Experimental Gerontology 64 (2015) 8–16

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

Associations of diet quality with health-related quality of life in older Australian men and women

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ARTICLE INFO

Article history:
Received 19 June 2014
Received in revised form 22 December 2014
Accepted 28 January 2015
Available online 29 January 2015

Section Editor: Holly M Brown-Borg

Keywords:
Diet
Health status
Longitudinal survey
Quality of life
Mental health
Nutrition status
Ageing

ABSTRACT

This study investigated associations between diet quality measures and quality of life two years later. Adults 55–65 years participating in the Wellbeing, Eating and Exercise for a Long Life (WELL) study in Victoria, Australia (n = 1150 men and n = 1307 women) completed a postal survey including a 111-item food frequency questionnaire in 2010. Diet quality in 2010 was assessed via the dietary guideline index (DGI), recommended food score (RFS) and Mediterranean diet score (MDS). The RAND 36-item survey assessed health-related quality of life in 2012. Associations were assessed using logistic regression adjusted for covariates. In men, DGI and RFS were associated with better reported energy (OR = 1.79, CI: 1.25, 2.55 and OR = 1.56, CI: 1.11, 2.19 respectively), and DGI was additionally associated with better general health (OR = 1.54, 95% CI: 1.08, 2.20), and overall mental component summary scale (OR = 1.51, CI: 1.07, 2.15) in the fully adjusted model. In women, associations between two indices of diet quality (DGI, RFS) physical function (OR = 1.66, CI: 1.19, 2.31 and OR = 1.70, CI: 1.21, 2.37 respectively) and general health (OR = 1.83, CI: 1.32, 2.54 and OR = 1.54, CI: 1.11, 2.14 respectively) were observed. DGI was also associated with overall physical component summary score (OR = 1.56, CI: 1.12, 2.17). Additional associations between emotional wellbeing and DGI (OR = 1.40, CI: 1.01, 1.93) and RFS (OR = 1.44, CI: 1.04, 1.99), and MDS and energy (OR = 1.53, CI: 1.11, 2.10) were observed in the fully adjusted model, in women only. Older adults with better quality diets report better health-related quality of life, with additional associations with emotional wellbeing observed in women.

1. Introduction

The world's ageing population continues to increase with the number of persons aged 60 years and over expected to exceed the number of children in the world by 2045 (United Nations, 2009). Increased longevity is supporting marked growth in the proportion of adults aged over 85 years (Australian Institute of Health and Welfare, 2007). As chronic disease burden increases with age, it is important that health and function are maintained to complement increased longevity. In 2011, adults aged 65 years and over formed 14% of the total Australian population (Australian Bureau of Statistics, 2012). Ageing is associated with a decline in health and increase in disability. Recent data from Australia indicates that only 42.7% of people aged 65–74 years rated their health as "very good" or "excellent", compared with 63.4% of people aged 25–34 years (Australian Bureau of Statistics, 2013). Furthermore, around 14% of women and 20% of men aged 65–74 years have heart disease, compared with 0.5% of women and men aged 25–34 years (Australian Bureau of Statistics, 2013).

An important aspect of healthy ageing is the maintenance of health-related quality of life (HRQoL) (Fuchs et al., 2013). HRQoL refers to how health impacts on an individual's ability to function and their perceived wellbeing in physical, mental and social domains (Hays and Morales, 2001). Chronic health problems, such as depression and cardiovascular disease, are associated with HRQoL deterioration in older adults (Buckley et al., 2013), which is a predictor of mortality risk (Kroenke et al., 2008).

Whilst previous research into nutrition and healthy ageing has focussed on the role of individual nutrients or foods, there is increasing interest in dietary pattern analysis as a chronic disease determinant (Newby and Tucker, 2004). Dietary patterns can be defined by two approaches: multivariate statistical techniques such as factor or cluster analysis (data driven approaches); and dietary scoring methods informed by a priori guidelines and recommendations, or diet quality indices. Diet quality indices can assess adherence to dietary guidelines (McNaughton et al., 2008), or a particular type of diet such as the Mediterranean diet (Trichopoulou et al., 2005).

Abbreviations: BMI, body mass index; CI, confidence intervals; DGI, dietary guideline index; FFQ, food frequency questionnaire; HRQoL, health-related quality of life; IPAQ-L, international physical activity questionnaire; MCS, mental component summary; MDS, Mediterranean diet score; MET, metabolic equivalent of task; OR, odds ratio; PCS, physical component summary; RAND-36, RAND 36-item general health survey; RFS, recommended food score; WELL study, Wellbeing, Eating and Exercise for a Long Life study.

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http://dx.doi.org/10.1016/j.exger.2015.01.047

Diet quality assessed by adherence to dietary guidelines has been associated with cardio-metabolic risk factors (McNaughton et al., 2009), whilst adherence to a Mediterranean diet has been associated with lower mortality (Australian Bureau of Statistics, 2012; McNaughton et al., 2012a) in older people. Recent cross-sectional evidence from Europe implicates diet quality in depression and anxiety in older age (Jacka et al., 2011b). However investigation of the relationship between diet quality and HRQoL in older adults at a population level is rare, with few longitudinal studies. A 10-year study of 2200 Europeans aged 70–75 years found adherence to a Mediterranean diet was not related to maintenance of health status or physical function (Haveman-Nies et al., 2003). In contrast, a cross-sectional study of 4000 men and women aged 65 years and older in Hong Kong found that diet quality assessed by the Diet Quality Index-International was associated with physical and mental health and frailty (Woo et al., 2010). These differences in findings could be due to methodological differences between studies, including choice of diet quality index. Despite the wide variety of diet quality indices available, few studies have included multiple indices in studies of diet quality and health among older adults.

Given the conflicting findings of previous research and paucity of data available on the relationship between multiple indices of diet quality and HRQoL among older adults, the aim of this study was to investigate associations between a food-based diet quality index reflecting the 2013 Australian Dietary Guidelines (National Health and Medical Research Council, 2013), two other a priori food-based indices of diet quality and HRQoL two years later in older men and women.

2. Methods

2.1. Design

This study is based on data from the Wellbeing, Eating and Exercise for a Long Life (WELL) study. The WELL study is a prospective, population-based longitudinal cohort study of nutrition and physical activity behaviours, obesity and quality of life, and the intrapersonal, social and environmental influences on these behaviours among adults (McNaughton et al., 2012b). Participants aged between 55 and 65 years, living in the community in urban or rural Victoria, Australia were selected from the Australian Electoral Roll, stratified by socioeconomic position using the Socioeconomic Index for Areas score (SEIFA) (Australian Bureau of Statistics, 2003). Potential participants living in a suburb with a population of less than 1000 overall or less than 200 in the 55–65 year age bracket were excluded. All eligible suburbs were classified by SEIFA and divided into tertiles (representing low, medium and high SEIFA). Fourteen postcodes from each SEIFA tertile were randomly selected. From each postcode, 134 participants (equal numbers of men and women) were selected for invitation into the study. A total of 11256 surveys were distributed to potential participants at baseline in 2010. Of these, 380 were returned as undeliverable and 95 were returned from individuals outside the age bracket. In total, 4082 completed surveys were returned at baseline (response rate 38%). Participation was voluntary and informed consent was obtained by return of the survey. In 2012, participants who agreed to take part in a follow-up were sent a similar survey ($n = 3368$). Of these, 2758 completed surveys were returned (response rate 82%). Data was collected as the same time of year in 2010 and 2012 to negate any potential seasonal effects.

Ethical approval for the survey was obtained from the Deakin University Human Research Ethics Committee (2009-105). Full details of the survey have been described elsewhere (McNaughton et al., 2012b).

2.2. Health-related quality of life

Self-rated HRQoL was assessed at follow-up via the RAND 36-item general health survey (RAND-36) (Hays and Morales, 2001). This measure is also known as the SF-36 health survey or Health Status Questionnaire and covers HRQoL across mental and physical domains. Questions were altered to Australian conditions consistent with other cohort studies (Lee et al., 2005; Mishra et al., 2011; Schofield and Mishra, 1998). The RAND-36 consists of 36 items which are converted into eight subscales to describe the amount an individual's health state impacts on their physical functioning, role limitations due to physical health, bodily pain, general health, energy/fatigue, social functioning, role limitations due to emotional problems and emotional wellbeing. Scores for the eight scales were calculated according to the summative method of calculating the mean of the items for each scale. Missing scores on items were treated as follows: for individuals with subscales where less than 50% of the items were missing, the mean of the remaining items was used to calculate the scale. Individuals with greater than 50% of items missing for a subscale ($n = 1361$) did not have the subscales calculated (4). Scores for the 8 subscales range from 0 to 100, where a higher score reflects a more positive health state. Physical component summary (PCS) and mental component summary (MCS) scale measures of the survey were also calculated based on factor analysis of the eight subscales from the 2004 South Australian Health Omnibus Survey (Hawthorne et al., 2007). Participants were divided into groups by the median cut-points of the 8 subscales, PCS and MCS for analysis.

2.3. Dietary intake

Usual dietary intake at baseline was assessed using a 111-item food frequency questionnaire (FFQ) (Hodge et al., 2000; Ireland et al., 1994), which assessed self-reported intake of food and beverages over the last six months. The FFQ has been previously used in other national studies (McLennan and Podger, 1995; Smith et al., 2010a, 2010b). The survey included seven additional validated short questions on food habits including salt use (during and after cooking), type of milk and bread consumed, trimming the fat from meat and daily fruit and vegetable consumption (McLennan and Podger, 1995; Rutishauser et al., 2001). Frequencies were converted into daily equivalents for analysis (Willett, 2013).

2.4. Diet quality

Diet quality was assessed using three previously developed indices: the dietary guideline index (DGI), the recommended food score (RFS) and the Mediterranean diet score (MDS). The indices were adapted for use with the data from the FFQ. The DGI is an updated version of a previous index developed to reflect Australian guidelines for optimal eating patterns which was shown to be a valid measure of diet quality (McNaughton et al., 2008). The index was updated to reflect the 2013 Australian Dietary Guidelines (National Health and Medical Research Council, 2013). For each dietary guideline component, indicators from the FFQ were identified and food groupings determined. Age and sex-specific scoring cut-offs for the five core food groups (vegetables, fruits, grains, meat and alternatives, and dairy), fluids and discretionary foods were devised. Discretionary foods (also commonly known as "extra" foods), are foods that are not essential to provide nutrient requirements due to the high content of sugar, fat and salt such as soft drinks, cordials, fruit juice drinks, chips, confectionary, chocolate, hamburgers, meat pies, pizza, cakes and muffins, pies and pastries, biscuits, and alcoholic beverages (National Health and Medical Research Council, 2013). Diet quality was incorporated through items referring to whole-grain cereals, lean protein, reduced-/low-fat dairy, unsaturated fats and dietary variety. A total of 13 components were included in the updated DGI. Each component of the DGI was scored proportionally from 0 to 10, where 10 indicated that a participant was fully meeting the recommendation. The total score was the sum of 13 items so that the diet score had a possible range of 0 to 130, with higher scores reflecting greater compliance with the Australian Dietary Guidelines. The previous version of the DGI was evaluated in the Australian population and shown to be related to sociodemographic factors, health behaviours, self-assessed health and intakes of key nutrients (McNaughton et al., 2008).

The RFS is a food-based score which assesses the frequency of consumption of a range of foods considered to be consistent with existing dietary guidelines (Kant et al., 2000). The RFS has been previously validated and is associated with biomarkers of dietary intake, chronic disease and mortality (Kant and Graubard, 2005; Kant et al., 2000). Participants are allocated a score of 1 for each recommended food consumed more than once per week. A total of 49 foods listed in the FFQ were considered as consistent with dietary guidelines (fruit, vegetable, whole grain, lean meat and alternatives and low-fat dairy groups) resulting in scores ranging from 0–49, with higher scores associated with a wider variety of consumption of recommended foods and greater diet quality.

Adherence to a Mediterranean diet was assessed using the most commonly used MDS by Trichopoulou et al (Trichopoulou et al., 2005). This index has demonstrated validity through reported relationships with nutrient biomarkers (Benitez-Arciniega et al., 2011) and health outcomes (Bollwein et al., 2013; Bosetti et al., 2003; McNaughton et al., 2012a; Milaneschi et al., 2011). The MDS includes vegetables, legumes, fruits and nuts, cereals, fish and seafood, dairy products, meat and meat products, and alcohol. In accordance with standard scoring techniques, we calculated sex-specific medians for frequency of intake of these items. For vegetables, legumes, fruits and nuts, cereals, fish and seafood, participants with an intake above the median were assigned a score of 1. For dairy products and meat and meat products, participants with an intake below the median were assigned a score of 1. For alcohol, a score of 1 was assigned for low to moderate intake (intake of no more than 2 times/day) and a score of 0 for no alcohol intake or intake greater than 2 times per day. Total score was calculated as the sum of all components, and ranged from 0–8, with higher scores reflecting greater adherence to a Mediterranean diet. An olive oil consumption or monounsaturated to saturated fat ratio item is also usually included. We were unable to include this item due to restrictions in reporting from the FFQ.

2.5. Covariates

Participant characteristics were collected during the baseline survey, including age, country of birth, marital status, retirement status, living arrangements and smoking status. Menopausal status at baseline was collected in women. Highest education level achieved was collected as a measure of socioeconomic position. Self-reported height and weight were collected for calculation of body mass index (BMI). Physical activity and sedentary behaviours were captured using the self-administered International Physical Activity Questionnaire (IPAQ-L), which has demonstrated validity and reliability in a 12-country, 14-site study (Craig et al., 2003). The IPAQ-L assesses duration, frequency and intensity of leisure, work, commuting and household/yard activities and sitting time during the past 7 days. Responses were converted into total metabolic equivalent of task (MET) hours per week.

2.6. Statistical analysis

Participants missing >10% responses on the FFQ, 1 or more responses to the dietary habits questions, or any calculated RAND-36 scales or covariates were excluded from analysis. Differences between men and women and included and excluded participants were explored using t-tests for normally distributed variables, the Wilcoxon rank sum test (Mann–Whitney test) for non-normally distributed variables and Chi square tests for categorical variables. Analysis was conducted in the whole sample and also separately for men and women. Participants were divided into groups of diet quality by their sex-specific quartile cut points for DGI, RFS and MDS scores. Associations between diet quality and RAND-36 were assessed via logistic regression. Linear trends were examined by linear regression analysis with diet quality and RAND-36 scales as continuous variables. Potential covariates adjusted for in regression models were determined by previous literature (Conklin et al., 2013; McNaughton et al., 2008; Wexler et al., 2006) and those associated with the outcome were included in the models. Multivariable regression models were adjusted for age, education, urban or rural location and menopausal status in women (model 1), with further adjustments made for smoking, physical activity (model 2) and BMI (model 3). BMI was included in the final adjustment as obesity may attenuate associations between diet quality and health outcomes, so the results of analysis with (model 3) and without BMI (model 2) could be assessed separately. $P < 0.05$ was considered significant.

3. Results

There was complete data available for analysis on 2457 participants (Table 1). Women had higher scores than men on the DGI and RFS, but not on the MDS. Women reported lower HRQoL on the RAND-36

Table 1
Characteristics of men and women aged between 55–65 years from the WELL study, Victoria, Australia, 2010–2012.

	Total		Men		Women	
n	2457		1150		1307	
	Mean	SD	Mean	SD	Mean	SD
DGI-2013	86.2	14.6	81.9	14.3	89.9**	13.7
RFS	24.9	7.80	23.0	7.58	26.6**	7.59
MDS	4.13	1.61	4.13	1.59	4.13	1.62
RAND-36						
Physical function	82.4	19.8	83.7	19.5	81.1**	20.0
Role physical	80.0	34.6	80.2	34.4	79.9	34.8
Role emotional	86.6	29.3	87.2	28.3	86.0	30.2
Energy	65.7	20.1	66.8	19.8	64.7*	20.3
Mental health	79.2	16.0	80.3	15.8	78.3**	16.1
Social functioning	86.8	21.1	87.2	20.6	86.5	21.7
Bodily pain	75.3	22.9	75.6	22.8	74.9	23.0
General health	70.0	19.7	68.6	19.8	71.2**	19.6
PCS T-score (norm score)	49.6	10.4	49.6	10.2	49.5	10.5
MCS T-score (norm score)	49.2	11.9	49.6	11.3	48.8	12.3
Age	59.9	3.1	59.9	3.1	59.9	3.1
BMI	27.1	5.2	27.5	4.6	26.8**	5.6
Physical activity[a]	105.0	88.8	114.5	97.4	96.7**	79.5
	n	%	n	%	n	%
Region						
Urban	1163	47.3	546	47.5	617	47.2
Rural	1294	52.7	604	52.5	690	52.8
Smoking						
Never smoked	1257	51.2	512	44.5	745*	57.0
Former smoker	939	38.2	500	43.5	439*	33.6
Daily smoker	261	10.6	138	12.0	123*	9.4
Country of birth[b]						
Australia	1982	80.8	916	79.9	1066	81.6
UK	180	7.3	82	7.2	98	7.5
Other	292	11.9	149	13.0	143	10.9
Marital status[b]						
Married/defacto	1956	79.7	961	83.6	995**	76.3
Separated/divorced	274	11.2	97	8.4	177**	13.6
Widowed	105	4.3	23	2.0	82**	6.3
Never married	118	4.8	68	5.9	50	3.8
Education						
Up to 10 years	827	33.7	333	29.0	494**	37.8
12 years/trade/certificate	881	35.9	466	40.5	415**	31.8
University degree	749	30.5	351	30.5	398	30.5
Menopausal status						
Yes					1285	98.3
No					9	0.7
Don't know					13	1.0

BMI, body mass index; DGI, dietary guideline index; MCS, mental component summary; MSD, Mediterranean diet score; PCS, physical component summary; RAND-36, RAND 36-item health survey; RFS, recommended food score; WELL, Wellbeing, Eating and Exercise for a Long Life.

* $P < 0.05$.

** $P < 0.01$ compared to men.

[a] Reported as MET hours per week.

[b] Reduced sample size for variable due to missing data.

physical function, energy and emotional wellbeing scales, and higher HRQoL on the general health scale compared to men. Overall, the final sample had a lower BMI, fewer smokers, and a higher proportion of participants who were married, born in Australia or the UK and had a university degree compared to participants with incomplete data excluded from the analysis (data not shown). There was no difference between included and excluded participants in age, gender or MET total hours of physical activity reported at baseline.

Overall, a better diet quality assessed by the DGI was associated with better self-reported HRQoL on the physical function (model 3; odds ratio (OR) = 1.56, 95% confidence intervals (CI): 1.22–1.99), bodily pain (model 3; OR = 1.29, CI: 1.01, 1.63), general health (model 3; OR = 1.72, CI: 1.36, 2.19), energy (model 3; OR = 1.51, CI: 1.19, 1.92), emotional wellbeing (model 3; OR = 1.36, CI: 1.08, 1.72) and PCS (model 3; OR = 1.46, CI: 1.15, 1.86) scales after adjustment for all covariates. A higher RFS was associated with better HRQoL on the physical function (model 3; OR = 1.43, CI: 1.13–1.82), general health (model 3; OR = 1.41, CI: 1.12, 1.78), energy (model 3; OR = 1.55, CI: 1.22, 1.96) and emotional wellbeing (model 3; OR = 1.41, CI: 1.12, 1.77) scales in the fully adjusted quartile. A MDS in the highest quartile was associated with better HRQoL on the general health (model 3; OR = 1.31, CI: 1.04, 1.65) and energy (model 3; OR = 1.39, CI: 1.10, 1.75) scales compared to the lowest quartile after adjustment for all covariates (Table 2).

Among men, a better diet quality assessed by the DGI was associated with better self-reported HRQoL on the general health (model 3; OR = 1.54, CI: 1.08, 2.20), energy (model 3; OR = 1.79, CI: 1.25, 2.55) and MCS (model 3; OR = 1.51, CI: 1.07, 2.15) scales after adjustment for all covariates (Table 3). A higher DGI score was associated with better HRQoL on the physical functioning scale after adjustment for smoking and physical activity (model 2; OR = 1.48, CI: 1.04, 2.11) but not BMI. Better diet quality assessed by the RFS was associated with better HRQoL on the energy scale (model 3; OR = 1.56, CI: 1.11, 2.19). There were no significant relationships between MDS score and HRQoL in the fully adjusted logistic regression analysis. However, higher MDS scores were linearly associated with higher scores on the energy scale (model 3; B = 0.734, $P = .044$) and PCS (model 3; B = 0.384, $P = 0.036$) after adjustment for all covariates.

Among women, a better diet quality assessed by DGI was associated with better HRQoL on the physical functioning (model 3; OR = 1.66, CI: 1.19, 2.31), general health (model 3; OR = 1.83, CI: 1.32, 2.54), emotional wellbeing (model 3; OR = 1.40, CI: 1.01, 1.93) and PCS (model 3; OR = 1.56, CI: 1.12, 2.17) scales (Table 4). Better diet quality as assessed by the RFS was associated with HRQoL on the physical functioning (model 3; OR = 1.70, CI: 1.21, 2.37), general health (model 3; OR = 1.54, CI: 1.11, 2.14), energy (model 3; OR = 1.54, CI: 1.11, 2.14) and emotional wellbeing (model 3; OR = 1.44, CI: 1.04, 1.99) scales. A MDS score in the top quartile was associated with a better score on the energy scale (model 3; OR = 1.53, CI: 1.11, 2.10). An association between MDS and general health was also observed after adjustment for smoking and physical activity (model 2; OR = 1.52, CI: 1.11, 2.08) but not BMI, although a significant linear regression remained (model 3; B = 0.790, $P = 0.020$).

4. Discussion

In men and women aged 55–65 years, adherence to a healthy diet as assessed by diet quality indices was associated with better HRQoL two years later. The relationships between diet quality and general health and energy in men, and physical function, general health, energy and emotional wellbeing in women remained after adjustment for confounders. More relationships with HRQoL were observed with the DGI and RFS, measures of adherence to national dietary recommendations and dietary variety respectively, than Mediterranean diet adherence via the MDS. The increase in score on RAND-36 scales from the lowest to highest group of diet quality ranged from 4–8 points, which is above the threshold thought to represent a minimal clinically important difference (3–5 points) (Samsa et al., 1999). These findings emphasise the importance of addressing overall diet quality in future community or population-based programs or policies to prevent chronic disease and support healthy ageing.

Much of the research around diet quality in older adults to date has focussed on specific health conditions such as metabolic syndrome (Australian Bureau of Statistics, 2013), or endpoints such as mortality (Ford et al., 2013; Haveman-Nies et al., 2002). Despite the complex health conditions and needs associated with ageing, there has been little population-based research in older adults investigating dietary patterns and generic measures of HRQoL able to capture a wide range of health states and co-morbid conditions. To date, investigation of this relationship longitudinally is rare and findings are mixed. A 10 year study of older Europeans found that a Mediterranean diet score was not related to maintenance of health status or physical function (Haveman-Nies et al., 2003). However, the current findings are supported by an Australian prospective cohort study that recently reported adherence to dietary guidelines was associated with better HRQoL on the SF-36 Health Survey physical function, general health, vitality/energy and PCS scales (Australian Bureau of Statistics, 2010). An association between diet quality and emotional wellbeing/mental health scale seen in women in the current study was not observed in this recent Australian study, although the analysis was not stratified by gender. Considering the gender differences in findings on the emotional wellbeing scale from the current study, future longitudinal investigations of diet quality and HRQoL stratified by gender are warranted.

Despite the wide range of a priori diet quality indices available for assessment, few studies have investigated more than one simultaneously against the same health outcome. McNaughton et al. (2012a) investigated three diet quality indices in a sample of adults aged 65 years and older from the UK and found mortality was associated with the RFS and MDS but not the Healthy Diet Score. It is noteworthy that most of the relationships between diet quality and HRQoL in the current study were observed using the DGI and RFS. Previously, the DGI was associated with lower intakes of energy, total fat and saturated fat and higher intakes of fibre, β-carotene, vitamin C, folate, calcium, and iron (McNaughton et al., 2008). The RFS was associated with intake of similar nutrients and also biomarkers of chronic disease risk including serum homocysteine, serum C-reactive protein, plasma glucose, total serum cholesterol and blood pressure in previous research (Kant and Graubard, 2005). The DGI and RFS may therefore represent adherence to a diet associated with reduced likelihood of chronic disease in this study, a key requirement for good HRQoL in older age (Buckley et al., 2013).

In contrast, fewer significant relationships were observed using the MDS in the current study, and previous research in older European men and women also did not find an association between MDS and maintenance of health status or physical function (Haveman-Nies et al., 2003). This may reflect the difficulties of adapting and assessing the Mediterranean diet in non-Mediterranean populations (Hoffman and Gerber, 2013). For example, studies of dietary patterns in the U.K. have shown a Mediterranean-style dietary pattern to be present (Brunner et al., 2008; Hamer et al., 2010), with adherence to a Mediterranean-style diet increasing since the 1960s, although still ranking only 28 out of 41 countries in level of adherence to the dietary pattern in 2000-2003 (da Silva et al., 2009). Similarly, studies in Australian samples have reported the presence of a Mediterranean-style dietary pattern (Rienks et al., 2013). Our choice of Mediterranean diet index included sample-specific median intakes of vegetables, legumes, fruits and nuts, cereals and fish as cut points for scoring. Although this enables adaptation of the score for a non-Mediterranean population, it likely reflects a dietary pattern with substantially lower absolute intakes of these foods compared to typical of Mediterranean populations as supported by a recent Australian study (Crichton et al., 2013). In addition, a large number of foods that are typically consumed in the Australian diet, including

Table 2
Multi-variable-adjusted OR and 95% CI according to quartile of dietary guideline index (DGI), recommended food score (RFS) and Mediterranean diet score (MDS) for a score above the median on RAND-36 in participants from the WELL study, Victoria, Australia, 2010–2012.

	DGI					RFS					MDS				
	Q1	Q2	Q3	Q4	*P*-trend	Q1	Q2	Q3	Q4	*P*-trend	Q1	Q2	Q3	Q4	*P*-trend
n	614	615	613	615		560	622	590	685		887	543	511	516	
Diet score range[a]	33.5–80.9	72.4–91.0	82.2–100	92.4–122		0–20	18–26	23–31	28–46		0–3	4	5	6–8	
		OR (CI)	OR (CI)	OR (CI)			OR (CI)	OR (CI)	OR (CI)			OR (CI)	OR (CI)	OR (CI)	
Physical function															
Model 1	1.0	1.23 (0.98, 1.55)	1.37 (1.09, 1.72)**	1.73 (1.37, 2.17)**	<0.001	1.0	1.28 (1.01, 1.62)*	1.34 (1.06, 1.70)*	1.51 (1.20, 1.90)**	<0.001	1.0	1.22 (0.98, 1.52)	1.55 (1.24, 1.94)**	1.48 (1.18, 1.86)**	<0.001
Model 2	1.0	1.19 (0.95, 1.50)	1.31 (1.03, 1.65)*	1.60 (1.26, 2.03)**	0.001	1.0	1.27 (1.00, 1.61)*	1.28 (1.01, 1.63)*	1.44 (1.14, 1.81)**	<0.001	1.0	1.19 (0.95, 1.48)	1.51 (1.20, 1.89)*	1.42 (1.13, 1.78)**	<0.001
Model 3	1.0	1.19 (0.93, 1.50)	1.32 (1.04, 1.68)*	1.56 (1.22, 1.99)**	0.008	1.0	1.25 (0.98, 1.59)	1.24 (0.97, 1.58)	1.43 (1.13, 1.82)**	0.002	1.0	1.12 (0.89, 1.40)	1.45 (1.15, 1.83)**	1.26 (1.00, 1.60)	0.006
Role physical															
Model 1	1.0	1.13 (0.89, 1.44)	1.15 (0.90, 1.47)	1.36 (1.06, 1.75)*	0.042	1.0	1.05 (0.82, 1.35)	1.13 (0.88, 1.46)	1.05 (0.82, 1.34)	0.050	1.0	1.08 (0.86, 1.37)	1.15 (0.90, 1.46)	1.28 (1.00, 1.64)	0.013
Model 2	1.0	1.05 (0.82, 1.34)	1.05 (0.82, 1.34)	1.20 (0.93, 1.55)	0.470	1.0	1.00 (0.78, 1.29)	1.06 (0.82, 1.37)	0.97 (0.75, 1.24)	0.265	1.0	1.05 (0.83, 1.32)	1.08 (0.85, 1.38)	1.19 (0.92, 1.52)	0.064
Model 3	1.0	1.05 (0.81, 1.34)	1.04 (0.81, 1.34)	1.17 (0.91, 1.52)	0.792	1.0	0.98 (0.76, 1.26)	1.02 (0.79, 1.32)	0.95 (0.74, 1.28)	0.458	1.0	1.00 (0.79, 1.27)	1.04 (0.82, 1.34)	1.11 (0.86, 1.43)	0.261
Bodily pain															
Model 1	1.0	1.20 (0.95, 1.50)	1.18 (0.94, 1.48)	1.34 (1.07, 1.69)*	0.022	1.0	1.12 (0.89, 1.41)	1.17 (0.92, 1.48)	1.07 (0.85, 1.35)	0.155	1.0	0.83 (0.67, 1.03)	1.08 (0.87, 1.35)	1.02 (0.82, 1.28)	0.059
Model 2	1.0	1.19 (0.94, 1.49)	1.16 (0.92, 1.46)	1.32 (1.04, 1.67)	0.229	1.0	1.10 (0.87, 1.39)	1.16 (0.91, 1.47)	1.05 (0.84, 1.33)	0.462	1.0	0.83 (0.67, 1.03)	1.07 (0.86, 1.34)	1.01 (0.81, 1.27)	0.145
Model 3	1.0	1.18 (0.94, 1.49)	1.16 (0.91, 1.46)	1.29 (1.01, 1.63)*	0.531	1.0	1.08 (0.85, 1.37)	1.12 (0.88, 1.42)	1.04 (0.82, 1.31)	0.802	1.0	0.79 (0.63, 0.98)*	1.03 (0.82, 1.29)	0.93 (0.74, 1.17)	0.603
General health															
Model 1	1.0	1.30 (1.04, 1.63)*	1.54 (1.23, 1.94)**	1.94 (1.54, 2.44)**	<0.001	1.0	1.21 (0.96, 1.52)	1.30 (1.03, 1.64)*	1.50 (120, 1.89)**	<0.001	1.0	1.19 (0.96, 1.48)	1.36 (1.09, 1.70)**	1.51 (1.21, 1.89)**	<0.001
Model 2	1.0	1.23 (0.98, 1.55)	1.44 (1.14, 1.81)**	1.76 (1.39, 2.22)**	<0.001	1.0	1.18 (0.94, 1.49)	1.23 (0.97, 1.56)	1.42 (1.13, 1.78)**	<0.001	1.0	1.15 (0.93, 1.43)	1.31 (1.05, 1.63)*	1.43 (1.14, 1.80)**	0.001
Model 3	1.0	1.23 (0.98, 1.55)	1.45 (1.14, 1.83)**	1.72 (1.36, 2.19)**	<0.001	1.0	1.16 (0.91, 1.46)	1.19 (0.94, 1.52)	1.41 (1.12, 1.78)**	<0.001	1.0	1.10 (0.88, 1.37)	1.26 (1.00, 1.58)*	1.31 (1.04, 1.65)*	0.010
Energy															
Model 1	1.0	1.40 (1.11, 1.75)**	1.50 (1.19, 1.88)**	1.69 (1.34, 2.12)**	<0.001	1.0	1.42 (1.13, 1.79)**	1.36 (1.08, 1.73)*	1.64 (1.30, 2.06)**	<0.001	1.0	1.07 (0.86, 1.33)	1.36 (1.09, 1.70)**	1.58 (1.26, 1.98)**	<0.001
Model 2	1.0	1.33 (1.06, 1.68)*	1.41 (1.12, 1.77)**	1.54 (1.21, 1.95)**	0.013	1.0	1.40 (1.11, 1.76)**	1.30 (1.02, 1.65)*	1.55 (1.23, 1.96)**	<0.001	1.0	1.04 (0.83, 1.29)	1.31 (1.05, 1.64)*	1.50 (1.19, 1.88)**	<0.001
Model 3	1.0	1.33 (1.06, 1.68)*	1.41 (1.12, 1.78)**	1.51 (1.19, 1.92)**	0.046	1.0	1.38 (1.09, 1.74)**	1.26 (0.99, 1.61)	1.55 (1.22, 1.96)**	0.001	1.0	0.99 (0.79, 1.23)	1.27 (1.01, 1.59)*	1.39 (1.10, 1.75)**	0.001
Social function															
Model 1	1.0	1.11 (0.89, 1.40)	1.16 (0.92, 1.47)	1.29 (1.02, 1.64)*	0.060	1.0	1.18 (0.94, 1.50)	1.11 (0.88, 1.41)	1.24 (0.99, 1.57)	0.003	1.0	0.92 (0.74, 1.14)	1.19 (0.94, 1.49)	1.11 (0.88, 1.39)	0.008
Model 2	1.0	1.06 (0.84, 1.34)	1.08 (0.85, 1.37)	1.18 (0.93, 1.50)	0.667	1.0	1.15 (0.91, 1.46)	1.06 (0.84, 1.35)	1.18 (0.93, 1.49)	0.040	1.0	0.90 (0.72, 1.12)	1.14 (0.91, 1.44)	1.06 (0.84, 1.34)	0.036
Model 3	1.0	1.06 (0.83, 1.34)	1.08 (0.85, 1.37)	1.15 (0.90, 1.47)	0.920	1.0	1.12 (0.88, 1.43)	1.02 (0.80, 1.30)	1.16 (0.92, 1.48)	0.099	1.0	0.85 (0.68, 1.06)	1.10 (0.87, 1.38)	0.97 (0.76, 1.23)	0.202
Role emotional															
Model 1	1.0	0.83 (0.63, 1.09)	1.01 (0.76, 1.34)	1.16 (0.87, 1.55)	0.044	1.0	1.09 (0.83, 1.45)	1.07 (0.81, 1.42)	1.26 (0.95, 1.67)	0.021	1.0	0.86 (0.67, 1.12)	1.11 (0.84, 1.47)	1.20 (0.90, 1.60)	0.202
Model 2	1.0	0.76 (0.57, 1.00)	0.89 (0.67, 1.19)	0.99 (0.74, 1.34)	0.754	1.0	1.03 (0.78, 1.37)	1.00 (0.75, 1.33)	1.16 (0.87, 1.54)	0.217	1.0	0.83 (0.64, 1.08)	1.05 (0.79, 1.38)	1.12 (0.84, 1.50)	0.535
Model 3	1.0	0.76 (0.57, 0.99)*	0.89 (0.67, 1.19)	0.98 (0.73, 1.32)	0.969	1.0	1.01 (0.76, 1.34)	0.97 (0.73, 1.29)	1.15 (0.86, 1.53)	0.312	1.0	0.81 (0.62, 1.05)	1.02 (0.77, 1.35)	1.07 (0.80, 1.43)	0.857
Emotional wellbeing															
Model 1	1.0	1.06 (0.85, 1.34)	1.41 (1.12, 1.76)**	1.49 (1.18, 188)**	0.001	1.0	1.39 (1.10, 1.75)**	1.28 (1.01, 1.62)*	1.47 (1.17, 1.85)**	<0.001	1.0	1.01 (0.81, 1.25)	1.39 (1.11, 1.73)**	1.22 (0.98, 1.53)	0.028
Model 2	1.0	1.02 (0.81, 1.28)	1.31 (1.04, 1.66)*	1.37 (1.09, 1.74)**	0.222	1.0	1.37 (1.09, 1.73)**	1.23 (0.97, 1.56)	1.41 (1.12, 1.78)**	0.032	1.0	0.98 (0.79, 1.22)	1.34 (1.08, 1.67)**	1.18 (0.94, 1.47)	0.102
Model 3	1.0	1.02 (0.81, 1.28)	1.32 (1.04, 1.66)*	1.36 (1.08, 1.72)**	0.309	1.0	1.36 (1.08, 1.72)**	1.21 (0.96, 1.54)	1.41 (1.12, 1.77)**	0.048	1.0	0.96 (0.78, 1.20)	1.32 (1.06, 1.65)*	1.14 (0.91, 1.43)	0.189
PCS															
Model 1	1.0	1.41 (1.12, 1.77)**	1.45 (1.15, 1.82)**	1.63 (1.29, 2.05)**	<0.001	1.0	1.11 (0.88, 1.40)	1.18 (0.94, 1.50)	1.17 (0.93, 1.47)	<0.001	1.0	1.09 (0.88, 1.35)	1.10 (0.88, 1.40)	1.21 (0.97, 1.52)	<0.001
Model 2	1.0	1.35 (1.07, 1.70)*	1.37 (1.09, 1.73)**	1.50 (1.19, 1.90)**	0.006	1.0	1.08 (0.85, 1.36)	1.13 (0.89, 1.43)	1.10 (0.87, 1.38)	0.007	1.0	1.06 (0.85, 1.32)	1.05 (0.84, 1.32)	1.14 (0.91, 1.43)	0.001
Model 3	1.0	1.35 (1.07, 1.71)*	1.39 (1.09, 1.76)**	1.46 (1.15, 1.86)**	0.035	1.0	1.05 (0.83, 1.33)	1.08 (0.85, 1.38)	1.08 (0.85, 1.37)	0.029	1.0	1.00 (0.80, 1.24)	1.00 (0.80, 1.26)	1.02 (0.81, 1.29)	0.028
MCS															
Model 1	1.0	0.97 (0.78, 1.22)	1.18 (0.94, 1.48)	1.29 (1.02, 1.62)*	0.039	1.0	1.13 (0.89, 1.42)	1.10 (0.87, 1.40)	1.27 (1.01, 1.60)*	0.005	1.0	0.94 (0.76, 1.17)	1.21 (0.97, 1.51)	1.12 (0.90, 1.41)	0.123
Model 2	1.0	0.94 (0.75, 1.19)	1.13 (0.89, 1.42)	1.22 (0.96, 1.54)	0.759	1.0	1.10 (0.88, 1.39)	1.07 (0.85, 1.36)	1.23 (0.98, 1.55)	0.094	1.0	0.93 (0.75, 1.15)	1.18 (0.94, 1.47)	1.09 (0.87, 1.37)	0.343
Model 3	1.0	0.94 (0.75, 1.19)	1.12 (0.89, 1.42)	1.21 (0.96, 1.53)	0.895	1.0	1.10 (0.87, 1.38)	1.06 (0.84, 1.35)	1.23 (0.97, 1.54)	0.125	1.0	0.92 (0.74, 1.14)	1.17 (0.93, 1.46)	1.07 (0.86, 1.35)	0.502

BMI, body mass index; CI, confidence intervals; DGI, dietary guideline index; MCS, mental component summary; MDS, Mediterranean diet score; OR, odds ratio; PCS, physical component summary; RFS, recommended food score; WELL, Wellbeing, Eating and Exercise for a Long Life.
Model 1: adjusted for age, sex, education and urban/rural location. Model 2: additionally adjusted for smoking and total physical activity. Model 3: additionally adjusted for BMI.

* $P < 0.05$.

** $P < 0.01$.

[a] Overlap in score range between quartiles reflect difference in sex-specific cutpoints.

Table 3
Multi-variable-adjusted OR and 95% CI according to quartile of dietary guideline index (DGI), recommended food score (RFS) and Mediterranean diet score (MDS) for a score above the median on RAND-36 in men from the WELL study, Victoria, Australia, 2010–2012.

	DGI					RFS					MDS				
	Q1	Q2	Q3	Q4	*P*-trend	Q1	Q2	Q3	Q4	*P*-trend	Q1	Q2	Q3	Q4	*P*-trend
n	288	287	287	288		274	267	295	314		413	267	236	234	
Diet score range	33.5–72.3	72.4–82.1	82.2–92.3	92.4–122.1		0–17	18–22	23–27	28–45		0–3	4	5	6–8	
		OR (CI)	OR (CI)	OR (CI)			OR (CI)	OR (CI)	OR (CI)			OR (CI)	OR (CI)	OR (CI)	
Physical function															
Model 1	1.0	0.95 (0.68, 1.34)	1.29 (0.91, 1.81)	1.66 (1.17, 2.34)**	<0.001	1.0	1.21 (0.85, 1.71)	1.23 (0.87, 1.73)	1.22 (0.87, 1.71)	<0.001	1.0	1.19 (0.87, 1.64)	1.38 (0.99, 1.93)	1.41 (1.01, 1.98)*	0.036
Model 2	1.0	0.88 (0.62, 1.25)	1.18 (0.83, 1.68)	1.48 (1.04, 2.11)*	0.003	1.0	1.17 (0.82, 1.67)	1.18 (0.84, 1.67)	1.18 (0.84, 1.66)	0.001	1.0	1.19 (0.86, 1.64)	1.36 (0.97, 1.90)	1.37 (0.98, 1.92)	0.089
Model 3	1.0	0.88 (0.61, 1.25)	1.21 (0.85, 1.73)	1.43 (0.99, 2.05)	0.005	1.0	1.18 (0.83, 1.69)	1.15 (0.81, 1.64)	1.21 (0.86, 1.72)	0.001	1.0	1.12 (0.81, 1.56)	1.37 (0.98, 1.93)	1.30 (0.92, 1.83)	0.117
Role physical															
Model 1	1.0	0.92 (0.65, 1.31)	1.07 (0.75, 1.54)	1.44 (0.98, 2.10)	0.105	1.0	0.90 (0.62, 1.30)	0.91 (0.63, 1.32)	0.90 (0.62, 1.29)	0.354	1.0	1.14 (0.82, 1.60)	1.14 (0.80, 1.62)	1.39 (0.96, 2.02)	0.155
Model 2	1.0	0.85 (0.59, 1.22)	0.98 (0.68, 1.42)	1.28 (0.86, 1.89)	0.445	1.0	0.87 (0.59, 1.26)	0.87 (0.60, 1.27)	0.86 (0.60, 1.25)	0.514	1.0	1.12 (0.80, 1.57)	1.09 (0.77, 1.56)	1.33 (0.91, 1.94)	0.266
Model 3	1.0	0.85 (0.59, 1.23)	0.99 (0.68, 1.44)	1.26 (0.85, 1.87)	0.527	1.0	0.86 (0.59, 1.26)	0.86 (0.59, 1.24)	0.89 (0.61, 1.29)	0.496	1.0	1.08 (0.77, 1.52)	1.10 (0.77, 1.57)	1.31 (0.90, 1.92)	0.313
Bodily pain															
Model 1	1.0	0.94 (0.67, 1.31)	1.19 (0.85, 1.67)	1.32 (0.94, 1.86)	0.042	1.0	1.02 (0.72, 1.44)	1.15 (0.82, 1.62)	0.96 (0.69, 1.35)	0.615	1.0	0.78 (0.57, 1.07)	0.98 (0.71, 1.37)	0.90 (0.64, 1.25)	0.421
Model 2	1.0	0.91 (0.65, 1.29)	1.16 (0.82, 1.64)	1.28 (0.90, 1.83)	0.135	1.0	1.01 (0.71, 1.42)	1.14 (0.82, 1.61)	0.95 (0.68, 1.33)	0.736	1.0	0.78 (0.57, 1.07)	0.98 (0.70, 1.36)	0.89 (0.64, 1.25)	0.525
Model 3	1.0	0.92 (0.65, 1.29)	1.17 (0.83, 1.66)	1.26 (0.88, 1.79)	0.181	1.0	1.01 (0.71, 1.43)	1.13 (0.80, 1.59)	0.97 (0.69, 1.36)	0.710	1.0	0.74 (0.54, 1.03)	0.97 (0.70, 1.36)	0.86 (0.61, 1.21)	0.622
General health															
Model 1	1.0	0.94 (0.67, 1.31)	1.29 (0.92, 1.79)	1.83 (1.30, 2.56)**	<0.001	1.0	1.16 (0.82, 1.63)	1.14 (0.82, 1.59)	1.32 (0.95, 1.83)	<0.001	1.0	1.21 (0.89, 1.66)	1.21 (0.87, 1.68)	1.38 (0.99, 1.91)	0.062
Model 2	1.0	0.85 (0.60, 1.19)	1.15 (0.81, 1.61)	1.58 (1.11, 2.25)**	0.006	1.0	1.11 (0.79, 1.57)	1.09 (0.78, 1.53)	1.27 (0.91–1.77)	0.002	1.0	1.20 (0.88, 1.64)	1.17 (0.84, 1.62)	1.32 (0.95, 1.84)	0.152
Model 3	1.0	0.84 (0.60, 1.19)	1.16 (0.82, 1.64)	1.54 (1.08, 2.20)*	0.009	1.0	1.12 (0.79, 1.58)	1.07 (0.76, 1.51)	1.30 (0.93, 1.83)	0.001	1.0	1.14 (0.83, 1.57)	1.17 (0.84, 1.63)	1.27 (0.90, 1.78)	0.190
Energy															
Model 1	1.0	1.34 (0.95, 1.87)	1.70 (1.22, 2.38)**	2.05 (1.46, 2.89)**	<0.001	1.0	1.36 (0.97, 1.92)	1.32 (0.94, 1.85)	1.56 (1.11, 2.17)**	0.001	1.0	1.08 (0.79, 1.47)	1.30 (0.94, 1.80)	1.35 (0.97–1.89)	0.012
Model 2	1.0	1.23 (0.87, 1.74)	1.55 (1.09, 2.18)*	1.83 (1.28, 2.60)**	0.007	1.0	1.32 (0.94, 1.87)	1.28 (0.91, 1.80)	1.51 (1.08, 2.11)*	0.003	1.0	1.05 (0.77, 1.45)	1.24 (0.89, 1.73)	1.30 (0.93, 1.81)	0.034
Model 3	1.0	1.24 (0.87, 1.75)	1.57 (1.11, 2.23)*	1.79 (1.25, 2.55)**	0.010	1.0	1.33 (0.94, 1.89)	1.26 (0.90, 1.78)	1.56 (1.11, 2.19)*	0.002	1.0	1.01 (0.73, 1.39)	1.24 (0.89, 1.73)	1.25 (0.89, 1.75)	0.044
Social function															
Model 1	1.0	0.95 (0.68, 1.33)	1.18 (0.84, 1.65)	1.43 (1.01, 2.03)*	0.206	1.0	1.18 (0.83, 1.67)	0.98 (0.70, 1.38)	1.19 (0.85, 1.66)	0.217	1.0	0.86 (0.63, 1.18)	1.00 (0.71, 1.39)	1.08 (0.77, 1.52)	0.572
Model 2	1.0	0.87 (0.62, 1.22)	1.06 (0.75, 1.50)	1.26 (0.88, 1.80)	0.731	1.0	1.14 (0.80, 1.62)	0.94 (0.67, 1.33)	1.14 (0.81, 1.61)	0.323	1.0	0.85 (0.62, 1.16)	0.96 (0.69, 1.34)	1.04 (0.73, 1.46)	0.770
Model 3	1.0	0.87 (0.61, 1.22)	1.08 (0.76, 1.53)	1.23 (0.85, 1.77)	0.869	1.0	1.14 (0.80, 1.63)	0.92 (0.65, 1.30)	1.18 (0.83, 1.67)	0.300	1.0	0.80 (0.58, 1.11)	0.96 (0.68, 1.35)	1.00 (0.70, 1.41)	0.884
Role emotional															
Model 1	1.0	0.75 (0.50, 1.12)	0.87 (0.58, 1.31)	1.37 (0.87, 2.14)	0.142	1.0	1.01 (0.66, 1.57)	0.78 (0.52, 1.17)	0.95 (0.62, 1.44)	0.783	1.0	0.72 (0.49, 1.04)	0.92 (0.61, 1.38)	1.00 (0.65, 1.53)	0.329
Model 2	1.0	0.68 (0.45, 1.03)	0.78 (0.51, 1.20)	1.21 (0.76, 1.93)	0.478	1.0	0.98 (0.63, 1.52)	0.75 (0.50, 1.14)	0.91 (0.60, 1.40)	0.623	1.0	0.71 (0.49, 1.04)	0.89 (0.59, 1.35)	0.97 (0.63, 1.49)	0.228
Model 3	1.0	0.69 (0.45, 1.03)	0.79 (0.52, 1.21)	1.20 (0.75, 1.92)	0.537	1.0	0.97 (0.63, 1.51)	0.73 (0.48, 1.11)	0.93 (0.61, 1.43)	0.631	1.0	0.69 (0.47, 1.01)	0.89 (0.59, 1.35)	0.96 (0.62, 1.48)	0.196
Emotional wellbeing															
Model 1	1.0	0.83 (0.59, 1.16)	1.33 (0.95, 1.85)	1.46 (1.04, 2.04)*	0.120	1.0	1.29 (0.91, 1.81)	1.23 (0.88, 1.72)	1.30 (0.93, 1.81)	0.232	1.0	1.00 (0.73, 1.36)	1.12 (0.81, 1.55)	1.21 (0.87, 1.69)	0.963
Model 2	1.0	0.78 (0.56, 1.11)	1.25 (0.89, 1.76)	1.37 (0.96, 1.94)	0.415	1.0	1.26 (0.89, 1.78)	1.21 (0.87, 1.70)	1.27 (0.91, 1.78)	0.313	1.0	0.99 (0.73, 1.36)	1.10 (0.79, 1.53)	1.20 (0.86, 1.67)	0.813
Model 3	1.0	0.78 (0.56, 1.11)	1.25 (0.89, 1.76)	1.36 (0.96, 1.92)	0.458	1.0	1.26 (0.89, 1.78)	1.21 (0.86, 1.69)	1.28 (0.92, 1.79)	0.306	1.0	0.98 (0.72, 1.35)	1.10 (0.79, 1.53)	1.19 (0.85, 1.66)	0.765
PCS															
Model 1	1.0	1.23 (0.88, 1.72)	1.53 (1.09, 2.15)*	1.54 (1.10, 2.17)*	0.001	1.0	0.90 (0.64, 1.28)	1.05 (0.75, 1.46)	1.00 (0.71, 1.39)	0.005	1.0	1.03 (0.75, 1.41)	0.95 (0.68, 1.32)	1.23 (0.88, 1.72)	0.010
Model 2	1.0	1.13 (0.80, 1.59)	1.40 (0.99, 1.98)	1.36 (0.95, 1.93)	0.020	1.0	0.87 (0.61, 1.23)	1.00 (0.71, 1.40)	0.95 (0.68, 1.34)	0.013	1.0	1.01 (0.74, 1.39)	0.91 (0.65, 1.27)	1.17 (0.83, 1.63)	0.027
Model 3	1.0	1.14 (0.80, 1.61)	1.44 (1.01, 2.04)*	1.31 (0.91, 1.88)	0.030	1.0	0.87 (0.61, 1.24)	0.97 (0.69, 1.37)	0.98 (0.69, 1.38)	0.010	1.0	0.95 (0.69, 1.32)	0.91 (0.65, 1.27)	1.11 (0.79, 1.57)	0.036
MCS															
Model 1	1.0	0.94 (0.67, 1.31)	1.28 (0.92, 1.78)	1.55 (1.11, 2.18)*	0.221	1.0	1.09 (0.77, 1.53)	1.06 (0.76, 1.48)	1.27 (0.91, 1.76)	0.845	1.0	0.85 (0.62, 1.16)	1.07 (0.77, 1.49)	1.10 (0.79, 1.53)	0.424
Model 2	1.0	0.92 (0.66, 1.30)	1.25 (0.89, 1.76)	1.52 (1.07, 2.16)*	0.644	1.0	1.07 (0.76, 1.51)	1.05 (0.75, 1.47)	1.25 (0.90, 1.74)	0.999	1.0	0.85 (0.62, 1.17)	1.07 (0.77, 1.49)	1.10 (0.79, 1.53)	0.315
Model 3	1.0	0.92 (0.66, 1.30)	1.26 (0.89, 1.77)	1.51 (1.07, 2.15)*	0.700	1.0	1.07 (0.76, 1.51)	1.04 (0.75, 1.46)	1.26 (0.90, 1.75)	0.991	1.0	0.85 (0.62, 1.16)	1.07 (0.77, 1.49)	1.09 (0.78, 1.52)	0.283

BMI, body mass index; CI, confidence intervals; DGI, dietary guideline index; MCS, mental component summary; MDS, Mediterranean diet score; OR, odds ratio; PCS, physical component summary; RFS, recommended food score; WELL, Wellbeing, Eating and Exercise for a Long Life.
Model 1: adjusted for age, education and urban/rural location. Model 2: additionally adjusted for smoking and total physical activity. Model 3: additionally adjusted for BMI.
* $P < 0.05$.
** $P < 0.01$.

Table 4
Multi-variable-adjusted OR and 95% CI according to quartile of dietary guideline index (DGI), recommended food score (RFS) and Mediterranean diet score (MDS) for a score above the median on RAND-36 in women from the WELL study, Victoria, Australia, 2010–2012.

	DGI					RFS					MDS				
	Q1	Q2	Q3	Q4	*P*-trend	Q1	Q2	Q3	Q4	*P*-trend	Q1	Q2	Q3	Q4	*P*-trend
n	326	328	326	327		286	355	295	371		474	276	275	282	
Diet score range	38–80	80.1–91	91.1–100	100.1–121.30		1–20	21–26	27–31	32–46		0–3	4	5	6–8	
		OR (CI)	OR (CI)	OR (CI)			OR (CI)	OR (CI)	OR (CI)			OR (CI)	OR (CI)	OR (CI)	
Physical function															
Model 1	1.0	1.53 (1.12, 2.09)**	1.43 (1.05, 1.96)*	1.77 (1.29, 2.43)**	<0.001	1.0	1.40 (1.02–1.93)*	1.50 (1.07, 2.09)*	1.87 (1.36, 2.57)**	<0.001	1.0	1.23 (0.91, 1.67)	1.72 (1.27, 2.34)**	1.55 (1.14, 2.10)**	<0.001
Model 2	1.0	1.50 (1.09, 2.06)*	1.40 (1.02, 1.92)*	1.68 (1.22, 2.31)**	0.001	1.0	1.37 (0.99–1.89)	1.44 (1.03, 2.02)*	1.73 (1.25, 2.40)**	0.001	1.0	1.20 (0.89, 1.62)	1.67 (1.22, 2.26)**	1.45 (1.06, 1.98)*	<0.001
Model 3	1.0	1.51 (1.09, 2.09)*	1.39 (1.00, 1.94)*	1.66 (1.19, 2.31)**	0.006	1.0	1.34 (0.96–1.86)	1.39 (0.98, 1.97)	1.70 (1.21, 2.37)**	0.005	1.0	1.12 (0.82, 1.53)	1.53 (1.12, 2.11)*	1.22 (0.89, 1.69)	0.022
Role physical															
Model 1	1.0	1.31 (0.94, 1.84)	1.20 (0.86, 1.68)	1.28 (0.91, 1.79)	0.259	1.0	1.24 (0.89–1.74)	1.45 (1.01, 2.08)*	1.25 (0.90, 1.75)	0.048	1.0	1.05 (0.76, 1.44)	1.19 (0.86, 1.66)	1.20 (0.86, 1.67)	0.036
Model 2	1.0	1.26 (0.89, 1.77)	1.11 (0.79, 1.55)	1.13 (0.80, 1.60)	0.666	1.0	1.17 (0.83–1.64)	1.31 (0.91, 1.89)	1.09 (0.77, 1.54)	0.243	1.0	0.99 (0.71, 1.37)	1.11 (0.79, 1.55)	1.07 (0.76, 1.50)	0.143
Model 3	1.0	1.26 (0.89, 1.77)	1.09 (0.77, 1.53)	1.11 (0.78, 1.57)	0.916	1.0	1.12 (0.79–1.58)	1.25 (0.86, 1.81)	1.04 (0.73, 1.48)	0.420	1.0	0.93 (0.67, 1.29)	1.03 (0.73, 1.44)	0.95 (0.67, 1.34)	0.565
Bodily pain															
Model 1	1.0	1.49 (1.09, 2.04)*	1.17 (0.86, 1.60)	1.34 (0.98, 1.84)	0.306	1.0	1.24 (0.90–1.70)	1.20 (0.86, 1.67)	1.20 (0.88, 1.65)	0.111	1.0	0.88 (0.65, 1.19)	1.18 (0.87, 1.60)	1.14 (0.84, 1.55)	0.069
Model 2	1.0	1.50 (1.09, 2.05)*	1.16 (0.85, 1.59)	1.32 (0.96, 1.82)	0.621	1.0	1.24 (0.90–1.70)	1.18 (0.84, 1.65)	1.18 (0.85, 1.62)	0.319	1.0	0.87 (0.64, 1.18)	1.17 (0.86, 1.59)	1.12 (0.82, 1.53)	0.176
Model 3	1.0	1.49 (1.08, 2.06)*	1.14 (0.83, 1.58)	1.29 (0.93, 1.79)	0.921	1.0	1.20 (0.86–1.65)	1.13 (0.80, 1.59)	1.13 (0.81, 1.57)	0.579	1.0	0.82 (0.60, 1.11)	1.08 (0.79, 1.48)	0.99 (0.72, 1.36)	0.794
General Health															
Model 1	1.0	1.74 (1.27, 2.38)**	1.81 (1.32, 2.47)**	2.00 (1.46, 2.74)**	0.001	1.0	1.29 (0.94–1.76)	1.50 (1.08, 2.09)	1.75 (1.27, 2.40)	<0.001	1.0	1.17 (0.87, 1.58)	1.52 (1.12, 2.05)**	1.65 (1.21, 2.24)**	<0.001
Model 2	1.0	1.69 (1.24, 2.32)**	1.73 (1.26, 2.38)**	1.85 (1.34, 2.55)**	0.007	1.0	1.24 (0.90–1.70)	1.41 (1.01, 1.97)*	1.58 (1.15, 2.19)**	<0.001	1.0	1.13 (0.83, 1.52)	1.44 (1.06, 1.96)*	1.52 (1.11, 2.08)**	0.001
Model 3	1.0	1.70 (1.23, 2.35)**	1.73 (1.25, 2.39)**	1.83 (1.32, 2.54)**	0.018	1.0	1.20 (0.87–1.66)	1.36 (0.96, 1.91)	1.54 (1.11, 2.14)*	0.001	1.0	1.06 (0.78, 1.44)	1.34 (0.98, 1.83)	1.34 (0.98, 1.85)	0.020
Energy															
Model 1	1.0	1.45 (1.06, 1.99)*	1.33 (0.98, 1.82)	1.42 (1.04, 1.94)	0.008	1.0	1.49 (1.09–2.05)*	1.44 (1.03, 2.00)*	1.75 (1.27, 2.41)**	<0.001	1.0	1.05 (0.78, 1.42)	1.42 (1.05, 1.93)*	1.83 (1.34, 2.50)**	<0.001
Model 2	1.0	1.42 (1.04, 1.95)*	1.29 (0.94, 1.77)	1.31 (0.95, 1.81)	0.049	1.0	1.46 (1.06–2.01)*	1.37 (0.98, 1.92)	1.58 (1.14, 2.18)**	0.001	1.0	1.01 (0.75, 1.37)	1.37 (1.00, 1.86)*	1.69 (1.23, 2.32)**	<0.001
Model 3	1.0	1.42 (1.03, 1.96)*	1.27 (0.92, 1.76)	1.29 (0.93, 1.78)	0.099	1.0	1.43 (1.03–1.98)*	1.32 (0.94, 1.86)	1.54 (1.11, 2.14)*	0.002	1.0	0.96 (0.71, 1.31)	1.28 (0.94, 1.75)	1.53 (1.11, 2.10)**	0.004
Social function															
Model 1	1.0	1.28 (0.93, 1.77)	1.14 (0.83, 1.56)	1.18 (0.86, 1.63)	0.197	1.0	1.24 (0.90–1.70)	1.30 (0.93, 1.82)	1.34 (0.97, 1.85)	0.002	1.0	0.97 (0.72, 1.32)	1.40 (1.02, 1.91)	1.14 (0.83, 1.55)	0.002
Model 2	1.0	1.27 (0.92, 1.75)	1.09 (0.79, 1.50)	1.12 (0.81, 1.54)	0.497	1.0	1.21 (0.87–1.67)	1.24 (0.88, 1.74)	1.27 (0.91, 1.76)	0.016	1.0	0.95 (0.70, 1.29)	1.35 (0.98, 1.85)	1.09 (0.80, 1.50)	0.011
Model 3	1.0	1.26 (0.91, 1.75)	1.07 (0.77, 1.48)	1.08 (0.78, 1.51)	0.726	1.0	1.16 (0.84–1.61)	1.18 (0.83, 1.67)	1.21 (0.87, 1.70)	0.040	1.0	0.89 (0.65, 1.21)	1.25 (0.90, 1.72)	0.96 (0.69, 1.32)	0.094
Role emotion															
Model 1	1.0	0.88 (0.60, 1.28)	1.12 (0.76, 1.65)	1.02 (0.70, 1.50)	0.197	1.0	1.22 (0.84–1.76)	1.52 (1.02, 2.28)*	1.66 (1.13, 2.45)**	<0.001	1.0	1.01 (0.71, 1.44)	1.33 (0.91, 1.93)	1.42 (0.97, 2.09)	0.009
Model 2	1.0	0.82 (0.56, 1.20)	0.99 (0.66, 1.47)	0.87 (0.59, 1.29)	0.639	1.0	1.13 (0.78–1.64)	1.35 (0.89, 2.03)	1.46 (0.98, 2.17)	0.007	1.0	0.95 (0.66, 1.36)	1.22 (0.83, 1.79)	1.28 (0.86, 1.89)	0.060
Model 3	1.0	0.81 (0.55, 1.20)	0.98 (0.66, 1.46)	0.85 (0.57, 1.27)	0.770	1.0	1.09 (0.75–1.59)	1.30 (0.86, 1.96)	1.41 (0.95, 2.10)	0.013	1.0	0.91 (0.63, 1.31)	1.16 (0.79, 1.70)	1.18 (0.79, 1.76)	0.159
Emotional wellbeing															
Model 1	1.0	1.34 (0.98, 1.83)	1.49 (1.09, 2.04)*	1.55 (1.13, 2.12)**	0.003	1.0	1.47 (1.07–2.02)*	1.31 (0.94, 1.82)	1.63 (1.19, 2.24)**	<0.001	1.0	1.02 (0.76, 1.38)	1.65 (1.22, 2.24)**	1.23 (0.91, 1.67)	0.003
Model 2	1.0	1.30 (0.95, 1.78)	1.41 (1.03, 1.93)*	1.41 (1.03, 1.95)*	0.019	1.0	1.41 (1.03–1.94)*	1.21 (0.86, 1.69)	1.47 (1.06, 2.03)*	0.002	1.0	0.97 (0.72, 1.32)	1.57 (1.15, 2.13)**	1.13 (0.83, 1.53)	0.016
Model 3	1.0	1.30 (0.95, 1.78)	1.40 (1.02, 1.92)*	1.40 (1.01, 1.93)*	0.026	1.0	1.39 (1.01–1.92)*	1.18 (0.84, 1.66)	1.44 (1.04, 1.99)*	0.003	1.0	0.95 (0.70, 1.29)	1.52 (1.11, 2.07)**	1.07 (0.78, 1.46)	0.038
PCS															
Model 1	1.0	1.62 (1.18, 2.22)**	1.38 (1.01, 1.89)*	1.68 (1.22, 2.31)**	0.033	1.0	1.35 (0.98–1.85)	1.35 (0.97, 1.89)	1.38 (1.01, 1.90)	0.020	1.0	1.15 (0.85, 1.56)	1.24 (0.91, 1.68)	1.20 (0.88, 1.63)	0.003
Model 2	1.0	1.59 (1.15, 2.18)**	1.35 (0.98, 1.85)	1.60 (1.16, 2.20)**	0.103	1.0	1.32 (0.96–1.81)	1.30 (0.92, 1.82)	1.29 (0.93, 1.78)	0.088	1.0	1.12 (0.83, 1.52)	1.19 (0.88, 1.62)	1.12 (0.82, 1.53)	0.014
Model 3	1.0	1.59 (1.15, 2.20)**	1.33 (0.96, 1.85)	1.56 (1.12, 2.17)**	0.247	1.0	1.27 (0.92–1.77)	1.24 (0.88, 1.76)	1.23 (0.88, 1.72)	0.248	1.0	1.05 (0.77, 1.43)	1.09 (0.79, 1.49)	0.95 (0.69, 1.31)	0.288
MCS															
Model 1	1.0	1.01 (0.74, 1.38)	1.10 (0.80, 1.50)	1.10 (0.80, 1.50)	0.099	1.0	1.16 (0.85–1.60)	1.15 (0.83, 1.61)	1.29 (0.94, 1.76)	<0.001	1.0	1.04 (0.77, 1.40)	1.33 (0.98, 1.80)	1.15 (0.85, 1.56)	0.006
Model 2	1.0	0.97 (0.71, 1.33)	1.04 (0.76, 1.42)	1.02 (0.74, 1.40)	0.360	1.0	1.12 (0.81–1.54)	1.08 (0.78, 1.52)	1.20 (0.87, 1.65)	0.003	1.0	1.00 (0.74, 1.36)	1.28 (0.94, 1.73)	1.08 (0.79, 1.47)	0.034
Model 3	1.0	0.97 (0.71, 1.33)	1.04 (0.75, 1.42)	1.02 (0.74, 1.40)	0.409	1.0	1.11 (0.81–1.53)	1.07 (0.77, 1.50)	1.19 (0.86, 1.64)	0.004	1.0	0.99 (0.73, 1.35)	1.26 (0.93, 1.71)	1.06 (0.77, 1.44)	0.060

BMI, body mass index; CI, confidence intervals; DGI, dietary guideline index; MCS, mental component summary; MDS, Mediterranean diet score; OR, odds ratio; PCS, physical component summary; RFS, recommended food score; WELL, Wellbeing, Eating and Exercise for a Long Life.
Model 1: adjusted for age, education, urban/rural location and menopausal status. Model 2: additionally adjusted for smoking and total physical activity. Model 3: additionally adjusted for BMI.
* $P < 0.05$.
** $P < 0.01$.

"extra" foods are also ignored in the MDS scoring. An olive oil or monounsaturated fat component was not included in the MDS in this study due to limitations in the FFQ. However, some controversy exists regarding the inclusion of this item in Mediterranean diet assessment in non-Mediterranean populations, as olive oil consumption is typically low and monounsaturated to saturated fat ratio instead reflects animal fat intake, which is low in the typical Mediterranean diet (Flood et al., 2007).

The marked difference in findings between our three indices of diet quality highlights the importance of choice of diet quality index appropriate for a specific population. However, it should be noted that mean scores reflected a medium level of adherence across all three indices, regardless of the index used. This is a similar level of adherence reported previously (McNaughton et al., 2008). The DGI measures adherence to the Australian Dietary Guidelines, a set of national recommendations to provide good nutrition, support health and reduce risk of disease in the Australian population. However, a large proportion of Australians do not meet these recommendations, particularly among low socioeconomic groups (Ball et al., 2004). Dietary guidelines from Australia and around the world, also advise the consumption of a wide variety of recommended foods (National Health and Medical Research Council, 2013; US Health and Human Services and US Department of Agriculture, 2005), as assessed by the RFS. Dietary variety is influenced by a range of factors, including socioeconomic position, personality traits, food avoidance behaviours and taste preferences (Scheibehenne et al., 2014). Reduced dietary variety may also reflect displacement of recommended foods included in the score with "extra" or discretionary foods.

The current study observed a relationship between the emotional wellbeing scale and diet quality in women, whilst diet quality was associated with energy and overall MCS in men, adding to the growing evidence of good nutrition for mental health in older age. Higher adherence to a Mediterranean diet was previously associated with reduced risk for cognitive impairment in older age, providing further evidence for its importance for brain health (Scarmeas et al., 2009). The underlying mechanisms for this relationship are likely to be multiple, with a large range of nutrients implicated in mental health, including omega-3 polyunsaturated fatty acids, B vitamins and antioxidants (Parletta et al., 2013). Just as nutrients play varied and essential roles human physiology overall, the brain has a requirement for nutrients to build and maintain its structure, promote effective neurotransmission and protect against neuronal damage and death (Bourre, 2006). As more evidence of the complex and synergistic role of nutrients in brain function emerge, the value of a varied holistic approach to diet which aims to meet all nutritional requirements simultaneously should be a focus of mental health research.

The current findings support previously observed differences between men and women in the relationship between diet quality and mental health (Jacka et al., 2011b). The underlying causes of these differences are not clear. It is plausible that response biases in dietary reporting and mental health-related items on the RAND-36 could have contributed to the difference in men and women observed in the current study. There are differences in reported mental health between men and women, with women more likely to suffer from depression and anxiety (McLean and Anderson, 2009; Parker and Brotchie, 2010). Furthermore, people suffering from depression report lower HRQoL on the emotional wellbeing scale compared with other chronic disease and general populations (Hays et al., 2000). Consistent with this, we observed a wider range of scores on the emotional wellbeing scale in women than men. However, there is evidence that depressive symptoms increase at a greater rate over time in older men and gender differences in severity disappear completely in the years preceding death (Burns et al., 2013). Therefore, further investigation of mental health and diet quality in older populations over time is warranted.

Strengths of this study include the large sample, inclusion of important confounding variables in analysis and longitudinal design. However, the study has some limitations. Dietary intake was assessed by a non-quantified FFQ, which did not allow adjustment for energy intake in statistical analysis. However, we did take into account key determinants of energy intake by stratifying analysis by sex and adjusting for age, BMI and physical activity. Financial status or income was not included as a covariate due to the low response rate from participants. However, education was included as a measure of socioeconomic position. Due to the short study period of two years, it is possible that the findings reflect reverse causality, and that dietary intake was a function of poor health in this study. However, the findings of previous high-quality studies do not support this hypothesis (Akbaraly et al., 2009; Sanchez-Villegas et al., 2009), including a study of diet quality and mental health in adolescents which specifically assessed and ruled out reverse causality (Jacka et al., 2011a). Continued longitudinal analysis of diet quality and HRQoL over longer periods of time will help to clarify these associations further.

5. Conclusion

In a sample of older adults residing in Victoria, Australia, men and women aged 55–65 years with better quality diets report better quality of life, with additional associations with emotional wellbeing observed in women. Further investigation will determine if diet can influence maintenance of quality of life over time in an ageing population. These findings emphasise the importance of addressing overall diet quality in future community or population-based programs or policies to prevent chronic disease and support healthy ageing.

Acknowledgements

This project was awarded funding from the Diabetes Australia Research Trust and the Australian Research Council (ID: DP1095595, FT100100581). CM is supported by an Alfred Deakin Postdoctoral Research Fellowship from Deakin University. KB is supported by a National Health & Medical Research Council Principal Research Fellowship, ID 1042442. The funding bodies had no involvement in study design; collection, analysis and interpretation of data; in drafting or submission of this article for publication. We declare no conflicts of interest.

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