Primary care

Behavioural counselling to increase consumption of fruit and vegetables in low income adults: randomised trial

Andrew Steptoe, Linda Perkins-Porras, Catherine McKay, Elisabeth Rink, Sean Hilton, Francesco P Cappuccio

ELPS

This is an abridged version; the full version is on bmj.com

Abstract

Objective To measure the effect of brief behavioural counselling in general practice on patients' consumption of fruit and vegetables in adults from a low income population.

Design Parallel group randomised controlled trial.

Setting Primary health centre in a deprived, ethnically mixed inner city area.

Participants 271 patients aged 18-70 years without serious illness.

Intervention Brief individual behavioural counselling based on the stage of change model; time matched nutrition education counselling.

Main outcome measures Self reported number of portions of fruit and vegetables eaten per day, plasma β carotene, α tocopherol, and ascorbic acid concentrations, and 24 hour urinary potassium excretion. Assessment at baseline, eight weeks, and 12 months.

Results Consumption of fruit and vegetables increased from baseline to 12 months by 1.5 and 0.9 portions per day in the behavioural and nutrition groups (mean difference 0.6 portions, 95% confidence interval 0.1 to 1.1). The proportion of participants eating five or more portions a day increased by 42% and 27% in the two groups (mean difference 15%, 3% to 28%). Plasma β carotene and α tocopherol concentrations increased in both groups, but the rise in β carotene was greater in the behavioural group (mean difference 0.16 μmol/l, 0.001 μmol/l to 1.34 μmol/l). There were no changes in plasma ascorbic acid concentrations or urinary potassium excretion. Differences were maintained when analysis was restricted to the 177 participants with incomes ≤ £400 (€596, $640) a week.

Conclusions Brief individual counselling in primary care can elicit sustained increases in consumption of fruit and vegetables in low income adults in the general population.

Introduction

Consumption of fruit and vegetables is thought to protect against cancer and cardiovascular disease[1][2] but is inversely related to socioeconomic position. Previous research on increasing consumption has used individual, worksite, and community approaches to intervention.[3] Brief interventions can be effective,[4] but few studies have used intention to treat analysis, and biomarkers have seldom been included.[5] We tested the hypothesis that brief behavioural counselling by nurses in general practice would lead to increased consumption of fruit and vegetables and to associated increases in plasma and urinary biomarkers over a 12 month period in adults from a low income population compared with time matched counselling based on nutrition education.

Methods

Participants

This randomised parallel group trial compared brief nutrition counselling with behavioural dietary counselling. Recruitment, assessments, and interventions were carried out by research nurses in a primary healthcare setting.

We randomly recruited by letter patients aged 18-70 years registered at one primary health centre in a deprived inner city area with a Jarman score of 40.3. We excluded individuals with serious illness and women who were pregnant or who planned to become pregnant within the next 12 months. We did not exclude individuals taking vitamin supplements but asked them to maintain a constant dose throughout the trial. After several months of recruitment, it became evident that many participants had relatively high incomes, suggesting that the study was attracting more affluent residents. Invitations were therefore modified to discourage people with a weekly income of more than £400 (€596, $640) from volunteering.

In total 459 patients expressed interest in the study. After exclusions the sample consisted of 166 women and 105 men (see figure). From 25 June 1999 to 3 November 2001 a member of the research team who had no contact with participants individually randomised participants into one of two counselling conditions. There were 136 in the behavioural counselling group and 135 in the nutrition group.

Counselling methods

Each intervention was a 15 minute individual consultation, carried out immediately after the baseline assessment. We prepared written information to support the consultations, and participants attended a second 15 minute consultation two weeks later. Eleven

Department of Epidemiology and Public Health, University College London, London WC1E 6BT
Andrew Steptoe *professor*
Linda Perkins-Porras *research nurse*

Department of General Practice and Primary Care, St George's Hospital Medical School, London SW17 0RE
Catherine McKay *research nurse*
Elizabeth Rink *senior lecturer*
Sean Hilton *professor*
Francesco P Cappuccio *professor*

Correspondence to: A Steptoe a.steptoe@ucl.ac.uk

participants (eight behavioural, three nutrition) did not attend the second session. The target was to increase intake of fruit and vegetables from baseline levels.

The nutrition counselling group received education about the importance of increasing consumption of fruit and vegetables, emphasising beneficial nutritional constituents and the way these act biologically to maintain health. The bioactive constituents of fruit and vegetables were described in lay terms, together with the range of effects that they have on bodily processes. The nurses emphasised the five a day message, established by the Department of Health.[6] Behavioural counselling was founded on social learning theory and the stage of change model, which posits that the most appropriate methods of encouraging change in behaviour vary with the motivational readiness of the individual.[7] Interventions were tailored to the individual, with personalised specific advice and setting of short and long term goals.

Methods of assessment

The main measure of consumption was a two item frequency questionnaire adapted from previous research.[8 9] We asked participants how many pieces of fruit and how many portions of vegetables they ate on a typical day and gave them detailed information about portion sizes.[6] Potatoes were excluded, and one serving of fruit juice was allowed. Patients also completed the dietary instrument for nutrition education (DINE), a weighted food frequency questionnaire that accounts for most fat and fibre in the typical UK diet.[10] Blood pressure was measured after the participant had been sitting for 10 minutes.

We assessed biomarkers of fruit and vegetable intake to determine whether counselling interventions had effects not only on reported consumption but also on potential biological mediators of health effects. Non-fasting blood samples were stored at − 70°C until the end of the trial and analysed for plasma ascorbic acid (vitamin C), α tocopherol (vitamin E), and β carotene. We collected 24 hour urine samples for the measurement of potassium excretion.

We devised a stage of change questionnaire that gauged participants' readiness to increase consumption at the start of the study, irrespective of whether they had made changes in the past. They were classified as precontemplators (no intention of changing behaviour), as contemplators (seriously thinking about changing behaviour), or as in the preparation stage (planning to change behaviour within the next month).

Our primary end points were changes in self reported intake of fruit and vegetables (number of portions per day and the proportion of individuals who increased intake to five a day) and changes in biomarkers (plasma β carotene, α tocopherol, and ascorbic acid concentrations, and 24 hour urinary excretion of potassium and urinary potassium: creatinine ratio). The secondary end points were changes in body weight, body mass index, blood pressure, total plasma cholesterol concentration, and DINE measures.

Statistical methods

We intended to investigate only low income adults, but some higher income volunteers also took part. We
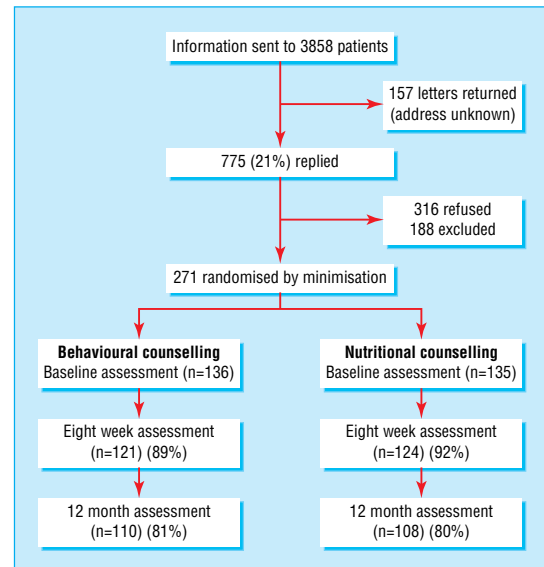
Recruitment of participants

therefore separately carried out analyses on the complete sample and on the lower income category. The criterion for the definition of lower income was less than £400 a week. One hundred and ten people (81%) in the behavioural counselling and 108 (80%) in the nutrition counselling groups completed the 12 month follow up (figure). The trial was analysed on an intention to treat basis..

We calculated scores indicating the change between 12 months and baseline, so a positive value indicates a beneficial change in fruit and vegetable consumption and in biomarkers. We have presented these scores with 95% confidence intervals adjusted for possible confounders.

We had data on consumption from all 271 participants, plasma β carotene from 268, α tocopherol from 266, and vitamin C from 265. Urine samples were obtained from 225 participants, but four individuals did not collect the full amount for the 24 hour period.

Results

The baseline characteristics of participants in the two groups were the same. The average age was 43 years; 68% were in the low income category; over a third were receiving benefits, and less than a half owned their own homes. The sample was ethnically mixed. A third were cigarette smokers, and nearly one third were taking vitamin supplements. As expected, many (55%) participants were in the preparation stage of change; a quarter were precontemplators, and a fifth contemplators.

The mean number of portions of fruit and vegetables eaten daily (excluding potatoes) was 3.6 at baseline, and a fifth of the participants were eating at least five portions a day (table 1). Both groups increased the number of portions consumed a day. After adjustment for covariates, the increase was greater in the behavioural counselling than in the nutrition counselling group (mean difference 0.62 portions, 95% confidence interval 0.09 to 1.13). The increase in the number eating five or more portions a

Table 1 Effect of counselling on intake of fruit and vegetables and biomarkers (complete sample)

Group (n)	Baseline (SD)	Unadjusted change over 12 months (95% CI)	Adjusted change over 12 months (95% CI)	Adjusted difference in change (95% CI)	P value for adjusted difference
Portions/day					
Nutritional (135)	3.67 (2.00)	0.99 (0.63 to 1.34)	0.87 (0.50 to 1.25)	0.62 (0.09 to 1.13)	0.021
Behavioural (136)	3.60 (1.81)	1.44 (1.09 to 1.80)	1.49 (1.12 to 1.86)*		
Five a day (%)					
Nutritional (135)	26.7%	28.7% (19.9 to 37.6)	26.8% (17.6 to 36.0)	15.4% (2.52 to 28.3)	0.019
Behavioural (136)	21.3%	40.2% (31.3 to 49.0)	42.2% (33.1 to 51.2)*		
β Carotene (μmol/l)					
Nutritional (134)	0.92 (0.68)	1.06 (0.94 to 1.21)	1.04 (0.94 to 1.15)	0.16 (0.001 to 1.34)	0.05
Behavioural (134)	0.90 (0.62)	1.22 (1.08 to 1.39)	1.20 (1.08 to 1.33)†		
α Tocopherol (μmol/l)					
Nutritional (132)	27.4 (10.9)	7.28 (5.25 to 9.31)	7.30 (5.58 to 9.02)	1.52 (−0.91 to 3.95)	0.22
Behavioural (134)	25.6 (11.3)	8.87 (6.85 to 10.9)	8.81 (7.12 to 10.5)†		
Ascorbic acid (μmol/l)					
Nutritional (131)	78.0 (33.0)	0.12 (−4.89 to 5.12)	0.51 (−4.00 to 5.01)	−4.57 (−10.9 to 1.80)	0.16
Behavioural (133)	75.6 (33.3)	−2.80 (−7.76 to 2.17)	−4.06 (8.52 to 0.41)‡		
Potassium excretion (mmol/24h)					
Nutritional (114)	75.0 (27.6)	−0.63 (−4.04 to 2.77)	−0.27 (−3.52 to 2.98)	0.46 (−4.22 to 5.13)	0.85
Behavioural (107)	73.0 (26.0)	0.19 (−3.33 to 3.70)	0.19 (−3.14 to 3.52)‡		
Potassium/creatinine ratio					
Nutritional (114)	6.69 (2.32)	−0.24 (−0.53 to 0.03)	−0.20 (−0.48 to 0.07)	0.13 (−0.27 to 0.53)	0.52
Behavioural (107)	6.34 (2.26)	−0.05 (−0.34 to 0.24)	−0.07 (−0.35 to 0.21)‡		

*Adjusted for sex, age, ethnicity, income, smoking, and baseline stage of change.
†Adjusted for sex, age, ethnicity, income, smoking, body mass index, and baseline level.
‡Adjusted for sex, age, ethnicity, income, smoking, body mass index, baseline level, and vitamin supplements.

day was also greater in the behavioural group (difference 15%, 3% to 28%). Plasma β carotene and α tocopherol concentrations increased in both groups, with no changes in plasma ascorbic acid concentration or potassium excretion. The increase in β carotene was greater in the behavioural group (difference 0.16 μmol/l, 0.001 μmol/l to 1.34 μmol/l).

Results were largely replicated when we restricted the analysis to the lower income participants (table 2). The increase in the number of portions was twice as great in the behavioural than in the nutrition groups, and the behavioural group also showed larger increases in plasma β carotene concentration (difference 0.18 μmol/l, 0.02 μmol/l to 0.37 μmol/l). In addition, there was also a more positive change in potassium:creatinine ratio in the behavioural group (difference 0.48, 0.01 to 0.95).

There were no changes in body weight, body mass index, blood pressure, or serum cholesterol, either in the complete sample or the lower income participants. DINE scores for fat consumption fell in both groups, while fibre intake increased slightly in the behavioural group only, but there were no significant differences between the groups in these measures.

Table 2 Effect of counselling on intake of fruit and vegetables and biomarkers (lower income sample)

Group	Baseline (SD)	Unadjusted change over 12 months (95% CI)	Adjusted change over 12 months (95% CI)	Adjusted difference in change (95% CI)	P value for adjusted difference
Portions/day					
Nutritional (86)	3.76 (2.11)	0.87 (0.41 to 1.32)	0.78 (0.31 to 1.24)	0.89 (0.25 to 1.54)	0.007
Behavioural (91)	3.34 (1.67)	1.64 (1.20 to 2.08)	1.67 (1.22 to 2.11)*		
Five a day (%)					
Nutritional (86)	27.9%	29.9% (18.3 to 41.5)	28.0% (16.2 to 39.9)	13.0 (−3.41 to 29.4)	0.12
Behavioural (91)	16.5%	40.5% (29.4 to 51.7)	41.0% (29.7 to 52.4)*		
β Carotene (μmol/l)					
Nutritional (86)	0.89 (0.59)	1.02 (0.88 to 1.18)	1.05 (0.89 to 1.13)	0.18 (0.02 to 0.37)	0.023
Behavioural (89)	0.94 (0.67)	1.22 (1.05 to 1.41)	1.23 (1.09 to 1.39)†		
α Tocopherol (μmol/l)					
Nutritional (84)	27.2 (10.8)	6.57 (4.01 to 9.14)	6.40 (4.31 to 8.48)	1.67 (−1.25 to 4.59)	0.26
Behavioural (89)	26.4 (11.2)	8.10 (5.62 to 10.6)	8.07 (6.05 to 10.1)†		
Ascorbic acid (μmol/l)					
Nutritional (85)	75.8 (33.0)	−0.88 (−6.92 to 5.14)	0.33 (−5.30 to 6.00)	−4.52 (−12.4 to 3.36)	0.26
Behavioural (89)	71.2 (34.7)	−2.87 (−8.75 to 3.02)	−4.20 (−9.67 to 1.27)‡		
Potassium excretion (mmol/24h)					
Nutritional (70)	72.3 (28.9)	−2.26 (−6.59 to 2.08)	−2.30 (−6.29 to 1.70)	4.94 (−0.76 to 10.6)	0.089
Behavioural (69)	70.2 (24.7)	2.25 (−2.12 to 6.61)	2.65 (−1.37 to 6.66)‡		
Potassium /creatinine ratio					
Nutritional (70)	6.71 (2.33)	−0.42 (−0.76 to −0.07)	−0.39 (−0.72 to −0.06)	0.48 (0.01 to 0.95)	0.046
Behavioural (69)	6.37 (2.19)	−0.09 (−0.26 to 0.44)	0.09 (−0.24 to 0.43)‡		

*Adjusted for sex, age, ethnicity, income, smoking, and baseline stage of change.
†Adjusted for sex, age, ethnicity, income, smoking, body mass index, and baseline level.
‡Adjusted for sex, age, ethnicity, income, smoking, body mass index, baseline level, and vitamin supplements.

Discussion

Brief counselling carried out by nurses in primary care can result in marked increases in reported fruit and vegetable consumption in an ethnically mixed sample. The average increase in the group assigned to behavioural counselling (1.5 portions per day) was similar to the increase seen in a six month study in more affluent participants (1.4 portions).[5] We did not expect such a large increase in the nutrition counselling group, but the mean rise of 0.87 portions per day was similar to that observed in studies with more active interventions.[4] This indicates that the nutrition counselling programme was not an inactive control procedure but itself had substantive effects. We do not know whether changes would have taken place in the absence of any professional advice because we did not have a control group in which no counselling took place. The beneficial effects of brief counselling were endorsed by positive changes in β carotene and α tocopherol concentrations.

The observed changes in consumption were similar when we restricted analysis to participants with lower incomes. The implication is that individual counselling in primary care may be an effective means of increasing consumption in less affluent adults, so targeting low income groups may help redress social inequalities in health.

Representativeness of the sample
We recruited participants from a primary care centre in a low income neighbourhood, but only a small proportion (12%) responded to our invitations. We had no information about the eating habits or income of non-participants. The demands of the study were onerous, involving three blood samples and three 24 hour urine collections, and this may have discouraged potential participants.

The average fruit and vegetable intake of 3.64 portions a day is comparable with the mean intake of 3.85 in the 1999 national food survey.[11] About 24% reported eating at least five portions a day, compared with 26% in the 2000 consumer attitudes survey.[12] Participants were not therefore remarkable with respect to fruit and vegetable intake before the study.

Variations in biomarker response
We did not record any changes in plasma ascorbic acid concentration. The explanation is not clear. The recent study in Oxford reported small increases in ascorbic acid in their intervention group at six months but from baseline concentrations that were much lower (34.4 μmol) than those of the present study (75 μmol/l).[5] The results for potassium excretion were also disappointing. Although there was difference between groups in changes in potassium:creatinine ratio in the low income sample, analyses of the complete sample showed no overall effects. The pattern of changes in biomarkers may have arisen from the specific food choices made by participants.

Limitations and implications
Although we complied with the CONSORT recommendations for parallel group randomised trials, we could not blind researchers to group assignment. Quality control of counselling sessions was built into the study. Nevertheless, it would have been

What is already known on this topic

Brief interventions can be effective in increasing consumption of fruit and vegetables

Biomarkers and intention to treat analyses have seldom been used in such interventions, and few studies have targeted low income populations

What this study adds

Compared with nutritional counselling, brief behavioural counselling carried out by nurses in primary care led to greater increases in fruit and vegetable intake and in plasma β carotene concentration

Favourable effects were observed in low income adults living in a deprived inner city area

preferable (had resources allowed) if the nurses administering the intervention had not been involved in assessments.

Our findings show that brief individual counselling in primary care can elicit sustained increases in consumption of fruit and vegetables, corroborated by biomarkers. Both nutrition and behavioural counselling stimulated increases in consumption, but the changes were greater with behaviourally oriented methods. Our techniques would be feasible in primary care, and they could be adapted for group administration. However, we do not know how effective they would be if applied by practice nurses outside the research setting.

1 Ness AR, Powles JW. Fruit and vegetables, and cardiovascular disease: a review. *Int J Epidemiol* 1997;26:1-13.
2 Working Group on Diet and Cancer, Committee on Medical Aspects of Food and Nutrition Policy. *Nutritional aspects of the development of cancer (48). Department of Health report on health and social subjects.* London: Stationery Office, 1998.
3 Bowen DJ, Beresford SA. Dietary interventions to prevent disease. *Ann Rev Public Health* 2002;23:255-86.
4 Ammerman AS, Lindquist CH, Lohr KN, Hersey J. The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. *Prev Med* 2002;35:25-41.
5 John JH, Ziebland S, Yudkin P, Roe LS, Neil HAW. Effects of fruit and vegetable consumption on plasma antioxidant concentrations and blood pressure: a randomised controlled trial. *Lancet* 2002;359:1969-74.
6 Department of Health. Five-a-day programme. www.doh.gov.uk/fiveaday (accessed 3 February 2003).
7 Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot* 1997;12:38-48.
8 Wardle J, Parmenter K, Waller J. Nutrition knowledge and food intake. *Appetite* 2000;34:269-75.
9 Cappuccio FP, Rink E, Perkins-Porras L, Mc Kay C, Hilton S, Steptoe A. Estimation of fruit and vegetable intake using a two-item dietary questionnaire: a potential tool for primary health care workers. *Nutr Metab Cardiovasc Dis* (in press).
10 Roe L, Strong C, Whiteside C, Neil A, Mant D. Dietary interventions in primary care: validity of the DINE method for diet assessment. *Fam Pract* 1994;11:375-81.
11 Ministry of Agriculture, Food and Fisheries. *National food survey 1999.* London: Stationery Office, 2000.
12 COI Communications and Food Standards Agency. *Consumer attitudes to food standards.* London: Taylor Nelson Sofres, 2001.

(Accepted 6 February 2003)