



Social connectedness and predictors of successful ageing

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ABSTRACT

Objectives: As populations age it is important to minimize the time people live in a less than successful state of ageing. Our aim was to identify predictors of successful ageing.

Study design: At baseline (1990–1994), demographic, anthropometric, health, social connectedness and behavioural data were collected for 41,514 men and women participating in the Melbourne Collaborative Cohort Study. Only those born in Australia, New Zealand and UK were included in this analysis. At follow-up in 2003–2007 data on health conditions, physical disability and psychological stress were collected and used to define successful ageing. A total of 5512 eligible participants with full data who were aged 70 and over, were included in this longitudinal analysis.

Outcome measures: Successful ageing at follow-up was defined as aged 70 years or over and absence of diabetes, heart attack, coronary artery bypass graft surgery, angioplasty, stroke, cancer; impairment, perceived major difficulty with physical functioning; and low risk of psychological distress.

Results: A body mass index in the healthy range, low waist/hip ratio, not smoking, being physically active, and not having arthritis, asthma, hypertension, or gallstones were associated prospectively with successful ageing. There was no evidence for an association of social connectedness with successful ageing.

Conclusions: A healthy lifestyle and maintenance of healthy weight, but not social connectedness, may improve the chances of ageing successfully by our definition. Social connectedness may be related to a perception of ageing well, but it does not appear to help avoid the usual conditions associated with ageing.

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1. Introduction

Older age is frequently considered to be a period of impending disability and death. However, older people themselves usually focus more on the positive aspects of their lives and how they can maintain these [1]. While considerable attention has been paid to predictors of death and disability, there has been less interest in the area of positive or successful ageing. In their seminal work Rowe and Kahn [2] made the distinction between people who undergo 'usual' ageing and those who undergo 'successful' ageing. They later defined successful ageing as the absence of disease, the maintenance of function and active engagement with life [3].

Along with physical disability and illness, other characteristics of 'successful' ageing include good mental health and cognitive

function, and in some instances measures of social and active engagement or social connectedness – relating to the number of friends and frequency of interactions with family and friends and activities of societal value [3,4]. These measures of social activity are often considered as predictors of, rather than components of, successful ageing, and have been associated with better health and successful ageing [5]. Psychosocial factors potentially have multiple benefits, e.g. increased access to health care, more likelihood of adopting preventive health measures, increased health promoting activities and even direct physiological effects on neural, hormonal and immunological processes [3].

Identifying modifiable risk factors for successful ageing for people who survive into old age is an important step in developing strategies to minimize the time people live in a less than successful state of ageing. Two recent reports from the Nurse's Health Study defined 'healthy' survival as surviving to age 70 years or older, freedom from chronic diseases, no major impairment of cognitive or physical function, and good mental health [6,7]. Physical activity and avoidance of mid-life adiposity were found to be associated with 'healthy' survival. However, the role of social connectedness,

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whether as a predictor of successful ageing, or as part of the definition of successful ageing, was not examined.

Our aim was to identify predictors of successful ageing using the Australian, New Zealand and UK born participants in the Melbourne Collaborative Cohort Study, considering a wide range of possible predictors and with a specific focus on measures of social connectedness.

2. Methods

2.1. Participants

The Melbourne Collaborative Cohort Study is a prospective cohort study comprising 17,045 men and 24,469 women, aged between 27 and 75 years at baseline (99.3% were aged 40–69 years). Study participants were recruited from the Melbourne metropolitan area between 1990 and 1994 via the Electoral Roll, advertisements, and community announcements in local media. Southern European migrants were deliberately over-sampled to extend the range of lifestyle exposures, but have not been included in this analysis due to poor response at follow-up, especially in our older target group.

Participants who reported ever having had any of the following conditions at baseline were excluded: angina, diabetes, cancer,

heart attack or stroke, as were people with elevated plasma glucose (≥ 7.0 mmol/L fasting or ≥ 11.1 mmol/L non-fasting) leaving eligible ($n = 26,044$) (Fig. 1). Of these participants 19,563 (75%) attended the follow-up between 2003 and 2007. This analysis focussed on people aged 70 years and over at follow-up ($n = 6208$) and after further exclusion for other missing data, 5512 people with a median follow-up of 11.7 years were included. Of 8134 eligible people who would have been 70 years or older at the first day of the follow-up, 692 (8.5%) had died by this date. All participants provided written consent for their participation in the study. The Cancer Council Victoria's Human Research Ethics Committee approved the study protocol which was conducted in accord with the Helsinki declaration. Further details of the study have been published elsewhere [8].

2.2. Baseline variables

At baseline and follow-up, participants completed comprehensive questionnaires covering physical activity, health, smoking status, current alcohol consumption, education and social connectedness. Anthropometric measurements were made using standard protocols.

Baseline data for the following variables were included in these analyses. Physical activity (none-low vs. moderate-high); body mass index (BMI in categories), waist to hip ratio (in categories) alcohol intake (g/day in categories); education (primary school, secondary, tertiary); Socio Economic Indexes for Areas Index of Relative Socioeconomic Disadvantage [9] based on census collection district (divided into quintiles with the lowest representing the greatest disadvantage), smoking status (never, past, current); and previous history of arthritis, hypertension, asthma, kidney stones or gallstones. Further details of category cut-points are shown in Table 1. Information on social connectedness was collected with questions on marital status (married/defacto or single/divorced/separated/widowed), the number of people in the household (1, 2, 3–4, 5+), the number of relatives visited each month, the number of friends that could be visited without an invitation (0, 1–2, 3–4, 5–9, 10+), and the number of hours of social activity per week (0, 1–2, 3–4, 5–9, 10+).

2.3. Definition of successful ageing at follow-up

Only those subjects who had survived to age 70 years were considered in our definition of successful ageing. We used similar methodology to that described by Sun et al. [7]. Any subject who at follow-up, reported diabetes, heart attack, coronary artery bypass graft surgery, angioplasty, or stroke, or had a cancer (excluding non-melanoma skin cancer) listed in the Victorian Cancer Registry since baseline was not considered to have aged successfully.

We also defined people who had impairment, or perceived major difficulty with physical functioning as not fulfilling criteria for ageing successfully. We did this in two ways – those subjects who answered the SF-12 [10,11] questions as having any limitation in moderate activities (such as moving a table, pushing a vacuum cleaner, bowling, or playing golf), or having a lot of limitation in climbing several flights of stairs were not considered to have aged successfully. We classified as usual ageing those subjects who reported some or more difficulty in personal activities of daily living [12], which included bathing, dressing, eating, standing up and toileting. We also labelled as usual ageing those subjects who reported some or more difficulty in using a telephone or who had a lot of difficulty or could not perform the following instrumental activities of daily living: shopping, walking 200 m, getting out by car or public transport by themselves, going up stairs or doing heavy work round the house such as shovelling dirt or washing walls.

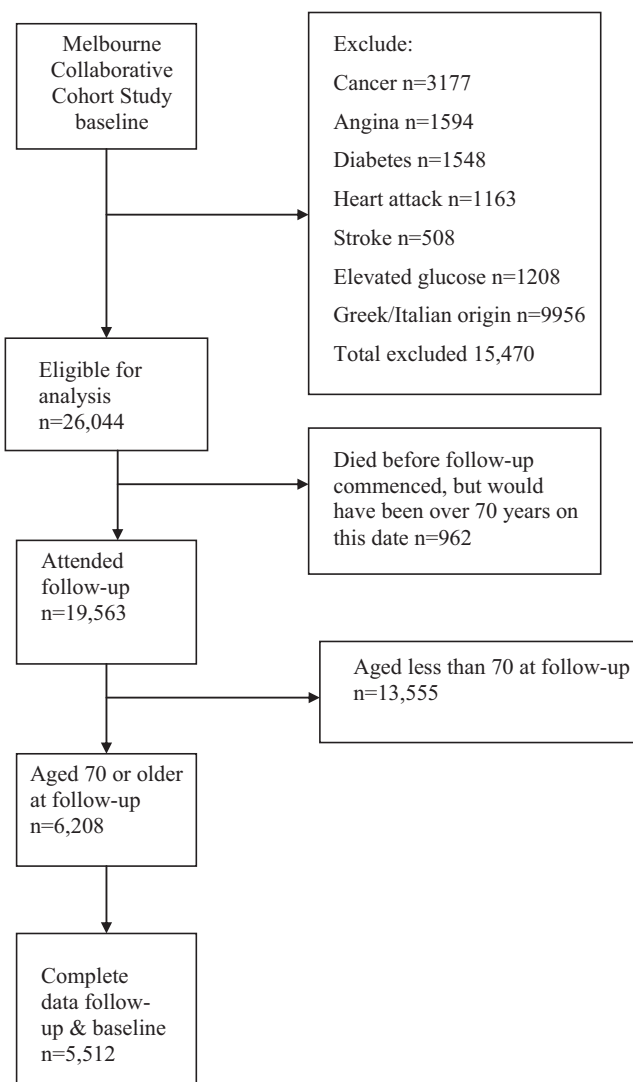


Fig. 1. Participant numbers and exclusions.

Table 1
Baseline characteristics by ageing status at follow-up.

Variable	Ageing successfully, <i>n</i> = 1185	Usual ageing, <i>n</i> = 4327	Died, <i>n</i> = 692	<i>p</i>
Age at baseline (years), mean ± SD	63.4 ± 3.2	64.1 ± 3.2	65.7 ± 2.8	<0.001
Period of follow-up (years), mean ± SD	11.5 ± 1.2	11.7 ± 1.3	6.4 ± 2.8 ^a	<0.001
Proportion female (%)	60.8	63.9	43.8	<0.001
Education level (%)				<0.001
Primary	4.8	6.2	11.4	
Secondary	67.6	71.7	70.2	
Tertiary	22.1	27.6	18.3	
Top quintile of socio economic indexes for areas index	35.6	27.5	21.7	<0.001
BMI (kg/m ²)				<0.001
<18.5	0.6	0.7	0.9	
18.5–25	48.9	36.1	37.3	
25–30	42.9	45.1	43.8	
30+	7.7	18.1	17.8	
Waist to hip ratio (men/women)				<0.001
<0.90/0.80	59.9	49.3	38.7	
0.90–1.00/0.80–0.85	31.6	36.3	42.8	
>1.0/0.85	8.5	14.4	18.2	
Physically active (%)	42.2	33.4	27.6	<0.001
Current smoker (%)	3.5	6.4	17.0	<0.001
Self-reported conditions				
Asthma (%)	8.9	11.9	14.4	<0.001
Hypertension (%)	21.7	30.7	32.8	<0.001
Arthritis (%)	28.5	46.7	43.2	<0.001
Kidney stones (%)	4.8	5.7	5.9	0.466
Gallstones (%)	6.4	11.0	7.2	<0.001
Social connectedness				
Live alone (%)	19.3	21.8	27.0	0.004
No reported social activity (%)	11.0	11.5	21.2	<0.001
Number of relatives visited at least once/month				0.002
None	7.0	5.8	8.7	
1–2	17.6	18.6	23.4	
3–4	20.2	19.4	19.6	
5–9	27.7	27.8	24.6	
10+	27.4	28.4	23.7	
Number of friends visited without invite				0.012
None	6.8	5.9	8.5	
1–2	11.6	13.4	16.3	
3–4	22.9	21.8	21.8	
5–9	27.5	29.0	27.0	
10+	31.0	29.3	26.3	
Marital status				<0.001
Married/de facto	71.2	68.4	60.5	
Divorced/single/separated/widowed	26.8	29.0	35.1	
Status not given				
Alcohol intake				<0.001
None	31.5	33.8	35.3	
1–20 g/day (%)	47.0	46.1	38.6	
21–40 g/day (%)	14.3	12.8	14.7	
41–60 g/day (%)	5.6	4.8	4.3	
60+ g/day	5.8	2.5	2.5	

^a Time from baseline to death.

In addition, participants completed the K10 (Kessler psychological distress scale). The K10 has 10 questions regarding symptoms experienced over the last 30 days, each item has 5 possible responses from 'All the time' to 'Never', scored from 5 to 1, so the total score has a minimum of 10 and maximum of 50, with 50 implying severe psychological distress [13]. The K10 has been demonstrated to have two second order factors relating to depression and anxiety [14]. We used the cut-point of 19/20 for significant psychological distress which has been demonstrated to have excellent detection rates for DSM IV diagnoses of anxiety and depressive disorders in community samples in Australia [15]. Anybody who scored 20 or more on the K10 was deemed to have not aged successfully.

2.4. Statistical analysis

The initial comparison included those people who would have been 70 by the start of follow-up, but who had died by then, along

with those who were 70 or older when they completed follow-up, divided into 'usual' and 'successful' ageing. These were compared by analysis of variance for means of normally distributed variables and chi squared tests for categorical variables. Multivariate logistic regression excluding people who had died before follow-up (usual ageing = 0, successful ageing = 1) was used to assess independent associations between baseline variables and successful ageing. Thus an odds ratio less than 1 indicates that the variable was associated with reduced odds of successful ageing, while an odds ratio greater than 1 indicates that the variable was associated with increased odds. All analyses were performed with Stata 11 (StataCorp, College Station, TX, USA).

3. Results

Table 1 shows baseline characteristics of people classified as ageing successfully or usually at follow-up or who had died before follow-up but would have reached age 70 by the start of

Table 2
Prevalence of characteristics that define 'usual' rather than 'successful' ageing.

Component of ageing status	Prevalence		
	Men, n = 2024	Women, n = 3488	Overall
Heart attack	9.2	4.1	6.0
Coronary bypass	7.8	1.8	4.0
Angioplasty	10.0	3.4	5.8
Stroke	6.3	4.1	4.9
Angina	7.5	4.7	5.7
Diabetes	7.5	6.0	6.5
Cancer	20.6	11.8	15.0
Distress (K10>20)	4.9	8.3	7.0
Health limits mod act SF-12	45.2	58.3	53.5
Health limits stairs SF-12	15.3	25.7	21.9
Any difficulty bathing	5.5	5.9	5.7
Any difficulty dressing	10.4	7.9	8.8
Any difficulty eating	3.1	4.4	3.9
Any difficulty standing up	21.1	29.0	26.1
Any difficulty with toilet	5.4	5.2	5.3
Any difficulty with phone	8.1	4.0	5.5
Lot of difficulty or can't do shopping	1.8	4.1	3.3
Lot of difficulty or can't do walking 200–300 m	5.6	8.5	7.4
Lot of difficulty or can't do transport	2.2	5.4	4.2
Lot of difficulty or can't do climbing 2–3 steps	2.5	5.6	4.5
Lot of difficulty or can't do heavy housework	13.6	32.6	25.6
Ageing successfully	22.9	20.7	21.5

follow-up. People who died before follow-up generally had worse values for risk factors than those who had survived; a lower proportion of women had died compared with men. People who were still alive but not ageing successfully tended to have risk factor levels between the successfully ageing and the deceased. There was little evidence of association between measures of social connectedness at baseline and subsequent successful ageing in survivors, but people who had died tended to be less socially connected at baseline.

Table 2 shows the prevalence of each of the items that classified a person as usual ageing. Limitations in moderate activities from the SF-12 occurred for 53% of the participants, difficulty in standing up from a chair for 26% and difficulty in doing heavy housework for 26%. Overall 21% of people were classified as ageing successfully. The things that prevented men and women from ageing successfully were different, with men suffering more from health conditions and women more from reduced physical function and psychological distress. However, overall proportions of men and women ageing successfully were similar.

Multivariate analysis presented in Table 3 confirms the importance of low waist to hip ratio, healthy BMI, not smoking, being physically active, being in the top socio economic indexes for areas quintile, and not having arthritis, asthma, hypertension or gallstones as predictors of successful ageing. Having survived to age 70 or more, there was no difference in the chance of ageing successfully between men and women. In comparison with non-drinkers, those who drank alcohol were more likely to age successfully, but for no level of intake did this reach significance.

There was little evidence that any measures of social engagement at baseline predicted successful ageing. Marital status was not associated with successful ageing. Sex-specific models showed that associations were similar for men and women and for the combined cohort.

4. Discussion

This study has found that not smoking, maintaining a healthy weight into middle-age and being physically active are all strong predictors of successful ageing for people who survive beyond 70

Table 3
Multivariate odds ratios for baseline characteristics as predictors of successful ageing (n = 5512, excludes people who died before follow-up finished).

	Odds ratio ^a	95% Confidence interval
Baseline age (years)	0.93	0.91–0.95
Waist to hip ratio category ^b		
Low	1.00	
Medium	0.83	0.71–0.98
High	0.74	0.58–0.94
BMI category		
<18.5	0.77	0.32–1.81
18.5–25	1.00	
25–30	0.81	0.70–0.94
30+	0.44	0.34–0.57
Follow-up (years)	0.97	0.91–1.02
Smoking status		
Never	1.00	
Former	0.72	0.61–0.84
Current	0.45	0.32–0.65
Alcohol intake (g/day)		
None	1.00	
1–20	1.06	0.90–1.24
21–40	1.16	0.93–1.46
41–60	1.02	0.72–1.45
60+	1.25	0.79–1.97
Female vs. male	0.94	0.79–1.10
Education		
Primary	1.00	
Secondary	0.94	0.69–1.28
Tertiary	0.99	0.71–1.39
Socio economic indexes for areas quintile		
1	1.00	
2	0.99	0.76–1.30
3	1.12	0.86–1.46
4	1.19	0.92–1.53
5	1.37	1.07–1.76
Hi vs. lo physical activity	1.36	1.18–1.56
Asthma vs. no asthma	0.74	0.59–0.94
Hypertension vs. no hypertension	0.76	0.64–0.89
Arthritis vs. no arthritis	0.51	0.44–0.59
Kidney stones vs. no kidney stones	0.84	0.62–1.15
Gallstones vs. no gallstones	0.69	0.53–0.89
Number in household		
1	1.00	
2	1.15	0.89–1.49
3–4	1.16	0.87–1.55
5+	0.88	0.53–1.45
Number of relatives visited at least once/month		
None	1.00	
1–2	0.83	0.61–1.12
3–4	0.92	0.68–1.25
5–9	0.90	0.67–1.21
10+	0.90	0.66–1.21
Number of friends visited without invite		
None	1.00	
1–2	0.74	0.54–1.03
3–4	0.92	0.68–1.24
5–9	0.79	0.58–1.06
10+	0.87	0.64–1.17
Number of hours of social activity per week		
None	1.00	
1–2	1.03	0.78–1.37
3–4	1.04	0.80–1.35
5–9	0.91	0.71–1.17
10+	0.94	0.73–1.19
Marital status		
Single	1.00	
Married/defacto	0.94	0.74–1.19
Risk classification	Men	Women
High risk	>1.0	>.85
Moderately high risk	0.90–1.0	0.80–0.85
Lower risk	<0.90	<0.80

Source: American Council on Exercise Personal Trainer Manual, third edition. <http://www.foodfit.com/iaff/articles/body.composition.asp> [30/03/2010].

^a Odds ratio greater than one indicates that the variable is associated with increased odds of ageing successfully.

^b Disease risk based on waist to hip ratio.

years of age. The absence of even relatively minor health conditions such as asthma, arthritis, hypertension, and gallstones at baseline was also associated with increased odds of ageing successfully. Interestingly, measures of social connectedness at baseline were not associated with successful ageing at follow-up.

This study was large, included participants from diverse backgrounds and had a prolonged follow-up of 12 years. We defined lack of success in mental health by a validated measure of psychological distress [15] rather than an arbitrary proportion of subjects [16].

Lack of assessment of cognitive function at follow-up is a weakness of the study. While it is unlikely that people with even modest cognitive impairment participated at follow-up because of the demanding nature of the questionnaires, subtle impairments could have been missed. It is also unlikely that people were misclassified as ageing successfully due to the absence of this assessment, as even relatively subtle cognitive impairment would likely have affected their ability to use the phone, do shopping or use transport.

Previous studies have reported diverse results for effects of social connectedness. As there is no clear definition of this it is not surprising that there have been many methods of measurement. Social connectedness has been found to predict successful ageing in some studies. For example, one study found that having 5 or more close personal contacts increased the chance of successful ageing, largely defined by a lack of disability, over 6 years [17]. Another study found that diverse social activities had positive effects on happiness, function, and mortality [18]. Yet another found that greater social networks decreased the risk of functional decline [19]. In a study of 205 community dwelling adults aged 60 years and over, time spent reading, listening to the radio and visiting with family were associated with a greater probability of ageing successfully; interestingly in this study many people with chronic illnesses and disability still rated themselves as ageing successfully [20]. In another cross-sectional study, highly functioning older people were more likely to engage in volunteer activities [21]. In a recent analysis from the Women's Health Initiative, social function and social interaction did not group with other variables considered as indicators of positive ageing in factor analysis. The two factors identified: Physical and social functioning, and emotional functioning, predicted reduced risk of mortality, dependence and major health conditions [5].

As noted by Montross et al. [20] and Strawbridge et al. [22], self-perceived healthy ageing does not agree well with a more objective Rowe and Kahn definition and it may be that social activity contributes in some way to self-perceived healthy ageing, while not helping to prevent disease conditions that preclude being classified as ageing well in our definition. A recently reported study by Doyle et al., using two large British cohorts, found that social engagement at baseline was associated with continuing engagement at follow-up, but not with other outcomes including self-reported health, level of activity relative to peers, living a healthy life and quality of life [23]. This suggests that social activity is not consistently associated with all aspects of ageing.

Previous studies and our own may have been sensitive to two major biases. Firstly reverse causality may influence results, particularly in cross-sectional and cohort studies of short duration. In these studies, the lack of major physical and mental disability allows individuals greater opportunity to participate in wide ranging social activities. The other form of bias operates in the reverse direction. Individuals who become disabled may require more physical and psychological support from families and friends, promoting engagement with those individuals. Our study and others with prolonged follow-up are less likely to be prone to these biases.

Our observation that obesity, either assessed as waist to hip ratio or BMI, was associated with reduced odds of healthy ageing is

consistent with the Nurses' Health Study, where women with a BMI of 30 kg/m² or more at baseline (mean age 50 years) had an odds ratio for successful ageing of 0.21 (95% CI 0.15–0.29) compared with women having a baseline BMI between 18.5 and 22.9 kg/m² [7]. This is in contrast to several studies showing that BMIs in the range 25–30 kg/m² are associated with lower mortality in older people [24–26]. This may reflect real differences between risk factors for survival vs. a comprehensive healthy ageing outcome, or possibly differences between studies in age when BMI was measured and length of follow-up. In an Australian mortality study [25] showing no increase in mortality for people with a BMI in the overweight range relative to normal weight, participants aged 70–75 years at baseline were followed up for an average of 10 years. A meta-analysis of people aged 65 years and older at baseline found that mortality was weakly associated with overweight and obesity, and only in studies with a follow-up period longer than 10 years [26]. In our analysis, baseline age was 63 years, with an average follow-up of 12 years. In the Nurses' Health Study participants were aged 50 years when BMI was measured at baseline and were followed up for an average of 24 years [7].

The association we observed between being more physically active and a greater odds of successful ageing is consistent with the observations from the Nurses' Health Study [6] using a composite healthy ageing outcome. Physical activity may help control BMI and reduce the risk of many of the conditions that characterize usual ageing [27]; baseline physical activity may also reflect better health at baseline that is not captured by the available measures.

The association between smoking and not ageing successfully is consistent with many studies [4]. The odds of ageing successfully for former smokers were not reduced to the extent of those still smoking, but were lower than those who never smoked.

The relatively minor health conditions such as asthma, hypertension, arthritis and gallstones at baseline were not considered severe enough to warrant exclusion, but were all associated with usual ageing at follow-up. We have previously demonstrated that asthma, arthritis and gallstones at baseline were associated with a higher K10 score indicative of possible psychological distress. Whether this is due to the worry, discomfort and inconvenience associated with these conditions, or to their association with other conditions is not known.

All levels of alcohol intake had ORs greater than 1, indicating a trend towards increased odds of successful ageing, although the association was not statistically significant. McCaul et al. [28] have shown that for men over the age of 70 years, alcohol intakes up to 4 drinks per day for a maximum of 6 days per week were associated with reduced mortality, and for women alcohol intakes up to two standard drinks per day were also associated with decreased mortality. At levels of 9 or more drinks per day mortality risk was increased for men.

Despite different factors being important in men and women defined as usual rather than successful ageing, the overall proportions of men and women ageing successfully were similar, as were the risk factors identified for successful ageing. A recent analysis of data collected in 2004–2005 from 11 European countries, England and the USA, found that similar to our observations, women were more likely to have non-lethal, disabling conditions such as functional limitations, arthritis or depression than men, while men were more likely to have heart disease [29].

No association was observed between social connectedness at baseline and successful ageing 12 years later. In contrast, avoiding overweight and obesity, not smoking, and remaining physically active were all associated with a better chance of avoiding usual ageing. The absence of an association between social connectedness and successful ageing might relate to the strict definition we chose for successful ageing.

Contributors

Allison Hodge, Dallas English, Graham Giles and Leon Flicker have all participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

Competing interests

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

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