Sustainable Work Ability during Midlife and Old Age Functional Health and Mortality

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1. Introduction

Because of changes in demographics, the world is facing the challenge of aging societies, which can cause financial burden, as they generate less income for health services and pension systems, as well as a shortage of hands for production and taking care of the elderly. To overcome this problem, many national policies aim to further extend working careers by increasing the statutory retirement age. Extended working careers mean longer labor market participation and longer work exposure. However, if people should be in the labor market for a longer period, they ought to be in good physical and mental health and have access to more flexible working arrangements, healthy workplaces, and lifelong learning and retirement schemes. The process of living and working conditions that enable people to continue working for a longer period is here called sustainability (Eurofound 2015). Good health and wellbeing throughout life is one of the 17 sustainable goals of the United Nations (UN 2015), which ensure a healthy working life and promote the wellbeing of people at all ages. This means one of the key themes addressed by this SDG target is promoting health and safety in the workplace to ensure a healthy working environment and, thus, healthy lives during working careers and beyond by decent work, employment creation, social protection, and rights at work for productive employment and sustainable economic growth. Job quality and good working conditions contribute to wellbeing and a good quality of working life (Drobnič et al. 2010). However, workplace health and working conditions in most developing countries are generally poor in many work sectors, which means that the overall subjective wellbeing is poor in these countries (Robertson et al. 2016; Eurofound and ILO 2019).

Quality of life is one of the dimensions of sustainable work and is perceived to decrease by age; however, when controlled for potential factors, the effects of age may disappear. Sustainable work is an important topic worldwide. Several indicators, such as sustainable employment, employability, work engagement, and organizational commitment have been used in the literature to describe sustainable work concepts (Ilmarinen et al. 2005; Van Dam et al. 2017). However, making sustainable work

requires a balance between the requirements of work, such as demands and control, and the needs of individuals, such as an individual's capacity, as both change over time. Moreover, whether a healthy and longer work-life is possible for every person remains unclear (Ilmarinen 2013). Good health among individuals is a prerequisite for this continuation, but knowledge about the possible health consequences of an extended working life is limited. Earlier research shows that retirement rather than an extended working career tends to be a relief for those who suffered from suboptimal self-rated health, sleep disturbances, fatigue, depression or headache diseases (Westerlund et al. 2009; Stenholm et al. 2016), or musculoskeletal pain (Neupane et al. 2018), whereas retirement seems to have an immediate positive effect on the risk of the incident of chronic conditions. Other studies have shown that exposure to poor working conditions at earlier stages of the working life may increase the possibility of poor health and disability in later life. The number of risk factors of physical functioning in later life start to accumulate from early to midlife, and include behavioral, environmental, lifestyle-related, and sociofactorial factors (Guralnik et al. 1993; Brown and Flood 2013). Yet, only a little is known about the link between work-related exposures from midlife and functional health in later life. There exists some evidence on the negative association between occupational physical activities (Hinrichs et al. 2014) and work stress (Verbrugge and Jette 1994), as well as work ability (Kulmala et al. 2014) in midlife and mobility limitations in later life. Physically demanding work with vigorous occupational physical activity in midlife increases the risk of mobility limitations in later life (Hinrichs et al. 2014), which could eventually progress to disability. Similarly, lower work-related stress (Kulmala et al. 2014) and better work ability (von Bonsdorff et al. 2016) in midlife have been reported to be protective to mobility limitations in later life, while poor work ability was reported to be associated with mortality (von Bonsdorff et al. 2011).

The occupation in midlife also plays a vital role in the onset of later life disability, with unskilled blue-collar workers being the high-risk group compared to white-collar workers (Prakash et al. 2016). Work-related high physical exposure and job strain in midlife were strongly associated with the severity of disability in later life (Prakash et al. 2017).

Sustainable work ability is a multifaceted concept that involves the matching of the needs and abilities of the individual with the quality of jobs on offer. Although sustainable work ability is often mentioned in reference to an aging workforce, it should be noted that sustainability relates to workers of all ages (Van Vuuren and Van Dam 2013). In order to stay in the workforce until retirement, it is important that employees work in a healthy workplace, whatever their age.

Work ability, defined as people's ability to cope with their work demands, is a broad concept and an important human capital of workers throughout their working career (Ilmarinen 2019). It requires continuous processes at workplaces, aiming to improve the fitting of human resources and work environments together. Proper working conditions enable a good fit between work and the characteristics of the individual throughout their working life. To achieve this dual goal, employers are required to develop new solutions for working conditions and career paths that help workers to maintain their work ability over an extended working life. Work ability tends to decline with age (Ilmarinen Juhani and Matti 1997), although the mean work ability of the working population between the ages of 20 and 65 years remains at a good or excellent level (Gould et al. 2008). In this chapter, work ability maintained at good or excellent during the work career was considered sustainable work ability. We studied the impact of sustainable work ability by examining trajectories over 16 years. Wellbeing was measured in terms of mobility limitations in old age after 12 years using longitudinal data on employees in a large amount of blue- and white-collar municipal occupations. We also studied the difference in survival and any cause of death among people in work ability trajectory groups. Our hypothesis was that people with sustainable work ability during midlife would have less mobility limitations and better survival than those who did not have sustainable work ability.

2. Materials and Methods

The Finnish Longitudinal study on Aging Municipal Employees (FLAME) was conducted among municipal workers from 1981 to 2009 (Ilmarinen et al. 1991; Tuomi et al. 1997; von Bonsdorff et al. 2011). At baseline, in 1981, a postal questionnaire was sent to 7344 municipal workers all around Finland. In total, 6257 (85.2%) 44–58-year-olds having worked as municipal workers for at least 5 years responded. Follow-up data were collected with postal questionnaires in 1985 (n = 5556), 1992 (n = 4534), 1997 (n = 3815), and 2009 (n = 3093) (von Bonsdorff et al. 2011). In this study, we analyzed work ability data from 16 years of follow-up from 1981 to 1997, which covers the work career of people from midlife until retirement. For inclusion in the trajectory analysis, the respondent must have replied at baseline, while in the regression analysis, we analyzed only those participants who had information on the outcome variable (mobility limitations) from the last round (2009) of follow-up (n = 2918). The respondents' exact retirement dates and mortality dates, from any cause, were obtained from the national pension registry and linked with the survey data. Figure 1 presents the follow-up process in detail.

The Ethics Committee of the Finnish Institute of Occupational Health, Helsinki, Finland approved the study.

2.1. Measurement of Variables

2.1.1. Work Ability

In this analysis, we used two types of work ability measures from the work career. Work ability index (WAI) was the composite measure of seven items (Table 1) based on subjective survey instruments (Ilmarinen et al. 1991). WAI indicates the wellbeing, health status, and quality of life as it measures how good a worker is at present and in the near future, and ability to work with respect to work demands (Ilmarinen et al. 2005). WAI was measured only at baseline

Table 1. Items of work ability index.

Items	Range
1. Current work ability compared with the lifetime best	0–10
2. Work ability in relation to the demands of the job	2–10
3. Number of current diseases diagnosed by a physician	1–7
4. Estimated work impairment due to diseases	1–6
5. Sick leave during the past year (12 months)	1–5
6. Own prognosis of work ability 2 years from now	1–7
7. Mental resources	1–4

The WAI ranges from 7 to 49, and the higher the score, the better the work ability. Based on the scores, WAI has been classified into four standard categories (poor 7–27, moderate 28–36, good 37–43, and excellent 44–49) (Gould et al. 2008). In this analysis, good and excellent work ability was combined.

The work ability score (WAS) was measured using a single item; the first item of the WAI is "current work ability compared with the lifetime best" with a score from 0 to 10, where 0 is incapable to work and 10 is the work ability at its best (von Bonsdorff et al. 2011; Ebener and Hasselhorn 2019). WAS is strongly associated with WAI and can be used as a simpler indicator for assessing work wellbeing (Ahlstrom et al. 2010). WAS was measured identically in all four surveys. The developmental patterns of work ability from four time points were used as the main independent variable in this analysis.

2.1.2. Mobility Limitation

Mobility Limitations (MLs) as an outcome of interest in this study were measured using self-reported questionnaires distributed among the participants in the last round of the follow-up in 2009. The International Classification of Functioning, Disability, and Health (ICF) was used to define the mobility limitations (World Health Organization 2001). Nine items related to activities and the mobility of the participants were used to create a final score. Table 2 shows the items included in defining mobility limitations. All the items, except walking 2 km, were assessed on a four-point scale of difficulty (manage without difficulties, manage with little difficulties, manage with lots of difficulties, and cannot manage). Walking 2 km was assessed on five levels (no difficulty—cannot manage with the help of others as well). In this analysis, all nine items were first dichotomized (no difficulty vs. at least some difficulty), then combined to make a summary score of 0 to 9 (score '0' represented no limitations in carrying out any of the 9 tasks and those who had at least some limitations in carrying out one or more of the 9 tasks scored '1–9' depending on the number of tasks entailing limitations) (Prakash et al. 2019; Hinrichs et al. 2014).

Table 2. International classification of functioning (ICF), disability, and health categories used to create mobility limitation (ML) (0–9).

Mobility	List of Categories	Questions	Range
Changing and maintaining body position	Changing basic body position	1. Squatting and standing up again?	1–4
		2. Bending down deep?	1–4
	Maintaining a body position	3. Maintaining body position/sitting still for 2 h?	1–4
Carrying moving and handling objects	Lifting and carrying objects	4. Lifting and carrying more than 10 kg?	1–4
	Fine hand use	5. Precise movements of hands?	1–4
	Hand and arm use	6. Lifting hands over the head?	1–4
Walking and moving	Walking	7. Walking 2 km?	1–5
	Moving around	8. Running 100 m?	1–4
		9. Climbing three floors/stairs?	1–4

2.1.3. Mortality

The study participants were followed for mortality between 1 January 1981 and 31 July 2009. Data on date of death, from any cause, were obtained from the Finnish National Population Register.

Demographic Information

Age (44–58 at baseline) was used as a continuous and categorical (44–49 vs. 50–58 years) variable in the analyses. Occupational class (white-collar, blue-collar) was created based on a detailed analysis of job profiles among 88 occupational titles, clustered into 13 job profiles and later, into two major groups (Kulmala et al. 2014; Prakash et al. 2016). Information on gender (female/male) was obtained from the questionnaire survey.

Lifestyle Characteristics

Leisure-time physical activity (LTPA) in the past year was collected in five categories (1—brisk exercise at least twice a week; 2—brisk exercise at least once a week; 3—some exercise at least once a week; 4—some exercise less than once a week or no exercise) and classified as high (1–2) or low (3–4) (Neupane et al. 2018). BMI (kg/m^2) was calculated using self-reported height and weight and dichotomized as <25.0 (normal) or ≥25.0 (overweight/obese). Those reporting current smoking >1 cigarette per day or past smoking were classified as smokers.

Morbidity

Information on morbidity was obtained by the question "Please indicate in the list below which diseases or impairments you have at present. In addition, check whether a physician has diagnosed or treated this condition". The list covered 47 items. We used the following categories (yes/no) of physician-diagnosed diseases: musculoskeletal, cardiovascular, respiratory, and metabolic diseases. The information on the number of diseases was summed up and categorized into three—0, 1, 2, or more morbidities.

Physical Workload

Physical workload at baseline was assessed with eight questions about current exposure to the following: vibration, repeated movements, standing still, bent or twisted postures, other poor postures, continuous walking or movement, carrying objects, and sudden strenuous efforts. Response options ranged from 0 (not at all)

to 4 (quite often). The composite score (Cronbach's $\alpha = 0.82$) ranging from 0 to 32 was dichotomized into high and low at the median value of 12, with median value included in high physical workload (Neupane et al. 2018).

2.2. Statistical Analyses

We first analyzed the mean distribution of the work ability index by age (as a continuous variable) using the box plot method. The cut-off line was plotted to separate out 'good and excellent', 'moderate', and 'poor' work ability.

Growth mixture modeling (GMM) was applied to identify trajectories of the work ability score (WAS) from four time points. The basic assumption of GMM is that all individuals follow the growth pattern of a random variation. GMM also accounts for within-class variations in the estimation of class memberships (Ram and Grimm 2009). All the study participants who responded at baseline to the survey were included in the trajectory analysis. The number of trajectories and their shape were determined first. The quadratic function best represented the patterns of change in the WAS. The final model was chosen based on a range of fit criteria (see appendix), including the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), sample size adjusted BIC, entropy, and posterior probabilities and meaning and their interpretability (Nylund et al. 2007). Based on these, a three-trajectory model was selected. The trajectory groups were illustrated by plotting the means of the WAS against survey year.

Baseline characteristics of the study participants were presented as frequencies and percentages by work ability trajectory. The difference between trajectories was tested by the Chi-square test.

Sixteen-year trajectories of the WAS were then used to study the associations with mobility limitations of the people after 12 years. A generalized linear model (GLM) with a Poisson function was used to calculate the incidence rate ratios (IRR) and their 95% confidence intervals (CIs) for the associations. Three models were fitted, the first model was the bivariate association of the trajectories of the WAS with mobility limitations. Bivariate association of the sociodemographic, behavior, and work-related variables from the baseline with the mobility limitations was also calculated in Model I. In Model II, the association of work ability trajectories with mobility limitation was adjusted for sociodemographic variables (age, gender, and occupational class). Model III was further adjusted for all the sociodemographic, lifestyle-related, morbidity, and work-related variables from Model I. The estimates with their 95% CIs are also presented for all the covariates used in the Model III.

Nelson–Aalen cumulative hazard estimates were plotted for mortality from any cause by trajectory membership. The follow-up time started from the baseline, 1 January 1981, and ended with censoring resulting from death or end of follow-up in 2009.

Trajectory analysis was conducted in Mplus v7.2 and the other analyses in R-studio and Stata v15.

3. Results

Figure 1 shows the mean distribution of work ability index at baseline by age of respondents. It shows that, in general, the work ability decreases with increasing age. The mean work ability was maintained as either good or excellent until the age of 51 years; after that, the mean level of work ability index decreased to moderate.

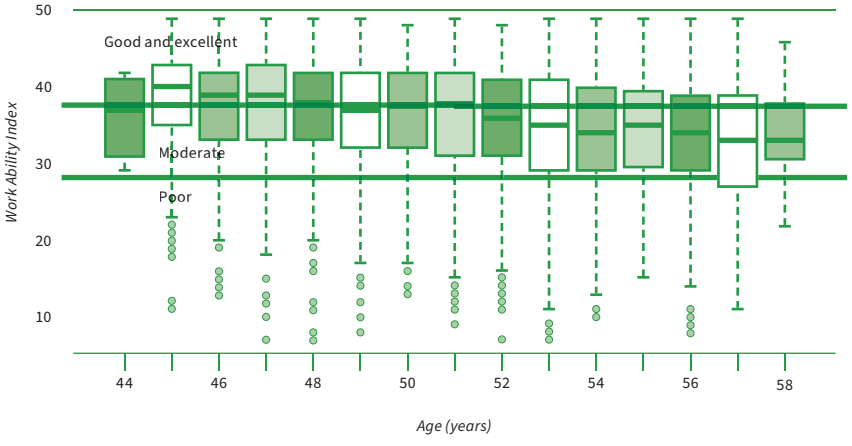

Figure 1. Distribution of the work ability index (7–49) by age (44–58 years) among study participants at baseline.

Participants were followed for 16 years after the baseline survey until 1997 to see the changes in WAS. We used trajectory analysis to see the change in work ability score using self-reported WAS data from four time points. Figure 2 shows the trajectories of mean WAS at different follow-up times. We found three distinct trajectories.

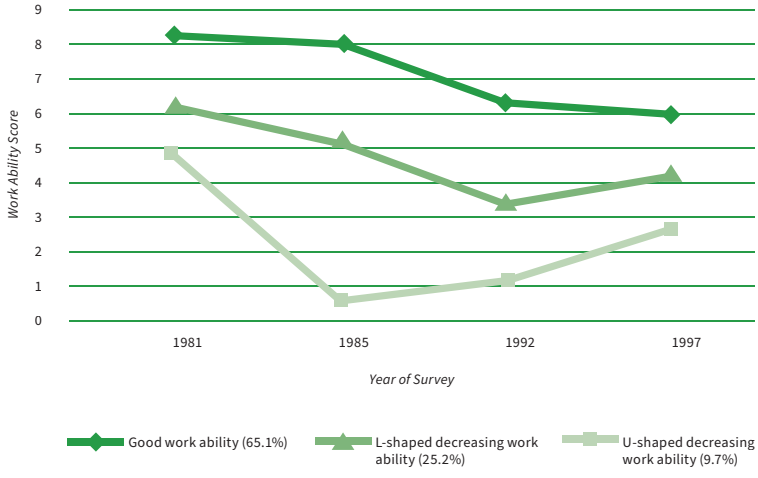

Figure 2. Trajectories of the mean of the work ability score from 1981 to 1997 among study participants.

Of the total subjects studied, the majority (65%) had good work ability during the 16 years of follow-up. The mean work ability score was about 8 at the baseline, which slightly decreased to, on average, 6 during the follow-up. This group of people who maintained good work ability during their work career was considered here as the sustainable work ability group. About 25% of the study participants had L-shaped decreasing work ability. They started with a mean WAS of 6 at baseline, which then later decreased in L shape during the follow-up. The third group consisted of about 10% of the participants, who had a U-shaped decreasing work ability. They started with a mean WAS of 5 at baseline, which decreased as U-shaped during the follow-up. In the good and L-shaped decreasing trajectories group, the decrease in the work ability score was steep until 1992; after that, the work ability mostly remained constant or improved. Meanwhile, among those in the U-shaped trajectory group, a slight improvement in work ability was observed already from 1992.

Table 3 shows the baseline characteristics of the study population by work ability trajectories. There were significantly more younger workers who had a good work ability trajectory compared to their older counterparts, while more older workers had L- or U-shaped decreasing work ability. Significantly more women, white-collar workers, high LTPA, low (<25) BMI, no or one comorbidity, and workers with low physical workload had good work ability. More men and more blue-collar workers had L- and U-shaped decreasing work ability. Meanwhile, ther was no significant difference in the distribution of work ability trajectories by smoking status.

Table 3. Baseline characteristics of the study sample by work ability trajectory groups.

Characteristics	Total N = 2918	Trajectory Membership			*p*-Value
		Good (n = 2083)	L-Shaped Decreasing (n = 661)	U-Shaped Decreasing (n = 174)	
Age (Years)					<0.001
44–49	1529	1149 (75.1)	319 (20.9)	61 (4.0)	
50–58	1389	934 (67.2)	342 (24.6)	113 (8.1)	
Gender					<0.001
Women	1858	1348 (72.5)	410 (22.1)	100 (5.4)	
Men	1060	735 (69.3)	251 (23.7)	74 (7.0)	
Occupational class					<0.001
White-collar	1688	1318 (78.1)	307 (18.2)	63 (3.7)	
Blue-collar	1230	765 (62.2)	354 (28.8)	111 (9.0)	
Smoking					0.447
No	1873	1345 (71.8)	424 (22.6)	104 (5.6)	
Yes	1045	738 (70.6)	237 (22.7)	70 (6.7)	
LTPA †					<0.001
High	1505	1130 (75.1)	294 (19.5)	81 (5.4)	
Low	1354	915 (67.6)	350 (25.9)	89 (6.5)	
BMI ‡					<0.001
<25.0	1442	1091 (75.7)	283 (19.6)	68 (4.7)	
≥25.0	1449	976 (67.4)	368 (25.4)	105 (7.2)	
Comorbidity					<0.001
0	1337	1145 (85.6)	168 (12.6)	24 (1.8)	
1	810	557 (68.8)	202 (24.9)	51 (6.3)	
2 or more	771	381 (49.4)	291 (37.7)	99 (12.8)	
Physical workload					<0.001
Low	1464	1195 (81.6)	229 (15.6)	40 (2.7)	
High	1454	888 (61.1)	432 (29.7)	134 (9.2)	

† Leisure-time physical activity; ‡ Body mass index.

The distribution of mean value of mobility limitations with their 95% CIs by work ability trajectories is presented in Table 4. It shows that the mean number of mobility limitations was lowest (mean 3.38, 95% CI 3.27–3.49) among those in the good work ability trajectory group, while it was highest (5.51, 95% CI 5.13–5.90) among those in the U-shaped decreasing trajectory group. Similarly, in the same table (Table 4), the mean work ability score is presented by survey year. This shows that the mean score decreased by survey year because of the increase in age of the workers in each survey round.

Table 4. Distribution of the mean mobility limitations (0–9) according to work ability trajectory group and mean work ability score (0–10) by year of survey.

Work Ability	**Mobility Limitation Mean, 95% CI**
Good	3.38 (3.27–3.49)
L-shaped decreasing	4.71 (4.51–4.92)
U-shaped decreasing	5.51 (5.13–5.90)
Year of Survey	**Work Ability, Mean ± SD**
1981	7.65 ± 1.70
1985	6.93 ± 2.14
1992	5.62 ± 2.79
1997	5.65 ± 2.42

The associations of work ability trajectories with the mobility limitation are presented in Table 5. It shows strong and statistically significant associations of L-shaped and U-shaped decreasing work ability trajectories with increased mobility limitations compared to those belonging to the good work ability trajectory group, so-called people with sustainable work ability. The crude model (Model I) shows that belonging to the L-shaped and U-shaped decreasing work ability trajectory groups was associated with increased risk of mobility limitations in the 12 years follow-up compared to those in the good work ability trajectories group. The associations remained statistically significant even after adjusting for age, gender, and occupational class in Model II. After further adjustment with smoking status, LTPA, BMI, morbidity, and physical workload in Model III, the association remained strong and statistically significant (IRR for L-shaped decreasing work ability 1.24, 95% CI 1.18–1.30 and U-shaped decreasing work ability 1.37, 95% CI 1.28–1.47). The magnitude of the association was higher for those in the U-shaped decreasing trajectory group in each model.

Table 5. Associations of 16-year work ability trajectories with mobility limitations in 28 years follow-up. Incidence rate ratios (IRR) and their 95% confidence intervals (CIs) from a Poisson regression model.

Characteristics	N † = 2533	IRR, 95% CI for Mobility Limitation		
		Model I	Model II	Model III
Work ability				
Good	1751	1	1	1
L-shaped decreasing	615	1.40 (1.34–1.46)	1.37 (1.31–1.42)	1.24 (1.18–1.30)
U-shaped decreasing	167	1.65 (1.54–1.76)	1.57 (1.46–1.68)	1.37 (1.28–1.47)
Age (Years)				
44–49	1278	1	1	1
50–58	1260	1.28 (1.23–1.32)	1.23 (1.18–1.27)	1.19 (1.14–1.23)
Gender				
Women	1707	1	1	1
Men	826	0.80 (0.76–0.83)	0.76 (0.73–0.79)	0.73 (0.69–0.76)
Occupational class				
White-collar	1460	1	1	1
Blue-collar	1078	1.13 (1.09–1.18)	1.13 (1.09–1.17)	1.03 (0.99–1.08)
Smoking				
No	1639	1		1
Yes	899	1.00 (0.97–1.04)		1.11 (1.06–1.16)
LTPA †				
High	1252	1		1
Low	1233	1.25 (1.20–1.29)		1.16 (1.11–1.20)
BMI				
<25.0	1202	1		1
≥25.0	1313	1.32 (1.27–1.37)		1.25 (1.20–1.30)
Comorbidity				
0	1092	1		1
1	731	1.27 (1.21–1.33)		1.16 (1.11–1.22)
2 or more	715	1.53 (1.46–1.60)		1.28 (1.22–1.34)
Physical workload				
Low	1230	1		1
High	1308	1.27 (1.22–1.32)		1.08 (1.04–1.13)

† Participants with at least some mobility limitations. Model I: Bivariate model; Model II: Adjusted for age, gender, and occupational class; Model III: Adjusted for all variables from Model II + smoking, LTPA, BMI, comorbidity, and physical workload.

The increasing rate of mobility limitations was found to be associated with older age, those who never smoked, low LTPA, higher BMI, those with one or more comorbidities, and those who reported high physical workload. These associations remained statistically significant in the final model (Model III). Meanwhile, compared to women, men were associated with lower incidence rates of mobility limitations and the association of blue-collar workers with mobility limitations was not clear in the final model.

Figure 3 presents the Nelson–Aalen cumulative hazard estimates by work ability trajectories group for all-cause mortality. The estimates in the different trajectory group already started to diverge after 5 years from the baseline survey. The hazard was highest among those in the U-shaped decreasing work ability trajectory group and lowest among those in the good work ability trajectory group. The estimates in the good and L-shaped decreasing work ability trajectory group started to diverge after 10 years of follow-up.

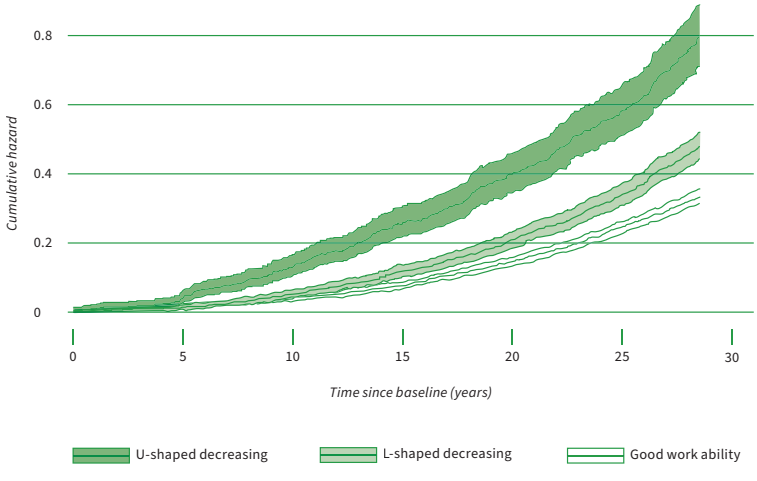

Figure 3. Nelson–Aalen cumulative hazard estimates of all-cause mortality by work ability trajectory group between 1981 and 2009.

4. Discussion

We used good work ability as an indicator of sustainable work ability in a long-term prospective follow-up study of municipal employees to study the health impact in later life. We found that about two-thirds of our study population had good or sustainable work ability during their late work career. Sustainable work ability was a very strong predictor of good health outcome in terms of mobility limitations in

old age. People belonging to the trajectories of decreasing work ability had increased risk of mobility limitations in old age. They also had a high cumulative hazard of death from any cause (i.e., worst survival) compared to those with a good work ability trajectory. Overall, our findings supported the importance of a sustainable work ability during the latter part of the work career.

Work ability has been used as a continuity construct since its establishment in the Finnish Institute of Occupational Health (Tuomi et al. 1998; Ilmarinen 2009, 2019). It considers the surrounding organizational and societal context, providing a wide perspective on the relationship between the individual and the work and social environment (Ilmarinen 2009). Work ability has been supported by the goal to prolong work careers and to prevent work disability (Gould et al. 2008). Work ability is also associated with health-related quality of life (Sörensen et al. 2008), which indicates wellbeing at present and its sustainability. It is, therefore, important to maintain work ability during the work career for better quality of life at midlife and beyond.

In our study, work ability was fairly stable for about two-thirds of the people during 16 years of follow-up in their midlife and the rest had decreasing work ability until the first 11 years of follow-up andm, then, slowly improved after that. This indicates that the majority of the employees had sustainable work ability and wellbeing at midlife. The work ability index at baseline also shows that the mean work ability was maintained either at good or excellent until the age of 51 years; after that, the mean level of work ability index decreased to moderate. There were 20–25% of 44–49 years old who had moderate or poor work ability. They risk losing their work ability if no preventive actions are taken. The stability of work ability indicates that the employees have enough resources to cope with their job demands, although there is a wide variation between white- and blue-collar occupations but less variation by gender. The majority of our study participants (75%) retired during the second round of the follow-up in 1992, and by the end of 1997, almost all (99%) were retired. The decreasing work ability trajectory group improved their mean work ability score after 1992, which means that retirement improved their perceived work ability. This means the quality of life and wellbeing of people improves when there is no pressure of work demands.

These results of our study are consistent with the French GAZEL study, showing that perceived health in older workers, exposed to poor working conditions, is relaxed after retirement (Westerlund et al. 2009). Another study also showed the health benefits of retirement but only for upper occupational class employees (Mein et al. 2003). Employees will be relieved from their physical and mental demands of the work, which is beneficial to health and quality of life.

Consistent with our results, similar findings have been reported in earlier studies. A study from the USA reported three trajectories of work ability with 74% having good work ability, 17% declining, and only few, 9%, having poor work ability (Boissonneault and de Beer 2018). An earlier study, from our FLAME study but with a longer follow-up, until old age, reported five trajectories of work ability, with a substantial proportion of individuals maintaining their work ability at a moderate level (von Bonsdorff et al. 2011). Our earlier study among younger working aged (mean age 42 years) people in the manufacturing industry showed that 90% had a good work ability trajectory during six years of follow-up (Oakman et al. 2019).

Trajectories of decreased work ability in either an L- or U-shape were associated with increased risk of mobility limitations in old age, even after controlling for the effect of demographic, lifestyle factors, morbidity and physical workload in the baseline. Mobility limitations in this study were used as an indicator of functional health in old age. Mobility limitations are associated with poor quality of life among older adults and predict all-cause mortality (Bergland et al. 2017). Consistent with our findings, an earlier study reported that better work ability protects from old age mobility limitations among those who retire due to non-disability and disability (von Bonsdorff et al. 2016). Other studies found that vigorous occupational physical activity (Hinrichs et al. 2014), higher work stress (Kulmala et al. 2014), and shift work (Prakash et al. 2019) were associated with mobility limitations in old age. We also found that among studied covariates, older age, being a woman, smoker, low leisure-time physical activity, high BMI, having multiple morbidities as well as having high physical workload at baseline were statistically significantly associated with an increased risk of mobility limitations in old age. Moreover, higher cumulative risk of mortality from any cause was found among those in the decreasing trajectories group compared to those in the sustainable work ability group.

Sustainable work ability is beneficial to everyone, industries and society as a whole. Individuals can benefit from better work outcomes, smoother transitions between life stages, and longer working lives from the sustainable work ability, whereas, for industries, sustainable work ability may lead to an improved efficiency or productivity. This implies that society will benefit from healthier populations, higher employment rates, more inclusive labor markets, and lower pressure on public budgets. Due to the ageing of the population and the shrinking workforce, new sources of growth and economic progress are needed where the sustainable work ability concept would be relevant. Sustainable work ability promotes a holistic approach that considers workers' health, personal characteristics, family, and social responsibilities. Those with a diminishing work

ability can be promoted for example, decreasing physical workload, adjusting work–rest schedules, and introducing age-management practices, flexible working time schedules, and teamwork (Ilmarinen and Rantanen 1999).

Sustainable work ability requires sustainable employment and wellbeing at work, which then enhances the quality of work life and satisfaction. The aging workforce also emphasizes the importance of sustainable employment; therefore, workers are willing to work after their normal retirement age (Armstrong-Stassen and Schlosser 2008; Gobeski and Beehr 2009), which can have the potential to achieve sustainable economic growth. "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" is one part of the agenda of the SDGs. Work organizations may have an important role, which can draw attention to an age-supportive atmosphere for workers of all ages (Oakman et al. 2016), although age-related changes are largely specific to individuals, with wide interpersonal variability (Sluiter 2006). A major strength of our study was the use of long prospective follow-up data from a representative population of Finnish municipal occupations. Among other strengths, there was a high response rate at baseline and follow-ups, use of official registers data on retirement and mortality, and elimination of recall bias. About 50% of the baseline respondents also participated in the last survey wave in 2009 after almost three decades. One can consider some of the limitations of this study while inferring the findings. The work ability scores as well as mobility limitations were both self-reported, which is possibly subject to information and recall bias and could lead to over-reporting. Nevertheless, these measures are validated tools and have been used extensively in earlier research (von Bonsdorff et al. 2011; Prakash et al. 2019; Hinrichs et al. 2014; Ilmarinen 2019). Another strength was that we used ICF classification of physical functioning that has been validated and frequently used in earlier studies (Hinrichs et al. 2014).

5. Conclusions

In all, we found that the majority of people maintain fairly good work ability during their work career in midlife, while a few have declining work ability. Sustainable work ability protects from mobility limitations in old age, while decreasing trajectories of work ability are associated with increased risk of mobility limitations as well as premature mortality. It is, therefore, important to detect workers with diminishing work ability in order to promote their work ability and prevent from future disability.

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