

From the Department of Clinical Neuroscience  
Section of Personal Injury Prevention  
Karolinska Institutet, SE-171 77 Stockholm, Sweden

# **THE WORK ABILITY CONTINUUM**

Epidemiological studies of factors promoting  
sustainable work ability

Per Lindberg



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## ABSTRACT

For the individual, the workplace and society, there would be considerable gains if the number of people suffering from physical and mental disorders could be reduced. The overall aim of this thesis was to identify determinants for future work ability among gainfully employed women and men, with special reference to promotive factors at work. "Work ability" is in this thesis defined as the ability to work with respect to demands at work on health and physical and mental resources, while "impaired work ability" is expressed in terms of sick leave rates. The reasons to study promoting factors were threefold: firstly, to find alternatives to traditional risk prevention. Secondly, if work ability is regarded as a continuum, promotive measures could bring individuals closer to the positive end-point and further away from the breaking point of getting sick-listed long-term. Thirdly, the scientific basis for workplace health promotion is limited.

The thesis comprises four prospective studies based on two different Swedish cohorts, for which data were collected 1999-2004. Studies I, III and IV are based on a strategic sample of 9 000 employees in the public sector aged 19–65 years, of which 81% answered a baseline questionnaire and were followed up for 1½–4 years by means of questionnaires and register data on sick leave. Study II is based on a random sample of 12 000 persons from the general population aged 35, 45 and 55 years, of which 65% answered a baseline questionnaire and were followed up for 1 year by means of register data.

In studies I–III several factors in private and working life acted as determinants of future work ability. Some of these determinants were associated solely with excellent work ability, some solely with poor work ability and others with both. Most of the identified lifestyle- and work-related determinants are amenable to influence in order to promote sustainable work ability. Such determinants associated with excellent work ability (no sick leave) were physical leisure exercise, content with number of working hours, good work postures, high role clarity, low psychological demands and positive feed-back from superior. Determinants associated with retained work ability ( $\leq 14$  days sick leave) were being recuperated, in the mood for work and physical non-strenuous work. Determinants associated with poor work ability (sick leave long-term,  $>28$  days) were obesity, not being recuperated, not in the mood for work, bullying, physical and mental demands at work higher than own capacity, high psychological demands and low decision latitude. No significant differences between the sexes were found.

In study IV were five single- and multi-question instruments for self-assessment compared with regard to prediction of future work ability. These instruments showed similar power to predict; also, they were better at discriminating for poor than for excellent work ability and discriminated poor work ability somewhat better for men than for women.

In conclusion, in this thesis work ability was associated with a number of factors both in private and in working life, somewhat different at the two end-points excellent and poor work ability. As most of the identified determinants are amenable to influence, this opens up for possible interventions. Single-item instruments for self-rated health/work ability can be used for purposes such as screening to identify risk groups for impaired work ability.

Further studies are needed to establish whether an approach in terms of promoting work ability is practicable for sustainable working life.

*Key words: work, work ability, sustainable, positive health, sick leave, sickness absence, self-rated health, SRH, health assessment, promotion, prevention, follow-up, epidemiology*

# SAMMANFATTNING

För individen, arbetsplatsen och samhället kan avsevärda vinster göras om antalet personer som lider av fysiska och mentala besvär kan reduceras. Det övergripande syftet med den här avhandlingen var att identifiera determinanter för framtida arbetsförmåga bland förvärvsarbetande kvinnor och män, med särskild avsikt att hitta främjande arbetsfaktorer. ”Arbetsförmåga” definierades i den här avhandlingen som förmågan att arbeta med avseende på arbetskravens inverkan på hälsan och fysiska och mentala resurser, medan ”nedsatt arbetsförmåga” definieras genom graden av sjukskrivning. Anledningen till att studera främjande faktorer var, för det första att hitta alternativ till traditionell risk prevention; för det andra, om man betraktar arbetsförmågan som ett kontinuum, kan främjande åtgärder tänkas föra individer närmare den positiva ändpunkten och längre bort från brytpunkten för att bli långtidssjukskriven; och för det tredje, det vetenskapliga underlaget för åtgärder som främjar arbetsförmågan är begränsat.

Avhandlingen består av fyra prospektiva studier baserade på två olika svenska kohorter, där data insamlades 1999–2004. Studie I, II och IV baseras på ett strategiskt urval av 9 000 individer i offentlig sektor i åldern 19–65 år, av vilka 81% besvarade en baslinjeenkät och därefter följdes under 1½–4 år genom enkäter och register data på sjukfrånvaro. Studie II baseras på ett slumpvis urval av 12 000 personer ur befolkningsregistret i åldersgrupperna 35, 45 och 55 år, varav 65% besvarade en baslinjeenkät och följdes under 1 år genom nationella sjukskrivningsregistret.

I studie I-III framkom många faktorer både i privat- och arbetslivet som visade på statistiskt signifikanta samband med framtida arbetsförmåga. Några av dess determinanter associerade endast med excellent arbetsförmåga, några endast med nedsatt arbetsförmåga och andra med både och. De flesta av de identifierade determinanterna som är knutna till livsstil och arbetsliv är möjliga att påverka för att främja en hållbar arbetshälsa. Determinanter som hade samband med excellent arbetsförmåga (0 sjukfrånvaro) var fritidssport, nöjd med arbetstiden, bra arbetsställningar, rolltydlighet inom arbetet, låga psykologiska krav, och positiv feedback från chefen. Samband med bibehållen arbetsförmåga ( $\leq 14$  dagars sjukskrivning) identifierades för faktorerna att vara återhämtad, att inte känna olust på väg till arbetet och att uppleva arbetet som icke fysiskt ansträngande. Samband med nedsatt arbetsförmåga (långtidssjukskrivning  $> 28$  dagar) identifierades för fetma, att inte vara återhämtad, utfrysning, om de fysiska och mentala kraven överstiger individens kapacitet, höga psykologiska krav och låg kontroll. Inga signifikanta skillnader mellan könen hittades.

I studie IV jämfördes fem en- och flerfrågeinstrument med avseende på prediktion av arbetsförmågan. Instrumenten visade likartad styrka att predicera, men var bättre på att predicera nedsatt jämfört med excellent arbetsförmåga och predicerade nedsatt arbetsförmåga något bättre för män än för kvinnor.

Sammanfattningsvis visar resultaten av den här avhandlingen att arbetsförmågan är betingad av en mängd olika faktorer både i privat- och arbetslivet, att bestämningsfaktorerna är något olika för excellent respektive nedsatt arbetsförmåga. Eftersom de flesta av de identifierade determinanterna går att påverka är det möjligt att intervensera. Enkla självskattningsinstrument för hälsa/arbetsförmåga kan användas för att t.ex. identifiera risk grupper för nedsatt arbetsförmåga.

Fler studier behövs för att kunna fastslå om ett perspektiv med främjande av arbetsförmågan är en framkomlig väg för hållbar arbetshälsa.

*Nyckelord: arbete, arbetsförmåga, hållbar, positiv hälsa, sjukfrånvaro, sjukskrivning, självskattad hälsa, SSH, främjande, förebyggande, uppföljning, epidemiologi*

*När vårt behov av att tro på något  
fördunklar vårt förnuft, bryr vi oss  
inte om vad vi vet.*

Lögnens olidliga lätthet  
Yrsa Stenius, 2005



## LIST OF PUBLICATIONS

The thesis is based on the following papers, which are referred to in the text by their Roman numerals:

- I. Vingård E, Lindberg P, Josephson M, Voss M, Heijbel B, Alfredsson L, Stark S, Nygren Å.  
Long-term sick-listing among women in the public sector and its associations with age, social situation, lifestyle and work factors:  
A three-year follow-up study.  
*Scandinavian Journal of Public Health*, 2005; 33: 370–375.
- II. Lindberg P, Vingård E, Josephson M, Alfredsson L.  
Retaining the ability to work – associated factors at work.  
*European Journal of Public Health*, doi:10.1093/eurpub/cki190.
- III. Lindberg P, Josephson M, Alfredsson L, Vingård E.  
Promoting excellent work ability and preventing poor work ability:  
the same determinants? Results from the Swedish HAKuL study.  
*Occupational and Environmental Medicine*, 2006;63:113–120.
- IV. Lindberg P, Josephson M, Alfredsson L, Vingård E.  
Work ability – a comparison of five self-administered instruments for  
predicting excellent as well as poor work ability.  
*Submitted*.

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## LIST OF ABBREVIATIONS

BMI	body mass index = body weight in kg/body height <sup>2</sup>
CI	confidence interval
GRR	general resistance resource
HR	hazard ratio
OR	odds ratio
RR	relative risk
SOC	sense of coherence
SRH	self-rated health
v.	versus
WHP	workplace health promotion

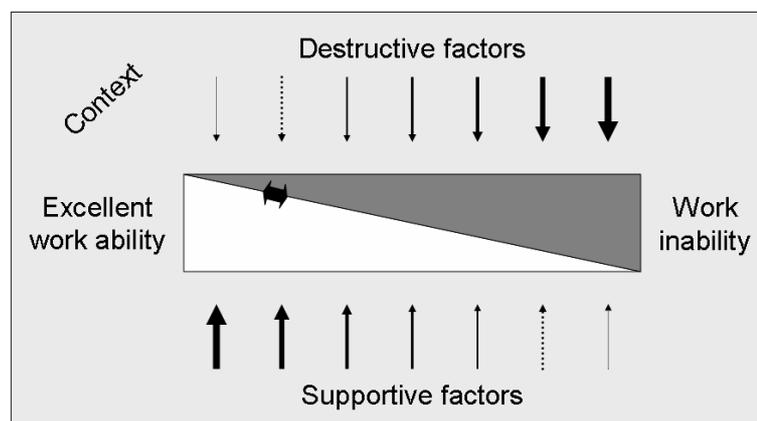
## DEFINITIONS

Fortigenesis	From Latin: <i>fortis</i> = strength, and Greek: <i>genesis</i> = origins, i.e. sources of strength
Global health	General or overall health of an individual assessed by a single question or by several questions combined into a scale.
Long-term sick leave	There is no general consensus on a definition of “long-term sick leave”. In this thesis it is defined as either - spells of sick leave $\geq 28$ days (studies I and IV); or - $>28$ days’ sick leave in total during 1 year (Study III).
Pathogenesis	From Greek: <i>pathos</i> = suffering, disease, and <i>genesis</i> = origins, i.e. sources of disease
Salutogenesis	From Latin: <i>salus</i> = health, and Greek: <i>genesis</i> = origins, i.e. sources of health
Work ability	As defined in this thesis:
- excellent:	Study III: no sick leave and no days of sickness attendance during 1 year; Study IV: no sick leave at all during 4 years
- poor:	Studies I and IV: one or more spells of sick leave $\geq 28$ days; Study III: $>28$ days of sick leave during 1 year
- retained:	Study II: $\leq 14$ consecutive days of sick leave during 1 year

## INTRODUCTION

For the individual, the workplace and society, there would be considerable gains if the number of people suffering from physical and mental disorders could be reduced. Traditionally in occupational health this has been done by treating illnesses and, by suspicion of causative elements, eliminating/reducing identified risk factors at work. This is still the first choice in trying to achieve a sustainable working life. However, sometimes it is not possible to do this because of costs, practical problems or no immediate solution. It would in general, and especially in these cases, be of great value if employees could be “strengthened” to retain their work ability. Why is it, for instance, that some people exposed to well-known risks do not get sick-listed and others do? Is it just genetics? A hypothesis is that there are factors in life and at work that enhance work ability, which in this thesis is defined as the ability to work with respect to demands at work on health and physical and mental resources.

During the work for this thesis and in the context of the study titled, “Work and sustainable health in the public sector in Sweden” (the HAKuL Study), a model of work ability during the course of life, “the work ability continuum”, was developed, inspired by the works of Lennart Nordenfelt<sup>126-129,131,132</sup> and Aaron Antonovsky<sup>6,7,9,10</sup> (Figure 1). The model illustrates how the work ability of an individual within his or her unique life context is influenced by a dynamic interplay between supportive factors promoting excellent work ability and counteracting, destructive factors. During his or her working life the individual will move up and down the “work ability continuum”.



**Figure 1.** The work ability continuum. The small black arrow on the slope represents the individual's movement between excellent work ability and work inability.

Somewhere along this slope there is a breaking point at which the individual experiences too reduced an ability to work and as a consequence will take sick leave. The breaking point is personal and reflects a standpoint which encompasses a wide range of factors such as somatic, psychiatric and social responses to disease, motivation,

attitudes, obligations towards work and family, flexibility at work, and construction of the health insurance and benefits involved. Some supportive factors can be actively chosen and some destructive factors can be actively avoided by the individual while other changes are only possible at the workplace and in society. The ability to act/work and achieve essential goals can be inherited, habitual and acquired, and can be affected in both promotive and destructive directions.

As working life is subject to constant changes and fairly accessible to interventions both at the individual and at the group and organizational levels this thesis will focus on factors at work.

## BACKGROUND

*Health is a state in which we neither suffer from evil  
nor are prevented from the functions of daily life.*

Galenos, ca. 130–200 AD

## HEALTH

In Greek mythology Asklepios was the God of medicine and healing. Asklepios had two daughters, Panakeia and Hygieia. Panakeia (= cure-all) was the goddess of cures, medicines, salves and other cures. To some part her cult is still alive in the search for a panacea, a cure for all. Hygieia (= healthy, sound) was the goddess of good health. She taught the Greeks that they could remain in good health if they lived according to reason, with moderation in all things. Hygieia, whose name can still be found in the word “hygiene”, was worshipped alongside her father also during the Roman period.

In ancient Greece and Rome there was an acknowledged relation between medicine and philosophy. Many of the ancient and medieval doctors were also philosophers. Plato’s and Aristotle’s ideas influenced medical thinking until Vesalius’ (1514–1564) observations at the dissection table introduced a more somatic approach to medicine. The Western medicine of today has lost some of its philosophical background in favour of one philosophical standpoint, extreme empiricism.<sup>116,127</sup>

During the second half of the 20th century some suggestions for definitions of “health” and “disease” emerged in the philosophic discourse. Two main perspectives can be distinguished. One is the biomedical view, with theories based on biological, chemical, physiological and statistical entities, e.g. atomistic-biological, mechanistic, molecular, and biostatistical theories. In the biomedical paradigm disease is in focus and health is defined as the absence of disease. The other perspective is a humanistic view, with theories based on humanistic and social concepts, according to which the whole is greater than the sum of the parts and a person and his or her context, actions and goals are central, e.g. holistic, molar, ecologic and salutogenic theories. In the humanistic paradigm health is in focus and viewed as something more than just the absence of disease.<sup>116,127</sup>

A modern representative of the biostatistical school, the American philosopher Boorse defines a disease entity as the state of an individual which interferes with or even prevents the normal function of some organ or system of organs belonging to the bearer of the state. Thus health is defined as follows:

Health is normal functioning, where the normality is statistical and the functions biological.<sup>30,31</sup>

Or, as explained by the Swedish philosopher Nordenfelt, “A person is in health if he has no disease, he is diseased if he has at least one disease. Health and disease are characterised as purely descriptive, scientific notions without any evaluative component”.<sup>127</sup>



**Figure 2.** Health-unhealth as defined by Boorse.<sup>31</sup>

In “A theory of health” the holistic American philosopher Whitbeck argues that health is much more than the absence of disease, and that a high level of health is compatible with having some disease, since health contrasts both with other aspects of social well-being and with happiness. Deriving from “hale”, which means “whole”, health connotes wholeness of a person. Wholeness of a person is more than the wholeness of an organism, although the wholeness of the organism contributes to the health or wholeness of the person. This sense of wholeness of a person implies the ability to engage in distinctly human activities or, as Whitbeck puts it, capabilities, meaning the ability to engage in activities that are characteristically intentional actions. To assess people’s health, one must take into account their capabilities and not merely their biological capacities.<sup>195</sup>

Another representative of the holistic perspective, the Finnish philosopher Pörn introduced an “equilibrium model of health” (Note that equilibrium in the context of Pörn’s model is not equal to biological homeostasis.) stating that

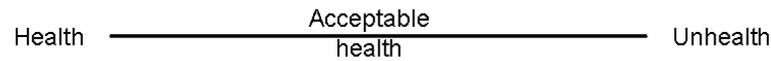
Health is a state of a person which obtains exactly when his repertoire is adequate relative to his profile of goals. A person who is healthy in this sense carries with him the intrapersonal resources that are sufficient for what his goals require of him.<sup>145</sup>

With reference to Whitbeck and Pörn<sup>145,195</sup>, Nordenfelt has presented a specification of the equilibrium theory:

Health is a person’s ability, given standard circumstances, to achieve his vital goals and thus realise minimal happiness.<sup>128</sup>

By “standard circumstances”, Nordenfelt means normal circumstances, e.g. not war; however, to avoid any confusion with “statistical normality” he used the word “standard”. The standard circumstance will, then, be different for a person who lives in Sweden compared with one who lives in China. To summarize the equilibrium theory Nordenfelt put forward that the convincing idea of the equilibrium theory is that health is fundamentally connected with the concept of ability and that unhealth or disease is connected with the concept of disability: “The healthy man is an able man, and the

unhealthy one is disabled.” Ability must be judged in relation to goals.<sup>127</sup> A consequence of this is that Nordenfelt also acknowledges that there can be different degrees of health, that health is not a dichotomy, an “either or”.



**Figure 3.** Health-unhealth as defined by Nordenfelt.<sup>128</sup>

In summarizing studies (1973–1998) on lay people’s evaluations of the notion of health Medin and Alexanderson<sup>116</sup> identified three main conceptions on health, viz. –

- health as the absence of illness;
- health as a resource, a strength (including the ability to withstand disease); and
- health as the state of being in balance, in form.

These ideas are not so far removed from Nordenfelt’s theory<sup>128</sup> and support that these concepts meet his criterion that a reasonable theory of health and disease must have the power to explain our everyday discourse concerning our ordinary intuitions as they are expressed in ordinary language.<sup>127</sup>

The definition of health by the World Health Organization (WHO),

Health is a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity,<sup>197</sup>

which is often criticized for its utopian aim, is sometimes referred to as the “Magna Carta of health”.<sup>198</sup> This maximal, holistic definition is rather close to the definitions by Whitbeck, Pörn and Nordenfelt<sup>128,145,195</sup> but lacks the action orientation.

In other words, there is no consensus about a generally accepted definition of health. Such a definition would be useful in enhancing the understanding of terms of health and how to improve health. It would also make it possible to assess the health status of individuals and populations and how it changes over time. It is known that people experience good health despite a chronic disease, and vice versa. Consequently there are reasons to separate the notions of healthy-diseased and health-unhealth. Disease is, then, a deviation from normal functions while health is an experience of well-being and the ability to act despite eventual disease.<sup>130,161</sup>

### **Positive health**

The concept of positive health or health beyond the absence of disease has been criticized by the atomistic-biostatistical school for not changing the underlying concept of health as the absence of disease as long as what is prevented is still disease.<sup>31</sup> Whereas Whitbeck<sup>195</sup> argues the term “wholeness” should not suggest that there exists an upper

limit, a state of optimum health. People can always increase their ability to act appropriately in some situations. The absence of an upper limit on health does not make the concept any more obscure than concepts such as wealth, which likewise has no upper limit.

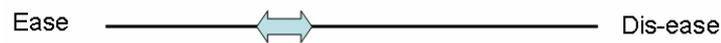
According to Seligman<sup>155</sup> there were within psychology some early works on positive psychology, e.g. Terman's studies on giftedness<sup>171</sup> and Jung's work concerning the search for and discovery of meaning in life.<sup>81</sup> However, the focus on pathology has been dominating since World War II. During the last decade the interest in positive psychology has been rekindled, investigating subjective experiences (e.g. well-being, contentment, happiness, flow and satisfaction), positive individual traits (e.g. hope, wisdom, creativity and courage) and positive institutions. An expected main effect is to help individuals and communities not just to endure and survive, but also, to flourish, and as a side effect learn how to buffer against and better prevent mental as well as some physical illnesses. Nelson<sup>125</sup> suggests that extending this movement into the realm of occupational health psychology and specifically to the study of work stress allows studies of positive aspects of the stress experience (eustress) and the question, Who stays healthy under stress?

Patrick and Bergner<sup>140</sup> argue that positive health, at the upper end of the health-illness continuum, is not easy to define. There tends to be wider disagreement about what is "good health" than about what is "bad health", they say. One approach, analogous to the functionalist definition of illness as undesirable deviations from the normal functioning of the total human individual, would be to define positive health as *desirable* deviations from expected or usual functions, activities or perceptions that constitute daily life. This approach would be consistent with the concept of physiologic reserve. Physiologic reserve represents the unused capacity of the organism that can be called upon in times of stress, crisis, or increased activity. Physiologic reserve decreases with age regardless of an individual's overall health; however, individual differences in reserve exist. Some of these differences may be genetic in origin; some may result from health-promoting states, interventions or behaviours. Positive health may be viewed as capacity rather than performance. Unfortunately, physiologic reserve in its positive sense, or positive health, is difficult to assess and developing such measurements remains a challenge, according to Patrick and Bergner.

The difficulties to assess positive health has also been addressed by Kemm<sup>85</sup> who describes that the developers of the "Sickness Impact Profile"<sup>23</sup> and the "Nottingham Health Profile"<sup>70</sup> both attempted to include items to measure positive health and both had to discard these items during development because they did not give valid results. One ground mentioned is the paucity of language used to describe positive health.

How unexplored the realm of positive health still is, is made clear by Ryff and Singer.<sup>152</sup> They state that defining health as the presence of wellness of mind and body rather than the absence of illness has its implications for science and practice. Positive human health, with its emphasis on complex body-mind processes that must be tracked through time, is a daunting biopsychosocial agenda. The vision required is to go beyond the separated layers of cultural, social, psychological and biological components into the synthesis of how they integrate.

In 1979 Aaron Antonovsky introduced the salutogenic model,<sup>6</sup> the fundamental question of which is not why people get sick, but why some people stay well despite stressful situations and hardship. Hence, what is the origin of health? Salutogenesis focuses on resources, and maintains and improves the movement towards health. It is the opposite of the pathogenic concept in which the focus is on obstacles and deficits. Antonovsky described health as a continuum between the two poles of excellent and ill health, along which people constantly move upwards and downwards<sup>7</sup> (Figure 4).



**Figure 4.** Health-unhealth as defined by Antonovsky.<sup>7</sup>

Salutogenetic studies aim at explaining factors that promote a movement towards the healthy pole. According to Antonovsky's theory, the point is that this often involves different factors, not only low levels of risk factors but also, factors acting as buffers and factors directly promoting health.<sup>7</sup>

Examples of factors that have been identified as having health-promotive effects at work are low to moderate exposures to the musculoskeletal apparatus for individuals who initially reported poor self-rated health (SRH)<sup>33</sup>; limited physical exertion; not working alone; a good working climate; being in a good mood on the way to work; and learning new things at work; as well as work that rarely demands too big an effort; increased collaboration; participation in the planning of the work;<sup>162</sup> and support from the supervisor.<sup>172,212</sup> Also, positive changes of one psychosocial aspect could partly buffer against adverse consequences from other job aspects and good support from the one's superior reduces the over-risk associated with low or decreased control over work tasks.<sup>183</sup> Furthermore, a balance between the sexes at work and in the family;<sup>71</sup> a reduced amount of repetitive work; satisfaction with the supervisor; and increased physical leisure activity were significant predictors of increased work ability for employees 55–62 years of age,<sup>181</sup> as was active leisure.<sup>212</sup>

Within the salutogenic perspective Antonovsky developed the theory about the sense of coherence (SOC),<sup>7</sup> a model including the three components comprehensibility, manageability and meaningfulness, reinforced by the concept of "general resistance resources" (GRRs), resources available to be used and reused to move in a health-promoting direction. A high SOC is characterized more by the ability to use the GRRs than by the number of them. Sense of coherence is mostly characterized as a measure of the individual's resistance to stress but according to Antonovsky, it can also be applied at group and societal level. Sense of coherence as an explanatory model/theory has been used in several studies within mental health, psychosomatic medicine, public health and stress research. The degree of SOC has been reported to predict psychiatric and somatic health problems both in the short and in the long term.<sup>153</sup> So far there is no firm empirical basis for an association between SOC and health as most studies are cross-sectional and have methodological shortcomings.<sup>61,89,169</sup> A further problem is the high

correlation between SOC and measures of anxiety and depression.<sup>61,89,153</sup> Longitudinal studies of the association between SOC and self-reported health,<sup>169</sup> and between SOC and sickness absence<sup>89,91</sup> show ambiguous results. In a large review Eriksson and Lindström<sup>54</sup> established that the SOC scale seems to be a reliable, valid and cross-culturally applicable instrument and that SOC predicts a positive outcome in a long-term perspective, although divergent findings have been reported. Suominen et al.<sup>169</sup> suggest that even if SOC can be interpreted as an autonomous internal resource it should be viewed as a compliment to and not substitute for information about other already known causes of health/unhealth.

It should be pointed out that salutogenesis is not equal to SOC. The reason to describe the salutogenic construct SOC is that it has gained a fairly wide interest in Sweden and in research of different aspects related to health. There are a number of other salutogenic constructs. Strümpfer<sup>164</sup> discusses the relationship between five such constructs, Antonovsky's SOC,<sup>6,7</sup> Kobasa's "personality hardiness",<sup>92</sup> Ben-Sira's "potency",<sup>19</sup> Thomas's and Colerick's "stamina",<sup>44,173</sup> and Rosenbaum's "learned resourcefulness".<sup>150</sup> Strümpfer views these constructs as being of fundamental importance for research and practice in health psychology, since the primary concern in health psychology is maintenance and enhancement of wellness, in addition to prevention and treatment of illness. Additionally referring<sup>165</sup> to Antonovsky's review<sup>8</sup> of Bandura's 'self-efficacy',<sup>17</sup> Rotter's 'locus of control',<sup>151</sup> as well as hardiness, as salutogenic strengths, Strümpfer argues that, as the metaphor of strength is inherent in all the above mentioned constructs, 'salutogenesis', which refers to the origin of health, should be broadened to 'fortigenesis', which refers to the origins of psychological strengths. Also Werner and Smith's work on resilience should here be mentioned.<sup>193</sup>

In epidemiological research the focus has so far almost exclusively been on the negative pole, trying to describe associations between suspected harmful factors from different contexts and morbidity/mortality. The context may be individual, social, lifestyle or working life. A different approach was suggested 10 years ago by Mackenbach et al. who in a cross-sectional study<sup>107</sup> explored the determinants of excellent health and those of ill health. Studying socio-demographic and lifestyle factors they found largely similar patterns of association with excellent health as with ill health. They concluded that the processes by which excellent health is generated probably have much in common with those that generate ill health but also that our understanding of the determinants of ill health is better than that of the determinants of excellent health. They recommended further studies of the latter.

## HEALTH MEASURES

Self-rated health is among the most frequently assessed health perspectives in clinical as well as epidemiological studies. It is frequently used as an end-point in studies concerning factors such as employment security,<sup>206</sup> sickness absence,<sup>26,91</sup> use of health care services,<sup>97</sup> work environment<sup>33,142,158</sup> and socio-economic situation.<sup>34</sup> A large number of studies have also demonstrated that a person's own appraisal of her or his health is a powerful predictor of future morbidity<sup>25,69,82,121,154</sup> and mortality<sup>25,1,18,20,43,64,73,99,158,210</sup> even after controlling for a variety of socio-demographic, physical and psychosocial

health status indices. Self-rated health is considered an inexpensive and convenient way of identifying risk groups and risk factors,<sup>25</sup> useful not least in working life.

Less is known about the ability to predict excellent health or work ability and whether there are differences in prediction between different instruments used. Prediction of future work ability could be important for designing preventive measures. It is noteworthy that, although studies of positive aspects of health have been recommended,<sup>107,109</sup> only a few studies have been performed on aspects such as analysing SRH as a possible predictor of positive outcomes, e.g. remaining in work,<sup>104</sup> recovery from fatigue<sup>69</sup> and survival among cancer patients.<sup>157</sup>

In epidemiological studies SRH is often operationalized by a single question. There are a large variety of question-response combinations; however, most questions can be categorized into non-comparative, age-comparative and time-comparative. The non-comparative question has been suggested as a standard, single-question measure.<sup>25,53</sup> Self-rated health may also be obtained by multiple questions, which have the advantage of increased reliability and validity and better ability to discriminate.<sup>25,35,167</sup> Four such scales have been reported<sup>108</sup> to be widely used: the 36-item short-form health survey (SF-36), in which 36 questions form eight sub-scales including a scale on general health, (SF-36 GH),<sup>167,168,191,192</sup> and its short version SF-12<sup>190</sup> containing one or two items from each of sub-scales, the EuroQol-5 dimensions (EQ-5D)<sup>38</sup> including 5 dimensions and general health measured on a visual analogue scale (VAS), and the Health Utilities Index (HUI)<sup>176</sup> which defines 8 health dimensions. In a study comparing the measures SF-12, EQ-5D and HUI3,<sup>56</sup> a modified version of HUI, in terms of their practical viability, coverage and discrimination no instrument performed better or worse than the other.<sup>108</sup>

According to available data, a simple one-item assessment of global SRH gives not only a useful measure of present health but also a predictive value, though there is no general consensus about terminology for and conceptualization of SRH. However, according to Bjorner et al.,<sup>25</sup> there seems to be an agreement that the experience of general health, often called “global health”, is a core concept of SRH. It has been suggested that SRH should be understood as a multi-dimensional phenomenon which includes different elements that are synthesized by the person, such as medical diagnoses, functional ability, perceptions of well-being and capacity for coping, personal attitudes and degree of optimism/pessimism, and intentions to act in healthy and health-promoting ways.<sup>25,34,73</sup>

Drawing upon knowledge from studies of other sensory modalities Bjorner et al.<sup>25</sup> is the meaning that it seems likely that key concepts in the description of the cognitive process of health evaluation could be attention to internal stimuli; interpretation of these stimuli; personal belief systems regarding health and disease; and personal norms for disease and health status – norms that may originate in the peer group or are based on previous experiences.

It has been proposed that in absence of more objective measures, perceived health status may be a suitable proxy measure of health status in epidemiological studies.<sup>82</sup> A concept that is closely related to health is functional ability – the ability to perform tasks and roles within a social context. There is no conceptual or terminological con-

sensus regarding functional ability and the distinction between health and functional ability is not always clear. Regardless of the assessment method, functional ability is a strong correlate of SRH in multivariate analyses. However, from a conceptual point of view, functional ability should be distinguished from health.<sup>25</sup>

It has been stated<sup>25</sup> that SRH can be applied in research as a screening method to identify high-risk groups and risk factors and as an end-point in evaluation of medical and psychosocial intervention studies. But it has also been stated that there is a need for new studies of SRH as a predictor of end-points other than mortality, on the factors that influence and determine a person's SRH, intervention studies with SRH as (one of) the end-point(s), and qualitative studies of SRH in order to understand more about the meaning of SRH for individuals and about the differences and similarities between SRH and biomedical health.<sup>34</sup> Short and valid instruments for scientific and screening purposes are sought after<sup>35</sup> and the number of instruments for assessing and predicting health-related outcomes raises questions about which instrument to choose.

## **SICK LEAVE**

According to §7 in the Swedish health insurance law (Swedish law 1962:381, chapter 3), sickness benefits are only paid when the sickness is accompanied by reduced work ability, which makes it the dominating legitimate reason for sickness absence. Thus, even if there are many reasons for sick leave, sick leave can with some limitations serve as proxy for work ability.

After a decline in the early 1990s the number of people on long-term sick leave in Sweden started to increase dramatically in 1997. There was a similar development in some European countries (Norway and the Netherlands), while others had a low number of sick-listed people (Denmark, Germany, Finland and Great Britain).<sup>136</sup> The reason for this development in Sweden is unclear. On the one hand, Sweden has an ageing work force, a high rate of employment both among men and women and a liberal social insurance system. On the other hand, public health in Sweden is good and the life expectancy rate is high. The increase in sick leave continued until 2002 and the rate has since then decreased somewhat. By contrast, the number of people with newly granted early retirement pension increased by 15% during 2002–2004. The people granted this have in most cases a prehistory of taking very long-term sick leave. Therefore the total number of people at working age who do not work at all or who partially work due to reduced work ability was almost the same in 2004 (784 000 individuals) as in 2002 (786 000 individuals) ([www.forsakringskassan.se](http://www.forsakringskassan.se) and [www.scb.se](http://www.scb.se)).

In September 2005, out of a total work force of 4.3 million gainfully employed, 191 000 persons were on long-term sick leave (>28 days), according to national statistics. Women dominated among the workers sick-listed long-term, and constituted 121 200, or 5.9%, of the female work force. In the male work force 69 800 persons, or 3.1%, were on long-term sick leave. There are some geographical differences in the prevalence of sick-listing and disability pension. In general there are more people on long-term sick leave in the northern provinces of Sweden than in the central and southern provinces.<sup>59,60</sup> The public sector in Sweden employs about 1.0 million people, about

80% of whom are women. Among these the increased number of women sick-listed long-term has been especially pronounced.<sup>162</sup>

Increased stress and work load as well as higher mean age in the workforce have been suggested as possible causes for the increase in sickness absence rates.<sup>11</sup> The situation on the labour market has also been considered to be of importance, with the higher the proportion of gainfully employed the higher the sick leave rates, though the evidence for this as well as for the underlying causal mechanisms is limited.<sup>4</sup>

An increasing number of empirical studies demonstrate associations between different factors related to working as well as to personal life and sickness absence.<sup>2,4,26,27,48,52,55,65,76,88,90,91,98,114,118,123,133,134,143,147,160,183,184,186,206,209</sup> Sickness absence is a complex phenomenon and not necessarily the same as the health status of the individual or sickness in a society.<sup>3</sup> It will not be understood if it is viewed as a simple function of unhealth or other individual factors such as being discontented with the work. Sick leave is better understood as an interplay between the individual's health v. the social insurance system; levels of benefits; type of work; flexibility at work by lowered working capacity; attitudes towards work; and other medical, social and psychological factors.<sup>2,77,98,110</sup> Sickness absence has been pointed out as a strong predictor of future sickness absence.<sup>37,160,184</sup>

## **SICKNESS PRESENTEEISM**

An alternative strategy to sickness absence when ill is sickness presenteeism, meaning that the individual attends work despite illness. Sickness presenteeism is by definition a state of poor health and, like sickness absenteeism, multi-factorial. Reported one-year prevalence of sickness presenteeism has been 64–76%.<sup>203,204</sup> Common causes for sickness presenteeism are low levels of sickness benefits, that there is nobody else to perform the work tasks, and loyalty towards the colleagues.<sup>203,204</sup> Compared with sickness absence few empirical studies concerning sickness presenteeism have been conducted. Associations have been shown between sickness presenteeism and sick leave,<sup>15,209</sup> symptoms such as back/neck pain and fatigue/slight depression,<sup>15</sup> individual boundarylessness (i.e. finding it hard to say no to others' wishes and expectations),<sup>14</sup> serious coronary events,<sup>87</sup> SRH<sup>14</sup> and occupations within the care, welfare and education sectors.<sup>15,115</sup>

## **WORK ABILITY**

In studies of the working population, sickness absence longer than 7 days has been suggested as a good proxy for health, whereas sick leave spells of 1–2 days were associated with job satisfaction; also, it has been suggested that absence due to sickness should be seen in the context of social and physical functioning and perceived well-being.<sup>110</sup> That is, if “healthy functioning” for people in stable jobs by definition means attendance at work, then absence from work indicates some lack in healthy functioning, whether the causes are psychological, social or physical. Absence due to sickness has also been explained as a coping strategy that reflects an individual's perception of his or her health and depends on a number of factors at different levels, primarily a

combination of job demands and coping possibilities at work.<sup>98</sup> This view is similar to the two dimensions of the illness flexibility model, namely adjustment latitude and attendance requirements at work. These two dimensions determine the possibilities of going to work or not during illness.<sup>77</sup> Together these aspects can, with some simplification, be conceptualized into the term “work ability”, which with its natural, flexible qualities is better suited to describing a gradual movement along the health continuum than is the dichotomization into health and disease.

Numerous empirical studies have demonstrated the associations between exposures at work and disorders. Physical factors in the work environment associated with musculoskeletal disorders that have been pointed out are awkward or static work posture, static load, heavy physical work, force, repetitive work, vibrations and direct mechanical pressure on bodily tissues.<sup>24,41,67,95,124,188</sup> A strictly biomechanical model is today considered to be too limited to fully explain work-related causation of musculoskeletal disorders. Even if mechanical/physical factors are important primary factors there are also psychological, psychosocial and organizational factors that can either independently provoke musculoskeletal disorders or amplify physical risk factors<sup>12,24,28,29,41,50,68,95,100,102,106,124,188</sup> Work-related disorders differ somewhat between men and women. A number of epidemiological studies have found that women are at higher risk for work-related neck and upper limb disorders, although associations with workplace risk factors are generally found to be stronger than are gender factors.<sup>40</sup> However, in a recent review<sup>4</sup> Allebeck and Mastekaasa found limited scientific evidence for an association between physical working conditions and sickness absence, possibly for ergonomic load in particular.

Psychiatric disorders, including stress-induced states and alcohol abuse, are the other main reason for sick leave in Sweden. Concerning the psychosocial work environment Allebeck and Mastekaasa found moderate scientific evidence that low control of the working situation leads to higher sickness absence.<sup>4</sup> They also concluded that most of the reviewed studies were based on the same type of stress theory, in particular Karasek’s demand-control model. This model was constructed by Robert Karasek in the 1970s<sup>83</sup> and later developed further in collaboration with Theorell.<sup>84</sup> The combination of high psychological demands and low control (or decision latitude) is called “job strain” and has been shown to have adverse effects on health. Johnson and Hall complimented the model with a third dimension, social support, which may buffer against the adverse effects of high job strain.<sup>78</sup> A third model for the effects of strain in working life on health is the “effort-reward imbalance model” constructed by Siegrist.<sup>159</sup> The effort-reward model stresses the importance of reward and predicts adverse health effects from situations in which high efforts are spent and low rewards are received.

Some common psychosocial work environment factors that have been found to be associated with sickness absence are psychological job demands, job control, high strain as well as passive jobs, social support, social relations at work, decision authority, skill discretion, psychological distress, a combination of at least one chronic or long-term disease and lower level of decision latitude, workplace bullying, job satisfaction, feeling overloaded, and teamwork.<sup>5,48,62,76,88,90,110,118,122,183</sup> In a recent review Hensing<sup>66</sup> found associations between sickness absence with psychiatric diagnosis and the following work-related factors: occupational group, male and female-dominated occupations, job position, social support, and demands, decision

latitude and stimulation. However, it was concluded that the scientific evidence was insufficient since none of the work-related factors was found in more than one study.

According to the “Survey on Work-Related Disorders, 2005”, nearly a quarter (28% of women and 22% of men) of all employed persons in Sweden have suffered from some form of disorder, either physical (15%) or mental (5%), or a combination (4%), that they can relate to their work during the past 12 months. On average 9% of women and 6% of men were absent from work due to sickness during some part of the week in which the interviews for the survey were carried out. Of these 36% of women and 30% of men claimed that their sick leave was due to work-related disorders. The corresponding figures for 2004 were 45% for the women and 38% for the men. The observed decrease in 2005 is statistically significant. Though stress-related disorders increased more than other disorders did during 1996–2003, both for women and men, physical factors (heavy manual labour, strenuous working postures and short repetitive tasks) are more likely to lead to work-related disorders than are stress and some other mental strain irrespective of sex.<sup>170</sup>

## **ASSESSING WORK ABILITY**

Common ways of defining functional status in clinical settings are e.g. to assess activities of daily living (ADLs) and mobility (locomotional status). A more comprehensive alternative is the International Classification of function and health (ICF),<sup>196</sup> which is WHO’s overall framework for the classification and assessment of health and health related domains that describes body functions and structures, activities and participation of an individual as well as of populations.

Assessment methods for work ability are rarer. The dominating assessment explicitly of work ability in the literature is the Finnish work ability index (WAI).<sup>180</sup> In his thesis Reiso<sup>146</sup> mentions two other, the Norwegian “Graded Reduced Work Ability Scale”<sup>63,138</sup> constructed for the Norwegian Ministry of Health and Social Affairs, and the British “The personal capability assessment” (PCA)<sup>141</sup> which is the test that the Department of Work and Pensions in the UK uses to decide whether a person is capable of work. Scientific publications of the latter two are scarce.

The work ability index (WAI) was constructed in the early 1980s. The conceptual definition of work ability was presented by the question, “How good is the worker at present and in the near future, and how able is he/she to do his/her job with respect to work demands, health and mental resources?”.<sup>179</sup> The WAI constitutes seven items and the index is derived as the sum of the ratings on these items. The summative score is classified into “poor”, “moderate”, “good” and “excellent work ability”.<sup>75</sup>

The predictive value of the WAI has been shown to be high. A 4-year follow-up indicated that of those women and men who at the age of 51 years had poor work ability, about one-third became disabled during the follow-up and of those scoring “good work ability” only a few became disabled.<sup>74</sup> The 11-year follow-up showed that work ability was dependent on job content. The greater the physical demands at work, the greater the decline in work ability with ageing.<sup>75</sup> However, for 14% of both women and men, the WAI score improved. Increased satisfaction with supervisors’ attitudes, a decrease in repetitive movements and increased vigorous physical exercise during

leisure time were significant predictors of improved work ability among men and women in physical, combined physical and mental, and mentally demanding work.<sup>181</sup>

Within the HAKuL Study<sup>205</sup> a short index, named “Health for working”, was constructed combining the SF-36 GH and the question from the WAI instrument, on the individual’s own prognosis of his or her work ability in 2 years. On the basis of considering good health as a sense of well-being and as giving the ability to act<sup>128</sup> “Health for working” intends to capture the relation between health and work. A detailed description is given in Study I. In Study IV this instrument has been further simplified in order to make it more efficient.

## **HEALTH PROMOTION, AND WORKPLACE HEALTH PROMOTION**

The interest in medical science has until now mainly focused on how and why certain individuals become diseased, i.e. on pathogenesis. The Swedish National Committee on Public Health has stated that there are good reasons, scientific and practical, for developing an outlook on health promotion and safety within public health activities, an obvious approach that is necessary for analysing and understanding why most people stay healthy despite many health risks and strains.<sup>161</sup> Some studies, though typical studies of risk,<sup>33,172,181,183,209,212</sup> have in part also identified health-promotive determinants. However, knowledge about the positive end of the health continuum is still vague.

At first (i.e. in the 1970s) health promotion emphasis was placed on influencing behaviour-dependent risk factors and promoting a “healthy life style”.<sup>174</sup> This approach is still dominant in many countries. In 1989 O’Donell presented an definition of health promotion in the American Journal of Health Promotion:

Health promotion is the science and art of helping people change their lifestyle to move toward a state of optimal health. Optimal health is defined as a balance of physical, emotional, social, spiritual, and intellectual health. Lifestyle change can be facilitated through a combination of efforts to enhance awareness, change behaviour and create environments that support good health practices. Of the three, supportive environments will probably have the greatest impact in producing lasting changes.<sup>137</sup>

At the Ottawa conference on health promotion in 1986, the WHO widened their definition of health as a state of complete physical, mental and social well-being<sup>199</sup> to state that it is also a resource for everyday life and health promotion is the process of enabling people to increase control over and improve their health.<sup>199</sup> The 6th WHO conference on health promotion in Bangkok in 2005 declared that the global context for health promotion has changed markedly since the development of the Ottawa charter, highlighting that “the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human” (another principle of the WHO’s constitution) and urging stakeholders at all levels in society to allocate resources for health promotion.

A concept related to the definition of health promotion given by the Ottawa charter enabling people to “increase control over and to improve their health”<sup>199</sup> is “empowerment”, which has become a topical issue in health promotion and rehabilitation literature. Yet the concept lacks a theoretical underpinning, and it remains difficult to make the concept operational and measurable. Since empowerment is more a principle than a solid theory, it has been suggested that Antonovsky’s salutogenic approach could form the theoretical framework and that the definition of individual empowerment be “a process by which people gain mastery (control) over their lives, by which they learn to see a closer correspondence between their goals and a sense of how to achieve these goals, and by which people learn to realize a relationship between their efforts and the outcomes thereof”.<sup>93</sup>

Two official documents with impact on the health of Europeans have been introduced during the last decade, viz. WHO Europe’s “HEALTH21 – health for all in the 21st century”<sup>200</sup> urging all sectors of society to adopt an effective approach of promoting and protecting health, and “The Luxembourg Declaration on Workplace Health Promotion in the European Union”.<sup>51</sup> Though the stated goals are to “achieve full health potential for all” and to “improve the health and well-being of people at work”, respectively, neither of the documents presents a definition of health. This could present a dilemma for the stakeholders.

During the last years, efforts have been made to widen the concept of health promotion to “workplace health promotion (WHP)”. More recent comprehensive approaches to WHP encompass the design of healthy working conditions and the in-corporation of health needs into corporate philosophy and management.<sup>119</sup> An example of this is The Luxemburg Declaration on Workplace Health Promotion in the European Union,<sup>51</sup> which was adopted by the members of the European Network for Health Promotion in 1997 and defines WHP as follows:

Workplace Health Promotion is the combined efforts of employers, employees and society to improve the health and well-being of people at work. This can be achieved through a combination of –

- improving the work organisation and the working environment;
- promoting active participation;
- encouraging personal development.<sup>51</sup>

However, WHP remains an extremely diverse concept and one which is difficult to define.<sup>119</sup>

## **AIMS OF THE THESIS**

The overall aim of this thesis was to identify determinants of future work ability among gainfully employed women and men, with special reference to promotive factors at work.

Specific aims were to –

- identify factors in private and working life acting as determinants of future work ability;
- explore whether the same determinants are active at both ends of a work ability continuum or whether the determinants of excellent work ability differ from those of poor work ability; and
- compare the ability of different self-administered health-related instruments to predict future work ability.

## MATERIALS AND METHODS

The thesis is built around four studies based on two different sets of material. Studies I, III and IV are based on data from the HAKuL Study (“Work and Sustainable Health in the Public Sector in Sweden”) collected 1999–2004, and Study II is based on data from the HPH Study (“Plan of Action for Increased Health in Working Life”) collected 2000–2001.

### THE HAKUL STUDY

A prospective cohort study titled “Hållbar Arbetshälsa i Kommuner och Landsting”, the HAKuL Study (“Work and Sustainable Health in the Public Sector in Sweden”) was launched in 1999–2000. The overall aim of the HAKuL Study was to strengthen sustainable health for working and well-being among employees in the public sector in Sweden as well as implement and support early rehabilitation for those with impaired work ability.

The employees in four county councils and in local authorities in six municipalities representing southern, central and northern Sweden, 81% of whom were women, were followed for 3 years by means of questionnaires and sick leave data. In some organizations sick leave data had been collected even after the three years. The participating organizations were strategically chosen in collaboration with the national and local employer organizations and unions in order to cover different parts of the country as well as different fields of activities in the public sector. This procedure was necessary in recruiting organizations with long-standing commitment to the study as the included organizations had to help out with administration of the questionnaires, take part in the rehabilitation procedures, report employees on long-term sick leave to the research group and start intervention activities after having received feedback from the three waves of surveys.

Roughly 25% of all gainfully employed workers in Sweden work in county councils and local authorities in the municipalities, around 80% of these are women. In 2000 both men and women employed by the local authorities, regardless of age group, demonstrated a significantly higher proportion of very long sick leave ( $\geq 1$  year) than seen in other sectors.<sup>162</sup>

The study started with a baseline postal questionnaire that covered individual factors, socio-economic situation, health, sleep and recuperation, lifestyle, and physical, psychological, social and organizational work factors. The items used in the questionnaire consisted mainly of questions and scales tested and used in previous occupational research.<sup>15,16,22,32,46,72,79,84,96,105,113,163,166,180,187,202</sup>

The questionnaire was handed out to all employees in the participating organizations who at the time of the baseline questionnaire had not been sick-listed long-term for 3 months or longer. Up to three reminders were mailed to non-respondents. The same

routines were used for the follow-up questionnaires 1½ and 3 years after the baseline survey. At baseline and at the 3-year follow-up similar questionnaires were used; a somewhat abridged version was used at the 1½-year follow-up.

The sample sizes and the response rates for the three surveys are shown in Table 1.

**Table 1.** Study population and answering rate in the HAKuL Study.

Survey	No. of employees asked to participate	No. of returned questionnaires (response rate)	Proportion of women among the respondents
Baseline	9 003	7 533 (84%)	83%
1½-year follow-up	9 292	6 969 (75%)	83%
3-year follow-up	9 373	6 617 (71%)	84%

During the 3 years 2 873 of the initial 9 003 employees ended their employment with the participating organizations, and 3 247 new employees joined the organizations. Of the 6 130 employees at baseline who were still employed by these organizations at the 3-year follow-up 4 539 (74%) completed both the baseline and the 3-year questionnaire. Around 120 occupational titles were represented in the HAKuL Study. The largest occupational groups were registered nurses, assistant nurses, home-based personal care workers in elderly care, employees at child care centres, administrative personnel, teachers, medical doctors, craftsmen, paramedics, and kitchen and cleaning staff. Around 70% of the women worked in occupations in which  $\geq 90\%$  were women. Descriptive baseline data from the HAKuL are given in Table 2.

The survey data were complemented with information from the employers on all employees who had spells of sick leave  $\geq 28$  days during the study period. Where this was possible records were also collected retrospectively on all absences from work from the participating organizations. The “28-day cases” reported during the study period were all offered contact with the occupational health care services as well as individual rehabilitation strategies. Those with impaired work ability because of musculoskeletal disorders, cardiovascular diseases, obstructive lung disease and stress-related psychiatric diagnosis were given the possibility of a fully paid 4-week stay at a specialised rehabilitation centre.

The HAKuL Study was approved by the Ethics Committee at Karolinska Institutet, Stockholm, Sweden (No. 99-242), and was funded by a grant from AFA Labour Market Insurances.

## THE HPH STUDY

The acronym “HPH” stands for “Handlingsplan för ökad hälsa i arbetslivet”, which is the Swedish for “Plan of Action for Increased Health in Working Life”. The prospective HPH Study<sup>101</sup> was conducted in 2001 for the Swedish Commission for a Plan of

Action for Increased Health in Working Life, commissioned by the Ministry of Health and Social Affairs. The HPH Study was a 1-year follow-up of a cross-sectional study

**Table 2.** Descriptive baseline data for the HAKuL Study and the HPH Study.

	HAKuL		HPH	
	N=7 533		N=6 337	
	Women	Men	Women	Men
Number of subjects	6 247 (83%)	1 286 (17%)	3 390 (53%)	2 947 (47%)
Age range, years	19–65	19–65	35–55	35–55
Mean age, years (SD)*	45.7 (10.2)	46.2 (10.0)	45.3 (8.0)	45.5 (8.1)
Born outside Sweden	7%	9%	8%	8%
Educational level				
9 years' compulsory school	20%	24%	21%	23%
11–14 years of schooling	39%	31%	34%	41%
University education	41%	44%	45%	36%
Personal finances <sup>†</sup>				
Very good	40%	39%	49%	55%
Strained	18%	18%	14%	12%
Self-rated health <sup>‡</sup>				
Very good	38%	43%	55%	56%
Failing	23%	17%	14%	12%
Work ability <sup>§</sup>				
Very good	70%	73%	72%	72%
Failing	6%	3%	5%	4%
Quality of life <sup>  </sup>				
Very good	46%	41%	51%	46%
Poor	10%	13%	12%	12%
Employment sector				
Local authority	66%	72%	10%	37%
County council	34%	28%	3%	12%
Government	–	–	12%	10%
Private	–	–	75%	41%

\*SD = standard deviation.

In the classification of answer alternatives, "intermediate class" is not shown in the Table. The classification is as follows:

<sup>†</sup>Personal finances:

very good = very good/good; intermediate = neither good nor bad; strained = strained/very strained.

<sup>‡</sup>Self-rated health: very good = excellent/very good; intermediate = good; failing = fair/poor.

<sup>§</sup>Work ability on a 10–0-point scale: very good = 10–8; intermediate = 7–5; failing = 4–0.

<sup>||</sup>Quality of life measured, on a 1–7-point scale, by happy–unhappy faces:

very good = 1–2; intermediate = 3–4; poor = 5–7.

conducted for the Commission on Health Insurance in 2000.<sup>204</sup> This initial study aimed to investigate how working conditions, patterns of sick listing behaviour and some individual factors associate with self-rated health and sick leave, as well as analysing how the economic situation of the individual and regulations in force affect sick leave/sickness attendance. For this study, Statistics Sweden randomly chose 16 031 "healthy" individuals from the Swedish national population register, who had no ongoing spell of sick leave  $\geq 28$  days at the time of being included in the study, as well

as 7 968 “sick” individuals, individuals who had been on sick leave for the previous 28 days or longer, from the national register on sick leave at the National Insurance Board in Sweden. The participants all belonged to the birth cohorts of 1945, 1955, 1965 and 1975, and were therefore 55, 45, 35 and 25 years of age at the time of selection.

In total 23 999 individuals were mailed a questionnaire with two reminders, covering questions on health, recuperation, working conditions, sick leave, sickness attendance, use of health care and attitude towards health insurance. The analyses included exposure assessments using questions designed for this study as well as questions and scales tested and used in previous occupational research<sup>15,16,32,72,84,113,163,166,180,187</sup> demonstrating associations with ill health. The self-reported data were complemented by register data on sex, age, civil status, country of birth, citizenship, geographical area of residence, and income. Of the individuals approached, 14 945 (62%) completed and returned the questionnaire. As the response rate among the 25-year-olds was just around 50%, this group was excluded from further analyses. Among the remaining “healthy” and “sick” cohorts the response rate was 64%. Descriptive data from the HPH baseline are given in Table 2.

The follow-up of the subjects in the HPH Study, aimed to identify factors of importance for maintained good health. Consequently the initially “healthy” respondents aged 35–55 (response rate 65%) were followed for 12 months with regard to sick leave spells lasting 14 days or longer. Data on sick leave were obtained from a register at the National Insurance Board in Sweden, which includes sick leave data on all Swedish residents with spells of sick leave >14 days. The first 14 days of a sick leave spell are paid by the employer and no central registration is therefore done.

Scientific analyses and publication of the HPH data were approved by the Ethics Committee at Karolinska Institute, Stockholm, Sweden (No. 2005/539-31). The data collection was financed by the Swedish government commissions “Commission on Health Insurance” (SOU 2000:121) and “Plan of Action for Increased Health in Working Life” (SOU 2002:5).

## SUBJECTS

An overview of the study design and the participants of the four studies included in this thesis are given in Table 3.

**Table 3.** Overview of the participants in the studies.

	Study I		Study II		Study III		Study IV	
Study design	3-year follow-up		1-year follow-up		1½- year 'quasi' follow-up		4-year follow-up	
Number of subjects (response rate)	5 224 (85%)		6 337 (65%)		5 638 (73%)		2 252 (86%)	
	Women	Men	Women	Men	Women	Men	Women	Men
Number of women and men (%)	5 224 (100%)	–	3 390 (53%)	2 947 (47%)	4 728 (84%)	910 (16%)	1 786 (79%)	466 (21%)
Age range, yrs	20–62	–	35–55	35–55	20–66	21–64	20–65	21–65
Mean age, yrs (SD) <sup>*</sup>	45.1 (9.9)	–	45.3 (8.0)	45.5 (8.1)	46.5 (9.5)	47.5 (9.3)	44.8 (10.9)	47.0 (10.1)

<sup>\*</sup>SD = standard deviation.

### Study I

Of a total of 6 246 women who completed the HAKuL baseline questionnaire (85% response rate) 5 224, classified as having “good” or “fairly good health for working”<sup>1</sup> at baseline, were included in Study I. Of these, 3 247 (62%) were younger than 50 years and 1 977 (38%) were 50–62 years old. During the 3-year follow-up 808 women left their jobs. Among those excluded with “poor health for working” the proportions of <50-year-olds and ≥50-year-olds were the same, 50%.

<sup>1</sup>In the HAKuL Study a “Health for working” index was constructed by combining the five questions on self-rated general health that form the 36-item short-form health survey (SF-36) general health (SF-36 GH) scale, a sub-scale of the SF-36 health survey<sup>166</sup> including one question from the Work ability index (WAI).<sup>180</sup> The WAI question concerns a person’s own prognosis for the ability to continue in his/her present work 2 years ahead from the time of answering, with regard to perceived current health status. Those with a score of ≥88 in the SF-36 GH and who answered the WAI question saying it was “likely” that they could continue their work with regard to their health 2 years from now were classified as having “good health for working”. Those scoring ≤64 in the SF-36 GH and reporting to the WAI question that it was “unlikely” or “not certain” were classified as having “poor health for working”. At baseline 21% were classified as having “good” and 12% as having “poor health for working”. The remaining 67%, the middle group, were considered to have “fairly good health for working” but with potential for improvement.

## **Study II**

Of the approached 12 034 men and women aged 35–55 years who received the baseline questionnaire, 7 806 (65%) completed this, 69% of the women and 60% of the men. Analysis of the non-respondents showed a somewhat lower response rate among low-income earners (53%), singles (58%) and subjects born outside Sweden (50%). Inclusion criteria for the study were full-time ( $\geq 35$  hours/week) working women and men and part-time working women, being employed or self-employed, and having at no time received any early retirement pension or disability pension. After excluding those who did not meet these criteria 6 337 individuals remained to be included, 3 390 women and 2 947 men.

## **Study III**

In Study III, 5 638 individuals out of 7 735 who were employed at the participating organizations both at baseline and at follow-up were included in the study having completed both the baseline and the follow-up questionnaires. Therefore the final sample represented 73% of those initially asked and consisted of 4 728 women and 910 men. The 1 025 non-respondents at baseline and 1 072 drop-outs at follow-up were 2 and 3 years younger on average, respectively, and included a somewhat higher proportion of men compared with the proportion of men among the included individuals. The drop-outs reported somewhat worse health and slightly more sick leave at baseline compared with the participants.

## **Study IV**

For the fourth study the research team had, at three of the local authorities taking part in the HAKuL Study, access to the employers' registers on all absences from work during the 4 years following the baseline survey. The baseline questionnaire was completed and returned by 2 306, 86%, out of 2 695 employed individuals. After excluding 54 persons because of missing follow-up data, 2 252, 1 786 women and 466 men, remained for the analyses.

## **METHODS**

### **Study I**

In Study I factors were investigated that associated with long-term sick leave among women in the public sector. The study was designed as a cohort study with a 3-year follow-up. The outcome measure was all causes of long-term sick leave defined as spells lasting  $\geq 28$  days. In this thesis work long-term sick leave is regarded as representing "poor work ability". In Sweden every employer is required to perform a rehabilitation investigation among employees who have been sick-listed for 28 days, in order to prevent long-term sick-listing. Thus the employers acquired current health status from the employees and these data were reported to the research team and used as outcome measures in this study. For different factors at baseline, exposed subjects were compared with unexposed subjects with regard to becoming continuously sick-listed for  $\geq 28$  days at least once during the 3-year follow-up period.

Exposure variables, self-reported health-related factors and factors adjusted for in the statistical analyses are given in Table 4.

## **Study II**

In Study II the aim was to find factors at work that were associated with retained work ability. Retained work ability was defined as not having had any spells of sick leave longer than 14 days during 1 year. The study was designed as a cohort study with a 1-year follow-up among women and men aged 35, 45 and 55 years in the general population. From the baseline questionnaire potential explanatory exposures were chosen to cover socio-demographic factors, sick leave, labour market situation and terms of employment, physical work, psychosocial work factors, and work organization. The variables are listed in Table 4.

The exposure variables were all originally designed for analysing association with ill health. However, as this study was about finding factors predicting retained work ability the chosen variables had to be dichotomized into exposed–unexposed, where “exposed” was expected to denote a health-supportive exposure level. This level was decided upon according to a hypothesis by the authors with regard to what would be the minimal level of positive exposure to promote retained work ability.

As sickness absence is seen as a strong potential predictor of future sickness absence<sup>160,184</sup> the analyses were adjusted for sick leave taken prior to the survey. Thus the respondents were divided into three groups according to their self-reported frequency of sick leave during the 12 months preceding the survey. Respondents who reported that they had neither been on any sick leave nor taken days of holiday or compensatory leave instead of reporting sick were classified as respondents with “no previous sick leave” (n=2 965; 1 413 women and 1 552 men). Respondents with one spell of sick leave and/or days of holiday or compensatory leave instead of sick leave were designated “on sick leave once previously” (n=2 225; 1 284 women and 941 men). Respondents who reported two or more spells of sick leave were labelled “on sick leave twice or more previously” (n=1 147; 693 women and 454 men).

## **Study III**

Study III aimed to explore whether the same determinants that promote excellent work ability also prevent poor work ability by using data from the 1½-years follow-up. Study III was designed as a “dual” study in which excellent and poor work ability, defined in terms of self-reported sick leave, and days attended while sick during the 12 months preceding the follow-up, were compared with an intermediate group.

As presumptive determinants, exposure assessments from the HAKuL baseline questionnaire representing three domains of interest were chosen, viz. socio-demography, lifestyle and working life. An overview of the variables considered in Study III is given in Table 4. The aim was to identify positive determinants of work ability at both ends of the health continuum. However, because of lack of empirical

**Table 4.** Potential explanatory variables used in studies I–IV.

Variables	Study I	Study II	Study III	Study IV
<b>Socio-demographic domain</b>				
Sex	—*	x	x	x
Age	x	x	x	x
Geographical area of residence and work	x			
Level of education		x	x	
Personal finances	x	x	x	
Family situation	x	x	x	
In charge of domestic responsibilities	x		x	
Negative influence of work on family life, and vice versa	x			
<b>Health and well-being domain</b>				
Self-rated health (single question or index)				x
Work ability (single question or index)				x
Bodily pain/discomfort	x			
Sick leave during the previous 12 months		x	x	
Sickness presenteeism during the previous 12 months	x			
Sleep	x			
Recuperated and full of energy (index)	x	x	x	
<b>Lifestyle domain</b>				
Smoking	x		x	
Obesity	x		x	
Leisure exercise	x		x	
<b>Working life domain</b>				
Employment sector		x		
Job security		x	x	
Number of working hours		x	x	
Mix of sexes at the workplace		x	x	
Work type <sup>†</sup>				x
Physically strenuous work <sup>‡</sup>	x	x	x	
Heavy lifting	x		x	
Forward-bent work posture	x		x	
Physical demands v. own capacity	x			
Mental demands v. own capacity	x			
In the mood for work		x	x	
Mastery (index)	x		x	
Satisfied with own performance		x		
Role clarity (index)	x		x	
Psychological demands (index)			x	
Decision latitude (index)			x	
The demand-control model (index)	x	x		
Changed conditions <sup>§</sup> at work during the previous 12 months	x			
Consequences of these changes	x			
Organizational culture	x			
Bullying at work	x			
Feedback from superior	x	x	x	
Good leadership from immediate superior		x		

\*Only women took part in the study.

<sup>†</sup>Mainly physical, mental or mixed physical-mental work tasks <sup>180</sup>.

<sup>‡</sup>According to Borg's Rating of Perceived Exertion (RPE) scale 6–20 <sup>32</sup>.

<sup>§</sup>With regard to workload, time pressure, work requirements, opportunities to develop and learn new things, support, co-operation, influence and control, down-sizing, job security, and involvement.

evidence about which (if any) exposure level of the chosen potential determinants supports work ability, the response categories were, in most cases, trichotomized. Cut-offs were set according to expectations and clinical experience of what would be highly supportive or somewhat supportive of or hazardous to an individual's work ability. The "hazardous category" was used as reference category.

The outcome measures were formed according to data collected at follow-up, and the study group was divided into three sub-groups, an "excellent work ability" group, a "poor work ability" group and an intermediate group. Thus, *excellent work ability* was defined as lack of both sick leave and sickness presenteeism during 12 months prior to follow-up. *Poor work ability* was defined as having had more than 28 days sick leave over the 12 months before follow-up. The remaining group, who had been on sick leave for 1–28 days and/or had attended work despite being sick at least once were used as comparison group.

## Study IV

In Study IV five self-rated instruments for assessing health/work ability were compared with respect to their ability to predict both excellent and poor work ability, defined by sick leave rates over 4 years. From the baseline questionnaire five health-oriented instruments for self-assessment, described below, were chosen as possible predictors and their answer categories were dichotomized in two ways as two outcomes were analysed. The choice of cut-off points for the "excellent" and "poor" predictor levels was made as recommended in the literature or as conventionally made in population studies, using the upper and lower quartile for indices and a more semantic, "what is reasonable" approach for single items.

### 1. Global self-rated health (SRH)

The non-comparative global health question, "In general, how would you describe your health? As excellent/very good/good/fair/poor?" was used. The response categories "excellent" and "very good" were aggregated and called "excellent Global SRH" and were compared with the less good categories (good/fair/poor) with regard to their ability to predict excellent work ability. The response categories "fair" and "poor" were termed "poor Global SRH" and compared with the better than poor categories (excellent/very good/good) to predict poor work ability.

### 2. Short-form 36-item general health questionnaire (SF-36 GH)

In addition to global SRH (above), the SF-36 GH scale includes the following four statements: (1) "I seem to get sick a little easier than other people"; (2) "I am as healthy as anybody I know"; (3) "I expect my health to get worse"; and (4) "My health is excellent". Five response alternatives are available, "definitely true", "mostly true", "don't know", "mostly false" and "definitely false". The values of the five items are summed and transformed to a 0–100 scale<sup>167</sup>. The cut-offs were set according to the quartiles in the HAKuL baseline (N=7 533). "Excellent SF-36 GH" (= highest quartile, score  $\geq 87.5$ ) versus "less good SF-36 GH" ( $< 87.5$ ) was used to

predict excellent work ability and “poor SF-36 GH” (= lowest quartile, score  $\leq 57$ ) versus “better than poor SF-36 GH” ( $>57$ ) was used to predict poor work ability.

### 3. *Work ability index*

The Work ability index (WAI)<sup>74,179,182</sup> is determined on the basis of the answers to ten questions covering seven items, viz. (1) current work ability compared with the life-time best; (2) work ability in relation to job demands; (3) number of diagnosed current diseases; (4) estimated work impairment due to diseases; (5) number of days on sick leave during the last 12 months; (6) own prognosis of work ability 2 years from now; and (7) mental resources in general. A sum score is calculated and the respondents are classified into poor, moderate, good, and excellent.<sup>180</sup>

The original WAI categorization was based on data on municipal workers in Finland. As the working and living conditions of municipal workers in Sweden are estimated to be similar the same categorical borders were used. In the baseline questionnaire of the HAKuL Study a modified version of the WAI was used, leaving out items 4 and 7. In the 3-year follow-up of the HAKuL Study the full WAI was included and using this as the gold standard enabled us to calculate adjusted sum score limits for the WAI categories in the modified version. The correlation between the original and the modified WAI categories was good (Cohen’s kappa 0.84). “Excellent WAI” (WAI category: excellent) versus “less good WAI” (good/moderate/poor) was used to predict excellent work ability and “poor WAI” (WAI categories: poor and moderate) versus “better than poor WAI” (good/excellent) was used to predict poor work ability.

### 4. *Work ability in 2 years*

Item six of the WAI index reads, “Do you believe that, from your health perspective, you will be able to do your current job 2 years from now?”, with response categories “relatively certain”, “not certain” and “unlikely”.<sup>180</sup> Considering the predictive capabilities of global SRH it was hypothesized that the prognostic question on work ability could have similar qualities. “Excellent Work ability in 2 years” (response category: relatively certain) versus “poor Work ability in 2 years” (not certain/uncertain) was used to predict future excellent work ability while “poor work ability in 2 years” (not certain/unlikely) versus “excellent Work ability in 2 years” (relatively certain) was taken to predict future poor work ability.

### 5. *Health for working*

In Study I<sup>205</sup> a two-item scale titled, “Health for working”, was used combining the SF-36 GH and “Work ability in 2 years”. In Study IV this scale was somewhat simplified by exchanging the SF-36 GH for global SRH. The Health for working scale intends to capture the relationship between health and work. The scores for global SRH (excellent = 1 point; poor = 5 points) were summed with weighted scores of Work ability in 2 years (relatively certain = 1.5 points; not certain = 2 points; unlikely = 5 points). The sum score was divided into five Health for working categories (excellent = 2.5–3 points; good = 3.5 points; moderate = 4–4.5 points; failing = 5–5.5 points; poor = 6–10 points). This instrument has so far not been validated. “Excellent Health for working” (Health for working category: excellent)

versus the less good categories (good/moderate/failing/poor) was used to predict excellent work ability while “poor health for working” (category: poor) versus the better than poor categories (failing/moderate/good/excellent) was taken to predict poor work ability.

In Study IV the outcome measure “excellent work ability” was defined as not having had 1 single day of sick leave, while “poor work ability” was defined as having had one or more spells of long-term sick leave  $\geq 28$  days during 4 years of follow-up. Access to the employers’ registers made it possible to accurately calculate length of sick leave spells and days at risk for the hazard analyses.

## **STATISTICAL METHODS**

Table 5 gives an overview of outcome measures. The Table also shows selected risk estimates to demonstrate associations between exposure variables and outcomes and the statistical methods used for these calculations.

### **Study I**

For different health-related factors at baseline, exposed subjects were compared with unexposed subjects with regard to becoming sick-listed for  $\geq 28$  days continuously at least once during the 3-year follow-up. Relative risks (RRs) were calculated with 95% confidence intervals (CIs) adjusted for geographical area (in three groups), using the method proposed by Mantel and Haenszel. No confounding from geographical area was observed and this factor was subsequently omitted. Factors with a RR  $\geq 1.2$  or lower confidence intervals  $> 1.0$  of becoming sick-listed were introduced in a Cox proportional hazards regression model, in order to calculate simultaneously adjusted hazard rate ratios with 95% confidence intervals. Person-time was calculated to the end of the follow-up, to the day of the first sick leave period of  $\geq 28$  days or to the day of leaving the job. The exact day of leaving the job was known in 25% of the cases. For those for whom the date of leaving was unknown, it was calculated 9 months of person-time for those leaving the job between the baseline questionnaire and 18-month follow-up while calculating 27 months of person-time for those leaving the job between 18 and 36 months’ follow-up. To test the proportionality assumption in the Cox regression the log minus log functions were used.

### **Study II**

Odds ratios (ORs) with the 95% confidence interval (CI) were calculated in order to estimate the strength of the associations between different health-related factors at baseline and retained work ability during follow-up. Univariate and multivariate logistic regression analyses were carried out separately for each sex. The same multivariate model was used for women and men, and included all factors in the univariate analyses that, either for women or for men, were associated with retained work ability with a point estimate of  $\geq 1.2$  and a lower bound of the 95% CI of  $\geq 1.0$ . In the

multivariate model the associations were adjusted for age, social and economic factors, employment sector and sickness absence during the year prior to the survey.

**Table 5.** Overview of outcome measures, risk estimates and statistical methods used in the different studies to demonstrate associations between exposure variables and outcomes.

	<b>Study I</b>	<b>Study II</b>	<b>Study III</b>	<b>Study IV</b>
Outcome measure	Long-term sick-listed <sup>I</sup>	Retained work ability <sup>II</sup>	Excellent and poor work ability <sup>III</sup>	Excellent and poor work ability <sup>IV</sup>
Risk estimate	Relative risk Hazard ratio	Odds ratio	Odds ratio	Hazard ratio
Statistical methodology				
Crude analysis	Yes	Yes	No	Yes
Univariate analyses	Mantel–Haenszel	Logistic regression model	Logistic regression model	Cox*
Factors adjusted for in the univariate analyses	Geographical area of residence and work	—	Sex, age, prior sick leave	Sex, age, work type <sup>†</sup>
Multivariate analyses, simultaneously adjusted for all included factors	Cox*	Logistic regression model	Logistic regression model	—
Analyses of the total sample	Yes	No	Yes	Yes
Analyses stratified by sex	— <sup>‡</sup>	Yes	Yes	Yes

<sup>I</sup> Long-term sick-listed ≥1 sick leave spells ≥28 days during 3 years.

<sup>II</sup> Retained work ability = no spells of sick leave >14 days during 1 year.

<sup>III</sup> Excellent work ability = no sick leave + no sickness presenteeism; and  
Poor work ability = sick leave >28 days during last 1 year.

<sup>IV</sup> Excellent work ability = no sick leave; and  
Poor work ability = sick leave spells ≥28 days during 4 years.

\*Cox proportional hazards regression model.

<sup>†</sup>Mainly physical, mental or mixed physical-mental work tasks <sup>180</sup>.

<sup>‡</sup>Only women were included in the study.

## Study III

In order to determine whether the considered health-related exposure variables acted as determinants promoting excellent work ability, preventing poor work ability, or achieving both, logistic regression models were fitted in three steps and separately for excellent and poor work ability. Each of these two groups was compared with an intermediate group. For the analyses of excellent work ability the intermediate group was the group that remained when 15% of respondents reporting poor work ability were omitted, and for the analyses of poor work ability the intermediate group was the group that remained when 13% reporting excellent work ability were omitted.

In the first step all exposure variables were individually examined and all variables that were associated with either of the two outcome variables were included in step 2. Association was defined as having a point estimate with a 95% CI that did not include 1; or a point estimate of  $\geq 1.2$  with the lower limit of the 95% CI  $\geq 0.95$ ; or a point estimate of  $\leq 0.83$  with the higher limit of the 95% CI  $\leq 1.05$ . In the second step four separate models were used to conduct the multivariate analyses – one for the control variables (sex, age, and previous sick leave), and one for each of the three domains. Thus identical models were used to analyse associations with the two outcome variables excellent and poor work ability. All exposure variables that, on the same grounds as used between step 1 and 2, had an association with the dependent variables were chosen for a third step, a full model. The gradual selection of variables was done in order to omit too many collinear variables in the final full models.

Separate analyses were carried out for women, men, and all respondents aggregated. All steps of the analyses were adjusted for age and previous sick leave, and in analyses of all respondents together also for sex. As the results for women and men throughout the analyses were almost identical only the combined results are shown.

#### **Study IV**

Sensitivity, specificity and predictive ability of the five instruments were separately analysed for the two outcomes for all respondents together, and stratified by sex. Cox proportional hazard regression models, crude and adjusted for sex, age and work type, were used giving hazard ratios (HRs) with 95% CIs for the associations between individual baseline measures and the outcomes. The work types were classified according to the WAI instrument<sup>180</sup> into mainly physical (e.g. caregivers in home-based personal care, and craftsmen), mainly mental (e.g. teachers and managers) and mixed (e.g. nurses and assistant nurses). During the 4 years 25% of the employees ended their employment, which was considered when calculating days at risk. Cox regressions are dependent on an “event”. To comply with this, the calculations of HRs for excellent work ability (= no sick leave), which is a “non-event”, had to be converted to HRs for having  $\geq 1$  day of sick leave, giving hazards  $< 0$  for predictors rated as excellent. The calculated HRs were then inverted in order to give the HRs for, or the chance of, having excellent future work ability. This procedure was also intended to facilitate the comparison between excellent and poor predictors.

# RESULTS

## STUDY I

During the 3-year follow-up 918 women, 18%, of the included had at least one spell of continuous sick-listing for  $\geq 28$  days. Long-term sick-listing was associated with factors related to health as well as with factors from each of the domains social situation, lifestyle and work.

Adjusted for age, health-related factors such as poor recuperation after a work period, RR 1.4, sickness presenteeism more than twice, RR 1.7, and reported pain from five or more body regions, RR 1.8, were determinants for long-term sick leave ( $\geq 28$  days) among women in the public sector (Table 6).

**Table 6.** Relative risks (RRs) and 95% confidence intervals (CIs) for becoming sick-listed long-term ( $\geq 28$  days) during a 3-year follow-up, for health-related factors among women in the public sector, adjusted for age in two groups,  $< 50$ -year-olds and  $\geq 50$ -year-olds.

Exposure	No. of exposed cases	RR	95% CI
Pain/discomfort from five or more body regions	345	1.8	1.6–2.1
Poor recuperation	175	1.4	1.2–1.7
Sickness presenteeism $> 2$ times last year	600	1.7	1.5–2.0

Analyses using the Cox regression model (Table 7) showed that, among socio-demographic and lifestyle factors, being 50 years or older, HR 1.4, having a strained financial situation, HR 1.3, and being obese, i.e. having a body mass index (BMI)  $\geq 30$ , HR 1.3, were determinants for long-term sick-listing  $\geq 28$  days.

Furthermore, with regard to the work situation, having physical demands at work higher than own capacity, HR 1.5, having mental demands at work higher than own capacity, HR 1.2, and being subjected to bullying from superiors and/or colleagues, HR 1.5, were also determinants of long-term sick-listing.

**Table 7.** Adjusted hazard ratios (HRs)\* and 95% confidence intervals (CIs) for becoming sick-listed long-term  $\geq 28$  days during a 3-year follow-up among women in the public sector. Statistically significant associations are highlighted for easier identification.

Exposure	No. of exposed cases	HR	95% CI
Age $\geq 50$ yrs	428	1.4	1.3–1.7
Strained financial situation	180	1.3	1.1–1.6
Obese (BMI $>30$ ) <sup>†</sup>	117	1.3	1.0–1.5
Daily smoking	212	1.2	0.9–1.4
Physical demands at work higher than own capacity	192	1.5	1.2–1.8
Mental demands at work higher than own capacity	210	1.2	1.0–1.5
Bullying from superiors or colleagues	175	1.5	1.3–1.8
Job strain (high demands and low control)	107	0.9	0.8–1.2
Negative consequences of changes at work	227	1.1	0.9–1.3

\*HR simultaneously adjusted for all factors shown in the Table.

<sup>†</sup>BMI = body mass index.

## STUDY II

Altogether 82% of the women and 89% of the men showed retained work ability, defined as not having had any spell of sick leave  $>14$  days during the follow-up. Most of the associations found in the crude analyses were attenuated in the multivariate analyses, indicating some correlations between the included variables (Table 8). The results did not point to any significant sex differences in the associations between baseline exposures and retained work ability during the follow-up, neither in the crude nor in the multivariate analyses. The CIs for all associations overlapped. Exposures that showed statistically significant associations in the multivariate analyses expressed as ORs will be described in the following.

Within the socio-demographic domain determinants for retained work ability found were for women being 45 years old, OR 1.3, and men being 35 years old, OR 1.4, compared with the 55-year-olds. Other determinants for retained work ability were for men to have good personal finances, OR 1.5, for women and men to have more than 11 years of schooling (women OR 1.2; men OR 1.8), to live together with another adult and child/children compared with other ways of cohabiting or to live alone (women OR 1.3; men OR 1.5), and to be employed by other employers than local authorities in the municipalities (women OR 1.3; men OR 1.5).

Factors concerning health and well-being that acted as determinants for retained work ability were: feeling recuperated when starting work and being full of energy during the working day (women OR 1.5; men OR 1.2), as well as the pattern of sick leave during the year preceding the survey: no spell of sick leave (women OR 2.7; men OR 2.6), or only one spell (women OR 1.6; men OR 1.9), compared with those who had two or more spells.

Workplace factors that acted as determinants for retained work ability during the follow-up were reporting the work as physically non-strenuous (women OR 1.6; men

OR 2.1), working at a workplace where no plans were being made to close down (women OR 2.3), and often being in the mood for work (men OR 1.4).

Table 8. Associations between different factors at baseline and retained work ability during the 1-year follow-up: presented as adjusted odds ratios (ORs) with 95% confidence intervals (95% CIs). Statistically significant associations in the adjusted analyses\* are highlighted for easier identification.

Exposure	Women n=3 390		Men n=2 947	
	No. exposed	Adjusted OR (95% CI)	No. exposed	Adjusted OR (95% CI)
<b>Socio-demographic factors</b>				
Age 35 v. 55 yrs	1 032	1.1 (0.8–1.4)	899	1.4 (1.0–2.0)
Age 45 v. 55 yrs	1 212	1.3 (1.0–1.7)	1 000	1.2 (0.9–1.7)
>11 years of schooling	1 852	1.2 (1.0–1.5)	1 482	1.8 (1.4–2.5)
Good personal finances	2 894	1.0 (0.8–1.3)	2 570	1.5 (1.0–2.1)
Household with another adult and child(ren)	1 728	1.3 (1.1–1.7)	1 586	1.5 (1.1–1.9)
Employer other than the local authorities	1 976	1.3 (1.0–1.6)	2 322	1.5 (1.0–2.2)
<b>Health and well-being</b>				
Fully recuperated and full of energy	2 521	1.5 (1.1–1.9)	2 159	1.2 (0.9–1.7)
No previous sick leave	1 413	2.7 (2.1–3.5)	1 552	2.6 (1.8–3.7)
On sick leave once previously	1 284	1.6 (1.2–2.0)	941	1.9 (1.3–2.7)
<b>Physical work factor</b>				
Physically non-strenuous work	1 995	1.6 (1.3–1.9)	1 826	2.1 (1.5–2.8)
<b>Psychosocial and organizational factors</b>				
Organization has no plans to close down	3 287	2.3 (1.3–4.2)	2 873	0.7 (0.2–2.0)
Employee is content with working hours	2 089	1.1 (0.9–1.4)	1 879	1.2 (0.9–1.6)
Employee is often in the mood for work	2 990	1.1 (0.8–1.4)	2 653	1.4 (1.0–2.0)
Employee is satisfied with own performance	2 485	0.9 (0.7–1.2)	2 253	1.1 (0.8–1.5)
Performance at work appreciated by superior	2 577	1.0 (0.8–1.3)	2 035	0.8 (0.5–1.1)
Mix of sexes at the workplace	1 817	1.1 (0.9–1.3)	1 662	1.0 (0.7–1.3)
Good leadership from immediate superior	2 315	1.2 (0.9–1.5)	1 890	1.0 (0.7–1.4)
Relaxed job v. job strain	1 124	1.2 (0.8–1.6)	1 315	1.0 (0.6–1.7)
Active job v. job strain	488	1.0 (0.7–1.5)	479	1.2 (0.7–1.9)
Passive job v. job strain	1 275	1.0 (0.8–1.4)	847	1.0 (0.7–1.7)

\*OR simultaneously adjusted for all factors displayed in the Table.

### STUDY III

Excellent work ability was found in 13% of the respondents and poor work ability was found in 15%. Men compared with women had a higher probability of excellent work ability, OR 1.4, and a lower probability of poor work ability, OR 0.5.

As the associations, expressed as ORs, between the determinants and the two outcomes were almost identical for women and men throughout the analyses only the combined results are shown (Table 9).

In the final models, associations in the domain-specific models remained largely unchanged. However, the associations between excellent work ability and recuperation as well as physical strenuous work were diluted, as were the associations between poor work ability and heavy lifting and job security. For age, the associations were not as expected at the excellent pole and a U-shaped relationship between being in the mood for work and excellent work ability became distinct in the full model.

Within the socio-demographic domain there was a decreased probability of excellent, OR 0.7, as well as of poor, OR 0.6, work ability for the youngest age group ( $\leq 44$  years). Personal finances not being strained decreased the probability of poor work ability, ORs  $\leq 0.7$ , as well as showing a tendency for increased excellent work ability, OR 1.3.

Factors concerning health and well-being acting as determinants were not having taken any days at all of sick leave during the year before baseline, associated with excellent, OR 4.3, and poor work ability, OR 0.3. There was also a lower probability of poor work ability among those with 1–28 days of sick leave, OR 0.4, and those who sometimes or more often felt recuperated, ORs  $\leq 0.7$ .

To have normal weight or even some overweight (BMI  $\leq 30$ ) decreased the probability of poor work ability, ORs  $\leq 0.7$ . Frequent leisure exercising showed a tendency for association with excellent work ability, OR 1.3.

Only two factors in the working life domain were associated with both excellent and poor work ability, viz. having low psychological demands at work, OR 1.3 for excellent work ability, and a tendency for poor work ability, OR 0.8; and sometimes feeling uneasy on the way to work OR 0.6 for excellent and OR 0.7 for poor work ability.

Most of the identified determinants were associated solely with promoting excellent work ability or preventing poor work ability. Being content with the number of working hours or wanting to work more hours, OR 1.6, almost never having bent work postures, OR 1.6, experiencing high clarity of goals, expectations and responsibilities, OR 1.4, and having one's performance at work appreciated by one's superior, ORs  $\geq 1.3$ , were determinants for with excellent work ability. Factors acting solely as determinants for poor work ability were experiencing a high mastery at work, OR 1.4, as well as a tendency for association when having high decision latitude, OR 0.8.

**Table 9.** Full multivariate logistic regression models showing baseline determinants for excellent and poor work ability, respectively, expressed as adjusted odds ratios (ORs)\* and their 95% confidence intervals (CIs). Statistically significant associations are highlighted for easier identification.

Poor work ability n=857			Determinants	Excellent work ability n=751		
Exposed cases	OR	95% CI		Exposed cases	OR	95% CI
Sex						
780	1		women	584	1	
77	0.52	0.39–0.70	men	167	1.37	1.09–1.73
Age						
215	1		≥55 yrs	219	1	
371	0.89	0.71–1.12	45–54 yrs	310	0.92	0.73–1.17
271	0.63	0.50–0.81	≤44 yrs	222	0.69	0.54–0.89
Personal finances						
202	1		strained	75	1	
363	0.72	0.57–0.91	neither good nor bad	285	1.20	0.87–1.65
286	0.65	0.51–0.84	good	389	1.33	0.96–1.83
Previous sick leave						
233	1		>28 days	29	1	
442	0.36	0.28–0.45	1–28 days	217	1.29	0.78–2.12
169	0.26	0.20–0.33	0 days	500	4.29	2.63–7.01
Recuperation						
127	1		rarely recuperated	30	1	
305	0.73	0.54–0.99	sometimes recuperated	122	0.93	0.56–1.54
387	0.63	0.46–0.86	mostly recuperated	581	1.40	0.85–2.29
Smoking						
266	1		smoker	167	1	
573	0.84	0.69–1.02	non-smoker	573	1.12	0.89–1.39
BMI						
141	1		≥30	53	1	
284	0.62	0.47–0.80	25–29.9	259	1.17	0.82–1.67
409	0.65	0.49–0.86	<25	420	1.14	0.80–1.60
Leisure exercise						
166	1		occasionally	87	1	
167	0.95	0.72–1.26	1x per week	160	1.28	0.93–1.77
504	0.95	0.75–1.20	2 or more x per week	484	1.29	0.97–1.70
Physically strenuous work						
181	1		strenuous (16–20)	65	1	
418	0.97	0.76–1.25	somewhat strenuous (13–15)	346	1.30	0.93–1.80
245	0.99	0.72–1.34	non-strenuous (<12)	331	1.34	0.93–1.92
Heavy lifting						
219	1		6 times or more per day	129	1	
252	0.96	0.75–1.23	1–5 times per day	195	1.00	0.75–1.33
376	0.85	0.65–1.11	almost never	421	0.90	0.67–1.22
Bent work posture						
229	1		>60 min. per day	118	1	
395	0.98	0.79–1.23	1–60 min. per day	312	1.15	0.88–1.51
223	0.99	0.75–1.30	almost never	315	1.61	1.21–2.16

**Table 9.** Continued.

Poor work ability n=857			Determinants	Excellent work ability n=751		
Exposed cases	OR	95% CI		Exposed cases	OR	95% CI
			Job security			
92	1		decreased	43	1	
684	0.87	0.64–1.17	unchanged	640	0.98	0.66–1.44
61	1.16	0.75–1.79	increased	47	1.24	0.75–2.07
			Number of working hours			
308	1		would like to work less	146	1	
457	0.84	0.69–1.02	content with the hours	546	1.64	1.30–2.07
78	1.18	0.84–1.67	would like to work more	54	1.61	1.08–2.42
			In the mood for work			
114	1		often feel uneasy on the way to work	26	1	
244	0.67	0.48–0.92	sometimes feel uneasy	78	0.55	0.32–0.92
492	0.56	0.41–0.78	rarely feel uneasy	642	0.92	0.56–1.50
			Mastery			
211	1		low perception of mastery	109	1	
476	1.11	0.88–1.40	moderate perception of mastery	439	0.85	0.64–1.13
150	1.44	1.05–1.97	high perception of mastery	189	0.96	0.68–1.35
			Role clarity			
214	1		low role clarity	131	1	
452	0.96	0.77–1.19	moderate role clarity	399	1.05	0.82–1.35
171	0.95	0.72–1.26	high role clarity	200	1.36	1.00–1.83
			Demands			
331	1		high demands	167	1	
318	0.94	0.77–1.16	moderate demands	276	1.15	0.90–1.46
191	0.78	0.61–1.01	low demands	296	1.30	1.01–1.68
			Control			
332	1		low decision latitude	199	1	
319	0.86	0.70–1.05	moderate decision latitude	300	1.00	0.79–1.26
188	0.80	0.63–1.03	high decision latitude	237	0.87	0.67–1.12
			Performance appreciated by superior			
273	1		to a fairly small extent	140	1	
333	1.02	0.82–1.26	to some extent	304	1.31	1.02–1.68
221	1.05	0.82–1.35	to a great extent	291	1.41	1.08–1.84

\*ORs simultaneously adjusted for all determinants listed in the Table.

Table 10 gives an overview of the results of the final multivariate analyses in studies I–III.

**Table 10.** Summary of significant associations\* found in studies I–III. On the left the associations at the negative end-pole are shown. On the right are associations at the positive end-pole of the work ability continuum shown. Associations for which the 95% confidence interval (95% CI) does not include 1 are marked S (= significant). Associations marked T (= tendency) signalize a point estimate of  $\geq 1.2$  with the lower limit of the 95% CI  $\geq 0.95$ ; or a point estimate of  $\leq 0.83$  with the higher limit of the 95% CI  $\leq 1.05$ . The full final models of the different studies are not shown. In this Table is only exposure variables given that were associated or tended to be associated with any of the outcomes.

Study I	Study III	Baseline determinants	Study II	Study III
3-year follow-up	1½-year follow-up		1-year follow-up	1½-year follow-up
<b>Poor work ability</b>			<b>Good work ability</b>	
Outcome: sick leave spells $\geq 28$ days	Outcome: $>28$ days of sick leave		Outcome: no sick leave spells $>14$ days	Outcome: no sick leave and no sickness presenteeism
<b>Socio-demographic domain</b>				
Women	Both sexes		Women	Men
S	S	Age	S	S
–	–	Level of education	S	S
S	S	Personal finances	–	S
–	–	Family situation	S	S
<b>Health and well-being domain</b>				
S <sup>†</sup>	–	Bodily pain/discomfort	–	–
–	S	Previous sick leave	S	S
S <sup>†</sup>	–	Previous sickness presenteeism	–	–
S <sup>†</sup>	S	Recuperated and full of energy	S	–
<b>Lifestyle domain</b>				
S	S	BMI <sup>‡</sup>	–	–
–	–	Leisure exercise	–	–
<b>Working life domain</b>				
–	–	Employment sector	S	S
–	–	Job security	S	–
–	–	Number of working hours	–	–
–	–	Physically non-strenuous work	S	S
–	–	Good work posture	–	–
S	–	Physical demands v. own capacity	–	–
S	–	Mental demands v. own capacity	–	–
–	S	In the mood for work	–	S
–	S	Mastery	–	–
–	–	Role clarity	–	–
–	T	Psychological demands	–	–
–	T	Decision latitude	–	–
S	–	Bullying at work	–	–
–	–	Feedback from superior	–	–

\*The associations were simultaneously adjusted for all variables included in respective model (= column) except for Study I, in which the variables within the “Health and well-being domain” were not included in the full model.

<sup>†</sup>Only adjusted for age and not included in the full model.

<sup>‡</sup>BMI = body mass index.

## Non-significant exposure variables studies I–III

For several of the baseline exposure variables used in the analyses, a significant association or a tendency to association with work ability could not be shown in any of the three studies. These variables were geographical area of residence and work, being in charge of domestic responsibilities, negative influence of work on family life, and vice versa, smoking, mixed sexes at the workplace, heavy lifting, the demand-control model, and good leadership from the immediate superior.

## STUDY IV

In general the same proportion of women as of men rated their health/work ability as good while a larger proportion of women rated their health/work ability as poor at baseline. At follow-up 4 years later 18% of women and 32% of men had not been on sick leave 1 single day (= excellent work ability) while 28% of women and 18% of men had been on long-term sick leave at least once (= poor work ability) (Table 11).

**Table 11.** Health assessments at baseline and cumulative incidence of sick leave at the 4-year follow-up.

Variables	Women (n=1 786)	Men (n=466)	All (n=2 252)
<i>Potential predictors</i>			
Excellent Global health	37%	38%	37%
Poor Global health	25%*	18%*	23%
Excellent SF-36 GH <sup>†</sup>	21%	22%	21%
Poor SF-36 GH	27%*	22%*	26%
Excellent WAI rating <sup>‡</sup>	39%	43%	40%
Poor WAI rating	25%*	18%*	23%
Excellent Work ability in 2 years	77%*	85%*	79%
Poor Work ability in 2 years	23%*	15%*	21%
Excellent Health for working	11%	13%	11%
Poor Health for working	14%*	10%*	13%
<i>Cumulative sick leave at 4-year follow-up</i>			
Having had no sick leave at all	18%*	32%*	21%
Having had ≥1 sick leave spell ≥28 days	28%*	18%*	25%

\*Statistically significant at  $p < 0.05$  for the difference between the proportion of women and men.

<sup>†</sup>SF-36 GH = short-form 36-item general health questionnaire.

<sup>‡</sup>WAI = Work ability index.

The HRs of the five instruments did not differ significantly in predicting excellent work ability (Table 12). For all respondents together, excellent WAI scores demonstrated the strongest association, HR 1.5. In the sex-stratified analyses, the HRs for women and men were almost identical with the HR for women and men combined.

Also, for predicting poor work ability, there were no statistically significant differences between the instruments, poor WAI having the strongest association, HR 2.6, for all

respondents together. For women, the results were almost identical, but for men, the HRs were on a distinctly higher level, being strongest for poor Health for working, HR 5.5. Two of the instruments, Work ability in 2 years and the Health-for-working scale, had significantly higher associations for men rating poor than for women rating poor.

**Table 12.** Four-year prediction of excellent work ability (= 0 days of sick leave), expressed as adjusted inverted hazard ratios (HRs) with 95% confidence intervals (CIs) for having  $\geq 1$  day of sick leave, and of poor work ability (= one or more sick leave spells  $\geq 28$  days), expressed as adjusted HRs with 95% CIs.

Predictors of excellent work ability			Predictors of poor work ability		
All (n=2 252)	Ex-posed cases	HR (95% CI) adjusted for sex, age and work type	All (n=2 252)	Ex-posed cases	HR (95% CI) adjusted for sex, age and work type
Excellent Global SRH*	225	1.43 (1.30–1.59)	Poor Global SRH*	222	2.13 (1.80–2.53)
Excellent SF-36 GH <sup>†</sup>	136	1.47 (1.30–1.67)	Poor SF-36 GH <sup>†</sup>	234	2.25 (1.90–2.66)
Excellent WAI <sup>‡</sup>	218	1.52 (1.37–1.69)	Poor WAI <sup>‡</sup>	207	2.55 (2.13–3.06)
Excellent Work ability in 2 years score	358	1.32 (1.18–1.49)	Poor Work ability in 2 years score	181	2.00 (1.67–2.40)
Excellent Health for working score	77	1.47 (1.25–1.72)	Poor Health for working score	131	2.28 (1.86–2.78)
<b>Women</b> (n=1 786)		Adjusted for age and work type	<b>Women</b> (n=1 786)		Adjusted for age and work type
Excellent Global SRH*	152	1.41 (1.27–1.59)	Poor Global SRH*	190	2.02 (1.68–2.43)
Excellent SF-36 GH <sup>†</sup>	95	1.49 (1.32–1.72)	Poor SF-36 GH <sup>†</sup>	196	2.06 (1.72–2.48)
Excellent WAI <sup>‡</sup>	141	1.52 (1.34–1.69)	Poor WAI <sup>‡</sup>	176	2.39 (1.97–2.90)
Excellent Work ability in 2 years score	227	1.27 (1.12–1.45)	Poor Work ability in 2 years score	151	1.78 (1.46–2.17)
Excellent Health for working score	53	1.52 (1.27–1.82)	Poor Health for working score	107	1.98 (1.59–2.46)
<b>Men</b> (n=466)			<b>Men</b> (n=466)		
Excellent Global SRH*	73	1.54 (1.20–1.96)	Poor Global SRH*	32	2.87 (1.84–4.50)
Excellent SF-36 GH <sup>†</sup>	41	1.35 (1.02–1.82)	Poor SF-36 GH <sup>†</sup>	38	3.83 (2.46–5.95)
Excellent WAI <sup>‡</sup>	77	1.54 (1.22–1.92)	Poor WAI <sup>‡</sup>	31	3.80 (2.36–6.11)
Excellent Work ability in 2 years score	131	1.61 (1.20–2.17)	Poor Work ability in 2 years score	30	4.53 (2.83–7.26)
Excellent Health for working score	24	1.23 (0.87–1.75)	Poor Health for working score	24	5.53 (3.37–9.08)

\*SRH = self-rated health.

<sup>†</sup>SF-36 GH = short-form 36-item (SF-36) general health questionnaire, a general health scale.

<sup>‡</sup>WAI = work ability index.

## DISCUSSION

The main objective of this thesis was to identify determinants of future work ability, with special reference to promoting factors at work. The solid reasons for finding promoting factors were several. One was to find alternatives to risk prevention when this is not immediately possible because of economic or practical limitations or because there are no solutions available. Another was if work ability is regarded as a continuum, promotive measures could hopefully bring individuals further away from the breaking point of getting sick-listed long-term. The hypothesis is that as work ability many times is affected by a combination of disease and adverse working conditions, promotive factors could then to some extent counteract these conditions and prolong good work ability. A third reason is that despite limited scientific knowledge about health-promotive factors, health promotion and workplace health promotion (and by this is not meant traditional risk elimination) has become a topic on the working life agenda, often with commercial interests.

The studies in this thesis have regarded work ability as being defined by sick leave rates, including all kinds of diseases but also, other reasons, e.g. accidents, severe grief and complications due to pregnancy. These are all conditions that can reduce work ability and thus result in sick leave. In studies I–III some mutual factors and some factors at either the positive or the negative end-points were found to be determinants for excellent (Study III), retained (Study II) or poor work ability (studies I and III). It is possible that the found associations, as well as “silent” potential associations (if any), would have been more pronounced if there had been a possibility to strictly look at specific disorders and diseases attributed to be connected to working conditions or life style factors and exclude diseases predominantly connected to the “genetic burden” of a person. However, the aim of these studies was not to differentiate how impaired work ability relates to specific diagnoses, but to find factors associated with work ability and sick-listing per se. With this focus, it is possible to suggest measures to promote sustainable work ability in a more general way.

In Study IV were five instruments for self-assessment investigated with regard to their ability to predict future work ability, instruments that can be used for screening purposes to identify risk groups for impaired work ability, for instance. These instruments showed similar power to predict, were better at discriminating for poor than for excellent work ability, and discriminated poor work ability somewhat better for men than for women.

## STUDIES I–III

### Work ability and sick leave

Sick leave, and consequently work ability defined by sick leave, is a complicated matter, and not a mere question of health status in relation to job requirements. The social insurance system, procedures for sick-listing, the health care situation, norms and attitudes at work and in society, are also factors of importance.<sup>2,3,98,110</sup> Sick leave is furthermore influenced by whether or not it is possible to adjust work demands and working conditions to the individual's needs.<sup>77</sup> This is an issue that is not solely concerned with the nature of the work, but also, with the attitudes of management, superiors and co-workers. The social insurance system is the same throughout Sweden but procedures among insurance authorities and doctors in the sick-listing process differ considerably.<sup>162</sup> Sweden has very good health among its inhabitants and a long life expectancy; nevertheless, sick-listing figures have recently been very high. This is a paradox and the underlying causes must be found in order to decrease the number of sick-listed people in Sweden and to prevent new cases, since the economic and social consequences for the individual, workplace and society are considerable.

Instead of taking sick leave when they are ill some people continue to go to work. As with sick leave, sickness presenteeism depends on the severity of the health situation and hence the work capacity; it also depends on the demands of the job and the possibilities to be flexible in work performance.<sup>15</sup> The consequences of sickness presenteeism for the individual are poorly investigated. In Study I was found that irrespective of age, repeated sickness presenteeism the year before the baseline was a strong predictor of poor work ability (long-term sick leave  $\geq 28$  days) during follow-up. The same analysis performed with sick leave twice or more during the year before baseline gave identical estimates, RR 1.7, 95% CI 1.5–2.0 (not shown).

Though studies II and III did not aim to establish the exact strength of each association, it is noticeable that the most pronounced predictor promoting good as well as preventing poor work ability was the degree of sick leave taken during the year before baseline. This result corroborates the long since established predictive power of prior sick leave for future sick leave.<sup>37,160,184</sup> It is also possible that people with health problems influencing their work capacity are more inclined to experience and report their working conditions as more strenuous than are healthy persons. Thus, controlling for previous sick leave in studies II and III was to ensure that extra vulnerability caused by any earlier disease or dysfunction would not affect the associations between the baseline characteristics and the outcome. In Study I it was in part controlled for this by only including women classified to have good health for working.

However, previous sick leave is not necessarily a confounder. It could be caused by the same determinants as recent sick leave and adjusting for it will then lead to a slight underestimation of the associations. To check this, the final analyses in Study III were repeated without adjusting for previous sick leave. There were minor changes in the associations, actually in both directions, but all significant results remained and no new ones were added (not shown). This implies that the work-related findings in these studies are applicable regardless of previous reasons and patterns in connection with sick leave, which could be an advantage with regard to achieving higher precision in

interventions. It also emphasizes the fact that preventive measures to lower the risk of sick leave are important with regard to future work ability in the work force.

## **Recuperation**

To feel recuperated was of importance as determinant for sustainable work ability in all three studies even though recuperation is to be seen more as a mediating factor than as a determinant in itself since recuperation can be dependent on, e.g., lifestyle, possibilities of recreation, and workload. What is noticeable is that even a fairly low level of recuperation seemed to be sufficient to have a promotive effect on work ability. These results are in line with those reported in other studies.<sup>16,48,76</sup> Even if recuperation is not an exposure in itself it therefore seems to be an important prerequisite to sustainable work ability. In the full model in Study III the association was weakened, but remained significant for poor work ability. One reason for this could be that recuperation to some extent covariates with feeling uneasy on the way to work (Spearman's rank correlation coefficient = 0 .45). The direction of this correlation was not investigated. However, it is possible in both ways. Not feeling fully recuperated can give an uneasy feeling on the way to work and result in worries about being able to manage. On the other hand, if feeling uneasy on the way to work is caused by an unpleasant working climate, thoughts about the work situation can disturb your sleep and thus cause limited recuperation.

## **Socio-demographic factors**

It was not possible neither in Study II nor in Study III to detect any large differences between women and men with respect to which factors predict future work ability. Consequently, not having to design different intervention programmes for the two sexes will hopefully facilitate taking such measures.

As expected, there were clear associations between age and work ability in studies I–III. In many reports and national statistics, age is a risk indicator for sick-listing.<sup>162</sup> This is also the case in studies with more sophisticated regression models.<sup>175</sup> In the Swedish report titled, “The Swedish illness: reports on sick-listing from eight countries”,<sup>136</sup> the authors estimate that 5% of the increase in sick-listing during recent years can be ascribed to the elevated age structure of the Swedish workforce. In Study III an interesting duality was shown for the employees who were 55 years or older. On the one hand, they had a higher probability of having excellent work ability; on the other hand, they had a higher probability of poor work ability, which demonstrates both a healthy worker effect and a vulnerability among ageing workers. This study group includes perhaps a wider range of individual capacities than do other age groups, which may be important to consider in working life.

In the public debate the combined role of working as well as having children and having the main responsibilities for domestic work has been much discussed as a factor that can explain the higher rates of sick-listing for women in Sweden. In some studies there is an increased risk of long-term sick-listing among women with children to care for<sup>26,201,208,213</sup> while in others the opposite has been found.<sup>36,114</sup> No association between having children to take care of and sick-listing could be found in the present studies.

However, in Study II it was a promotive factor both for women and men, to live with another adult and have children.

Another well-established association is the one between socio-economic level and health<sup>111</sup> and sickness absence.<sup>4,133</sup> Personal finances were of importance in studies I–III, but the level of education was associated with work ability only in Study II. An economic measure was chosen with the aim to better mirror the total financial situation of the individual. Instead of just looking at the annual income the measure used also takes into account other aspects such as wealth and the spouse's income, as well as expenditures. Household wealth has been shown to be strongly associated with factors such as morbidity.<sup>112</sup> Personal finances was a stronger determinant than educational level, and strained economy was a risk indicator per se in studies I and III, which was a little surprising as lower education often is associated with low-status manual work and high prevalence of sick leave.

### **Life-style factors**

Of the lifestyle factors, BMI was the only significant determinant of poor work ability. For excellent work ability the life style factors associated even weaker. There was an association, but not significant, for frequent leisure exercise to promote excellent work ability. Obesity as a risk factor for absenteeism has been reported in other studies.<sup>120,178</sup> The fact that obesity is associated with several diseases and disorders, such as circulatory problems, diabetes and musculoskeletal disorders, is well known. In many Swedish companies the employees are encouraged to join what the management regards as health-promotive activities such as a physical work-out, smoking cessation and weight reduction. By sponsoring participation the companies show an expectation of lowered numbers on sick leave and therefore of reduced costs. The studies presented here give limited support for the assumption that this could be a track to support sustainable work ability and the expectations should be within reason. In a review, Proper et al.<sup>144</sup> found limited evidence for an effect of physical activity programmes at worksites on absenteeism. Nurminen et al.<sup>135</sup> studying women with physically demanding work found no reduced sick leave in those taking part in physical activity at the worksite once a week compared with a control group although the former slightly improved their perceived work ability. However, it is possible that such activities can have secondary effects such as promoting a good social work climate and thus influencing work ability.

### **Physical work factors**

Physical and psychosocial factors at work are often ascribed to cause musculoskeletal disorders.<sup>13,24,29,40,67,68,95,124,188</sup> Such disorders are one of the main reasons for sick leave in Sweden and often end in prolonged sick-leave spells.<sup>149</sup> Melchior et al.<sup>117</sup> found that work characteristics accounted for 19% (women) and 21% (men) of all absences. (In 2005 in Sweden this was true for 36% and 30% respectively.<sup>170</sup>) Physical work conditions accounted for 42% (women) and 13% (men) of absences for musculoskeletal disorders, and work stress accounted for 48% (women) and 40% (men) of psychiatric absences. Accordingly, in Study II one of the most important factors for subjects to retain their work ability during the follow-up was having a physically non-

strenuous job. And in Study III associations were found between rarely working with bent work posture and excellent work ability. This was in line with what Borg et al. found<sup>33</sup> investigating work environment and changes in SRH, and with Voss et al.<sup>209</sup> who found a lower incidence of sickness among both women and men who did not complain about heavy lifting and monotonous movements. Rather surprisingly, no convincing associations were found between work assessed as physically strenuous and poor work ability. In Study III in the separate analyses of each exposure variable adjusted for sex, age and previous sick leave there were statistically significant associations between physical factors at work and poor work ability. These associations were deleted in the multivariate models, indicating that organizational and psychosocial factors were of greater significance with regard to preventing poor work ability, even though a correlation matrix did not reveal any associations between physical exertion and psychological demands, as others have shown.<sup>80</sup> However, in Study I, when physical demands at work were related to the individual's capacity and assessed as higher, this was a risk indicator for long-term sick-listing.

The results concerning physical risk factors were fairly unexpected as others have demonstrated a clear association between externally judged as well as self-rated physical demands and sickness absence.<sup>27,177</sup> Consequently non-strenuous work was expected in the first line to protect from poor work ability. In this thesis work, however, the level of physical strain is a subjective rating of perceived exertion. This is assumed to involve not only cardio-vascular strain, but also, exertion due to static muscular efforts, and can be influenced by previous experience and motivation, leading to under- or overestimation and consequently to a dilution of results.<sup>86</sup> An indication that perceived exertion also includes muscular efforts is that controlling for co-variation between the physical variables used in Study III revealed that Spearman's rank correlation coefficient between physical strenuous work and lifting was 0.50 while it was 0.36 between physical strenuous work and bent work posture. The latter weak correlation can explain the independent associations these two factors had with excellent work ability in the more limited domain-specific analyses.

### **Psychosocial and organizational work factors**

Among the work factors in Study I, bullying from superiors and/or colleagues was the strongest determinant for sick-listing. Bullying is an indicator of the work climate. This should be taken very seriously and all signs of bullying should be dealt with immediately. Bullying as a risk factor for sick-listing has been reported in a study of hospital staff in Finland.<sup>88</sup> In another study, occurrence of bullying at the workplace was associated with a twofold increase in the relative risk for sickness incidence among women, but not among men.<sup>209</sup>

As other studies have reported that social support from the supervisor has a positive influence on well-being<sup>103</sup> and reduces the level of absence without a doctor's certificate<sup>172</sup> it seemed plausible to expect an association in this direction. However, weak support was found for this except in Study IV where positive feed-back from the superior was a determinant for excellent work ability. It is possible that if the studies in this thesis had looked at the first 7 days of sick leave, for which no doctor's certificate

is required in Sweden, sick leave may have been found to be influenced by social support from the manager. However, as only longer spells of sick leave were investigated, the level of social support from the superior was perhaps not sufficient to buffer against the adverse effects of other factors.

Being in the mood for work associated with both good and poor work ability. Being in the mood for work could be an indication of job satisfaction. It could also indicate that the individual's personal capacity, mentally as well as physically, was in line with the work tasks. Also, it could indicate that there was a good "climate" at the workplace and that the performance was appreciated.

Mental demands higher than the person's capacity were a determinant for sick-listing in Study I. Many rapid changes take place at the working arena in today's society and involvement and sufficient capacity and skill to deal with new situations are probably essential for how a person reacts to changes.<sup>94,139</sup> In a study from Finland negative changes in the psychosocial work environment had adverse effects on the health of employees, measured as sickness absence.<sup>183</sup> Several investigations have found that job strain and the combination of high mental demands and low decision latitude at work are risk factors for sickness absence.<sup>84,91</sup> These factors were also of importance both for poor and for good work ability, but as separate factors. No significant associations with job strain were found in the adjusted analyses.

Two of the tested psychosocial factors in Study III need to be commented on, namely clarity of the role at work, and perceived high mastery at work. High role clarity was found to promote excellent work ability but had no influence on poor work ability among employees in the public sector. These results are only slightly contrary to those reported in a private sector study by Väänänen et al.<sup>211</sup> They found that in male white-collar employees low role clarity was associated with a higher rate of long absences ( $\geq 21$  days) compared with high role clarity. However, role clarity was not found to predict absence in other groups of employees, which is in line with the findings for all groups in Study III. A possible explanation for the discrepancy in results could be the divergent work situation in the public and private sector, or that male white-collar employees were not explicitly analysed in Study III.

The second factor, perceived high mastery at work, and its association with a higher probability of poor work ability may seem contradictory. This result could be interpreted as revealing that limited professional challenges lead to a perception of high mastery. A close look at the proportions of those perceiving high mastery in the participating professions supports this interpretation. Among personal assistants, cleaners, child-care workers, and constructions workers 25–32% reported high perception of mastery while among teachers, psychologists, and physiotherapists only 13–14% did.

To be content with the number of working hours or wanting to work more hours was not surprisingly a factor that was associated with good work ability. This factor could be an indicator of having a job that is in line with one's capacity, that the work ability is good, that the working conditions are favourable, that there is a balance between work and the personal sphere or that the employment is not full-time.

The secure feeling of working at a place with no plans for closure was a strong predictor for retained work ability in Study I. It has been shown that job insecurity is strongly associated with poor SRH and minor psychiatric morbidity for both sexes.<sup>45,58,207</sup> Major down-sizing of organizations has been reported to be associated with an increase in sickness absence among permanent employees but not among temporary employees.<sup>185</sup> Without being able to draw conclusions about causal pathways, associations between moderate down-sizing (women and men) and considerable expansion (women), respectively, and increased risk of long-term ( $\geq 90$  days) sickness absence have been demonstrated.<sup>194</sup>

In Study II the probability of retained work ability during the follow-up was greater among both women and men employed in the private sector, the county councils or the government compared with those employed by local authorities. Explanations for this finding could be that organizations other than local authorities offer jobs with other demands, and better working conditions, and are better organized in terms of rehabilitation and facilitating staying at work. It could also be that the local authorities do not dismiss people so quickly. As a matter of fact, there is an overrepresentation of employees on long-term sick leave ( $>60$  days) in the public sector compared with the private sector.<sup>148</sup>

## **STUDY IV**

### **Instruments predicting work ability**

In Study IV a greater proportion of women than of men scored low (= poor) on the baseline measures and developed poor work ability during the follow-up. However, the HR for developing poor work ability was markedly higher for men – statistically significant for two instruments. In other words, at the “poor” end-point the instruments seemed to discriminate better among men than among women and therefore gave stronger point estimates. Findings showing that women’s SRH assessments, as well as negative affects, are based on a wider range of health-related and non-health-related factors than are men’s and consequently cause dilution may explain this difference.<sup>21</sup>

The described associations decreased only to a minor extent from the crude to the adjusted models. In order to secure the results also analyses stratified by age (cut-off point 49/50 years) and by the three work types were performed. These also did not show any statistically significant difference to the crude analyses, neither for women nor for men. These results suggest that the crude measurements in Study IV, when stratified by sex, seem to be fairly reliable to use when more sophisticated analyses are not possible, e.g. for screening purposes in occupational health care.

Furthermore, as the discriminating ability for excellent baseline assessments was found to be markedly lower than for poor assessments cut-offs at the upper and lower 15th percentile were tested to explore whether this would show stronger associations. It was possible to perform these calculations for the three indices. The HRs turned out almost identical to the ones presented here. In order to achieve better discriminating ability for response alternatives at the positive end of the scale, it is obvious that the scales have to be further developed, e.g. to include more categories or different wording.

As three of the predictors included the prognostic question on work ability in 2 years it was hypothesized that the predictive precision would be even better at a 2-year follow-up. Performing the same analyses as described here did not confirm this hypothesis.

One of the research questions concerned the use of single questions versus multiple questions. In a study predicting mortality and health care utilization no difference between single- and multi-item measures was found.<sup>49</sup> The same results were found in Study IV, there were tendencies for differences between the point estimates, but the CIs overlapped. It has been suggested that single-question items are better suited as end-points while multiple-question items are better as independent variables.<sup>35</sup> This may perhaps be true but according to the results in Study IV, if space is limited a single question on global health as determinant is still a reasonable choice.

## **METHODOLOGICAL CONSIDERATIONS, STUDIES I-IV**

Major strengths of the studies included in this thesis are the prospective cohort designs that facilitate us to draw some conclusions about causes and effects, the rather large cohorts with a wide range of occupations represented and the good quality of the outcome measures.

Three of the studies, studies I, III and IV, were performed on employees from strategically selected local authorities and county councils mainly working in human relation professions, a constraint which somewhat limits the degree to which the findings can be generalized. It is possible that the patterns of determinants would be different in other settings, not least because there may be other ways of setting up and organizing work and consequently the demands may differ. On the other hand, as most of the investigated exposures are rather general, it is likely that studies performed on the general population would give similar results as here. However, as the intention in Study IV was to compare the predictive ability of five selected instruments, and not to establish the levels of association per se, it is likely that these results would be very similar also in a general population. In Study II the subjects were all aged 35, 45 or 55 years, randomly chosen from the general population. This age structure could at a first glance make the results look somewhat ill suited for generalizations. However, as these age groups cover the most active years in working life it is not probable that the results would have been very different with a traditional random selection among 20–64-year-olds.

### **Response rate**

The response rates in Study I (85%) and Study IV (86%) are considered to be very good.<sup>39</sup> Also, the response rate in Study III, 73%, is sufficiently good to draw conclusions. In Study II the response rate, 65%, is acceptable<sup>39</sup> but raises questions about the reliability of results. The prevalence data at baseline could be skewed by selection. This has been controlled for as far as possible by adjusting the analyses for socio-demographic factors, labour market issues and previous sick leave. In order to establish how stable the main results were, “worst scenarios” were calculated as if the response

rate had been 100%. This showed that at least 60% of the missing women and 67% of the missing men would have had to report a physically strenuous workload and yet retained their work ability during the follow-up in order to eliminate the associations found between workload and retained work ability. This distribution of exposure and retained work ability is extremely unlikely.

### **Selected variables and cut-offs**

Many factors influence health and sick leave.<sup>4</sup> For this reason, exposure variables covering different life domains were included and their impact on both ends of a work ability continuum was looked at. A limitation of the studies is that all items used in this thesis stem from a pathogenic approach and there is not enough empirical evidence to make them suited for a salutogenic approach. Consequently, to decide on cut-off points for these variables and especially at the positive end-point raised some difficulties because of lack of empirical knowledge about the level at which the chosen exposures would act as promotive agents. In Study II this was explored, based on hypotheses on what could be health-supportive, by testing the included variables at different cut-offs in order to find the least positive exposures needed to retain work ability. The ground for this was that such levels can be easier to implement and still be health-supportive. In Study III the variables were trichotomized at what was judged to be reasonable levels, partly by relying on experiences from Study II. The found patterns of associations may have been different with different cut-off points. Since research in this area is so scanty, it is very possible that there are factors in the separate domains that are influential for promoting work ability that have yet not been identified and therefore no tools to scrutinize are available. One direction to take in this search could be to look into the employees' reactions to different work characteristics rather than at the characteristics themselves, as has been suggested for further research on psychosocial factors and low back pain.<sup>47</sup> The results from the crude analyses in Study I, which showed that assessing the physical and mental demands at work greater than own capacity showed stronger associations with long-term sick leave, than did just assessing the work as physically demanding, indicate that this could be a fruitful way. It is further possible that a reason for the lack of promoting exposure variables is that some of those factors solely appear to be health-promotive. This means that their absence does not cause any risk for unhealth and therefore has not been of interest (or not been discovered) as scientists have mainly focused on risk-oriented research.

### **Outcomes**

One of the strengths of studies II and IV is that there is practically no misclassification of the outcome measures. In Study II the Swedish national register in which all sick leave spells >14 days are registered was used, whereas in Study IV the employers' registers of all absences from work were used. In Study I the data on sick leave spells  $\geq 28$  days were consecutively reported to the research team. This procedure may have entailed that not all cases were reported and that the results were therefore diluted, given the misreporting is unrelated to the exposures. On the other hand, for studies I and IV, it was possible at an individual level to calculate accurate times at risk and outcome categories. In Study III self-reported data on sick leave and sickness

presenteeism were used to define the three levels of work ability, excellent, medium and poor. There were no means available to check the validity of these self-reports. Previous studies<sup>42,156,189</sup> have reported low sensitivity for self-reported data on sick leave; by contrast, a recent study<sup>57</sup> reported a relatively good agreement between the annual numbers of self-reported and recorded sickness absence days in both sexes.

## **FURTHER RESEARCH**

Based on the findings presented in this thesis and experiences during the research process, further research activities for a better understanding of the prerequisites for sustainable work ability could include the following:

- exploring what are employees' and self-employed individuals' own thoughts about the notion of work ability and what factors are of importance in relation to these;
- further developing existing scales in order to achieve a better discriminating ability for response alternatives at the positive end of the scale;
- developing new items and scales directly designed for scrutinizing factors promoting work ability;
- explore for the minimum levels of exposure needed for various factors to support work ability; and
- evaluating health-supportive interventions at work places where risk factors can for the time being not be eliminated or are non-existing.

## **POLICY IMPLICATIONS**

The following points may be made with regard to policy implications:

- As identified determinants are amenable to influence, this opens up the way for interventions;
- somewhat different approaches may be needed to address excellent and poor work ability;
- supporting health-promotive work factors does not reduce the importance of traditional risk elimination;
- prediction of future work ability can be used for preventive measures; and
- single-question instruments for self-rated health or work ability can be useful in predicting future work ability as defined by sick leave rates.

## CONCLUSIONS

Several factors in working life as well as factors in private life acted as determinants of future work ability, as defined by sick leave rates in this thesis work. Some of these determinants were associated solely with excellent work ability, some solely with poor work ability and others with both.

Most of the identified lifestyle- and work-related determinants are amenable to influence in order to promote sustainable work ability. Such determinants associated with

- excellent work ability and no sick leave were: physical leisure exercise, content with number of working hours, good work postures, high role clarity, low psychological demands and positive feed-back from superior;
- retained work ability and at the most 14 days sick leave were: being recuperated, in the mood for work and physical non-strenuous work; and
- poor work ability and long-term sick leave were: obesity, not being recuperated, not in the mood for work, bullying, physical and mental demands at work higher than own capacity, high psychological demands and low decision latitude.

No significant differences between the sexes were found with regard to the question of which specific determinants are associated with work ability.

For some of the analysed exposure variables, no associations were found with future work ability. These were geographical area of residence and work, having main responsibility for domestic work, negative influence of work on family life, and vice versa, smoking, a mix of sexes at the workplace, heavy lifting, job strain (high demands and low control), and good leadership from the immediate superior.

Comparison of the self-administered health-related instruments did not show any significant differences in predicting future work ability in terms of sick leave rates, even if there was a tendency for stronger associations with multiple-question instruments. The predictive ability of the instruments worked in both directions, but discriminated better for poor than for excellent work ability. There were no significant sex-specific differences with regard to which exposure variables could act as determinants of future work ability. However, for men, the compared health-related instruments associated distinctly stronger, two instruments significantly higher, with poor work ability than they did for women.

Further studies are needed to establish whether an approach in terms of promoting work ability is practicable for a sustainable working life.

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*Om man sätter sig på en sten  
blir man två gånger glad,  
den ena gången när man sätter sig,  
den andra när man stiger upp.*

Tillskrivet Eddan

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