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DIETARY PATTERNS AS PREDICTORS OF SUCCESSFUL AGEING

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Abstract: *Objectives:* To examine associations between dietary patterns identified by factor analysis, and successful ageing. *Design:* Prospective cohort study with diet measured in 1990-4, and successful ageing in 2003-7. Ordered logistic regression with outcome determined as dead/usual ageing/successful ageing was used to examine associations with quintile groups of dietary factor scores. *Participants:* Men and women (n=6308), without history of major illness at baseline, and aged >70 years at follow-up, or who had died before follow-up but would have been aged >70 at the commencement of follow-up, from the Melbourne Collaborative Cohort Study. *Measurements:* Frequencies of intake of 121 foods at baseline were collected in a food frequency questionnaire. Anthropometry and other health and lifestyle data were collected. At follow-up, questionnaire data relating to mental health, physical function and medical history were used to define successful ageing. *Results:* Four dietary factors were identified, characterized by higher loadings for (1) vegetables; (2) fruit, (3) feta, legumes, salad, olive oil, and inverse loadings for tea, margarine, cake, sweet biscuits and puddings; (4) meat, white bread, savoury pastry dishes and fried foods. In models excluding body size, the second factor 'Fruit' was positively associated with successful ageing (OR in top 20% vs lowest 20% of score 1.31, 95%CI (1.05-1.63), p trend across quintile groups 0.001); while the fourth factor 'Meat/fatty foods' was inversely associated (OR in top 20% vs lowest 20% of score 0.69, 95%CI (0.55-0.86), p trend across quintile groups 0.001). Factors 1 and 3 did not show significant associations with successful ageing. The association for 'Fruit' was little altered after adjustment for body size, while for 'Meat/fatty foods' the association was somewhat attenuated. *Conclusion:* A dietary pattern including plenty of fruit while limiting meat and fried foods may improve the likelihood of ageing successfully.

Key words: Successful ageing, dietary patterns, prospective study.

Introduction

More people are surviving to an older age, which may be considered desirable, but may be at the expense of reduced quality of life in the latter years. There is, thus, some urgency not only to identify which factors are associated with longevity but also which factors will predict a healthy old age. One potentially modifiable factor in this regard is diet.

There has been a recent trend to study diet overall rather than individual foods or nutrients, reflecting the numerous interactions between dietary components and that people eat combinations of foods. The two main ways of describing overall diet are a priori diet scores based on adherence to a notionally 'healthy' diet, for example the Mediterranean Diet Score (MDS); and data-driven a posteriori methods such as factor analysis and cluster analysis (1). We have previously used factor analysis to explore associations between diet and diabetes incidence (2), cardiovascular disease (CVD) mortality (3) and breast cancer incidence (4) in the Melbourne Collaborative Cohort Study (MCCS), finding associations between dietary patterns and outcomes in each case. As the cohort has now aged, it is probable that the MCCS may be used to find dietary patterns associated with measures of healthy or successful ageing.

Successful ageing has been defined by Rowe and Kahn (5) as absence of disease, good social engagement, lack of physical disability and good mental health, but few studies have considered such a comprehensive outcome. Two recent reports from the Nurse's Health Study have defined "healthy survival", in contrast to "usual survival", as surviving to age 70 years or older in the absence of 11 major chronic diseases, any major impairment of cognitive function and any major limitation of physical function while maintaining good mental health (6, 7). Healthy survival, so defined, was reported to be associated with higher levels of physical activity (7) and avoidance of weight gain (6).

The aim of this study was to identify dietary patterns within the MCCS using factor analysis, and evaluate their associations with a comprehensive successful ageing outcome.

Methods

Participants

The MCCS 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 Rolls, advertisements, and community announcements in local media. Southern European migrants were deliberately over-sampled to extend the range of

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lifestyle exposures, in particular diet (8); but while we included them in the dietary pattern derivation, we did not include them in the main analysis, due to the poor response rates at follow-up, especially in the older age range that was our focus.

For the derivation of dietary patterns we included all MCCS participants (n=37,260) other than those with dietary energy intakes in the greatest and least 1% of the sex specific distributions, those with missing data for dietary pattern variables and those self-reporting diabetes, heart attack, or angina at baseline, as their diets may have altered (Figure 1) to maximise the variation in diet. For the longitudinal analysis, those who self-reported they had any of the following additional conditions at baseline were also excluded: cancer, stroke, or elevated plasma glucose (>7.0 mmol/L fasting or >11.1 mmol/L non-fasting) as by definition they were not ageing successfully; as were those born in Greece or Italy, leaving 25,607 eligible participants. Of these participants, 18,945 (74%) attended a follow-up examination between 2003 and 2007. This analysis focussed on people aged 70 years and over at follow-up (n=6,109) or those who would have been in this age group at the first follow-up date (May 5th, 2003), had they survived (n=675). After further exclusion for other missing data, 5636 people who attended follow-up and 673 who died before follow-up were included in these analyses. The Cancer Council Victoria's Human Research Ethics Committee approved the study protocol. Further details of the study's recruitment and profile have been published elsewhere (8).

Baseline dietary data

Dietary data were collected using a self-administered 121-item food frequency questionnaire specifically developed for the MCCS (9). Alcohol intake data were collected using beverage specific frequency and quantity questions. Factor analysis was performed on the 121 items from the food frequency questionnaire, plus olive oil. For the 121 items, intake was measured as daily equivalent frequency, while intakes of olive oil were measured in millilitres/week. The principal factor method was used to extract factors, followed by orthogonal (varimax) rotation to assist in interpretation of the factors and to ensure that the factors were uncorrelated. Examination of Eigen values and the scree plot were used to identify factors to be retained. Variables with factor loadings having absolute values of 0.3 or greater were used in interpreting the factors (17). Scores were computed for rotated factors as the sum of products of observed variables multiplied by their factor loading, and they were analyzed as quintile groups. Factors were initially extracted separately for men and women, with similar results, so factors derived from the pooled data were used.

Other baseline data

Possible predictors of healthy ageing recorded at baseline included: physical activity (none-low vs moderate-high), alcohol intake (g/d categorized as shown in Table 1), education (primary school, secondary, tertiary), smoking status (never, past, current), marital status (married/defacto or single/divorced/separated/widowed), Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socioeconomic Disadvantage (10) based on census collection district (divided into quintiles with the lowest representing the greatest disadvantage), and previous history of arthritis, hypertension, asthma, kidney stones or gallstones. Body mass index (BMI) and waist to hip ratio (WHR) were also considered as potential variables in the causal pathway between diet and ageing status.

Figure 1

Numbers of participants included and excluded

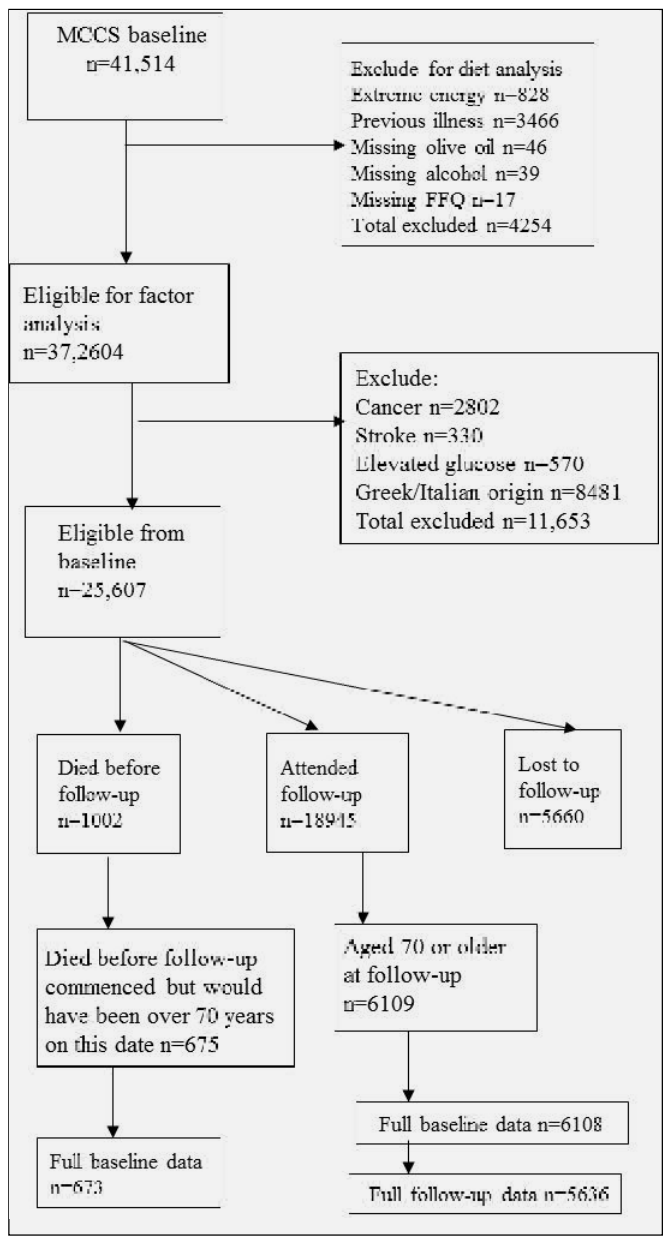

Table 1
Baseline characteristics according to status at follow-up

Variable	Dead n=673	Usual ageing n=4460	Successful ageing n=1175	p
Age at baseline (years) Mean +SD	65.8+2.8	64.0+3.3	63.4+3.2	<0.001
Period of follow-up (years) Mean +SD	6.4+2.8	11.8+1.4	11.5+1.2	<0.001
Proportion female (%)	44.0	64.2	60.8	<0.001
Education level (%)				<0.001
Primary	10.5	6.2	4.8	
Secondary	70.6	71.7	67.7	
Tertiary	18.9	22.1	27.6	
SEIFA Quintile[1]				<0.001
1	17.4	13.8	9.4	
2	21.1	18.7	14.9	
3	19.8	17.8	17.1	
4	19.3	22.2	22.9	
5	22.1	27.3	35.5	
Marital status[2]				<0.001
Single/divorced/separated/widowed	34.6	28.8	26.4	
Married/de facto	61.1	68.6	71.4	
Diet				
Energy intake (kJ/d)	9560+3300	9396+3027	9481+3040	0.350
Quintile 5 Factor 1 (Vegetables) (%)	18.9	26.1	29.2	<0.001
Quintile 5 Factor 2 (Fruit) (%)	10.2	14.5	17.7	<0.001
Quintile 5 Factor 1 (Mediterranean) (%)	4.2	3.8	4.9	0.342
Quintile 5 factor 2 (Meat) (%)	21.7	16.4	12.3	<0.001
Alcohol Intake (%)				<0.001
None	35.3	33.5	31.4	
1-20 g/d (%)	38.5	46.5	47.1	
21-40 g/day (%)	14.4	12.8	14.8	
41-60 g/day (%)	5.6	4.7	4.3	
60+ g/d	5.9	2.4	2.5	
Physically active (%)	27.6	33.6	42.2	<0.001
Smoking status (%)				<0.001
Never smoked	42.0	60.9	68.7	
Former smoker	41.0	32.8	27.9	
Current smoker	16.9	6.3	3.4	
BMI (kg/m^2) (%)				<0.001
<18.5	0.89	0.67	0.60	
18.5-25	37.7	35.6	48.8	
25-30	43.5	45.7	43.0	
30+	17.8	18.0	7.7	
WHR (men/women) (%)				<0.001
<0.90/0.80	39.1	49.6	60.0	
0.90-1.00/0.80-0.85	42.6	35.7	31.5	
>1.0/0.85	18.3	14.6	8.5	
Self Reported Conditions				
Asthma (%)	14.6	11.9	8.9	0.001
Hypertension (%)	32.7	30.6	21.5	<0.001
Arthritis (%)	42.8	46.8	28.7	<0.001
Kidney stones (%)	6.1	5.9	4.8	0.365
Gallstones (%)	7.4	11.0	6.5	<0.001
Gallstones (%)	7.4	11.0	6.5	<0.001

1. SEIFA not calculated for 11 people; 2. Marital status not provided for 168 people.

Definition of Successful Ageing at follow-up

We used a similar definition to that described by Sun et al (6) based on surviving to age 70 years or older in the absence of major chronic diseases, and major limitations of physical function while maintaining good mental health. Unlike Sun et al we did not evaluate cognitive function. Any participant who had self-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 were considered not to have aged successfully, that is to have aged 'usually'.

We also defined those people who had impairment, or perceived major difficulty with physical functioning as usual ageing. We did this in two ways – i) those subjects who

answered the SF12 (11, 12) questions as having a little or more 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; or ii) who reported having some or more difficulty in personal activities of daily living (ADL) (13) which included bathing, dressing, eating, transferring and toileting, who had 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 (IADL): shopping, walking 200 meters, 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.

In addition, participants completed the K10 (Kessler psychological distress scale) (14). 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 (14). The K10 has been demonstrated to have two second order factors relating to depression and anxiety (15). 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 (16). Anybody who scored 20 or more on the K10 was deemed to have not aged successfully.

Statistical analysis

Baseline characteristics for those ageing usually and those ageing successfully, along with people who had died before the start of follow-up but would have been 70 years or older on that date, were compared by analysis of variance for means of normally distributed variables and chi squared tests for categorical variables. Ordered logistic regression (dead=1, usual ageing=2, successful ageing=3) was used to assess associations between dietary factors and ageing status, adjusting for covariates (physical activity, alcohol intake, education, smoking, marital status, SEIFA index, and medical history) as described above, age, lenghth of follow-up and dietary energy intake divided into quintile groups. BMI and WHR were not included in the first model (model 1), they were however included in a second model (model 2) in order to determine whether dietary pattern associations were independent of body size. An OR less than 1, if statistically significant, indicates that the variable was associated with reduced odds of healthy ageing, while a statistically significant OR greater than 1 indicates that the variable was associated with increased odds of healthy ageing. All analyses were performed with STATA 11 (Statacorp, 2009, College Station, Texas, USA).

Results

The factor analysis of the baseline diet identified four factors with Eigen values of greater than 2; the dietary variables loading on these are shown in Appendix 1. For convenience the factors were labeled 'Vegetables' – consisting of high loadings for a range of different vegetables; 'Fruit' – high loadings for a range of fruit including olives; 'Southern European" – inverse loadings for tea, margarine, sweet biscuits, puddings and cake and positive for capsicum, salad greens, olive oil, cucumber, cooked dry legumes and feta cheese; and 'Meat/fatty foods' – high positive loadings for a range of meats, white bread, fried eggs, savoury pastry dishes, potato cooked with fat and fried fish. Because most of the factor scores are correlated with eating more of a variety of foods, dietary energy intakes tended to increase across quintile groups of factors 1, 2 and 4, while for factor 3 which had inverse loadings for several foods, energy intakes decreased across quintile groups (data not shown).

Table 2

Eating patterns as predictors of healthy ageing

Variable	ORs (95%CI)[1]	ORs (95%CI)[2]
Age at baseline (yrs)	0.94(0.92-0.96)	0.94(0.92-0.95)
Follow-up (yrs)	1.82(1.75-1.88)	1.83(1.76-1.89)
Female vs male	1.06(0.92-1.24)	1.04(0.89-1.21)
Educational attainment		
Primary	1.00	1.00
Secondary	1.07(0.83-1.37)	1.05(0.81-1.35)
Tertiary	1.43(1.08-1.89)	1.37(1.04-1.82)
SEIFA Quintile		
1	1.00	1.00
2	0.92(0.75-1.15)	0.91(0.73-1.12)
3	1.05(0.85-1.30)	1.02(0.82-1.26)
4	1.43(1.16-1.76)	1.38(1.12-1.71)
5	2.09(1.70-2.58)	2.02(1.64-2.48)
Marital status		
Single/divorced/separated/widowed	1.00	1.00
Married/de facto	1.03(0.90-1.18)	1.02(0.89-1.17)
Dietary energy		
Q1	1.00	1.00
Q2	0.96(0.78-1.18)	0.94(0.77-1.16)
Q3	1.11(0.90-1.37)	1.08(0.87-1.33)
Q4	1.22(0.97-1.53)	1.18(0.94-1.49)
Q5	1.14(0.88-1.48)	1.08(0.83-1.40)
Factor 1 score (Vegetables)		
Q1	1.00	1.00
Q2	1.08(0.84-1.38)	1.06(0.83-1.36)
Q3	1.21(0.95-1.53)	1.18(0.93-1.49)
Q4	1.11(0.87-1.41)	1.07(0.84-1.37)
Q5	1.33(1.03-1.71)	1.28(0.99-1.65)
p trend	0.090	0.161
Factor 2 score (Fruit)		
Q1	1.00	1.00
Q2	1.04(0.86-1.25)	1.04(0.87-1.26)
Q3	1.13(0.93-1.36)	1.13(0.94-1.37)
Q4	1.03(0.85-1.27)	1.04(0.85-1.28)
Q5	1.31(1.05, 1.63)	1.32(1.05, 1.64)
p trend	0.001	<0.001
Factor 3 score (Mediterranean)		
Q1	1.00	1.00
Q2	1.11(0.95-1.30)	1.11(0.95-1.31)
Q3	1.01(0.84-1.21)	1.03(0.86-1.24)
Q4	1.16(0.93-1.44)	1.19(0.96-1.49)
Q5	1.08(0.78-1.48)	1.14(0.83-1.57)
p trend	0.179	0.053

Factor 4 score (Meat)		
Q1	1.00	1.00
Q2	1.08(0.90-1.28)	1.13(0.95-1.35)
Q3	0.83(0.69-1.01)	0.89(0.74-1.08)
Q4	0.77(0.63-0.94)	0.84(0.69-1.04)
Q5	0.69(0.55-0.86)	0.78(0.62-0.98)
p trend	0.001	0.030
Alcohol intake		
Non drinker	1.00	1.00
1-20 g/d (%)	1.19(1.03-1.36)	1.17(1.02-1.34)
21-40 g/day (%)	1.37(1.11-1.67)	1.33(1.09-1.63)
41-60 g/day (%)	1.27(0.94-1.74)	1.29(0.95-1.76)
60+ g/d	1.17(0.78-1.76)	1.20(0.80-1.80)
Physically active vs inactive	1.44(1.27-1.64)	1.44(1.27-1.64)
Smoking status		
Never smoker	1.00	1.00
Ex smoker	0.67(0.59-0.77)	0.69(0.60-0.79)
Current smoker	0.39(0.30-0.50)	0.38(0.29-0.48)
BMI (kg/m^2)		
<18.5		0.80(0.38-1.67)
18.5-25		1.00
25-30		0.84(0.73-0.96)
30+		0.58(0.48-0.71)
WHR category (men/women)		
<0.90/0.80		1.00
0.90-1.00/0.80-0.85		0.87(0.75-1.00)
>1.0/0.85		0.75(0.61-0.91)
Asthma vs no asthma	0.75(0.62-0.91)	0.76(0.63-0.91)
Hypertension vs no hypertension	0.70(0.61-0.80)	0.76(0.66-0.87)
Arthritis vs no arthritis	0.52(0.46-0.59)	0.54(0.48-0.61)
Kidneystones vs no kidneystones	0.88(0.68-1.13)	0.87(0.67-1.13)
Gallstones vs no gallstones	0.84(0.69-1.03)	0.90(0.74-1.10)

1. Model without BMI and WHR; 2. Model with BMI and WHR

The median follow-up was 11.7 years for survivors and 6.4 years for those who died before follow-up began. Overall 18.9% of men and 18.4% of women who attended the follow-up examination were considered to have achieved successful ageing; 15.5% of males and 7.6% of females died before follow-up, leaving 65.5% of men and 73.9% of women ageing 'usually'. Table 1 shows baseline characteristics of people who were dead, ageing usually or ageing successfully at follow-up. People who aged successfully tended to be in the top 20% of the distribution of scores for factors 1 and 2 (Vegetables and Fruit), but being in the top 20% of Factor 4 (Meat/fatty foods) was associated with not surviving to follow-up. Factor 3 (Southern European) was not associated with ageing status

Multivariate analysis confirmed the associations between successful ageing and the 'Fruit' (positive) and 'Meat/fatty foods' (negative) patterns, which both showed significant trends across quintile groups. The OR for the top 20% of 'Vegetable' pattern score relative to the lowest was similar to that for the 'Fruit' pattern but the trend across groups was not statistically significant. For both the 'Fruit' and 'Vegetable' patterns the potential benefits were only seen in the top quintile group, while for the 'Meat/fatty foods' pattern there was a more consistent inverse trend across quintile groups. No association was seen for the Southern European pattern. After additional adjustment for BMI and WHR, the association for 'Fruit' was little changed, but that for 'Meat/fatty foods' was attenuated and that for the Southern European pattern was somewhat stronger and the p for trend approached significance (p=0.053) (Table 2). Moderate alcohol intakes, less than 40g/d, but not higher intakes, were also associated with increased likelihood of successful ageing.

Discussion

We have shown that a comprehensive successful ageing outcome, is positively associated with a fruit based eating pattern, and negatively with an eating pattern based on meat and other fatty foods. This definition of successful ageing included lack of chronic disease, little limitation in physical function and good mental health

Strengths of this study included its size, and the prolonged period of follow-up of 12 years. We defined lack of success in mental health by a validated measure of psychological distress (16) rather than an arbitrary proportion of subjects (7). By including Southern European migrants in the derivation of the dietary patterns we captured greater diversity in diet.

Limitations of this study included the unavailability of an assessment of cognitive function at follow-up as this is a common component of successful ageing. 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 have affected their ability to use the phone, do shopping or use transport, about which subjects were specifically questioned.

There are few reports on the association of diet with healthy ageing, despite the numerous studies of eating pattern measures, such as the Mediterranean Diet Score, and various outcomes. In the ARIC study, baseline intakes of dairy, fruit and vegetables were evaluated against lower extremity function, ADLs and IADLs nine years later (17). Each of the three food groups was inversely associated with disability and functional limitation (17). In the Health, Aging, and Body Composition Study a healthy dietary pattern based on low fat dairy, fruit, whole grains, poultry, fish and vegetables, as defined in cluster analysis, was associated with more years of healthy life and lower mortality than other patterns (18). In a recent review, Gu and Scarmeas (19) reported that dietary patterns including more fruit, vegetables, fish , nuts and legumes, and less sweets, high fat diary and meat, as assessed by various methods, were associated with less cognitive decline and lower risk of Alzheimer's Disease, important contributors to successful ageing. In a cross-sectional study of frail elders, health-related quality of life by three different measures (perceived health status, the number of good health days per month, and the number of days when not confined to bed each month) was inversely associated with nutritional risk assessed by the SCREEN questionnaire (20). SCREEN however is not

just a dietary questionnaire as it covers other areas which can put people at risk of inadequate nutrition, and it is quite likely that having poorer health-related quality of life could contribute to some of these risk factors: appetite, frequency of eating, motivation to cook, ability to shop and prepare food, weight changes, isolation and loneliness, and money to buy food (20).

We have previously found a mixed Mediterranean style dietary pattern identified by factor analysis to be inversely associated with CVD mortality (3), while in relation to diabetes incidence, a meat based pattern similar to that seen in the current analysis was associated with increased risk and a fruit and salad pattern with decreased risk (2). A fruit and salad pattern was also inversely associated with breast cancer incidence in the MCCS. Dietary patterns that might reduce the incidence of these conditions would be expected to increase the chance of successful ageing.

In the current study we identified a dietary pattern that we have labeled Southern European as we have previously seen in the MCCS that a similar pattern was associated with the Southern European migrants in the study (2). This pattern is different to that described by the Mediterranean Diet Score (MDS) (21), reflecting a pattern that is actually consumed by the migrants in our study rather than an ideal Mediterranean diet. Because we excluded the Southern European migrants for their poor response to follow-up, around half of the people remaining in this analysis were in the two lowest groups for this diet pattern, which may have contributed to the lack of association observed. Whereas most dietary pattern studies find a 'healthy' pattern with high intakes of fruit and vegetables, we do not find that these load together in the MCCS.

Although the MDS is a different way of looking at overall diet, higher scores reflect higher intakes of fruit and vegetables and lower intakes of meat, such that observations relating to the MDS may be relevant in regard to the dietary patterns we have identified. Both CVD and cancer were inversely associated with the MDS in a recent meta-analysis (22); and diabetes incidence was inversely related to the MDS in Spain (23). We have also recently reported that the MDS was associated with a reduced risk of psychological distress based on the K10 score in the MCCS (24) and that the MDS was inversely related to mortality from all causes and from CVD for the MCCS cohort (25).

The PREDIMED study, a randomized controlled trial of a traditional Mediterranean diet plus nuts or olive oil, versus a healthy low fat diet in people at high risk of CVD, showed the benefit of both Mediterranean interventions for CVD (26) but also that polyphenols associated with the Mediterranean diet were associated with better cognitive performance (27).

On the basis of observations in populations with higher than average proportions of centenarians, Davinelli et al (28) have recently recommended a diet rich in fruit, vegetables, legumes and whole grain with reduced saturated fat to promote longevity. Again these recommendations largely agree with our observations.

While there is overall reasonable evidence that certain dietary patterns consistent with dietary guidelines are likely to promote successful ageing, studies of single nutrients and age related disablement have not been very successful, suggesting that nutrients seen to be associated with better outcomes in observational studies were actually acting as biomarkers for the whole of diet, and the benefits observed were associated with the whole dietary pattern and the various nutrients included, as well as the foods/nutrients not included which may promote illness and less successful ageing (29).

We have shown that a dietary pattern based on frequent consumption of a variety of fruits was positively associated with our comprehensive definition of successful ageing, while a meat-based pattern was inversely associated with this outcome. There was also evidence for a vegetables-based pattern being associated with successful ageing, but only in the top 20% of adherence to this pattern. While this is generally consistent with other studies, we believe this is the first report using a comprehensive definition of successful ageing as the outcome.

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Appendix 1

Factor loading scores for selected items on the food frequency questionnaire

Food items	Factor 1	Factor 2	Factor 3	Factor 4
Apples[1,2]	0.14	0.41	0.06	-0.09
Zucchini/squash/eggplant	0.36	0.13	0.15	-0.07
Broccoli	0.60	0.07	0.03	-0.07
Carrot	0.58	0.07	-0.06	-0.06
Orange/mandarin	0.11	0.44	0.02	-0.05
Tea	0.18	-0.07	-0.38	-0.03
Peach/nectarine	0.03	0.68	0.04	-0.03
Apricot	0.03	0.69	-0.08	-0.03
Pear	0.09	0.54	0.12	-0.01
Plum	0.01	0.64	-0.03	-0.01
Potato cooked no fat	0.41	-0.03	-0.29	0.01
Pumpkin	0.54	-0.01	-0.22	0.01
Canteloupe/honeydew	0.13	0.56	0.17	0.02
Grape	-0.01	0.58	-0.02	0.02
Strawberry	0.13	0.47	-0.01	0.03
Cooked leafy greens	0.45	0.12	0.21	0.03
Celery/fennel	0.44	0.21	0.26	0.03
Capsicum	0.33	0.16	0.33	0.03
Cabbage/Brussels sprouts	0.55	0.01	-0.02	0.03
Salad greens	0.34	0.23	0.35	0.04
Cauliflower	0.59	0.01	-0.05	0.04
Pineapple	0.23	0.31	-0.01	0.04
Onion/leek	0.31	0.15	0.22	0.05
Olive oil	-0.12	0.14	0.41	0.06
Figs	-0.09	0.43	0.19	0.06
Cucumber	0.33	0.25	0.39	0.07

Green beans/peas	0.47	-0.01	-0.21	0.08
Margarine	0.16	-0.09	-0.37	0.08
Beetroot	0.42	0.07	0.01	0.09
Watermelon	0.03	0.56	0.22	0.10
Sweet biscuits	0.01	0.02	-0.33	0.12
Cooked dry legumes	0.27	0.12	0.31	0.12
Pudding	0.12	-0.02	-0.30	0.14
Olives	-0.04	0.30	0.29	0.14
Cake	0.06	0.02	-0.33	0.17
Coleslaw	0.33	0.10	0.14	0.18
Feta cheese	-0.07	0.13	0.30	0.19
White bread	-0.21	0.01	-0.06	0.30
Fried fish	-0.01	0.02	0.09	0.31
Bacon	0.02	-0.06	-0.11	0.31
Mixed lamb dish	0.09	-0.01	-0.04	0.32
Fried egg	-0.02	-0.05	-0.05	0.33
Beef steak	0.01	-0.01	0.00	0.33
Savoury pastry	0.00	-0.05	-0.07	0.33
Beef/veal schnitzel	-0.06	0.09	0.27	0.35
Potato cooked with fat	0.08	0.01	-0.02	0.37
Beef/veal roast	-0.01	0.03	0.15	0.40
Beef rissole	0.03	0.03	0.10	0.40

1. Factor loadings in bold have an absolute value > 0.30 and these items have been used to interpret the factors.; 2. Food items with factor loadings < 0.30 for all four factors have not been shown

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