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Received 26 September 2008; accepted in revised form 1 June 2009

Age and Ageing 2009; **38:** 594–599
doi: 10.1093/ageing/afp121
Published electronically 23 July 2009

Current patterns of diet in community-dwelling older men and women: results from the Hertfordshire Cohort Study

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Abstract

Background: dietary patterns analysis takes account of the combined effects of foods and may be a more meaningful way of assessing dietary exposure than considering individual nutrients. Little is known about the dietary patterns of older adults in the UK.
Objective: to describe the dietary patterns of a population of community-dwelling older men and women and to examine factors associated with compliance with these patterns.
Setting and Participants: 3,217 men and women aged 59–73 years who were participants in the Hertfordshire Cohort Study.
Methods: diet was assessed using an administered food frequency questionnaire; dietary patterns were identified using principal component analysis.
Results: two dietary patterns were identified. The first was characterised by high consumption of fruit, vegetables, oily fish and wholemeal cereals ('prudent' pattern); the second was characterised by high consumption of vegetables, processed and red meat, fish and puddings ('traditional' pattern). High 'prudent' diet scores were more common in women, in men and women in non-manual classes and in non-smokers (all $P < 0.05$), whilst high 'traditional' diet scores were more common in men, in men and women who had partners and were associated with higher alcohol consumption (all $P < 0.05$).
Conclusions: we have described large variations in food consumption and nutrient intake amongst older adults that are likely to have implications for future health. The specific socio-demographic correlates of the dietary patterns provide insights into the contexts within which good and poor diets exist, and may help in the identification of opportunities for dietary intervention.

Keywords: *dietary patterns, older adults, diet, elderly*

Introduction

Public health advice to prevent chronic disease is commonly based upon evidence of disease-promoting or protective effects of individual nutrients [1, 2]. However, diet is a complex combination of foods, nutrients and non-nutrients, and there are interactions between them [3]. The relationships between diet and disease may therefore differ from those predicted from known nutrient-disease associations [4].

This has led to an increased interest in the identification of dietary patterns to understand the relationship between diet and disease. Dietary patterns analysis allows examination of the whole diet, and takes account of the combined effects of foods and nutrients consumed together; it may therefore be a more meaningful measure of dietary exposure than a consideration of the effects of single dietary constituents in isolation [5]. Although there is now an extensive literature on the dietary patterns of middle-aged adults, our knowledge of the dietary patterns of older men and women is limited [6]. In a recent evaluation of dietary patterns of older European adults in the EPIC-Elderly study, Bamia and colleagues (2007) found that a 'plant-based' dietary pattern was associated with lower all-cause mortality [7], but importantly, this association was not seen within the UK. There is little other contemporary information on the dietary patterns of older adults in the UK to compare with the EPIC-Elderly study. We therefore need to know more about current dietary patterns in older adults, and to determine how these patterns relate to health and disease.

We describe the dietary patterns of 3,217 men and women aged 59–73 years who were participants in the Hertfordshire Cohort Study [8].

Participants and methods

The Hertfordshire Cohort Study (HCS)

In 1998, 7,106 men and women who were born between 1931 and 1939 and who were still living in Hertfordshire were traced using the NHS central registry [8]. A total of 1,684 (54%) men and 1,541 (52%) women agreed to be interviewed at home, when diet was assessed by a trained research nurse and information was obtained on the participant's medical and social history. Complete dietary data were available for 1,677 (54%) men and 1,540 (52%) women.

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

Dietary patterns analysis

Diet was assessed using a food frequency questionnaire (FFQ) that was based on the EPIC questionnaire [9, 10]. The FFQ was administered by a trained research nurse. Before the dietary patterns analysis, the foods in the FFQ were combined into 51 food groups on the basis of similarity of type of food and nutrient composition. For example, carrots, parsnips, swede & turnip were included in the 'root vegetables' group; bacon, ham, corned beef, pies & sausages were included in the 'processed meats' group. Principal component analysis (PCA) of reported weekly frequencies of consumption of these food groups was used to define patterns of diet. This statistical technique produces new variables (components) that are independent linear combinations of the dietary variables that account for maximum variance [11]; each component identifies a pattern of foods. A score was calculated for every participant in the study for each dietary pattern, which indicates his or her compliance with the pattern. For each pattern, the coefficient defined by the PCA for each food group was multiplied by the participant's reported frequency of consumption of the group, and these values were summed to provide the participant's pattern score.

Statistical analysis

The normality of variables was assessed by testing for skewness and kurtosis. Body mass index (BMI) and nutrient variables were not normally distributed and were transformed by taking their natural logarithms. Dietary pattern scores were used as continuous outcome variables to examine how participant characteristics related to compliance with these dietary patterns. The pattern scores were divided into quintiles for presentation purposes (Table 1, Figure 1). The *t*-tests were used to test for differences in the dietary pattern scores between men and women; univariate and multiple linear regressions were used to explore the correlates of dietary pattern scores. In order to compare relationships between pattern scores and nutrient intake that were independent of total energy intake, nutrient intakes were adjusted for energy intake according to Willett's residual method [12]. Data were analysed using Stata version 10.

Results

The men and women were aged between 59 and 73 years; 57% of men and 58% of women were in manual social classes. Most men (81%) and women (82%) had left full-time education at the age of 15 or above, and most (85% of men and 72% of women) were married or living with a partner. A total of 16% of the men and 11% of women were current smokers. Average height was 174.2 (SD 6.5) cm for men and 160.8 (SD 5.9) cm for women; median (IQR) BMI was 26.8 (24.5–29.3) for men and 27.1 (24.0–30.5) for women.

Dietary patterns in the Hertfordshire Cohort Study

Separate principal component analyses of the men's and women's dietary data identified almost identical patterns of foods (data not shown), so the data were combined. The first component, that explains the greatest variance in the dietary data, was characterised by high consumption of fruit, vegetables, oily fish and wholemeal cereals but by low consumption of white bread, added sugar, full-fat dairy products, chips

Table 1. Weekly consumption of selected foods according dietary pattern scores for 3,217 men and women in the Hertfordshire Cohort Study

Median (IQR)	Fifths of dietary pattern score				
	Lowest $n = 644$	$n = 643$	$n = 644$	$n = 643$	Highest $n = 643$
'*Prudent pattern*'					
Salad vegetables (portions)[a]	3.7 (1.5–6.0)	4.7 (2.7–8.0)	6.1 (3.7–9.0)	7.5 (5.0–10.2)	10.0 (7.0–14.0)
Apples, bananas & other fruit (portions)	5.5 (2.2–9.5)	8.5 (4.3–12.5)	10.0 (6.5–14.5)	12.9 (8.9–17.9)	16.7 (12.0–23.5)
Oily fish (portions)	0.5 (0.2–1.0)	0.5 (0.4–1.0)	0.7 (0.5–1.0)	1.0 (0.5–1.5)	1.5 (1.0–3.0)
Brown & wholemeal bread (slices)	0 (0–0.5)	0.3 (0–3.5)	2.8 (0.1–8.8)	3.5 (1.5–8.8)	8.8 (2.8–8.8)
White bread (slices)	8.8 (8.8–15.8)	8.8 (3.5–8.8)	3.5 (1.5–8.8)	2.8 (0.3–8.8)	0.3 (0–2.8)
Added sugar (teaspoons)	6.0 (1.0–12.0)	1.0 (0–5.0)	0 (0–2.0)	0 (0–1.0)	0 (0–0)
Full-fat spread (portions)	8.8 (3.5–15.8)	8.8 (1.5–8.8)	3.0 (0–8.8)	1.5 (0–7.0)	0 (0–3.5)
Processed meat[b]	5.5 (3.5–8.0)	4.0 (2.7–6.2)	3.5 (2.5–5.2)	3.0 (2–4.5)	2.2 (1.2–3.9)
Chips & roast potatoes (number of potatoes)	2.0 (1.5–4.0)	2.0 (1.2–2.8)	1.5 (1.0–2.0)	1.2 (0.7–2.0)	1.0 (0.4–1.5)
'*Traditional pattern*'					
Salad vegetables (portions)[a]	4.0 (1.6–6.5)	5.2 (3.0–8.0)	6.5 (4.0–9.5)	7.4 (4.2–10.9)	9.0 (6.0–13.0)
Root vegetables (portions)	1.5 (1.0–3.5)	3.2 (1.5–4.0)	3.5 (2.0–4.0)	3.5 (3.0–6.0)	4.0 (3.0–6.0)
Green vegetables (portions)[c]	6.0 (3.9–8.0)	7.5 (5.5–10.0)	8.5 (5.9–11.2)	10.0 (7.2–12.5)	12.0 (9.0–16.0)
Other vegetables (portions)[d]	2.0 (1.0–4.0)	3.5 (1.7–5.5)	4.5 (3.0–7.0)	5.7 (3.5–8.0)	7.5 (5.0–10.5)
Processed meat (portions)[b]	2.5 (1.5–4.0)	3.2 (2.0–5.0)	3.5 (2.2–5.5)	4.0 (2.5–5.7)	5.0 (3.0–7.7)
Beef, pork & lamb (portions)	1.7 (1.0–3.0)	2.0 (1.2–3.7)	2.5 (1.5–4.1)	3.0 (1.5–4.5)	3.5 (2.0–5.0)
Offal (portions)	0 (0–0.2)	0.2 (0–0.5)	0.2 (0–0.5)	0.2 (0–0.5)	0.5 (0–1.0)
White fish & shellfish (portions)[e]	1.2 (0.7–1.7)	1.5 (1.0–2.1)	1.5 (1–2.2)	1.7 (1.1–2.5)	2.0 (1.4–3.0)
Puddings (portions)	1.4 (0.7–2.7)	2.0 (1.0–3.7)	2.5 (1.0–4.5)	3.0 (1.5–5.2)	3.7 (1.7–7.0)
Eggs & egg dishes	1.0 (0.5–3.0)	1.0 (0.5–3.0)	3.0 (0.5–3.0)	3.0 (1.0–3.0)	3.0 (1.0–3.0)

[a]Includes lettuce, tomatoes, coleslaw; [b]includes bacon, sausages, meat pies; [c]includes cabbage, broccoli, peas; [d]includes onion, mushroom, beetroot; [e]includes processed fish products, shellfish.

Table 2. Associations between dietary pattern scores and nutrient intakes[a]

	Men ($n = 1,677$)		Women ($n = 1,540$)	
	Correlation with 'prudent' diet score	Correlation with 'traditional' diet score	Correlation with 'prudent' diet score	Correlation with 'traditional' diet score
Protein (g)	0.344*	0.303*	0.394*	0.280*
Fat (g)	−0.304*	0.103*	−0.383*	0.089†
Saturated fat (g)	−0.470*	−0.057‡	−0.557*	−0.089†
Carbohydrate (g)	0.138*	−0.223*	0.170*	−0.207*
Dietary fibre (g)	0.656*	0.277*	0.689*	0.325*
Retinol (μg)	−0.062‡	0.140*	−0.040	0.120*
Carotene (μg)	0.418*	0.397*	0.505*	0.424*
Thiamin (mg)	0.438*	0.191*	0.421*	0.165*
Riboflavin (mg)	0.343*	0.066†	0.324*	0.007
Vitamin B6 (mg)	0.483*	0.183*	0.488*	0.153*
Folate (μg)	0.566*	0.262*	0.540*	0.253*
Vitamin B12 (μg)	0.179*	0.232*	0.248*	0.223*
Vitamin C (mg)	0.522*	0.262*	0.524*	0.262*
Vitamin D (μg)	0.318*	0.147*	0.407*	0.167*
Vitamin E (mg)	0.375*	0.138*	0.388*	0.180*
Calcium (mg)	0.276*	−0.071†	0.267*	−0.115*
Iron (mg)	0.534*	0.208*	0.514*	0.186*
Zinc (mg)	0.363*	0.230*	0.328*	0.200*

[a]Nutrient intakes were adjusted for energy intake according to Willett's residual method [12]. Pearson's correlations between log-transformed nutrient intakes and dietary pattern scores: *$P < 0.001$; †$P < 0.01$; ‡$P < 0.05$.

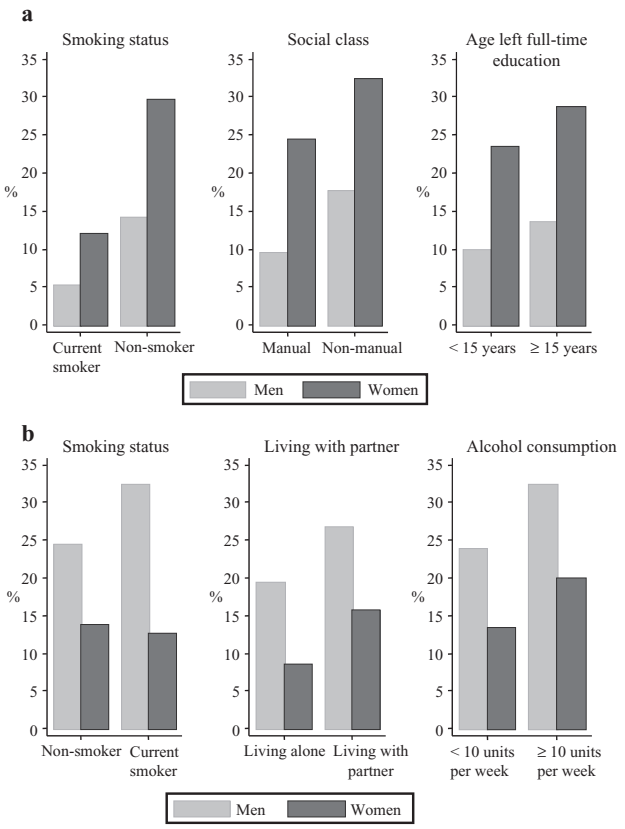

Figure 1. (a) Percentage of men and women with 'prudent' diet scores in the top fifths of the distribution (with high consumption of fruit, vegetables, oily fish, and wholemeal cereals), according to smoking status, social class and age at leaving full-time education. (b) Percentage of men and women with 'traditional' diet scores in the top fifths of the distribution (with high consumption of vegetables, processed & red meat, fish and puddings), according to smoking status, whether living with a partner and alcohol consumption.

and processed meat (please see Appendix 1 for the component coefficients, available at *Age and Ageing* online). This pattern of diet reflects recommendations for a healthy diet, and we called it a 'prudent' diet, to be consistent with other studies [13]. The second component was characterised by high consumption of green, root, salad and other vegetables, processed meat, offal, fish, red meat and puddings but by low consumption of milky drinks, reduced fat spread and breakfast cereals. This pattern was less easy to interpret. It may represent a more traditional pattern of eating, and we called it a 'traditional' pattern. We also examined a further two components identified by the PCA but they explained less of the variance (3.5 and 3.2%, respectively), and did not define meaningful or interpretable patterns of foods and we did not consider them further.

Variations in pattern scores were associated with large differences in food consumption. Weekly consumption of selected foods is shown in Table 1 according to variation in 'prudent' and 'traditional' dietary pattern scores. When comparing men and women who had low or high 'prudent' diet scores (in extreme fifths of the distribution), there were at least 2-fold differences in consumption of the foods that characterised this pattern. Variation in 'traditional' diet scores was also associated with marked differences in consumption of the foods that characterised the pattern, although in comparison with the 'prudent' dietary pattern, the differences tended to be smaller.

Nutrient intakes of the men and women studied are given in Appendix 2, available at *Age and Ageing* online. Table 2 shows the associations between dietary pattern scores and macronutrient and micronutrient intakes. 'Prudent' diet scores were inversely associated with fat intakes and positively associated with intakes of protein, fibre and most micronutrients. Whilst 'traditional' diet scores were also positively associated with intakes of protein, fibre and many micronutrients, the associations were less strong than those with 'prudent' diet scores and 'traditional' diet scores were also positively associated with fat intake. These patterns of associations were similar for men and women.

Correlates of dietary pattern scores

Women had higher 'prudent' diet scores than men [mean (SD) score 0.66 (1.74) vs −0.61 (2.07), $P < 0.001$], but lower 'traditional' diet scores [mean (SD) −0.35 (1.55) vs 0.33 (1.67) $P < 0.001$]. A total of 28% of women had high 'prudent' diet scores (in the top fifth of the distribution) compared with 13% of men; conversely, 14% of women had high 'traditional' diet scores (in the top fifth of the distribution) compared with 26% of men. Correlates of the dietary pattern scores were therefore considered separately for men and women.

In men, higher 'prudent' diet scores were associated with being a non-smoker ($P < 0.001$), of higher social class ($P < 0.001$), leaving full-time education at 15 years or above ($P = 0.002$) and having a moderately high alcohol consumption (22–35 units/week, $P = 0.02$). Each of these factors was independently related to the score. In women, the key correlates were similar; higher 'prudent' diet scores were found amongst non-smokers ($P < 0.001$), in women of higher social class ($P = 0.002$), who had left full-time education at 15 years or above ($P = 0.036$) and who had low or moderate alcohol consumption (1–14 units/week $P = 0.001$). These associations were independent. In both men and women, 'prudent' diet score was not related to BMI and did not differ according to whether living with a partner or not. The most important factors associated with the 'prudent' pattern are illustrated in Figure 1a; the proportion of men and women with high 'prudent' diet scores are shown according to smoking status, social class and age at leaving full-time education.

Higher 'traditional' diet scores in men were associated with heavier alcohol consumption (drinking more than 11 units of alcohol per week, $P < 0.05$), leaving school before 15 years ($P = 0.001$), being a smoker ($P = 0.034$) and in men who were married ($P < 0.001$) or living with a partner

($P = 0.029$). Each of these factors was independently related to the 'traditional' diet score. Higher scores were found amongst women who drank alcohol (all levels of consumption, $P < 0.05$), and amongst women who were married ($P = 0.015$) or living with a partner ($P = 0.022$); these associations were independent. Unlike the men, there were no associations with age at leaving school or smoking status. 'Traditional' diet scores were not related to BMI in men or women. The proportion of men and women with high 'traditional' diet scores are shown according to variations in the key correlates in Figure 1b.

Discussion

We have used PCA to identify two patterns of diet in a large cohort of older community-dwelling men and women living in the UK. Variations in compliance with these dietary patterns are indicative of large differences in food consumption and in nutrient intake that are likely to have implications for future health. The patterns have specific socio-demographic correlates that provide insights into the contexts within which good and poor patterns of diet are found amongst older adults, and may help in the identification of opportunities for dietary intervention.

'Prudent' dietary pattern

The most important, and most interpretable pattern of diet was characterised by high consumption of fruit, vegetables, oily fish and wholemeal cereals but by low consumption of white bread, added sugar, full-fat dairy products, chips and processed meat. This pattern of diet reflects 'healthy eating' guidelines, and we called it a 'prudent' diet in common with studies of younger adults [13–15].

There are few studies of the dietary patterns of older adults in the UK with which we can compare our findings directly. In the EPIC-Elderly study of 100,000 men and women in nine European countries who were aged 60 years or older, the first principal component identified a 'vegetable-based diet', characterised by high consumption of fruit, vegetables and legumes [6], which is comparable with the 'prudent' pattern that we observed. In our study, high 'prudent' diet scores were associated with lower fat intakes and with higher intakes of many micronutrients. This favourable profile of nutrient intake would be expected to be beneficial for future health. However, although high 'prudent' diet scores have been related to lower cardiovascular and cancer risk [13–15], and a 1 SD increase in the vegetable-based pattern score was associated with a reduction of 14% in all-cause mortality amongst the older adults in the EPIC-elderly study, this relationship was not evident in the UK [7]. Ongoing follow-up of the men and women in the Hertfordshire Cohort will enable us to address how the 'prudent' dietary pattern we identified relates to morbidity and mortality in these older adults.

'Traditional' dietary pattern

The second pattern was characterised by high consumption of vegetables, processed meat, offal, fish, red meat and puddings but by low consumption of milky drinks, reduced fat spread and breakfast cereals. This pattern was less easily interpreted than the 'prudent' pattern, and its significance is less clear. It is comparable to the second component identified in the National Diet and Nutrition Survey of younger adults in the UK [16], but differs from the second ('sweet and fat dominated') pattern found in the EPIC-Elderly study [6]. The 'traditional' pattern was less strongly associated with nutrient intake, and the pattern of associations differed from the 'prudent' pattern. Without follow-up data, it is not possible at this stage to assess its importance for future health.

Context of different dietary patterns

We examined a number of socio-demographic factors in relation to variations in 'prudent' and 'traditional' diet scores. For both dietary patterns, a key influence on dietary pattern scores was gender; high 'prudent' diet scores were twice as common in women than in men, whilst the reverse was true for high 'traditional' diet scores. The finding that women have higher scores for a 'healthy' dietary pattern is consistent with the findings of the EPIC-Elderly study [6], although surprising as the majority of the men and women that we studied were living with a partner, and we might have expected the diets of such older men and women to be more comparable. Living with a partner was only related to the 'traditional' dietary pattern and was associated with higher scores in both men and women. One explanation for this may be that diets characterised by high consumption of meat and vegetables necessarily include more cooked meals, and are therefore less common among older men and women who live alone.

Higher 'prudent' diet scores were more common among men and women of higher social class, who left full-time education at an older age and who were non-smokers. These influences on 'healthier' patterns of eating have been observed in other studies [6, 17] and are likely to reflect greater compliance with general health recommendations. In comparison with the 'prudent' pattern, there were fewer factors associated with the 'traditional' dietary pattern—particularly amongst women. A key relationship was with alcohol consumption—with higher 'traditional' diet scores found amongst men and women who had moderate and heavy alcohol consumption. The explanation for this relationship is not clear.

These correlates of the dietary patterns should provide insights into the contexts within which different food choices are made. For example, if healthier patterns of eating are much less common amongst older men, this has implications for health promotion in this age group. Our data also suggest that efforts to address the quality of the diets of older men and women need to consider variations in smoking behaviour and alcohol consumption.

Strengths & weaknesses

We studied a large population of older men and women living in the community. Although membership of this cohort was defined by area of birth, and there has been loss to follow-up, the participants' characteristics are comparable with those of the wider community [8], and the dietary patterns we describe should be of relevance to older adults in other parts of the UK. We assessed diet using an administered FFQ [10]. Whilst there is concern that FFQ can be prone to measurement error [18], they have been shown to define patterns in a comparable way to other dietary assessment methods [19, 20]. A weakness of our study is that the data are cross-sectional, and we do not yet know how well the patterns that we describe reflect dietary habits in the past, or how stable these patterns will be in the future.

Key points

- Dietary patterns analysis takes account of the combined effects of foods, and may be a more meaningful way of assessing dietary exposure than considering individual nutrients.
- There is an extensive literature on the dietary patterns of middle-aged adults, but our knowledge of the dietary patterns of older men and women is very limited.
- In a large cohort of older men and women in the UK, we have described two patterns of diet that reflect large differences in food consumption, that are likely to have implications for future health.

Acknowledgements

We thank all the men and women who took part in the Hertfordshire Cohort Study (HCS), the HCS research staff and Vanessa Cox who managed the data. This work was supported by the Medical Research Council, UK.

Conflicts of interest

None.

Supplementary data

Supplementary data are available at *Age and Ageing* online.

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Received 16 December 2008; accepted in revised form 4 June 2009