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Clustering of lifestyle risk factors and poor physical function in older adults: The Hertfordshire Cohort Study

Siân M Robinson, PhD, **Karen A Jameson, MSc**, **Holly E Syddall, MSc**, **Elaine M Dennison, PhD**, **Cyrus Cooper, DM**, **Avan Aihie Sayer, PhD**, and **the Hertfordshire Cohort Study Group**
MRC Lifecourse Epidemiology Unit, University of Southampton

Abstract

OBJECTIVES—To examine the relationship between number of lifestyle risk factors (out of: low physical activity, poor diet, obesity and smoking) and physical function in older community-dwelling men and women.

DESIGN—Cross-sectional study, Hertfordshire, UK

PARTICIPANTS—1682 men and 1540 women aged 59-73 years

MEASUREMENTS—Physical activity was assessed by administered questionnaire and a score derived (0-100); low activity was defined as a score ≤50. Diet was assessed by food frequency questionnaire; diet quality was assessed according to a score for a principal component analysis-defined 'healthy' dietary pattern. Poor diet was categorised as a dietary pattern score in the lowest quarter of the distribution. Obesity was defined as BMI ≥30kg/m^2. Physical function was assessed by self-report (SF-36 PF); poor function was defined as a score in lowest quarter of the distribution. A sub-group of participants had objective assessments of physical function (timed up-and-go, timed 3-m walk, chair rises, one-legged standing balance).

RESULTS—There were graded positive increases in prevalence of poor self-reported physical function in both men and women, in parallel with increasing number of risk factors (men: adjusted odds ratio for 3 or 4 risk factors in comparison with none: 3.79 (95% CI 2.31 to 6.21); women: adjusted odds ratio 5.37 (95% CI 2.66 to10.84). With the exception of balance, the objective assessments also showed graded relationships with increasing number of risk factors, such that a greater number of risk factors was associated with poorer physical function.

CONCLUSION—These modifiable lifestyle risk factors are linked to marked differences in risk of poorer physical function in older adults. Efforts to encourage healthy lifestyles have the potential to improve physical function and to promote healthier ageing.

Keywords

older adults; SF-36; physical function; lifestyle; risk factor

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INTRODUCTION

A significant challenge faced by ageing populations is how to enable older adults to remain independent and to maintain their quality of life. Central to independence is physical capability – that is to be able to perform the physical tasks of everyday living[1]. Although

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declining physical capability in later life is expected, in parallel with age-related losses of muscle mass and strength, the rate of decline is not spread evenly across the population, and relatively greater losses are observed in lower socioeconomic groups[2,3]. This inequality in distribution points to the possibility of modifiable behavioural factors, such as diet and lifestyle, that may have a significant influence on the physical function of older adults[4,5]. More importantly, it also suggests that lifestyle interventions to optimise physical capability could be effective at this age.

A number of lifestyle influences have been linked to impaired physical function in older adults, although in comparison with other degenerative conditions of ageing, far less is known about their roles. In cross-sectional and longitudinal analyses, poorer physical function is found in older adults who are physically inactive[6],[7], who have 'unhealthy' dietary patterns[8],[9], who are obese[10,11], and are current smokers[12]. The independent effect of individual risk factors is often considered in multivariate statistical models that, appropriately, take account of possible confounding effects of other variables. However it is known that lifestyle risk factors commonly co-exist[13]. Furthermore they are recognised to be unequally distributed in the population, and differentially associated with income and education[14,15]. To understand their public health impact there is therefore increasing interest in assessing the combined effects of having multiple risk factors on disease outcomes[16], and a number of studies have shown clear graded associations between increasing number of lifestyle risk factors and mortality[16,17,18]. Few studies have used this approach in relation to physical function in older adults, although effects on disability have been described[19,20]. For example, in the Taiwan Longitudinal Study in Aging[20], participants with healthy behaviours (non-smoker, regular exercise, moderate alcohol consumption, and 6-8 hours sleep per day) had a lower risk of developing functional disability, defined as reported difficulty with activities of daily living, during a follow-up period of 14 years. When compared with the reference group who had none of these behaviours, men and women who had all four, had a 75% reduction in risk (hazard ratio 0.25, 95% confidence interval: 0.11, 0.57) of developing functional disability[20]. However, in this study, the effects of obesity and poor diet were not examined.

In the present paper, we consider the relationship between lifestyle risk factors and physical function in a cohort of 3,222 older men and women who took part in the Hertfordshire Cohort Study[21]. Our primary aim was to examine the association between increasing number of risk factors (out of: low physical activity, poor diet, obesity, smoking) and poor physical function, using self-reported data (SF-36) and, in a sub-group, objective measurements of physical function (short battery).

METHODS

The Hertfordshire Cohort Study (HCS)

From 1911 to 1948, midwives kept detailed records, which included birth weight, on all infants born in the county of Hertfordshire, UK. These records have been described previously[21]. In 1998, 7106 men and women born between 1931 and 1939 who were still alive and living in Hertfordshire were traced using the National Health Service central registry. General Practitioners gave permission for us to write to 3126 (82%) men and 2973

(91%) women. 1684 (54%) men and 1541 (52%) women agreed to be interviewed at home. During the interview information was obtained on the participant's social and medical history and the Short Form 36 (SF-36) questionnaire[22] was administered. 1579 of these men (94%) and 1418 of the women (92%) subsequently attended a clinic for further investigations, where height and weight were measured.

The study had ethical approval from the Bedfordshire & Hertfordshire Local Research Ethics Committee and the West Hertfordshire Local Research Ethics Committee. All participants gave written informed consent.

Lifestyle risk factors

Physical activity was assessed from responses to questions about the frequency and duration of gardening, housework, climbing stairs and carrying loads in a typical week[23]. A standardized activity score, ranging 0–100, was calculated, with higher scores indicating a greater level of activity. The questionnaire was designed to characterise levels of customary physical activity among older community-dwelling adults, and has been shown to be repeatable and to have validity in comparison with objective measures[23]. Diet was assessed using a food frequency questionnaire (FFQ) that was administered by a trained research nurse at the home interview. Participants described their average frequency of consumption of 129 foods and food groups[24] over the preceding 3 months. The foods listed in the FFQ were put into 51 food groups on the basis of similarity of type of food and nutrient composition. Principal component analysis of the reported weekly frequencies of consumption of these food groups was used to describe the dietary patterns of the men and women[24]. The most important pattern of diet was characterised by high consumption of fruit, vegetables, wholemeal cereals and oily fish but by low consumption of white bread and chips, sugar and full-fat dairy products. This pattern of diet reflects recommendations for a healthy diet, and was called a 'prudent' dietary pattern, in common with other published studies[24,25]. A prudent diet score was calculated for each participant using the coefficients from the analysis. The coefficient for each of the food groups was multiplied by the reported frequency of consumption of the group, and these values were summed to provide a single score, indicating the participant's compliance with the prudent pattern. A high prudent diet score therefore indicates a diet characterised by high consumption of fruit, vegetables, wholemeal cereals and oily fish; a low score indicates a diet characterised by high consumption of white bread and chips, sugar and full-fat dairy products[24].

Body mass index (BMI) was calculated from height and weight measurements taken at clinic. Participants reported their smoking history at the home interview. Units of alcohol consumed each week were calculated from the reported frequency (7 frequency categories ranging from never to more than once per day) and amount consumed of 5 different types of alcoholic drinks. One unit of alcohol was equivalent to 284 mL beer, 125 mL wine, 50 mL fortified wine, or 25 mL spirits.

Self-reported assessment of physical function (SF-36 PF)

Physical function was assessed according to the participants' responses to ten questions included in the physical functioning scale of the Short Form health survey questionnaire

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(SF-36 PF)[22]. This questionnaire is widely used to describe physical function in older adults[26,27], and has been shown to provide a reliable and valid measure of function when compared with objective assessments[27]. Participants were asked about the extent to which they were limited in their ability to take part in vigorous activities (eg running, strenuous sports), moderate activities (eg pushing a vacuum cleaner, playing golf), lifting or carrying groceries, climbing several flights of stairs, climbing one flight of stairs, bending, kneeling or stooping, walking more than a mile, walking half a mile, walking 100 yards, bathing or dressing oneself. They reported whether they were limited 'a lot', 'a little' or 'not limited'. Each item was scored (limited a lot=0; a little=50; not limited=100); the sum of the scores was divided by 10. Physical function scores (SF-36 PF) could therefore range between 0 and 100. Scores were available for 1682 men and 1540 women.

Objective assessments of physical function (short battery)

At clinic, a sub-group of participants completed a short physical performance battery[6,28]. This included: a timed 3-m walk, a timed up-and-go test (to rise from a seated position, complete a 3-m customary pace walk and return to seated position), timed chair rises (time for 5 chair rises completed as quickly as possible), timed one-legged standing balance test (eyes open, up to a maximum of 30 seconds). 1729 participants who had a physical function score (SF-36 PF) also completed the timed 3-m walk; 1735 completed the timed up-and-go test; 971 completed the timed chair rises; 987 completed the timed balance test.

Data analysis

Normality of variables was assessed and variables were transformed as required. Differences in continuous variables between men and women were tested using t-tests and Wilcoxon rank-sum tests where appropriate; differences in proportions were tested by Pearson's χ^2 test. Univariate and multiple linear and logistic regression analyses were used to investigate associations between adult lifestyle variables and physical function. The number of comorbidities out of bronchitis, diabetes, IHD, hypertension and stroke was assessed, using self-reported and clinic data; IHD was defined according to presence of typical angina (Rose questionnaire), coronary artery bypass or angioplasty, or significant Q waves on the ECG. Poor physical function was defined as an SF-36 PF score in the bottom quarter of distribution for men and women separately. With the exception of balance, objectively assessed physical function measurements were used as continuous variables. One-legged balance data were bimodal and analysed as the proportion of people who lost their balance within the first 5 seconds (i.e. having "poor balance") versus the rest of the group. In order to consider the effects of increasing number of lifestyle risk factors, the data were categorised: low physical activity was defined as an activity score ≤ 50; 'poor' diet was defined as a prudent diet score in the bottom quarter of the distribution; obesity was defined as a BMI > $30 kg/m^2$; smokers were grouped into current smokers and current non-smokers (including ex-smokers). Data were analysed using Stata version 12[30].

RESULTS

The characteristics of the HCS men and women studied are shown in Table 1. There was a modest difference in activity score between men and women, such that women were slightly less active; 544 (35.3%) of women and 509 (30.3%) of men were categorised as being physically inactive (activity score ≤50). As previously described in this cohort[24], women had higher prudent diet scores than the men, indicating that they had 'healthier' diets. A greater proportion of women were categorised as obese (BMI ≥30 kg/m^2) compared with men; men and women also differed in terms of smoking status and alcohol consumption. The pattern of co-morbidities was comparable in the HCS men and women, although IHD and stroke was more common among the men studied.

The proportion of HCS participants who reported significant limitations in the ten assessed components of the SF-36 physical functioning score varied, ranging from 2% for 'bathing & dressing oneself' (men and women) to 28% (men) and 40% (women) for vigorous activities (data not shown). With the exception of 'bathing or dressing yourself', women were more likely to report limitations when compared with the men (P<0.001 for each of the nine other activities) and they had lower overall scores: median (IQR) SF-36 PF scores for men, 90 (80-95) vs. 85 (65-95) for women (P<0.001). Because the scores were skewed in their distribution, sex-specific quartiles were used to divide the groups. Further analyses considered the risk of poor physical function – defined as having an SF-36 PF score in the lowest quarter of the distribution (80 or less for men; 65 or less for women).

Poorer self-reported physical function was associated with increasing age (Table 2). Univariate analyses using lifestyle measures as continuous variables showed that lower physical activity score, lower prudent diet score, and greater BMI were each associated with greater risk of poor function in the men and women studied (all P<0.05 for men and women; data not shown). The odds ratio for poor physical function in relation to categorised low physical activity, poor diet and obesity are shown in Table 2. Smoking was associated with poorer function, although this appeared to be more marked in the large groups of ex-smokers. Compared with participants who did not consume alcohol, poor physical function was less common in moderate and high consumers (Table 2).

To examine their combined effects, our next analyses examined the relationship between increasing number of risk factors and poor self-reported physical function. Four risk factors were considered: low physical activity level (activity score ≤ 50), poor diet (prudent diet score in the bottom quarter of the distribution), obesity (BMI ≥30kg/m^2) and smoking status (current smoker). Because a greater proportion of non-drinkers reported poor physical function, high alcohol consumption was not included as a risk factor. As few participants (n=13) had all four risk factors, the groups with three or four risk factors were combined. Of the four risk factors considered, 515 (32.8%) men and 568 (40.1%) women had none, 633 (40.3%) men and 560 (39.6%) women had one, 320 (20.4%) men and 242 (17.1%) women had two, and 101 (6.4%) men and 45 (3.2%) women had three or four.

The numbers of participants within each of these groups who reported poor physical function are given in Table 3; the proportions of each group that they represented are illustrated in Figure 1. In both men and women, there were clear graded increases in the prevalence of poor physical function as the number of risk factors increased, ranging from 15.7% (men) and 14.4% (women) who had no risk factors, to 44.6% (men) and 57.8% (women) who had 3 or 4. The odds ratio for poor self-reported physical function, according to number of risk factors, is shown in Table 3. For both men and women there were marked increases in risk of poor physical function in parallel with an increase in the number of risk factors. After adjustment for age, this amounted to a 4-fold increase in men (odds ratio 4.43 (95% CI 2.80 to 7.03) who had 3 or 4 risk factors (when compared with men who had none), and to an 8-fold increase in women (odds ratio 7.98 (95% CI 4.22 to 15.09). Further adjustment, for number of co-morbidities, attenuated the size of the effect in women but not in men (Table 3). The final analyses examined whether changing the cut-offs for categorisation of the risk factors affected the associations with poor physical function. In every scenario considered (data not shown), marked graded increases in risk of poor function with increasing number of risk factors were still evident; in many cases, higher odds ratios for participants with 3 or 4 risk factors were observed when compared with the *a priori*-defined groups as presented in the paper.

The subgroup of participants who had objective measurements of physical function had similar self-reported physical function when compared to the rest of the cohort (data not shown). These men and women did not differ in BMI, but tended to slightly older, to have higher prudent diet scores and were more likely to be non-smokers (all $P<0.05$ for men and women) than the rest of the cohort, although the differences were small. The men in the subgroup were also slightly less active ($P=0.007$). The associations between number of lifestyle risk factors and the four objective measures of physical function are shown in Table 4. With the exception of poor balance, graded associations were found between each measure of physical function in both men and women, such that a greater number of risk factors was associated with poorer function. These associations were robust to adjustment for age and number of co-morbidities. Whilst poor balance was more prevalent among the men and women who had a greater number of risk factors, the trends were not statistically significant after adjustment. Although the inverse association between measured physical function and number of risk factors was common to men and women, the effect size tended to be greater in women. The differences in timed measurements between the top (3 or 4 risk factors) and the bottom (none) groups amounted to 8-15% in the men studied, but 13-24% among the women.

DISCUSSION

This study evaluated the associations between increasing number of lifestyle risk factors (low physical activity, poor diet, obesity and smoking) and physical function in a large population of older community-dwelling adults. Poor self-reported physical function and objective measures of function from a short battery were considered. Using both types of outcome there were strong inverse and graded associations between number of risk factors and physical function in the men and women studied. The effect size was large, such that 45% of men and 58% women who had three or four risk factors reported poor physical function. After taking account of age and co-morbidities, this amounted to a fourfold increase in risk of poor self-reported physical function in men who had 3 or 4 lifestyle risk factors (compared with none), and a fivefold difference in women.

To our knowledge, although there is increasing interest in looking at the combined effects of lifestyle risk factors on disease risk and mortality[16,17,18], only one study has considered their combined effects on impairment in physical function in adults of comparable age to our cohort. In the Taiwan Longitudinal Study in Aging (TLSA), four healthy behaviours were examined in a large national sample of men and women aged 60 or older[20]. When the combined effects were evaluated, a dose-response relationship was observed; the greater the number of healthy behaviours at baseline the lower the risk of developing functional disability, such that participants who had all four behaviours were 75% less likely to become disabled in the follow-up period, when compared with those who had none. As the TLSA is longitudinal, its findings provide important support for the cross-sectional associations observed in the present study. However there are some other notable differences between the studies. Firstly, the lifestyle factors considered were different. Because of a growing literature that links obesity and poor diet to impaired physical function[8,9,10,11], they were considered in the present study, whereas they were not included in the TLSA[20], and conversely, our analyses did not consider sleep duration or high alcohol consumption. In common with other investigators[31], we found poorer self-reported physical function was more common among non-drinkers. Secondly the two studies considered different measures of physical function. However, irrespective of differences in the design of the two studies, both suggest that modifiable risk factors, linked to variation in health behaviours in older people, could have important implications for their current and future physical capability, and therefore for future health.

A strength of our study is that data were analysed from a large population of older men and women who had been characterised in detail in adult life. The risk factors considered have established links to impairment in physical function, and there are proposed biological mechanisms that could explain their effects on muscle function and/or loss of muscle mass and strength in older adults[4,5,31,32,33,34]. Whilst membership of the Hertfordshire cohort was defined by area of birth and residence, and there has been loss to follow-up, the participants' characteristics are comparable to those of the wider community[21]. Although *a priori*-defined cut-offs were used to identify groups of participants who were inactive or whose diet was poor, using calculated physical activity and dietary scores, sensitivity analyses showed that changing these cut-offs did not alter the strong association between increasing number of risk factors and poor physical function. Low physical activity and poor diet are widely recognised to be common in older adults in high-income countries[35,36]. It is therefore to be expected that there are currently significant numbers of older community-dwelling men and women in these populations who have these risk factors that are strongly linked to poorer physical function.

Poor physical function was assessed in the whole cohort using the Short Form (SF-36 PF) questionnaire. This is a widely used tool in epidemiological studies and has been shown to have good validity in its assessment of physical function[27]. The proportion of HCS participants who reported significant limitations in the ten assessed activities was comparable to a recent study of older Finnish adults[37]. Although a self-reported assessment of physical function may be less accurate than objective measurements, the derived physical function score has been shown to be a valid marker of mobility-disability, when compared with objective measurements[27]. It is a strength of this study that in addition to self-reported data, physical function was also assessed objectively in a large sub-group of the cohort. The findings, using these objective measurements, were consistent with the self-reported data -

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with graded decreases in three of the measures observed with increasing number of risk factors. However, a significant limitation of the current study is that the comparisons are cross-sectional and the temporal relationships between adult lifestyle characteristics and poor physical function cannot be addressed. In ongoing follow-up of the cohort we will be able to examine their longitudinal associations and gain insight into the direction of causal effects.

Conclusion

In a community-dwelling population of older men and women, we found that low physical activity, poor diet, obesity and smoking were common. Their striking associations with poor physical function suggest that they make a significant contribution to impaired physical function of older adults - and in turn, may underlie some of the observed inequalities in physical capability in older people[2,3]. The importance of lifestyle has recently been underscored by the finding that even after the age of 75, lifestyle behaviours are associated with survival[38]. Although there may be limited research available on effective strategies to foster health behaviours in older adults at present [39], the growing evidence of the sizeable health effects that are linked to healthy lifestyles in this age group[16,17,18,38] suggests that real benefits could come from targeted health promotion strategies.

Footnotes

Corresponding author: Dr Sian Robinson, MRC Lifecourse Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton, SO16 6YD, UK. Telephone +44 (0)23 8077 7624. Fax +44 (0)23 8070 4021 smr@mrc.soton.ac.uk

Alternate corresponding author: aas@mrc.soton.ac.uk

Author contributions: SM Robinson: conceived the idea for the analyses, wrote the first draft of the paper;, KA Jameson: analysed the data; HE Syddall, EM Dennison, C Cooper, A Aihie Sayer: Hertfordshire Cohort Study design and supervision. All authors contributed to the interpretation of the data and approved the final version of the manuscript.

Conflict of interest: No author declared a conflict of interest

Elements of financial/personal conflicts	**Sian Robinson**		**Karen Jameson**		**Holly Syddall**		**Elaine Dennison**		**Cyrus Cooper**		**Avan Aihie Sayer**	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employment or affililation		X		X		X		X		X		X
Grants/funds		X		X		X		X		X		X
Honoraria		X		X		X		X		X		X
Speaker forum		X		X		X		X		X		X
Consultant		X		X		X		X		X		X
Stocks		X		X		X		X		X		X
Royalties		X		X		X		X		X		X
Expert testimony		X		X		X		X		X		X
Board member		X		X		X		X		X		X

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Elements of financial/personal conflicts	Sian Robinson		Karen Jameson		Holly Syddall		Elaine Dennison		Cyrus Cooper		Avan Aihie Sayer	
Patents		X		X		X		X		X		X
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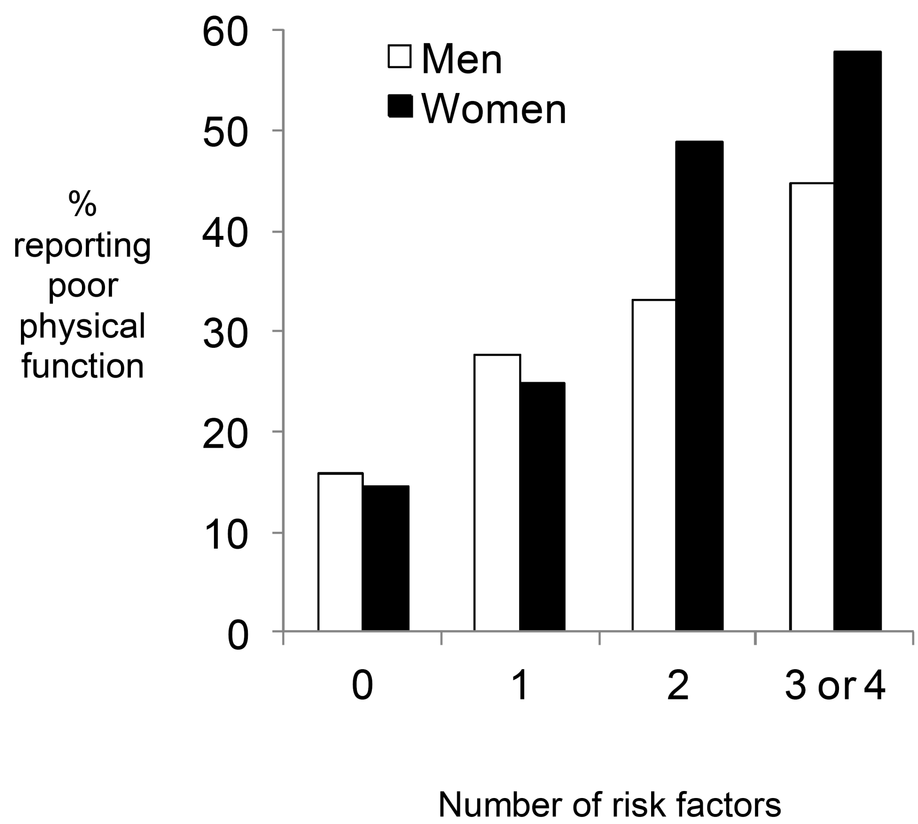

Figure 1. Proportion of men and women who reported poor physical function according to number of lifestyle risk factors, Hertfordshire Cohort Study.

Poor physical function defined by SF-36 physical functioning score in bottom quarter of distribution (men ≤ 80; women ≤ 65). Lifestyle risk factors: low physical activity (activity score ≤50), poor diet (prudent diet score in bottom quarter of distribution), obesity (BMI ≥30kg/m^2), current smoker.

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Table 1

Characteristics of the Participants, Hertfordshire Cohort Study

	Men			Women			
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	***P*-value**[a]
Age, years	1682	65.6	2.9	1540	66.6	2.7	<0.001
Activity score[b]	1682	60.4	15.8	1540	58.2	16.6	<0.001
Prudent diet score (SD)[c]	1676	−0.61	2.07	1539	0.66	1.74	<0.001
	n	**%**		**n**	**%**		
Body mass index (kg/m^2)[d]							
−25	454	28.9		456	32.2		<0.001
−30	801	51.0		565	39.9		
≥30	315	20.1		395	27.9		
Alcohol consumption[e]							
non-drinker	108	6.4		335	21.8		<0.001
≤recommended	1211	72.0		1129	73.4		
>recommended	362	21.5		75	4.9		
Smoker status							
Never	546	32.5		923	60.0		<0.001
Ex-smoker	872	51.8		449	29.2		
Current	264	15.7		166	10.8		
Co-morbidities							
Bronchitis	106	6.3		75	4.9		0.078
Diabetes	244	15.5		207	14.8		0.587
IHD	240	15.4		142	10.2		<0.001
Hypertension	630	40.0		577	40.8		0.654
Stroke	91	5.5		46	3.0		0.001

[a] *P*-value for the difference between men and women.

[b] Activity score, assessed from responses to questions about the frequency of activities. Range 0–100; higher scores indicate a greater level of activity.

[c] Score (SD units) calculated for a ‘prudent’ dietary pattern, identified by principal component analysis (characterised by high consumption of fruit, vegetables, wholemeal cereals and oily fish, and low consumption of white bread and chips, sugar and full-fat dairy products).

[d] Weight (kg)/height (m)^2.

[e] Recommended weekly alcohol consumption: up to 21 units (men), up to 14 units (women).

Table 2

Age and Lifestyle Characteristics, and Poor Self-Reported Physical Function, Hertfordshire Cohort Study[a]

	Men (n=1682)				Women (n=1540)			
	n	Odds Ratio	95% CI	*P*-value	n	Odds Ratio	95% CI	*P*-value
Age (yrs)	1682	1.07	(1.03, 1.11)	<0.001	1540	1.05	(1.01, 1.09)	0.027
Physical activity								
Reference	1173	1	(1.00, 1.00)		996	1	(1.00, 1.00)	
Low activity[b]	509	2.62	(2.09, 3.28)	<0.001	544	3.53	(2.79, 4.46)	<0.001
Diet quality								
Reference	1058	1	(1.00, 1.00)		1353	1	(1.00, 1.00)	
Poor diet[c]	618	1.27	(1.02, 1.58)	0.033	186	1.55	(1.12, 2.15)	0.008
Weight status								
Reference	1255	1	(1.00, 1.00)		1021	1	(1.00, 1.00)	
Obesity[d]	315	2.11	(1.63, 2.75)	<0.001	395	2.90	(2.25, 3.73)	<0.001
Alcohol consumption								
Non-drinker	108	1	(1.00, 1.00)	.	335	1	(1.00, 1.00)	.
≤ recommended[e]	1211	0.44	(0.30, 0.66)	<0.001	1129	0.64	(0.49, 0.83)	0.001
≥ recommended[e]	362	0.48	(0.31, 0.74)	0.001	75	0.47	(0.25, 0.86)	0.014
Smoker status								
Never	546	1	(1.00, 1.00)	.	923	1	(1.00, 1.00)	.
Ex	872	1.60	(1.25, 2.05)	<0.001	449	1.75	(1.37, 2.24)	<0.001
Current	264	1.50	(1.08, 2.10)	0.016	166	1.25	(0.86, 1.81)	0.245

[a]Poor physical function defined by SF-36 physical functioning score in bottom quarter of distribution (men ≤ 80; women ≤ 65);

[b]activity score, assessed from frequency of activities - low activity defined as score ≤50;

[c]diet quality defined according to score for a ‘prudent’ dietary pattern - poor diet defined as score in bottom quarter of the distribution,

[d]BMI≥30kg/m^2;

[e]recommended weekly alcohol consumption: up to 21 units (men), up to 14 units (women).

Table 3

Number of Lifestyle Risk Factors and Poor Self-Reported Physical Function, Hertfordshire Cohort Study[a]

Number of risk factors[b]	Men				Women			
	n with poor physical function	Odds Ratio	95% confidence interval	*P*-value[c]	n with poor physical function	Odds Ratio	95% confidence interval	*P*-value[c]
0	80	1	(1.00, 1.00)	.	81	1	(1.00, 1.00)	.
1	164	2.03	(1.49, 2.76)	<0.001	130	1.72	(1.26, 2.36)	0.001
2	102	2.67	(1.88, 3.79)	<0.001	111	5.01	(3.50, 7.17)	<0.001
3 or 4	39	3.79	(2.31, 6.21)	<0.001	21	5.37	(2.66, 10.84)	<0.001

[a]Poor physical function defined by SF-36 physical functioning score in bottom quarter of distribution (men ≤80; women ≤ 65).

[b]Lifestyle risk factors, out of: low physical activity (activity score ≤50), poor diet (prudent diet score in bottom quarter of distribution),obesity (body mass index≥30kg/m^2), current smoker.

[c]Adjusted for age at assessment and number of co-morbidities

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Table 4

Number of Lifestyle Risk Factors and Objective Measures of Physical Function, Hertfordshire Cohort Study

Number of risk factors[a]	Men					Women				
	n	Mean (SD)	Regression coefficient	95% CI	*P*-value[b]	n	Mean (SD)	Regression coefficient	95% CI	*P*-value[b]
3-m walk (s)										
0 (reference)	263	3.13 (0.45)	0	(0.00, 0.00)	.	381	3.21 (0.55)	0	(0.00, 0.00)	.
1	267	3.23 (0.46)	0.09	(0.02, 0.17)	0.018	382	3.34 (0.56)	0.09	(0.01, 0.18)	0.025
2	138	3.32 (0.55)	0.18	(0.08, 0.27)	<0.001	159	3.55 (0.71)	0.31	(0.20, 0.42)	<0.001
3 or 4	38	3.45 (0.49)	0.30	(0.14, 0.46)	<0.001	24	3.64 (0.85)	0.42	(0.18, 0.66)	0.001
6m walk timed-up-and-go (s)										
0 (reference)	264	10.29 (1.53)	0	(0.00, 0.00)	.	381	10.30 (1.66)	0	(0.00, 0.00)	.
1	268	10.64 (1.77)	0.34	(0.05, 0.63)	0.024	384	10.91 (1.98)	0.52	(0.24, 0.81)	<0.001
2	138	11.07 (2.18)	0.76	(0.40, 1.11)	<0.001	159	11.78 (2.62)	1.38	(1.00, 1.75)	<0.001
3 or more	38	11.21 (1.45)	0.87	(0.29, 1.46)	0.004	25	12.17 (2.91)	1.75	(0.93, 2.56)	<0.001
Chair rises (s) [c]										
0 (reference)	127	14.44 (1.21)	1	(1.00, 1.00)	.	250	16.83 (1.29)	1	(1.00, 1.00)	.
1	123	15.57 (1.23)	1.07	(1.02, 1.12)	0.010	239	17.82 (1.25)	1.05	(1.01, 1.10)	0.022
2	59	15.71 (1.21)	1.09	(1.03, 1.17)	0.005	100	19.71 (1.34)	1.17	(1.10, 1.24)	<0.001
3 or more	14	16.53 (1.26)	1.15	(1.03, 1.29)	0.013	14	20.87 (1.30)	1.24	(1.08, 1.43)	0.002
Poor balance [N(%)]										
0 (reference)	127	18 (14.2%)	1	(1.00, 1.00)	.	258	35 (13.6%)	1	(1.00, 1.00)	.
1	124	22 (17.7%)	1.22	(0.61, 2.46)	0.575	246	42 (17.1%)	1.20	(0.73, 1.97)	0.463
2	60	13 (21.7%)	1.58	(0.70, 3.59)	0.275	102	32 (31.4%)	2.72	(1.55, 4.78)	<0.001
3 or more	14	3 (21.4%)	1.69	(0.41, 7.00)	0.470	14	5 (35.7%)	2.98	(0.89, 9.92)	0.075

[a] Lifestyle risk factors, out of: low physical activity (activity score ≤50), poor diet (prudent diet score in bottom quarter of distribution), obesity (body mass index ≥30kg/m^2), current smoker;

[b] adjusted for age and number of comorbidities;

[c] regression coefficients represent a multiplicative change in outcome.