

Does participation in a population-based dietary intervention scheme have a lasting impact on fruit intake in young children?

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Background The National Schools Fruit Scheme (NSFS) is intended to improve fruit intake in young children by providing free daily fruit at school.

Methods We used a parentally completed questionnaire for three consecutive years to study fruit intake in young children before, during and after participation in the NSFS compared with a control region.

Results In 2003, 2004 and 2005, a total of 224, 220 and 179 schools, respectively, were studied with responses from 5606, 5111 and 3382 children for each survey. Between 2003 and 2004, individual fruit consumption in the intervention region increased by more (from a median of 7.5 to 14.0 pieces/week) than in the control region (from a median of 9.2–11.0 pieces/week), resulting in a difference ($P < 0.001$) between the two regions in 2004. However, after ceasing to be eligible for the NSFS, fruit intake in children in the intervention region fell to a median of 12 pieces per week, lower than that in the control region (median value of 14 pieces per week, $P = 0.02$).

Conclusions School-based fruit distribution schemes providing free fruit at school appear to be an effective means of increasing dietary fruit intake in young children, including those who live in relatively socio-economically deprived areas. However, this approach does not influence fruit intake after the provision of free fruit ends, so schemes may need to be sustained to provide the maximum benefit to young children.

Keywords Fruit, nutrition, public health, children

A diet rich in fruit is thought to be generally beneficial to health, particularly with regard to the risk of cardiovascular disease^{1,2} and cancer^{1,3,4} in adults, and the risk of asthma in children.^{5–7} It is also likely that patterns of dietary intake of fruits and other healthy foods are established early in life.⁸ It is, therefore, important to develop interventions that increase regular fruit intake in young children, especially those from less

affluent sectors of society, as diet may be one lifestyle factor contributing towards socio-economic differentials in health.⁹

In 2002, the UK government announced a national initiative designed to increase fruit intake in children by providing each child aged 4–6 years at the beginning of the school year in England with a free piece of fruit each day in school. The programme was implemented across England in a phased manner on a region by region basis. As summarized in Figure 1, this provided an opportunity to evaluate the impact of this public health intervention in a natural experiment, comparing fruit intake over time in a cohort of children of the same age, half of whom lived in a region that introduced the scheme while they were in the targeted age range, and the other half who lived in a region that implemented the scheme later, by which time when they were too old to

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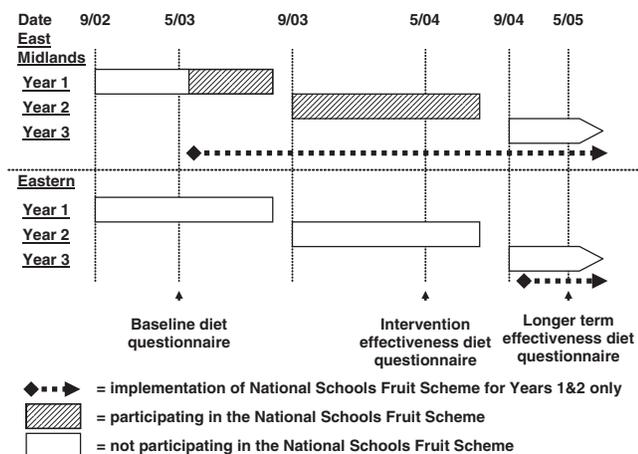


Figure 1 A summary of the evaluation of National Schools Fruit Schemes

qualify for the scheme. This has allowed us to determine whether the NSFS increased intake of fruit in young children, and whether any effect was sustained after children ceased to receive free fruit at school.

Methods

Study design and sample

The National Schools Fruit Scheme (NSFS) was introduced in England with the aim of providing every child of the age 4–6 years at the beginning of the school year (Age 4, 5 and 6 years corresponding to Reception Year, Year 1 and Year 2, respectively) attending a Local Educational Authority maintained school with a daily piece of fruit distributed at school, and was implemented in different regions of the country over a period of ~2 years from 2002 to 2004. The fruit was provided by local wholesalers when possible, was considered good or excellent by 93% of schools and consisted of familiar fruit such as apples, bananas, satumas and pears.¹⁰ In the East Midlands region, the NSFS was implemented for all eligible children just before the end of the school year in June 2003, and children in Year 1 in this region in June 2003, therefore, went on to receive daily fruit at school until they reached the end of Year 2 in July 2004. In the Eastern region, the NSFS was not implemented until September 2004, by which time all children who were in Year 1 in June 2003 were now too old to qualify for the scheme (Figure 1). In autumn 2004, the NSFS was renamed the School Fruit and Vegetable Scheme.

In May 2003, we recruited a random sample of 113 schools in the East Midlands and 122 schools in the Eastern region of England. We collected baseline data on diet using a short simple questionnaire completed by the parents of children who were then in Year 1 (aged 5–6 years). We then repeated this measure in these children in May 2004 (aged 6–7 years) and again in May 2005 (aged 7–8 years). The eligible children in the East Midlands region had received daily fruit at school between the dates of the first and second questionnaires but not between the dates of the second and third questionnaires;

the children in the Eastern region did not receive fruit at school at any stage. Ethics approval was obtained from the Eastern Multiple Regional Ethics Committee.

The questionnaires were distributed and returned via the schools, and we had to rely on the goodwill and cooperation of the school staff to oversee this process. We had no opportunity to pursue non-respondents. Schools that refused to participate or returned very few (<6) questionnaires in any year were omitted from analysis. The number of children eligible to participate each year was estimated from data provided by the participating schools. Some of the smaller community schools catered for students up to Year 2 only, and to ensure that we continued to include as many as possible of our original study population, we identified and contacted the schools that these children were entering in Year 3, and if agreeable recruited them into the study.

Fruit intake was quantified by two questions asking parents how many days in a typical week the child ate fruit, excluding fruit juice, either at school or home, and how many pieces of fruit were consumed on average every day. The same questions were used for all three years of the survey. The completed questionnaires were scanned and entered into a database (Document Capture Company, Wembley, UK). Parents provided their postcode, which was linked to the census area statistic ward and in turn to the Townsend Z score for the 2001 census, as a marker of socio-economic status. The Townsend Score is a normally distributed measure with negative scores indicating higher, and positive scores lower, socio-economic status.¹¹

Statistical analysis

We analysed these data as three cross-sectional studies in 2003, 2004 and 2005. For each year, we derived two outcome measures of fruit intake for each child; a binary indicator of whether fruit was eaten every day or less than every day, and a continuous measure of number of pieces of fruit per week computed by multiplying frequency of days eaten per week by the number of pieces of fruit eaten per day. To allow for clustering, we then aggregated these measures by school, calculating for each school the proportion of children eating fruit every day, and the median number of pieces of fruit per week per child. For each of 2003, 2004 and 2005, we compared these outcomes between schools in intervention and control regions using the independent samples *t*-test and Mann Whitney U-test, respectively in accordance with the distribution of each outcome variable. We analysed the data in this way rather than longitudinally, since the children and schools taking part were not consistent over the 3 years of the study. Finally, we calculated the median Townsend score for students in each school, and used this value to create a median value for all of the schools in the study. We divided the schools into those above and below the overall median, and then repeated our analyses stratified by this marker of higher or lower deprivation. SPSS (Version 12.0, Illinois, USA) was used for all analyses.

Results

In 2003, 2004 and 2005, the schools had 10470, 10104, 8386 children who were attending the classes participating in

Table 1 Description of the study population

	Region	Year of survey		
		2003	2004	2005
No. of schools	EM (fruit)	108	107	91
	E (control)	116	113	88
No. of eligible children	EM (fruit)	4984	4676	4003
	E (control)	5576	5428	4383
No. of questionnaires returned (% response rate)	EM (fruit)	2665 (54)	2333 (50)	1581 (39)
	E (control)	2941 (53)	2778 (51)	1801 (41)
No. of males (%)	EM (fruit)	1336 (50.2)	1134 (48.6)	723 (45.7)
	E (control)	1473 (50.2)	1358 (49.0)	858 (47.7)
Median Townsend Score for individuals (IQR)	EM (fruit)	-1.0 (-2.4 to +1.7)	-0.6 (-2.4 to +1.7)	-1.0 (-2.4 to +1.7)
	E (control)	-1.5 (-2.7 to +0.6)	-1.4 (-2.7 to -1.4)	-1.4 (-2.6 to +0.7)
Children's median weekly fruit intake per school (pieces of fruit, IQR)	EM (fruit)	7.5 (7.0–11.4)	14.0 (12.0–14.0)	12.0 (9.0–14.0)
	E (control)	9.2 (7.0–14.0)	11.0 (12.0–14.0)	14.0 (11.2–14.0)
% per school eating fruit every day (mean, 95% CI)	EM (fruit)	46.7 (44.0–49.4)	65.1 (62.3–67.8)	58.5 (55.1–61.9)
	E (control)	51.6 (48.8–54.4)	54.1 (51.7–56.4)	61.3 (58.5–64.1)

EM (fruit), East Midlands; E (control), Eastern region; IQR, interquartile range; CI, confidence intervals.

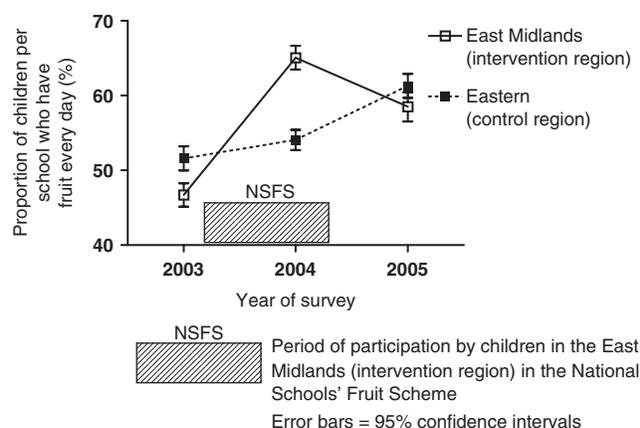


Figure 2 The proportion of children eating fruit every day for schools in the intervention and control regions 2003–05

the study. We received completed questionnaires from 5606, 5111 and 3382 children, respectively, giving response rates of 53, 51 and 40% for the 3 years of the study. The study population is described in Table 1.

The proportion of children eating fruit every day in schools in the intervention (East Midlands) and control (Eastern) regions in each year is presented in Figure 2. In May 2003, when the children were in Year 1, before either region participated in the NSFS, the proportion of children eating fruit every day was lower in the intervention than the control region with a mean difference of -4.9% (95% confidence interval, 95% CI -8.7 to -1.1). In May 2004, while the children were in Year 2 and the intervention region was participating in the NSFS, this pattern was reversed such that the proportion eating fruit every day was markedly higher in the intervention than the control region with a difference of $+11.0\%$ (95% CI $+7.4$ to $+14.6$) between the two regions. However in May 2005, once children in the intervention region ceased to participate in the NSFS,

the proportion eating fruit every day fell to less than the control region (-2.8% , 95% CI -7.2 to $+1.6$). There was a similar pattern in the number of pieces of fruit eaten per week (Figure 3), being lower at baseline in 2003 in the intervention region than in the control region, rising to above that of the control region during participation in the NSFS, and falling below the control region once participation in the NSFS has ceased (all $P \leq 0.02$). The effect of participation in the National School Fruit Scheme on the proportion of children per school eating fruit every day is presented stratified by Townsend deprivation score for the two regions in Figure 4. Those living in relatively more deprived areas ate less fruit at baseline in both the control and intervention regions. In the intervention region, a similar size increase in fruit intake during the period of participating in the fruit scheme was apparent in the more and less deprived areas.

Discussion

This study has demonstrated that on the basis of parent reported questionnaire findings, a dietary intervention aimed at providing free fruit to young children in school is effective in increasing fruit intake, and that this effect is similar across the range of socio-economic deprivation. However, this increase in fruit intake was not sustained after participation in the NSFS ended. The implication of our study is, therefore, that school based dietary interventions can be effective, but may need to be for a longer duration to achieve consistent changes in children's diet.

As a high intake of dietary fruit is associated with a lower risk of disease in later life,^{1–4,12} this approach has the potential to translate into substantial benefits at the population level.¹³ New effective interventions to increase fruit intake in young children are urgently required as a recent survey in England demonstrated that 70% of young children typically eat citrus fruit, and 30% apples or pears, less than once a week,¹⁴ while recent guidelines from the American Dietetic Association

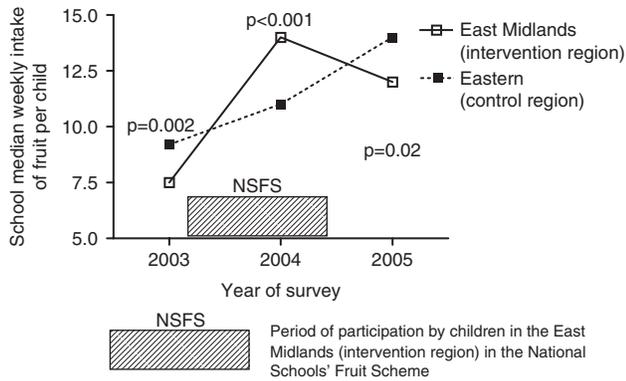


Figure 3 The median intake of fruit per week for schools in the intervention and control regions 2003–05

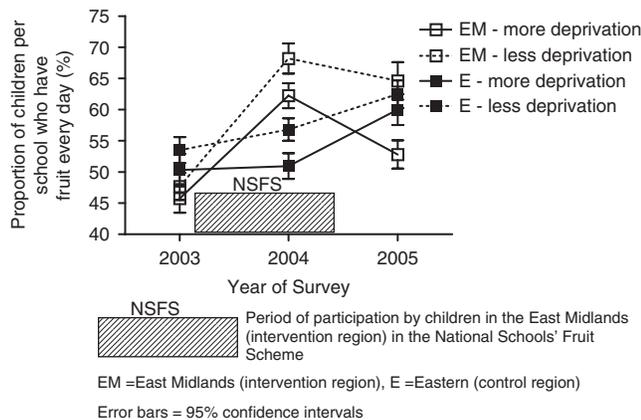


Figure 4 The proportion of children who eat fruit every day for schools in the intervention and control regions 2003–05: stratified by deprivation index

suggest that most American children's diets also need improvement.¹⁵

Strengths and limitations

Our study used a prospective design, with three surveys in consecutive years covering the periods before, during and after participation in the NSFS for children in the East Midlands who were aged 5–6 years in 2003, with comparable data for the Eastern region which provided a control group. The response rates in 2003 and 2004 of 51–53% were reasonable for surveys conducted by distributing questionnaires to parents via the schools, and probably underestimate the true response rate since it does not take into consideration those who were absent from school on the day the questionnaire was distributed. The response rate of 40% in 2005 was more disappointing and probably reflects a change in the schools included in the study in the 3rd year. Approximately 25% of infant schools included in the original survey took children to year 2 only, and whilst we endeavoured to recruit the new junior schools that these children subsequently attended in the 3rd year, these larger junior schools would not have been involved in the NSFS,

and may have been less committed to taking part in, or achieving good response rates for, our study. The lower response in 2005 was similar between intervention and control areas, and respondents in 2005 had a similar socio-economic profile to those in 2003 and 2004. However, we cannot exclude the possibility that parents of children who consumed more fruit and vegetables may be more likely to respond to repeated questionnaires, and this may have contributed in part to the increase in intake in Year 3 in the control group. This response bias is likely to be non-differential between the intervention and control groups, and therefore unlikely to have had an appreciable effect on the validity of our results. An alternative explanation for the increase in fruit consumption in the control group in 2005 may be a consequence of the higher socio-economic status of the total control population compared with those who participated in the NSFS, which resulted in the continuation of the increase in daily fruit intake in Year 3 seen in earlier years. We attempted to avoid potential bias arising from parents being aware of the intervention that we were evaluating by telling them only that they were taking part in a survey of 'health and diet'. However, if some parents were unaware of the fruit eaten by their children in school, our estimates of the effect of the fruit in schools scheme on consumption may have been conservative. In addition, we are unable to exclude the possibility that an increased awareness of their children's fruit intake by parents in East Midlands (the intervention region) may have resulted in a higher reported fruit intake that did not reflect reality and thus introduced bias to our observations.

One of the potential limitations of this study is that our estimates of children's fruit intake are based on parental responses to a simple questionnaire, rather than a more direct measure of dietary intake. However, parentally completed food frequency questionnaires have been shown to provide reasonably accurate estimates of fruit intake in children of this age,¹⁶ and the average fruit intake at baseline in our study was comparable with that reported in national UK surveys of children aged 5–7 years,¹⁴ although we have not specifically validated our two simple questions assessing frequency and quantity of fruit intake. It is likely that aspects of the implementation of the scheme, and the range of fruit on offer, will have differed between schools in the intervention region, and we have no data on the implementation of the NSFS in individual schools to establish whether such differences affected intake. In addition, a differential in local policies involving either fruit distribution schemes or healthy eating health promotion programmes between the intervention and control regions would be an alternative explanation for our data, particularly the increase in fruit intake observed in the control region in 2005 after the children have become ineligible for the NSFS. However, having contacted the authorities responsible for the implementation of the NSFS in the control region, we are not aware of the presence of any additional local fruit supplementation initiatives after the introduction of the NSFS.

Comparison with other interventions

This is a pragmatic study that evaluated a practical intervention in regional populations, and was able to ascertain the efficacy

of a public health intervention on fruit intake, outside the relative constraints that can accompany a more formal clinical trial. While there have been studies assessing a variety of interventions aimed at modifying diet in school children in the context of an experimental intervention, these have tended to be relatively small,^{17–23} and very few of these have prospectively assessed the impact of a dietary intervention that involved young children aged 5–7 years, an age at which dietary preferences may be developing. A cross-sectional evaluation of the NSFS using a 24 h recall food tick list demonstrated that daily median fruit consumption was 117 g in infants attending participating schools compared with 67 g for infants in control schools, with no effect seen in older children who had participated in the pilot stages of the NSFS and subsequently stopped receiving free fruit at school.²⁴ In the United States, the Eat Well and Keep Moving Program assessed a school-based interdisciplinary health behaviour programme among children aged 9–10 years that used a classroom based intervention aimed at improving diet and physical activity.²⁵ While 24 h recall measures indicated an increase in daily fruit and vegetable intake of approximately 0.73 servings, no effect was observed using food frequency measures or repeated cross-sectional surveys. The Cafeteria Power Plus project promoted the choice of fruit and vegetables at lunch time for children aged 5–8 years from 26 schools²⁶ by making these foods available and attractive in the cafeteria in conjunction with special events such as challenge weeks. This initiative resulted in an increase in fruit intake of 0.16 portions of fruit at lunchtime. However, a similar intervention in 9 to 10-year-old children from 20 schools improved fruit intake by 0.62 servings per day as assessed by 24 h recall with follow up 1–3 months after the intervention had ceased.²⁷ A study from the United Kingdom of an intervention in 7 to 11-year-old children in 10 primary schools incorporating teacher training, modification of school meals, school action plans targeting the curriculum, physical education, tuck shops and playground activities demonstrated an increase in vegetable consumption of 0.3 portions/day as assessed by 24 h recall but not when using a 3-day food diary, and had no impact on fruit intake.²⁸

A recent report from Norway evaluated the lasting impact of providing free fruit at school to 517 children with a mean age of 11 years alongside an educational programme in 9 intervention and 10 control schools. They reported that one year after the intervention had ended, the children from the intervention schools were taking 0.6 daily portions of fruit more than the controls, an effect partly explained by increased participation rates in a subscription programme that provided daily fruit at school.²⁹

Interpretation of results

The fact that our evaluation of a population based dietary intervention identified substantial increases in fruit intake suggests that a practical approach that simply provides nutritious food directly to young children is an effective means of promoting a healthier diet. The daily cost of the scheme was estimated by the UK Department of Health to be ~£0.10 per child (US\$0.20), which equates to an annual cost of approximately £20 (US\$40) per child. Such an intervention may need to be made available to a wider age range of children than just those aged 5–7 years to produce a persistent increase in fruit intake, as we have shown that the dietary benefits only last for the duration of the intervention. In addition, as this intervention also has an impact in relatively more deprived individuals, and low fruit intake is one of the lifestyle factors that may contribute to the health inequalities between different sectors of society, providing free fruit to children via the schools has the potential to reduce socio-economic gradients in health.³⁰

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Conflict of interest: Lindsey Davies, Nick Salfield and Ann Goodwin are employed by the Department of Health, and are involved in the coordination of the National Schools Fruit Scheme. There are no other potential conflicts of interest.

KEY MESSAGES

- Giving a daily piece of fruit to young children increases their weekly fruit intake.
- There is no lasting effect on the young children's fruit intake after they cease to receive free fruit at school.
- To have a lasting impact on young children's diet, it is likely that free fruit at school should be provided for longer than 1 year.

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