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Midlife cardiovascular status and old age physical functioning trajectories in older business men

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ABSTRACT

Background. The associations between cardiovascular disease (CVD) risk and later physical functioning have been observed, but few studies with follow-up into old age exist. We investigated the association between cardiovascular status in midlife and physical functioning trajectories in old age.

Methods. In the Helsinki Businessmen Study cohort (Caucasian men born in 1919-1934) three CVD status groups were formed based on clinical measurements carried out in 1974: signs of CVD (diagnosed clinically or with changes in ECG, chronic disease present or used medication, n=563); healthy and low CVD risk (n=593) and high CVD risk (n= 1222). Of them, 1560 men had data on physical functioning from at least one of four data collection waves between 2000-2010. Ten questions from the RAND-36 (SF-36) survey were used to construct physical functioning trajectories with latent class growth mixture models. Mortality was accounted for in competing risk models.

Results. A five-class solution provided the optimal number of trajectories: 'intact', 'high stable', 'high and declining', 'intermediate and declining' and 'consistently low' functioning. Compared to low CVD risk, high CVD risk in midlife decreased the risk of being classified into the 'intact' (fully adjusted β -3.98, SE 2.0, p=0.046) relative to 'consistently low' physical functioning trajectory. Compared to low CVD risk, those with signs of CVD were less likely to follow the 'intact', 'high stable' or 'high and declining' relative to the 'consistently low' trajectory (all p<0.018).

Conclusions. Among businessmen, a more favorable CVD profile in midlife was associated with better development of physical functioning in old age.

Key words: Cardiovascular health, physical functioning trajectories, growth mixture model, life course epidemiology, healthy ageing

64 **INTRODUCTION**

65 Adequate physical functioning is important in maintaining independence and quality of life with
66 advancing age.[1] Associations between poor physical functioning and adverse outcomes such as
67 geriatric syndromes, nursing home admission and premature mortality[2-6] stress the importance
68 of identifying modifiable risk factors in time. Knowledge on these risk factors may help in
69 designing interventions aimed at maintaining the ability to actively engage in society and live
70 independently.[7]

71

72 Evidence from longitudinal studies suggests that individual modifiable cardiovascular risk
73 factors such as high blood pressure and cholesterol, smoking, obesity and hyperglycemia are
74 linked with later physical functioning.[8-12] While the association of clusters of three or four CVD
75 risk factors[13-15] and established composite CVD risk indices[16-19] and later physical functioning
76 measures have been studied, only few studies with follow-up from midlife into old age
77 exist.[15,16,18,19] Furthermore, little is known about whether and how midlife cardiovascular status
78 is associated with various trajectories of physical functioning in old age. There is marked
79 heterogeneity in the progression of physical functioning with advancing age[20] and it is
80 influenced by current, but also past risk factors. More information on early risk factors for
81 patterns of physical functioning in older age would provide insight into more targeted
82 promotion of functioning. We investigated the association between modifiable midlife
83 cardiovascular risk factors measured in the year 1974 and physical functioning trajectories in
84 old age, which had been assessed at four time points over a 10-year period between 2000 and
85 2010.

86

87

88 **MATERIALS AND METHODS**

89 **Study population**

90 The Helsinki Businessmen Study (HBS) cohort has been described in detail earlier.[21] Briefly, the
91 present study population consisted of white men born between 1919 and 1934. They shared a
92 similar working status and belonged to the highest socioeconomic class. Between the years
93 1964 and 1973, 3490 men participated in voluntary health check-ups at the Finnish Institute of
94 Occupational Health that included measurements on CVD risk factors which were considered
95 to be important at that time. Of these men, 3309 formed the baseline cohort for later
96 examinations, see Figure 1. During the years 1972-73 these men were screened for eligibility
97 for a CVD primary prevention trial and in 1974, 1222 men were assessed as having high or low
98 CVD risk or signs of CVD (see below for definitions of CVD risk).[21] During 1974-1980, 1222 high
99 CVD risk men participated in a multifactorial prevention trial,[22] but participation in the trial did
100 not affect the present analyses and all men were included to improve statistical power. Of the
101 2378 men who had data on CVD status in 1974, 1560 had data on physical functioning from at
102 least one of the four subsequent data collection waves carried out in the years 2000, 2003, 2007
103 and 2010 (response rates were 81.5%, 66.3%, 65.1%, 67.8%, respectively) and they formed the
104 analytical sample of this study. The follow-up studies of the HBS have been approved by the
105 Ethics Committee of the Department of Medicine, Helsinki University Hospital, Finland and the
106 study has been registered as Clinical Trials.gov identifier: NCT02526082.

107

108 **Cardiovascular status and risk definitions in midlife**

109 Examinations for CVD risk factors and health status were carried out in 1974 at a mean age of
110 47.3 (SD 4.0) years. Overweight was determined by relative body weight (%) (body weight in
111 kilograms x 100 divided by height in centimeters minus 105).[23] Smoking was inquired in a

112 questionnaire asking how many cigarettes per day they smoked. Blood pressure was measured
113 in a sitting position after 10 min rest using a mercury sphygmomanometer. Fasting serum
114 cholesterol and triglycerides were measured using standard methods. Blood glucose (mmol/L)
115 was measured 1 hour after a glucose load of 1g/kg of body weight administered orally. Resting
116 and exercise electrocardiograms were taken at the laboratory and medical history was
117 recorded. In 1974, cohort members were classified into groups according to risk factors and
118 possible signs of CVD and other chronic diseases.[22] The CVD risk factors and cut-offs were
119 defined as follows: 1) relative body weight ≥120% (corresponds to BMI ≥27.8 kg/m^2); 2) smoking
120 >10 cigarettes/day; 3) blood pressure ≥160/95 mmHg; 4) serum cholesterol ≥7.0 mmol/L
121 (corresponds to 6.4 mmol/L with current laboratory methods); 5) serum triglycerides ≥1.7
122 mmol/L; and 6) 1-hour post-load glucose ≥9.0 mmol/L.[22] The distribution of risk factors in our
123 analytical sample (according to cut-offs described above) was as follows: 41.4% had one, 32.2%
124 had two, 17.0% had three and 9.4% four or more CVD risk factors. It is of note that risk
125 definitions reflected the situation in the 1970´s. Albeit according to current standards, low-risk
126 men would rather be defined to be at "intermediate" risk, we wanted to use the original CVD
127 grouping that has been reported in several papers.[22,24]
128
129 Three CVD status groups were formed: 1) *low CVD risk* (n=593, healthy, no signs of CVD, none
130 of the aforementioned risk factors); 2) *high CVD risk* (n=1222, healthy, no signs of CVD, but had
131 at least one of the CVD risk factors, mean 2.1 risk factors); and 3) *signs of CVD* (n=563, CVD
132 diagnosed either clinically or with changes in ECG, receiving regular medication for
133 hypertension, hyperlipidemia or diabetes, or having been diagnosed with serious non-CVD). The
134 last group was named 'signs of CVD' while the majority of the conditions that the men had were
135 cardiovascular diseases or related to the metabolic system.

136

137 **Physical functioning**

138 In the year 2000 at a mean age of 73.3 (SD 4.1) years, physical functioning was assessed using
139 ten items included in the physical functioning domain from the validated RAND-36 Health
140 Survey (Version 1.0) (identical with the Short Form SF-36).[25,26] Cohort members were asked to
141 what extent their health limited daily activities such as walking two or half a kilometer or 100
142 meters or climbing 1 or several flight of stairs. If the participants had no difficulties, some
143 difficulties or they were unable to perform a task, these were coded as 100, 50 and 0,
144 respectively, they were summed up and divided by 10. Scores range from 0 to 100 and a higher
145 score indicated better physical functioning. For each data collection wave, 7 out of the 10
146 physical functioning items were required for the score to be calculated (and in that case the
147 summed score was divided by the respective number of answered items). The proportion of
148 those who had data missing on three items at most ranged between 1.0 and 1.7% across the
149 four data collection waves and when considering all four follow-ups the percentage of those
150 with 7 out of 10 answers for each follow-up we were able to include 48 persons (3.1%).

151

152 **Health characteristics in midlife and old age**

153 The cohort members were inquired in 1974 about self-rated health with response alternatives:
154 very good, fairly good, average, fairly poor and very poor. For the analyses, two latter ones were
155 coded into one category "poor" due to few cases in the very poor category.[27] In the year 2000,
156 the participants were asked about physician-diagnosed illnesses in a mailed questionnaire. The
157 men who reported having at least one of the following diseases: stroke, transient ischemic
158 attack, high blood pressure, coronary artery disease, heart failure, or dysfunction in
159 cerebrovascular or lower extremity circulation were classified as having CVD. Dates of death

were retrieved from the Finnish Population Register Center for the entire cohort between 1974 and 2010.

Statistical methods

We identified different physical functioning trajectories by fitting latent class growth mixture models (LGMM) to all available physical functioning data of the 1560 cohort members from the years 2000, 2003, 2007 and 2010 using Mplus version 7.0.[28] In the analyses, we used LGMM with Full Information Maximum Likelihood, in order to capture unobserved subpopulations (latent groups) in all available data with similar physical functioning trajectories, but which were distinct across the latent groups over the follow-up time. Grouping was based on the likelihood of the membership calculated for each individual's own trajectory. Each latent group had their own growth parameters, intercept (indicating similar trajectories over time) and slope (indicating changes in physical functioning scores over time). We estimated the quadratic and cubic shapes of the trajectories in order to identify all potential differences in the development of physical functioning. We used several model fit indices to determine the optimal number of latent groups.[28] For Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC), lower values indicate a better fit of the model. Clarity of classification into trajectory classes was assessed with 1) high percentage of individuals falling into the latent class based on the posterior probabilities (indicates the probability of a participant belonging in a given trajectory class) and 2) high model entropy (an aggregate of posterior probabilities), which ranges between 0 and 1, with values near 1 indicating clear classification.

The conceptual model for investigating the association between CVD status in midlife and physical functioning trajectories in old age is presented in Figure 2. We constructed a competing

risks multinomial regression model to model the risk related to physical functioning trajectory class membership while simultaneously accounting for mortality risk during the physical functioning assessments between the years 2000 and 2010. Kaplan-Meier survival curves did not cross for the major part of time thus supporting proportionality. The proportionality of hazards was tested using the scaled Schoenfeld residuals, where non-significant p-values lend support for the proportionality assumption. The proportionality was supported for all covariates with an effect in the mortality part of the model: CVD status in y. 1974 (high risk vs. rest, p=0.575; sick vs. rest, p = 0.797), self-rated health in y. 1974 (p=0.629), CVD in y. 2000 (p=0.669) and the global estimate of proportionality (p=0.875). We estimated unstandardized regression coefficients (β), their mean errors (SE) and related p-values for the associations. Based on the proportional hazards model, the latent effect of excess mortality risk was used to adjust the physical functioning trajectory class for mortality risk. In addition, the model was adjusted for birth year, self-rated health in midlife and self-reported CVD in the year 2000. 71 (4.6%) individuals had missing data for self-rated health, which were imputed using multiple imputation in SPSS with data on all intact variables included in the prediction of missing values. Significance level was set at 0.05 and tests were two sided.

RESULTS

The model fit indices used to determine the best model fit for the physical functioning data in the 10-year follow-up indicating the optimal number of latent classes, i.e. physical functioning trajectories, are presented in the Supplementary Table S1. BIC was lowest for the five-class solution. Average membership probabilities in the five latent classes ranged between 0.78 and 0.88, while model entropy was 0.71 indicating reasonable classification clarity. The five physical functioning trajectories were named *'intact'* (approximately 10% of the cohort belonged to this

208 class), *'high stable'* (32%), *'high and declining'* (29%), *'intermediate and declining'* (23%), and
209 *'consistently low'* (6%) (Figure 3). Individual observations belonging to each physical functioning
210 trajectory are presented in Supplementary Figure S1.
211
212 There were statistically significant differences in the characteristics of the cohort members
213 across the physical functioning trajectories presented in Table 1. The men classified into the
214 'intact' and 'high stable' trajectory were younger at baseline, 45.2 (SD 3.6) and 46.5 (SD 3.9)
215 years, respectively, whereas those in the 'consistently low' trajectory were the oldest 49.0 (3.8)
216 years. The proportion of men with signs of CVD was higher in the poorer physical functioning
217 trajectories (7.7% in the 'intact' vs. 33.7% in the 'consistently low' trajectory). There were also
218 differences for self-rated health in midlife across the trajectories; of those in the 'intact'
219 trajectory, 44.0% rated their health very good or fairly good, whereas the corresponding
220 proportion was 19.0% in the 'consistently low' trajectory. The prevalence of CVD in the year
221 2000 was 31.0% for the men assigned to the 'intact' trajectory and increased in the poorer
222 physical functioning trajectories being 85.4% in men belonging to the 'consistently low'
223 trajectory. Out of the 1560 cohort members, 539 (34.6%) died between the years 2000 and
224 2010. Mortality during ten years was higher among those who were classified into the poorer
225 physical functioning trajectories (17.6% in the 'intact' trajectory vs. 84.3% in the 'consistently
226 low' trajectory).
227
228
229 The results of the associations between midlife CVD status and physical functioning trajectories
230 in old age for the competing risk multinomial regression models are presented in Table 2.
231 Compared to those with low CVD risk in midlife, those with high CVD risk were less likely to be

classified into the 'intact' (fully adjusted β -3.98, SE 2.0, p=0.046) trajectory relative to 'consistently low' physical functioning trajectory. In terms of effect size, the associations were parallel for the 'high stable' and 'high and declining' trajectories but not statistically significant. Compared to the men with low CVD risk, those with signs of CVD in midlife were also less likely to be classified into the 'intact', 'high stable' and 'high and declining' physical functioning trajectory relative to the 'consistently low' trajectory, all p-values <0.018. The association was also parallel but statistically non-significant for the 'intermediate and declining' trajectory. The proportion of those who died during the follow-up increased gradually with declining physical functioning trajectories. The prevalence of mortality was lowest among those in the 'intact' trajectory (approximately 18%) and highest among those in the 'intermediate and declining' (54%) and 'consistently low' trajectories (84%), p-value <0.001.

DISCUSSION

We identified five distinct physical functioning trajectories during a 10-year period in a cohort of old business executives who have been followed up from midlife. Albeit around forty percent of the men were classified into the 'intact' or 'high stable' physical functioning trajectory, a fair number of cohort members showed signs of declining physical functioning which progressed during the follow-up period in old age. A clinically significant decrease of 5 or more points[29] in the RAND-36 physical functioning sub-category score was observed in all other trajectories expect for the 'intact' trajectory. A more favorable CVD profile in midlife was associated with better development of physical functioning in old age. Compared to low CVD risk, those with high CVD risk or signs of CVD were less likely to follow one of the four more favorable physical functioning trajectories. The association persisted after adjustment for CVD in old age and also after accounting for mortality as a competing risk. Our findings provide new evidence on the

256 long-term association between modifiable CVD risk factors and subsequent patterns of physical
257 functioning.
258
259 Previous studies have found that higher CVD risk scores, indicating impaired cardiovascular
260 health, are related to poorer subsequent physical functioning.[16-19] However, to the best of our
261 knowledge, there are no previous studies on the patterns of physical functioning that are
262 related to earlier CVD status. In the present study, high CVD risk in midlife decreased the
263 probability of being assigned to a physical functioning trajectory that was intact across the 10-
264 year follow-up of physical functioning in old age. For the men with signs of CVD in midlife, i.e.
265 CVD diagnosed either clinically or with changes in ECG, receiving regular medication for
266 hypertension, hyperlipidemia or diabetes, or having been diagnosed with serious non-CVD, the
267 association was more pronounced. Signs of CVD decreased the probability of being assigned to
268 a more favorable physical functioning trajectory in old age. This association was observed for
269 those men who were assigned to the 'consistently low', 'high and declining' and 'high stable'
270 functioning trajectories compared to those in the 'intact' trajectory. This might be due to
271 disease-related impairments and decreased level of reserve capacity and compensation ability
272 in midlife which may have later led to functional decline.[30]
273
274 The mechanisms underlying impaired physical functioning are complex and may include many
275 physiological changes related to disease processes and geriatric syndromes.[6,31] For example,
276 smoking and hypertension may lead to peripheral artery disease which predisposes to declining
277 physical functioning.[32] Furthermore, damage to the musculoskeletal and peripheral nervous
278 systems start to occur well before the consequences for physical functioning can be detected.
279 Evidence that the onset of the chronic disease burden starts already early on in life is growing.[33]

280 Notably, early detection of risk factors that are known to subsequently be related to disability
281 later in life help to identify individuals who potentially stand to gain from preventive health care
282 measures.[30] Modelling physical functioning trajectories provide more knowledge on the
283 progress of limitation and the timing of preventive measures for maintaining physical capability.
284
285 The strengths of our study include the well-characterized sample of businessmen and
286 executives who came from a homogenous background and who have been followed up across
287 several decades. Midlife cardiovascular status was determined based on
288 measurement/assessment of several CVD risk factors which is similar to other established CVD
289 risk scores such as the Framingham Risk Score.[34] Physical functioning was assessed using the
290 ten items included in the sub-scale of physical functioning from the validated RAND-36 Health
291 Survey questionnaire[25] and having several data collection waves allowed for modeling
292 trajectories over time. GMM analyses are data-driven and a person-centered approach to
293 classifying study participants into sub-groups in a post-hoc manner. The method can be used to
294 describe differences in longitudinal change between and within the unobserved groups. We
295 used a competing risk model to account for mortality that occurred during the 10-year physical
296 functioning follow-up among the old businessmen.
297
298 Some limitations of the study should be recognized. The cohort comprised of men only and
299 included individuals belonging to the highest socioeconomic strata which limits generalizability.
300 The business executives and managers at that time worked typically long hours and the work
301 was often stressful. These aspects of work have been shown to contribute to a higher
302 prevalence of CVD.[35] We did not have the same measures of CVD risk available in old age that
303 we had in midlife and were not able to investigate the long-term association between CVD risk

status and later outcomes. During the follow-up of physical functioning between the years 2000 and 2010, mortality was relatively high. Using a maximum likelihood method in the GMM analyses, which uses all existing information and does not require complete data, we accounted for non-random missingness related to mortality. We also further accounted for mortality during the follow-up by using a competing risk model in the multinomial regression analyses. We did not have data on physical functioning in midlife and thus adjusted for self-rated health, which is a good general measure of health and is related to adverse outcomes in later life such as frailty.[36]

In conclusion, in a cohort of older businessmen and executives, midlife cardiovascular status was related to physical functioning patterns in old age which varied greatly among the men. Trajectories that indicate stability/maintenance of physical functioning into old age are markers for healthy ageing and quality of life and important outcomes in terms of the individual's ability to lead an independent and active life. Our results indicate that CVD risk status in midlife is a useful measure in determining the risk of poor physical functioning decades later. Furthermore, intervening in these modifiable risk factors already in midlife might help mitigate decline in physical functioning in older age.

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Conflict of Interest

The authors declare no conflicts of interest.

329 **Author contributions**

330 MBvB drafted the paper, analyzed the data, designed the study; MJH interpreted the data,
331 designed the study, revised the paper critically for important intellectual content; TT
332 interpreted the data, designed the study, revised the paper critically for important intellectual
333 content; KP interpreted the data, designed the study, revised the paper critically for important
334 intellectual content; SS interpreted the data, designed the study, revised the paper critically
335 for important intellectual content; TS responsible for data acquisition, interpreted the data,
336 designed the study, revised the paper critically for important intellectual content.

337

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343

344

345

346 **LEGENDS**

347

348 Figure 1 Study flowchart.

349

350 Figure 2 Conceptual model for assessment of midlife CVD status and physical functioning
351 trajectories in old age when accounting for birth year, self-rated health in midlife, CVD in older
352 age and excess mortality risk. Squares are observed values and circles are latent values.

353

354 Figure 3 Identified physical functioning trajectories over the 10-year follow-up from the year
355 2000 to 2010.

356

357 Supplementary Figure S1 Individual observations belonging to each physical functioning
358 trajectory.

359

360 Supplementary Table S1. Model Fit Statistics, Group Sizes and Average Latent Class
361 Probabilities for Most Likely Class Membership.

362

363

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450

Table 1 Characteristics of the Cohort Members According to Physical Functioning Trajectories

	Physical functioning trajectories*					p-value
	Intact	High stable	High and declining	Intermediate and declining	Consistently low	
	n=142	n=518	n=440	n=371	n=89	
Birth year, %						<0.001
1919-1925	20.4	31.1	40.2	54.2	53.9	
1926-1933	79.6	68.9	59.8	45.8	46.1	
Age in 1974, years, mean (SD)	45.1 (3.6)	46.5 (3.9)	47.6 (3.9)	48.5 (3.8)	49.0 (3.8)	<0.001
CVD status in 1974, %						<0.001
Low risk	43.0	33.6	32.7	18.6	13.5	
High risk	49.3	51.5	51.1	57.1	52.8	
Signs of CVD	7.7	14.9	16.2	24.3	33.7	
Self-rated health in 1974, %						<0.001
Very good	13.9	3.9	3.8	1.7	0.0	
Fairly good	40.1	35.1	32.9	22.7	19.0	
Average	40.9	50.8	52.6	54.3	51.2	
Poor	5.1	10.2	10.7	21.3	29.8	
CVD* in year 2000, %	31.0	52.1	62.7	69.0	85.4	<0.001
Died between 2000 and 2010, %	17.6	21.4	28.9	54.2	84.3	<0.001

SD= standard deviation

* Assessed between 2000 and 2010

†CVD included self-reported prevalence of stroke, transient ischemic attack, high blood pressure, coronary artery disease, heart failure, or dysfunction in cerebrovascular or lower extremity circulation.

Table 2 Unstandardized Betas, Standard Errors and P-values for Path Coefficients of Models for Midlife CVD Status Predicting Physical Functioning Trajectories in Old Age in the Helsinki Businessmen Study

	Intact vs. Consistently low			**High stable vs. Consistently low**			**High and declining vs. Consistently low**			**Intermediate and declining vs. Consistently low**		
	β	S.E.	p-value	β	S.E.	p-value	β	S.E.	p-value	β	S.E.	p-value
CVD status in midlife*												
Low CVD risk	ref.			ref.			ref.			ref.		
High CVD risk	-3.981	1.991	0.046	-3.768	1.984	0.058	-3.697	1.968	0.060	-2.311	1.841	0.209
Signs of CVD	-6.291	2.425	0.009	-5.752	2.402	0.017	-5.634	2.375	0.018	-3.812	2.198	0.083

CVD=cardiovascular disease

*Estimated with adjustment for birth year, self-rated health in midlife, CVD status in the year 2000 and excess mortality risk between 2000 and 2010.

Figure 1

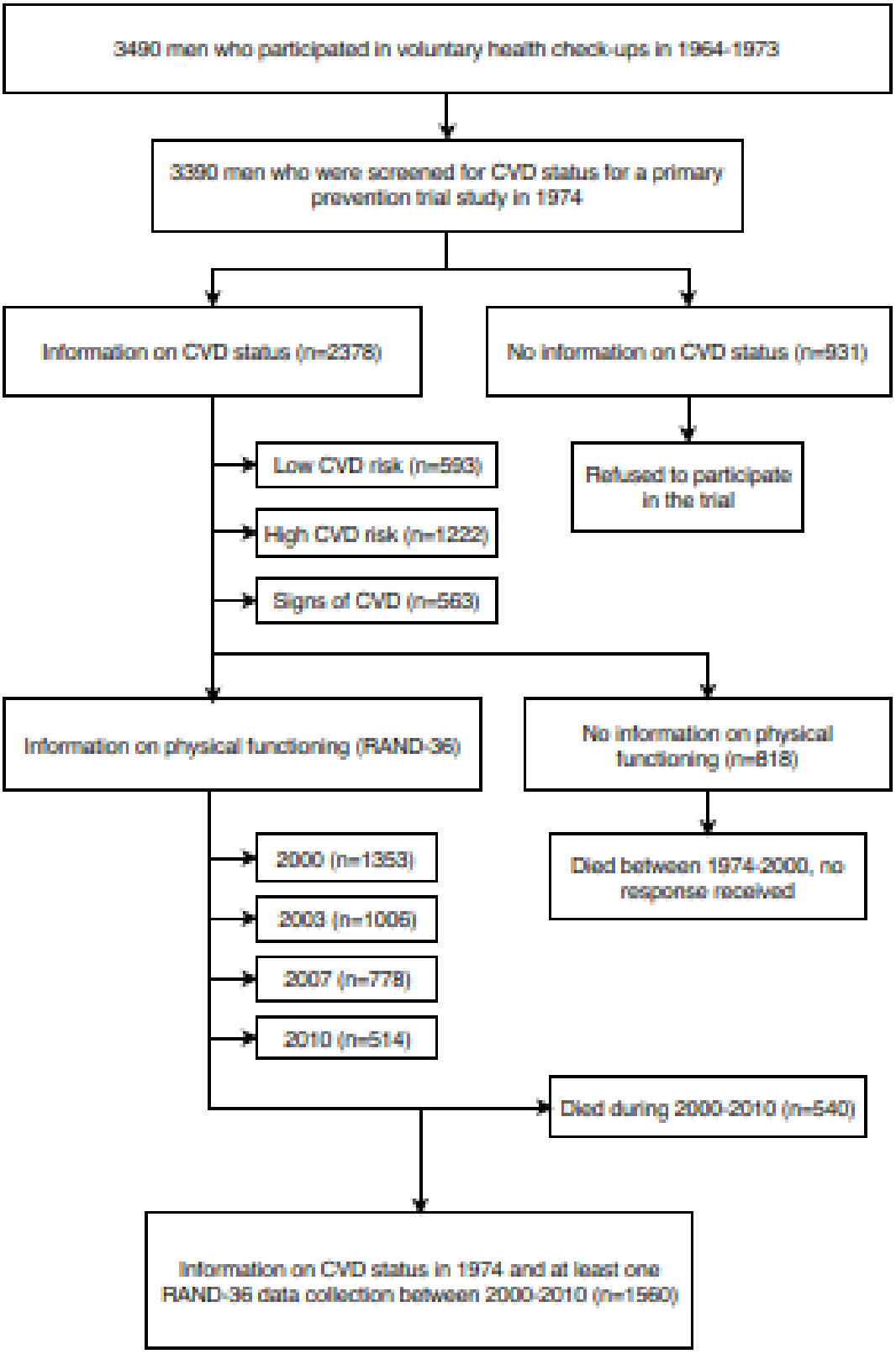

3490 men who participated in voluntary health check-ups in 1964-1973
3390 men who were screened for CVD status for a primary prevention trial study in 1974
Information on CVD status (n=2378)
No information on CVD status (n=931)
Low CVD risk (n=593)
High CVD risk (n=1222)
Signs of CVD (n=563)
Refused to participate in the trial
Information on physical functioning (RAND-36)
No information on physical functioning (n=818)
2000 (n=1353)
2003 (n=1006)
2007 (n=778)
2010 (n=514)
Died between 1974-2000, no response received
Died during 2000-2010 (n=540)
Information on CVD status in 1974 and at least one RAND-36 data collection between 2000-2010 (n=1560)

Figure 2.

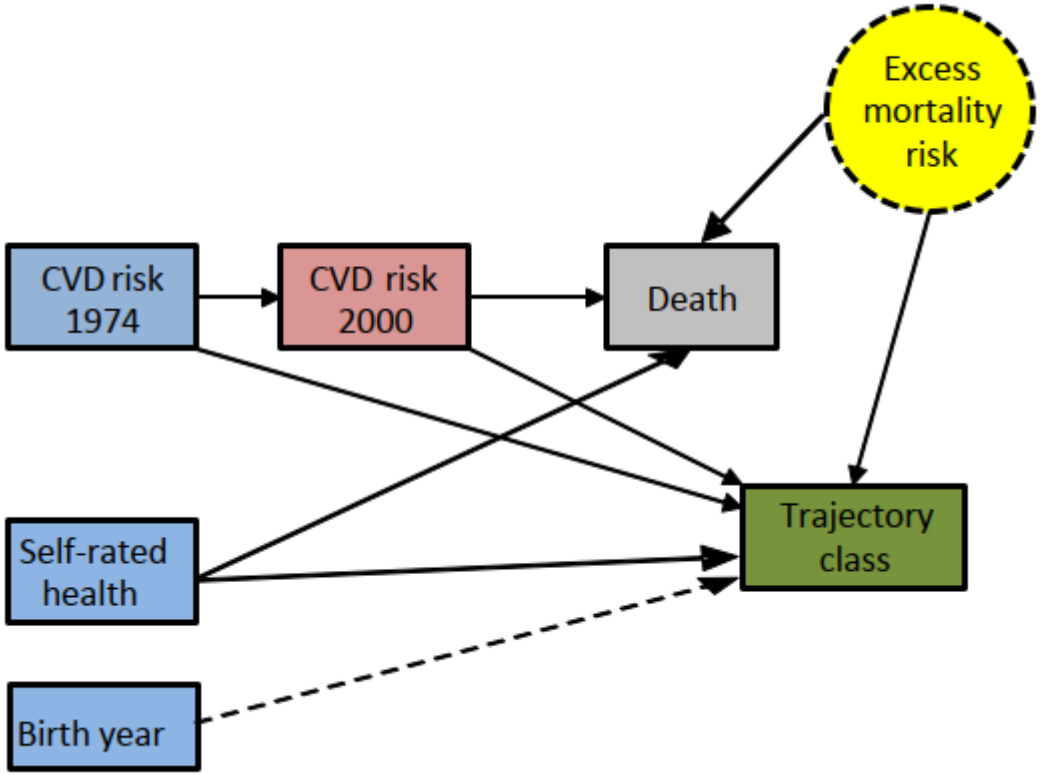
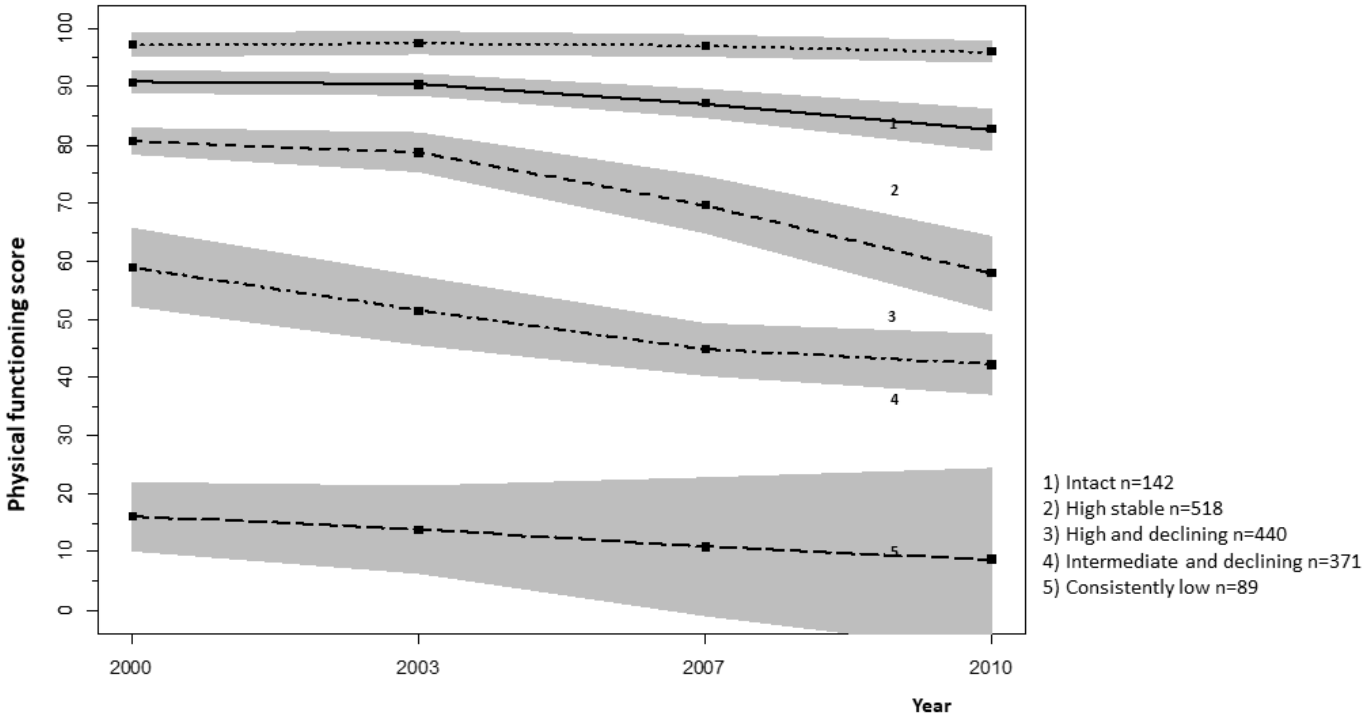

Excess mortality risk
CVD risk 1974
CVD risk 2000
Death
Self-rated health
Trajectory class
Birth year

Figure 3


Physical functioning score
0
10
20
30
40
50
60
70
80
90
100
2000
2003
2007
2010
Year
1
2
3
4
5
1) Intact n=142
2) High stable n=518
3) High and declining n=440
4) Intermediate and declining n=371
5) Consistently low n=89

Supplementary Table S1. Model Fit Statistics, Group Sizes and Average Latent Class Probabilities for Most Likely Class Membership.

				Information criteria				Group size (Average latent class probability for most likely latent class membership)					
Classes	**LL**	**Scaling**	**Free parameters**	**AIC**	**BIC**	**aBIC**	**Entropy**	n_1	n_2	n_3	n_4	n_5	n_6
1	-21939	1.88	13	43904	43977	43935	1.000	1991 (1.00)					
2	-20815	1.26	27	41684	41835	41749	0.742	960 (0.95)	1031 (0.91)				
3[b]	-20597	1.49	38	41270	41483	41362	0.712	742 (0.93)	818 (0.84)	431 (0.81)			
4[c]	-20495	1.31	49	41087	41361	41206	0.691	610 (0.78)	198 (0.80)	517 (0.92)	666 (0.78)		
5[d]	**-20453**	**1.24**	**54**	**41009**	**41312**	**41140**	**0.712**	**556 (0.78)**	**191 (0.79)**	**461 (0.84)**	**631 (0.78)**	**152 (0.88)**	
6[e]	-20422	1.18	65	40973	41337	41131	0.658	535 (0.73)	189 (0.78)	139 (0.66)	619 (0.79)	377 (0.66)	132 (0.79)

Note. LL = loglikelihood, scaling = Robust maximum likelihood scaling factor, AIC = Akaike information criterion, BIC = Bayesian information criterion, aBIC = sample size adjusted Bayesian information criterion.
[b]Parameter restrictions in class 3: var(Q)=0, cov(I,Q)=0, cov(S,Q)=0.
[c]Parameter restrictions in class 2: var(Q)=0, cov(I,Q)=0, cov(S,Q)=0, and in class 3: var(Q)=0, cov(I,Q)=0, cov(S,Q)=0.
[d]Parameter restrictions in class 2: var(Q)=0, cov(I,Q)=0, cov(S,Q)=0, and in class 3: var(I) = 0, var(S), var(Q)=0, cov(I,Q)=0, cov(I,S) = 0, cov(S,Q)=0, and in class 4: intercept(Q)=0, var(I) = 0, var(Q)=0, cov(I,Q)=0, cov(I,S) = 0, cov(S,Q)=0.
[e]Parameter restrictions in class

Supplementary Figure S1