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**Trajectories of work ability from midlife to pensionable age and their association with
retirement timing**

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What is already known on this subject?

- Low work ability has been highlighted as the driver for early retirement among aging employees
- Less is known how work ability changes in the last years of employment and how this is associated with retirement timing (retiring at individual pensionable age vs. voluntary extension of employment beyond individual pensionable age)
- This study is carried out to get clear picture on development of work ability from midlife to later career and its effect on retirement timing

What this study adds?

- Group-based latent trajectory analysis using eight measurement points over 16 years of follow-up showed that work ability remained constant from midlife to late career among most of the participants.
- Stable excellent work ability from midlife to late career was associated with higher likelihood of extending employment beyond individual pensionable age, which indicates that maintenance of good work ability throughout the working career is important and may support extended employment

ABSTRACT

Background: This study aimed to identify the trajectories of work ability over 16 years preceding the individual pensionable age and to examine the association with retirement timing.

Methods: The study population consisted of 2,612 public sector employees from the Finnish Retirement and Aging Study and Finnish Public Sector study. Participants were grouped into “no-extension” (retired at the individual pensionable date or worked no longer than 6 months after that date) and “extension” (worked more than 6-months after individual pensionable age). Trajectories of self-reported work ability score (0-10) in maximum of eight measurement points over 16-years preceding retirement was examined using the group-based latent trajectory analysis. Log-binomial regression was used to analyze the association between trajectory groups and extended employment.

Results: Four stable (“Stable excellent”, 7%; “Stable high”, 62%; “Stable medium”, 24% and “Low”, 4%), and one decreasing (“Declining”, 3%) work ability trajectories were identified. After taking into account gender, age, occupational status, marital status and self-rated health, “Stable excellent” trajectory was associated with a higher likelihood of extended employment compared to the “Low” (RR 2.38, 95% CI 1.21–4.68) and to the “Declining” (RR 2.82, 95% CI 1.32–6.01) trajectories. There was no difference in retirement timing between “Declining”, “Low” and “Stable medium” trajectories.

Conclusion: Work ability remained relatively stable among majority of the participants over 16 years of follow-up. Stable excellent work ability from midlife to late career was associated with higher likelihood of extending employment beyond individual pensionable age than those with low or declining work ability.

Key words: extended employment; work ability; trajectory analysis; longitudinal studies

INTRODUCTION

Work ability, a concept based on the stress–strain model is defined as an *equilibrium between employees' perception of the demands of his or her job and his or her ability and resources to cope with those demands*¹. Sustainability of employment may be facilitated by a good work ability of employees during their career^{2,3}. However, only a little is known about the changes in work ability from midlife to retirement. Earlier analyses among middle-aged Finnish municipal workers over a period of 11 years has shown that work ability declines from midlife onwards¹, and age and occupation were the key predictors of work ability. Likewise, a study of Finnish aging managers reported decreasing work ability among most of the lower-level managers⁴. However, it has also been observed among Finnish public sector and private sector employees as well as among US employees aged 50 years or above that a substantial number of employees maintain good or moderate level of work ability from midlife onwards⁵⁻⁷.

A systematic review on effectiveness of workplace interventions to improve work ability suggested that these interventions could result in a positive change but they further reported that quality of evidence was weak and warranted high quality studies⁸. Maintenance of good work ability, which includes physical and mental capacities, across the life course, is suggested to be essential factor in extending working life². Indeed, decreased work ability has been highlighted as the predictor of early retirement among aging employees^{4,9-11}. Furthermore, American workers with low and declining work ability were more likely to become unemployed before retirement or retire prematurely⁶.

However, the extent to which long-term work ability from midlife to late career is associated with a voluntary extension of employment beyond individual pensionable age is still unclear. To address the gap in the literature, we aimed to investigate work ability trajectories over a 16-year period from midlife to individual pensionable age and to examine whether those

trajectories predict working beyond individual pensionable age among aging Finnish public sector employees.

METHODS

Study population

The study population consisted of aging public sector employees from the Finnish Retirement and Aging Study (FIREA), which is an ongoing longitudinal cohort study established in 2013^{12,13}. The aging workers whose individual pensionable age was between 2014 and 2019 have been followed from final working years to the full-term retirement and beyond. The actual date of retirement for every respondents was obtained through survey and estimated individual retirement date was obtained the institute for public sector pensions in Finland. Participant were first contacted 18 months prior to their estimated individual pensionable age by sending them a questionnaire, which was then sent at least four times annually.

Out of 6783 cohort members who had responded at least once by the end of 2019 (64% of the eligible sample), those who had answered to the questionnaire at least once before the individual pensionable age, had reported their actual retirement date or were working beyond the individual pensionable age were included (n=4,013). Furthermore, we further restricted the study population to those FIREA participants who had given permission to link their data from Finnish Public Sector (FPS) study to the data from the FIREA surveys and that they responded at least once to the question about work ability (either in FPS or FIREA) while they were still at work (n=3,091). The FPS is a large ongoing cohort study since the 1990s on work and health among public sector employees of Finland¹⁴. During their working career, around 91% of the participants in FIREA had participated in the FPS study. To enable accurate estimation of work ability over 16 years, we included only those participants who had responded to the question

about work ability at least once 10 years or more prior to pensionable age (years -16, -14, -12, -10) and at least once within the last 8 years prior to pensionable age (years -8, -6, -4, -2). This gave a final study sample of 2,612 participants for the current study. The Ethics Committee of the Hospital District of Southwest Finland approved the FIREA study, the Ethics Committee of the Hospital District of Helsinki and Uusimaa approved FPS study and both studies were conducted in line with Helsinki declaration.

Work ability

The work ability was assessed with a question “Assume that your work ability at its best has a value of 10 points. What score would you give your current work ability?”¹. Continuous score 0-10 was used in the analysis. Participants provided information on work ability on average at 4.4 (SD 0.7) of maximum of eight measurement points during the 16-year follow-up.

Retirement Timing

This study utilized two different measures of retirement. First, individual pensionable age was obtained from the institute for public sector pensions in Finland. In Finland, the Public Sector Pensions Act regulates the retirement ages of the public sector employees. From 2005 onwards, public sector employees can retire on a statutory basis after aged 63 years but at the latest before the age of 68 years¹⁵. Following a pension reform in January 2017, each age group has their own retirement age, which is tied to the life expectancy, although the general rule of 63 to 68 years still applies. The pension ages in some occupations were below 63 years because those public sector employees have chosen to keep their earlier retirement age based on previous pension act (for example: 58 years for practical nurses and 60 years for primary school teachers)¹⁶. The institute for public sector pensions in Finland has calculated the individual pensionable date for each employee accordingly and working beyond that date will accrue pension income level. Second, the participants reported the actual retirement date in survey

questionnaires. We defined retirement event as a transition from work to full-time retirement based on survey responses.

The difference between the individual pensionable date and the actual retirement date in days was calculated for each participants, which was then used to dichotomize participants into:

- 1) Those who did not extend their employment or extended it six months or less beyond the individual pensionable date (no-extension group);
- 2) Those who extended their employment by more than six months (extension group) as in a previous study ¹⁵.

Pre-retirement characteristics

Information on participant's *sex*, *date of birth* and *occupational status* was obtained from the institute for public sector pensions in Finland. The occupational titles of the last occupation preceding retirement were coded according to the International Standard Classification of Occupations (ISCO) and categorized into three groups: high (ISCO classes 1-2 e.g., teachers, physicians), intermediate (ISCO classes 3-4 e.g., registered nurses, technicians), and low (ISCO classes 5-9 e.g., cleaners, maintenance workers) ¹⁷. The other characteristics before retirement were obtained from the survey preceding retirement. *Marital status* was collected in five categories (never married, cohabitation, married, divorced or separated and widowed) and it was dichotomized into currently married/cohabitated (yes) and non-married/non-cohabiting (no). *Self-rated health* was assessed by asking participant to rate their overall health status on a 5-point scale (1=Good, 2=Rather good, 3=Average, 4=Rather poor, 5=Poor) and dichotomized into good (good and rather good) and sub-optimal (average, rather poor and poor) ¹³.

Statistical analysis

We used a data-driven approach, a group-based latent trajectory analysis to analyze the changes and heterogeneity in work ability over the 16 years preceding retirement. The latent trajectory analysis enables the identification of distinctive groups of individuals from the data who show similar developmental trajectories over time^{18,19}. We used PROC TRAJ macro in the statistical software SAS 9.4 (SAS Institute Inc., Cary, NC, USA) to estimate latent trajectories. Statistical analysis was conducted in two phases. First, we identified the development of work ability during 16 years prior to retirement (eight different measurement points) by using the trajectory analysis. We followed the two-step procedure formulated by Nagin and Odgers (2010)²⁰ to determine the optimal number of latent trajectories, and to choose the number and order of regression parameters. In the first step, we fitted an increasing number of work ability trajectory models (1-8) with a polynomial shape until no further improvements were observed. Additionally, quadratic and liner trajectories models were used to test the model chosen in first step. The latent class growth model was based on censored normal distribution. The assessment of model fit was based on Bayesian information criterion values (BIC), Akaike information criterion values (AIC), higher log-likelihood and posterior probabilities, prevalence of latent classes as well as Odds of Correct Classification (OCC). Model fit statistics for work ability trajectories with 1 to 8 different trajectory solutions are present in **eTable 1**. Based on these criteria, we chose a five-class polynomial model. The five classes were “Stable excellent (7%)”, “Stable high (62%)”, “Stable medium (24%)”, “Stable low (4%)” and “Declining (3%)” work ability trajectory. In the chosen five trajectory solution each trajectory have a posterior probability greater than 0.80, indicating good class separation in the models¹⁹ and in all trajectories, OCC values exceeded 5, which is considered good¹⁹.

In the second phase, we compared different pre-retirement characteristics across the five work ability trajectories using chi-square test for categorical and analysis of variance for continuous

variables. In addition, we examined the distribution of extenders and non-extendors across different workability trajectories. Finally, we analyzed whether the identified work ability trajectories predicted extended employment (extension vs. no extension beyond individual pensionable age) by using log-binomial regression analysis with risk ratio (RR) estimates and their 95% confidence intervals (CI). The “Low” and “Declining” work ability trajectories were used as the reference groups. The analyses were adjusted for factors that are previously shown to predict extended employment^{15, 21-24}. The models were initially adjusted for age and gender (model I), and the following models were additionally adjusted for occupational status (model II), marital status (model III), and self-rated health (model IV). Statistical software SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) was used for all the analyses.

RESULTS

The pre-retirement characteristics of entire study population are shown in **Table 1**. Majority of the participants were women (83%) and the mean age was 62.5 years (1.2, standard deviation). More than one third belonged to high occupational class (35%), about three fourth were married (73%), and more than three fourth reported good self-rated health (76%).

Figure 1 illustrates the selected five work ability trajectories over 16 years preceding the individual retirement age. Four of the trajectories represented stable level of work ability over time (“Stable excellent”, 7%; “Stable high”, 62%; “Stable medium”, 24% and “Low”, 4%) and one trajectory represented a gradual decline of work ability over time (“Declining”, 3%).

The proportions of pre-retirement characteristics in each of the five work ability trajectories are shown in **Table 1**. In each trajectory, the proportion of women were 80%. The study subjects representing “Stable excellent” and “Stable high” trajectories were slightly older than those who were representing “Declining” and “Low” trajectories. There were differences in the

occupational categories across trajectory groups so that intermediate occupational status (43%) was most common in the “Low” trajectory, low occupational status (54%) was most common in the “Declining” trajectory, whereas high occupational class was most common in the “Stable excellent” and “Stable high” trajectories (41% and 38% respectively). The study subjects who were married had almost one-third representation in each trajectories. More than 80% of the participants representing “Low” and more than 90% of the participants representing “Declining” trajectory had suboptimal self-rated health compared to that only 2% in “Stable excellent” and 13% in “Stable high” trajectory had suboptimal self-rated health.

The differences in the retirement timing across the five different work ability trajectories are presented in **Figure 2**. Of 2,612 selected respondents, 26.5% extended their employment by more than six months. The highest proportion of extenders were represented in the “Stable excellent” (41%, 95%CI 33%–48%) trajectory whereas, highest proportion of non-extendors were represented by “Declining” trajectory (86%, 95% CI 78%–94%).

Table 2 shows the associations of work ability trajectories and extended employment based on log-binomial regression analysis. In the age- and gender-adjusted model, “Stable excellent” (RR 3.04, 95% CI 1.63–5.66) and “Stable high” (RR 1.80, 95% CI 1.04–3.13) trajectories were associated with a higher likelihood of extended employment while the estimates for “Stable medium” and “Declining” trajectories were not statistically significant when compared with the “Low” trajectory. After further adjustment for occupational status, estimates for “Stable excellent” (RR 2.70, 95% CI 1.44–5.06) remained statistically significant. However, estimates for “Stable high” (RR 1.62, 95% CI 0.93–2.83) trajectory was no longer statistically significant. The estimates for “Stable excellent” trajectory attenuated slightly when further adjusted for marital status and self-rated health (RR 2.38, 95% CI 1.21–4.68).

When comparing to those in “Declining” trajectory, the participants in “Stable excellent” (RR 3.92, 95% CI 1.93–7.97) and “Stable high” (RR 2.33, 95% CI 1.22–4.45) trajectories were more likely to extend employment in age and gender adjusted model. Further adjustment for occupational status and marital status, attenuated the estimates for both “Stable excellent” and “Stable high” trajectories, but they remained statistically significant. After adjustment for self-rated health “Stable excellent” trajectory (RR 2.82, 95% CI 1.32–6.01) remained associated with extended employment, whereas “Stable high” trajectory was no longer associated (RR 1.72, 95% CI 0.86-3.42). There was no difference in the likelihood of extended employment among those in “Stable medium” trajectory or “Low” trajectory compared to the “Declining” trajectory.

DISCUSSION

Eight measurement points over a period of 16 years preceding individual pensionable age provided us a rich repeat data of aging public sector employees enabling us to examine the developmental pathways (latent trajectories) of work ability from midlife to statutory retirement age. Most of the study subjects had stable work ability during this period apart from some 3% who had gradually declining work ability during the period of 16 years. “Stable excellent” work ability trajectory from midlife to late career was associated with higher likelihood of extending employment beyond individual pensionable age than those with “Low” or “Declining” work ability trajectories.

This is one of the few studies examining long-term trajectories of work ability. In accordance with the previous studies ⁴⁻⁷, we found that most trajectories remain constant from midlife to late career and majority of the participants had “Excellent” or “High” work ability throughout the years. These trajectories were characterized by high occupational status and good self-rated

health. Similar to Oakman et al. 2019, we found one unstable trajectory among our study subjects and the “Declining” trajectory was characterized by low occupational status and suboptimal health, and the both were even more prevalent than in the “Stable low” trajectory. This corroborates the findings by a previous study ⁴, which reported decreasing work ability among lower-level managers. However, the comparisons should be made cautiously as the participants retired early due to ill health in the aforementioned study ⁴ and nobody retired early due to ill health in our study.

To the best of our knowledge, this was the first study to examine how long-term trajectories of work ability predict extended employment beyond individual pensionable age. Previous studies have mainly focused on premature exit from working life and found that decreased work ability predicts early retirement among aging employees ^{4,9-11}. We found that “Stable excellent” and “Stable high” trajectories over 16 years prior to retirement were associated with a higher likelihood of extended employment when compared with “Low” and “Declining” trajectory of work ability even after taking into account age, sex, occupation, marital status and self-reported health. Our findings underline that the perceived work ability over midlife to late career may influence on the likelihood to extend employment beyond pensionable age. In addition, we found that the participants representing “Stable medium” and “Stable high” work ability trajectory had higher likelihood of extending employment beyond individual pensionable age compared to those having “Declining” trajectory from midlife to late career. Due to lack of statistical power, the results for “Stable high”, “Stable medium” and “Declining” work ability trajectory comparisons were not statistically significant after final adjustments, but the estimates were higher for both “Stable medium” and “Stable high” trajectories, which pointed towards the positive impact of maintained medium and high work ability on retirement timing.

Strengths and limitations

The use of repetitive measurements of work ability across 16 years, with maximum of eight measurement points, is a major strength of this study. A relatively homogenous working population able to work until their individual retirement date, measured objectively for all cohort members and data-driven trajectory modelling that identified the developmental pathways of work ability are additional strengths of this study. All participants were still in employment, when first contacted, and were relatively homogeneous, which suggests that health related selection bias is not a major concern in our study.

The salient limitation of this study includes a limited generalizability of these findings to employees in private sectors, cohorts representing general population and countries who have dissimilar pension systems than Finland. The administration of pension scheme is decentralized in Finland as the wage earners in the public sector are automatically covered under public sector pension act, and institute for public sector pensions (Keva) manages their pensions. However, pensions in the private sector are mostly arranged through insurance policies coordinated by the Finnish Center for Pensions under supervision of the Ministry of Social Affairs and Health and the Finnish Financial Supervisory authority²⁵. In addition, use of single self-rated item to assess work ability instead of the work ability index could be the other limitation because the single item does not capture all the mental and physical capacities, which are key factors projecting work ability. However, the single-item work ability score used in this study was validated and reported as a reasonable alternative to the seven-item work ability index²⁶. Since the majority of our participants were women, the results should be cautiously generalized to male workers. However, the gender distribution in our study (83% women) is typical in Finnish public sector occupations in recent decades as 78% of people working in local government sectors are women²⁷.

Conclusions

Work ability remained relatively stable over the 16-year time-window preceding the statutory retirement age among majority of the participants. Stable excellent work ability from midlife to late career was associated with higher likelihood of extending employment beyond individual pensionable age than those with low or declining work ability. Maintenance of good work ability throughout the working career is important and may support extended employment.

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CONFLICT OF INTEREST: The authors declare that they have no conflict of interest

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Table 1: Pre-retirement characteristics in the total study population and by trajectory groups

Pre-retirement characteristics	Total (N=2,612)		Stable excellent (n=173)		Stable high (n=1,691)		Stable medium (n=580)		Declining (n=79)		Low (n=89)		<i>p</i> -value ^{a, b*}
	n	%	n	%	n	%	n	%	n	%	n	%	
Gender													0.43
Men	436	17	32	19	273	16	97	17	13	16	21	24	
Women	2,176	83	141	81	1,418	84	483	83	66	84	68	76	
Age(mean ± SD)	62.50±1.22		62.68±1.27		62.57±1.20		62.31±1.28		62.33±1.08		62.42±1.18		<0.0001
Occupational status													<0.0001
High	913	35	70	41	642	38	165	28	20	26	16	18	
Intermediate	825	32	57	33	531	32	183	32	16	20	38	43	
Low	858	33	45	26	506	30	230	40	42	54	35	39	
Married/Cohabiting													0.45
Yes	1,865	73	123	73	1,223	74	409	72	51	68	59	69	
No	678	27	46	27	420	26	162	28	24	32	26	31	
Self-rated health													<0.0001
Good	1,974	76	170	98	1,477	87	306	53	6	8	15	17	
Suboptimal	633	24	3	2	212	13	271	47	73	92	74	83	

^aChi square for categorical variables; ^bAnalysis of variance for continuous variables; **p*-value for trajectory group differences SD(Standard Deviation)

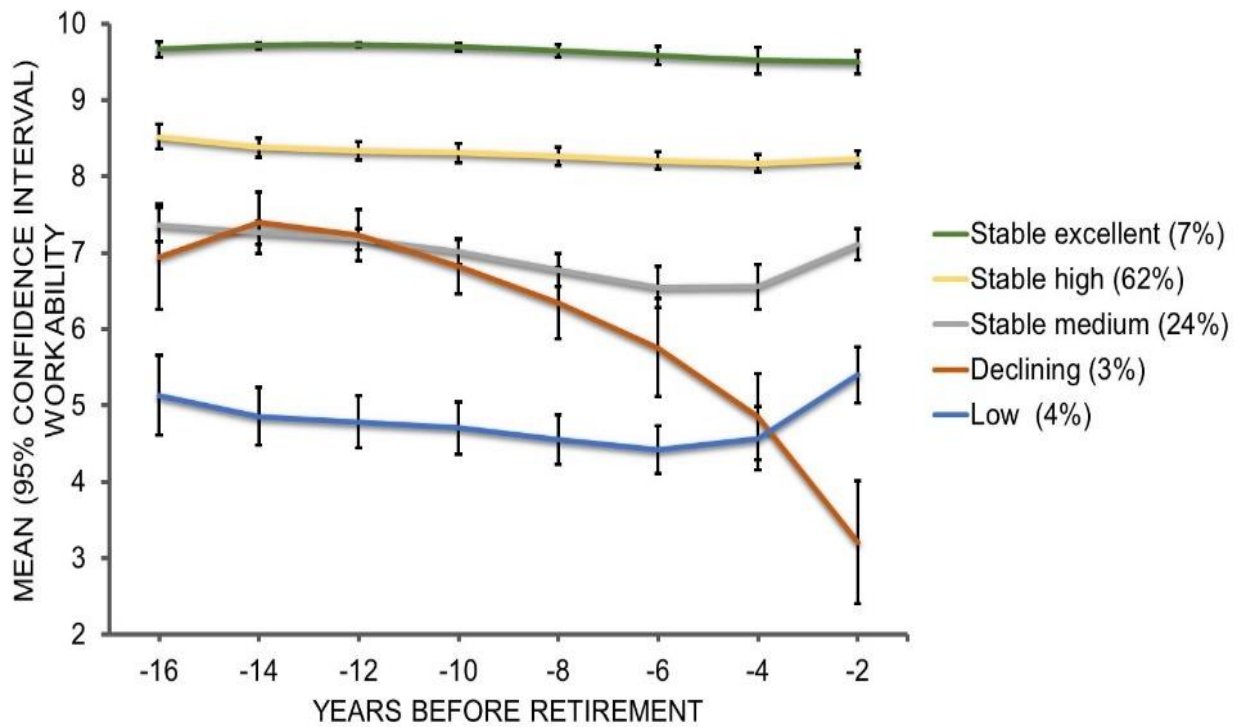


Figure 1: Trajectories of work ability (Curvi-linear, five class) over 16 years prior to individual pensionable age

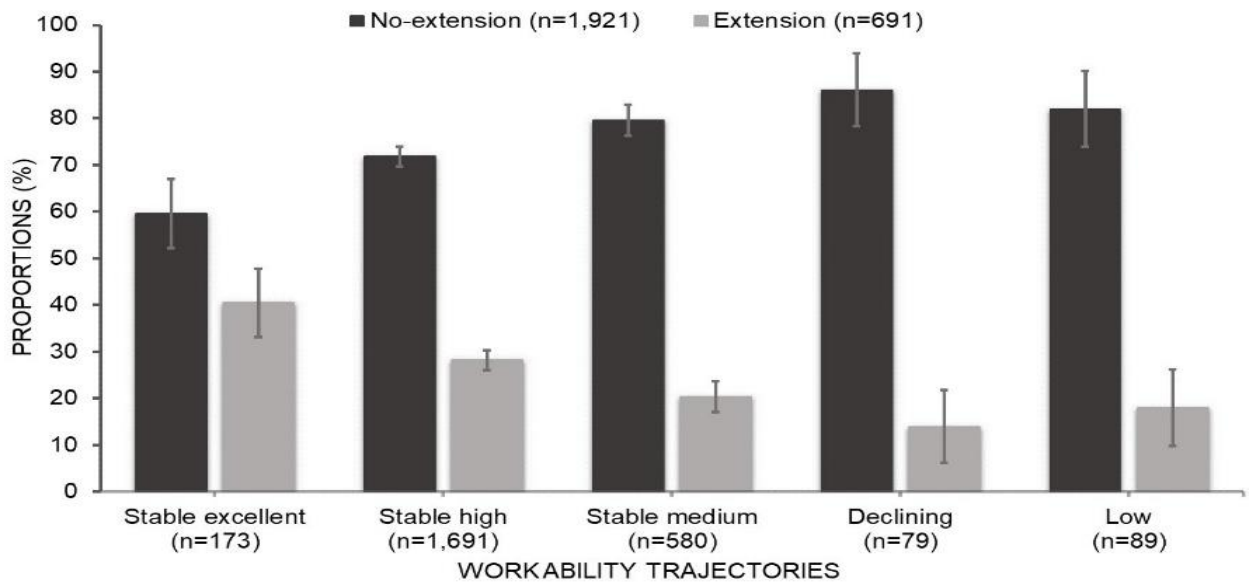


Figure 2: Proportion (95% confidence intervals) of no-extension and extension groups across trajectories of work ability

Table 2: Log-binomial regression analysis for the associations of work ability trajectories with retirement timing extended employment (n=691) vs. no-extension (n=1,921)

Workability trajectories	Model I ^a		Model II ^b		Model III ^c		Model IV ^d	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Stable excellent vs. Low	3.04	1.63–5.66	2.70	1.44–5.06	2.85	1.49–5.43	2.38	1.21–4.68
Stable high vs. Low	1.80	1.04–3.13	1.62	0.93–2.82	1.70	0.95–3.01	1.45	0.79–2.64
Stable medium vs. Low	1.21	0.68–2.15	1.15	0.64–2.06	1.21	0.66–2.20	1.12	0.61–2.05
Declining vs. Low	0.77	0.34–1.79	0.77	0.33–1.79	0.83	0.35–1.95	0.84	0.36–1.99
Stable excellent vs. Declining	3.92	1.93–7.97	3.50	1.71–7.14	3.45	1.68–7.02	2.82	1.32–6.01
Stable high vs. Declining	2.33	1.22–4.45	2.10	1.09–4.02	2.05	1.06–3.96	1.72	0.86–3.42
Stable medium vs. Declining	1.56	0.80–3.05	1.49	0.76–2.92	1.46	0.74–2.89	1.33	0.67–2.66

Note: RR, Risk Ratio; CI, Confidence Interval

^aAdjusted for age and gender;

^bAs model I + additionally adjusted for occupational status

^cAs model II + additionally adjusted for marital status

^dAs model III + additionally adjusted for self-rated health

Trajectories of work ability from midlife to pensionable age and their association with retirement timing

Prakash, Virtanen, Kivimäki, et al.,

Supplement table

eTable 1: Model fit statistics of the latent trajectory analysis from polynomial models with 1 to 8 trajectories for work ability

Number of trajectories	Shape	BIC:	AIC:	Log-likelihood:	Average posterior probabilities Prevalence of latent class (%) OCC	Smallest group (%)
1	4	-20735.24	-20717.64	-20711.64	1	100
2	44	-19620.02	-19584.81	-19572.81	0.91/0.97 18/82 46.06/7.1	18.4
3	333	-19231.26	-19187.25	-19172.25	0.91/0.93/0.84 13/72/15 67.7/5.2/29.8	12.6
3	444	-19239.30	-19186.49	-19168.49	0.90/0.93/0.84 13/72/15 60.2/5.2/29.8	12.5
4	3333	-19054.58	-18995.90	-18975.90	0.91/0.81/0.90/0.80 6/24/63/7 158.4/13.5/5.3/97.4	5.8
4	4444	-19066.39	-18995.98	-18971.98	0.90/0.81/0.90/0.88 6/24/63/7 141.0/13.5/5.3/97.4	5.8
5	33333	-18927.23	-18853.88	-18828.88	0.86/0.88/0.81/0.89/0.88 5/3/26/59/7 116.7/237.1/12.1/5.6/97.4	2.7
5	44444	-18941.45	-18853.43	-18823.43	0.90/0.87/0.81/0.90/0.89 4/3/24/62/7 216.0/216.4/13.5/5.5/107.5	3.3
6	333333	-18858.2	-18770.21	-18740.21	0.88/0.79/0.86/0.80/0.85/0.86 4/5/3/28/54/6 176.0/71.5/198.6/10.3/4.8/96.2	2.8
6	444444	-18857.34	-18751.72	-18715.72	0.87/0.86/0.80/0.81/0.92/0.87 2/2/5/15/66/10 327.9/301.0/76.0/24.2/5.9/60.2	1.8
7	3333333	-18768.58	-18665.89	-18630.89	0.85/0.81/0.92/0.82/0.78/0.83/0.87 2/6/2/4/32/48/6 277.7/66.9/563.5/109.3/7.5/5.3/104.8	2.0
7	4444444	-18772.05	-18648.83	-18606.83	0.86/0.81/0.91/0.83/0.76/0.86/0.87 2/6/2/4/30/50/6 301.0/66.9/495.4/117.2/7.4/6.1/104.8	2.3
8	33333333	-18731.53	-18614.17	-18574.17	0.89/0.86/0.91/0.81/0.77/0.75/0.82/0.87 2/2/1/7/5/35/42/6 396.5/301.0/1001.0/56.6/63.6/5.6/6.3/104.8	1.2
8	44444444	-18757.17	-18616.34	-18568.34	0.87/0.88/0.92/0.80/0.78/0.85/0.81/0.91 3/2/1/6/8/55/23/2 216.4/359.3/1138.5/62.7/40.8/4.6/14.3/495.4	1.2

Note: Chosen trajectory model is shown in bold. Polynomial function 4 refers to curvi-linear shape of trajectory; 3 refers to cubic shape of trajectory; BIC, Bayesian Information Criterion; AIC, Akaike Information Criterion; OCC, Odds of Correct Classification