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The impact of inter-generational social and regional circumstances on dietary intake patterns of British adults: results from the 1946 British Birth Cohort

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Abstract

Objectives: (1) To determine the extent to which an individual's childhood social circumstances and region of residence influence their dietary pattern at age 43 years and (2) to establish the extent to which an individual adopts the dietary pattern of their social and regional circumstances at age 43 years.
Design: Longitudinal study of a social class stratified, random sample of all legitimate, singleton births in the week of 3–9 March 1946.
Settings: England, Scotland and Wales.
Subjects: The 3187 survey members who provided sociodemographic information at age 4 years in 1950 and sociodemographic and dietary data (48-hour dietary recall) at 43 years in 1989.
Results: People who remained in the non-manual social class consumed significantly higher amounts of food items correlated with the factor *health aware* (items include high-fibre breakfast cereals, wholemeal breads, apples and bananas) than those who remained in the manual social class. Those who made the transition from manual social class in childhood to non-manual social class at age 43 years partly adopted the distinctive dietary patterns of the non-manual social classes. Consumption of items in the factors *refined* (items include whole-fat milk, white bread, sugar and butter) and *sandwich* (items include tomatoes, lettuce, onions, bacon and ham) did not differ by social class or regional mobility.
Conclusions: This work suggests that although adult dietary patterns are developed as a result of childhood influences, these patterns can be modified as a result of social and regional transitions. Such changes in dietary patterns may influence susceptibility to disease.

Keywords
Social mobility
Childhood
Adulthood
Social class
Region of residence
Dietary pattern

Studies have demonstrated a cumulative influence of social circumstances throughout life on mortality risk[1,2]. Attention has been focused on mortality with respect to cardiovascular disease (CVD), and risk factors, both behavioural and physiological, have been identified as being influenced by past and/or present socio-economic circumstances[3]. However, the relative importance of childhood and adult socio-economic circumstances is not clear. Poorer socio-economic status in childhood has been associated with a greater risk of stroke in Scotland, even in those men who achieved upward social mobility[4]. However, studies of a London cohort showed that cardiovascular risk factors in adulthood are more strongly related to adult than to childhood socio-economic circumstances[5]. Alongside this, epidemiological evidence suggests that certain foods, in particular fruit and vegetables, protect against CVD[6,7] and some cancers[8], and that a high intake of dietary fat is associated with increased risk for CVD, obesity and type II diabetes[9]. A large part (60–85%) of the variability of eating patterns has been shown to be due to environmental factors in a study of American twins aged 50 years or more, although there were also genetic influences[10]. Regional changes and subsequent effects on diet have been investigated in relation to migration and acculturation[11,12] but there is little information on the results of regional mobility within Britain over the last 50 years, there having been more focus on social mobility and mortality. It is possible that dietary patterns established in childhood may track into later life. Since food and its components play a role in the aetiology of disease, it would be valuable to know how changes in social class and region of residence impact on these patterns as one moves from childhood into adulthood.

The aim of the current study was to identify changes in adult dietary patterns as influenced by movements in social class and region of residence from childhood. This was made possible by use of the data from the Medical

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Research Council National Survey of Health and Development (MRC NSHD), also known as the 1946 British Birth Cohort, which has tracked subjects from birth in 1946 to the present day. A range of information on these individuals, including diet, socio-economic circumstances and geographical region of residence, has been collected. The multivariate statistical technique of factor analysis was used to identify the combinations of foods consumed by this population, which were then related to their socio-economic and regional background. Dietary patterns identified in this cohort can be considered a reflection of 'dietary behaviour' that subsequently influences food choices and nutrient intake and, ultimately, the onset of chronic disease later in life. The availability of socio-economic and regional data at two time points enabled the relative magnitude of these influences on dietary patterns to be followed.

Methods

The MRC NSHD is a socially stratified cohort of 5362 singleton legitimate births in England, Scotland and Wales during the first week of March 1946. Throughout childhood and adulthood, medical, social, educational and other information has been collected on 21 occasions[13]. Data on health, diet, family and lifestyle were collected by local health visitors at home visits at age 4 years (in 1950) and by research nurses at age 43 years (in 1989). The 3187 survey members from whom dietary records were collected at the age of 43 years in 1989 form the sample population for the current analysis and were still representative of 43-year-olds in the native-born population[14].

Dietary assessment

A 48-hour recall of all food and drink recorded in household measures was obtained by interview at age 43 years[15]. All food and nutrients were calculated using the in-house suite of programs based on *McCance & Widdowson's The Composition of Foods*[16–18]. Among the sample population more than 1000 different types of food and drink were consumed during the 48-hour recall period. Related or similar foods/drinks were combined into 44 food/drink categories and the mean daily weight of each category for each individual was calculated (see Appendix).

Statistical analysis

With the sample stratified by gender, exploratory factor analysis was performed using the method of principal components and varimax rotation on the 44 food categories[19]. Categories that cross-loaded on several factors, or had correlations of less than 0.3 with all of the factors, were subsequently eliminated[19]. Inter-item reliability for each factor was assessed by Cronbach's alpha coefficients for standardised variables. In order to assess the stability of the factors, factor structures were compared with the results from the samples after they had been split randomly into two sub-samples and the analyses repeated on each half.

In 1950, when aged 4 years, survey members had been classified according to the occupational social class of their father[20]; they were also classified according to their own occupational social class in 1989, at age 43 years[21].

Two categories of occupational social class were defined as *non-manual* (I, II, III non-manual) and *manual* (III manual, IV, V). Social class category could not be assigned to those in the armed forces in 1950 and to women who were not in paid employment in 1989. Social class categories were grouped to reflect consistency or change in social class from 4 to 43 years of age: manual social class at both time points, non-manual social class at both time points, manual to non-manual social class transition, non-manual to manual social class transition.

Four regions of residency were defined as *Scotland*, *The North* (North, North West, Yorkshire), *Central, South West and Wales* (Midlands, North Midlands, Eastern, Southern, South West, Wales), *London and South East*. Combinations of the region of residence at age 4 and 43 years were used to define inter-generational regional circumstances: Scotland at both time points; migration from Scotland to other regions; The North at both time points; migration from The North to other regions; Central, South West and Wales at both time points; migration from Central, South West and Wales to other regions; London and South East at both time points; migration from London and South East to other regions.

Multiple regression analysis with standardised factor scores as outcome measure was used to examine the differences in dietary patterns by social and regional mobility. In the regression model both social mobility and regional mobility were treated as independent categorical variables. This was done by defining both these variables in the CLASS statement of the generalised linear models procedure (PROC GLM) of SAS[22]. Bonferroni corrections were used in the *post hoc* comparisons of means to reduce the effects of inflated type 1 errors due to multiple comparisons. Adjusted means and confidence intervals for each social and regional mobility category were calculated using the least-squares means option of PROC GLM.

Results

The distributions of social class and regional mobility are given in Table 1. Those that were in non-manual circumstances at both time points were in the majority. Less than 10% of men and women were downward mobile. A higher proportion of women than of men were upwardly mobile (36% vs. 28%). Eleven per cent of all men and 12% of all women were in Scotland in 1950, but only 2% of all men and 3% of all women migrated from Scotland to the other regions of the UK by age 43 years. Similarly,

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Table 1 Social class and regional mobility during childhood and adulthood in the Medical Research Council National Survey of Health and Development with dietary records at ages 4 and 43 years ($n = 3187$)

		Men *n* (%)	Women *n* (%)
Social class mobility			
Father's (1950)	Own (1989)		
Non-manual	Non-manual	463 (35)	458 (37)
Manual	Non-manual	371 (28)	447 (36)
Non-manual	Manual	97 (7)	75 (6)
Manual	Manual	393 (30)	262 (21)
		1324 (100)	1242 (100)
Regional mobility			
Childhood (1950)	Adulthood (1989)		
Scotland	Scotland	135 (9)	127 (9)
Scotland	Other regions	28 (2)	38 (3)
The North	The North	289 (20)	253 (17)
The North	Other regions	102 (7)	88 (6)
Central, South West and Wales	Central, South West and Wales	363 (25)	403 (28)
Central, South West and Wales	Other regions	213 (15)	196 (13)
London and South East	London and South East	249 (17)	286 (20)
London and South East	Other regions	76 (5)	68 (5)
		1455 (100)	1459 (100)

Sample sizes quoted are the maximum available and are reduced to $n = 2544$ for social class, due to missing values.

only 10% of subjects migrated from London and South East. Forty per cent of the subjects lived in Central, South West and Wales as children but this was the region from which there was the most migration, with approximately 78% moving to London and South East.

Exploratory factor analysis of dietary items for men led to deletion of the item sweet biscuits and cakes due to cross-loading and the omission of 11 items due to a loading of less than 0.3 (meat pie, fish, fried food excluding chips, crisps and corn snacks, squashes and soft drinks, confectionery, cheese, brown bread, porridge, poultry, soup). Among women 12 items were omitted due to a loading of less than 0.3 (meat pie, fish, fried food excluding chips, crisps and corn snacks, dilute squashes and soft drinks, brown bread, porridge, poultry, soup, low-fat spreads, red wine, beer).

Results of the factor analysis revealed five distinct, interpretable dietary patterns (Table 2). The eigenvalues corresponding to these five principal components were greater than one, suggesting that the five-dimensional model was appropriate. The Cronbach's alpha coefficients ranged from 0.31 to 0.53, indicating moderate internal reliability. In both men and women, the five factors accounted for 30% of the total variance. Further support for the factor structure was obtained when the analyses were repeated on split samples and the same structure was found for each gender group.

Descriptive names were assigned to the factors: *health aware* (items include high-fibre breakfast cereals, wholemeal breads, apples, bananas and e.g. a negative factor loading for beer and white bread in both men and women); *dinner party* (coffee, white wine, cream); *traditional* (potatoes, green vegetables, carrots, red meat, peas); *refined* (sugar, butter, white bread, whole milk); *sandwich* (tomatoes, lettuce, onions, bacon, ham). A number of differences in items corresponding to the same dietary patterns were observed between men and women. For example, the items sweet biscuits and cakes and confectionery were associated with the factor *refined* for women only.

Multiple regression analysis revealed that social class mobility was associated with the dietary patterns *health aware* (men: $P < 0.0001$; women: $P < 0.0001$) and *dinner party* (men: $P < 0.001$; women: $P < 0.0001$). Regional mobility was associated with the dietary patterns *traditional* (men: $P < 0.0001$; women: $P = 0.02$) and *dinner party* (men: $P < 0.0001$). Figures 1 and 2 present factor means, adjusted for regional or social mobility as appropriate, for dietary intake patterns for men and women aged 43 years categorised by social and regional mobility. Only significant results ($P < 0.05$) have been shown. The higher the factor score, the greater is the consumption of food items associated with that factor. People who remained in the non-manual classes consumed higher amounts of food items correlated with the factors *health aware* and *dinner party* than those who remained in the manual classes. Those who made the transition from manual in childhood to non-manual at age 43 years showed an intermediate position.

Change in region of residence was strongly associated with the factors *dinner party* and *traditional* ($P < 0.0001$) among men who had moved from Central, South West and Wales to other regions as they took on the dietary patterns of their adopted region of residence. Men and women who remained in Scotland consumed below-average quantities of the foods correlated with the factor *traditional* and those who remained in London and South East consumed above-average quantities of these foods ($P < 0.0001$). However, those who moved from London and South East to elsewhere did not significantly

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Table 2 Factor loadings [cumulative percentage of variation and (internal reliability*)] estimated from responses from 3187 subjects aged 43 years

Men		Women	
Food items	Factor loading	Food items	Factor loading
Factor 1: *Health aware* [9% (0.49)*]		**Factor 1: *Health aware*** [8% (0.44)]	
Fruit (excluding apples and bananas)	0.55	Wholemeal breads	0.58
High-fibre breakfast cereal	0.54	Fruit (excluding apples and bananas)	0.49
Apples	0.52	Apples	0.44
Wholemeal breads	0.45	High-fibre breakfast cereal	0.41
Bananas	0.38	Bananas	0.38
Polyunsaturated fat spreads	0.32	Fruit juice	0.33
Red meat	−0.31	Other fat spreads	0.30
White bread	−0.31	Beer	−0.30
Beer	−0.38	Chips	−0.43
		White bread	−0.51
Factor 2: *Dinner party* [14% (0.42)]		**Factor 2: *Traditional*** [14% (0.53)]	
Coffee	0.57	Potatoes	0.66
Red wine	0.52	Carrots	0.59
White wine	0.46	Red meat	0.57
Spirits	0.44	Leafy green vegetables	0.54
Fruit juice	0.35	Peas	0.48
Cream	0.30		
Tea	−0.58		
Factor 3: *Traditional* [19% (0.51)]		**Factor 3: *Refined*** [20% (0.38)]	
Potatoes	0.71	Sugar	0.64
Carrots	0.55	Whole-fat milk	0.52
Red meat	0.53	Sweet biscuits & cakes	0.48
Leafy green vegetables	0.48	Butter	0.40
Peas	0.44	Confectionery	0.34
Chips	−0.39	Skimmed milk	−0.50
Factor 4: *Refined* [25% (0.43)]		**Factor 4: *Sandwich*** [25% (0.46)]	
Whole-fat milk	0.59	Tomatoes	0.77
Sugar	0.57	Lettuce	0.77
Butter	0.52	Onions	0.43
White bread	0.45	Bacon, ham	0.34
Skimmed milk	−0.37	Eggs	0.30
Low-fat spreads	−0.37		
Factor 5: *Sandwich* [29% (0.44)]		**Factor 5: *Dinner party*** [30% (0.31)]	
Tomatoes	0.71	Coffee	0.60
Lettuce	0.65	White wine	0.45
Onions	0.49	Spirits	0.33
Bacon, ham	0.39	Cream	0.36
Eggs	0.35	Polyunsaturated fat spreads	−0.37
Other fat spreads	0.30	Tea	−0.58

* Cronbach's alpha.

change their dietary pattern, likewise for women moving from Scotland.

Social mobility was not associated with the factors *traditional* (men: $P = 0.2$; women: $P = 0.6$), *refined* (men: $P = 0.6$; women: $P = 0.2$) and *sandwich* (men: $P = 0.1$; women: $P = 0.5$). Similarly, regional mobility was not associated with the factors *health aware* (men: $P = 0.2$; women: $P = 0.4$), *dinner party* (women: $P = 0.2$), *refined* (men: $P = 0.1$; women: $P = 0.9$) and *sandwich* (men: $P = 0.1$; women: $P = 0.2$).

Discussion

This paper uses factor analysis to identify dietary patterns of British adults. Identifying dietary patterns is of practical importance, since interventions aimed at improving diet should attempt to influence overall eating patterns, rather than focusing only on specific foods or nutrients. As far as we are aware, it is the first study to examine the impact of social and regional mobility on dietary patterns in Britain. As such, an understanding of the patterns of dietary intake and the factors that influence them are important in order to plan, target and implement public health initiatives.

The food groups identified by factor analysis are indicative of food items that are consumed together or food items that substitute for one another. The fact that five similar food groupings were found in men and women reveals the consistency of eating patterns among British adults. Several of the dietary patterns identified in this study are consistent with those found for previous studies in Britain using cluster analysis of dietary intake. For example, the factors *traditional* and *health aware* are similar to those reported by Pryer *et al.*[23].

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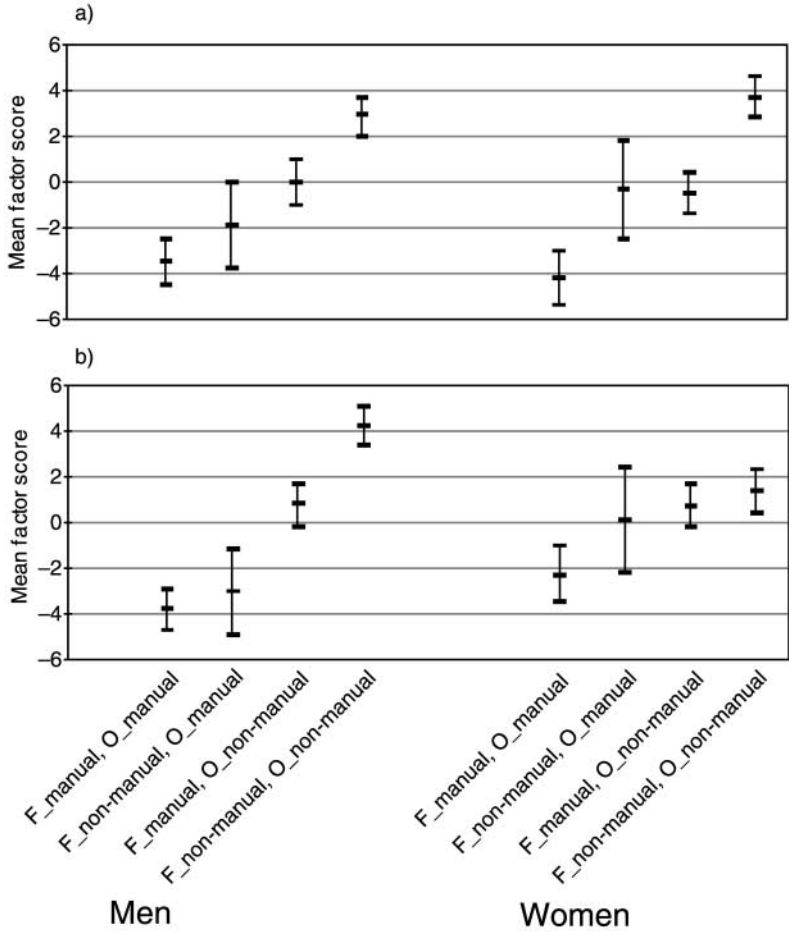

Fig. 1 Adjusted* mean and 95% confidence intervals by social mobility and gender for: (a) factor *health aware*; (b) factor *dinner party*. *Adjusted for regional mobility. Social mobility was represented by the combination of the father's and the participant's own occupation. For example F_manual refers to the father being in manual occupation in 1950 while O_manual refers to the participant being in manual occupation at age 43 years in 1989. Factor scores = standardised factor scores × 10

This study has shown that social mobility is likely to result in a change of dietary pattern away from that of childhood towards that characteristic of the socio-economic echelon into which the individual is moving. Thus, those who moved from childhood in the family of a manual worker to a non-manual position in adulthood were consuming a diet containing more of the foods associated with good health (e.g. high-fibre breakfast cereal, apples, bananas, wholemeal breads) and also those that might be expected to be associated with a higher income (e.g. white wine, fruit juice, cream). So there could be two factors operating here: education, which would have propelled the person towards a non-manual occupation, and the financial advantage that would have accrued from that change. Social mobility would also have been achieved for women through marriage at a time when further education for women was far less likely than for men. The movement towards a healthier diet by the upward socially mobile agrees with the report that individuals such as these have levels of illness and mortality rates in between those of the class they have left and the class to which they have moved[24].

There are very clear differences between regions with respect to the intake of foods associated with the factor *traditional* (potatoes, green vegetables, carrots, red meat, peas) but these differences appear to be much more impervious to change. The numbers of people moving between regions was much smaller than those moving between socio-economic groups but it would appear that those born in London and South East and women born in Scotland retained the dietary pattern of their birthplace after migration. However, the men born in Scotland did show a move towards a *traditional* diet characteristic of the more southerly parts of the country. The diet of this cohort when aged 4 years showed clear differences in the consumption of vegetables, with those in Scotland consuming less than those in the rest of the country including the north of England[25]. Factors such as inclement weather and distribution might have been expected to influence availability in 1950, but not by 1989. The low consumption of vegetables in Scotland has been reported from other more recent studies[26,27]. These dietary patterns in the present study are consistent when corrected for socio-economic circumstances at both time

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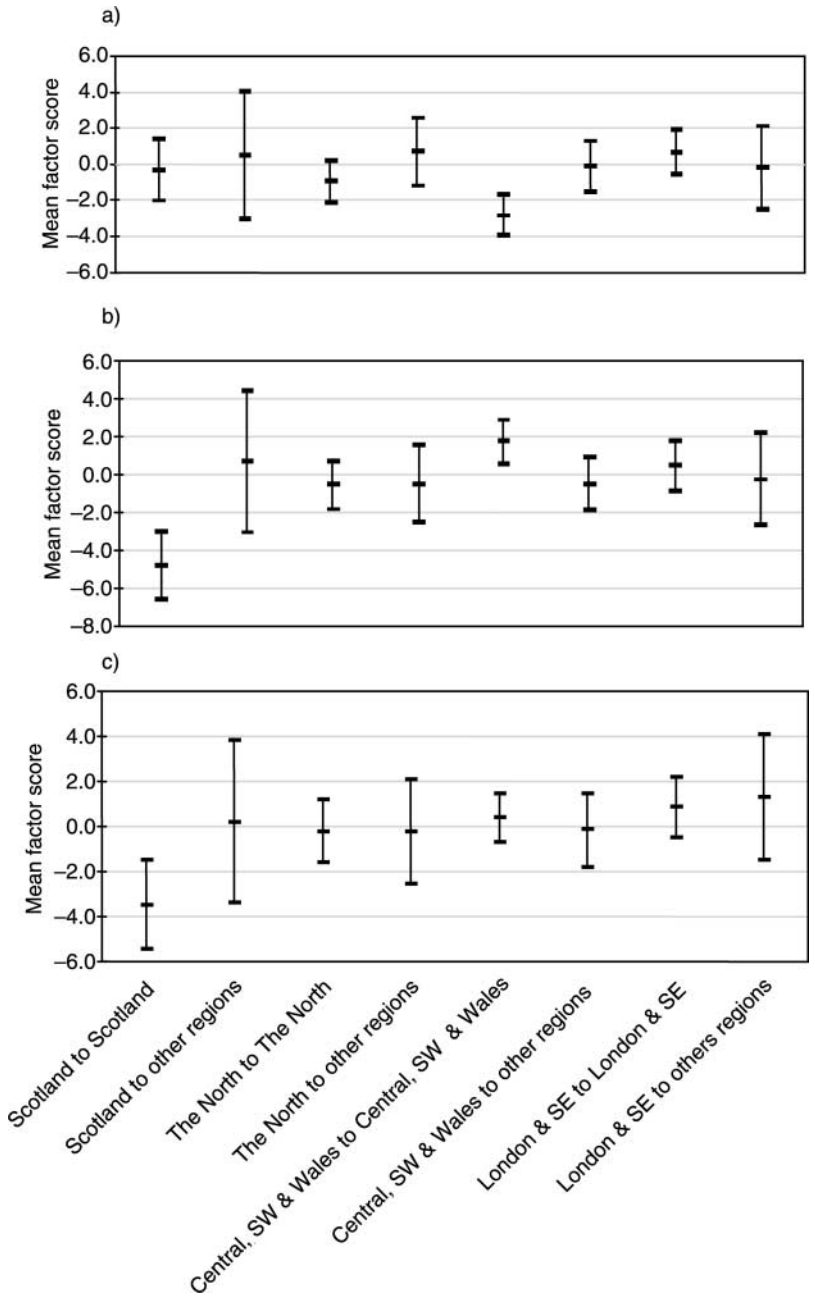

Fig. 2 Adjusted* mean and 95% confidence intervals by regional mobility for: (a) factor *dinner* party among men; (b) factor *traditional* among men; (c) factor *traditional* among women. *Adjusted for social mobility. Factor scores = standardised factor scores × 10

points and would appear to be resilient to geographical movement. In view of these results it is of interest that Harding and Maxwell reported that migrants from Scotland to the rest of Britain have higher mortality rates than the rest of the population of England and Wales[28].

The dietary patterns of men moving from Central, South West and Wales to London and South East appear to change in the direction of those associated with their adopted region of residence: a greater consumption of foods associated with *dinner party* and lower consumption of those associated with *traditional*. Regional mobility is associated with childhood socio-economic background and level of education[29] but these results were corrected for social class. Another agent of change might be that, having moved, these men could have married women from the region they moved to and their wives, having greater responsibility for food practices within the family, would have had an influence on their meal patterns[30]. In contrast, changes in the dietary patterns of women were not strongly associated with regional mobility.

These findings highlight the complexity of the associations between social and regional mobility and

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different components of dietary intake. Cross-sectional results are also consistent with other studies showing socio-economic gradients in food intake. For example, the finding that those who remained in manual occupations reported below-average consumption of those foods associated with the *health aware* cluster – wholemeal breads or high-fibre breakfast cereals – is consistent with other reports of lower than average intakes of 'healthy' foods among these groups[23,31].

There were several limitations with the present study. Self-report bias is a problem inherent in studies of dietary intake, and responses in the present study may have been confounded by selective under- or over-reporting of particular food items. Finally, the factor analytic method is limited in that the patterns of consumption of certain food items that were omitted from analyses due to low loadings, or cross-loading on more than one factor, cannot be determined. For example, sweet biscuits and cakes may comprise an important part of dietary intake for men, but in this study it was omitted from the analyses as it was grouped with more than one major factor (cross-loaded). Even though factor structure is dependent on the number of items initially assessed, the large number of items included here should be representative of the broad range of foods consumed in Britain in 1989.

This work suggests that although adult dietary patterns are developed as a result of childhood influences, these patterns can be modified as a result of social and regional transitions albeit some regional characteristics do seem to be resilient to change. Such changes in dietary patterns may influence susceptibility to disease in later life. However, it is not clear to what extent the effects of childhood disadvantage on long-term health can be overcome by improving circumstances in adulthood. For example, a study in New Zealand has reported that upwards social mobility did not mitigate or reverse the adverse effects of low childhood socio-economic status on adult health[32]. Also, evidence from developing countries (so-called 'countries in transition'), where people have experienced a very rapid rise in standards of living since childhood, suggests that these individuals are more susceptible to degenerative diseases of later life[33]. Understanding the nature of these transitions and their associated disease risks will assist in the formulation of food-based dietary recommendations and practical public health advice.

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Appendix – Description of the 44 food groupings used in the analysis of dietary patterns

Food item or food group
Apples only
Bananas only
Other fruit (including citrus fruit)
Fruit juice
Carrots only
Onions only
Peas, green beans
Green leafy vegetables (excluding lettuce)
Lettuce
Tomatoes (including juice)
Brown breads
White breads
Wholemeal breads
Chips
Fried foods (excluding chips)
Potatoes (excluding chips and crisps)
Soup
Butter
Low-fat spreads
Polyunsaturated fat spreads
Other fat spreads
Cheese
Meat pies including chicken pies
Bacon, ham
Red meat
Eggs
Poultry
Fatty fish including roe
Breakfast cereals (medium-, high-fibre)
Porridge
Beer and cider (excluding low-alcohol)
Red wine
White wine
Spirits
Soft drinks (including dilute squashes)
Tea
Coffee
Cream
Skimmed milk
Whole milk
Sweet biscuits and cakes (not buns)
Confectionery (including chocolates)
Crisps and corn snacks
Sugars and preserves

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