Short Communication

Increasing Fruit and Vegetable Intake Among Adults Attending Colorectal Cancer Screening: The Efficacy of a Brief Tailored Intervention[1]

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Abstract

Fruits and vegetables appear to confer protection against several cancers, but most adults in the United Kingdom eat substantially less than the recommended amounts. Cancer screening services could provide a valuable context in which to provide advice on increasing fruit and vegetable intake. This study examined the efficacy of a brief, tailored, psycho-educational intervention for increasing fruit and vegetable intake, carried out in a cancer screening clinic. The study was a randomized, controlled trial. 742 participants, 55–64 years of age, recruited from three cancer screening clinics, completed a baseline questionnaire. They were assigned either to the tailored intervention group or to an untreated control group. The primary outcome measure was self-reported consumption of fruit and vegetables. At 6 week follow-up there were significant increases in daily servings of fruit and vegetables in the tailored intervention group (CI, 0.87–1.25) compared with the untreated group (CI, 0.08–0.43). These results support the efficacy of a simple, written message, which is tailored to the intake and knowledge levels of the individual, for modifying cancer-protective dietary behaviors, at least in the short term. They also suggest that cancer screening clinics may be a good context for providing this service.

Introduction

There is ample evidence that fruit and vegetable intake is associated with reduced risk of both heart disease and cancer (1, 2). Current guidelines recommend consumption of ≥400 g of fruit and vegetables a day (3), but the average intake of British adults is <250 g (4). Recent results show that only 30% of the United Kingdom population is aware of the five-a-day recommendation, and <50% are aware of a link between fruit and vegetable intake and any disease other than scurvy (5).

One of the most promising approaches to health behavior change uses computer programs to provide materials, which are tailored to the level of knowledge, attitudes, and behavior of the individual, and personalized with their own details (6). Tailored interventions have proved effective in reducing fat intake (7–11). Findings for fruit and vegetables have been more variable but have also produced positive results (9–15). Cancer-protective dietary interventions might be even more effective if they were provided in contexts where the issues of cancer risk are particularly salient. The Next Step Trial, which was delivered at the worksite to employees of the automotive industry who are at higher risk of colorectal cancer (16) significantly decreased fat and increased fruit and vegetable intake. A brief tailored intervention, delivered to callers to a Cancer Information Service also increased fruit and vegetable intake (13).

These encouraging results suggest that cancer-relevant settings could provide a good context within which to deliver cancer-preventive dietary advice. The present study used a colorectal cancer screening clinic as the setting through which to provide an individually tailored, psycho-educational intervention, designed to increase fruit and vegetable intake.

Subjects and Methods

Sampling and Procedures. The sampling frame was older adults (55–64 years of age) attending three cancer screening clinics as part of a population-based trial of flexible sigmoidoscopy screening for the prevention of bowel cancer (17). People attending the clinic were invited to complete a baseline questionnaire including items on fruit and vegetable intake and nutrition knowledge. It also offered the option for respondents to give their names and addresses if they were interested in receiving more information about diet. Interested participants were randomized to receive the two-page, tailored psycho-educational intervention by post, or to an untreated, control group. Outcome was assessed using a mailed, follow-up questionnaire sent 6 weeks after the intervention, after which control participants were mailed an intervention leaflet.

Measures. Fruit and vegetable intake were assessed with two questions (*How many servings of fruit/vegetables do you eat?* Response options ranged from "*<1 serving a week*" to "*6 or more servings a day*") from the self-completion version of the Dietary Instrument for Nutrition Education (18). This measure has been shown to be valid (19), and data from a pilot sample in the present study showed high test-retest correlations (fruit: $r = 0.90$; vegetable: $r = 0.85$) over 2 weeks. The questions are similar to the fruit and vegetable items on the Block *et al*. rapid food screener (20). Knowledge of the current recommendations for intake of fruit and vegetables, and awareness of diseases related to fruit and vegetable consumption were assessed with items from a validated nutrition knowledge questionnaire (21). Negative attitudes were assessed with six questions derived from research on barriers to fruit and vegetable consumption in

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Table 1 Characteristics of the clinic sample who completed the baseline questionnaire

	Participants who wanted dietary information $n = 742$	Participants who did not want dietary information $n = 309$
Gender n (%)		
Men	355 (48%)	130 (49%)
Women	373 (52%)	136 (51%)
Qualifications n (%)		
Primary school	33 (4%)	15 (6%)
Secondary	433 (58%)	141 (54%)
Trade	116 (16%)	42 (16%)
Diploma	76 (10%)	23 (9%)
University degree	72 (10%)	40 (15%)
Economic deprivation[a] n (%)		
High (0)	48 (8%)	19 (7%)
Medium (1)	99 (13%)	34 (13%)
Low (2)	590 (79%)	211 (80%)
Daily fruit intake (mean, 95% CI)	1.53 (1.44–1.63)	1.47 (1.31–1.62)
Daily vegetable intake (mean, 95% CI)	1.52 (1.43–1.60)	1.61 (1.46–1.76)
Estimated recommended servings (mean, 95% CI)	4.02 (3.90–4.14)	3.93 (3.73–4.15)

[a] Composite of housing tenure (0–1) and car ownership (0–1).

the United Kingdom (22), which included evaluations of taste, convenience, ease of storage and preparation, and cost of fruits and vegetables. Stage of change was assessed using a simple algorithm to assess whether the individual had changed in the past or intended to change in the future. Simple questions assessed demographic factors. A follow-up questionnaire was mailed ~6 weeks after the intervention materials had been mailed, with the questions on recommended servings, attitudes, and intake.

Tailored Psycho-Educational Intervention. The theoretical framework guiding the development of the intervention was the Stages of Change model (23). This proposes that movement across stages from precontemplation to action requires a mix of materials, with more emphasis on educational and motivational factors for those in precontemplation and contemplation, and more on skills and reinforcement for those in action and maintenance.

Baseline data showed that knowledge of recommendations was poor and intake was low across the board, so all of the individuals received feedback on these issues, but it was framed in a manner appropriate to their stage of change. Feedback on present intention to change behavior and advice on sustaining or accelerating behavior change was given in a stage-matched fashion (23). Reminders about reported negative attitudes (perceived barriers), with suggestions on how to overcome them were given in relation to the two most negative attitudes. The message feedback file contained 97 different messages with >30 million possible combinations. Background questionnaires were scanned for data capture and then merged with the message feedback to create the individualized materials.

Statistical Analysis. A sample of 350 per group provided 95% power ($\alpha = 0.05$) to detect an average difference of 0.5 servings of fruit and vegetables a day between the two groups. Analyses were done with SPSS version 10. χ^2 and *t*-tests were used to compare responders and nonresponders. The effect of the intervention was analysed using analysis of variance, using an intention-to-treat analysis, with nonresponders in both groups being assigned the average increase of the responders in the control group. Multiple regression was used to assess the mediating role of increased knowledge in the behavior change.

Results

Older adults (1251) attending the clinic were offered a baseline questionnaire, of whom 1051 (84%) completed it, and 742 (59%) gave their name and address to receive more information on diet. There were no significant differences between those who did or did not volunteer (see Table 1).

Respondents reported eating 3.04 (CI, 2.90–3.18) servings of fruit and vegetables at baseline. Only 25% achieved five servings of fruit and vegetables a day. Their estimates of the recommended intake averaged four, with only 47% aware of the five-a-day message. Fewer than 30% ($n = 208$) of participants were aware of a link between fruit and vegetable intake and disease. There were no baseline differences between those randomized to intervention or control conditions.

Follow-up response rates were 87% ($n = 325$) in the intervention group and 85% ($n = 316$) in the control group, with only minor differences between those who returned or did not return the follow-up questionnaire. In order to use an intention-to-treat analysis, nonresponders were assigned a follow-up intake score based on the average increase in intake reported by the control group (fruit: baseline + 0.17 servings; vegetables: baseline + 0.13 servings). This was preferred to "baseline-carried-forward" because it gave a more conservative estimate of the difference between the groups. There was a significant group-by-time interaction for both fruit [$F(1,735) = 27.84$; $P < 0.001$] and vegetables [$F(1734) = 19.77$; $P < 0.001$], with intervention participants increasing their intake more than the control group (see Table 2).[3] The number consuming five servings a day increased from 25% to 42% in the intervention group, while there was no increase in the control group (26% to 26%).

The same approach was used to estimate the impact of the intervention on knowledge, showing a significant group-by-time interaction in estimations of the recommended daily intake [$F(1708) = 28.54$; $P < 0.001$]. The number aware of the five-a-day message increased from 47% to 73% in the intervention group and from 47% to 59% in the control group.

[3] Repeating the analyses using logarithmic transformations of the intakes, in order to combat the skew in the data, revealed very similar results, so data are presented here for the untransformed scores.

Table 2 Baseline, follow-up, and change in knowledge and intake ($n = 742$)

	Baseline	Mean (95% CI) follow-up	Increase
Daily fruit intake			
Intervention group	1.51 (1.39–1.64)	2.10 (2.00–2.23)	0.59 (0.47–0.71)
Control group	1.56 (1.43–1.69)	1.70 (1.58–1.83)	0.14 (0.03–0.26)
Daily vegetable intake			
Intervention group	1.56 (1.44–1.68)	2.03 (1.93–2.16)	0.47 (0.36–0.59)
Control group	1.45 (1.35–1.58)	1.57 (1.47–1.70)	0.12 (0.01–0.23)
Total daily intake			
Intervention group	3.06 (2.87–3.26)	4.12 (3.91–4.33)	1.06 (0.87–1.25)
Control group	3.01 (2.82–3.22)	3.27 (3.07–3.48)	0.26 (0.08–0.43)
Knowledge of recommended servings			
Intervention group	3.98 (3.81–4.15)	4.72 (4.55–4.90)	0.75 (0.57–0.93)
Control group	4.06 (3.88–4.23)	4.14 (3.96–4.32)	0.08 (−0.08–0.25)

Attitude change was assessed on the basis of changes in the mean attitude scores for fruits and vegetables (on the completers). There were no differences between groups at baseline, but attitudes to fruit became more positive in the intervention group [group by time interaction: $F(1567) = 15.46$; $P < 0.001$].

In order to gain some indication of the processes that contributed to the intervention effect on intake, two multiple regression models were analyzed. The first included a dummy variable for study group, along with baseline intake of total fruit and vegetables and gender as control variables. In the second analysis, knowledge change was added at an earlier step to see if the variance associated with study group was reduced. The standardized β coefficient associated with the intervention effect in the first analysis was 0.24 (R^2 change = 0.06; $F = 54.1$; $P < 0.001$). When knowledge change was added as a first step, the intervention effect was reduced ($\beta = 0.18$; R^2 change = 0.03; $F = 32$; $P < 0.001$). No additional reduction was achieved by including the attitude measures.

Discussion

The results from the baseline survey confirm other observations of low intake of fruit and vegetables, and poor knowledge about the recommended intake levels in population samples (4, 5) despite the participants being likely to be more health-concerned than a random sample of adults. Completion of the survey and requests for more information were both high, suggesting that cancer screening clinics provide an appropriate setting for cancer protective dietary intervention. This trial used a short follow-up period in order not to cause too much delay for the control group who did not receive their intervention until after the follow-up, so the results must be interpreted very cautiously. In addition, the measures were self-reported, and, therefore, susceptible to demand effects, although this limitation applies to most other similar studies. The intake measures were also limited by being single items, with inherently lower reliability, although the lower reliability might be expected to reduce rather than increase the chance of getting significant group differences. With these caveats in mind, the results of this trial were very promising, indicating that the tailored intervention substantially increased fruit and vegetable intake, even on an intention-to-treat analysis, and that part of the efficacy was attributable to individuals learning about the recommendations. Possible explanations for why it was more effective than others in the literature (*e.g.* Refs. 9, 12), include the fact that it addressed fruit and vegetables alone, rather than being combined with a fat reduction intervention, and that it had a significant knowledge component, in recognition of the lack of public awareness. Most important is probably that the participants were attending a screening program concerned with cancer prevention and had volunteered to receive extra information on diet, thus they can be assumed to be more motivated towards cancer prevention than others in the population. However, participation in both screening and the dietary intervention were comparatively high, so it is likely that the situation itself contributed to the good outcome. In fact, the results are not dissimilar to those from the 4-week data from the Cancer Information Service study, which achieved an increase of 0.6 servings a day among the responders (13), compared with a differential increase of 0.7 servings a day in the present study. Future work should test the efficacy of a tailored intervention, with all of the additional effort involved in obtaining baseline information, against a generic intervention containing similar material.

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