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This study examined characteristics that explain socioeconomic differences in the length of work career among a non-disabled population near retirement. People with higher occupational classes were two times more likely to continue working beyond the pensionable age compared to those with lower occupational classes. This was explained by physically lighter job, better work time control and better self-rated working capacity.

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Original article

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Occupational class and working beyond the retirement age: a cohort study

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Objectives The aim of this study was to examine occupational class differences in working more than six months beyond the mandatory retirement age and factors that may contribute to these differences.

Methods The study comprised a prospective cohort study of a total of 5331 Finnish municipal employees (73% women) who were not on work disability pension and reached the age eligible for old-age pension in 2005–2011. Occupational class included four categories: managers and professionals, lower grade non-manual, skilled manual, and elementary occupations. Survey responses while at work were linked to national health and pension registers.

Results A total of 921 participants (17.3%) worked beyond the pensionable age. Compared with elementary workers, skilled manual workers had a similar probability [gender-adjusted risk ratio (RR) 0.95, 95% confidence interval (95% CI) 0.72–1.23] while lower grade non-manual workers had a 2.03-fold (95% CI 1.59–2.58), and managers and professionals had a 1.79-fold (95% CI 1.41–2.27) probability of working beyond the pensionable age. Adjustment for physical workload (32.0% in lower non-manual, 36.7% in managers and professionals), work time control (20.4% and 11.4%) and perceived work ability (16.5% and 29.1%) contributed to the largest attenuation for these associations. Analyses using a counterfactual approach suggested greater mediated effects for physical workload and work time control than those observed in traditional mediation analyses.

Conclusions Employees with higher occupational classes are two times more likely to continue working beyond the retirement age compared to those with lower occupational classes. A large proportion of these differences were explained by having physically light job, better work time control, and better self-rated work ability among employees with high occupational class.

Key terms counterfactual; health; mediation working condition; socioeconomic.

In Europe, the population is greying; in 1950, there were more than seven people of working age for every one of pension age but by 2050, the corresponding number will be fewer than two (1). In order to deal with financing the increase in pension costs and halt the rise in the economic dependency ratio, many countries have made reforms to their pension systems, often implying a better retirement income for people extending their work careers and correspondingly, a poorer retirement income for a shorter working life (1–3). Nonetheless, relatively little is known about factors that may motivate people to continue working after they have reached retirement age.

To date, there is extensive literature on characteristics associated with early exit from the labor market due to disability retirement. For example, low occupational class (4–8), behavior-related risk factors [such as smoking (9, 10), heavy alcohol use (11), obesity (12) and low physical activity (10, 13)] as well as stressful psychosocial working conditions (6, 7, 14) have been found to predict disability retirement. However, disability pensions only account for a minority of all pensions; a greater impact on the public economy may

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come from the remaining working population having the potential to prolong their work careers voluntarily. Some studies have examined intentions (rather than actual decisions) of people to continue working after the age of 65 years and found that high education (a correlate of high occupational class), good physical health, and good psychosocial working conditions were associated with intentions to work longer (15–17). Some studies have focused on "bridge employment", that is, having a paid job after retirement. Those studies have found male gender, high education, having an employed spouse, being in good health and having good working conditions in one's career job to predict a transfer to bridge employment (18–20). However, because bridge jobs typically involve a job change or a switch to self-employment, the contribution of pre-retirement organizational characteristics or working conditions to the individual's retirement choices is not well known. In one study from the US, higher psychological distress, higher role overload, and lower marital and family satisfaction predicted continued career employment in contrast to full retirement, whereas for work-related factors, a significant association was found for lower career goal achievement only (20). In our previous study, we found that employees with high occupational class, good mental health and high control over working times were more likely to work beyond the statutory pensionable age (21). Thus, occupational class appears to be one of the key determinants of extended work careers, but few studies have examined this in detail and we are aware of no investigations on explanatory factors for such occupational class differences.

In this prospective cohort study of Finnish public sector employees, we sought to quantify occupational class differences in employees' decisions to work after the retirement age and to identify the contribution of work-, health- and behavior-related factors to these differences. Furthermore, we compared two different methods for examining such explanatory factors, the traditional "difference method" to quantify mediation (22, 23) and the new "counterfactual method" (24).

Methods

Context

The statutory (old-age) pension insurance in Finland consists of components, such as a national pension and a guarantee pension, which are not earnings-related, and an earnings-related pension. The earnings-related pension system covers the entire workforce, including the self-employed. While the old-age pension is an extension of the work career, the disability pension provides financial security in the case of illness or injury. Part-time pension, in turn, enables an ageing employee to decrease his or her work contribution prior to retiring on an old-age pension. In 2005, a pension reform was implemented that included a substantial financial advantage for those delaying retirement and all wage-earners were eligible to this scheme. The pension accrual rose between the ages 63–68 at an accelerating rate after the age of 65. The accrual for old-age pensions was smaller between the ages of 53–62. An individual pensionable retirement date was assigned to all employees and in some cases it was <63, depending on the occupation (eg, fire-fighters) and the year the employee entered the job. Our data were collected between 2005 and 2011. At that time, the target workplaces did not implement personnel reductions and, thus, there was no "push" for retirement by employers.

Participants and procedure

This study was part of the Finnish Public Sector Study, a prospective epidemiological cohort study of employees working in ten towns, which is coordinated by the Finnish Institute of Occupational Health (25) The ethics committee of Helsinki and Uusimaa Hospital District approved the study. As in our previous study (21), the data included municipal employees of the ten towns who were not retired for any reason and who were eligible for old-age pension after the pension reform on 1 January 2005. The inclusion criteria were: (i) participants were employed for ≥6 months during any year between 1991–2005; (ii) were alive and either retired due to old age between 2005–2011 or were employed for >6 months beyond their individual pensionable age between 2005–2011; and (iii) during their employment responded to ≥1 study survey(s) administered in 2000–2001, 2004, and 2008; a total of 5372 employees. The latest survey response and the employers' records for each participant were linked to national pension and health registers, resulting in 5331 participants (1446 men, 3885 women) with survey and register data.

Measures

Occupational class was derived from employers' registers and based on International Standard Classification of Occupations (ISCO) 2001 at Statistics Finland (26). In this classification, there are ten hierarchically ordered occupational classes: (i) legislators, senior officers and managers; (ii) professionals (eg, medical doctors, dentists, teachers, computing professionals); (iii) technicians and associate professionals (eg, nurses, physiotherapists); (iv) clerks (eg, secretaries, library clerks, book-keeping clerks, cashiers, receptionists); (v) service workers (eg, cooks) and care workers (eg, child-

care workers, practical nurses); (vi) skilled agricultural and fishery workers; (vii) craft and related trades workers (eg, building traders workers, electronic mechanics and fitters); (viii) plant and machine operators and assemblers; (ix) elementary occupations (eg, cleaners, kitchen helpers, construction and maintenance laborers); and (x) armed forces, separate from the hierarchy (not in the present data). Due to small numbers in some occupational groups, we combined some classes and labelled the new groups as "managers and professionals" (classes 1 and 2), "lower grade non-manual" (classes 3 and 4), "skilled manual" (classes 5 to 8) and "elementary workers" (class 9).

Pensionable date was determined based on data from the pension insurance Institute for the public sector in Finland (Keva), including the individual pensionable retirement date assigned to each participant. Type and date of actual retirement were obtained from the register kept by the Finnish Centre for Pensions, which covers all pensions in Finland. As previously, the outcome – "working beyond the pensionable age" - was defined as staying employed for over six months beyond the individual pensionable date (21). "Not working" denoted those who retired on a statutory basis no later than six months after the pensionable date. Pensionable age (age when eligible to pension) was derived from pensionable date and date of birth.

Work-related factors were derived from the last survey response: any shift work (yes/no); night work (yes/no); physical workload (from a single-item question on physical strenuousness at work: rather/very strenuous vs. rather/very light); job strain (27) (measured as a difference between psychological job demands and job control and dichotomized as the highest tertile versus the other two tertiles); work time control (28) (mean score of seven items concerning employee's influence over starting and ending times of the work day, breaks during the day, scheduling the shifts and total working hours) which was dichotomized as the lowest tertile versus the other two tertiles. Information on part-time pension (yes/no) was derived from the register kept by the Finnish Centre for Pensions.

Health-related factors included having at least one major chronic somatic disease (yes/no): cardiovascular disease (coronary artery disease, chronic heart failure, stroke), chronic hypertension, diabetes, mental disorders, musculoskeletal disorders, cancer, and asthma. For these, we collected information from several data sources; prescribed medicines and entitlements to special reimbursements for a chronic disease and diagnosis-specific sickness absence of >9 days from Social Insurance Institution of Finland; diagnosis-specific hospitalization from the National Institute for Health and Welfare; and cancer from the Finnish Cancer Registry. The register-based information covered five years before the individual pensionable date and was successfully linked to all participants. Data on cardiovascular diseases, diabetes, mental disorders, musculoskeletal disorders, and asthma were completed by survey responses to a check-list of doctor-diagnosed chronic diseases. From this information, we derived a separate variable for history of mental disorder (yes/no). Psychological distress was measured using the GHQ-12 (12-item version of the General Health Questionnaire) (29) in which caseness was defined as a positive response to 4 or more items (30) Self-rated work ability was elicited by a question about current work ability compared with the respondent's lifetime best (worded as "Assume that your work ability at its best has a value of 10 points. What score would you give your current work ability?"), the scale ranging from 0 = not able to work at all, 10 = my best work ability ever (31). In this study, work ability was dichotomized into good (8–10 points) and reduced (0–7 points), as previously (32).

Behavior-related factors included self-reported current smoking (yes/no), high alcohol use (>192 g/week for women; >288 g for men) (33), obesity (body mass index of ≥30 kg/m^2, based on self-reported height and weight), and self-reported low leisure-time physical activity (<2.0 metabolic equivalent task [MET] hours per day); one MET hour corresponding to approximately 30 min of walking per day (34).

Covariates were obtained from employers' registers (gender, age), and survey responses (marital status; married or cohabited versus single, divorced/separated, or widowed).

Statistical analysis

We examined differences between occupational class categories and work-, health- and behavior-related explanatory factors using χ^2 test. To examine the association between occupational class and working beyond the retirement age, we used log-binomial regression models, and expressed the associations using risk ratios (RR) and their 95% confidence intervals (95% CI). Log-binomial analysis is recommended when the outcome event is common, as in this case (17.3%). Similarly, we examined the associations between work-, health- and behavior-related factors and working beyond the retirement age. We observed no interaction between gender and occupational class associated with the outcome (P for interaction=0.17) and therefore men and women were analyzed together and the models were adjusted for gender. To be a "mediator" (explanatory factor), a variable needs to represent a step in the causal chain between the exposure (occupational class) and the outcome (working beyond the pensionable age) and therefore be correlated with both (35). We estimated the PERM (percentage of excess risk mediated) as: PERM

= risk ratio (gender adjusted) – risk ratio (gender and explanatory factor adjusted)/[risk ratio (gender adjusted) - 1] × 100.

The above described mediation analysis is referred to as the traditional "difference method", based on the Baron and Kenny's method (22, 23) which, however assumes no interaction between exposure and mediator. Unlike traditional approaches, the new causal inference methods based on the counterfactual framework allow for effect decomposition into direct and indirect effects in the presence of exposure–mediator interactions. When omitting interaction, the estimate of the indirect effect may be biased downwards and correspond to estimates obtained from the traditional method (23, 24). Here, we used a "counterfactual method" for comparison, as suggested by Valeri & VanderWeele (24), to perform analyses with dichotomous exposure, mediator and outcome variables. All statistical analyses were performed with SAS 9.4 (SAS Institute, Cary, NC, USA).

Results

There were significant differences in almost all work-, health-, and behavior-related factors by occupational class, except in psychological distress (supplementary table A, www.sjweh.fi/index.php?page=data-repository). Women, non-married or cohabiting, shift and night workers, those reporting physical workload, job strain, poor work time control and reduced work ability, those with a record of chronic somatic disease, smoking, obesity and low physical activity were more likely to be in lower occupational classes. Recorded history of mental disorder treatment and self-reported alcohol use above recommended limits was more common among managers, professionals and lower grade non-manual workers than skilled manual and elementary workers. Part-time retirement was most common among lower grade non-manual and least common among skilled manual workers. Individual pensionable age (age when eligible for full pension) was 63–65 years for the majority of employees (76.7%). The mean pensionable age was 63.4 [standard deviation (SD) 1.7] years; 62.6 (SD 2.0) among skilled manual workers, 63.2 (SD 1.6) among lower non-manual workers, 63.9 (SD 1.2) among elementary occupations, and 63.9 (SD 1.3) among managers and professionals (data not shown).

On average, 17.3% (N=921) extended their employment more than six months beyond the pensionable age (supplementary table A, www.sjweh.fi/index.php?page=data-repository). Higher proportions were found among managers and professionals (20.8%) and lower grade non-manual workers (23.0%) while lower proportions were found among skilled manual (11.3%) and elementary workers (10.4%). Pensionable age was associated with extended work career: of those with 57–61 years, 10.9% extended; of those with 62–63 years, 18.3% extended; and of those with 64–65 years, 18.6% extended (data not shown).

Gender-adjusted comparisons between occupational groups are presented in table 1, showing a probability of 0.95 (95% CI 0.72–1.23) for skilled manual, 2.03 (1.59–2.58) for lower grade non-manual, and 1.79 (1.41–2.27) for managers and professionals to extend their employment when compared to elementary occupations. Adjustment for age or pensionable age had minor effects on the estimates (data not shown).

The associations between potential work-, health- and behavior-related explanatory factors and working beyond the pensionable age are presented in supplementary table B (www.sjweh.fi/index.php?page=data-repository). Men, non-married, full-time workers, day workers, those with low physical workload, low job strain, high work time control, no chronic somatic disease, no psychological distress, good work ability, and no obesity had a greater likelihood of working longer.

A summary of the potential explanatory factors is presented in supplementary table C (www.sjweh.fi/index.php?page=data-repository). The requirements for an explanatory factor are: (i) association with occupational class and (ii) association with the outcome. Marital status and history of mental disorder treatment (marked with -) were unlikely explanatory factors because of their inconsistent associations with occupational class and working beyond pensionable age potentially leading to negative PERM estimates. Part-time retirement, psychological distress, smoking, alcohol use and low physical activity (marked with + and brackets) were only associated with either occupational class or outcome, thus being unlikely explanatory factors but were included in further analyses to confirm this. A likelihood of being an explanatory factor was marked with + (shift work, night work, job strain, somatic disease, obesity) and a strong likelihood was marked with ++ (physical workload, work time control, work ability).

Serial adjustment for potential explanatory factors and their PERM explaining occupational class differences in extended employment using traditional mediation analysis are presented in table 1. Elementary workers were assigned as the reference group. We did not assess reduction of the estimates between skilled manual and elementary workers because there was no difference in the likelihood of working beyond the retirement age between these groups. The largest reductions in RR for "lower grade non-manual" and "managers and professionals" were found after adjusting for physical workload (32.0% and 36.7%, respectively), work time control (20.4% and 11.4%), and work ability (16.5% and 29.1%). Together, adjustment for work-related factors

Table 1. Association between occupational class and extended employment with serial adjustments for different explanatory factors (N=4886). All separate analyses are adjusted for gender. [PERM=percentage of excess risk mediated (calculated against the gender-adjusted estimate); RR=relative risk; 95% CI=95% confidence interval.]

Adjustments	Elementary occupations	Skilled manual		Lower grade non-manual		PERM	Managers and professionals		PERM
	Reference	RR	95% CI	RR	95% CI	%	RR	95% CI	%
Unadjusted	1.00	0.97	0.75–1.27	2.05	1.61–2.61	.	1.84	1.45–2.33	.
Adjusted for gender	1.00	0.95	0.72–1.23	2.03	1.59–2.58	reference	1.79	1.41–2.27	reference
+part-time retirement	1.00	0.92	0.70–1.19	2.03	1.59–2.58	0	1.78	1.40–2.26	1.3
+shift work	1.00	0.95	0.73–1.24	1.99	1.56–2.54	3.9	1.73	1.36–2.21	7.6
+night work	1.00	0.96	0.73–1.25	2.04	1.60–2.59	-1.0	1.79	1.41–2.27	0
+physical workload	1.00	0.92	0.71–1.21	1.70	1.31–2.22	32.0	1.50	1.15–1.95	36.7
+job strain	1.00	0.94	0.72–1.22	1.97	1.55–2.52	5.8	1.72	1.35–2.20	8.9
+work time control	1.00	0.95	0.72–1.24	1.82	1.42–2.33	20.4	1.70	1.33–2.17	11.4
+all above work factors	1.00	0.91	0.69–1.20	1.60	1.22–2.10	41.7	1.46	1.12–1.91	41.8
+chronic somatic disease	1.00	0.95	0.73–1.24	2.02	1.58–2.57	1.0	1.75	1.38–2.22	5.1
+psychological distress	1.00	0.95	0.73–1.23	2.02	1.59–2.57	1.0	1.79	1.41–2.27	0
+work ability	1.00	0.91	0.70–1.18	1.86	1.46–2.36	16.5	1.56	1.23–1.98	29.1
+all above health indicators	1.00	0.92	0.70–1.19	1.88	1.47–2.38	14.6	1.57	1.24–1.99	27.8
+smoking	1.00	0.94	0.72–1.23	2.02	1.59–2.57	1.0	1.78	1.40–2.26	1.3
+alcohol use	1.00	0.95	0.72–1.23	2.03	1.59–2.58	0	1.79	1.41–2.27	0
+obesity	1.00	0.94	0.72–1.23	2.01	1.58–2.56	1.9	1.77	1.39–2.24	2.5
+physical activity	1.00	0.95	0.72–1.24	2.03	1.59–2.58	0	1.79	1.41–2.28	0
+all above lifestyle factors	1.00	0.97	0.74–1.26	2.03	1.60–2.59	0	1.81	1.42–2.30	-2.5
+ all covariates	1.00	0.91	0.69–1.20	1.58	1.21–2.07	43.7	1.38	1.06–1.80	51.9

reduced 41.7% and 41.8% the excess likelihood of lower grade non-manual and managers and professionals to extend their work career, respectively. The corresponding percentages for all health-related factors were 14.6% and 27.8%. Health behaviors did not contribute to the associations. When all potential explanatory variables were entered simultaneously to the model, the PERM were 43.7% for the difference between elementary and lower grade non-manual workers and 51.9% for the difference between elementary workers and managers and professionals.

The results from counterfactual-based mediation analyses in comparison with the traditional approach are presented in tables 2, 3, and 4. Here, we dichotomized occupational class groups into high (managers and professionals combined with lower grade non-manual) and low (skilled manual combined with elementary workers) because the occupational groups merged together had similar probabilities of extending their employment. We focused on the three major mediators, physical workload, work time control and perceived work ability. As shown for physical workload in table 2, the controlled direct effect for the association between occupational class and extended working (a model adjusted for gender and physical workload) was 1.69 (95% CI 1.44–1.98) in the traditional approach and the counterfactual approach not allowing interaction; the mediated effect was 28.1% in the first and 29.1% in the latter approach. When allowing interaction between exposure and mediator in the counterfactual approach, the natural direct effect was RR=1.60 (95% CI 1.34–1.91); this represents the effect of high occupational class on future employment if physical workload among all participants was at the same level as it was among people with low occupational class. The natural indirect effect was 1.23 (95% CI 1.10–1.38). This indicates that, by being associated with lower physical workload, high occupational class indirectly increases the likelihood of extended employment (24, 36). The total mediated effect, including both direct and indirect mediated effects, was 38.0%, and thus higher than that obtained from the traditional mediation analysis (28.1%). We then examined the interaction between exposure (occupational class) and mediator (physical workload) associated with the outcome. In stratified analysis examining the exposure-mediator interaction, the likelihood of extended working was RR=1.44 (95% CI 1.17–1.77) times higher for low compared to high physical workload among participants with high occupational class. The corresponding RR was 1.14 (95% CI 0.87–1.50) among participants with low occupational class. However, the interaction term did not reach statistical significance at conventional levels (P=0.13).

Results from the traditional and counterfactual analyses for work time control as a mediator are presented in table 3. Controlled direct effect in the traditional and counterfactual model not allowing interactions was RR=1.83 (95% CI 1.60–2.10). In the analysis allowing interaction, RR for controlled direct effect, natural direct effect and natural indirect effect were 1.38 (1.07–1.77), 1.78 (1.55–2.05) and 1.10 (1.07–1.14), respectively. Work time control explained 13.5% of the total effect of the association between occupational class and extended

Table 2. Traditional and counterfactual mediation analysis on the association between occupational class (exposure) [a] and extended employment (outcome), with physical workload as a mediator. [RR=risk ratio; 95% CI=95% confidence interval.]

Method of analysis	RR	95% CI	Proportion mediated (%)
Traditional analysis			
High vs low occupational class	1.96 [b]	1.71–2.24	
High vs low occupational class	1.69 [c]	1.44–1.98	28.1
Counterfactual analysis [b]			
Interaction (exposure × mediator) not allowed; high vs low occupational class (effect)			
Controlled direct	1.69	1.44–1.98	
Natural direct	1.69	1.44–1.98	
Natural indirect	1.17	1.07–1.27	
Total	1.97	1.72–2.26	29.1
Interaction (exposure × mediator) allowed; high vs low occupational class (effect)			
Controlled direct	1.48	1.17–1.88	
Natural direct	1.60	1.34–1.91	
Natural indirect	1.23	1.10–1.38	
Total	1.96	1.71–2.25	38.0

[a] High occupational class includes low-grade non-manual workers, managers and professionals. Low occupational class includes elementary occupations and skilled manual workers.
[b] Adjusted for gender.
[c] Additionally adjusted for physical workload.

Table 3. Traditional and counterfactual mediation analysis on the association between occupational class (exposure) [a] and extended employment (outcome), with work time control as a mediator. [RR=risk ratio; 95% CI=95% confidence interval.]

Method of analysis	RR	95% CI	Proportion mediated (%)
Traditional analysis			
High vs low occupational class	1.96 [b]	1.71–2.25	
High vs low occupational class	1.83 [c]	1.60–2.10	13.5
Counterfactual analysis [b]			
Interaction (exposure × mediator) not allowed; High vs low occupational class (effect)			
Controlled direct	1.83	1.60–2.10	
Natural direct	1.83	1.60–2.10	
Natural indirect	1.08	1.05–1.10	
Total	1.97	1.72–2.26	14.2
Interaction (exposure × mediator) allowed; High vs low occupational class			
Controlled direct effect	1.38	1.07–1.77	
Natural direct effect	1.78	1.55–2.05	
Natural indirect effect	1.10	1.07–1.14	
Total effect	1.96	1.71–2.25	19.0

[a] High occupational class includes low-grade non-manual workers, managers and professionals. Low occupational class includes elementary occupations and skilled manual workers.
[b] Adjusted for gender.
[c] Additionally adjusted for work time control.

employment in the traditional analysis and 19.0% in the counterfactual analysis. We found a significant interaction (P=0.007) between exposure and mediator associated with the outcome; high work time control was associated with 1.11-fold (95% CI 0.87–1.41) and 1.68-fold (95% CI 1.40–2.02) higher probability of extended employment among participants with low and high occupational classes, respectively, thus being a stronger predictor of future employment among high-occupational-class participants.

The findings for perceived work ability (table 4) suggested a different pattern: the proportion mediated effect was 17.2% in the traditional and 16.9% in counterfactual analysis allowing interaction, thus, allowing interaction did not increase the proportion mediated. There was no interaction between occupational class and work ability associated with extended employment (P=0.70).

We also considered several confounding factors. The corresponding mediation analyses with multivariable adjustments are presented in supplementary tables D to F (www.sjweh.fi/index.php?page=data-repository). There were no major differences between multivariable-adjusted and gender-adjusted analyses except that effect estimates were lower and proportions mediated were somewhat smaller in multivariate adjusted models.

Discussion

This study examined occupational class differences in working beyond the individual retirement age among non-disabled employees reaching the age of retirement. We found that lower grade non-manual employees and managers and professional had approximately a two-fold greater likelihood of extending their work career when compared to those with elementary occupations and skilled manual work. Assessment of potential explanatory factors suggested that perceived physical workload, work time control and perceived work ability had the greatest contribution in explaining the occupational class differences, each explaining 11% to 37% of the observed associations.

Additional counterfactual analyses suggested that with regard to physical workload and work time control, our main analyses, based on the traditional difference method, might have had provided an underestimate of the mediated effects. We also found that associations of physical workload and work time control were somewhat stronger in the high occupational class groups than those with lower occupational class, indicating the presence of interaction. Counterfactual analysis, but not the difference method, takes into account such exposure-mediator interactions. We found no evidence of interaction for work ability; as expected, this resulted

Table 4. Traditional and counterfactual mediation analysis on the association between occupational class (exposure) [a] and extended employment (outcome), with perceived work ability as a mediator

Method of analysis	RR	95% CI	Proportion mediated (%)
Traditional analysis			
High vs low occupational class	1.99 [b]	1.73–2.28	
High vs low occupational class	1.82 [c]	1.59–2.09	17.2
Counterfactual analysis [b]			
Interaction (exposure × mediator) not allowed; High vs low occupational class (effect)			
Controlled direct	1.82	1.59–2.09	
Natural direct	1.82	1.59–2.09	
Natural indirect	1.09	1.06–1.11	
Total	1.98	1.73–2.28	16.4
Interaction (exposure × mediator) allowed; High vs low occupational class (effect)			
Controlled direct	1.75	1.36–2.25	
Natural direct	1.82	1.58–2.09	
Natural indirect	1.09	1.06–1.12	
Total	1.98	1.73–2.27	16.9

[a] High occupational class includes low-grade non-manual workers, managers and professionals. Low occupational class includes elementary occupations and skilled manual workers.

[b] Adjusted for gender.

[c] Additionally adjusted for work ability.

almost identical proportion mediated shown by the traditional and counterfactual approaches. Our findings are in agreement with VanderWeele & Vansteelandt's hypothesis (37) that the traditional and counterfactual approaches will coincide only when there is no exposure-mediator interaction and that ignoring interaction leads the estimate of the indirect effect to be biased downwards (23, 24).

Our findings are also in line with previous studies showing that low occupational class is associated with disability retirement (4–7) and that high education is associated with a transfer from career job to bridge employment (18–20). However, ours is the first study to examine the contribution of work and non-work related factors to occupational class differences in this context. A US study examined continued career employment but did not specifically focus on occupational class (20). In that study, lower career goal achievement before the retirement age was the only work-related predictor of longer career employment. We did not observe a clear occupational gradient; higher and lower grade non-manual employees were equally likely to work beyond the pensionable age while skilled manual and elementary workers were equally less likely to do so – even though we found several differences in work-, health- and behavior-related factors.

Physical workload was strongly associated with occupational class and it is often considered a core element of manual work. Risk factors for experienced physical workload are posture, movements, force, lack of recovery, and combinations of these exposures; thus, physical workload can be considered a function of work exposures and individual resources (eg, physical fitness and recovery options during work and leisure time) (38). In our study, 16% of managers and professionals and 21% of lower grade non-manual workers reported high physical workload while 15% of elementary workers and 30% of skilled manual workers reported low physical workload. Employees in office work may have monotonous albeit not strenuous physical work tasks, which still expose them to physical workload towards neck, shoulder, upper arms, and wrists (38). However, physical workload was strongly associated with elementary occupations, and adjustment for physical workload explained about a third of the occupational class differences.

Of the psychosocial factors at work assessed, only work time control remarkably contributed to occupational class differences in extended work career, by reducing 20% and 11% of the estimates. High work time control may be beneficial to work–life balance among older workers, for example, by enhancing family and social commitments as well as possibilities to adjust personal work ability to varying life and work circumstances (39). Previously, high work time control has been associated with lower sickness absence and work disability rates (28, 40). Our findings suggest that work time control particularly motivates higher-grade employees to extend their work career and therefore support the relevance of future intervention studies to examine the effects of increased work time control in greater detail.

A third major contributor to occupational class differences was perceived work ability, explaining 16.5% of the greater likelihood of lower grade non-manual and 29% of the greater likelihood of managers and professionals to work longer. A slightly surprising observation was that the prevalent diseases per se did not explain occupational class differences but instead, a perception of one's work ability played a major role. This suggests that own assessment of work ability might predict occupational class differences in working longer better than the presence of chronic disease, of which many are asymptomatic or may be well controlled by treatment. One's experience of impaired work ability may therefore be a proxy for a broad range of biomedical and psychosocial factors that affect the ability and willingness to work. Thus, management approaches which emphasize adjusting the work tasks to impaired work ability and supporting older workers with disabilities might be useful when aiming towards longer work careers (41).

Our findings suggesting a negligible role of health behaviors are in accordance with a previous study which reported no contribution of health behaviors to occupational class differences in work disability retire-

ment (8) but are in contrast with another study in which health behaviors explained a third of the socioeconomic status differences (42). However, because our cohort comprised non-disabled participants who all continued until their old-age pension, the studies are not fully comparable. It seems that work-related factors, such as physical working conditions and work time control, as well as work ability based on a person's own evaluations, are more important in this context.

The main strengths of this study are its large scale and prospective design. Information on the date when the employee was eligible to pension and the actual retirement date were based on nationwide municipal pension register which are considered highly accurate. National health registers completed by survey responses were used to assess chronic diseases. This means that undiagnosed and untreated cases were not detected. The assessment of work-related factors and work ability was based on self-reports instead of objective measurement, which might be affected by response style. Although our study sample represents well the Finnish municipal workforce, the findings may not be generalizable to the whole Finnish working population or countries with different pension systems. As in all observational studies, we were not able to eliminate residual confounding by imprecisely measured or unmeasured factors. A causal interpretation is possible only when all potential confounding variables have been controlled for, including confounding between the exposure and the outcome, the mediator and the outcome, the exposure and the mediator, and in addition, confounding in the mediator-outcome association that is affected by the exposure (24). In our study, the measured work-, health- and behavior-related factors could explain about half of the observed associations; thus, the unexplained part remains to be investigated in future studies.

In summary, this study, carried out among public sector employees, found that people with higher occupational classes are twice as likely to continue working beyond the retirement age compared to those with lower occupational classes. Factors explaining this difference included physically lighter job, better work time control and better self-rated work ability. Focused intervention studies among ageing workers are needed to investigate their potential to reduce occupational class differences in the length of work careers.

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References

1. Polvinen A, Gould R, Lahelma E, Martikainen P. Socioeconomic differences in disability retirement in Finland: the contribution of ill-health, health behaviours and working conditions. Scand J Public Health 2013 Jul;41(5):470–8. http://dx.doi.org/10.1177/1403494813482400.

2. Koskenvuo K, Broms U, Korhonen T, Laitinen LA, Huunan-Seppälä A, Keistinen T et al. Smoking strongly predicts disability retirement due to COPD: the Finnish Twin Cohort Study. Eur Respir J 2011 Jan;37(1):26–31. http://dx.doi.org/10.1183/09031936.00008910.

3. Lallukka T, Rahkonen O, Lahelma E, Lahti J. Joint associations of smoking and physical activity with disability retirement: a register-linked cohort study. BMJ Open 2015 Jul;5(7):e006988. http://dx.doi.org/10.1136/bmjopen-2014-006988.

4. D'Addio AC, Von Nordheim F. Towards an integrated agenda to deliver effective higher retirement ages: an issues note from the pension perspective. Workshops on delivering longer working lives and higher retirement ages, Brussels 12th-13th November 2014: OECD 2014. Available from: http://www.google.fi/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjK5P3zvsHTAhXIDZoKHasPBbYQFgggMAA&url=http%3A%2F%2Fec.europa.eu%2Fsocial%2FBlobServlet%3FdocId%3D13073%26langId%3Den&usg=AFQjCNG1V1yYXWVIJzdwlZrJ4596BPM99w. (accessed Apr 26, 2017).

5. Rechel B, Grundy E, Robine JM, Cylus J, Mackenbach JP, Knai C et al. Ageing in the European Union. Lancet 2013 Apr;381(9874):1312–22. http://dx.doi.org/10.1016/S0140-6736(12)62087-X.

6. Wise DA. Facilitating longer working lives: international evidence on why and how. Demography 2010;47 Suppl:S131–49. PubMed http://dx.doi.org/10.1353/dem.2010.0000</jrn>

7. Krokstad S, Johnsen R, Westin S. Social determinants of disability pension: a 10-year follow-up of 62 000 people in a Norwegian county population. Int J Epidemiol 2002 Dec;31(6):1183–91. http://dx.doi.org/10.1093/ije/31.6.1183.

8. Polvinen A, Laaksonen M, Gould R, Lahelma E, Martikainen P. The contribution of major diagnostic causes

to socioeconomic differences in disability retirement. Scand J Work Environ Health 2014 Jul;40(4):353–60. http://dx.doi.org/10.5271/sjweh.3411.

9. Lahelma E, Laaksonen M, Lallukka T, Martikainen P, Pietiläinen O, Saastamoinen P et al. Working conditions as risk factors for disability retirement: a longitudinal register linkage study. BMC Public Health 2012 Apr;12:309. http://dx.doi.org/10.1186/1471-2458-12-309.

10. Samuelsson Å, Ropponen A, Alexanderson K, Svedberg P. Psychosocial working conditions, occupational groups, and risk of disability pension due to mental diagnoses: a cohort study of 43,000 Swedish twins. Scand J Work Environ Health 2013 Jul;39(4):351–60. http://dx.doi.org/10.5271/sjweh.3338.

11. Salonsalmi A, Laaksonen M, Lahelma E, Rahkonen O. Drinking habits and disability retirement. Addiction 2012 Dec;107(12):2128–36. http://dx.doi.org/10.1111/j.1360-0443.2012.03976.x.

12. Roos E, Laaksonen M, Rahkonen O, Lahelma E, Lallukka T. Relative weight and disability retirement: a prospective cohort study. Scand J Work Environ Health 2013 May;39(3):259–67. http://dx.doi.org/10.5271/sjweh.3328.

13. Robroek SJ, Reeuwijk KG, Hillier FC, Bambra CL, van Rijn RM, Burdorf A. The contribution of overweight, obesity, and lack of physical activity to exit from paid employment: a meta-analysis. Scand J Work Environ Health 2013 May;39(3):233–40. http://dx.doi.org/10.5271/sjweh.3354.

14. Mäntyniemi A, Oksanen T, Salo P, Virtanen M, Sjösten N, Pentti J et al. Job strain and the risk of disability pension due to musculoskeletal disorders, depression or coronary heart disease: a prospective cohort study of 69,842 employees. Occup Environ Med 2012 Aug;69(8):574–81. http://dx.doi.org/10.1136/oemed-2011-100411.

15. ten Have M, van Dorsselaer S, de Graaf R. Associations of work and health-related characteristics with intention to continue working after the age of 65 years. Eur J Public Health 2015 Feb;25(1):122–4. http://dx.doi.org/10.1093/eurpub/cku181.

16. Taylor AW, Pilkington R, Feist H, Dal Grande E, Hugo G. A survey of retirement intentions of Baby Boomers: an overview of health, social and economic determinants. BMC Public Health 2014 Apr;14:355. http://dx.doi.org/10.1186/1471-2458-14-355.

17. Carr E, Hagger-Johnson G, Head J, Shelton N, Stafford M, Stansfeld S et al. Working conditions as predictors of retirement intentions and exit from paid employment: a 10-year follow-up of the English Longitudinal Study of Ageing. Eur J Ageing 2016;13:39–48. http://dx.doi.org/10.1007/s10433-015-0357-9.

18. Beehr TA, Bennett MM. Working after retirement: features of bridge employment and research directions. Work Aging Retire 2015;1:112–28. http://dx.doi.org/10.1093/workar/wau007.

19. Staudinger UM, Finkelstein R, Calvo E, Sivaramakrishnan K. A Global view on the effects of work on health in later life. Gerontologist 2016 Apr;56 Suppl 2:S281–92. http://dx.doi.org/10.1093/geront/gnw032.

20. Bennett MM, Beehr TA, Lepisto LR. A longitudinal study of work after retirement: examining predictors of bridge employment, continued career employment, and retirement. Int J Aging Hum Dev 2016 Sep;83(3):228–55.

21. Virtanen M, Oksanen T, Batty GD, Ala-Mursula L, Salo P, Elovainio M et al. Extending employment beyond the pensionable age: a cohort study of the influence of chronic diseases, health risk factors, and working conditions. PLoS One 2014 Feb;9(2):e88695. http://dx.doi.org/10.1371/journal.pone.0088695.

22. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Pers Soc Psychol 1986 Dec;51(6):1173–82. http://dx.doi.org/10.1037/0022-3514.51.6.1173.

23. Jiang Z, VanderWeele TJ. When is the difference method conservative for assessing mediation? Am J Epidemiol 2015 Jul;182(2):105–8. http://dx.doi.org/10.1093/aje/kwv059.

24. Valeri L, Vanderweele TJ. Mediation analysis allowing for exposure-mediator interactions and causal interpretation: theoretical assumptions and implementation with SAS and SPSS macros. Psychol Methods 2013 Jun;18(2):137–50. http://dx.doi.org/10.1037/a0031034.

25. Kivimäki M, Lawlor DA, Davey Smith G, Kouvonen A, Virtanen M, Elovainio M et al. Socioeconomic position, co-occurrence of behavior-related risk factors, and coronary heart disease: the Finnish Public Sector study. Am J Public Health 2007 May;97(5):874–9. http://dx.doi.org/10.2105/AJPH.2005.078691.

26. Statistics Finland. Classification of Occupations 2001. Available from: http://www.stat.fi/meta/luokitukset/ammatti/001-2001/index_en.html. (accessed Apr 26, 2017).

27. Karasek R, Theorell T. Healthy work: stress, productivity, and the reconstruction of working life. New York: Basic Books, 1990.

28. Ala-Mursula L, Vahtera J, Kivimäki M, Kevin MV, Pentti J. Employee control over working times: associations with subjective health and sickness absences. J Epidemiol Community Health 2002 Apr;56(4):272–8. http://dx.doi.org/10.1136/jech.56.4.272.

29. Goldberg DP, Gater R, Sartorius N, Ustun TB, Piccinelli M, Gureje O et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. Psychol Med 1997 Jan;27(1):191–7. http://dx.doi.org/10.1017/S0033291796004242.

30. Holi MM, Marttunen M, Aalberg V. Comparison of the GHQ-36, the GHQ-12 and the SCL-90 as psychiatric screening instruments in the Finnish population. Nord J Psychiatry 2003;57(3):233–8. http://dx.doi.org/10.1080/08039480310001418.

31. Tuomi K, Huuhtanen P, Nykyri E, Ilmarinen J. Promotion of work ability, the quality of work and retirement. Occup Med (Lond) 2001 Aug;51(5):318–24. http://dx.doi.org/10.1093/occmed/51.5.318.

32. Saltychev M, Laimi K, Oksanen T, Pentti J, Kivimäki M, Vahtera J. Does perceived work ability improve after a multidisciplinary preventive program in a population with no severe medical problems? The Finnish Public Sector Study. Scand J Work Environ Health 2013 Jan;39(1):57–65. http://dx.doi.org/10.5271/sjweh.3298.

33. Aalto M. Alkoholin riskikäytön rajat (Limits for risky alcohol use). In: Seppä K, Alho H, Kiianmaa K (eds.) Alkoholiriippuvuus [Alcohol dependence, in Finnish], Helsinki: Duodecim. 2010;10.

34. Kujala UM, Kaprio J, Koskenvuo M. Modifiable risk factors as predictors of all-cause mortality: the roles of genetics and childhood environment. Am J Epidemiol 2002 Dec;156(11):985–93. http://dx.doi.org/10.1093/aje/kwf151.

35. Rothman KJ, Greenland S, Lash TL. Modern epidemiology. Philadelphia, PA: Lippincott, Williams & Wilkins, 2008.

36. VanderWeele TJ. Policy-relevant proportions for direct effects. Epidemiology 2013 Jan;24(1):175–6. http://dx.doi.org/10.1097/EDE.0b013e3182781410.

37. Vanderweele TJ, Vansteelandt S. Odds ratios for mediation analysis for a dichotomous outcome. Am J Epidemiol 2010 Dec;172(12):1339–48. http://dx.doi.org/10.1093/aje/kwq332.

38. Hansson GO, Balogh I, Ohlsson K, Granqvist L, Nordander C, Arvidsson I et al. Physical workload in various types of work: part II. Neck, shoulder and upper arm. Int J Ind Ergon 2010;40:267–81. http://dx.doi.org/10.1016/j.ergon.2009.11.002.

39. Costa G, Sartori S, Akerstedt T. Influence of flexibility and variability of working hours on health and well-being. Chronobiol Int 2006;23(6):1125–37. http://dx.doi.org/10.1080/07420520601087491.

40. Vahtera J, Laine S, Virtanen M, Oksanen T, Koskinen A, Pentti J et al. Employee control over working times and risk of cause-specific disability pension: the Finnish Public Sector Study. Occup Environ Med 2010 Jul;67(7):479–85. http://dx.doi.org/10.1136/oem.2008.045096.

41. Morelock JC, McNamara TK, James JB. Workability and requests for flexible work arrangements among older adults. J Appl Gerontol 2016 Jan;733464815624149.

42. Robroek SJ, Rongen A, Arts CH, Otten FW, Burdorf A, Schuring M. Educational inequalities in exit from paid employment among Dutch workers: the influence of health, lifestyle and work. PLoS One 2015 Aug;10(8):e0134867. http://dx.doi.org/10.1371/journal.pone.0134867.

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