

Health-Related Behaviours

What influences diet in early old age? Prospective and cross-sectional analyses of the Boyd Orr cohort

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Background: The aim of this study is to identify the socio-economic and health-related factors in childhood and later life associated with healthy eating in early old age. **Methods:** The study is based on surviving members of the Boyd Orr cohort aged 61–80 years. Data are available on household diet and socio-economic position in childhood and on health and social circumstances in later life. A 12-item Healthy Diet Score (HDS) for each subject was constructed from food frequency questionnaire responses. Complete data on all exposures examined were available for 1234 cohort members. **Results:** Over 50% of study members had inadequacies in at least half of the 12 markers of diet quality. In multivariable models having a childhood diet which was rich in vegetables was associated with a healthy diet in early old age. The HDS for those in the upper quartile of childhood vegetable intake was 0.30 (95% confidence interval –0.01 to 0.61) higher than those with the lowest intake levels (*P*-trend across quartiles = 0.04). The adult factors that were most strongly associated with a healthy diet were not smoking, being an owner-occupier, and taking anti-hypertensive medication. **Conclusion:** Our analysis indicates that diet in early old age is influenced by childhood vegetable consumption, current socio-economic position, and smoking. Interventions for improving the diet of older people could usefully focus on both encouragement of healthy diet choices from an early age and higher levels of income or nutritional support for older people.

Keywords: childhood, diet quality, housing tenure, life course, smoking, vegetables

Epidemiological and biomedical research suggests that diet is important in determining susceptibility to a range of chronic diseases including cancer, osteoporosis, dementia, and cardiovascular and respiratory disease.¹ Population surveys indicate, however, that the diets of many older people are unhealthy.^{2,3} It has long been suggested that socially patterned differences in diet may partially account for socio-economic influences on health,⁴ but the factors which influence diet and healthy eating patterns in later life are not well understood. The potential importance of early life in health inequalities is recognized in current UK government policy⁵ with proposals to eliminate child poverty and to reduce social exclusion. Amendments to the UK food welfare scheme aim to provide fruit and vegetables to poorer families and free fruit to primary school pupils.⁶ Few research investigations, however, have been able to assess the long-term importance of dietary patterns established in childhood.⁷ The life course approach to chronic disease epidemiology aims to bridge this gap in knowledge.^{8,9} The Boyd Orr cohort with diet and socio-economic factors measured in childhood and over 60 years' follow-up provides a unique opportunity

to examine the relative impact of both childhood and later life factors on diet in early old age. Such information is of importance in developing appropriate public health strategies to improve diet in later life and thereby improve the health and quality of life of current and future cohorts of the elderly.

This paper describes an assessment of the social, lifestyle, and health-related factors in childhood and adulthood which influence the establishment of a healthy diet in early old age. The analyses are on data from the Boyd Orr cohort,¹⁰ based on the records of 4999 children aged 0–19 years from 1343 families living in England and Scotland whose diets and living conditions were assessed both in childhood (1937–1939¹¹) and in adulthood as part of a follow-up study of the diet and health of surviving study members.

Methods

Childhood data

For each family a detailed record was made of social circumstances, family food expenditure, and diet, measured using a 7-day household inventory method. The original household diet records have been re-coded using the DIDO (diet in data out) program¹² developed at the Medical Research Council Human Nutrition Research, Cambridge, UK. Dietary analysis was carried out using programs based on McCance and Widdowson's *The Composition of Foods*.¹³ The programs were adapted using pre-war food tables where the composition of 1930s foods were very different from how they are today (e.g. meat products) or where there was no modern-day equivalent. Per capita food and nutrient intake was calculated as in the original study, by dividing daily total intakes by the total

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number of household members and taking into account meals missed by family members and meals consumed by visitors. Intakes were then adjusted according to age and sex of household members by applying weights proposed by the BMA's 1933 committee of nutrition.¹⁴

Adult data

In 1997–1998 all 3182 traced surviving study members were sent comprehensive health and lifestyle questionnaires. These included a food frequency questionnaire and questions on social circumstances and health. Subjects were asked to report on their employment history (from which occupational social class was determined), income, and other indicators of socio-economic status such as car ownership, housing tenure, and household composition. They reported their height and weight (from which body mass index (BMI) was calculated), their general health, health-related behaviours such as cigarette smoking and frequency of alcohol consumption, and any medication taken. Completed or partially completed questionnaires were returned by 1647 subjects (52%). Responders and non-responders were of a similar mean age and gender distribution; responders were more likely to come from families in the upper social classes and to live currently in more affluent areas than those who did not respond.¹⁵ Mean age of respondents was 68.6 years (interquartile range 60.9–79.8 years).

The questionnaire included a 113-item food frequency questionnaire (FFQ), a modified version of that used in the Cambridge arm of the European Prospective Study into Cancer and Nutrition (EPIC).¹⁶ Of the 1647 subjects who returned completed or partially completed questionnaires, usable FFQs were available for 1475 respondents. These subjects form the basis of the present study. The FFQs were used to estimate daily food and nutrient intake for each individual. To calculate nutrient intake, weekly frequency of consumption of a food was multiplied by the nutrient content of a standard portion of that food¹⁷ using programs based on food tables as above.

The Healthy Diet Score (HDS)

Subjects were assigned an HDS based on their intake of saturated fatty acids, polyunsaturated fatty acids, protein, carbohydrate, fibre, fruit and vegetables, pulses and nuts, sugars, cholesterol, fish, red meat, and calcium (table 1).¹⁸ Subjects scored 0 or 1 on the basis of their intake of each of these 12 items, high scores

indicating a healthier diet. The score was broadly modelled on a nine-item index, based on WHO healthy diet recommendations, developed by Huijbregts and colleagues,¹⁹ modified to comply with advice on healthy eating from the UK Committee on Medical Aspects of Food Policy (COMA).^{20,21}

We also calculated an HDS for cohort members based on their childhood diet. Reflecting the dietary patterns of the time, the childhood fruit and vegetable consumption of <1% of study members fell within intakes recommended to reduce risk of chronic diseases such as cancer and heart disease. For this reason the distribution of childhood fruit and vegetable consumption was used instead of the cut-off point of 400 g. Those above the median (93 g per head per day) scored 1 and those below, 0. All other cut-off points are the same as for the adult HDS.

Statistical methods

Linear regression models were used to investigate factors associated with the HDSs. We grouped possible explanatory factors into five broad categories of childhood and adult social and health-related factors: (i) childhood diet: energy intake, vegetable consumption, fruit consumption, childhood HDS; (ii) childhood social circumstances: social class and per capita household food expenditure; (iii) adult social circumstances: social class, housing tenure, per capita household income, car ownership, marital status, and household size; (iv) adult health-related behaviours: smoking and alcohol consumption; (v) adult health: general health, BMI, treatment for high blood pressure, and chronic bronchitis.

Multivariable analyses

Factors individually associated with HDS ($P \leq 0.20$)²² in age- and sex-adjusted models were subsequently included in separate multivariable models for each of the five broad categories of explanatory variables (see above) and independent predictors of HDS ($P \leq 0.20$) within each category were identified. All factors found in these five models to be related to HDS ($P \leq 0.20$) were examined together in a final multivariable model.

Initial age- and sex-adjusted analyses of each variable are based on all subjects with measured values for that variable. Final multivariable models are based on only those subjects with complete data for all variables. For ease of presentation, as there was no evidence that associations differed between males and females, we combined the data on males and females in sex-adjusted models. For continuous variables which have

Table 1 Cut-off points for the Healthy Diet Score

Index items	Score 1	Score 0
1. Saturated fatty acids (% energy intake)	0–10	>10
2. Polyunsaturated fatty acids (% energy intake)	6–10	<6 or >10
3. Protein (% energy intake)	10–15	<10 or >15
4. Total carbohydrates (% energy intake)	50–70	<50 or >70
5. Dietary fibre (g)	18–32	<18 or >32
6. Fruit and vegetables (g)	≥400	<400
7. Pulses and nuts (g)	≥30	<30
8. Total non-milk extrinsic sugars (% total energy intake)	0–10	>10
9. Cholesterol (mg)	0–245	>245
10. Fish (g)	≥32	<32
11. Red meat and meat products (g)	≤90	>90
12. Calcium (mg)	≥700	<700

been categorized for presentational purposes, tests for linear trend are based upon the continuous measure. We repeated our main analyses excluding those subjects whose ratio of energy intake to estimated basal metabolic rate was <1.2 (possible under-reporters of energy intake). All analyses were carried out using Stata (release 8.0, Stata Corporation).

Results

Mean HDS was 5.43 (standard deviation 1.99, range 1–11) and was normally distributed. This indicates that $>50\%$ of the study members surveyed had inadequacies in at least half of the 12 markers of diet quality as measured by the HDS.

Childhood longitudinal data

Table 2 shows mean HDS in relation to the socio-economic and dietary explanatory variables measured in childhood. Females had healthier diets (P -value for difference <0.001). Almost 30% of study members were from social classes I–III in childhood. Childhood social class and food expenditure group as indicators of childhood socio-economic position were not strongly related to adult HDS. Of the four measures of childhood diet examined, only vegetable consumption was associated with adult HDS. Those with higher levels of vegetable intake in childhood tended to have better quality adult diets. There was no association between childhood HDS and adult HDS.

Adult cross-sectional data

Table 3 shows modest gender differences in the distribution of some the adult explanatory variables. Females tended to be older and more males were in the upper social classes, higher income brackets, and owned their own homes. As expected, more men were married or living as married and more women were widowed. Males were more likely to be current or ex-smokers and heavier drinkers, but were less likely to be obese. Surprisingly, HDS did not decline with increasing age. Markers of higher adult socio-economic status—occupational social class and housing tenure—were associated with better quality diets. There was some evidence that female car owners also had healthier diets. There was no clear evidence that single or widowed men had worse diets than those who were married. Current smokers had the least healthy diets with ex-smokers diets being more similar, but generally poorer, than those who had never smoked. There were no strong associations with alcohol intake or BMI but those with bronchitis had poorer diets. Treatment for blood pressure was associated with a healthier diet.

Linear regression analysis of factors associated with HDS

We found no evidence of interactions between gender and the various social, economic, and health variables with respect to their influence on adult HDS. Our main evaluation of the factors influencing HDS is therefore based upon data on males and females combined, controlling for age and sex. Findings from linear regression analyses are shown in table 4. We included in these models only subjects with complete data on all the exposures examined ($n = 1234$). The factors listed in the first column of table 4 are those that were significant predictors of HDS ($P \leq 0.20$) in the five categories of explanatory variables. The coefficients represent the change in HDS (95% confidence interval) with each change of category of the exposure examined. Associations in this table are age- and sex-adjusted, and for this reason as well as the reduced sample size, the levels of statistical significance differ from those in tables 2 and 3. Multivariable associations are adjusted for age, sex, and all other factors listed in table 4.

Childhood longitudinal data

Childhood vegetable consumption was independently associated with a healthier diet. This association remained after adjusting

for all other factors. We examined whether the association was due to consumption of vegetables in adulthood or more generally to other aspects of the HDS. The Spearman rank correlation coefficient between childhood vegetable intake and adult vegetable intake was low ($r = 0.07$). We repeated the final multivariable model with the fruit and vegetable item removed from the adult HDS. The pattern of association was similar to that found with the 12-item adult HDS; however, the linear trend was weaker ($P = 0.13$).

Adult cross-sectional data

Poor housing, smoking, and chronic bronchitis were associated with lower HDS. Treatment for high blood pressure was independently associated with a healthier diet. Further examination of the association between smoking and diet showed smokers had a higher intake of saturated fat and meat and lower consumption of fruit, vegetables, and fibre (not shown in table).

The final multivariable models were repeated excluding those subjects ($n = 170$) whose ratio of energy intake to estimated basal metabolic rate was <1.2 (i.e. possible under-reporters of energy intake). Smoking, housing tenure, and treatment for high blood pressure remained the strongest predictors of HDS, and childhood vegetable consumption was still independently associated with a healthier diet ($P = 0.03$).

Discussion

Childhood longitudinal data

We found that higher levels of vegetable consumption in childhood (as measured from family-level diet data) were associated with a healthier pattern of food consumption in early old age. Although previous studies have shown that people who *recall* that they ate high levels of fruit and vegetables in childhood tend to continue to consume higher levels in adulthood,^{23,24} to the best of our knowledge this is the first study in which an aspect of diet *measured* in childhood has been shown prospectively to be related to diet in later life. The association was weaker but still evident when fruit and vegetables were excluded from the HDS. This could indicate that childhood vegetable consumption may be a marker of a generally health-conscious family. Such attitudes may then persist into adulthood and contribute to an overall healthy diet pattern. This finding needs replication but underlines the potential long-term importance of encouraging children to eat healthier diets.

We were able to investigate the long-term influence of childhood socio-economic position on adult diet. We found no association between our two measures—childhood social class and family food expenditure—and diet quality in early old age. This is in contrast to the study by Lynch and colleagues, who examined associations between social circumstances at different stages of the life course and various aspects of adult diet.⁷ Lynch *et al.* reported that men who came from the poorest childhood circumstances had significantly lower mean intake of fruit, vegetables, vitamin C, and carotene and higher levels of salt intake and coffee consumption compared with those who were better off in childhood. Although these associations appeared to be stronger in relation to current socio-economic position, they are in contrast to the findings in our analysis. The differences may reflect the fact that Lynch *et al.*'s subjects were younger (40–60 years old) than the Boyd Orr study members and that relationships with childhood socio-economic position may become weaker with age.

Adult cross-sectional data

The strongest association was with smoking. In multivariable models the HDS score of current smokers was approximately

Table 2 Adult mean Healthy Diet Score (HDS) for the Boyd Orr cohort members in relation to socio-economic and dietary variables measured in childhood (longitudinal data)

Characteristic	Males		Females		All	
	n (%)	Mean HDS	n (%)	Mean HDS	n (%)	Mean HDS
Overall mean HDS score	672 (46)	5.19	803 (54)	5.63	1475 (100)	5.43
<i>Childhood social class</i>						
I-II	55 (8.2)	5	75 (9.3)	5.39	130 (8.8)	5.22
III	132 (19.6)	5.23	169 (21.0)	5.92	301 (20.4)	5.61
IV	169 (25.1)	5.34	170 (21.2)	5.51	339 (23.0)	5.43
V	108 (16.1)	5.26	120 (14.9)	5.65	228 (15.5)	5.46
Unemployed	173 (25.7)	5.01	203 (25.3)	5.59	376 (25.5)	5.32
Not recorded	35 (5.2)	5.6	66 (8.2)	5.79	101 (6.8)	5.72
P-value (trend)		0.62		0.65		0.54
<i>Childhood food expenditure group (new pence per head per week)</i>						
<25	323 (48.1)	5.15	431 (53.7)	5.57	754 (51.1)	5.39
25-35	207 (30.8)	5.23	201 (25.0)	5.77	408 (27.7)	5.5
>35	141 (21.0)	5.21	169 (21.0)	5.63	310 (21.0)	5.44
Not recorded	1 (0.2)	6	2 (0.3)	6	3 (0.2)	6
P-value (trend)		0.71		0.56		0.6
<i>Childhood household diet</i>						
<i>Quartile of energy intake</i>						
Q1 (lowest)	167 (24.8)	4.91	202 (25.2)	5.6	369 (25.0)	5.29
Q2	155 (23.1)	5.55	213 (26.5)	5.56	368 (25.0)	5.56
Q3	169 (25.1)	5.06	198 (26.7)	5.81	367 (24.9)	5.47
Q4 (highest)	180 (26.8)	5.25	188 (23.4)	5.54	368 (25.0)	5.4
Not recorded	1 (0.1)	6	2 (0.2)	6	3 (0.2)	6
P-value (trend)		0.41		0.89		0.61
<i>Quartile of vegetable intake</i>						
Q1 (lowest)	159 (23.7)	4.95	209 (26.0)	5.59	368 (25.0)	5.32
Q2	162 (24.1)	5.18	206 (26.6)	5.43	368 (25.0)	5.32
Q3	165 (24.5)	5.11	204 (25.4)	5.65	369 (25.0)	5.41
Q4 (highest)	185 (27.5)	5.46	182 (22.7)	5.88	367 (25.9)	5.67
Not recorded	1 (0.1)	6	2 (0.2)	6	3 (0.2)	3
P-value (trend)		0.03		0.1		0.01
<i>Quartile of fruit intake</i>						
Q1 (lowest)	177 (26.3)	5.04	191 (23.8)	5.61	368 (24.9)	5.34
Q2	155 (23.1)	5.14	214 (26.6)	5.65	369 (25.0)	5.44
Q3	166 (24.7)	5.4	201 (25.0)	5.52	367 (24.9)	5.46
Q4 (highest)	173 (25.7)	5.17	195 (24.3)	5.74	368 (24.9)	5.47
Not recorded	1 (0.1)	6	2 (0.2)	6	3 (0.2)	6
P-value (trend)		0.36		0.68		0.35
<i>Tertiles of childhood HDS</i>						
T1 (lowest)	323 (48.1)	5.09	421 (52.4)	5.61	744 (50.4)	5.38
T2	210 (31.2)	5.31	211 (26.3)	5.81	421 (28.5)	5.56
T3 (highest)	138 (20.5)	5.22	169 (21.0)	5.45	307 (20.8)	5.35
Not recorded	1 (0.1)	6	2 (0.2)	6	3 (0.2)	6
P-value (trend)		0.35		0.62		0.88

The table gives the P-value for trend or difference between categorical variables; those with missing data have been removed from the analysis

Table 3 Adult mean Healthy Diet Score (HDS) for the Boyd Orr cohort members in relation to adult socio-economic and health-related variables (cross-sectional data)

Characteristic	Males		Females		All	
	n (%)	Mean HDS	n (%)	Mean HDS	n (%)	Mean HDS
Age						
<65	276 (41.1)	5.32	349 (43.5)	5.76	625 (42.4)	5.57
65–69	252 (37.5)	5.08	256 (31.9)	5.39	508 (34.4)	5.23
70–74	120 (17.9)	5.08	169 (21.0)	5.69	289 (19.6)	5.44
75+	24 (3.6)	5.33	29 (3.6)	5.90	53 (3.6)	5.64
P-value (trend)		0.33		0.67		0.35
<i>Adult social circumstances</i>						
Social Class						
I	37 (5.5)	5.40	40 (5.0)	6.15	77 (5.2)	5.79
II	133 (19.8)	5.25	170 (21.2)	5.77	303 (20.5)	5.54
III non-manual	50 (7.4)	5.42	73 (9.1)	5.37	123 (8.3)	5.39
III manual	257 (38.2)	5.22	242 (30.1)	5.68	499 (33.8)	5.44
IV	129 (19.2)	5.02	131 (16.3)	5.39	260 (17.6)	5.21
V	31 (4.6)	5.10	34 (4.2)	4.97	65 (4.4)	5.03
Not reported	35 (5.2)	4.88	113 (14.1)	5.70	148 (10.0)	5.32
P-value (trend)		0.13		0.01		0.003
Household per capita income (per head per week)						
<£75	267 (39.7)	5.19	357 (44.5)	5.57	624 (42.3)	5.41
£75–250	249 (37.0)	5.15	258 (32.1)	5.7	507 (34.4)	5.43
>£250	47 (7.0)	5.49	30 (3.7)	6	77 (5.2)	5.69
Not reported	109 (16.2)	5.13	158 (19.7)	5.58	267 (18.1)	5.4
P-value (trend)		0.61		0.23		0.41
Housing tenure						
Owned outright	408 (60.7)	5.24	484 (60.3)	5.81	892 (60.5)	5.55
Owned: mortgaged	115 (17.1)	5.19	96 (12.0)	5.75	211 (14.3)	5.44
Rented: private/other	36 (5.4)	4.8	42 (5.2)	5.36	78 (5.3)	5.1
Rented: council	96 (14.3)	5.03	156 (19.4)	5.14	252 (17.1)	5.1
Other	9 (1.3)	6.11	7 (0.9)	4.57	16 (1.1)	5.44
Not reported	8 (1.2)	5	18 (2.2)	5.44	26 (1.8)	5.31
P-value (difference)		0.23		<0.0001		0.001
Car ownership						
No	67 (10.0)	5.31	137 (17.1)	5.37	204 (13.8)	5.35
Previously	47 (7.0)	5.04	103 (12.8)	5.39	150 (10.2)	5.28
Yes	546 (81.2)	5.18	535 (66.6)	5.75	1081 (73.3)	5.46
Not reported	12 (1.8)	5.33	28 (3.5)	5.57	40 (2.7)	5.5
P-value (difference)		0.74		0.02		0.34
Marital status						
Married or living as married	569 (84.7)	5.21	506 (63.0)	5.67	1075 (72.9)	5.43
Widowed	45 (6.7)	4.98	183 (22.8)	5.6	228 (15.5)	5.47
Separated or divorced	26 (3.9)	4.58	58 (7.2)	5.67	84 (5.7)	5.33
Single	26 (3.9)	5.5	31 (3.9)	5.13	57 (3.9)	5.3
Not reported	6 (0.9)	5.5	25 (3.1)	5.64	31 (2.1)	5.61
P-value (difference)		0.65		0.27		0.65

(Continued on next page)

Table 3 (continued)

Characteristic	Males		Females		All	
	n (%)	Mean HDS	n (%)	Mean HDS	n (%)	Mean HDS
No. of people in household						
1	58 (8.6)	5.05	198 (24.7)	5.6	256 (17.4)	5.48
2	451 (67.1)	5.25	461 (57.4)	5.68	912 (61.8)	5.47
3+	98 (14.6)	5.15	77 (9.6)	5.23	175 (11.9)	5.19
Not reported	65 (9.7)	4.94	67 (8.3)	5.84	132 (9.0)	5.39
P-value (trend)		0.98		0.33		0.12
Adult health-related behaviours						
Smoking status						
Never	168 (25.0)	5.62	353 (44.0)	5.91	521 (35.3)	5.82
Ex-smoker	337 (50.2)	5.33	275 (34.3)	5.61	612 (41.5)	5.46
Current smoker	163 (24.3)	4.46	169 (21.1)	5.06	332 (22.5)	4.77
Not reported	4 (0.6)	4.5	6 (0.8)	5.83	10 (0.7)	5.3
P-value (difference)		<0.0001		<0.0001		<0.0001
Alcohol						
Non-drinkers	105 (15.6)	5.3	154 (19.2)	5.7	259 (17.6)	5.54
Special occasion/light	137 (20.4)	5.24	295 (36.7)	5.46	432 (29.3)	5.39
Low/moderate	350 (52.1)	5.23	319 (39.7)	5.75	669 (45.4)	5.48
Above recommendations	80 (11.9)	4.78	35 (4.4)	5.66	115 (7.8)	5.04
P-value (difference)		0.15		0.59		0.16
Adult health						
Body mass index (kg/m ²)						
<25	250 (37.2)	5.18	319 (39.7)	5.65	569 (38.6)	5.44
25–30	311 (46.3)	5.22	295 (36.7)	5.69	606 (41.1)	5.45
>30	86 (12.8)	5.14	136 (16.9)	5.55	222 (15.0)	5.39
Not reported	25 (3.7)	5.08	53 (6.6)	5.36	78 (5.3)	5.27
P-value (trend)		0.99		0.73		0.81
Self-reported general health						
Very good	160 (23.8)	5.37	206 (26.7)	5.86	366 (24.8)	5.65
Good	253 (37.7)	5.02	317 (39.5)	5.51	570 (38.6)	5.3
Fair	161 (24.0)	5.22	195 (24.3)	5.58	356 (24.1)	5.42
Bad/very bad	48 (7.1)	5.42	47 (2.9)	5.28	95 (6.4)	5.35
Not reported	50 (7.4)	5.12	38 (4.7)	6.02	88 (6.0)	5.51
P-value (trend)		0.95		0.06		0.13
Anti-hypertensive/cardiovascular medication						
Never	513 (76.3)	5.06	603 (75.1)	5.59	1116 (75.7)	5.35
Yes: in the past	20 (3.0)	5.25	26 (3.2)	5.27	46 (3.1)	5.26
Yes: currently	139 (20.7)	5.63	174 (21.7)	5.82	313 (21.2)	5.74
P-value (difference)		0.002		0.22		0.003
Chronic bronchitis						
No	554 (82.4)	5.22	646 (80.4)	5.71	1200 (81.4)	5.48
Yes	114 (17.0)	5.05	154 (19.2)	5.28	268 (18.2)	5.18
Not reported	4 (0.6)	4.75	3 (0.4)	7	7 (0.5)	5.71
P-value (difference)		0.41		0.02		0.03

The table gives the P-value for trend or difference between categorical variables; those with missing data have been removed from the analysis

Table 4 Multivariable linear regression analysis of factors associated with the Healthy Diet Score ($n = 1234$)

Explanatory variable	Coefficient (95% confidence intervals), P-value for linear trend	
	Simply adjusted models ^a	Multivariable models ^b
Childhood longitudinal data		
<i>Childhood diet</i>		
Quartile of vegetable intake		
Q1 (lowest)	Reference	Reference
Q2	0.03 (-0.28 to 0.35)	-0.007 (-0.32 to 0.30)
Q3	0.15 (-0.16 to 0.47)	0.12 (-0.19 to 0.43)
Q4 (highest)	0.39 (0.07 to 0.70)	0.30 (-0.01 to 0.61)
	$P = 0.01$	$P = 0.04$
Adult cross-sectional data		
<i>Adult social circumstances</i>		
Social class		
I	Reference	Reference
II	-0.30 (-0.81 to 0.21)	-0.24 (-0.74 to 0.26)
III non-manual	-0.34 (-0.92 to 0.24)	-0.22 (-0.79 to 0.35)
III manual	-0.23 (-0.72 to 0.26)	-0.08 (-0.56 to 0.41)
IV	-0.58 (-1.29 to 0.13)	-0.20 (-0.72 to 0.33)
V	-0.60 (-1.50 to 0.29)	-0.45 (-1.15 to 0.24)
	$P = 0.17$	$P = 0.71$
Housing tenure		
Owned outright	Reference	Reference
Owned: mortgaged	-0.09 (-0.41 to 0.23)	-0.08 (-0.40 to 0.23)
Rented: private/other	-0.51 (-1.02 to 0.004)	-0.40 (-0.90 to 0.10)
Rented: council	-0.48 (-0.82 to -0.14)	-0.42 (-0.74 to -0.09)
	$P = 0.002$	$P = 0.005$
<i>Adult health-related behaviours</i>		
Smoking status		
Never	Reference	Reference
Ex-smoker	-0.20 (-0.45 to 0.05)	-0.12 (-0.37 to 0.13)
Current smoker	-0.88 (-1.18 to -0.59)	-0.74 (-1.04 to -0.44)
	$P < 0.0001$	$P < 0.0001$
<i>Adult health</i>		
Self-reported general health		
Very good	Reference	Reference
Good	-0.46 (-0.73 to -0.19)	-0.42 (-0.69 to -0.15)
Fair	-0.32 (-0.63 to -0.01)	-0.19 (-0.50 to 0.11)
Bad/very bad	-0.23 (-0.74 to 0.27)	-0.06 (-0.56 to 0.44)
	$P = 0.11$	$P = 0.57$
Anti-hypertensive/cardiovascular medication		
Never	Reference	Reference
Yes: in the past	0.01 (-0.62 to 0.64)	0.08 (-0.54 to 0.71)
Yes: currently	0.48 (0.20 to 0.75)	0.46 (0.19 to 0.74)
	$P = 0.001$	$P = 0.001$

(continued on next page)

Table 4 (continued)

Explanatory variable	Coefficient (95% confidence intervals), P-value for linear trend	
	Simply adjusted models ^a	Multivariable models ^b
<i>Adult health</i>		
Chronic bronchitis		
No	Reference	Reference
Yes	-0.37 (-0.66 to -0.08)	-0.30 (-0.59 to -0.01)
	P = 0.02	P = 0.05

a: Regression coefficient: change in HDS per unit change in explanatory factor in separate models controlling for age and sex

b: Regression coefficient: change in HDS per unit change in explanatory factor controlling for age and sex as well as other variables listed in the first column of this table in the same model

0.7 points (13%) lower than for those who had never smoked. The association between smoking and poor diet has been previously reported; however, explanations for the relationship have been less well researched. Possible causes include the financial impact of having less money to spend on healthy food due to the high cost of cigarettes, the clustering of unhealthy behaviours within individuals who take little interest in health promotion messages or who adopt a fatalistic attitude to health,^{25–27} and the influence on food choices of the physiological impairment of taste and olfactory senses caused by smoking.²⁸ Although there was slight attenuation of the smoking–HDS association in fully adjusted models, the persisting relationship suggests that explanations other than similarities in the socio-economic patterning of diet and smoking are likely to be important. The observation that ex-smokers have diets more similar in quality to those of non-smokers suggests that either smoking cessation occurs in the context of a more general effort to adopt a healthier lifestyle or that smoking has a direct effect on taste preferences, which diminishes on cessation. By contrast, a study examining changes in diet among a group of smokers, some of whom gave up smoking, reported that 12 months after stopping there were no significant differences in the fruit, vegetable, or fish intakes of the ex-smokers compared with those who continued to smoke.²⁹ A better understanding of the association between smoking and poor diet is required.

In keeping with other studies,^{2,30,31} we found that people from socially disadvantaged backgrounds in adulthood—as indexed by adult social class and housing tenure—had poorer diets in early old age. In multivariable models only housing tenure remained associated with the HDS score. Rather than interpreting this as a true ‘independent effect’ of housing, we feel that it reflects a more general association of adult socio-economic position with HDS; housing tenure, in this analysis, is perhaps the best marker of socio-economic position in later life.³²

The association between treatment for high blood pressure and healthy diet may be due to changes to diet after receiving dietary advice. The cross-sectional nature of the data, however, makes this difficult to assess. Likewise it is not possible to determine from the data available whether having chronic bronchitis *per se* affects food choice or whether it is a marker of some other determinant of food choice such as past or current cigarette smoking.

Study strengths and limitations

The strength of the analyses presented here is that we were able to assess influences on diet quality of factors operating at two stages of the life course—childhood and early old age. In a cohort with more than 60 years without direct access to survivors’ addresses, relatively high levels of non-response are

inevitable but may not bias associations. Although questionnaire respondents were more affluent in childhood and adulthood, there was no significant difference between respondents and non-respondents with respect to age, gender, or other childhood factors.¹⁵ Study members were aged 0–19 years when their family’s diet was assessed and it is possible that any long-term influence of childhood diet on adult diet differs with age of exposure. However, we found no evidence ($P(\text{interaction}) = 0.80$) that the association of vegetable intake with adult HDS score depended on the age at which childhood diet was measured.

The associations between adult factors and healthy diet are cross-sectional in nature and therefore weaken the case for causality. The main limitation of the study is that the measure of diet quality is based on self-reported adult diet measures with the implicit assumption that they reflect actual, habitual intake with no systematic bias in the measures. The extent to which this assumption is true cannot be fully determined. Likewise our measure of childhood diet is of family rather than individual diet and so may not reflect an individual’s childhood diet. One potential source of bias (under-reporting of energy intake) was examined. Similar results were found after exclusion of under-reporters, indicating no systematic bias in energy intake. Also there are difficulties in defining a ‘healthy diet’ and in creating a diet score with which to measure it.¹⁸ A number of scores have been devised,³³ but with no standard approach, comparisons with other studies are problematic.

Conclusion

Although childhood circumstances were not associated with HDS, childhood vegetable consumption was, suggesting some early life influences on diet in later life. Smoking and living in rented accommodation were associated with poorer quality diet as defined by our HDS. Further research is required to confirm the childhood diet finding, but these data suggest that strategies to improve the quality of diet at older ages might usefully involve both encouragement of healthy diet choices from an early age and higher levels of income or nutritional support for older people. Our analysis also suggests additional potential benefits of smoking cessation in early old age.

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Key points

- This study examines childhood and adult factors associated with healthy eating in early old age.
- Adjusted for adult factors, a childhood diet rich in vegetables was associated with a healthy diet in later life.
- Being a non-smoker and being an owner-occupier were the adult circumstances most strongly associated with a healthy diet.
- Promoting both healthy diet choices from a young age and nutritional support in later life may improve the diets of older people.

References

- 1 World Health Organization. *Diet, nutrition and the prevention of chronic disease*. Technical Report Series 916:i–viii. Geneva: World Health Organization, 2003: 1–149.
- 2 Ministry of Agriculture Fisheries and Food. *National diet and nutrition survey of people aged 65 years and over*, vol. 1: *Report of the diet and nutrition survey*. London: The Stationery Office, 1998.
- 3 Khaw KT. Epidemiology in old age. In: Ebrahim S, Kalache A, editors. *Nutritional status*. London: BMJ Publishing Group, 1996: 171–83.
- 4 Davey-Smith G, Brunner E. Socio-economic differentials in health: the role of nutrition. *Proc Nutr Soc* 1997;56:75–90.
- 5 Department of Health. *Choosing health: making healthy choices easier*. London: The Stationery Office, 2004.
- 6 Department of Health. *Healthy start. Proposals for reform of the welfare food scheme*. London: Department of Health, 2002.
- 7 Lynch JW, Kaplan GA, Salonen JT. Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. *Soc Sci Med* 1997;44:809–19.
- 8 Darnton-Hill I, Nishida C, James WP. A life course approach to diet, nutrition and the prevention of chronic disease. *Public Health Nutr* 2004;7:101–21.
- 9 Kuh DL, Ben Shlomo Y. *A life course approach to chronic disease epidemiology*, 2nd edn. Oxford: Oxford University Press, 2004.
- 10 Gunnell DJ, Frankel S, Nanchahal K, et al. Lifecourse exposure and later disease: a follow-up study based on a survey of family diet and health in pre-war Britain (1937–1939). *Public Health* 1996;110:85–94.
- 11 Rowett Research Institute. *Family diet and health in pre-war Britain*. Scotland: Carnegie United Kingdom Trust, 1955.
- 12 Price GM, Paul AA, Key FB, et al. Measurement of diet in a large national survey: comparison of computerized and manual coding of records in household measures. *J Hum Nutr Diet* 1995;8:417–28.
- 13 Holland B, Welch AA, Unwin ID, et al. *McCance and Widdowson's the composition of foods*, 5th edn. London: The Royal Society of Chemistry and MAFF, 1991.
- 14 British Medical Association. *Report of committee on nutrition*. London: BMA, 1933.
- 15 Gunnell DJ, Berney L, Holland P, et al. How accurately are height, weight and leg length reported by the elderly, and how closely are they related to measurements recorded in childhood? *Int J Epidemiol* 2000;29:456–64.
- 16 Bingham SA, Gill C, Welch A, et al. Validation of dietary assessment methods in the UK arm of EPIC using weighed records, and 24-hour urinary nitrogen and potassium and serum vitamin C and carotenoids as biomarkers. *Int J Epidemiol* 1997;26(Suppl.):S137–S151.
- 17 Ministry of Agriculture Fisheries and Food. *Food portion sizes*. London: HMSO, 1993.
- 18 Maynard M, Ness AR, Abraham L, et al. Selecting a healthy diet score: lessons from a study of diet and health in early old age (The Boyd Orr cohort). *Public Health Nutr* 2005;8:321–326.
- 19 Huijbregts P, Feskens E, Rasanen L, et al. Dietary pattern and 20 year mortality in elderly men in Finland, Italy, and the Netherlands: longitudinal cohort study. *Br Med J* 1997;315:13–7.
- 20 Department of Health. *Nutritional aspects of cardiovascular disease*. Report on Health and Social Subjects No. 50. London: HMSO, 1994.
- 21 Department of Health. *Nutritional aspects of the development of cancer*. Report on Health and Social Subjects No. 48. London: HMSO, 1998.
- 22 Maldonado G, Greenland S. Simulation study of confounder-selection strategies. *Am J Epidemiol* 1993;138:923–36.
- 23 Devine C, Wolfe W, Frongillo E, Bisogni C. Life-course events and experiences: association with fruit and vegetable consumption in three ethnic groups. *J Am Diet Assoc* 1999;99:309–14.
- 24 Krebs-Smith SM, Heimendinger J, Patterson B, et al. Psychosocial factors associated with fruit and vegetable consumption. *Am J Health Promot* 1995;10:98–104.
- 25 Tang J, Muir J, Lancaster T, et al. Health profiles of current and former smokers and lifelong abstainers. *J R Coll Physicians Lond* 1997;31:304–9.
- 26 Thompson D, Warburton D. Lifestyle differences between smokers, ex-smokers and non-smokers; and implications for their health. *Psychol Health* 1992;7:311–21.
- 27 Blair S, Jacobs D, Powell K. Relationships between exercise or physical activity and other health behaviours. *Public Health Rep* 1985;100:172–80.
- 28 de Jong N, Mulder I, de Graaf C, van Staveren WA. Impaired sensory functioning in elders: the relation with its potential determinants and nutritional intake. *J Gerontol A Biol Sci Med Sci* 1999;54:B324–31.
- 29 Thompson RL, Pyke SD, Scott EA, et al. Dietary change after smoking cessation: a prospective study. *Br J Nutr* 1995;74:27–38.
- 30 Hulshof KF, Brussaard JH, Kruizinga AG, et al. Socio-economic status, dietary intake and 10 year trends: the Dutch National Food Consumption surveys. *Eur J Clin Nutr* 2003;57:128–37.
- 31 Dubois L, Girard M. Social position and nutrition: a gradient relationship in Canada and the USA. *Eur J Clin Nutr* 2001;55:366–73.
- 32 Phillips A, Davey Smith G. How independent are 'independent' effects? Relative risk estimation when correlated exposures are measured imprecisely. *J Clin Epidemiol* 1991;44:1223–31.
- 33 Kant AK. Indexes of overall diet quality: a review. *J Am Diet Assoc* 1996;96:785–91.

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