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Retirement age and type as predictors of frailty: a retrospective cohort study of older businessmen

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ABSTRACT

Objectives To study the association between retirement characteristics and frailty in a homogenous population of former business executives.

Design Cross-sectional cohort study using data from the Helsinki Businessmen Study.

Setting Helsinki, Finland.

Participants 1324 Caucasian men, born in 1919–1934, who had worked as business executives and managers and of whom 95.9% had retired by the year 2000. Questions on age at and type of retirement, lifestyle and chronic conditions were embedded in questionnaires.

Primary and secondary outcome measures Frailty assessed according to a modified phenotype definition at mean age 73.3 years.

Results Mean age at retirement was 61.3 years (SD 4.3) and 37.1% had retired due to old age. The prevalence of frailty was lowest among men retiring at ages 66–67 years but increased among those who worked up to age 70 years or older. Compared with men who retired before age 55 years, those retiring at ages 58–69 years were at decreased risk of frailty in old age relative to non-frailty (adjusted ORs 0.07–0.29, p<0.05). Compared with men who transitioned into old age retirement, those who retired due to disability were at increased risk of prefrailty (adjusted OR 1.53, 95% CI 1.01 to 2.32) and frailty (adjusted OR 3.52, 95% CI 1.97 to 6.29), relative to non-frailty.

Conclusion Exiting working life early and continuing to be occupationally active until age 70 years and older were both associated with increased risk of frailty among the men. Promotion of longer work careers could, however, promote healthier ageing, as the lowest prevalence of frailty was observed in former business executives who retired at ages 66–67 years.

Strengths and limitations of this study

- This study is among the first to report associations between the age at retirement, type of pension and frailty in old age among a homogenous population characterised with high socioeconomic position.
- Generalisation of the results to other socioeconomic or occupational groups should be made with caution. The study included 1324 men who had worked as business executives and managers during their work careers.
- Frailty was defined according to a modified phenotype definition, assessed using questionnaire data, and information on retirement characteristics was self-reported in this cross-sectional study.

INTRODUCTION

The geriatric syndrome frailty, which refers to a loss of biological reserves and increased vulnerability to stressors, is associated with adverse health outcomes including falls, hospitalisation and premature mortality.[1 2] Frailty is a highly significant public health concern in populations aged 65 years and older, who also comprise the globally fastest growing demographic group.[3–5] In this population, retirement from paid work represents an important life transition, with potential changes to health behaviour including reduced cigarette smoking and increased physical activity in the short term.[6] With an emphasis on promoting longer work careers in current retirement planning,[7] and given the importance of preventive measures in reducing the prevalence of frailty in ageing populations,[8] it becomes increasingly important to understand how occupational activity is associated with frailty in old age.

Previous evidence suggests a two-directional association between retirement and frailty. On one hand, being frail during the work career has been associated with an increased risk of premature exit from the workforce, comparing against non-frail individuals.[9] Accordingly, in another study, those who exited the workforce prematurely had a higher mean frailty index score than those who continued working full time until age 65 years.[10] Considering the recent trend of increasing statutory retirement age in retirement planning, however, little is known about whether being occupationally active in older age, beyond age 65 years and older, would

also associate with the prevalence of frailty. To study these associations is of importance, given the employment rate of Finns aged 65 years and older has almost doubled from 7.2% in 2001 to 13.8% in the year 2016.[11]

Being occupationally active in older age is particularly common among individuals of higher occupational classes.[12] The Helsinki Businessmen Study (HBS)[13] comprises a homogenous population of business executives and managers, who provided information on their age at and type of retirement as well as an assessment of the stressfulness of their work career, and who were assessed for frailty in old age. The aim of the present study was to find whether occupational activity in older age would also associate with frailty. We hypothesised that business executives who continued to be occupationally active would also have less of frailty in old age.

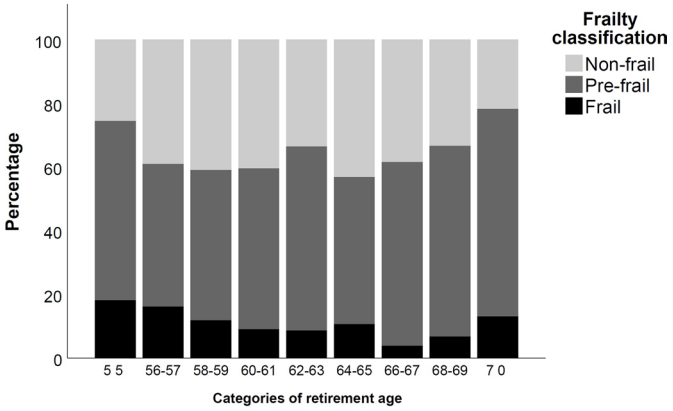

Figure 1 Distribution of frailty classification assessed at an average age of 73.3 years according to categories of age at retirement.

METHODS

Study population

The HBS has been described in detail previously.[13–15] In brief, 3490 men born between 1919 and 1934, who mostly were business executives and managers during their work careers, participated in voluntary health check-ups in mid-life at the Finnish Institute of Occupational Health. Altogether, 3310 men could be traced using a personal identification number assigned to all Finnish citizens in the 1970s and were thus included in the study. In the year 2000, all 2287 surviving participants (1023 participants (29.3%) had died between 1964 and 2000) of the original cohort received a mailed questionnaire (including the Rand 36-Item Health Survey (RAND-36)/36-Item Short Form Survey health-related quality of life instrument, questions about lifestyle, current weight and morbidity), and of these, 1864 (81.5%) responded. After screening, 1769 participants had full information on age at and type of retirement. Frailty could be assessed among 1366 men using a modified phenotype definition[16] at mean age 73.3 years (SD 4.1 years). Information on age at and type of retirement was self-reported and was obtained using questionnaires. The participants had been retired for a mean duration of 12.0 years (SD 5.2 years) prior to frailty assessment. The analytical sample of the present study consisted of 1324 men who had complete data on both frailty and age at and type of retirement.

Age at and type of retirement

The participants were asked to provide information on their working status in the mailed questionnaire. In the year 2000, practically all (95.9%; n=1787) of the men reported that they had retired, and they provided the exact age at which they had retired together with information on the type of retirement. Participants who had not reported that they had retired (n=95) were excluded prior and after screening, 1769 participants had full information on both age at and type of retirement. Information on occupation or the age which was considered 'statutory retirement age' in these sectors/occupations was not known. Due to the non-linear association between age at retirement and frailty (figure 1), as well as given the fact that no universal retirement age could be defined in this group consisting of managers and executives, we categorised retirement age into nine groups: ≤55 years (n=95, 7.3%); 56–57 years (n=87, 6.7%); 58–59 years (n=129, 10.0%); 60–61 years (n=324, 25.0%); 62–63 years (n=295, 22.8%); 64–65 years (n=275, 21.2%); 66–67 years (n=52, 4.0%); 68–69 years (n=15, 1.2%); ≥70 years (n=23, 1.8%). The types of retirement identified were as follows: old age retirement (n=507; 38.3%), early old age retirement (n=269; 20.3%), pension benefit packages (ie, early retirement incentives or redundancy packages) (n=251; 19.0%), part-time retirement (n=19; 1.4%), unemployment retirement (n=103; 7.8%) and disability retirement (n=175; 13.2%). The category 'part-time retirement' was merged with the category 'early old age retirement' due to few observations in the former and as the groups were otherwise similar regarding background information.

In Finland, the lower age limit for old age retirement was 65 and 63 years, respectively, for private and public sector workers. However, employers had individual old age retirement schemes that varied between ages 60 and 65 years. Early old age pensions could be granted if the applicant was older than 60 years and working in the private sector, or over 58 years if they worked in the public sector. Similar age criteria were applied for part-time pensions for workers transitioning from full-time to part-time work. Unemployment retirement could be granted to individuals aged 55–60 years who had received the maximum of 500 days of daily unemployment allowance. Disability pensions can be granted to individuals aged 16 years and older who have a significant disability that reduces work capacity continually for over 300 workdays. Relaxed disability pensions require the minimum age of 55 years, a long work career and a chronic disease that causes disability.[17]

Frailty

The modified phenotype frailty definition used in HBS has been described previously and shown to have

predictive validity.[16] In brief, as walking speed was not measured in 2000, the following four criteria were implemented: (1) *shrinking* defined as weight loss of ≥5% from mid-life, or having a current body mass index of <21 kg/m^2; (2) *weakness* defined as self-reported difficulty (not at all=0) in carrying or lifting a grocery bag in the physical functioning domain of the RAND-36 questionnaire[18]; (3) *exhaustion* defined as self-reported low energy most of the time during the previous 4 weeks in the vitality domain of the RAND-36 questionnaire[18]; (4) *low physical activity* defined as answering 'No' to the question 'Do you exercise regularly weekly?'. The participants were classified as frail (3 or 4), prefrail (1 or 2) and non-frail (none), according to the number of criteria met. We excluded participants with any missing questionnaire information on any of the subdomains of frailty (n=498).

Covariates

The postal questionnaire provided self-reported information on health behaviours and chronic physician-diagnosed conditions in the year 2000. Smoking was coded into 'never smokers', 'ex-smokers' and 'current smokers'. Alcohol consumption was reported as the weekly number of units of alcoholic beverages and categorised into 'zero consumption', 'light consumption' (1–98 g/week, reported as maximum 7 drinks/week), 'moderate consumption' (99–196 g/week, maximum 14 drinks/week) and 'high consumption' (>196 g/week, more than 14 drinks/week) as in earlier publications.[19] Participants provided information on the presence or history of the following conditions: hypertension, coronary heart disease, claudication, heart failure, diabetes, chronic pulmonary disease, memory disturbances, stroke, cancer, musculoskeletal disorders, psychiatric conditions, or any other long-term conditions, including trauma. In the year 2003, the participants were asked to rate the stressfulness of their entire work career using a visual analogue scale, translated into 0 (very stressful) to 10 (not stressful at all). This information was available for 72% (n=957) of the analytical sample in the present study.

Statistical methods

The data are presented as means and SDs for continuous variables, and as percentages for categorical variables. They were tested for differences using analyses of variance for normally distributed and Kruskal-Wallis test for non-normally distributed continuous variables and cross-tabulation for categorical variables. Group differences were tested across and between all frailty groups. Multinomial regression analysis was used to estimate ORs and 95% CIs of associations between age at and type of retirement and frailty in old age. Two adjustment schemes were used: model 1 was adjusted for age; model 2 was additionally adjusted for smoking, alcohol consumption, cardiovascular disease (CVD) (0/1) and diabetes (0/1). Likelihood ratio test was used to test for difference in the point estimates of frailty according to groups of retirement age. We also performed our main analyses dividing the participants into three equal groups by birth year (cut-offs in 1924 and 1929) and into two groups between historical events including the Great Depression (1929–1939), to differentiate between possible birth cohort and historical cohort effects. The analysis between age at retirement and frailty was also run separately for each retirement type. The analyses were two tailed, and significance was set at 0.05. The analyses were carried out using statistical software SPSS (IBM SPSS Statistics V.25.0 released 2017; IBM) and Mplus V.7.0 for the likelihood ratio test.

Patient and public involvement

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient-relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

RESULTS

The prevalence of frailty was 10.7% at the mean age of 73.3 years (SD 4.1 years; range 66–81 years). Across the three frailty groups, frail men were on average older (p for trend between frailty groups <0.001), more frequently current smokers (p<0.001) and 'high' consumers of alcohol (p=0.014), and had more chronic conditions, including diabetes (p=0.019, online supplemental table 1). Mean age at retirement was 61.3 years (SD 4.3; range 27–76 years) and 98.5% retired at age 50 years or older. More than a third of the participants (37.1%) had retired due to old age, and 1 in 8 (12.8%) retired because of disability (table 1). Table 1 shows that the participants differed in terms of age, chronic conditions, retirement age and frailty, according to the type of retirement.

Frailty could be assessed for 1366 out of 1864 responders. Participants with incomplete questionnaire data to determine frailty were older, consumed less alcohol and had less of CVD and diabetes in the year 2000. No statistical differences in retirement characteristics or smoking were observed between the groups (data not shown).

Age at and type of retirement

In table 1, a declining trend of mean retirement age was observed across those retiring because of old age (63.5 years), early old age (61.0 years), those receiving pension benefit packages (60.6 years), unemployment (59.1 years) and disability (57.7 years), p<0.001. The percentage of men who reported retirement transitions beyond age 65 years was 13.4% among old age retirees, 5.7% among those receiving pension benefit packages, 3.6% among early old age retirees, and minimal among unemployment (0%) and disability (0.6%) retirees (data not shown).

Table 1 Characteristics of the men according to retirement type (proportion and per cent unless stated otherwise)

	All	Old age retirement	Early old age retirement	Pension benefit package	Unemployment retirement	Disability retirement	P value*
n (%)	1324	507 (37.1)	288 (21.1)	251 (18.4)	103 (7.5)	175 (12.8)	
Old age characteristics assessed in the year 2000 (n=1324)							
Age in years, mean (SD)	73.3 (4.1)	74.6 (4.0)	72.9 (4.0)	72.5 (3.9)	71.4 (3.1)	72.6 (4.1)	<0.001
Cardiovascular disease, n (%)	812 (59.4)	307 (60.6)	159 (55.2)	155 (61.8)	47 (45.6)	124 (70.9)	<0.001
Diabetes, n (%)	113 (8.6)	35 (6.9)	22 (7.6)	26 (10.4)	7 (6.8)	23 (13.1)	0.018
Smoking status, n (%) (n=1322)							0.371
Current smoker	106 (8.0)	35 (6.9)	19 (6.6)	27 (10.8)	10 (9.7)	15 (8.6)	
Quit smoking	719 (54.8)	269 (53.3)	160 (55.6)	129 (51.4)	59 (57.3)	102 (58.3)	
Never smoked	497 (37.2)	201 (39.8)	109 (37.8)	95 (37.8)	34 (33.0)	58 (33.1)	
Alcohol consumption, n (%) (n=1040)							<0.001
None	153 (14.7)	68 (16.9)	30 (12.9)	23 (11.3)	11 (13.1)	21 (17.8)	
Light	448 (43.1)	176 (43.8)	114 (48.9)	79 (38.9)	36 (42.9)	43 (36.4)	
Moderate	234 (22.5)	103 (25.6)	39 (16.7)	47 (23.2)	18 (21.4)	27 (22.9)	
High	205 (19.7)	55 (13.7)	50 (21.5)	54 (26.6)	19 (22.6)	27 (22.9)	
Age at retirement (n=1284)							
In years, mean (SD)	61.3 (4.3)	63.5 (3.6)	61.0 (3.7)	60.6 (3.7)	59.1 (3.7)	57.7 (4.4)	<0.001
Categorised age at retirement, n (%) (n=1284)							<0.001
≥70 years	23 (1.8)	14 (2.9)	4 (1.4)	5 (2.0)	0	0	
68–69 years	15 (1.2)	11 (2.3)	1 (0.4)	2 (0.8)	0	1 (0.6)	
66–67 years	52 (4.1)	40 (8.2)	5 (1.8)	7 (2.9)	0	0	
64–65 years	273 (21.3)	204 (41.8)	35 (12.5)	21 (8.6)	6 (6.0)	7 (4.1)	
62–63 years	292 (22.8)	126 (25.8)	82 (29.2)	45 (18.4)	15 (15.0)	24 (14.0)	
60–61 years	321 (24.9)	69 (14.1)	85 (30.2)	90 (36.9)	38 (38.0)	39 (22.8)	
58–59 years	127 (9.9)	11 (2.3)	41 (14.6)	37 (15.2)	13 (13.0)	25 (14.6)	
56–57 years	87 (6.8)	3 (0.6)	17 (6.0)	20 (8.2)	17 (17.0)	30 (17.5)	
≤55 years	94 (7.3)	10 (2.0)	11 (3.9)	17 (7.0)	11 (11.0)	45 (26.3)	
Frailty assessed in the year 2000, n (%) (n=1324)							<0.001
Non-frail	496 (37.5)	177 (34.9)	108 (37.5)	123 (49.0)	44 (42.7)	44 (25.1)	
Prefrail	686 (51.8)	281 (55.4)	152 (52.8)	110 (43.8)	49 (47.6)	94 (53.7)	
Frail	142 (10.7)	49 (9.7)	28 (9.7)	18 (7.2)	10 (9.7)	37 (21.1)	
Stressfulness of work career, assessed in the year 2003 (n=972)							<0.001
0 (high stress) to 10 (no stress)	5.3 (2.8)	5.7 (2.9)	5.2 (2.8)	4.9 (2.7)	5.7 (3.0)	4.6 (2.7)	

*P for difference in means/distributions between groups.

Table 2 ORs and 95% CIs of prefrailty and frailty compared with non-frailty according to age at and type of retirement

	Prefrailty		Frailty	
	OR (95% CI)		OR (95% CI)	
	Model 1†	Model 2‡	Model 1†	Model 2‡
Categories of retirement age (years)				
≥70	0.78 (0.25 to 2.46)	0.83 (0.26 to 2.62)	0.28 (0.06 to 1.40)	0.38 (0.08 to 1.97)
68–69	0.51 (0.15 to 1.73)	0.55 (0.16 to 1.89)	0.11 (0.01 to 1.03)	0.10 (0.01 to 1.02)
66–67	0.49 (0.23 to 1.04)	0.52 (0.24 to 1.12)	0.07 (0.01 to 0.34)***	0.07 (0.01 to 0.37)**
64–65	0.37 (0.21 to 0.64)***	0.40 (0.22 to 0.70)***	0.19 (0.09 to 0.40)***	0.21 (0.10 to 0.46)***
62–63	0.61 (0.35 to 1.06)	0.67 (0.38 to 1.17)	0.20 (0.09 to 0.45)***	0.24 (0.11 to 0.54)***
60–61	0.49 (0.29 to 0.85)**	0.48 (0.28 to 0.83)**	0.22 (0.10 to 0.47)***	0.22 (0.10 to 0.47)***
58–59	0.45 (0.24 to 0.83)**	0.46 (0.25 to 0.87)*	0.28 (0.12 to 0.66)**	0.29 (0.12 to 0.70)**
56–57	0.50 (0.26 to 0.98)*	0.49 (0.25 to 0.98)*	0.51 (0.21 to 1.24)	0.45 (0.18 to 1.14)
≤55	(Ref)	(Ref)	(Ref)	(Ref)
Type of retirement				
Old age	(Ref)	(Ref)	(Ref)	(Ref)
Early old age	1.02 (0.74 to 1.40)	0.99 (0.72 to 1.37)	1.22 (0.71 to 2.09)	1.24 (0.72 to 2.16)
Pension benefit package	0.66 (0.47 to 0.91)*	0.61 (0.44 to 0.85)**	0.71 (0.39 to 1.30)	0.62 (0.33 to 1.15)
Unemployment	0.89 (0.56 to 1.41)	0.86 (0.54 to 1.37)	1.36 (0.62 to 2.98)	1.44 (0.64 to 3.21)
Disability	1.62 (1.07 to 2.45)*	1.46 (0.96 to 2.23)	4.34 (2.47 to 7.63)***	3.52 (1.97 to 6.29)***
Stressfulness of work career				
Per 1-unit increase	0.94 (0.89 to 0.99)*	0.94 (0.90 to 0.99)*	0.94 (0.86 to 1.03)	0.95 (0.87 to 1.04)

*P<0.001; **P<0.01; ***P<0.05.
†Model 1 adjusted for age in the year 2000 (age at measuring frailty).
‡Model 2 adjusted additionally for smoking, alcohol consumption, cardiovascular disease and diabetes.

Age at retirement and frailty in old age

Retirement age was similar for non-frail (mean 61.4 years, SD 4.3) and prefrail (mean 61.4 years, SD 4.2) men, and younger among frail men (mean 60.4 years, SD 4.5; p for trend=0.059). The proportions of non-frail, prefrail and frail men in the retirement age groups are shown in figure 1. The prevalence of frailty in old age was lowest (3.8%) among men who had retired at ages 66–67 years and lower than the cohort average (8.7%) among men who had retired at ages 60–63 years. Conversely, the prevalence of frailty in old age was well above the cohort average (10.7%) among men retiring at age 57 years or younger (17.6%) and at age 70 years and older (13.0%). The proportions of non-frail, prefrail and frail participants varied according to categories of retirement age (p for trend=0.015).

In table 2, compared with those who retired at age 55 years or younger, those retiring between the ages of 64 and 65 years were at decreased risk of prefrailty (adjusted OR 0.40, 95% CI 0.21 to 0.64) and frailty (adjusted OR 0.21, 95% CI 0.10 to 0.46), relative to non-frailty. The risks of frailty in old age relative to non-frailty were generally lower for men retiring between the ages of 58 and 69 years compared with men retiring at age 55 years or younger (adjusted ORs between 0.07 and 0.29). The point estimates showed a decreasing trend for men who retired at ages 56–69 years, and then increased in men retiring at the age of 70 years and older, compared with men retiring at age 55 years or younger. However, the differences among ORs were not statistically significant (likelihood ratio test for model 1: p=0.103; model 2: p=0.173). The findings showed a similar trend for prefrailty. Online supplemental table 2 presents associations between age at retirement and frailty separately for each retirement type and shows that the direction of the point estimates for the associations between age at retirement and frailty was generally like those observed for the whole cohort.

Type of retirement and frailty in old age

In table 1, the prevalence of frailty in old age was lowest for men receiving pension benefit packages (7.2%), and slightly higher for men retiring due to old age (9.7%), early old age (9.7%) and unemployment (9.7%). The prevalence of frailty was almost twice the cohort average (21.1%) among disability retirees (p≤0.001). Figure 2 shows the proportions of non-frail, prefrail and frail participants according to the type of retirement.

In table 2, compared with men who had retired due to old age, those who retired due to disability were at increased risk of prefrailty (age-adjusted OR 1.62, 95% CI 1.07 to 2.45) and frailty (age-adjusted OR 4.34, 95% CI 2.47 to 7.63), relative to non-frailty. The association

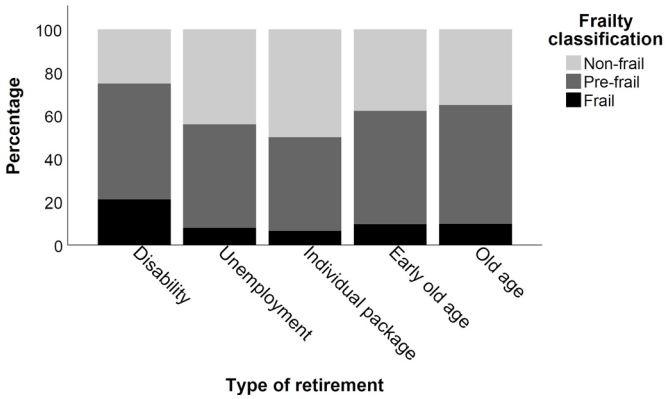

Figure 2 Distribution of frailty classification assessed at an average age of 73.3 years according to the type of retirement.

for frailty persisted after adjustment for smoking, alcohol use, CVD and OR 3.52 (95% CI 1.97 to 6.29). Compared with men who retired due to old age, men who received pension benefit packages were at decreased risk of prefrailty (adjusted OR 0.61, 95% CI 0.44 to 0.85), but not with frailty, relative to non-frailty.

Stressfulness of work career

In additional analyses among the men (n=957) who had rated the stressfulness of their entire work career, each 1-unit increase in the stressfulness scale, indicating lower overall stress during the work career, was associated with a decreased risk of prefrailty (model 2-adjusted OR 0.94, 95% CI 0.90 to 0.99), relative to non-frailty. The finding for frailty was parallel but did not reach statistical significance.

DISCUSSION

The HBS provided a unique opportunity to study the association between age at retirement as an indicator of the length of work career and frailty in old age in a homogenous population of men with a high socioeconomic standing. Our findings suggest that transitioning into retirement at an older age was associated with a decreased risk of subsequent frailty in old age among the men, which persisted even after allowing for lifestyle factors and main chronic conditions. However, retiring at age 70 years or older yielded no further health benefit as the proportion of frail men started to increase in this group. Men who retired due to disability were at increased risk of prefrailty and frailty when they were compared against men retiring due to old age. Additionally, we found evidence suggesting an association between higher stressfulness during the entire work career and increased risk of prefrailty.

The present study corroborates and extends the scarce findings reported on the association between younger retirement age and increased risk of frailty. A recent English study found that men who exited the labour market prematurely at age 49 or 60 years were at increased risk of frailty compared with men who worked full time until the age of 65 years.[10] The study found the frailty trajectory of men who entered working life late and exited at age 60 years to rise steeper than that of other groups. These men were often educated professionals and, while few in the study, highlight the need to understand these phenomena among men in higher socioeconomic groups.

Men in the present study had mostly worked as business executives and managers in enterprises in the fields of industry and commerce.[13] They had retired on average 2 years younger than men in other Finnish cohorts with similar occupational backgrounds,[12 20] but at an older age than the national average for all men in Finland in the year 2000, which was 58.9 years.[21 22] Some of the men in the present study were entrepreneurs who do not automatically have a statutory retirement scheme and thus transitioning into retirement is more flexible.[23] In addition, the men had reported to be in good physical health and represented the highest socioeconomic class, both of which have been found to be protective of frailty[24 25] and to predict longer work careers.[12 26 27] Despite the positive influence of socioeconomic factors in the present study, we found the prevalence of frailty to be 10.8%, which is comparable to or even higher than that of community-dwelling cohorts of similar age.[28] While information on the reason to continue to be occupationally active in old age was not available, we believe that as business executives the participants continued working also for reasons other than financial. Previously, continuing to be occupationally active in old age by choice and because of enjoyable work associated with better quality of life, as opposed to those continuing to work due to financial reasons, which associated with worse quality of life.[29] In the present study, those who were occupationally active at and beyond age 65 years had rated the stressfulness of their work career to be less stressful than those who had retired by age 65 years. Ultimately, not all studies report beneficial health effects of working beyond the statutory pension age. In a British cohort, occupational activity in old age was not associated with better or worse health in fully adjusted analyses.[30]

We observed the proportion of individuals who were frail in old age to increase towards both extremes of age at retirement; the prevalence of frailty was above the cohort average among men exiting the workforce before age 55 years, as well as among those who continued being occupationally active at and beyond the age of 70 years. The risk of frailty was lowest for those who retired between the ages of 60 and 69 years.

Although the number of men who were occupationally active at and beyond age 70 years was small, the finding of increasing frailty in old age in this group is relevant given recent increases in retirement age. Additional analyses showed that men who were occupationally active at age 70 years and older did not differ from men retiring at age 69 years or younger in terms of smoking and drinking habits, as well as the prevalence of chronic conditions including CVD and diabetes. Working life can impose stress on employees particularly in managerial positions[31] which could facilitate and accelerate age-related decline

across physiological systems. Work-related psychosocial stress has been associated with disability,[32] use of hospital care,[33] as well as premature mortality.[34] Moreover, there is evidence of an association between psychosocial work characteristics, such as low reward, high effort, effort to reward ratio, and effort to control ratio, and frailty in old age.[35] We found evidence that those who exited working life prematurely perceived their work career to have been more stressful.

Business executives who had transitioned into disability retirement were at increased risk of prefrailty and frailty in old age, when the men were compared against men who had retired due to old age. Frail individuals are at risk of negative employment outcomes including unemployment and leaving work for health reasons,[9] even in higher managerial positions.[36] While transitioning into disability retirement may allude poor health and highlight susceptibility to various health problems, associations between disability retirement and frailty were independent of age, smoking, alcohol use, CVD and diabetes in the present study. Business executives who received pension benefit packages, for example, early retirement incentives or redundancy packages, were at decreased risk of prefrailty, but not frailty, compared with men retiring due to old age. These packages may have included, alongside pension benefits, access to healthcare during retirement, which may also have contributed to better health in old age.

We were able to investigate associations between age at and type of retirement and subsequent frailty in old age in a homogenous population comprising retired business executives belonging to the higher socioeconomic groups, of whom more than 140 could be classified as frail. The cohort included businessmen only working in non-manual occupations at public or private institutions, or as entrepreneurs, minimising potential confounding related to sex, socioeconomic status, as well as work characteristics. We expect the occurrence of career breaks low in this group, as well as a high recall rate of retirement characteristics, given that data on retirement were self-reported. However, we were not able to characterise the participants further with information related to education, income or wealth, as previous studies have.[37] We did sensitivity analyses excluding participants (n=5) with any inconsistent information on retirement (eg, a few men reported that they transitioned to early old age pension but that their retirement age was 68 years or more). These results were parallel to those observed in the present study. Cohort effects may be present as the criteria for retirement benefits may have varied with time. Though the lower age limits for old age and early old age pensions were extremely stable in Finland from the 1950s to the 1990s, that of unemployment pensions varied between 55 and 60 years during this time. Furthermore, we found no evidence of the existence of birth cohort effects in analyses stratified by birth cohort. We also found no evidence that the association between age at retirement and frailty would contradict our main hypothesis, in that retiring older would associate with less frailty, in analyses stratified by retirement type. An extraordinary recession hit the Finnish economy during 1991–1994, leaving many senior employees out of employment, giving rise to unemployment retirement for workers that otherwise could have qualified for old age retirement. In Ireland, worsening economic news during a banking crisis coincided with less intentions to retire at the state pension age at the time.[38] While the first law on Occupational Safety was passed in Finland in the year 1930, working conditions are subject to change over time. Although the definition of frailty used in the present study comprised four criteria and was assessed using questionnaires, it has been validated to be predictive of outcomes including slower walking speed, disability and mortality in this cohort.[16] Mortality and loss to follow-up may have resulted in survivor effects, leaving out participants in poor health. This can potentially undermine the associations in the present study, as we expect that the potentially most frail participants, who died before the questionnaire sent in 2000, also retired earlier. As executives and managers, the participants in the present study are likely to have been in better overall health than men who were unemployed or in other occupational groups, summarised in 'the healthy worker effect'.[39] To control this and possible reverse causality, we adjusted the analyses with factors known to be associated with retirement characteristics. Hence, generalisations of the results to other occupational or socioeconomic groups, women or other ethnicities should be made with caution.

In conclusion, exiting working life early and continuing to be occupationally active until older age (age 70 years and older) were both associated with an increased risk of frailty in old age among businessmen and managers. However, this needs to be further studied in larger and more diverse populations. Postponing retirement decisions in professional non-manual occupations was not observed to be disadvantageous for frailty, provided that the retirement transition occurred before age 70 years. Promotion of longer work careers could also promote healthier ageing, which was supported in the present study by the fact that the lowest prevalence of frailty (3.6%) was observed in the men who retired at ages 66–67 years, which is clearly older than the average recorded for Finnish men.

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Contributors MJH designed the present study, drafted the article, analysed the data and drafted the manuscript. MBvB designed the present study, interpreted the data and revised the article critically for important intellectual content. MEvB, NMP, TT and AYS interpreted the data and revised the article critically for important intellectual content. TES acquired funding for the cohort, data collection, interpreted the data and revised the article critically for important intellectual content.

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