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Does the School Fruit and Vegetable Scheme improve children's diet? A non randomised controlled trial

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ABSTRACT

Objective: Evaluation of the impact on diet of the school fruit and vegetable scheme (SFVS).

Design: Non-randomised controlled trial.

Setting: Infant and primary schools in the north of England.

Participants: 3703 children aged four to six years (reception, year 1, and year 2).

Intervention: One portion of fruit or vegetable provided per child on each school day between February and December 2004.

Main outcome measures: Fruit and vegetables consumed and intake of nutrients.

Results: The SFVS was associated with an increase in fruit intake across reception and year 1 pupils of 0.4 portions (95% confidence interval, 0.2 to 0.5) and 0.6 portions (0.4 to 0.9), respectively, at three months, which fell to 0.2 (0.1 to 0.4) and 0.3 (0.1 to 0.6) at seven months. In year 2 it was associated with an increase of 0.5 portions (0.2 to 0.7) of fruit at three months, which fell to baseline values at seven months when these children were no longer eligible for the scheme. Overall, at seven months there were no changes in vegetable

consumption, no associations between the SFVS and energy, fat, or salt intake, and small changes in carotene and vitamin C intake.

Conclusions: The SFVS promoted an increase in fruit intake after three months. At seven months the effect remained significant but reduced, and it returned to baseline in year 2

when pupils were no longer part of the scheme. There was a small impact on the intake of some nutrients across the children surveyed.

INTRODUCTION

Research suggests that young people do not consume enough fruit and vegetables to benefit their health. The National Diet and Nutrition Survey of 4 to 18 year olds revealed that most young people consume less than the recommended daily amount of fruit and vegetables. Overall, one in five children ate no fruit, and three of five ate no green leafy vegetables during a usual week.[1]

There is convincing evidence that a low intake of fruit and vegetables is a risk factor for cancer and cardiovascular disease in later life.[2–5] Tackling these diseases is a government priority, as they account for 60% of all early deaths in England.[6 7]

The NHS Plan focuses on strategies for preventing cardiovascular disease and cancer. A key component of the plan is to improve diet and nutrition. It states that, ‘‘eating at least five portions of fruit and vegetables a day could lead to estimated reductions of up to 20 per cent in overall deaths from chronic diseases’’. Apart from a reduction in smoking, an increase in fruit and vegetable consumption is considered the most effective strategy for reducing the risk of cardiovascular disease and cancer.[8]

Despite convincing evidence of the preventive health effects of a diet rich in fruit and vegetables, the average UK consumption is only three portions per day.[9] It has been noted that consumption of fruit and vegetables is lower in low compared with high socioeconomic groups, and is particularly low in children.[1 9]

In order to address some of the dietary and health issues outlined above, the government has implemented the national 5 A DAY programme to raise awareness of the health benefits of eating more fruit and vegetables. One aspect of the 5 A DAY programme is the school fruit and vegetable scheme (SFVS), devised as part of a government strategy to address children’s low intakes of fruit and vegetables.

The SFVS is the largest scale intervention in English children's diet since the introduction of free school milk in 1946. Since November 2004 a free piece of fruit or vegetable has been provided to children aged four to six years on each school day. The scheme aims to distribute 440 million pieces of fruit and vegetables each year to over two million children in 18 000 schools. It has cost £42 million to set up and has received a further £77 million from the Department of Health to run until 2006.[10]

The SFVS presents the hypothesis that providing free fruit and vegetables for schoolchildren aged four to six will improve their overall consumption of fruit and vegetables by up to one portion a day, with subsequent associated improvement in nutrient intake. Two key aims of this research were therefore to evaluate the impact of this intervention on children's consumption of fruit and vegetables, and to assess their intake of nutrients.

A randomised controlled trial was not possible because the roll out of the SFVS across English schools was at an advanced stage by the time the evaluation study was commissioned. This left too few regions from which to randomise a control and intervention group. For logistical reasons every school in a region had to start the scheme at the same time, so we could not randomise at the school level either. A non-randomised design was therefore used.

METHODS

Study Design

Two random samples (one intervention sample from the North East Region and a matched control sample from Yorkshire and Humberside) of maintained schools with pupils in reception (four years old), year 1 (five years old), and year 2 (six years old) were drawn in December 2003. These excluded schools involved in formal pilots of the SFVS.

Sampling method

The intervention schools were randomly sampled from a list of all primary schools in the North East Region, stratified on the following background criteria to ensure the sample was representative of English schools: local education authority (LEA) type (rural/metropolitan); school type (infant, primary); key stage 1 attainment (based on an examination of the number of pupils achieving level 2 at key stage 1); percentage of pupils with free school meals (FSME); percentage of pupils defined as having special educational needs (SEN); and percentage of pupils with English as an additional language (EAL).

A control sample was drawn and frequency matched on the same criteria. The required total sample size of 1800 children was calculated to provide a power of 95% to detect a difference of 0.5 portions of fruit or vegetables consumed between the two groups. The data used to calculate the sample size were derived from a previous study where the fruit and vegetable intake of children aged four to seven years was recorded.[11] The following parameters were used to estimate the sample size: standard deviation of outcome (portions of fruit and vegetables)=2.04, intra-class correlation=0.15, pupils per class=8, giving a design effect of 2.05.

This equates to 37 schools per group, and 24 pupils (three classes of eight randomly selected) per school. The final intended sample size was increased to 55 schools in the intervention group and 45 in the control group, with all pupils in each class approached. This was to allow for attrition occurring between the three data collection phases and failure to receive consent for children to take part in the study. The uneven numbers of schools between intervention and control were chosen to accommodate further subgroup analysis and qualitative work within the intervention group. The samples drawn were twice the size of the intended achieved samples. This was based on an assumed 50% recruitment rate, achieved in the validation study of the Child and Diet Evaluation Tool (CADET).[11]

Two hundred and five schools were contacted at the beginning of the spring term 2004, and invited to take part in the evaluation. Only pupils for whom a signed consent form was received from a parent or guardian were eligible to take part in the evaluation. Three phases of data collection were scheduled for the evaluation. The CADET was administered to each cohort of children on three separate occasions—that is, longitudinally. They were March (phase 1), June (phase 2), and November (phase 3) of 2004. Shortly after the baseline dietary assessment (phase 1), the SFVS was rolled out to all schools in the intervention group but not the control group.

Intervention

The intervention comprised a daily piece of fruit or vegetable offered to pupils in reception, year 1 classes, and year 2 classes. A rota was devised of fruit and vegetables, pre-tested for their suitability in terms of their acceptability to children, any health and safety issues relating to risk of choking and anaphylaxis, and ease of preparation and storage within the school. The rota of items included apples, pears, easy to peel citrus fruit, bananas, and occasional seasonal items such as strawberries in the summer months. Carrot sticks and small tomatoes were also included in the rota from time to time. Vegetables are more difficult to provide as a break time snack as they tend to require more preparation and are not so acceptable as a snack food as a piece of fruit.

In addition, educational materials and activities relating to the benefits of eating fruit and vegetables developed as part of the SFVS were promoted to schools taking part in the intervention. These included an introductory training video for teachers, wall charts, cooking activities, and games for children. Information relating to the benefits of eating fruit and vegetables was also made available to parents as part of the wider 5 A DAY scheme.[10]

Dietary assessment

The CADET was used to estimate the usual dietary intake (including portions of fruit and vegetables), energy, and nutrients. The CADET was designed as a simple dietary

assessment tool and records a child's dietary intake over 24 hours. It is based on a tick box design, completed by adults on behalf of children. It has been validated for use with young children between the ages of four and seven years. The validation study compared the CADET with a 24 hour semiweighed food diary obtained from the same children for the same day and shows a close association with usual diet. Correlation coefficients comparing CADET with diary ranged from 0.44 to 0.89 for foods and from 0.41 to 0.68 for nutrients.[11] Repeatability and reliability of the CADET were also determined in a subgroup of the same validation study, giving an intraclass correlation between CADET and diary for change in fruit and vegetable consumption of 0.72 (95% confidence interval (CI), 0.54 to 0.89).

Statistical analysis

Multilevel modelling was used to assess the impact of the SFVS, allowing for the structure of the data by taking account of five levels in our model: local education authority, school, class, pupil, and time point. Adjustment was made, where necessary, for the following pupil level and school level variables:

Pupil level: sex (boy or girl); year group (reception, year 1 or year 2); ethnicity (white UK or minority ethnic); time point (phases 1, 2, or 3); lunch arrangement (whether they usually have a packed lunch, go home for lunch, or have a school dinner); percentage of people in the post code area aged 16 to 74 years with no qualifications (census data); percentage of people in the post code area not in good health (census data); overall deprivation index (census data).

School level: intervention or comparison group; school type (infant or primary); percentage of pupils with SEN; percentage of pupils with EAL; percentage of pupils eligible for free school meals; key stage 1 average attainment (banded).

Multilevel models were fitted initially with all background variables included. In the interest of parsimony redundant variables were removed from the model. Variables significantly related to the outcome (p,0.05) or borderline were kept in the model.

RESULTS

Ninety eight schools (53 intervention and 45 control) participated in the study at baseline; 49 and 43 schools in the intervention and control groups, respectively, completed all three phases of the study, thus meeting the achieved sample targets (fig 1).

At phase 2, 2045 (78%) of the 2622 CADETs dispatched to the intervention group were returned. In the control group, 1648 (78%) of the 2113 CADETs dispatched were returned. Both the response rate and the return rate of CADET were within the range allowed in the power calculation.

At baseline the intervention group was similar to the control group in terms of sex, age, and intake of fruit, vegetables, fat, and salt (table 1). The intervention group had significantly
higher intakes of total energy, sugars, carotene, and vitamin C, indicating the importance of adjustment for baseline intakes in the multilevel models. Unadjusted results are shown in table 2.

Table 3 shows the estimated changes in fruit, vegetable, and nutrient intake associated with the SFVS at three and seven months post-intervention by year group. The SFVS was associated with an increased fruit and vegetable intake across reception and year 1 of 0.5 portions (95% CI, 0.3 to 0.7) and 0.7 portions (0.3 to 1.0) at three months, which fell to 0.2 (0 to 0.4) at seven months in reception and to 0.2 (20.2 to 0.6) in year 1. The impact of the SFVS on year 2 pupils was associated with an increased fruit and vegetable intake of 0.5 portions (95% CI, 0.2 to 0.9) three months after the introduction of the SFVS. This fell to 20.2 (20.5 to 0.2) at seven months. By this time year 2 pupils were no longer eligible to receive free fruit and vegetables.

Table 3 shows no long term impact on vegetable intake in any of the groups at seven months.

There were no associations between the SFVS and change in energy, fat, or salt intake across the year groups. Carotene intake at seven months increased in reception and year 1 by 14% (95% CI, 5% to 24%) and 21% (5% to 40%), respectively, but declined in year 2 by 14% (21% to 26%); similarly, vitamin C intake at seven months increased in reception and year 1 by 8 mg (95% CI, 3 to 30 mg) and 9 mg (3 to 16 mg), and decreased in year 2 by 23 mg (15 to 32 mg). There was a non-significant increase in sugar intake in reception and year 1. In contrast, year 2 had a decrease in sugar intake associated with the intervention, by 38.2 g (46.0 to 30.5 g) at seven months.

In the model for fruit and vegetable intake, local education authority accounted for 1% of the variation, school 8%, class 3%, pupil 84%, and occasion 5%.

DISCUSSION

This school based dietary intervention showed positive changes associated with fruit intake in young children who remained in the scheme but this effect waned over time. At three months children were eating half a portion of fruit more than they were at baseline, but this was reduced by seven months and disappeared completely in year 2 pupils, who are no longer eligible for the SFVS.

There may be several reasons for these observations. Children in year 2 only participated in the intervention from March until the end of the school year in July 2004. This may not have been long enough to have had an impact on their long term eating habits. The waning effect observed in all groups could have been affected by the long summer vacation, where a multitude of influences would affect the fruit and vegetable eating behaviour of these children. In addition, other changes in eating behaviour may have taken place as a result of the scheme. There was evidence that children's intake of fruit and vegetables declined at home at the same time as it increased at school.[12] Parents and carers, despite being generally supportive of the SFVS, may have supplied less fruit and vegetables at home, believing that their children were being provided with an adequate intake at school. This may be an undesirable secondary effect of the intervention.

The waning effect could also be influenced by the narrow range of produce on offer. Throughout the school year a menu cycle of daily fruit and vegetables is devised. The most common items are apples, pears, easy peel citrus fruit, and bananas. Health and safety considerations have restricted items which may add variety to the scheme and stimulate a continuing interest in fruit and vegetable consumption—for example, fruit with stones are not allowed because of the risk of choking. It must also be borne in mind that, although large in scale, the SFVS only constitutes a small intervention in a child's total diet. To have a greater impact on fruit and vegetable intake we hypothesise that the intervention would need to be more structured and target other meal events such as school dinners, packed lunches, and meals eaten at home. It would also need to be sustained throughout a child's education.

Systematic reviews of interventions to increase fruit and vegetable intake in young children have identified the importance of a range of factors which effect children's eating behaviour. These factors include peer and parental modelling of fruit and vegetable eating; message reinforcement to sustain the children's interest in the intervention; the use of a supportive environment including involvement from the whole school, which includes teachers, parents, the local community, and canteen staff.[14–16] In addition, there is evidence that rebranding fruit and vegetables as ''fun'' rather than healthy has a positive effect on intake.[14]

There are several limitations to this study. First, it was not a randomised controlled trial and therefore we remain uncertain of any bias that could have skewed the results; there may be some residual confounding that we have not accounted for. Second, we were not able to measure the full impact of the scheme as we did not follow reception pupils through the full three years of the scheme and beyond. Third, this evaluation was conducted in two distinct geographical regions, the North East and Yorkshire and Humberside. Fruit and vegetable intake in each of these regions is among the lowest in England.[13] Though a cluster randomised trial would have been better, this was not possible because the intervention had already started in all but three regions. We could

not randomise at the school level because, for logistical reasons, each school in a reGion had to start the intervention at the same time.

Despite the shortcomings of our study design, it is arguably superior to a recent smaller scale cross sectional evaluation of the SFVS conducted by Wells and Nelson in schools in London and the south east.[17] Their findings showed a small effect of the SFVS on the fruit intake of four to six year old pupils but no long term effect on the fruit intake of seven and eight year olds who were no longer receiving free fruit. The findings of our study and those of Wells and Nelson cast doubt on the effectiveness of the SFVS to sustain long term increased fruit and vegetable intake in children.

What does this study add?

- National interventions can lead to increases in fruit intake in young children.
- Increases in fruit intake reduce over time in those who remain in the scheme and return to baseline in those who do not.

Policy Implications

- To provide an effective intervention to increase young children's consumption of fruit requires measures not only to initiate a change of fruit intake, but also to sustain changes that occur in the short term.

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Competing interests: All authors declare that the answer to the questions on your competing interest form bmj.com/cgi/content/full/317/7154/291/DC1 are all No and therefore have nothing to declare.

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Contributors: JKR initiated the research, contributed to writing reports and the interpretation of data; DCG and JEC contributed to the study design and report writing. DCG also contributed to statistical analysis and interpretation of nutritional data. SS secured funding, and led the design of the study. IS led the analysis of data and contributed to the study design and writing the report. DT coordinated the evaluation study and led the report writing. SB and GW developed survey material and assisted with managing the evaluation. ES conducted statistical analysis. All authors contributed to subsequent drafts and approved the final version of this paper. JEC and SS are guarantors for this study.

Ethical approval was not required for this evaluation.

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Figure 1: Flow diagram of schools and children recruited, and number of CADETs returned. CADET, child and diet evaluation tool; SFVS, school fruit and vegetable scheme.

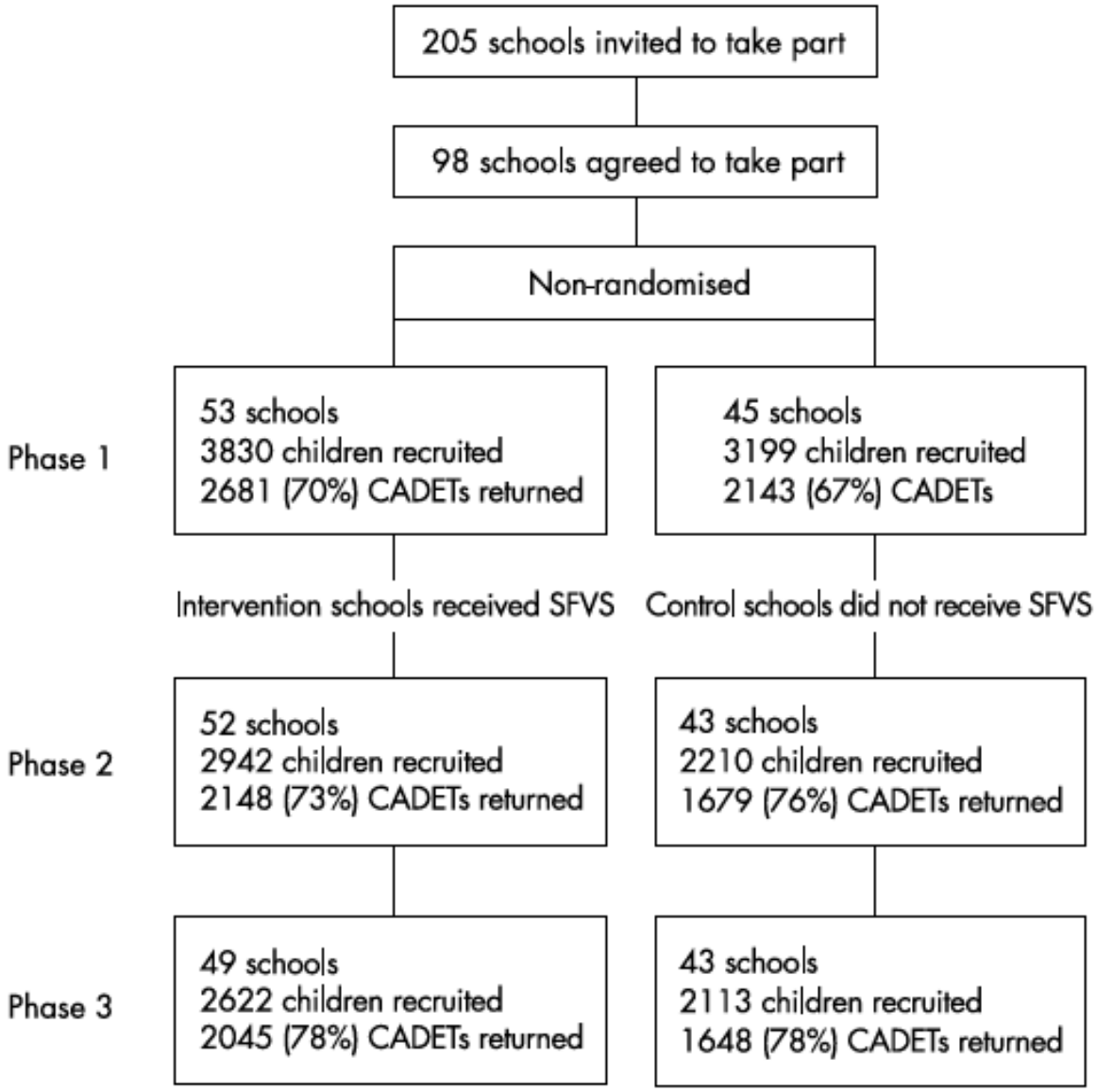

Table 1: Baseline characteristics of the sample*

	INTERVENTION	CONTROL
Pupil level data		
Gender		
Girl (%)	1248 (49)	1033 (51)
Boy (%)	1278 (51)	1003 (49)
Total (%)	2562 (100)	2033 (100)
Age (months) (SD)	72.1 (10.5)	72.4 (10.3)
Portions of fruit (SD)	1.9 (1.4)	1.8 (1.3)
Portions of vegetables (SD)	1.5 (1.5)	1.6 (1.5)
Portions of fruit and vegetables eaten daily (SD)	3.4 (2.2)	3.4 (2.2)
Total energy intake (MJ) (SD)	6.6 (1.6)	6.2 (1.6)
Fat (g) (SD)	57 (18)	57 (17)
Salt (g) (SD)	5.2 (1.6)	5.0 (1.6)
Sugars (g) (SD)	119 (39)	101 (41)
Carotene (mg) **	939	779
Vitamin C (mg) (SD)	72 (42)	62 (40)
School level data		
% children with English as an additional language (SD)	2.7 (5.4)	4.7 (14.2)
% children with free school meals eligibility (SD)	18 (11)	20 (14)
% children defined as having special educational needs (SD)	1.4 (1.4)	2.0 (1.8)

*Figures quoted are means (standard deviations). For food and nutrient intakes this is mean intake per day.

**For carotene, the figure quoted is the geometric mean intake per day.

Table 2: Intake of fruit vegetables and key nutrients 7 months after the introduction of the SFVS*

	INTERVENTION		**CONTROL**	
	At 3 months	At 7 months	At 3 months	At 7 months
Portions of fruit (SD)	1.9 (1.4)	1.6 (1.4)	1.7 (1.4)	1.6 (1.3)
Portions of vegetables (SD)	1.5 (1.6)	1.5 (1.5)	1.6 (1.6)	1.6 (1.5)
Portions of fruit and vegetables eaten daily (SD)	3.4 (2.3)	3.1 (2.1)	3.3 (2.3)	3.2 (2.1)
Total energy intake (MJ) (SD)	6.6 (1.7)	6.5 (1.6)	6.4 (1.7)	6.3 (1.7)
Fat (g) (SD)	56 (18)	57 (17)	58 (19)	57 (18)
Salt (g) (SD)	5.1 (1.6)	5.2 (1.7)	5.0 (1.6)	5.0 (1.7)
Sugars (g) (SD)	123 (40)	113 (37)	115 (39)	106 (38)
Carotene (mg) **	828	1004	832	985
Vitamin C (mg) (SD)	84 (48)	79 (45)	68 (44)	68 (42)

*Figures quoted are means (standard deviations). For food and nutrient intakes this is mean intake per day.

**For carotene, the figure quoted is the geometric mean intake per day.

Table 3: Adjusted change in food and nutrient intakes* associated with the SFVS intervention compared to controls, by year group**

	RECEPTION (4 years old)		YEAR 1 (5 years old)		YEAR 2 (6 years old)	
	At 3 months (95% CI)	At 7 months (95% CI)	At 3 months (95% CI)	At 7 months (95% CI)	At 3 months (95% CI)	At 7 months (95% CI)
Fruit (portions)	0.5 (0.2 to 0.5)	0.2 (0.1 to 0.4)	0.6 (0.4 to 0.9)	0.3 (0.1 to 0.6)	0.5 (0.2 to 0.7)	0 (-0.2 to 0.3)
Vegetables (portions)	0 (-0.2 to 0.2)	-0.2 (-0.5 to 0.1)	0 (-0.3 to 0.3)	-0.2 (-0.5 to 0.2)	0.5 (0.2 to 0.9)	-0.3 (-0.6 to 0.1)
Fruit & vegetables (portions)	0.5 (0.3 to 0.7)	0.2 (0 to 0.4)	0.7 (0.3 to 1.0)	0.2 (-0.2 to 0.6)	0.5 (0.2 to 0.9)	-0.2 (-0.5 to 0.2)
Energy (MJ)	-0.07(-0.29 to 0.15)	-0.03 (-0.25 to 0.19)	0.16 (-0.23 to 0.54)	0.03 (-0.35 to 0.4)	-0.81 (-1.19 to 0.15)	-0.63 (-1.01 to 0.25)
Fat (g)	-1.8 (-3.3 to -0.3)	-0.6 (-2.2 to 0.9)	-0.8 (-3.4 to 1.8)	0.1 (-2.8 to 3.1)	-1.5 (-4.1 to 1.1)	1.7 (-1.3 to 4.7)
Salt (g)	-0.1 (-0.3 to 0)	-0.1 (-0.3 to 0.1)	0 (-0.3 to 0.2)	-0.2 (-0.4 to 0.1)	-0.2 (-0.5 to 0)	-0.0 (-0.3 to 0.3)
Sugars (g)	2.9 (-1.2 to 7)	2.3 (-1.9 to 6.4)	7.1 (1.0 to 13.1)	3.0 (-3.1 to 9.1)	-38.0 (-45.6 to -30.5)	-38.2 (-46.0 to -30.5)
Carotene (% change)	-10 (-17 to -2)	14 (5 to 24)	-9 (-21 to 5)	21 (5 to 40)	-28 (-40 to -14)	-14 (-26 to 1)
Vitamin C (mg)	13 (8 to 17)	8 (3 to 12)	15 (9 to 21)	9 (3 to 16)	-13 (-21 to -4)	-23 (-32 to -15)

** Adjusted for significant confounders*

***At 7 months, 92 schools returned data from 3,703 pupils; 3,405 food diaries were included in the analysis*

**** Where numbers do not add up this is because of small amounts of missing data*