

# A family-based intervention to increase fruit and vegetable consumption in adolescents: a pilot study

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## Abstract

*Objective:* To evaluate the feasibility and effectiveness of a pilot family-based newsletter intervention to increase fruit and vegetable (FV) consumption among adolescents.

*Design:* Family-based, two-group randomised control trial with baseline, post-intervention and follow-up measures. The intervention group received two FV newsletter packs over a 1 month period by postal mail. Social cognitive and behavioural choice theories provide the theoretical framework for the design and development of intervention materials. Control families were provided with all intervention materials at the end of the study. Adolescent FV consumption was assessed by an FFQ. Adolescent-reported barriers to eating FV, FV habits and preferences were the secondary outcomes, along with parent FV consumption, and parents reported knowledge, encouragement, home availability and accessibility of FV. Repeated-measures ANOVA was used to detect differences in behavioural and psychosocial outcomes between groups, time and group-by-time.

*Setting:* East Midlands, UK.

*Subjects:* Forty-nine parents and adolescents aged 12–14 years.

*Results:* Process evaluation indicated high reach, dose acceptability and fidelity of the intervention. At post-intervention and 6 weeks later at follow-up, adolescents in the intervention group had significantly higher fruit: ( $P < 0.01$ ) and vegetable ( $P < 0.05$ ) consumption and higher preferences for vegetables ( $P < 0.01$ ), compared with the control group. At post-intervention and follow-up, parents in the intervention group had significantly higher fruit ( $P < 0.001$ ) and vegetable ( $P < 0.001$ ) consumption and reported higher accessibility of fruit and vegetables ( $P < 0.001$ ), compared with those in the control group.

*Conclusions:* Family-based, newsletter interventions promoting FV consumption to adolescents appear to be feasible and effective at increasing FV consumption.

**Keywords**  
Family  
Adolescents  
Fruit and vegetable consumption  
Intervention

There is increasing evidence that fruit and vegetable intake in young people is associated with health benefits<sup>(1,2)</sup>, including lower BMI<sup>(3)</sup> and reduced risk of cancer in adulthood<sup>(4)</sup>. Despite this, many young people eat less fruit and vegetables than is recommended for health<sup>(5,6)</sup> and consumption declines throughout childhood and adolescence<sup>(7)</sup> and may track into adulthood<sup>(8,9)</sup>. The development, implementation and evaluation of interventions to increase fruit and vegetable consumption among adolescents are therefore imperative.

The influence of the family on adolescent fruit and vegetable consumption is well documented<sup>(7,10)</sup>. The relationship between the parent and adolescent, including modelling of health behaviours, choosing, preparing and making foods available, encouraging and reinforcing healthy eating patterns and knowledge (education) about healthful foods, suggests that parents and the home

environment must be significantly involved in interventions promoting healthy nutrition<sup>(10,11)</sup>. However, the best method for involving families in promoting change in adolescent's fruit and vegetable consumption is unclear<sup>(12)</sup>.

Interventions have been predominantly school-based programmes with limited effectiveness and have often targeted a range of healthy eating behaviours rather than focusing specifically on increasing fruit and vegetable consumption<sup>(13)</sup>. Direct parental involvement in such interventions is nominal and difficult to evaluate<sup>(13)</sup>. Furthermore, school-based healthy eating programmes, including a parental component, have shown low participation rates by parents if not directly linked to the school curriculum<sup>(14–16)</sup>. Although the school is an important environment for nutrition intervention, about two-thirds of the foods that young people consume are from home<sup>(17)</sup>. Thus, intervening directly at the family

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environmental level may be a more efficacious method for promoting fruit and vegetable consumption among adolescents.

Recent family-based interventions, targeting parents and their children, have been successful in increasing pedometer steps and cereal consumption<sup>(18)</sup>, as well as being successful in increasing child- and parent-mediating variables associated with fruit and vegetable consumption<sup>(19)</sup>. Home-delivered, leaflet-based interventions have shown effectiveness for modifying feeding practices in mothers of pre-school children<sup>(20)</sup> and in increasing fruit and vegetable intake in adults<sup>(21)</sup>. The purpose of the present study was to evaluate whether a short-term home-based newsletter intervention promoting increased fruit and vegetable consumption, aimed at both parents and adolescents, was feasible and whether it could positively affect adolescent fruit and vegetable consumption and psychosocial variables associated with adolescent fruit and vegetable consumption over time.

## Methods

### Recruitment

Parents of adolescents aged 12–14 years were recruited through newspaper and website advertisements, posters in workplaces (universities, factories and warehouses), and letters through schools and activity clubs/societies in the East Midlands region of the United Kingdom between September and December 2008. The method of recruitment was aimed at targeting parents from a range of socio-economic backgrounds. The study was approved by the Ethical Advisory Committee of the host university.

### Participants and design

Other than recruitment, the present study was conducted solely through mail correspondence at no financial costs to participating families. Fifty-one families (parent–adolescent pairs) agreed to take part in the study and were mailed baseline questionnaires throughout October–December 2008. Those mails contained separate questionnaires for parents and adolescents. All parents provided informed consent and all adolescents provided assent at the time of baseline assessment. Forty-nine families (96% response rate) returned baseline questionnaires and were randomly assigned to receive the delayed intervention (control group) or to receive the fruit and vegetable newsletter packs (intervention group). Families randomised to the intervention group were mailed two fruit and vegetable newsletter packs over a 1 month period. Packs contained separate materials for parents and adolescents. The control group did not receive intervention materials until the end of the study.

All participating families were mailed questionnaire packs (identical to baseline apart from the demographic questions) immediately post-intervention (2 weeks after the intervention group received their second fruit and vegetable

newsletter packs or 6 weeks after completing the baseline questionnaires) and 6 weeks later at follow-up.

## Intervention

### Overview

This pilot, home-delivered, family-based intervention was entitled ‘Choosing Five Fruit and Veg Every Day’ and contained three main components addressing environmental, personal and behavioural factors derived from the behavioural choice and social cognitive (SCT) theories of individual change. Behavioural choice theory draws on behavioural economics<sup>(22)</sup> in which the choice to eat certain foods may be determined by the interaction of environmental factors (accessibility and availability of foods) and the individual (e.g. habits, preferences and reinforcing value of foods). Research has shown that choice of healthy foods can be enhanced by decreasing access to unhealthy foods and improving access to healthy foods<sup>(23)</sup>. Parents in the intervention group were encouraged to make fruit and vegetables readily *available* and *accessible* for their children and to provide fruit and vegetable alternatives to energy-dense snacks. Adolescents in the intervention group were encouraged to try new fruit and vegetables instead of energy-dense snacks as well as trying recipes that included fruit and vegetables.

The SCT<sup>(24)</sup> explains human behaviour in terms of a reciprocal relationship between personal, behavioural and environmental factors<sup>(25)</sup>. SCT constructs addressed in this intervention included outcome expectancies, self-regulation, to learn by observing others, self-efficacy, behavioural factors, such as behavioural capability, and environmental factors including the availability and accessibility of fruit and vegetables. A distinct aspect of the ‘Choosing Five Fruit and Veg Every Day’ programme was that parent and child behaviours would be targeted reciprocally. This approach was designed to enhance the efficacy of the intervention, given that parental intake of fruit and vegetables and home availability of fruit and vegetables are significant predictors of child fruit and vegetable consumption<sup>(10)</sup>.

### Newsletter intervention

Two sets of adolescent newsletter packs and two sets of parent newsletter packs were developed for the present study. Adolescent newsletters were designed to (i) target normative beliefs by highlighting others’ fruit and vegetable consumption and approval of fruit and vegetable consumption; (ii) target health and nutritional knowledge; (iii) increase preferences for fruit and vegetables and overcoming barriers to eating fruit and vegetables by providing alternative ways of preparing, cooking, serving and eating fruit and vegetables; and (iv) improve behavioural skills and healthy eating. In addition to the newsletters, adolescents received quizzes about fruit and vegetables and recipes for using fruit and vegetables for snacks and meals.

Parent newsletters were designed to (i) target health and nutrition knowledge; (ii) target parents' fruit and vegetable consumption; and (iii) target home availability and accessibility of fruit and vegetables. Parents also received leaflets including top tips and recipe ideas for using fruit and vegetables, and fruit and vegetable portion guides. Monitoring charts and pencils were included in adolescent and parent newsletter packs. Charts encouraged adolescents and parents to log the amount and types of fruit and vegetables they had eaten and to reach for 'Five Fruit and Veg Every Day'.

### **Measurement**

Identical measures for parents and adolescents were administered at baseline, post-intervention and follow-up.

#### *Adolescent measures*

Adolescent's gender and date of birth were collected at baseline only.

#### *Primary outcome measure: adolescent fruit and vegetable consumption*

Adolescent fruit and vegetable consumption was assessed using a twenty-seven-item FFQ, based on the previously validated youth/adolescent FFQ<sup>(26)</sup>. Adolescents were asked how often they ate thirteen different fruits and fourteen different vegetables in the past month. A five-point response scale was provided for each fruit and vegetable item; responses were recoded (scores presented in parentheses) and summed to compute total frequency of fruit and vegetable consumption per day: one or more a day (1); 2–6 a week (0.57); 1 a week (0.14); 1–3 a month (0.06); and never/less than once a month (0).

#### *Secondary measures*

Barriers to eating fruit and vegetables were assessed with eight items (e.g. 'When you do not eat fruit and vegetables, is it because they take too much time to eat?') from a previously validated questionnaire<sup>(27)</sup>. Fruit and vegetable habits (e.g. 'Eating fruit and vegetables is something I do without having to remember') were assessed using the previously validated twelve-item self-report habit index<sup>(28)</sup>. Preferences for fruit and vegetables were assessed with a single-item question asking 'Which of the following do you like or dislike?' A list of thirteen fruits and thirteen vegetables were provided. Internal consistency of items and scales measuring *barriers* to eating fruit and vegetables and fruit and vegetable *habits* and *preferences* are shown in Appendix 1.

#### *Parent measures*

Information on age, ethnicity, marital status, education level and occupation of the main income earner in the household was assessed at baseline only. Socio-economic position was determined using the Index of Multiple Deprivation, based on the postcode of the participants'

home, and thus represents an area-level approximation of socio-economic status.

*Fruit and vegetable consumption* was assessed with a single-item for fruit and vegetables, adapted from the '5-a-Day Power Plus Program' parent survey<sup>(29)</sup>. For example, 'Thinking back over the past week, how many portions of fruit did you usually eat on a typical day?' Responses were measured using an eight-point scale ranging from (1) No fruit to (8) Five or more portions.

Internal consistency of items and scales measuring parental *knowledge* of fruit and vegetable recommendations, *encouragement* and home *availability* and *accessibility* of fruit and vegetables are shown in the Appendix.

### **Process evaluation**

Given that the present study was a pilot, process evaluation was as important as the assessment of the outcome measures. Process evaluation questions were included in the follow-up questionnaire packs for both parents and adolescents in the intervention group. Guided by previous process evaluations of public health interventions<sup>(30,31)</sup>, the process evaluation assessed reach, dose, acceptability and fidelity of intervention delivery. For example, participants were asked whether they received all of the intervention materials; whether or not they used them; and about their favourite/least favourite aspects of the programme.

### **Statistical analyses**

All analyses were conducted using the Statistical Package for the Social Sciences statistical software package version 16.0 (SPSS Inc., Chicago, IL, USA). Forty-nine families provided full data at baseline (twenty-five intervention and twenty-four control families), forty-four families provided full data at post-intervention (twenty-three intervention and twenty-one control families) and thirty-nine families provided data at follow-up (nineteen intervention and twenty control families). Analyses were conducted under the intent-to-treat assumption by replacing missing values at follow-up with the most recent available data from either the post-intervention and/or baseline assessments. Pearson's  $\chi^2$  tests and independent *t* tests were used to examine baseline differences between the intervention and control group in sociodemographic characteristics and outcome measures.

Repeated-measures ANOVA was used to detect any univariate differences in adolescent fruit and vegetable consumption, barriers, habits and preferences, between-groups (intervention and control), time (baseline, post-intervention and follow-up) and group-by-time. The same analysis was conducted for all parent outcome measures. For each analysis, the main effect for group, the main effect for time and the interaction between group and time are reported in the tables. Bonferroni contrast analyses were used to detail specific differences. Where significant interactions were detected, the time and group

values were plotted according to the outcome variable to illustrate the interaction.

To allow comparisons of effect sizes across different measures and studies, partial  $\eta^2$  effect sizes were calculated for differences in time, group and time-by-group. Partial  $\eta^2$  values of 0.01, 0.06 and 0.14<sup>(32)</sup> were applied to determine small, moderate and large effects, respectively, and are reported in Tables 2 and 3. Alpha levels were set at 0.05 for all the analyses.

**Results**

**Sample characteristics**

The study sample consisted of forty-nine parent-adolescent pairs. Most of the parents in the study were women (73%), married (88%), of white ethnic background (88%) and of high socio-economic status (62%). Adolescents were boys (57%) with a mean age of 12.5 years. Table 1 presents the baseline characteristics of the intervention and control group samples. No differences were found between groups on sociodemographic characteristics, behavioural or psychosocial outcomes at baseline, indicating that randomisation was successful.

**Intervention effects for adolescents**

*Frequency of consumption of fruit and vegetables*

A significant time-by-group interaction was observed for fruit consumption, with a large effect size ( $\eta^2 = 0.25$ ; Table 2). At post-intervention and follow-up, adolescents in the intervention group reported eating significantly more fruit than adolescents in the control group ( $P < 0.01$ ).

A significant time-by-group interaction was observed for vegetable consumption, with a medium effect size ( $\eta^2 = 0.08$ ). At follow-up, adolescents in the intervention group ate significantly more vegetables than adolescents in the control group ( $P < 0.05$ ).

*Secondary measures*

There was no significant time-by-group interaction for fruit and vegetable habits (Table 2). However, a significant

increase in habits was observed over the three time points ( $P < 0.05$ ).

There was a significant time-by-group interaction for preferences for vegetables, with a large effect size ( $\eta^2 = 0.20$ ). At post-intervention and follow-up, adolescents in the intervention group had significantly higher preferences for vegetables than those in the control group ( $P < 0.01$ ).

Time, group and time-by-group differences in barriers to eating fruit and vegetables and preferences for fruit were non-significant.

**Intervention effects for parents**

*Frequency of consumption of fruit and vegetables*

There was a significant time-by-group interaction for fruit consumption, with a large effect size ( $\eta^2 = 0.28$ ; Table 3). At post-intervention and follow-up, parents in the intervention group reported eating significantly more fruit than parents in the control group ( $P < 0.001$ ).

There was a significant time-by-group interaction for parent vegetable consumption, with a large effect size ( $\eta^2 = 0.19$ ). At post-intervention and at follow-up, parents in the intervention group reported eating significantly more vegetables than parents in the control group ( $P < 0.01$ ).

*Other measures*

No significant time-by-group interaction was observed for parental knowledge of the fruit and vegetable recommendations (Table 3). However, a significant increase was observed in knowledge over the three time points ( $P < 0.01$ ).

No significant time-by-group interaction was observed for parental encouragement and home availability of fruit and vegetables. However, a significant increase was observed in parental encouragement ( $P < 0.01$ ) and home availability of fruit and vegetables ( $P < 0.05$ ) over the three time points.

There was a significant time-by-group interaction for home accessibility of fruit and vegetables, with a large effect size ( $\eta^2 = 0.32$ ). At post-intervention and follow-up, parents in the intervention group reported higher home accessibility of fruit and vegetables than that of the control group ( $P < 0.001$ ).

**Intervention implementation**

Feedback from adolescents and parents regarding the newsletter packs, intervention delivery and overall satisfaction with the programme was positive. The majority of parents (95%) reported receiving both newsletter packs, found the newsletters (82%), the recipes and portion guides (80%) and the top tips useful (75%). After reading the newsletters, over 75% of parents felt that they could increase their own and their child's fruit and vegetable intake; they could make changes at home; encourage and

**Table 1** Baseline characteristics of the pilot study sample

	Intervention (n 25)		Control (n 24)	
	Mean or %	sd	Mean or %	sd
<b>Adolescent characteristics</b>				
Age (years)	12.6	0.95	12.3	0.74
Gender (boys)	56		58	
<b>Parent characteristics</b>				
Age* (years)	44.4	5.32	43.9	3.60
Gender* (male/fathers)	29		25	
Marital status (dual parents)	92		84	
<b>Socio-economic status</b>				
Low	16		4	
Medium	28		29	
High	56		67	
Ethnicity, White	96		79	

\*Parents who provided consent and completed questionnaires.

**Table 2** Frequency of consumption of fruit and vegetables and psychosocial outcomes for adolescents at baseline, post-intervention and follow-up

	Intervention group (n 25)		Control group (n 24)		Main effects (F-value)			Bonferroni contrast
	Mean	SD	Mean	SD	Time (T)	Group (G)	T × G	
Frequency of fruit consumption/d								
Baseline	2.1	1.1	2.2	1.1	7.21**	2.66	7.47**	B < PI, FU
Post-intervention	3.1	1.7	2.3	1.4	$\eta^2 = 0.24$	$\eta^2 = 0.05$	$\eta^2 = 0.25$	In > Con at PI and FU
Follow-up	3.3	1.8	2.2	1.6				
Frequency of vegetable consumption/d								
Baseline	2.2	1.3	2.3	1.3	5.57**	1.65	4.07*	B < FU
Post-intervention	3.2	1.8	2.5	2.1	$\eta^2 = 0.11$	$\eta^2 = 0.05$	$\eta^2 = 0.08$	In > Con at FU
Follow-up	3.4	2.2	2.4	2.1				
Barriers to eating fruit and vegetables								
Baseline	2.1	0.7	2.1	0.6	1.25	0.392	1.74	
Post-intervention	2.0	0.6	2.2	0.5	$\eta^2 = 0.05$	$\eta^2 = 0.01$	$\eta^2 = 0.07$	
Follow-up	2.1	0.8	2.3	0.7				
Fruit and vegetable consumption habits								
Baseline	3.3	0.8	3.5	0.7	3.95*	1.25	0.14	B < PI, FU
Post-intervention	3.4	0.9	3.6	0.6	$\eta^2 = 0.15$	$\eta^2 = 0.03$	$\eta^2 = 0.01$	
Follow-up	3.5	0.9	3.7	0.8				
Preferences for fruit								
Baseline	3.5	0.9	3.6	0.8	0.39	1.03	0.64	
Post-intervention	3.6	0.9	3.8	0.6	$\eta^2 = 0.02$	$\eta^2 = 0.02$	$\eta^2 = 0.03$	
Follow-up	3.7	0.9	3.8	0.7				
Preferences for vegetables								
Baseline	3.2	0.7	3.2	0.7	0.29	1.13	6.19**	In > Con at PI and FU
Post-intervention	3.4	0.7	3.0	0.8	$\eta^2 = 0.01$	$\eta^2 = 0.02$	$\eta^2 = 0.20$	
Follow-up	3.4	0.8	3.1	0.9				

B, baseline; PI, post-intervention; FU, follow-up; In, intervention group; Con, control group.

Repeated measures ANOVA examining within-group differences (T), between-group differences (G) and time-by-group interactions (T × G).  $\eta^2$ : Partial eta-squared effect sizes (0.04 = small; 0.06 = medium; 0.14 = large).

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

**Table 3** Frequency of consumption of fruit and vegetables and psychosocial outcomes for parents at baseline, post-intervention and follow-up

	Intervention group (n 25)		Control group (n 24)		Main effects (F-value)			Bonferroni contrast
	Mean	SD	Mean	SD	Time (T)	Group (G)	T × G	
Frequency of fruit consumption/d								
Baseline	1.6	0.9	1.6	1.1	7.49**	3.90**	8.94***	B < PI, FU
Post-intervention	2.2	0.8	1.5	0.8	$\eta^2 = 0.25$	$\eta^2 = 0.12$	$\eta^2 = 0.28$	In > Con at PI and FU
Follow-up	2.6	0.7	1.5	1.0				
Frequency of vegetable consumption/d								
Baseline	1.7	0.7	1.9	0.9	3.52*	0.82	5.23**	B < PI, FU
Post-intervention	2.3	0.9	1.9	0.9	$\eta^2 = 0.13$	$\eta^2 = 0.02$	$\eta^2 = 0.19$	In > Con at PI and FU
Follow-up	2.3	0.7	1.8	1.0				
Knowledge of fruit and vegetable recommendations								
Baseline	4.8	0.6	4.4	1.1	4.92**	0.57	1.29	B < PI, FU
Post-intervention	4.9	0.4	5.1	1.5	$\eta^2 = 0.86$	$\eta^2 = 0.01$	$\eta^2 = 0.02$	
Follow-up	5.1	0.4	4.8	0.8				
Encouragement to child for eating fruit and vegetables								
Baseline	3.7	0.8	3.7	0.8	7.06**	1.45	2.46	B > PI, FU
Post-intervention	4.1	0.6	3.7	0.7	$\eta^2 = 0.24$	$\eta^2 = 0.03$	$\eta^2 = 0.10$	
Follow-up	4.2	0.7	3.8	0.8				
Availability of fruit and vegetables in the home								
Baseline	4.0	0.7	4.0	0.6	2.845*	0.04	1.30	B > PI
Post-intervention	4.2	0.6	4.1	0.5	$\eta^2 = 0.10$	$\eta^2 = 0.00$	$\eta^2 = 0.05$	
Follow-up	4.2	0.7	4.0	0.5				
Accessibility of fruit and vegetables in the home								
Baseline	3.2	0.7	3.3	0.8	3.89*	2.89	10.73***	B > FU
Post-intervention	3.7	0.7	3.0	0.6	$\eta^2 = 0.15$	$\eta^2 = 0.06$	$\eta^2 = 0.32$	In > Con at PI and FU
Follow-up	3.8	0.8	3.3	0.6				

B, Baseline; PI, Post-intervention; FU, Follow-up; In, Intervention group; Con, Control group.

Repeated measures ANOVA examining within-group differences (T), between-group differences (G) and time-by-group interactions (T × G).  $\eta^2$ : Partial eta-squared effect sizes (0.04 = small; 0.06 = medium; 0.14 = large).

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

facilitate their child's fruit and vegetable intake; and that they knew more about the importance of a diet rich in fruit and vegetables. Over 90% of parents were happy with the methods used to contact them and to deliver the intervention. Over 75% of parents encouraged their child to read and make use of the materials that were sent to them.

Parents felt that the intervention materials were 'very useful and made me think about how important the fruit and vegetables are for parents and children'. The monitoring charts were very well received: 'we used them as a family to have competitions to see who ate the most fruit and vegetables'.

The majority of adolescents (95%) received and opened both of their newsletter packs. Most adolescents liked and read/used the newsletters (64%), recipes (79%), quizzes (84%) and monitoring charts (74%). After reading the newsletters and other materials, more than 70% of adolescents felt that they could start to eat more fruit and vegetables; they knew more about fruit and vegetables; they could try new fruit and vegetables; and could make their own snacks and meals using fruit and vegetables. Most of the adolescents (79%) were pleased to have materials sent to them that 'were just for them' and not for the whole family to read together.

Adolescents felt that the intervention materials 'were colourful and had lots of good information on fruits I hadn't tried but I now like'; 'using the chart helped me to get to five because I could see what I had eaten in a day'.

## Discussion

The purpose of the study was to evaluate the feasibility and efficacy of a short-term, home-based newsletter intervention to increase adolescent fruit and vegetable consumption. The intervention was successfully implemented and produced significant increases in adolescent and parent FV consumption. To our knowledge, this is one of the first family-based studies to show that a theory-based programme, delivered entirely by mail to participants' homes, could positively influence adolescents' and parents' fruit and vegetable consumption.

The current study achieved significant changes in both adolescent and parent fruit and vegetable consumption over time. Intervention effect sizes for changes in adolescent and parent fruit and vegetable consumption were moderate-to-large. Given that parental fruit and vegetable intake is a significant predictor of adolescent fruit and vegetable intake<sup>(10)</sup>, it may be that parents who alter their fruit and vegetable intake are likely to be better role models and may modify the home environment to make fruit and vegetables more available and accessible to their children. The newsletters contained sections encouraging parents to be role models to their children, and the process evaluation indicated that the intervention materials made parents think about the importance of fruit and vegetable consumption

for themselves and for their children. Targeting parents to change their own behaviour may be an effective way of increasing both adolescent and parent fruit and vegetable consumption.

In both adolescents and parents in the intervention group, fruit and vegetable consumption increased from baseline to post-intervention, with further increases (or a sustained increase for parent vegetable consumption) seen at follow-up. A similar intervention in adults, lasting 4 months, showed significant increases in fruit and vegetable consumption at 6 month follow-up<sup>(21)</sup>. Given that positive effects were seen in the present short pilot intervention study, it is possible that the intervention effect might be sustained for substantially longer if the intervention period was extended, and additional newsletter packs and materials were provided to families. Future research is needed to examine the composition and timing of newsletter packs to maximise the long-term intervention effects.

Significant effects were also found for several of the psychosocial variables assessed as potential mediators of change in fruit and vegetable consumption. Preferences for vegetables increased significantly over time with a greater increase among adolescents in the intervention group. Preferences in adolescents have most often been examined as taste preferences for fruit and vegetables as a composite and have been positively associated with consumption<sup>(33)</sup>. In the present study, we examined fruit and vegetable preferences separately and found a change in preferences for vegetables only. Fruit preferences were higher than those for vegetables at baseline; thus, there may have been limited scope for increasing them further, and may reflect the difference in how and when fruit and vegetables are eaten. Adolescents were provided with recipes and tip sheets on trying new fruit and vegetables, as well as encouraging adolescents to ask their parents for a variety of fruit and vegetables while food shopping. Increases in preferences for vegetables may reflect an increase in parents' provision of vegetables at home as snacks and at mealtimes.

Parents' knowledge of the fruit and vegetable recommendations increased over time in both the intervention and control groups. Parental encouragement for fruit and vegetables and home availability of fruit and vegetables increased over time, with a trend for a greater increase in the intervention group than in the control group. Accessibility of fruit and vegetables at home increased significantly in the intervention group over time compared with the control group. These factors have been previously associated with adolescent fruit and vegetable consumption<sup>(7,10)</sup>. Future research should examine the mediating effects of such psychosocial variables on change in adolescent and parent fruit and vegetable consumption.

Process evaluation indicated that, in the main, intervention materials were delivered as planned and the majority of parents and adolescents reported that the

methods used to deliver the intervention were acceptable. Process evaluation also indicated a high dose and fidelity of the intervention. Home-delivered, leaflet-based interventions have shown effectiveness for modifying feeding practices in mothers of pre-school children<sup>(20)</sup>, and in increasing fruit and vegetable intake in adults<sup>(21)</sup>. The provision of materials that promote thoughts on the importance of fruit and vegetable consumption, as well as simple ways to achieve the recommendations for fruit and vegetables, appear to be an effective intervention strategy for parents and adolescents. Both parents and children appeared to particularly like, and make use of, the monitoring charts that were provided. Self-monitoring is a systematic observation, and recording of target behaviours and previous research has identified this technique as the cornerstone of behavioural treatment<sup>(34,35)</sup>. Future research should examine the effect of self-monitoring of fruit and vegetable consumption on change in the fruit and vegetable consumption.

The results of the present study are encouraging, but there are a number of shortcomings that need to be addressed. The sample was predominantly white and of high socio-economic status; therefore, it is not possible to state whether the results would have been similar in a more ethnically and socio-economically diverse sample. Several studies have identified the overestimation of fruit and vegetable intake when using FFQ<sup>(36,37)</sup>. Given that the fruit and vegetable consumption levels reported by participants in the present study are higher than those reported by the same aged adolescents and adults in the Health Survey for England<sup>(5)</sup>, our findings may be reflective of our high socio-economic status sample (as there are national differences in fruit and vegetable consumption according to socio-economic status<sup>(38)</sup>) or an overestimation, because fruit and vegetable consumption is perceived as healthy and socially desirable. However, the aim of the present study was to examine the change in fruit and vegetable consumption over time, rather than absolute values. The present study had a control group, and there were no significant differences in fruit and vegetable consumption between groups at baseline; thus, we may expect the overestimation to be similar for both groups at each time point. However, the intervention may have led to a higher level of social desirability in the intervention group than in the control group.

Other potential limitations include the short duration of the intervention programme and the small sample size. Strengths of the study include a delivery channel that minimised the participant's burden, targeting of parents and adolescents together, a high programme dose and acceptability and a thorough process evaluation.

## Conclusion

The present pilot, family-based intervention was successfully implemented and produced significant increases

in adolescent and parent fruit and vegetable consumption. Family-based, newsletter interventions promoting fruit and vegetable consumption of adolescents appear to be feasible and effective in increasing fruit and vegetable consumption. Future research is needed to examine the feasibility, efficacy and dose of such an intervention with a larger and more diverse sample.

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## References

1. Antova T, Pattenden S, Nikiforov B *et al.* (2003) Nutrition and respiratory health in children in six Central and Eastern European countries. *Thorax* **58**, 231–236.
2. Baranowski T, Mendlein J, Resnicow K *et al.* (2000) Physical activity and nutrition in children and youth: an overview of obesity prevention. *Prev Med* **31**, S1–S10.
3. Roseman MG, Yeung WK & Nickelson J (2007) Examination of weight status and dietary behaviors of middle school students in Kentucky. *J Am Diet Assoc* **107**, 1139–1145.
4. Maynard M, Gunnel D, Emmett P *et al.* (2003) Fruit, vegetables and antioxidants in childhood and risk of adult cancer: the Boyd Orr cohort. *J Epidemiol Community Health* **57**, 218–225.
5. The Information Centre for Health and Social Care (2006) *Health Survey for England 2006. Report*. London: The Stationery Office.
6. World Health Organization (2004) Young people's health in context: selected key findings from the Health Behaviour in School-aged Children study. Fact Sheet EURO/04/04 2004. <http://www.euro.who.int/document/mediacentre/fs0404e.pdf> (accessed 14 May 2007).
7. Rasmussen M, Krolner R, Klepp KI *et al.* (2006) Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *Int J Behav Nutr Phys Act* **3**, 22.
8. Resnicow K, Smith M, Baranowski T *et al.* (1998) 2-year tracking of children's fruit and vegetable intake. *J Am Diet Assoc* **98**, 785–789.
9. Mikkila V, Rasanen L, Raitakari OT *et al.* (2004) Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The Cardiovascular Risk in Young Finns Study. *Eur J Clin Nutr* **58**, 1038–1045.
10. Pearson N, Biddle SJH & Gorely T (2008) Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutr* **12**, 267–283.
11. Eisenmann JC, Gentile DA, Welk GJ *et al.* (2008) SWITCH: rationale, design, and implementation of a community,

- school, and family-based intervention to modify behaviors related to childhood obesity. *BMC Public Health* **8**, 223.
12. Baranowski T, Baranowski JC, Cullen KW *et al.* (2003) The Fun, Food, and Fitness Project (FFFP): the Baylor GEMS pilot study. *Ethn Dis* **13**, Suppl. 1, S30–S39.
  13. Knai C, Pomerleau J, Lock K *et al.* (2006) Getting children to eat more fruit and vegetables: a systematic review. *Prev Med* **42**, 85–95.
  14. Burgess-Champoux T, Marquart L, Vickers Z *et al.* (2006) Perceptions of children, parents, and teachers regarding whole-grain foods, and implications for a school-based intervention. *J Nutr Educ Behav* **38**, 230–237.
  15. Reynolds KD, Franklin FA, Binkley D *et al.* (2000) Increasing the fruit and vegetable consumption of fourth-graders: results from the High 5 project. *Prev Med* **30**, 309–319.
  16. Nader PR, Sellers DE, Johnson CC *et al.* (1996) The effect of adult participation in a school-based family intervention to improve children's diet and physical activity: the Child and Adolescent Trial for Cardiovascular Health. *Prev Med* **25**, 455–464.
  17. Adair LS & Popkin B (2005) Are child eating patterns being transformed globally? *Obes Res* **13**, 1281–1299.
  18. Rodearmel SJ, Wyatt HR, Barry MJ *et al.* (2006) A family-based approach to preventing excessive weight gain. *Obesity (Silver Spring)* **14**, 1392–1401.
  19. Cullen KW & Thompson D (2008) Feasibility of an 8-week African American web-based pilot program promoting healthy eating behaviors: Family Eats. *Am J Health Behav* **32**, 40–51.
  20. Essemey EV, DiMarco NM, Rich SS *et al.* (2008) Mothers of preschoolers report using less pressure in child feeding situations following a newsletter intervention. *J Nutr Educ Behav* **40**, 110–115.
  21. Lutz SF, Ammerman AS, Atwood JR *et al.* (1999) Innovative newsletter interventions improve fruit and vegetable consumption in healthy adults. *J Am Diet Assoc* **99**, 705–709.
  22. Meyerhoefer CD (2008) Economic principles. In *Youth Physical Activity and Sedentary Behavior: Challenges and Solutions*, pp. 429–451 [AL Smith and SJH Biddle, editors] Champaign, IL: Human Kinetics.
  23. Lappalainen R & Epstein LH (1990) A behavioral economics analysis of food choice in humans. *Appetite* **14**, 81–93.
  24. Bandura A (1986) *Social Foundations of Thought and Action: A Social Cognitive Theory*. New York: Prentice Hall.
  25. Baranowski T, Perry CL & Parcel GS (2002) How individuals, environments, and health behavior interact: social cognitive theory. In *Health Behavior and Health Education: Theory, Research and Practice*, 3rd ed. [K Glanz, FM Lewis and BK Rimer, editors]. San Francisco, CA: Jossey-Bass.
  26. Rockett HR, Breitenbach M, Frazier AL *et al.* (1997) Validation of a youth/adolescent food frequency questionnaire. *Prev Med* **26**, 808–816.
  27. De Bourdeaudhuij I, Klepp KI, Due P *et al.* (2005) Reliability and validity of a questionnaire to measure personal, social and environmental correlates of fruit and vegetable intake in 10–11-year-old children in five European countries. *Public Health Nutr* **8**, 189–200.
  28. Verplanken B & Orbell S (2003) Reflections on past behaviour: a self-report index of habit strength. *J Appl Soc Psychol* **33**, 1313–1330.
  29. Perry C, Bishop D, Taylor G *et al.* (1998) Changing fruit and vegetable consumption among children: The 5-a-Day Power Plus Program in St Paul, Minnesota. *Am J Public Health* **88**, 603–609.
  30. Baranowski T & Stables G (2000) Process evaluations of the 5-a-day projects. *Health Educ Behav* **27**, 157–166.
  31. Steckler A, Ethelbah B, Martin CJ *et al.* (2003) Pathways process evaluation results: a school-based prevention trial to promote healthful diet and physical activity in American Indian third, fourth, and fifth grade students. *Prev Med* **37**, Suppl. 1, S80–S90.
  32. Cohen J (1988) *Statistical Power for the Behavioral Sciences*, 2nd ed. Hillsdale, NJ: Lawrence Erlbaum.
  33. Neumark-Sztainer D, Wall M, Perry C *et al.* (2003) Correlates of fruit and vegetable intake among adolescents. Findings from Project EAT. *Prev Med* **37**, 198–208.
  34. Klem ML, Wing RR, McGuire MT *et al.* (1997) A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *Am J Clin Nutr* **66**, 239–246.
  35. Weber Cullen K, Kay Bartholomew L, Parcel GS *et al.* (1998) Intervention mapping: use of theory and data in the development of a fruit and vegetable nutrition program for girl scouts. *J Nutr Educ* **30**, 188–195.
  36. Kremers SP, Brug J, de Vries H *et al.* (2003) Parenting style and adolescent fruit consumption. *Appetite* **41**, 43–50.
  37. Van Assema P, Brug J, Ronda G *et al.* (2002) A short Dutch questionnaire to measure fruit and vegetable intake: relative validity among adults and adolescents. *Nutr Health* **16**, 85–106.
  38. Nelson M, Erens B, Bates B *et al.* (2007) *Low Income Diet and Nutrition Survey. Summary of Key Findings*. London: Food Standards Agency.

**Appendix** Internal consistency of items and scales measuring potential predictors of adolescent fruit and vegetable consumption

Construct with item	Response category	Internal consistency, Cronbach's $\alpha$		
		B	PI	FU
<b>Adolescent survey items</b>				
Perceived barriers based on a previously validated questionnaire from the Pro-Children project <sup>(27)</sup>				
When you do not eat fruit and vegetables, is it because they take too much time to eat?	Five-point scale from (1) Yes, most of the time to (5) No, never	0.61	0.60	0.74
When you do not eat fruit and vegetables, is it because you want to eat something else?				
When you do not eat fruit and vegetables, is it because your hands get messy?				
When you do not eat fruit and vegetables, is it because they get squashed in your school bag?				
When you do not eat fruit and vegetables, is it because there aren't any at home?				
When you do not eat fruit and vegetables, is it because there aren't any at school?				
When you do not eat fruit and vegetables, is it because they don't look very tasty?				
When you do not eat fruit and vegetables, is it because they cost too much to buy?				
<b>Habits</b>				
Twelve-item self-report habit index (SRHI) <sup>(28)</sup>				
I eat fruit and vegetables regularly	Five-point scale from (1) Strongly agree to (5) Strongly disagree	0.92	0.93	0.93
I eat fruit and vegetables without anyone telling me to				
Eating fruit and vegetables is something I do without having to remember				
I feel weird if I do not eat fruit and vegetables				
I eat fruit and vegetables without thinking about it				
It would take effort not to eat fruit and vegetables				
Eating fruit and vegetables is something that belongs to my (daily, weekly, monthly) routine				
I start eating fruit and vegetables before I realise that I'm doing it				
I would find it hard not to eat fruit and vegetables				
Eating fruit and vegetables is something I don't have to think about doing				
Eating fruit and vegetables is something that is typically 'me'				
I have been eating fruit and vegetables for a long time				
<b>Preferences for fruit</b>				
Which of the following fruits do you like or dislike? List of thirteen fruits: apples, bananas, oranges, pears, peaches, nectarines, grapes, fresh fruit juice, raisins, kiwi fruit, pineapple, mango and tomatoes	Five-point scale from (1) Like a lot to (5) Really don't like	0.88	0.85	0.87
<b>Preferences for vegetables</b>				
Which of the following vegetables do you like or dislike? List of thirteen vegetables: cucumber, cabbage, carrots, green beans/peas, broccoli, lettuce, cauliflower, swede, celery, onion, peppers, leeks and spinach	Five-point scale from (1) Like a lot to (5) Really don't like	0.78	0.83	0.86
<b>Parent survey items</b>				
<b>Knowledge</b>				
How much fruit and vegetables do you think your child should eat each day to have a healthy diet?	Open question			
<b>Encouragement</b>				
How often do you encourage your child to eat fruits?	Five-point scale from (1) Always to (5) Never	0.70	0.74	0.76
How often do you encourage your child to eat vegetables?				
How often do you praise your child when they eat fruits?				
How often do you praise your child when they eat vegetables?				
<b>Availability</b>				
How often are different kinds of fruits available in your home?	Five-point scale from (1) Always to (5) Never	0.75	0.68	0.72
How often are different kinds of vegetables available in your home?				
How often do you serve fruit at mealtimes?				
How often do you serve vegetables at mealtimes?				
<b>Accessibility</b>				
In the past week, were there any fruits on the kitchen counters or somewhere in the open that you could see?	Five-point scale from (1) Yes, everyday to (5) No, never	0.65	0.78	0.83
In the past week, were there any vegetables on the kitchen counters or somewhere in the open that you could see?				
In the past week, were there any fruits, cut up fruits, or fresh fruit juice, on the front shelf of the fridge?				
In the past week, were there any vegetables, cut up vegetables or fresh vegetable juice on the front shelf of the fridge?				
In the past week, were there any fruits that were prepared to be eaten as a snack or as part of a meal?				
In the past week, were there any vegetables that were prepared to be eaten as a snack or as part of a meal?				

B, baseline; PI, post-intervention; FU, follow-up.