Successful aging: the contribution of early-life and midlife risk factors.

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Abstract

Objectives

To test whether early life factors (education, height, father's social position) and midlife social, behavioral and psychosocial factors were associated with entering older age without disease and good functioning.

Design

A longitudinal, British civil service-based cohort study. Participants were followed for 17 years to assess successful aging. This was defined as being free of major disease and in the top tertile of physical and cognitive functioning measured in 2002–4.

Setting

Twenty London-based Civil Service departments

Participants

Four thousand, one hundred and forty men and 1823 women, free of major disease at baseline in 1985–8 (mean age 44, range 35–55 years)

Measurements

Behavioral, biological and psychosocial risk factors, physical and cognitive functioning and disease outcomes

Results

548 (12.8%) men and 246 (14.6%) women were successfully aging at follow up. This was strongly predicted by midlife socioeconomic position (age adjusted odds ratio for men highest vs. lowest 7.06, 95% CI 3.4, 14.6). Height, education (men), not smoking, diet, exercise, moderate alcohol (women) and work support (men) were related to a favorable older life after adjustment for age and socioeconomic position.

Conclusion

Interventions to promote adult healthy behavior may attenuate harmful effects of less modifiable risk factors and reduce social inequalities.

MESH Keywords Adult ; Aging ; psychology ; Female ; Health Behavior ; Health Promotion ; Health Status ; Humans ; Life Style ; Logistic Models ; London ; epidemiology ; Male ; Middle Aged ; Risk Factors ; Social Support ; Socioeconomic Factors

Author Keywords Aging, cohort studies, health behaviors ; inequalities

INTRODUTION

We live in a global aging society. The World Health Organization (WHO) estimates that there were 600 million people aged 60 and over in the year 2000 and this will increase to 1.2 billion by 2025 and 2 billion by 2050 (1). Aging can be seen to be a societal achievement but it is also a challenge in terms of provisions for health care and continued healthy functioning for this growing group of individuals. Thus, it is important to ensure that these extra years are not only free from major disease but that there is maintenance of mental and physical functioning. This will reduce the enormous economic and social responsibility faced by the population. It is estimated that nearly half of lifetime health care expenditure is realized during the post-65 years (2) and the total US per capita costs due to aging are projected to increase by 18 percent between 2000 and 2050 (3).

One of the most commonly used terms to describe a good old age is “successful aging”, often attributed to R. J. Havighurst in the 1960s, who defined it as “adding life to the years”(4). Interest in successful aging remained high though the successive decades and there was a general realization among biomedical researchers that quality of life may be as important as quantity of years added to life (5).

Whilst a precise definition of successful aging has not been agreed, there is general consensus that it includes freedom from chronic disease and the ability to continue to function effectively, both physically and mentally, in old age (6, 7).

Key research and policy areas include investigating the factors that permit individuals to continue to function effectively, both physically and mentally, into older age and determining whether these factors are modifiable. Prospective epidemiological studies with substantial numbers of participants with phenotypic information useful for gerontololgical research are rare but essential to identify risk factors for health and survival at older ages (8). Previous research has shown income (9), education (8, 10, 11), ethnicity (9,10), exercise (10, 12, 13, 14), diet (14), smoking habits (8, 9, 14, 15, 16, 17) and social networks (10, 12) all to be related to successful aging. The relative importance of these factors remains unclear and our primary objective here was to compare early and mid-life predictors of successful aging.

METHODS

The Whitehall II study was established in 1985 as a longitudinal population-based study to examine the socioeconomic gradient in health and disease among 10,308 civil servants (6,895 men and 3,413 women).(18) All civil servants aged 35–55 years in 20 London based departments were invited to participate by letter. In total, 73 percent of those invited agreed to take part in Phase 1. Baseline examination (Phase 1) took place during 1985–1988, and involved a clinical examination and a self-administered questionnaire containing sections on demographic characteristics, health, lifestyle factors, work characteristics, social support and life events. Clinical examination included measures of blood pressure, anthropometry, biochemical measurements, neuroendocrine function, and sub-clinical markers of cardiovascular disease. Subsequent phases of data collection have alternated between postal questionnaire alone (phases 2, 4, 6) and postal questionnaire accompanied by a clinical examination (phases 1, 3, 5 and 7). The median length of follow up from Phase 1 to Phase 7 was 17 years, with 535 individuals dying during this period. The clinical examination where physical functioning and cognitive tests were administered, phase 7, was attended by 6944 participants. The University College London Ethics Committee approved the study.

Measures of socioeconomic position (SEP) at phase 1: Based on salary and work role, the civil service defines a hierarchy of employment grades ranging from senior executive officers to clerical and support staff. This is a three level variable representing high (administrative grades), intermediate (professional or executive grades) and low (clerical or support grades) SEP. People in the three SEP groups differ with respect to salary, social status and level of responsibility. Although mostly white collar, respondents covered a wide range of SEP, with annual salaries in 1995 ranging from £4,995 to £150,000.

Early life factors (father's social class, age when left education and adult height) were ascertained from self-completed questionnaire and clinic data. Adult height was used in this way as it has been shown to be associated with prenatal and childhood exposures. (19)

Measures of health behaviors at Phase 1: Smoking, exercise, diet, and alcohol were assessed by questionnaire. Smoking was grouped as current, ex-smoker and never-smokers. Exercise was derived from questions on frequency and number of hours per week taken in activities that were mildly energetic, moderately energetic or vigorous. These were grouped as vigorous or moderate if they did one or more hours per week of these, or as none/mild. A summary index of poor diet was defined if 2 or all of the following applied: most frequently used bread was white, usually used milk was whole, and fruit or vegetables were eaten less often than daily. Alcohol consumption in the last week was expressed in units of alcohol where 1 unit = 8 grams ethanol.

Measures of psychosocial factors at Phase 1: The first set of factors were work based and consisted of the central components of the job strain model, that is, psychological job demands, decision latitude, and social support at work (20). Four items dealt with psychological job demands, and 15 items dealt with decision authority and skill discretion, which were combined into an index of decision latitude (or job control). Social support at work is the sum of two subscales: support from co-workers and support from supervisor. Social network was assessed using an adapted version of the Berkman & Syme scale (1979). This scale assesses the frequency and the number of friends, relatives and work colleagues seen; and participation in social and religious groups; high scores indicating a bigger network (21). Sample selection: Participants were classed as aging successfully if they were free from major disease up to Phase 7 and had good physical and mental functioning at Phase 7. For the analysis of successful aging we included the 5,823 men and women with no prevalent disease at phase 1, who had measures of functioning at phase 7 and who had attended five or more phases of follow-up. The latter exclusion was to reduce potential reporting bias since those who attend most phases have the greatest opportunity for declaring the presence of major diseases. Any residual confounding due to this was removed by adjusting for the number of phases attended in all analyses. Prevalent disease at Phase 1 was defined as a self-report in the questionnaire on coronary heart disease (CHD), cancer, diabetes or depression. The incidence of disease (CHD, stroke, cancer, diabetes, depression and the ATPIII metabolic syndrome) was determined from all relevant data collected between Phase 1 and Phase 7 from self-reports in questionnaires, medication use and from clinical examinations (metabolic syndrome) together with supporting evidence from general practitioners and hospitals (CHD). Good functioning at Phase 7 was defined as being in the best third of the sex-specific distribution for three or four of the four measures: Walking speed, lung function, Alice Heim 4-I (AH4-I) cognitive test and Physical Component Score of Short Form36 General Health Survey (22) (or two or three in the top third for the 26 percent of subjects who only had three of the four measures). Walking speed was measured by a trained study nurse over a clearly

marked eight foot walking course. Participants were asked to “walk to the other end of the course at your usual walking pace, just as if you were walking down the street to go the shops. Walk all the way past the other end of the tape before you stop”. Times were recorded in seconds to two decimal places. Three tests were conducted and the mean walk time was used in the analysis. Lung function was assessed using forced expiratory volume (FEV) which is the volume of air expelled in the first second of a forced expiration starting from full inspiration (23) The AH4-I is composed of a series of 65 verbal and mathematical reasoning items of increasing difficulty. This is a test of inductive reasoning that measures the ability to identify patterns and infer principles and rules (24).

Statistical analysis

Logistic regression analyses were performed, separately in men and women, to determine the association between phase 1 factors and successful aging at phase 7. All analyses were adjusted for age at Phase 1 and the number of phases attended (5, 6 or 7) to remove potential reporting bias since participants who came to more phases had more opportunities to report adverse health outcomes. The overall effect of early life factors, midlife health behaviors and psychosocial factors were summarized by creating a score for each from the individual factors (see appendix). A high score on each summary measure indicates a more favourable level. The effect of each of these on successful aging was expressed per 1 standard deviation change in each score.

Sensitivity analyses

We undertook additional sets of sensitivity analyses using slight variations on the definition of successful aging in order to assess whether it influenced the role of risk factors for successful aging. First, successful aging was defined using only the disease criteria and then only the functioning criteria. Second, the occurrence of metabolic syndrome was excluded from the definition of disease in recognition that it measures a constellation of risk factors not a clinical disease. Finally, cognitive functioning was excluded from the definition of successful aging.

RESULTS

Of the 10,308 participants in the study, 402 (6 percent) men and 238 (7 percent) women had prevalent disease at Phase 1. Of the remaining subjects, 77 percent (5179 men and 2231 women) attended five or more of the seven phases of the study. A further 1039 men and 548 women were excluded because they either did not attend Phase 7 or had missing data on functioning at Phase 7, or had unknown metabolic syndrome status at all phases. The remaining 5823 subjects (4140 men and 1683 women) form the sample for this analysis. The 4485 subjects excluded from the analyses tended to be older (mean age at Phase 1, 45.1 years v 43.9), more often women (39 percent v 29 percent) and from the lowest SEP group (33 percent v 15 percent). Of the 5823 subjects in the analysis, 548 (12.8 percent) men and 246 (14.6 percent) women were successfully aging at phase 7. During follow up 2286 participants (38.9 percent) developed at least one of the specified major diseases (CHD, stroke, cancer, diabetes, depression, metabolic syndrome). (Table 1)

As we would expect, participants who were younger at the start of the study are more likely to be disease free and functioning well at follow-up (average age at Phase 7, of those who were successfully aging compared to those who were not was 57.5 vs. 60.8 for men and 57.3 vs. 61.3 for women). Therefore, all analyses are adjusted for age. SEP in midlife (employment grade) was strongly related to successful aging for both men and women. Those in the highest employment grades were much more likely to be successfully aging than those in the lowest grades (age adjusted odds ratio 7.06, 95 percent confidence interval: 3.4, 14.6 for men). As this effect is so strong and is related to many other risk factors, we present both the age and age and SEP adjusted odds ratios in table 2. With age adjustment alone, education, height, smoking, diet, physical activity, decision latitude and work support were associated with successful aging for men. After additional adjustment for SEP, decision latitude was no longer statistically significant. For women, the affects of SEP adjustment were more pronounced. Height, smoking, alcohol, and physical activity remain associated with successful aging after adjustment for age and SEP.

The relative importance of early life factors, midlife SEP, and midlife behavioural and psychosocial factors are shown in table 3. A one standard deviation improvement in grouped early-life factors is associated with an increased likelihood of successful aging (OR 1.41, 95 percent confidence interval: 1.27, 1.57 for men). When all the factors are adjusted for each other, the strongest effects are seen for SEP for both men and women, but independent, significant effects are seen for all other groupings except psychosocial factors in women. When stratified into two age categories (data not shown), early life and behavioural factors were more important for young men (35–44 at baseline) then older men (45–55 at baseline). There were no interactions with age among the women.

Sensitivity analysis

The sensitivity analysis (tables 2A, 2B, 2C, 2D), undertaken with different definitions of successful aging, do not substantially change our original conclusions, although there were changes in magnitudes of effects. For example, we found much stronger effects of social position when successful aging was defined as high functioning (table 2B) compared to when successful aging was defined as avoidance of disease, i.e. ignoring functioning. (table 2A). Exclusion of the metabolic syndrome made very little impact (table 2C). Excluding cognitive functioning from the definition reduced the effects of education and social position, but all other effects were broadly similar (table 2D).

Further analyses removing the adjustment for the number of phases attended made only a very small difference to the magnitude of the estimates presented. When the participants with less than five visits were included in the analyses, the odds ratio estimates of SEP in Table 2 were increased by at most 4% and the age and SEP adjusted odds ratios for all other factors showed only small changes. Analysis of the 535 deaths that occurred between Phase 1 and Phase 7 showed that low SEP was associated with increased mortality with the hazard ratio (95% CI) for low versus high SEP being 2.33 (1.71, 3.18) in men ($p<0.001$) and 1.67 (1.02, 2.72) in women ($p=0.04$).

DISCUSSION

Position in the social hierarchy in midlife is strongly associated with the chances of entering early old age free from major disease and with good functioning. Independent of SEP, there are contributions from early life factors, midlife health behaviors and midlife psychosocial factors. Therefore, strategies aimed at attenuating the modifiable risk factors would lessen the inequalities dealt out in childhood and experienced throughout the life course and thus increase everyone's chances of living to a successful old age. This finding is supported by previous analyses of cohorts in which successful aging was predicted by variables assessed before the age of 50 and by several factors that were under some personal control and therefore potentially modifiable (11).

Although a precise definition of successful aging does not yet exist, most researchers agree that it needs to include freedom from chronic disease and high function (6, 7). In the analysis shown in this paper we have chosen to interpret this broad definition to include high physical and cognitive functioning. The decision to include good cognition in our definition of successful aging was based on the fact that increasing lifespan makes cognition an increasingly important health measure for older adults. In developed countries, dementia prevalence is around 1.5% at age 65 years, and doubles every 4 years to reach 30% at 80 years of age. (25) Thus, it is important to consider cognitive function in research on successful aging, particularly one that is subject to age related decline. (26) However, in order to ensure that our results were not driven by one aspect of our definition of successful aging, we undertook sensitivity analysis using different definitions of successful aging. These results suggest no major differences in the importance of the predictors of successful aging. For instance, removing cognition from the definition reduces the importance of social position somewhat but it still remains a strong predictor of successful aging.

Examination of the sensitivity of our results to the effect of removing and controlling for those participants who did not attend all phases of the study showed that the effects of social position may have been marginally underestimated but had little effect on the other factors. In addition, attrition of the cohort due to mortality is greater among those of lower social position and reinforces our observations that those of higher social position age more successfully. Hence, the gradient of successful aging with socio-economic position would be increased if the definition of successful aging also included death.

There were some differences between the importance of predictors in men and women (table 2). In the early life factors, education was important for men and height, reflecting childhood factors, was more important in women. Among the health behaviours, diet was important for men and alcohol for women. Finally, among the psychosocial factors, work support did not play a role among women. These gender differences in the importance of predictors for successful aging warrant further investigation. It is important to note that all predictors were assessed very early in midlife (average age for men was 43.8 and for women 44.3 years) and their impact on successful aging might vary later in the lifecourse. This is likely to be particularly true of measures of social support and social network, which are likely to become important for older adults.

There are a number of limitations to this study. Caution is needed when extrapolating results to the whole population as the study consisted of London-based office workers. In particular, we did not have sufficient numbers to look at the effects of ethnicity. Secondly, we did not look at the probability of having good physical and mental functioning in later life among those with chronic disease as we excluded prevalent disease at baseline. It would be interesting to explore the factors that enable those with co-morbidities and disabilities to continue to function and maintain independence. This is still considered to be “successful aging” by some (5). A strength of this study is that disease incidence was determined by ongoing surveillance and exposure variables measured before disease diagnosis. Therefore the sequence of events is clear, and we have avoided the problem of reverse causation whereby health behaviors change due to disease labeling.

The importance of socioeconomic factors for health through the life-course is well documented (18, 27). However, the role of socioeconomic factors in predicting successful aging remains little explored. One exception to this general rule is the investigation into predictors of dementia in old age. Education is widely believed to have a protective effect on dementia (28, 29). Data from a population-based study were recently used to develop an equation for the prediction of the risk of late-life dementia in people of middle age (30). Age, low education and vascular risk factors like hypertension, hypercholesterolemia, and obesity in mid life were found to be highly predictive of dementia during the 20-year follow-up period.

Results from the Berlin Aging Study showed successful aging to be relatively free from the effects of social class (31). However, as the analysis was based on those over 70 years of age it was necessarily restricted to those who had survived up to this age. It is possible

that the effects of socioeconomic position are diluted when examined amongst the oldest old. Factors believed to protect against dementia at earlier times have been found to have little effect at the end of life (32). The focus of our analysis is on successful aging in early old age and results show SEP to be an important correlate. Our measure of SEP is a global measure and is linked to education, income, cognitive complexity of occupation and perhaps other lifestyle factors. We show SEP to be associated with successful aging after adjustments for early life factors, health behaviors and some psychosocial factors. The precise mechanisms through which SEP influences disease and functioning outcomes needs further investigation. Certainly, the influence of factors associated with socioeconomic position is large.

In this study, we have shown that even with a disadvantaged start to life (including little education and poor parents), the likelihood of entering old age with enhanced physical and mental capabilities is influenced by midlife health behaviors and exposure to psychosocial stressors. From a public health perspective, our results provide a reflection both on the definition of “successful aging” and the predictors of successful aging. In terms of definition, it is vital to emphasize the importance of both a disease free and a high functioning status. The analysis on the predictors of successful aging suggests that targeting modifications to health behaviors in early midlife might be beneficial for successful aging. A focus on health behaviors might also have the consequence of reducing social inequalities in health at older ages. (33, 34)

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Footnotes:

Author Contributions: All authors designed the study, were involved in data acquisition and prepared the text. Dr. Britton conducted the literature review and wrote the first draft. Mr Shipley was primarily responsible for statistical analyses. Professor Marmot is responsible for quality assurance and control.

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TABLE 1

Incidence of disease and prevalence of good functioning by Phase 7 in men and women.

	Men	Women
Total number of participants*	4140	1683
Mean age (SD) at Phase 1	43.8 (5.9)	44.3 (5.9)
Disease		
- CHD/Stroke	655 (15.8 %)	315 (18.7 %)
- Cancer	125 (3.0 %)	77 (4.6 %)
- Diabetes	175 (4.2 %)	99 (5.9 %)
- Depression	253 (6.1 %)	131 (7.8 %)
- Metabolic syndrome	855 (20.7 %)	320 (19.0 %)
- Any of the above	1591 (38.4 %)	695 (41.3 %)
No disease	2549 (61.6 %)	988 (58.7 %)
Good functioning†	757 (18.3%)	361 (21.5%)
No disease and good functioning: “Successful aging”	548 (12.8%)	246 (14.6%)

* Among those who had no prevalent disease at Phase 1, who attended 5 or more Phases of follow-up and had measures of functioning Phase 7.

† Good functioning is defined as being in the best third of the sex-specific distribution for three or four of the four measures (or two or three in the top third for the 26% of subjects who only had three of the four measures).

TABLE 2

Odds ratios for successful aging at Phase 7 associated with demographic factors, early life factors, health behaviors and psychosocial factors at Phase 1

		Men (528 successfully aged/4140 men)			Women (246 successfully aged/1683 women)		
			Odds ratio* (95% CI)			Odds ratio* (95% CI)	
		N	Age adjusted	Age & SEP adjusted	N	Age adjusted	Age & SEP adjusted
Socio-economic Position							
Employment grade	- High	1728	7.06 (3.4, 14.6)		272	7.68 (4.9, 12.1)	
	- Medium	2197	2.79 (1.3, 5.8)		753	3.64 (2.4, 5.5)	
	- Low	215	1.0		658	1.0	
P-value for trend			<0.001			<0.001	
Early Life Factors							
Father's social class	- Non manual	2448	1.11 (0.9, 1.4)	0.97 (0.8, 1.2)	849	1.81 (1.3, 2.5)	1.26 (0.9, 1.7)
	- Manual	1465	1.0	1.0	667	1.0	1.0
P-value			0.30	0.78		<0.001	0.18
Age left Education	- > 18 yrs	1862	2.13 (1.6, 2.8)	1.39 (1.0, 1.8)	533	2.30 (1.6, 3.3)	1.11 (0.7, 1.7)
	- 17 - 18 yrs	1033	1.56 (1.2, 2.1)	1.31 (1.0, 1.8)	366	1.76 (1.2, 2.6)	1.18 (0.8, 1.8)
	- ≤ 16 yrs	1094	1.0	1.0	688	1.0	1.0
P-value for trend			<0.001	0.03		<0.001	0.65
	- Tallest	1442	1.90 (1.5, 2.4)	1.64 (1.3, 2.1)	615	2.87 (1.9, 4.2)	2.03 (1.4, 3.0)

Height tertiles							
	- Middle	1408	1.53 (1.2, 2.0)	1.42 (1.1, 1.8)	575	1.80 (1.2, 2.7)	1.47 (1.0, 2.2)
	- Shortest	1286	1.0	1.0	493	1.0	1.0
P-value for trend			<0.001	<0.001		<0.001	<0.001
Health behaviors							
Smoking habit	- Never	2079	3.16 (2.1, 4.7)	2.72 (1.8, 4.1)	969	2.37 (1.5, 3.9)	2.24 (1.3, 3.7)
	- Ex	1520	2.64 (1.8, 4.0)	2.46 (1.6, 3.7)	411	2.64 (1.5, 4.5)	2.17 (1.3, 3.7)
	- Current	509	1.0	1.0	292	1.0	1.0
P-value for trend			<0.001	<0.001		0.007	0.006
Alcohol	- None	429	0.97 (0.7, 1.4)	1.24 (0.9, 1.8)	405	0.26 (0.2, 0.5)	0.50 (0.3, 0.9)
	- 1-14	2401	0.99 (0.8, 1.2)	1.00 (0.8, 1.2)	1083	0.75 (0.5, 1.1)	1.00 (0.7, 1.5)
	- 15+	1280	1.0	1.0	175	1.0	1.0
P-value for trend			0.87	0.39		<0.001	0.01
Poor Diet	- No	2226	1.55 (1.3, 1.9)	1.39 (1.1, 1.7)	1024	1.54 (1.1, 2.1)	1.11 (0.8, 1.6)
	- Yes	1799	1.0	1.0	570	1.0	1.0
P-value			<0.001	0.001		0.008	0.53
Physical activity	- Vigorous	2254	2.39 (1.5, 3.7)	1.94 (1.2, 3.1)	485	2.23 (1.5, 3.4)	1.66 (1.1, 2.6)
	- Moderate	1508	1.75 (1.1, 2.8)	1.48 (0.9, 2.4)	771	1.72 (1.1, 2.6)	1.41 (0.9, 2.2)
	- None/mild	364	1.0	1.0	412	1.0	1.0
P-value for trend			<0.001	<0.001		<0.001	0.03
Psychosocial factors							
Decision latitude	- High	1789	1.89 (1.4, 2.5)	1.20 (0.9, 1.6)	393	2.74 (1.9, 3.9)	1.36 (0.9, 2.0)
	- Medium	1417	1.42 (1.1, 1.9)	1.09 (0.8, 1.4)	517	1.99 (1.4, 2.8)	1.32 (0.9, 1.9)
	- Low	918	1.0	1.0	741	1.0	1.0
P-value for trend			<0.001	0.18		<0.001	0.15
Job demands	- Low	932	0.85 (0.7, 1.1)	1.25 (0.9, 1.6)	596	0.57 (0.4, 0.8)	1.18 (0.8, 1.8)
	- Medium	1838	1.02 (0.8, 1.3)	1.22 (1.0, 1.5)	710	0.99 (0.7, 1.4)	1.35 (0.9, 1.9)
	- High	1361	1.0	1.0	360	1.0	1.0
P-value for trend			0.27	0.08		0.003	0.43
Work support	- High	1410	1.36 (1.1, 1.7)	1.31 (1.0, 1.7)	528	1.18 (0.8, 1.7)	1.12 (0.8, 1.6)
	- Medium	1393	1.12 (0.9, 1.4)	1.04 (0.8, 1.3)	502	1.08 (0.8, 1.5)	0.95 (0.7, 1.4)
	- Low	1322	1.0	1.0	635	1.0	1.0
P-value for trend			0.008	0.02		0.33	0.54
Network Index	- High	1571	1.12 (0.9, 1.4)	1.04 (0.8, 1.3)	560	0.97 (0.7, 1.4)	0.92 (0.6, 1.3)
	- Medium	1510	1.03 (0.8, 1.3)	0.98 (0.8, 1.3)	631	0.97 (0.7, 1.4)	0.86 (0.6, 1.2)
	- Low	1026	1.0	1.0	470	1.0	1.0
P-value for trend			0.32	0.69		0.89	0.70

* All odds ratios are adjusted for number of phases attended in addition to adjustments given

TABLE 3

Odds ratio of successful aging associated with a one standard deviation improvement in socio-economic position, early life factors, health behaviors and psychosocial factors.

	Men (426 successfully aged/3329 men)						Women (198 successfully aged/1196 women)					
	Age adjusted			Fully adjusted*			Age adjusted			Fully adjusted*		
	OR+	95% CI	P-value	OR+	95% CI	P-value	OR+	95% CI	P-value	OR+	95% CI	P-value
Socio-economic position	1.70	1.52, 1.90	<0.001	1.52	1.34, 1.72	<0.001	1.85	1.57, 2.18	<0.001	1.58	1.31, 1.92	<0.001
Early life factors	1.41	1.27, 1.57	<0.001	1.19	1.06, 1.33	0.003	1.61	1.36, 1.90	<0.001	1.23	1.01, 1.49	0.04
Health behaviors	1.41	1.26, 1.56	<0.001	1.29	1.16, 1.44	<0.001	1.45	1.22, 1.71	<0.001	1.29	1.09, 1.54	0.003
Psychosocial factors	1.19	1.07, 1.31	<0.001	1.12	1.01, 1.24	0.03	1.18	1.01, 1.37	0.03	1.10	0.94, 1.28	0.25

* Adjusted for age and all the other factors in the table

+ All odds ratios are adjusted for number of phases attended in addition to adjustments given

Appendix

Scores allocated to each measure to create socio-economic position, early life factor, health behaviors and psychosocial factor.

		Score
Socio-economic position		
Employment grade	- High	2
	- Medium	1
	- Low	0
Early Life Factors		
Father's social class	- Non manual	1
	- Manual	0
Age left Education	- > 18 years	2
	- 17 – 18 years	1
	- ≤ 16 years	0
Height	- Tallest third	2
	- Middle third	1
	- Shortest third	0
Health behaviors		
Smoking habit	- Never smokers	2
	- Ex-smokers	1
	- Current smokers	0
Alcohol	- None	0
	- 1–14	1
	- 15+	0
Physical activity	- Vigorous	2
	- Moderate	1
	- None/mild	0
Diet	- Good diet	1
	- Bad diet	0
Psychosocial factors		
Decision latitude	- High	2
	- Medium	1
	- Low	0
Job demands	- Low	2
	- Medium	1
	- High	0
Work support	- High	2
	- Medium	1
	- Low	0