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Longitudinal dietary changes between 1984–5 and 1991–2 in British adults: associations with socio-demographic, lifestyle and health factors

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The study aimed to examine dietary changes and their associations with demographic, lifestyle and health variables in a random sample of British adults. The *Health and Lifestyle Survey* of 1984–5 (HALS1) identified four main dietary components by principal component analysis from food frequency data. Comparison of the HALS1 dietary component scores with those of the follow-up survey of 1991–2 (HALS2) for the same individuals revealed increases on component 1 (high weightings for fresh fruit, salads, 'brown' bread, fruit juice and green vegetables but low weightings for chips, fried food and processed meat). There were substantial decreases on component 2 (high weightings for puddings/pies, cake, potatoes, biscuits, preserves, pulses and meat), small increases on component 3 (high weightings for crisps, soft drinks and chips) and increases on component 4 (high weightings for confectionery, biscuits and cake and low weightings for vegetables of all kinds). Except for women on component 3 the changes were all significant, $P < 0{\cdot}001$. Unadjusted score changes were smallest in elderly respondents for all components. Differences in score changes between groups were based on an analysis of covariance adjusting for the HALS1 score. On component 1 the largest score increases were associated with non-manual groups, improvements in lifestyle and good health. For component 2 the greatest changes in score were associated with changes in household size, smoking habit and heavy drinking. Score increases on component 3 were also associated with heavy drinking, whilst the largest rises on component 4 were amongst the non-manual, the non-drinkers and the non-smokers and, for women only, those who had few malaise symptoms or who lived in Scotland. The results show that there have been overall dietary changes and that changes have been associated with longitudinal alterations in socio-demographic, lifestyle and health circumstances.

Dietary patterns: Longitudinal dietary changes: Principal component analysis

Although dietary habits are often analysed by nutrient intakes, it is also of interest to examine them by consumption of food items, since people choose their diets by foods rather than by nutrients. Some recent epidemiological studies have analysed food intakes using principal component analysis, thereby grouping foods into 'dietary components' which reflect eating patterns (Gex-Fabry *et al.* 1988; Barker *et al.* 1990; Gregory *et al.* 1990; Whichelow & Prevost, 1996).

In recent years changes have been recorded in the British diet. A marked trend towards an increase in the consumption of low-fat spreads and milk, and a reduction in the frequency of eating other high-fat foods (processed meats, fried food, chips and carcass meat) and in the frequency of eating potatoes and in the amount of bread consumed were identified over the 7 years between the *Health and Lifestyle Survey* of 1984–5 (HALS1;

Cox *et al.* 1987) and the follow-up survey of 1991–2 (HALS2; Cox *et al.* 1993) (Whichelow, 1993). These findings are in agreement with the National Food Survey (Ministry of Agriculture, Fisheries and Food, 1993) which has shown trends of decreasing energy and fat consumption between 1985 and 1992 in Great Britain. Nevertheless, the proportion of food energy derived from fat has increased as that from carbohydrate has decreased, reflecting a considerable reduction in the consumption of bread and potatoes (Ministry of Agriculture, Fisheries and Food, 1987, 1993).

Socio-demographic and lifestyle changes have also taken place, with more people living alone (Bridgwood & Savage, 1993), and fewer adults smoking (Smyth & Browne, 1992). There is a debate about the possible benefits of modest alcohol consumption whilst at the same time there is a tendency for heavy drinking to be increasing (Royal College of Physicians, Psychiatrists and General Practitioners, 1995). It is therefore relevant to investigate how changes in dietary habits relate to these changes and also to health, particularly in relation to the targets set out in the White Paper *The Health of the Nation* (Department of Health, 1992).

From the HALS1 data on eating habits (Whichelow, 1987), four main dietary patterns were identified, each with clear and distinct associations with demographic, lifestyle and health variables (Whichelow & Prevost, 1996). HALS2 (Cox *et al.* 1993) on the same respondents provided the opportunity to examine longitudinal changes in diet and to relate these to social circumstances, lifestyle and self-reported health at HALS1 and the changes that had occurred in these factors over the 7 years between the surveys.

METHODS

The planning and execution of HALS1 and HALS2 and the questionnaires employed are described in detail elsewhere (Cox *et al.* 1987, 1993). HALS1 was carried out on a random stratified sample of 9003 adults resident in England, Scotland and Wales. In 1991–2 a total of 5352 respondents, who were still alive, could be traced and were able to participate, were studied again. For each sex the age structure of the HALS2 respondents compared well with those aged over 25 years in the 1991 census (Office of Population Censuses and Surveys, 1993). The same information was collected at each survey.

In common with the previous publication (Whichelow & Prevost, 1996) principal component analysis was the method used to identify dietary components from the dietary data at HALS2. Most of the thirty-nine food items were in the form of frequency of consumption: 'more than once a day', 'once a day', 'most days', 'once or twice a week', 'less than once a week' and 'rarely or never' (Whichelow, 1987). For seasonal foods such as fresh fruit and salad vegetables the respondents were asked about their consumption in summer and winter. For vegetables the questions posed were: 'Root vegetables, like carrots, turnips and parsnips', 'Peas and beans: all kinds, including baked beans and lentils', and 'Other cooked vegetables including onions and mushrooms'. The question about confectionery was asked as 'Sweets, chocolate', and for preserves as 'Jam, marmalade, golden syrup, honey'. Puddings were specified as 'Sweets or puddings, fruit pies, flans and tarts' and light desserts as 'Ice cream, yoghurt, mousse, milk puddings'. Carcass meat was listed as 'Beef, lamb, pork, ham, bacon' and processed meat as 'Sausages, tinned meat, paté, meat pies, pasties, burgers etc.'. The type of bread usually consumed was recorded and grouped as 'brown' which included all non-white breads, and 'white'. The types of milk (skimmed and semi-skimmed or full cream) and spread (low-fat or full-fat) were recorded, as was the average daily amount of bread consumed, in slices, and milk, in pints. The food-frequency categories were translated into weekly consumption

frequencies, i.e. 'more than once a day' 10, 'daily' 7, 'most days' 4·5, 'once or twice a week' 1·5, 'less than once a week' 0·5, and 'never' 0.

Details about socio-economic group, household size, ethnicity, region of residence, smoking habit and alcohol consumption were recorded at HALS1 and HALS2. Very few respondents had moved from their HALS1 region by HALS2. Socio-economic group was assessed according to the *Standard Occupational Classification* (Office of Population Censuses and Surveys, 1990) and grouped as non-manual and manual. Household size was condensed into two categories, as the respondent living alone or with others, usually family members. The smoking categories used were non-smoker (not smoking regularly as much as one cigarette, pipe or cigar per day at HALS1), smoker (regularly smoking at least one cigarette, pipe or cigar per day at survey), 'less' (smoker at HALS1 and HALS2, but a reduced consumption at HALS2), ex-smoker (smoker at HALS1 and quit between HALS1 and HALS2). Alcohol consumption was recorded as that drunk 'last week' using a 7 d recall diary. Respondents were grouped as 'nil' drinkers, 'sensible' drinkers (1–21 units (men) and 1–14 units (women)) and 'unwise' drinkers (over 21 units (men) and over 14 units (women)). At both surveys respondents were asked whether they were following a prescribed diet for any medical reason, and whether they were taking dietary supplements, i.e. vitamins or tonics.

The respondents were asked whether they had suffered from any of sixteen symptoms of physical illness and from any of a number of psychosocial (malaise) symptoms in the previous month. The numbers of symptoms reported were grouped as 'low', 'medium' and 'high' for both types of symptoms. They also assessed their health, for their age, as 'excellent', 'good', 'fair' or 'poor'.

The 262 subjects with incomplete dietary or other relevant data or who were in the armed forces or who could not be assigned to a socio-economic group were excluded.

Statistics

Principal component analysis, using SPSSX (Statistical Package for the Social Sciences, 1990), was employed to derive dietary components from the standardized food frequency data collected at HALS2, as described for HALS1 (Whichelow & Prevost, 1996). Each component consisted of a weighted combination of all the food items in which the item weights, 'factor loadings', described the degree that food items were associated with the component. The components were uncorrelated. Each subject achieved a standardized score on each component resulting from the frequency of consumption of each food item and its factor loading. The four main components derived at HALS2 and their factor loadings were almost identical to those originally derived from the full sample and the HALS2 subset at HALS1. This allowed the adoption of the original HALS1 factor loadings to compute HALS2 scores on the same dietary components. Each component had a mean score of zero at HALS1 and values are shown as standard deviations from the mean.

At HALS1 men and women had quite different mean scores and associated covariates, although separate derivations led to similar dietary components. Separate analyses of scores were performed for men and women. Since mortality was previously related to the dietary scores (Whichelow & Prevost, 1996), the surviving HALS2 non-responders were compared with those seen at HALS2 in terms of the initial HALS1 scores, adjusting for covariates, with ANOVA using GLIM (Francis *et al.* 1993).

The principal outcome of interest for each component was the individual's change in dietary score (HALS2 score minus HALS1 score). The score change was found to be dependent on the initial score because of natural regression to the mean. Socio-

demographic, lifestyle and self-reported health associates of the initial score have previously been identified (Whichelow & Prevost, 1996). Analysis of covariance of score change (GLIM) adjusting for the initial score was employed in order to prevent HALS1 associates of the initial score spuriously contributing to the estimation of associates of score change (Streiner & Norman, 1995). If HALS2 were a fresh cross-sectional sample or if score change were not dependent on the initial score, the adjustment would not have been needed, and unadjusted score change would be an appropriate estimator of dietary change. The issue that is addressed in this paper is: did individuals with the same dietary score at HALS1 change their score differentially according to their HALS1 characteristics or to changes in these characteristics by HALS2?

Included in the model were demographic covariates treated as constant at both survey times: HALS1 age, socio-economic group, region of residence and ethnicity. Also included were covariates which varied between the two survey times, mainly lifestyle and health measures: household size, smoking, alcohol consumption, food supplement status, prescribed diet status, disability/handicap, physical illness symptoms, 'malaise' symptoms and self-assessed health. The likelihood ratio F test was used with significance levels 5, 1 and 0·1 %. The association of time-constant covariates (e.g. region) with the change in dietary score was assessed by comparing the likelihood from the full model with that which omitted the covariate. The association of time-varying covariates (e.g. smoking) was assessed using two successive tests. Tested first was the longitudinal association of a change in dietary score with change in circumstance, health or behaviour (e.g. smoking alterations) beyond that predicted from initial behaviour. This addresses the question of whether a change in diet was associated with a concurrent change in, for example, smoking, between the surveys. Tested second was the association of a change in dietary score with prior behaviour (HALS1 smoking) irrespective of behaviour change. This addresses the question of whether different original (e.g. smoking) characteristics were associated with differing subsequent changes in diet. Such longitudinal associations allow investigation of the previous cross-sectional findings, highlighting the association of individuals' concurrent lifestyle changes and reflecting a time ordering of events.

RESULTS

Respondents not seen at HALS2, who were not known to be dead, did not differ from those seen at HALS2 in the HALS1 initial dietary scores except for men on component 3. This was confined to those aged 18–31 years ($P < 0·05$) where non-responders scored 0·21 higher (95 % CI 0·09–0·32) whereas for other age groups non-responders scored only 0·04 higher (95 % CI −0·04–0·12).

Table 1 shows the main constituents of each of the four dietary components in rank order of factor loading obtained at HALS1. The rank orders and factor loadings at HALS2 were almost identical for the sample as a whole and separately for men and women. The HALS1 components were adopted for computing the HALS2 scores. The full list of the thirty-nine food items was given in the previous paper (Whichelow & Prevost, 1996). Comparison with the 1984 and 1985 National Food Surveys shows that these items accounted for approximately 85 % by weight of the average person's food consumption (Ministry of Agriculture, Fisheries and Food, 1987, 1993).

The unadjusted mean scores at HALS1 and HALS2 for men and women are shown in Table 2. The scores increased significantly in all groups on components 1 and 4, and fell significantly on components 2 and 3 (men).

Table 1. *Foods with factor loadings greater than ±0·3 in the dietary components*

Dietary Components							
1		2		3		4	
Fruit (winter)	0·650	Puddings/pies	0·559	Crisps	0·463	Confectionery	0·405
Fruit (summer)	0·648	Cake	0·541	Soft drinks	0·419	Biscuits	0·355
Salad (summer)	0·576	Potatoes	0·460	Chips	0·416	Cake	0·323
Salad (winter)	0·565	Biscuits	0·422	Fried food	0·358		
'Brown' bread	0·541	Preserves	0·368	Coffee	0·321	Potatoes	− 0·308
Fruit juice	0·477	Pulses	0·361	Pasta/rice	0·321	Other vegetables	− 0·356
Green vegetables	0·441	Carcass meat	0·360	Processed meat	0·308	Pulses	− 0·366
Spread (low fat)	0·387	Root vegetables	0·346			Root vegetables	− 0·479
Milk (semi-skimmed)	0·359	Cream	0·333	Preserves	− 0·301	Green vegetables	− 0·495
Other vegetables	0·354	Cooked fruit	0·331	Tea	− 0·331		
Root vegetables	0·353	Confectionery	0·320				
		Green vegetables	0·314				
Processed meat	− 0·359	Milk (amount)	0·309				
Fried food	− 0·411	Eggs	0·303				
Chips	− 0·503	Light desserts	0·300				

Table 2. *Dietary component-scores† (unadjusted) from the* Health and Lifestyle Survey *of 1984–5 (HALS1; Cox* et al. *1987) and the follow-up survey of 1991–2 (HALS2; Cox* et al. *1993)*

Dietary component ...	1	2	3	4
Men (*n* 2190)				
Mean HALS1 score	− 0·27	0·19	0·13	− 0·08
Mean HALS2 score	0·06	− 0·17	0·07	0·15
	***	***	***	***
Mean change score	+0·33	− 0·36	− 0·06	+0·23
Women (*n* 2900)				
Mean HALS1 score	0·28	− 0·12	− 0·10	0·07
Mean HALS2 score	0·60	− 0·41	− 0·08	0·25
	***	***	NS	***
Mean change score	+0·32	− 0·29	+0·02	+0·18

Significance of *F* ratios: *** $P < 0·001$.
† For details of dietary components, see Table 1.

Component 1 (high in fruit and vegetables, low in fat)

Fig. 1 shows the mean unadjusted component 1 scores at HALS1 and HALS2 for men (a) and women (b) by 7-year age groups. Comparison of the two surveys showed the scores had risen by HALS2, in each age group, considerably more than would be expected for the 7-year advance in age. Thus, for example, women aged 25–31 years at HALS1 had a mean score of 0·1. By HALS2, when they were aged 32–38 years, the score had risen to 0·51, higher than the 0·32 score of those who were aged 32–38 years at HALS1. There were also interactions between the survey indicator and the age at survey, with the greatest increase in scores occurring in the youngest subjects ($P < 0·05$).

Table 3 shows the changes in the scores, adjusted for all other variables and for the HALS1 score, in relation to demographic characteristics. The manual men and women had

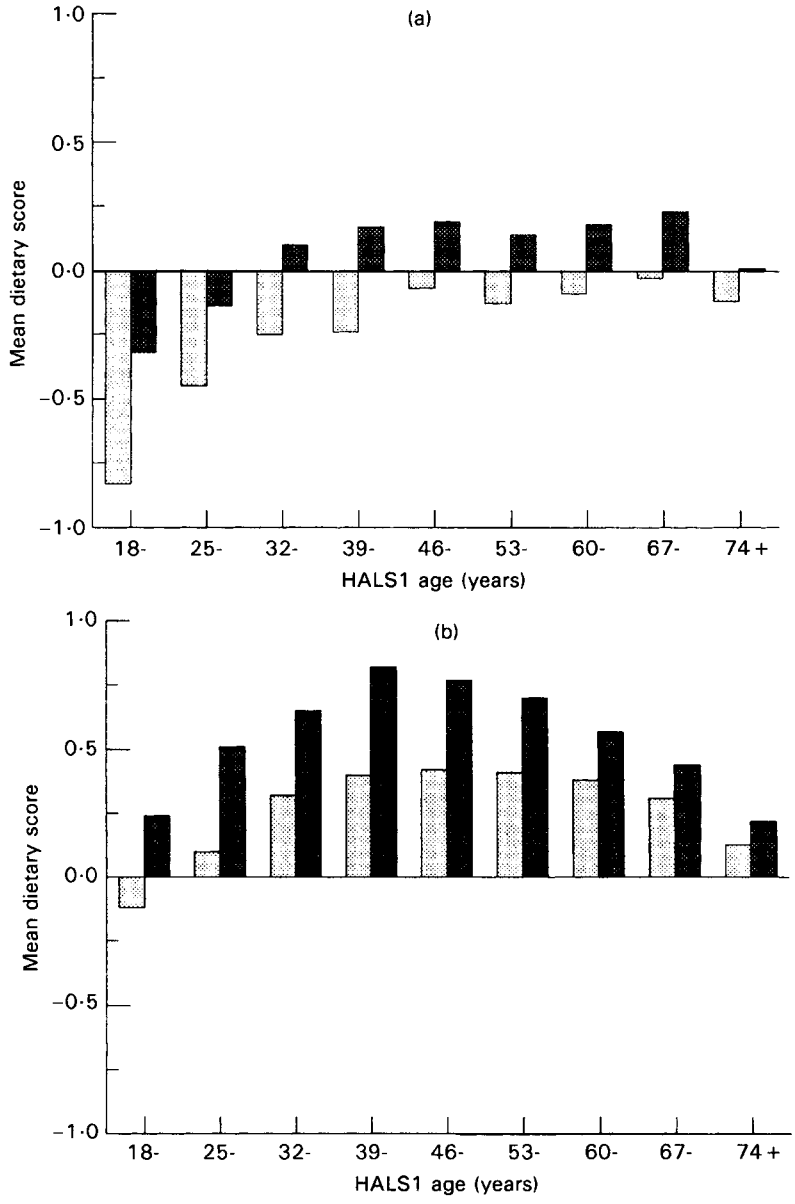

Fig. 1. Component 1: mean dietary scores from the *Health and Lifestyle Survey* of 1984–5 (HALS1, ▤; Cox *et al.* 1987) and the follow-up survey of 1991–2 (HALS2, ▦; Cox *et al.* 1993) by 7-year age groups for (a) men and (b) women. For details of component 1, see Table 1.

smaller score increases than the non-manual responders overall and in both age groups. There was no association of score change with household size, or for men, with region of residence. For women, those in the 'North' had the largest and those in Scotland and Greater London the smallest score increases. Ethnicity was controlled for but showed little association with the change in any of the component scores.

Lifestyle habits were closely associated with score changes for component 1 (Table 4). The score changes were closely associated with the initial HALS1 smoking status, where non-smokers had a larger score increase than smokers. The scores of those who had changed their smoking habits between HALS1 and HALS2 differed from the scores of those who had not. The score increases of those who had given up smoking were greater than those of continuing smokers, whilst those who had taken up smoking had smaller score increases. Those who continued to smoke at the same level showed the smallest score

Table 3. *Socio-demographic associations with dietary component† score change from the* Health and Lifestyle Survey *of 1984–5 (HALS1; Cox* et al. *1987) to the follow-up survey of 1991–2 (HALS2; Cox* et al. *1993), adjusted for HALS1 score and all other variables*

		Dietary component score changes								
		Men (*n* 2190)					Women (*n* 2900)			
Dietary component …		1	2	3	4		1	2	3	4
Socio-economic group (all ages)	*n*	***	**	NS	**	*n*	***	NS	NS	*
Non-manual	948	0·40	− 0·42	− 0·07	0·30	1371	0·37	− 0·26	0·01	0·22
Manual	1242	0·28	− 0·32	− 0·05	0·18	1529	0·27	− 0·31	0·02	0·15
Socio-economic group by age (years)	*n*	NS	*	NS	NS	*n*	NS	NS	**	NS
Non-manual 18–52	648	0·43	− 0·47	− 0·06	0·27	970	0·43	− 0·33	0·05	0·21
Manual 18–52	799	0·32	− 0·43	− 0·06	0·19	1007	0·32	− 0·37	0·01	0·12
Non-manual 53+	300	0·33	− 0·33	− 0·09	0·36	401	0·24	− 0·12	− 0·07	0·24
Manual 53+	443	0·20	− 0·11	− 0·05	0·16	522	0·17	− 0·16	0·04	0·21
Household size (HALS1 status)	*n*	NS	NS	NS	NS	*n*	NS	*	NS	NS
'Family'	2038	0·32	− 0·36	− 0·06	0·23	2594	0·32	− 0·27	0·01	0·19
Alone	152	0·41	− 0·40	− 0·02	0·29	306	0·25	− 0·39	0·05	0·17
Altered household size (HALS1 to HALS2)	*n*	NS	***	NS	NS	*n*	NS	***	NS	*
'Family' 'Family'	1902	0·33	− 0·34	− 0·06	0·22	2387	0·32	− 0·24	0·02	0·17
Alone	136	0·20	− 0·64	− 0·12	0·33	207	0·32	− 0·57	− 0·02	0·37
Alone Alone	104	0·36	− 0·53	− 0·05	0·39	274	0·25	− 0·49	0·05	0·20
'Family'	48	0·50	− 0·17	0·02	0·09	32	0·32	0·05	0·05	0·10
Region	*n*	NS	NS	NS	NS	*n*	*	NS	NS	**
South East	425	0·29	− 0·36	− 0·07	0·23	524	0·36	− 0·28	0·05	0·17
Greater London	207	0·35	− 0·42	− 0·06	0·22	256	0·22	− 0·23	0·07	0·11
South West	177	0·25	− 0·32	− 0·14	0·25	220	0·28	− 0·22	− 0·01	0·14
East Anglia	81	0·37	− 0·27	− 0·12	0·31	126	0·26	− 0·25	0·02	0·21
East Midlands	182	0·35	− 0·43	− 0·07	0·20	221	0·34	− 0·26	0·01	0·05
West Midlands	191	0·35	− 0·32	− 0·09	0·32	257	0·30	− 0·35	− 0·04	0·08
Yorkshire/Humberside	205	0·35	− 0·25	− 0·06	0·18	252	0·36	− 0·26	0·07	0·19
North West	240	0·34	− 0·36	− 0·09	0·20	397	0·35	− 0·36	0·04	0·17
North	109	0·36	− 0·28	− 0·09	0·06	189	0·43	− 0·37	0·05	0·20
Wales	133	0·36	− 0·47	− 0·07	0·09	155	0·30	− 0·28	− 0·06	0·27
Scotland	240	0·34	− 0·43	− 0·00	0·35	303	0·22	− 0·28	− 0·02	0·37

Significance of *F* ratios: *$P < 0·05$, **$P < 0·01$, ***$P < 0·001$.
† For details of dietary components, see Table 1.

Table 4. *Initial (from the* Health and Lifestyle Survey *of 1984–5 (HALS1), Cox* et al. *1987) and altered (from HALS1 to the follow-up survey of 1991–2 (HALS2), Cox* et al. *1993) lifestyle associations with dietary component† score change, adjusted for HALS1 score and all other variables*

			Dietary component score changes								
			Men (*n* 2190)				Women (*n* 2900)				
Dietary component ...			1	2	3	4		1	2	3	4
Smoking (HALS1 status)		*n*	***	NS	NS	***	*n*	***	NS	NS	**
Non smoker		1360	0·40	− 0·37	− 0·07	0·29	2030	0·37	− 0·27	0·02	0·22
Smoker		830	0·22	− 0·35	− 0·05	0·13	870	0·18	− 0·31	0·00	0·10
Altered smoking status (HALS1 to HALS2)		*n*	***	*	NS	**	*n*	***	*	NS	NS
Non smoker	Non smoker	1283	0·41	− 0·36	− 0·06	0·30	1951	0·39	− 0·26	0·02	0·22
	Smoker	77	0·11	− 0·51	− 0·16	0·11	79	0·18	− 0·54	0·05	0·16
Smoker	Smoker	406	0·09	− 0·31	− 0·06	0·05	502	0·09	− 0·30	0·00	0·06
	Less	240	0·32	− 0·29	− 0·07	0·11	206	0·21	− 0·35	− 0·06	0·07
	Ex-smoker	184	0·36	− 0·48	0·02	0·30	162	0·41	− 0·32	0·10	0·21
Alcohol (HALS1 status)		*n*	**	***	NS	***	*n*	NS	NS	NS	**
Nil		602	0·26	− 0·32	− 0·08	0·39	1441	0·31	− 0·26	0·00	0·20
Sensible		1055	0·37	− 0·32	− 0·03	0·20	1292	0·33	− 0·31	0·02	0·19
Unwise		533	0·33	− 0·48	− 0·10	0·12	167	0·33	− 0·39	0·04	− 0·03
Altered alcohol status (HALS1 to HALS2)		*n*	NS	NS	*	*	*n*	NS	*	**	NS
Nil	Sensible/nil	410	0·24	− 0·30	− 0·12	0·41	1095	0·31	− 0·26	− 0·03	0·20
	Unwise	192	0·29	− 0·34	0·01	0·37	346	0·28	− 0·25	0·12	0·22
Sensible	Sensible/nil	919	0·36	− 0·30	− 0·04	0·23	1224	0·33	− 0·30	0·02	0·19
	Unwise	136	0·40	− 0·43	0·02	0·02	68	0·29	− 0·49	0·15	0·16
Unwise	Unwise	302	0·33	− 0·53	− 0·03	0·05	53	0·29	− 0·56	0·14	− 0·05
	Sensible/nil	231	0·32	− 0·42	− 0·17	0·20	114	0·34	− 0·31	0·00	− 0·02
Prescribed diet (HALS1 status)		*n*	NS	NS	NS	NS	*n*	*	NS	NS	NS
No diet		2054	0·33	− 0·36	− 0·06	0·23	2647	0·33	− 0·29	0·01	0·19
Diet		136	0·35	− 0·37	− 0·10	0·16	253	0·22	− 0·28	0·09	0·17
Altered prescribed diet status (HALS1 to HALS2)		*n*	***	***	NS	*	*n*	***	***	NS	***
No diet	No diet	1932	0·30	− 0·34	− 0·06	0·24	2415	0·29	− 0·27	0·00	0·21
	Diet	122	0·68	− 0·64	− 0·09	0·10	232	0·76	− 0·51	0·08	− 0·05
Diet	Diet	63	0·54	− 0·47	− 0·11	− 0·04	92	0·39	− 0·37	0·10	0·17
	No diet	73	0·22	− 0·31	− 0·10	0·30	161	0·17	− 0·25	0·09	0·15

Significance of *F* ratios: $*P < 0.05$, $**P < 0.01$, $***P < 0.001$.
† For details of dietary components, see Table 1.

rise, followed by those who had taken up smoking between the surveys. Men who had been 'sensible' drinkers at HALS1 had the greatest increases on component 1 scores. Following a prescribed diet at HALS2, particularly for those who had not been on a diet at HALS1, was associated with a relatively large score increase whilst ceasing to diet was associated with the smallest rise. Taking vitamin supplements or tonics showed little association with the change in scores on this or any other dietary component.

There were few significant associations with any of the self-reported health measures once adjustment had been made for all other variables (Table 5), except for self-assessed health for men and illness symptoms for women. Men who reported their health to be

'excellent' or 'good' at HALS1 or whose health status improved between the surveys, had greater score increases than those whose health was still 'fair' or 'poor'. For women, those experiencing few illness symptoms at HALS1 had the greatest score increases regardless of their experience of symptoms at HALS2. Disability/handicap showed little association with change in scores on any of the dietary components.

Component 2 (high in energy-dense foods)

Fig. 2 shows that the score decreases were not uniform across the age groups, but were smaller in the older subjects ($P < 0{\cdot}05$). The HALS2 scores were all less than would have been expected for the 7-year advance in age, had no population shift in the popularity of this diet taken place.

The non-manual men had larger score decreases than the manual subjects, particularly in the older group, whilst there were no socio-economic group associations for the women (Table 3). The initial (HALS1) household size (women) and change in household size between the surveys were associated with variations in the change of scores on component 2. The largest decreases in score were in those who had come to live alone by HALS2. In contrast amongst those who were alone at HALS1 but were living with others (spouse, children, parents, friends, etc.) at HALS2 there was a smaller score decrease in the men and virtually no change for women. There were no associations with region of residence.

Men and women who began smoking between the surveys showed the greatest decreases in score, whilst men who continued smoking and women who did not change their smoking habit had the least score change (Table 4). Changes in dietary scores were also associated with alcohol consumption. On component 2 men who were 'nil' or 'sensible' drinkers at HALS1 and who had kept their drinking within these limits at HALS2 showed the smallest decrease in score. Men and women who were 'unwise' drinkers at both surveys had the largest decrease in scores. Starting a prescribed diet between HALS1 and HALS2 was associated with the largest score decrease in both men and women and ceasing to diet with the smallest score decrease.

Table 5 shows that only in the men was component 2 associated with any of the self-reported health measures, with the largest decrease in scores recorded for those who experienced a reduction in physical illness symptoms but also those whose self-assessed health was 'fair/poor' at HALS2.

Component 3 (high in convenience foods)

The HALS1 and HALS2 scores for each 7-year age group are shown in Fig. 3. Although, in the men, the scores had decreased in each age group, except those aged 67–73 years at HALS1 (74–80 years at HALS2), the changes were small and less than expected just for the 7-year advance in age. Women aged 39 years and over at HALS1 showed the same trends, but in the younger women there was an increase in score by HALS2, contrary to the expected age trend.

Only for older women was there a socio-economic difference in score change (Table 3), with the non-manual women exhibiting a score decrease and the manual women a small score increase. There were no other associations with the demographic factors studied or with smoking or being on a prescribed diet (Tables 3 and 4). The largest relative decreases in score for component 3 were observed in men and women who were, or became, non- or sensible drinkers by HALS2.

The only associations with self-reported health were with illness symptoms for men, where the largest decreases in score were amongst those who had experienced the most symptoms at HALS1 (Table 5).

Table 5. *Initial (from the* Health and Lifestyle Survey *of 1984–5 (HALS1), Cox* et al. *1987) and altered (from HALS1 to the follow-up survey of 1991–2 (HALS2), Cox* et al. *1993) health associations with dietary component† score change, adjusted for HALS1 score and all other variables*

			Dietary component score changes								
			Men (*n* 2190)				Women (*n* 2900)				
Dietary component ...			1	2	3	4		1	2	3	4
Illness symptoms (HALS1 status)		*n*	NS	NS	*	NS	*n*	***	NS	NS	NS
Low		1065	0·31	−0·36	−0·02	0·23	1064	0·38	−0·26	0·03	0·15
Medium/high		1125	0·35	−0·36	−0·10	0·23	1836	0·28	−0·30	0·01	0·20
Altered illness status (HALS1 to HALS2)		*n*	NS	*	NS	NS	*n*	NS	NS	NS	NS
Low	Low	754	0·32	−0·37	−0·05	0·21	673	0·37	−0·28	0·05	0·19
	More symptoms	311	0·28	−0·35	0·05	0·28	391	0·40	−0·24	0·01	0·08
Medium/high	Medium/high	779	0·36	−0·31	−0·09	0·24	1370	0·29	−0·30	0·01	0·20
	Fewer symptoms	346	0·33	−0·46	−0·12	0·21	466	0·27	−0·34	0·02	0·20
Malaise symptoms (HALS1 status)		*n*	NS	NS	NS	NS	*n*	NS	NS	NS	***
Low		991	0·34	−0·37	−0·09	0·21	928	0·33	−0·33	0·02	0·27
Medium/high		1199	0·33	−0·36	−0·04	0·24	1972	0·31	−0·27	0·01	0·14
Altered malaise status (HALS1 to HALS2)		*n*	NS	NS	NS	NS	*n*	NS	NS	NS	*
Low	Low	758	0·34	−0·35	−0·09	0·23	692	0·35	−0·32	0·03	0·27
	More symptoms	233	0·33	−0·42	−0·07	0·15	236	0·31	−0·37	−0·01	0·26
Medium/high	Medium/high	845	0·33	−0·36	−0·02	0·27	1453	0·30	−0·27	0·03	0·17
	Fewer symptoms	354	0·32	−0·36	−0·07	0·18	519	0·36	−0·29	−0·02	0·05
Self-assessed health (HALS1 status)		*n*	**	NS	NS	NS	*n*	NS	NS	NS	NS
Excellent/good		1625	0·36	−0·36	−0·08	0·24	2156	0·32	−0·30	0·01	0·18
Fair/poor		565	0·25	−0·36	−0·02	0·20	744	0·31	−0·25	0·03	0·19
Altered self-assessed health status (HALS1 to HALS2)		*n*	*	*	NS	NS	*n*	NS	NS	NS	NS
Excellent/good	Excellent/good	1349	0·37	−0·34	−0·07	0·25	1823	0·33	−0·31	0·01	0·18
	Fair/poor	276	0·28	−0·43	−0·10	0·19	333	0·29	−0·23	0·04	0·17
Fair/poor	Fair/poor	293	0·20	−0·45	−0·04	0·17	379	0·27	−0·27	0·00	0·16
	Excellent/good	272	0·30	−0·27	0·00	0·21	365	0·34	−0·23	0·06	0·20

Significance of *F* ratios: $*P < 0·05$, $**P < 0·01$, $***P < 0·001$.
† For details of dietary components, see Table 1.

Component 4 (high in sugary foods, low in vegetables)

The scores for both men and women (Fig. 4) followed the same pattern at HALS1 and HALS2; high in youth and older age, and low in middle age, but the scores at HALS2 were all higher, and higher than would have been expected for the 7-year advance in age. Non-manual respondents had greater score increases than manual respondents, and there were regional variations with the largest score increase found in women in Scotland (Table 3). Women who were living alone at HALS2 had larger score increases than those living in a 'family' situation.

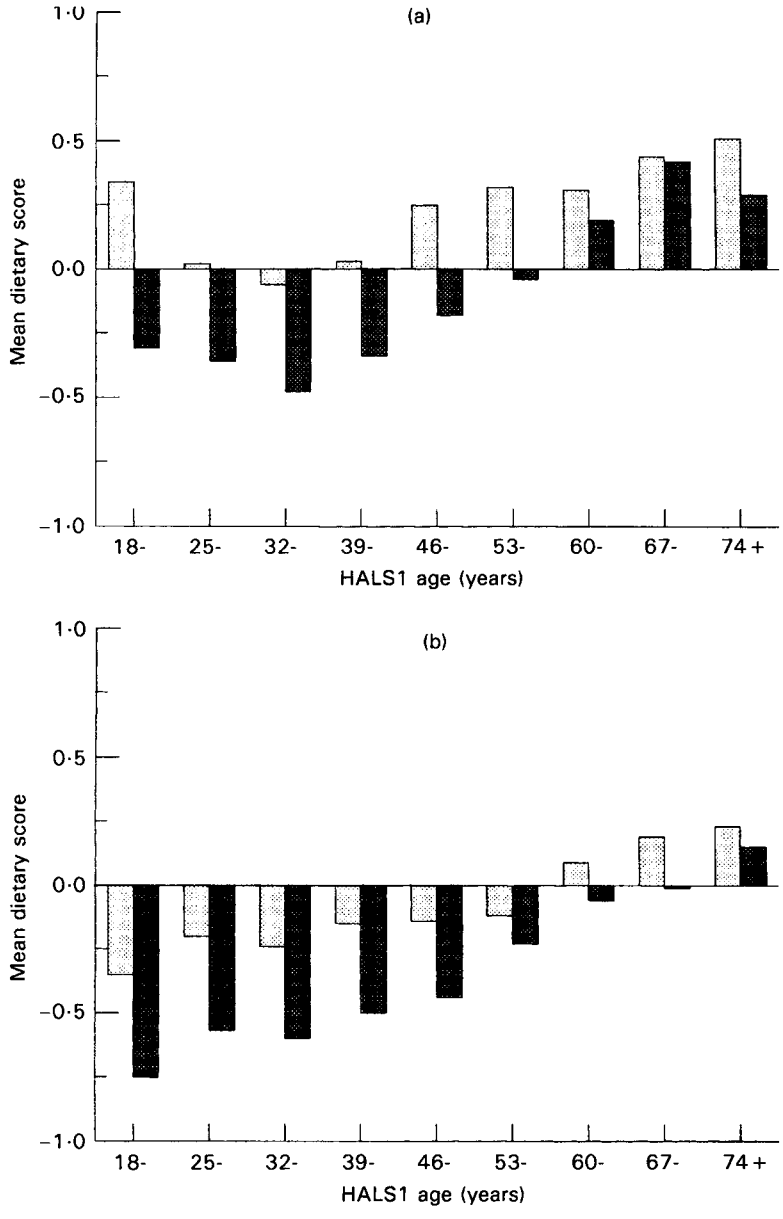

Fig. 2. Component 2: mean dietary scores from the *Health and Lifestyle Survey* of 1984–5 (HALS1, ▩; Cox *et al.* 1987) and the follow-up survey of 1991–2 (HALS2, ■; Cox *et al.* 1993) by 7-year age groups for (a) men and (b) women. For details of component 2, see Table 1.

Changes in component 4 scores were associated with all of the lifestyle habits studied. Subjects who were non-smokers at HALS1, and men who were ex-smokers by HALS2, had greater score increases than other groups (Table 4). In relation to alcohol consumption it was respondents who were non-drinkers at HALS1 who had the greatest score increase. Those who had started a prescribed diet by HALS2 and men continuing a diet had the smallest score increases.

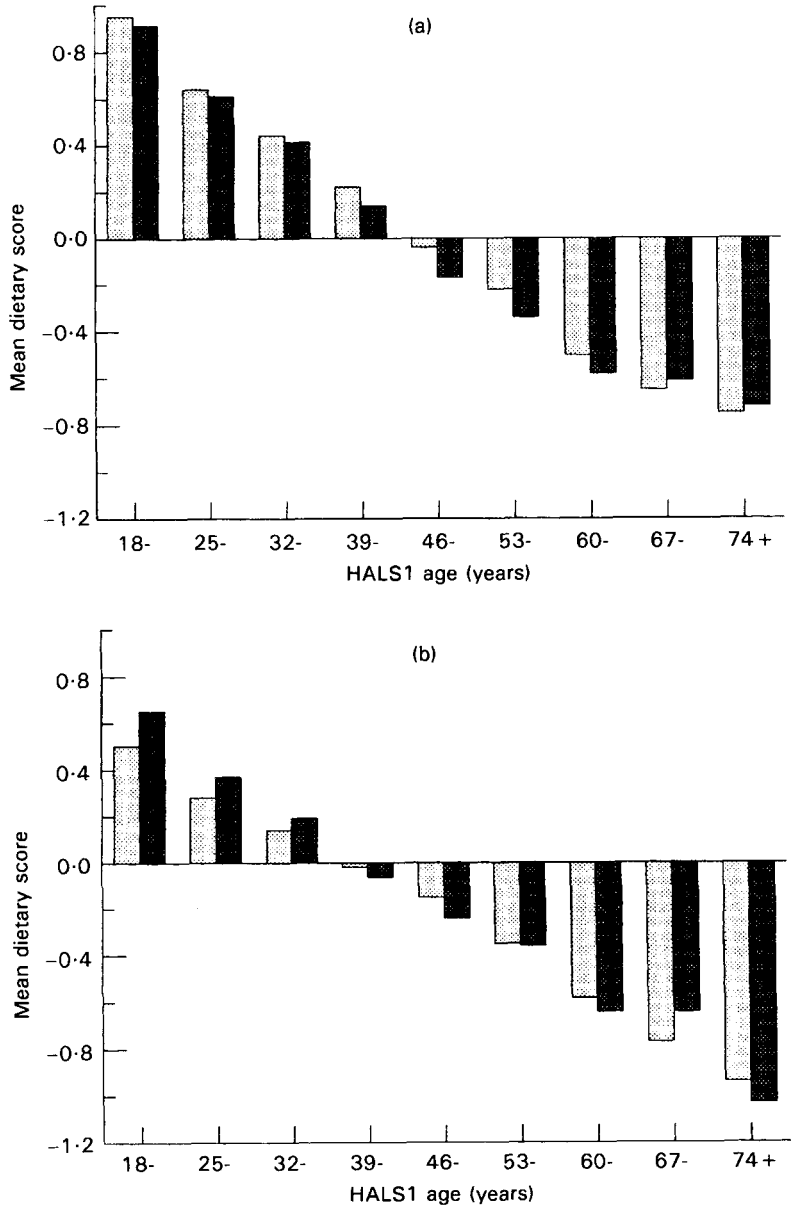

Fig. 3. Component 3: mean dietary scores from the *Health and Lifestyle Survey* of 1984–5 (HALS1, ▩; Cox *et al.* 1987) and the follow-up survey of 1991–2 (HALS2, ■; Cox *et al.* 1993) by 7-year age groups for (a) men and (b) women. For details of component 3, see Table 1.

The only association with self-reported health was for women, where those who had the greatest score increases experienced few malaise symptoms at HALS1 (Table 5).

DISCUSSION

A marked stability of eating patterns, in terms of the variety of foods consumed, has been demonstrated by the finding that the components of the four dietary patterns established

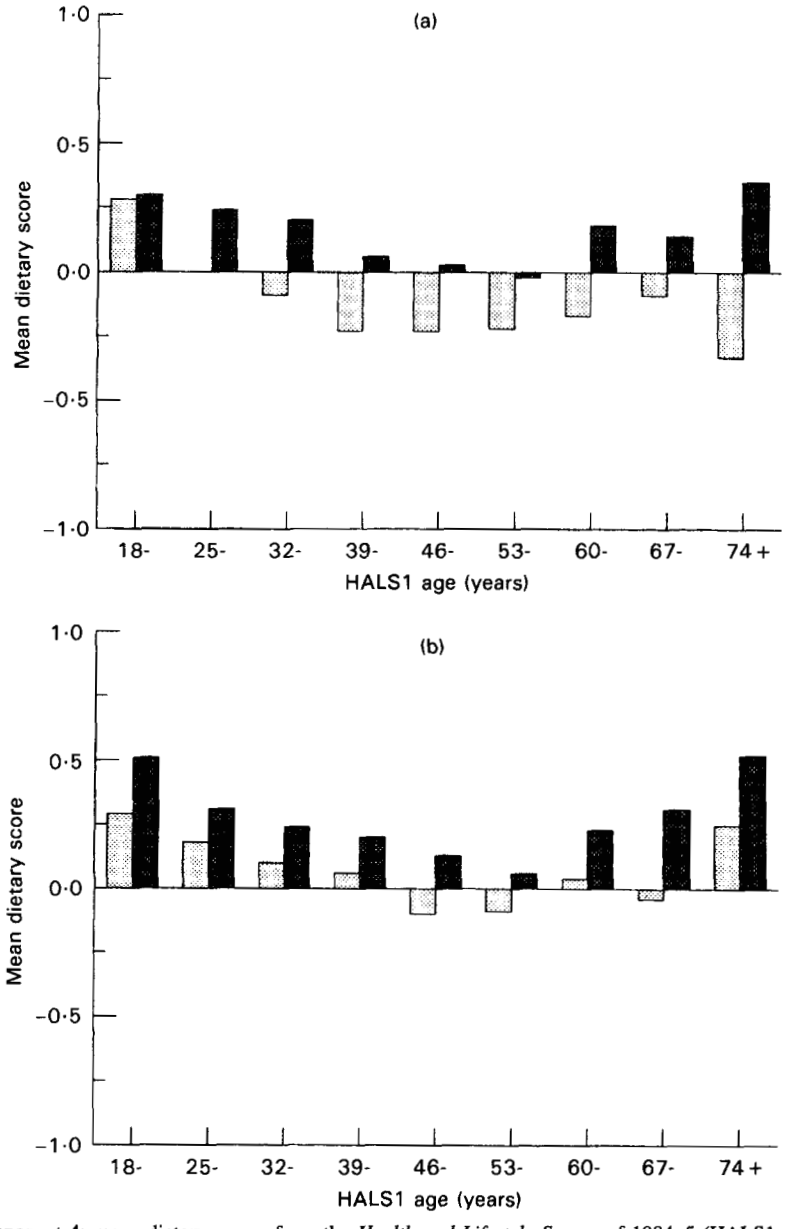

Fig. 4. Component 4: mean dietary scores from the *Health and Lifestyle Survey* of 1984–5 (HALS1, ▩; Cox *et al.* 1987) and the follow-up survey of 1991–2 (HALS2, ■; Cox *et al.* 1993) by 7-year age groups for (a) men and (b) women. For details of component 4, see Table 1.

from the 1984–5 survey were the same as those from the 1991–2 respondents. This suggests a resistance to changing the variety of foods consumed. On the other hand for the majority of respondents, the scores on components 1, 2 and 4 had changed considerably indicating a cohort effect with a change in frequency of consumption of some items. The reduction in the frequency of consumption of a number of foods with a high fat content (chips, fried food, processed meat, cheese, eggs, carcass meat, puddings and pies) and more

noticeably the change from full-fat to reduced-fat milk and spread, reported earlier (Whichelow, 1993), has contributed considerably to the changes observed, particularly in the component 1 scores. The National Food Survey (Ministry of Agriculture, Fisheries and Food, 1987) has also found a reduction in the consumption of fat over recent years.

The high loadings for fruit, salad, vegetables and 'brown' bread consumption, reflecting frequent consumption, together with strong negative loadings for many fatty foods, reveal that dietary component 1 is similar to that recommended for a healthy lifestyle: the higher the score, the healthier the eating habits. Greater increases in score were observed amongst the younger than the older age groups, suggesting that they were more influenced by the health education messages. The larger score decreases on component 2 in the younger respondents of both sexes, compared with the men over 60 years and women over 53 years suggest either a decrease in energy output or an increasing awareness of body weight. However for component 3, with its weightings of high-fat foods, in common with other respondents the younger subjects had resisted change towards 'healthier' eating habits by HALS2.

The degree of longitudinal change on component 1 score was mainly associated with economic status and lifestyle habits. The finding that, for non-manual and manual respondents with the same initial score and behavioural change, the mean score increase was lower for the manual respondents indicated a limited response to dietary aspects of health promotion. It is this very group which was initially over-represented amongst the lower scorers (Whichelow & Prevost, 1996). This suggests a polarizing of dietary habits by social group in Great Britain.

Polarization is further emphasized by consideration of the longitudinal associations between dietary change and altered lifestyle habits. Smokers at HALS1, particularly the heavy smokers, had lower component 1 scores at HALS1 than non-smokers (Whichelow & Prevost, 1996), and over the 7 years between HALS1 and HALS2 non-smokers' scores increased more than those of smokers with comparable initial diets. Furthermore those who started smoking between HALS1 and HALS2 had only small score rises, more similar to the continuing smokers than to their continuing non-smoking counterparts, or to those who had given up smoking.

Following a prescribed diet at HALS1 was associated with a high component 1 score (Whichelow & Prevost, 1996), and those who were on a diet at HALS2 had greater score increases than those who had not been dieting at either survey or those who had stopped dieting. The latter group had the smallest increase. These observations suggest that these diets, which were mainly for weight loss, diabetes, hypercholesterolaemia, hypertension or CHD were based on the food patterns of component 1.

The considerable decrease in scores between HALS1 and HALS2 on component 2 reflected changes in many items with positive loadings. These results are compatible with the acknowledged trend in the reduction in energy intake of the British population (Ministry of Agriculture, Fisheries and Food, 1987) which has occurred despite an increase in obesity (Cox, 1993; Bennett *et al.* 1995), strongly suggestive of a concomitant decrease in exercise levels. At HALS1 component 2 was favoured by those living in larger households (Whichelow & Prevost, 1996). The changes in component 2 scores in relation to household structure show that this diet, which is characterized by a very wide variety of foods, became less popular amongst those who started or continued to live alone relative to other respondents with comparable initial diets. Living with others, usually other family members, was associated with eating a wider variety of foods, particularly those of which a traditional cooked meal is composed: meat, vegetables, potatoes and puddings/pies and light desserts.

The association of the largest score reductions on component 2 with heavy drinking at HALS2 in men and women who were drinkers at HALS1, suggests that energy from alcohol may be substituting for food energy.

Component 4, characterized by foods which need little preparation, and negatively weighted for all vegetables, showed a significant increase in scores for all age groups. At HALS1 this diet was associated with living alone and it was again those living alone at HALS2 who, relative to others with a comparable initial diet, showed greater than average increases in score. This suggests a lack of interest in meal preparation by those in single person households and is of relevance in view of the increasing number of people in Britain living on their own.

There is evidence that this diet was increasingly popular in Scotland as not only at HALS1 did men and women in Scotland have the highest scores, but they also had the greatest increase of score by HALS2 relative to respondents with comparable initial scores from any other region. Since the frequency of consumption of green vegetables, pulses and potatoes (excluding chips) was significantly lower in Scotland in 1984–5 than in most other regions, particularly the south of Britain (Whichelow *et al.* 1991), this is further evidence of polarization of eating habits. The observation that the mean score of the non-manual group increased more than that of the manual group on the 'less healthy' component 4, in terms of being weighted towards easily prepared high-sugar–high-fat foods with few vegetables, is in contrast with the situation with 'the all-round healthy' component 1. However the component 1 non-manual–manual differences in scores were greater than those on component 4, with higher levels of significance.

The lack of change in the component 3 scores, despite the considerable changes expected for a 7-year advance in age, reveals a considerable population shift in the frequency of consumption of many of the items of this diet and a strong age cohort association with this diet. Under-representation at HALS2 of initially high scoring respondents on component 3 was confined to men aged 18–31 years at HALS1. Such non-response does not explain the population shift in consumption of this diet amongst both men and women of all ages in this sample. Whilst the changes observed in component 1 were in accord with the targets in *The Health of the Nation* (Department of Health, 1992), the lack of change in component 3 was not, suggesting an increasing tendency for all age groups towards the 'burger, chips and cola' pattern of eating usually associated with teenagers and young adults. The findings suggest that once this pattern of eating is established it does not change as subjects age, and that those who are currently young adults will persist with this dietary behaviour. The National Food Survey only began measuring food purchased for consumption outside the home in 1994, so that the increasing popularity of 'fast foods', is not reflected to any extent in the food surveys of 1985 and 1992.

These findings suggest that the non-manual groups, and those with desirable lifestyle habits (non-smoking and modest alcohol consumption) have responded positively to current health messages with regard to diet. However, when comparing those with similar initial dietary scores, the manual groups and those with poorer lifestyles have not, on average, responded as well to health messages, raising questions about the implications for a widening of the health divide.

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