	56	14
Chronic pain or ache (> 3 months)																		
No	333	78	153	86	180	72	62	64	25	71	37	60	593	76	309	83	284	70
Yes	94	22	25	14	69	28	35	36	10	29	25	40	185	24	64	17	121	30
Symptoms of depression last month																		
No	186	62	91	69	95	57	21	28	11	41	10	21	343	61	199	71	144	51
Yes	113	38	40	31	73	43	53	72	16	59	37	79	222	39	82	29	140	49
Experienced health																		
Good or very good	335	78	145	80	190	76	54	55	25	71	29	46	619	80	321	85	298	74
Very bad, bad or moderately	95	22	36	20	59	24	44	45	10	29	34	54	161	20	56	15	105	26

N = number of workers
SD = standard deviation

Table B. Descriptive characteristics of work factors at baseline and changes in work factors between baseline and 1- year follow-up for the study sample.

	Baseline						**Plausible increased negative exposure, baseline – 1- year follow-up**						**Plausible decreased negative exposure, baseline – 1- year follow-up**					
	All workers (N =1311)		Males (N = 593, 45%)		Females (N = 718, 55%)		All workers		Males		Females		All workers		Males		Females	
Physical work factors	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Computer time, h/day, in general last month							239	18	102	17	137	19	201	15	94	16	107	15
< 2 h/day	506	39	214	36	292	41												
2-4 h/day	368	28	192	33	176	25												
>4 h/day	432	33	186	31	246	34												
Computer use 2 h with no breaks > 10 min, last month							378	29	158	27	220	31	364	28	169	28	195	27
Never	291	22	115	19	176	25												
Once in awhile	369	28	146	25	223	31												
A couple of times per month	198	15	90	15	108	15												
A couple of times per week	202	16	109	18	93	13												
Most days	248	19	133	23	115	16												
Hands above shoulder level last month							246	19	108	18	138	19	273	21	129	22	144	20
Never	361	28	137	23	224	32												
< 1 h/day	606	46	263	45	343	48												
1-2 h/day	190	15	112	19	78	11												
>2 h/day	143	11	79	13	64	9												

Flexed or extended neck last month							345	26	154	26	191	27	309	24	142	24	167	23
Never	238	18	84	14	154	22												
< 3 h/day	546	42	286	49	260	36												
3-5 h/day	258	20	113	19	145	20												
>5 h/day	261	20	106	18	155	22												
Flexed back last month							297	23	152	24	155	22	293	22	140	24	153	21
Never	276	21	108	18	168	24												
< 0,5 h/day	291	22	146	25	145	20												
0,5-1 h/day	272	21	137	23	135	19												
>1 h/day	465	36	198	34	267	37												
Lifting 5-10 kg last month							249	19	127	21	122	17	270	21	120	20	150	21
0-4 times/day	518	42	169	31	349	52												
5-15 times/day	316	26	153	28	163	24												
16-30 times/day	147	12	85	15	62	9												
>30 times/day	242	20	144	26	98	15												
Lifting 11-15 kg last month							189	14	112	19	77	11	223	17	132	22	91	13
0-4 times/day	685	59	242	45	443	70												
5-15 times/day	261	22	152	28	109	17												
16-30 times/day	105	9	63	12	42	7												
>30 times/day	114	10	78	15	36	6												
Lifting 16-25 kg last month							136	10	84	14	52	7	166	13	95	16	71	10
0-4 times/day	809	71	314	59	495	82												
5-15 times/day	199	17	125	23	74	12												
16-30 times/day	57	5	36	7	21	3												
>30 times/day	76	7	59	11	17	3												

Lifting > 25 kg last month							115	9	70	12	45	6	131	10	81	14	50	7
0-4 times/day	902	79	374	70	528	86												
5-15 times/day	157	14	99	19	58	10												
16-30 times/day	32	3	21	4	11	2												
>30 times/day	53	4	39	7	14	2												
Forceful grip last month							221	17	119	20	102	14	267	20	131	22	136	19
Seldom or never	707	54	227	39	480	67												
Several times/day	397	31	220	37	177	25												
Several times/h	152	12	108	18	44	6												
Several times/min	44	3	33	6	11	2												
Use of vibrating tools							58	4	33	6	25	3	46	4	31	5	15	2
No	965	78	318	58	647	93												
Yes, in work	278	22	233	42	45	7												
Psychosocial work factors																		
Experiencing high job demands							385	29	150	25	235	33	236	18	107	18	129	18
Correspond very poorly	79	6	34	6	45	6												
Correspond fairly poorly	240	18	90	15	150	21												
Correspond fairly well	612	47	285	49	327	46												
Correspond very well	374	29	179	30	195	27												
Experiencing job control							388	30	168	28	220	31	199	15	90	15	109	15
Correspond very poorly	16	1	8	1	8	1												
Correspond fairly poorly	84	6	33	6	51	7												
Correspond fairly well	689	53	309	52	380	53												
Correspond very well	517	40	239	41	278	39												

Experiencing social support at work							420	32	179	30	241	34	239	18	103	17	136	19
Correspond very poorly	45	3	19	3	26	4												
Correspond fairly poorly	176	14	81	14	95	13												
Correspond fairly well	556	43	260	44	296	41												
Correspond very well	527	40	227	39	300	42												
Experiencing reward relative to effort							415	32	189	32	226	31	326	25	133	22	193	27
Correspond very poorly	124	10	57	10	67	9												
Correspond fairly poorly	310	24	131	22	179	25												
Correspond fairly well	582	44	263	45	319	45												
Correspond very well	287	22	136	23	151	21												
Experiencing negative influence of job demands on private life							411	31	172	29	239	33	349	27	149	25	200	28
Very seldom	552	42	275	47	277	39												
Fairly seldom	237	18	108	18	129	18												
Sometimes	346	27	139	23	207	29												
Fairly often	116	9	47	8	69	10												
Very often	55	4	22	4	33	4												
Work outside the workplace last month							317	24	138	23	179	25	209	16	95	16	114	16
Never	817	63	380	65	437	61												
Once in awhile	267	20	107	18	160	23												
A couple of times per month	107	8	47	8	60	8												
A couple of times per week	72	6	36	6	36	5												
On the whole every day	40	3	20	3	20	3												

Overtime work (>12 h/day) last month							319	24	167	28	152	21	264	20	123	21	141	20
0 times	739	57	299	51	440	61												
1-2 times	316	24	144	24	172	24												
3-8 times	169	13	90	15	79	11												
9-15 times	44	3	26	4	18	3												
>15 times	42	3	34	6	8	1												
Need to be reachable by mobile phone in duty after working hours last month.							340	26	172	29	168	23	249	19	117	20	132	18
Never	685	53	293	50	392	55												
Once in awhile	258	20	104	17	154	22												
A couple of times per month	113	9	65	11	48	7												
A couple of times per week	71	5	34	6	37	5												
On the whole every day	176	13	94	16	82	11												
Noise annoyance at the workplace last month							427	33	190	32	237	33	329	25	147	25	182	25
Never	174	13	98	17	76	11												
Once in awhile	261	20	103	17	158	22												
A couple of times per month	163	13	67	11	96	13												
A couple of times per week	195	15	81	14	114	16												
On the whole every day	512	39	239	41	273	38												

N = number of workers