Education Attenuates the Association between Dietary Patterns and Cognition

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Key Words

Nutrition • Cognitive functions • Population-based study • Education

Abstract

Background/Aims: Various foods have been shown to be associated with cognitive outcomes. As individual food items are not consumed in isolation, we examined the association between dietary patterns and cognitive function, with special attention to the role of education in this association. **Methods:** Analyses were carried out on 4,693 stroke-free white European participants of the Whitehall II study. Two dietary patterns were determined using principal component analysis: a ‘whole food’ and a ‘processed food’ pattern. Cognitive function was assessed using a battery of 5 tests. **Results:** After adjustment for demographic, behavioral and health measures, higher intake of ‘whole food’ diet was associated with lower and high consumption of ‘processed food’ with higher odds of cognitive deficit. However, adjustment for education significantly attenuated most of these associations. **Conclusions:** Education, through its role as a powerful confounder, shapes the relationship between dietary patterns and cognitive deficit in a healthy middle-aged UK cohort.

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Introduction

Cognitive impairment and dementia are among the most prevalent of the aging-related pathologies and the world faces an increase in both the number of elderly people and lifespan at the oldest ages [1]. The association between nutrition and cognition has increasingly been investigated in the last decade [2, 3]. Studies on single nutrients or foods associated with cognition constitute the large majority of the literature [3], while studies that examine the associations with dietary patterns are limited [3, 4].

A number of factors, sociodemographic, health behaviors and chronic diseases, are associated both with nutrition and cognition [5], making it important to consider them as potential confounders in the analysis of the association between nutrition and cognition. The role of education may be important as it has been shown to shape food choices [6, 7]. Further, there is extensive evidence to suggest that high education might delay or protect from cognitive impairment [8–11]. As the onset of dementia is insidious with the underlying pathologies believed to be active many years before clinical expression, it is important to examine risk factors for cognitive deficit and decline earlier than in elderly populations. The objective of this study was to examine the association between nutri-

tion typologies, rather than 'single nutrients', and cognition in a middle-aged population. A further objective was to investigate the influence of sociodemographic factors, health behaviors and health measures on this association, with special attention to the role of education.

Subjects and Methods

Study Population

The target population for the Whitehall II study was all London-based office staff, aged 35–55 years, working in 20 civil service departments. The cohort consisted of 10,308 participants at the first phase in 1985 [12]. A total of 6,767 participants completed the phase 7 medical examination (2002–2004). Analyses in this study were restricted to the 4,693 white European participants with data on cognitive function, dietary assessments and all co-variables at phase 7. Black ($n = 93$) and Asian ($n = 197$) participants were excluded due to differences in eating behavior. We also excluded participants with self-reported stroke or transient ischemic attack ($n = 120$).

After complete description of the study to the subjects, written informed consent was obtained. The University College London ethics committee approved the study.

Dietary Assessment

A machine-readable Food Frequency Questionnaire (FFQ) [13] based on one used in the US Nurses Health study [14] was sent to the participants. The food list (127 items) in the FFQ was anglicized, and foods commonly eaten in the UK were added [15]. A common unit or portion size for each food was specified, and participants were asked how often, on average, they had consumed that amount of the item during the previous year. Response to all items was on a 9-point scale, ranging from 'never or less than once per month' to 'six or more times per day'. The selected frequency category for each food item was converted to a daily intake.

According to the nutrient profile and culinary use of food items, the 127 items of the FFQ were grouped in 37 predefined food groups (by adding food items within each group; Appendix 1). Dietary patterns were identified using principal component analysis of these 37 groups. The factors were rotated by an orthogonal transformation (varimax rotation function in SAS; SAS Institute, Cary, N.C., USA) to achieve a simple structure, allowing greater interpretability. Two dietary patterns were identified using multiple criteria: the diagram of eigenvalues, the scree plot, the interpretability of the factors and the percentage of variance explained by the factors (table 1). The factor score for each pattern was calculated by summing intakes of all food groups weighted by their factor loadings. Factor loadings represent correlation coefficients between the food groups and particular patterns. The first pattern was heavily loaded by high intake of vegetables, fruits, dried legume and fish, labeled the 'whole food' pattern. The second pattern, labeled 'processed food', was heavily loaded by high consumption of sweetened desserts, chocolates, fried food, processed meat, pies, refined grains, high-fat dairy products, margarine and condiments. Each participant received a factor score for each identified pattern. Factor analysis does not group individuals into clusters; instead, all individuals contribute to

Table 1. Factor loading¹ for high-loading items (≥ 0.40)² on the two dietary patterns

	'Whole food' pattern	'Processed food' pattern
Leafy vegetables	0.68	–
Other vegetables	0.67	–
Cruciferous vegetables	0.57	–
Tomatoes	0.55	–
Fruits	0.53	–
Fish	0.46	–
Salad dressing	0.43	–
Peas and dried legume	0.42	–
Desserts/biscuits	–	0.55
Chocolate and sweets	–	0.50
Fried food	–	0.49
Processed meats	–	0.46
Quiche/pie	–	0.45
Margarine	–	0.44
Refined grain	–	0.41
High-fat dairy products	–	0.41
Condiments	–	0.41

¹ The two dietary patterns were identified using principal component analysis. Factor loadings issued from orthogonal rotation represent the correlation between the factors and individual items from the food group.

² The factor score for each pattern was calculated by summing intakes of the 37 predefined food groups (see Appendix 1) weighted by their factor loadings. In order to simplify interpretation of the two patterns, values < 0.40 were not listed in the table.

both factors and it is the homogeneity between food items that defines the factors. To assess the validity of the dietary patterns resulting from this a posteriori food grouping, we performed the principal component analyses using the 127 individual food items, and the results obtained were similar.

Cognitive Function

The cognitive test battery [16] consisted of 5 standard tasks chosen to comprehensively evaluate cognitive functioning in white-collar middle-aged adults, ensuring that the tests did not create problems with ceiling effects. High scores on all tests denote better performance. The first was a 20-word free-recall test of short-term verbal memory. Participants were presented with a list of 20 one- or two-syllable words at 2-second intervals and were then asked to recall in writing as many of the words as they could, in any order; they had 2 min to do so. Next was the AH4-I [17], composed of a series of 65 verbal and mathematical reasoning items of increasing difficulty. This test of inductive reasoning measures the ability to identify patterns and infer principles and rules. Participants had 10 min to complete this section. This was followed by the Mill Hill Vocabulary Test [18] that assesses knowledge of verbal meaning and encompasses the ability to recognize and comprehend words. We used this test in its multiple format,

Table 2. Characteristics of the sample as a function of the dietary patterns at phase 7 (2002–2004)

	'Whole food' dietary pattern				'Processed food' dietary pattern			
	tertile 1 ^a (n = 1,564)	tertile 2 ^a (n = 1,565)	tertile 3 ^a (n = 1,564)	p for trend	tertile 1 ^a (n = 1,564)	tertile 2 ^a (n = 1,565)	tertile 3 ^a (n = 1,564)	p for trend
Women, %	24.2	24.3	30.1	<10–4	38.5	25.2	14.9	<10–4
Age ^b , years	60.7 (5.9)	61.1 (6.0)	61.3 (5.9)	0.02	60.9 (5.8)	61.0 (5.9)	61.2 (6.2)	0.45
Single or divorced, %	24.1	17.3	16.3	<10–4	20.9	17.6	19.2	<10–4
No academic qualification, %	13.0	8.6	6.9	<10–4	8.2	8.8	8.2	0.05
Current smoker, %	14.7	9.3	8.6	<10–4	9.4	10.9	12.3	0.02
Low level of physical activity, %	19.7	12.7	11.5	<10–4	15.5	14.1	14.4	0.59
Diabetic, %	5.9	5.9	5.9	0.98	4.8	6.8	5.9	0.06
With hypertension, %	34.6	35.8	36.8	0.45	36.1	36.9	34.3	0.32
Dyslipidemic, %	39.2	38.9	37.4	0.54	39.8	40.0	35.7	0.02
With CHD, %	6.3	7.1	6.6	0.64	6.1	6.3	7.5	0.22
BMI ^b	26.6 (4.3)	26.5 (4.0)	26.5 (4.2)	0.48	26.3 (4.4)	26.6 (4.1)	26.6 (4.0)	0.17
GHQ score ^b	77.1 (15.8)	77.6 (15.3)	78.3 (15.0)	0.09	77.5 (16.2)	78.5 (14.5)	77.0 (15.4)	0.02
Total energy ^b , kcal/day	1,927 (568)	2,186 (551)	2,489 (666)	<10–4	1,723 (405)	2,115 (393)	2,765 (596)	<10–4

GHQ = General Health Questionnaire.

^a Tertiles 1, 2 and 3 represent individuals in the lowest, intermediate and highest thirds of the dietary factor score.

^b For continuous variables, means with standard deviation in parentheses were given.

which consists of a list of 33 stimulus words ordered by increasing difficulty and 6 response choices. Finally, we used two measures of verbal fluency: phonemic and semantic [19]. Phonemic fluency was assessed via 's' words and semantic fluency via 'animal' words. Subjects were asked to recall in writing as many words beginning with 's' and as many animal names as they could. One minute was allowed for each test of fluency. Test-retest reliability of these measures was estimated from a reexamination on a subsample of 556 participants who returned for a medical examination within a month of their original screening. These estimates for the various tests are as follows: $r = 0.58$ for the short-term verbal memory, $r = 0.87$ for the AH4-I, $r = 0.85$ for the Mill Hill Vocabulary Test, $r = 0.68$ for the phonemic fluency and $r = 0.71$ for the semantic fluency test.

Covariates

Sociodemographic variables consisted of age, gender, marital status (married or cohabited, single, divorced, widowed) and education, regrouped into 5 levels (no formal education, lower secondary education, higher secondary education, university degree, higher university degree). Health behaviors measured were smoking habits (nonsmoker, former, current smoker) and physical activity, converted into MET scores [20] and categorized as 'mildly energetic' (MET values below 3), 'moderately energetic' (MET values ranging from 3 to 6) and 'vigorous' (MET values of 6 or above) physical activity. Health status was ascertained by prevalence of coronary heart disease (CHD), based on clinically verified events and included nonfatal myocardial infarction and definite angina as described previously [21], diabetes (diagnosed according to WHO definition), hypertension (systolic/diastolic blood pressure $\geq 140/90$ mm Hg or use of hypertensive drugs), dyslipidemia (low-density lipoprotein cholesterol ≥ 4.1 mmol/l or use of lipid-lowering drugs), BMI and mental health (using the 30-item General Health Questionnaire) [22].

Statistical Analysis

Cognitive deficit was defined as performances in the worst sex-specific quintile. Among men (women), this corresponded to scores ≤ 5 (5) for memory, ≤ 39 (31) for reasoning, ≤ 24 (21) for vocabulary, and ≤ 13 (12) for phonemic and semantic fluency. Logistic regression was used to model the association between the tertiles on the two factors representing the two dietary patterns and cognitive deficit. In the first model (M1), the analyses were adjusted for sex, age and energy intake. In the fully adjusted model (M2), the analyses were further adjusted for marital status, health behaviors and health measures. All the analyses were carried out first without and then after adjustment for education. Interaction between dietary patterns and education was also tested, and analyses of the association between dietary patterns and cognition stratified by education (by grouping no formal education and lower secondary education together and levels above higher secondary education) were performed. All analyses were conducted with the use of SAS software, version 9 (SAS Institute).

Results

Compared to the 6,767 stroke-free participants still alive at phase 7, participants included in the analyses ($n = 4,693$) were less likely to be women (26.2 vs. 39.2%) or to have no academic qualifications or lower secondary education (30.7 vs. 45.0%).

Sample characteristics as a function of the tertiles of the two dietary patterns, 'whole food' and 'processed food', are shown in table 2. Tables 3 and 4 show the association between the tertiles of the 'whole food' (table 3)

Table 3. Association between tertiles of the ‘whole food’ pattern and cognitive deficit

		Without adjustment for education						After adjustment for education					
		T1 ^a	T2 ^a		T3 ^a		p for trend	T1 ^a	T2 ^a		T3 ^a		p for trend
		OR	OR	95% CI	OR	95% CI		OR	OR	95% CI	OR	95% CI	
Memory	M1	1	0.79	0.65–0.97	0.67	0.54–0.84	0.002	1	0.87	0.71–1.07	0.78	0.62–0.98	0.09
	M2	1	0.85	0.69–1.05	0.74	0.59–0.93	0.03	1	0.93	0.75–1.15	0.85	0.68–1.08	0.42
Reasoning	M1	1	0.68	0.57–0.82	0.64	0.53–0.77	<10 ^{−4}	1	0.81	0.67–0.98	0.85	0.70–1.05	0.08
	M2	1	0.73	0.61–0.88	0.69	0.57–0.84	0.0002	1	0.86	0.71–1.04	0.92	0.75–1.13	0.31
Vocabulary	M1	1	0.68	0.57–0.81	0.55	0.45–0.67	<10 ^{−4}	1	0.84	0.70–1.02	0.78	0.63–0.96	0.04
	M2	1	0.68	0.56–0.81	0.54	0.44–0.66	<10 ^{−4}	1	0.82	0.68–1.00	0.75	0.60–0.92	0.02
Phonemic fluency	M1	1	0.77	0.64–0.92	0.72	0.59–0.88	0.002	1	0.87	0.72–1.05	0.89	0.73–1.10	0.32
	M2	1	0.83	0.69–1.00	0.80	0.66–0.98	0.06	1	0.94	0.77–1.13	0.98	0.80–1.21	0.77
Semantic fluency	M1	1	0.66	0.56–0.79	0.57	0.47–0.68	<10 ^{−4}	1	0.75	0.63–0.90	0.70	0.57–0.85	0.0004
	M2	1	0.69	0.58–0.82	0.59	0.50–0.72	<10 ^{−4}	1	0.78	0.65–0.93	0.72	0.59–0.88	0.002

M1 = Adjusted for age, sex and energy intake; M2 = model 1 + adjusted for marital status, health behavior (smoking habits, physical activity) and health status (diabetes, hypertension, CHD, dyslipidemia, BMI and mental health); T = tertile.

^a Tertiles 1, 2 and 3 represent individuals in the lowest, intermediate and highest thirds of the dietary factor score.

Table 4. Association between tertiles of the ‘processed food’ pattern and cognitive deficit

		Without adjustment for education						After adjustment for education					
		T1 ^a	T2 ^a		T3 ^a		p for trend	T1 ^a	T2 ^a		T3 ^a		p for trend
		OR	OR	95% CI	OR	95% CI		OR	OR	95% CI	OR	95% CI	
Memory	M1	1	1.17	0.94–1.46	1.40	1.06–1.85	0.06	1	1.06	0.85–1.32	1.15	0.87–1.55	0.61
	M2	1	1.13	0.91–1.41	1.26	0.95–1.67	0.26	1	1.03	0.83–1.29	1.06	0.79–1.41	0.92
Reasoning	M1	1	1.37	1.13–1.66	1.68	1.31–2.14	<10 ^{−4}	1	1.14	0.93–1.39	1.15	0.89–1.49	0.43
	M2	1	1.34	1.10–1.62	1.55	1.21–1.98	0.001	1	1.12	0.91–1.37	1.09	0.84–1.42	0.55
Vocabulary	M1	1	1.62	1.33–1.96	2.45	1.92–3.14	<10 ^{−4}	1	1.33	1.08–1.63	1.63	1.25–2.13	0.001
	M2	1	1.58	1.30–1.92	2.36	1.84–3.04	<10 ^{−4}	1	1.31	1.07–1.62	1.63	1.25–2.13	0.001
Phonemic fluency	M1	1	1.26	1.04–1.53	1.83	1.43–2.35	<10 ^{−4}	1	1.10	0.90–1.34	1.42	1.10–1.83	0.02
	M2	1	1.23	1.01–1.49	1.70	1.33–2.19	10 ^{−4}	1	1.07	0.88–1.32	1.34	1.04–1.74	0.06
Semantic fluency	M1	1	1.21	1.00–1.45	1.68	1.33–2.12	<10 ^{−4}	1	1.04	0.86–1.26	1.28	1.00–1.63	0.10
	M2	1	1.17	0.97–1.42	1.58	1.25–2.01	0.0005	1	1.02	0.84–1.24	1.23	0.96–1.57	0.17

M1 = Adjusted for age, sex and energy intake; M2 = model 1 + adjusted for marital status, health behavior (smoking habits, physical activity) and health status (diabetes, hypertension, CHD, dyslipidemia, BMI and mental health); T = tertile.

^a Tertiles 1, 2 and 3 represent individuals in the lowest, intermediate and highest thirds of the dietary factor score.

and ‘processed food’ (table 4) dietary patterns and cognitive deficit, defined as performance in the worst quintile for each cognitive test. In analyses unadjusted for education, being in the highest tertile of the ‘whole food’ dietary pattern was associated with lower odds of deficit on all cognitive tests (table 3). On the other hand, participants with high intake of ‘processed food’ compared to those with a low intake had higher odds of cognitive deficit for reasoning (odds ratio, OR = 1.55; 95% confidence

interval, CI = 1.21–1.98), vocabulary (OR = 2.36; 95% CI = 1.84–3.04), phonemic (OR = 1.70; 95% CI = 1.33–2.19) and semantic fluency (OR = 1.58; 95% CI = 1.25–2.01), but not for memory (OR = 1.26; 95% CI = 0.95–1.67) in analyses adjusted for marital status, health behaviors and health status (M2, table 4). However, adjustment for education attenuated all associations. The lower odds of cognitive deficit associated with higher intake of ‘whole food’ only remained significant for vocabulary (OR =

0.75; 95% CI = 0.60–0.92) and semantic fluency (OR = 0.72; 95% CI = 0.59–0.88) (table 3). Similarly, the higher odds of cognitive deficit associated with greater intake of ‘processed food’ remained significant for vocabulary (OR = 1.63; 95% CI = 1.25–2.13) and phonemic fluency (OR = 1.34; 95% CI = 1.04–1.74) (table 4).

The interaction term between the dietary patterns and education (by grouping no formal education and lower secondary education together and levels above higher secondary education) did not provide any evidence for a moderating effect for education (all *p* values between 0.12 and 0.89). In analyses stratified by education, there was no evidence of different associations between diet and cognition in the different education groups (results not shown).

Discussion

We examined associations between two distinct dietary patterns, i.e. ‘whole food’ (rich in fruit, vegetables, dried legume and fish) and ‘processed food’ (rich in processed meat, chocolates, sweet desserts, fried food, refined cereals and high-fat dairy products), and cognitive deficit in a middle-aged population. In the fully adjusted models, but without taking into account the influence of education, our results suggested that the ‘whole food’ pattern was associated with lower and the ‘processed food’ pattern with increased odds of cognitive deficit. However, adjustment for education considerably attenuates these associations, suggesting that education is an important confounder in the association between nutrition and cognition.

While dietary patterns have been investigated in relation to several chronic diseases such as cardiovascular diseases [23], or diabetes [24], studies on the relation between dietary patterns and cognitive functioning are less frequent. One exception is a recent study [4] that examined the association between dietary pattern, using dietary indices, and the risk of Alzheimer’s disease and cognitive decline in an elderly population. They showed that high adherence to a Mediterranean diet [25] decreased the risk of cognitive decline and Alzheimer’s disease in a nondemented, multiethnic elderly cohort (*n* = 2,258, mean age 77.2 ± 6.6 years). This association remained significant after adjustment for education. The use of an ‘a priori’ definition like the Mediterranean score presents the inconvenience of weighting equally the underlying individual food component categories, which, in turn, are composed of a number of food constituents. Using an

‘a posteriori’ factor analysis, our results, unadjusted for education, support those reported using the Mediterranean diet [4] by suggesting that a diet rich in fruits, vegetable and fish is associated with lower odds of cognitive deficit while a diet rich in processed meat, chocolates and sweeteners, desserts, fried food, refined grains and high-fat dairy products is associated with greater odds of cognitive deficit.

In our analysis, the diet and cognition relationship remained unchanged after adjustment for sex, age, energy intake, marital status, physical activity, smoking habits, chronic diseases (diabetes, dyslipidemia, CHD, hypertension), BMI and mental health. Our finding, before adjustment for education, of a relationship between the ‘whole food’ dietary pattern and cognitive deficit is supported, partly, by results of two prospective studies that found high intake of vegetables to be associated with a slower rate of cognitive decline at older ages [26, 27]. The beneficial effect of fruits and vegetables on cognition could be a result of high amounts of antioxidants in these foods. However, the literature on the association between antioxidant levels in the blood or estimated from food intake and cognitive performances or dementia is inconsistent and dependent on the specific nutrient examined [28]. Our ‘whole food’ dietary pattern also included a high intake of fish and there is consistent evidence to support this finding. Many studies have shown high fish consumption to be associated with low incidence of dementia [29, 30] including Alzheimer’s diseases [29–31], slower cognitive decline in elderly [32, 33] and lower cognitive impairment in a middle-aged population [34]. The protective effects of fish consumption has been traditionally attributed to its high content in long-chain omega-3 polyunsaturated fatty acids which are a major component of neuron membranes and have vascular and anti-inflammatory properties [35]. Then, the association between the ‘whole food’ diet and cognition observed in our study could be explained by the cumulative and synergic effect of nutrients from different sources of foods rather than by the effect of one isolated nutrient.

The ‘processed food’ factor described in our study was highly loaded by sweets, desserts, fried food, processed food, refined grain products and high-fat dairy products and was very close to the ‘Western’ pattern defined in the American population [36] which has been shown to be correlated with markers of systemic inflammation [37]. Several lines of investigation have suggested that inflammation is involved in the pathogenesis of dementia [38–42]. However, the association between inflammation and cognition is still under debate [43] and more studies are

needed to better understand the association between the 'processed food' intake, inflammation process and cognition.

In this middle-aged British population, we showed education to influence the relationship between dietary pattern and cognition. The test for interaction suggests that it does not moderate the association between dietary factors and cognition, in that the diet-cognition association is similar in high- and low-education groups. The attenuation of the diet-cognition association after adjustment for education is a statistical result and could suggest two things. One, that education mediates the association between dietary factors and cognition in that dietary factors influence education which then influences cognition. However, the first part of this causal chain is unlikely as education was assessed prior to the dietary measures, and it appears unlikely that dietary factors influence education in this way. The second explanation for the substantially attenuated association between dietary patterns and cognition is that education acts as a confounder. Previous research shows that education is linked to dietary behavior [6, 7], the exposure being considered here and cognition [8–11], the outcome. Thus, we argue that education plays an important confounding role in the association between dietary patterns and cognition. The fact that this effect for education is evident after adjustment for multiple covariates is remarkable, particularly as Whitehall II is a white-collar middle-aged cohort.

The confounder role of education could work in several ways. One, education is associated with dietary habits and nutrient intake. Low education is associated with poor health behaviors, smoking, and less regular physical activity. Thus, participants with lower education have less healthy eating patterns compared to those with higher education. Furthermore, there is some evidence to show that lower socioeconomic position, of which education is a measure, is associated with purchase of foods that are cheaper per unit of energy rather than foods rich in protective nutrients [44–47]. Finally, low education is also related to poorer health-related nutrition knowledge [6, 7] which determines food choice. Second, education as a risk factor of cognitive impairment could confound the diet-cognition relationship. Low education has been shown to be associated with increased risk of dementia [8–11]. These observations are supported by the cognitive reserve hypothesis [48, 49], which stipulates that cognitive reserve delays the onset of clinical manifestations of dementia.

Our study has several potential limitations. First, the use of a semi-quantitative food questionnaire, only on specific foods, is recognized to be less precise than di-

etary assessment using a diary questionnaire. However, in this study population, at a previous wave of data collection, we have shown that nutrient intakes estimated by the FFQ method were well correlated with biomarker levels and with intake estimates from the generally more accurate 7-day diary [13]. Second, the cross-sectional framework of the analyses makes it impossible to draw causal inferences on the association between nutrition and cognition. Third, Whitehall II study participants are office-based civil servants, who are not fully representative of the British population [12, 50]. Finally, the factor analysis approach used to identify these patterns involves several arbitrary decisions such as the consolidation of food items into food groups, the number of factors extracted, the methods of rotation or labeling of the factors [51].

Despite these limitations, by considering an overall diet approach rather than a 'single' nutrient or food approach, our study is the first to show, in a middle-aged general population, that education, through its role as a powerful confounder, shapes the relationship between the two dietary patterns – 'whole food' and 'processed food' pattern – and cognitive function.

Acknowledgments

The authors thank all of the participating civil service departments and their welfare, personnel, and establishment officers; the British Occupational Health and Safety Agency; the British Council of Civil Service Unions; all participating civil servants in the Whitehall II study, and all members of the Whitehall II study team. The Whitehall II study has been supported by grants from the British Medical Research Council (MRC); the British Heart Foundation; the British Health and Safety Executive; the British Department of Health; the National Heart, Lung, and Blood Institute (grant HL36310); the National Institute on Aging (grant AG13196); the Agency for Health Care Policy and Research (grant HS06516), and the John D. and Catherine T. MacArthur Foundation Research Networks on Successful Midlife Development and Socioeconomic Status and Health. A.S.-M. is supported by a 'European Young Investigator Award' from the European Science Foundation. M.G.M. is supported by an MRC research professorship. The sponsors did not participate in the design and conduct of the study; collection, management, analysis, and interpretation of the data, or preparation, review, or approval of the manuscript.

Appendix 1: Food Groups Used for Factor Analyses

Foods or food groups	Food items	Foods or food groups	Food items
Red meat	Beef, beef burgers, pork, lamb	Fruit juice	100% real fruit juice
Poultry	Chicken or other poultry	Leafy vegetables	Spinach, salads
Processed meats	Bacon, ham, corned beef, spam, luncheon meats, sausages	Cruciferous vegetables	Broccoli, kales, Brussels sprouts, cabbage, cauliflower, coleslaw
Organ meat	Liver	Other vegetables	Carrots, marrow, courgettes, parsnip, leeks, mushroom, peppers, onion, garlic
Fish	White fish, oily fish and shellfish	Tomatoes	Tomatoes
Refined grain	White bread and rolls, cream cracker, cheese biscuits, crisp bread, refined grain ready-to-eat cereals, white pasta, white rice	Peas and dried legume	Beans, peas, baked beans, dried lentils
Whole grain	Brown bread and rolls, wholemeal bread and rolls, wholemeal pasta, brown rice, whole grain ready-to-eat cereals	Soup	Vegetable soup, meat soup
Eggs	Eggs	Nuts	Peanuts, other nuts, peanut butter
Butter	Butter	Potatoes	Boiled, mashed potatoes, jacket potatoes, potato salad
Margarine	Margarines, spread	Quiche/pie	Quiche, meat pie
High-fat dairy	Full cream milk, Channel Island milk, coffee whitener, single or clotted cream, cheese, ice cream	Pizza/lasagne	Pizza, lasagne
Low-fat dairy	Skimmed milk, sterilized milk, dried milk, yoghurt, cottage cheese	Fried food	Chips or French fries, roast potatoes, fish fingers, fried fish in batter
Soya product	Soya milk, tofu, soya bean curd, soya meat, TVP, veggie-burger	Snacks	Crisps
Liqueurs/spirits	Port, sherry, liqueurs, spirits	Desserts/biscuits	Sweet biscuits, cakes, buns, pastries, fruit pies, tarts, crumbles, milk pudding, sponge puddings
Wine	Wine	Chocolate and sweets	Chocolate bars, sweets, toffees, sugar added to tea, coffee, jam, marmalade, honey
Beer	Beers, ciders	Sugar beverages	Fizzy soft drinks, fruit squash
Hot drinks	Tea, regular coffee, decaffeinated coffee, cocoa, hot chocolate, chicory	Low-calorie beverages	Low-calorie or diet fizzy soft drinks
Fruits	Apples, pears, oranges, mandarins, grapefruit, bananas, grapes, melon, peaches, plums, apricots, strawberries, raspberries, tinned fruit, dried fruits	Condiments	Sauce, tomato ketchup, pickles, marmites
		Salad dressing	French vinaigrette, salad cream

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