Can school fruit tuck shops increase children's fruit consumption? A cluster randomised controlled trial.

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Abstract

Background: The aim of the study was to examine the impact of school fruit tuck shops on children's consumption of fruit and other sweet and savoury snacks.

Methods: The study employed a cluster randomised design with school as the unit of analysis. Forty-three primary schools in south Wales and south-west England were randomly assigned to an intervention or control condition. Intervention schools were asked to operate fruit tuck shops throughout the academic year. Consumption of fruit and other snacks were assessed using a computerised single-day 24-hour recall procedure and a brief questionnaire. Data were collected from children in years 5 and 6 (aged 9-11). For the recall measure, data were obtained from 1902 children at baseline and 1924 children at follow-up. For the questionnaire measure, data were obtained from 1976 children at follow-up. Tuck shop sales were also recorded throughout the year. Data were analysed using school level regression analysis and random effects logistic regression.

Results: Children in intervention schools more likely to report eating fruit as a snack at school 'often' (odds ratio 1.49 (95% confidence interval 1.15, 1.95)). It is estimated that 70,000 fruits were sold in the 23 intervention schools over the year, equivalent to approximately 0.06 fruits per student per day. The recall measure suggested a small increase in children's fruit intake at school (+0.06 portions (-0.10, 0.21)), but this was not statistically significant. There were no significant differences in children's intake of other snacks. For fruit consumed at school there was a significant interaction ($p<0.02$) between intervention group and school food policy with a greater effect found in schools with a policy that restricted food items that students were allowed to bring to school to 'fruit only' (+0.37 portions (0.11, 0.64)) or 'no food' (+0.14 portions (-0.30, 0.58)) compared to that among those with no food restrictions (-0.13 portions (-0.33, 0.07)).

Conclusions: The results suggest that, when used in isolation, the tuck shops were not effective in bringing about substantial changes to children's diets. However, impact was greater where tuckshops were introduced in schools with policies restricting the types of foods students were allowed to bring to school for consumption at morning break.

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Background

In recent years there has been increasing concern about the diets of British school children. Research shows that many children consume large amounts of sugar, salt and saturated fats, whilst very few achieve the recommended intake of fruit and vegetables [1]. These dietary habits are associated with a wide variety of health problems, including cardiovascular disease, stroke, cancer and diabetes [2, 3, 4, 5, 6]. UK death rates from coronary disease are now among the highest in the world [7] and it is likely that the incidence of childhood type 2 diabetes will become increasingly common [8]. As part of an attempt to reverse these trends, the UK government has introduced a number of measures aimed at improving children's diets, including the introduction of initiatives designed to increase consumption of fruit and vegetables [9].

In some instances, good quality fruit and vegetables are simply not readily available. For example, many school canteens provide only limited amounts of fruit and salad [10] and cooked vegetables may be poorly prepared [11]. Those on low incomes also tend to have limited access to affordable, healthy foods [12]. This can be the result of poor local food facilities together with difficulties reaching supermarkets and other shops because of a lack of transport. Thus many government initiatives are based on the assumption that low levels of fruit and vegetable consumption are in part due to a lack of availability or affordability and that if these issues are addressed, increases in consumption will follow. Such initiatives have included the introduction of nutritional standards for food provided in schools [13] and the provision of free fruit for 4-7 year olds [14].

The view that fruit and vegetable consumption is partially dictated by availability is consistent with the fact that those on low incomes, who lack easy access to these foods, tend

to have poorer diets [12, 14]. A number of studies have also shown that availability of fruit and vegetables predicts, or is positively associated with, levels of consumption [15, 16, 17, 18, 19, 20, 21]. However, it is possible that such associations reflect other variables. For example, a group's preference for a particular food may independently influence both their consumption and, via demand, levels of availability in their homes, schools and local shops. Thus it is unclear from these studies whether increasing the availability of fruit and vegetables would in fact lead to increases in consumption. To make such a claim, experimental data are required.

Unfortunately, very little experimental research has examined the impact of fruit and vegetable availability on consumption. The evaluation of intervention programmes aimed at increasing consumption usually employ experimental study designs. However, these tend to include availability as just one of a number of different intervention components and do not assess its effects separately [22; 23; 24; 25; 26, 27]. Thus, where these interventions have been successful, it has been unclear to what extent, if any, this was due to increased availability.

A limited number of studies have directly examined the effects of increased fruit and vegetable availability on consumption and the results of some of these have been promising. In Denmark, primary schools piloted a fruit 'subscription' scheme whereby 6-10 year olds whose parents subscribed to the scheme were provided with one portion of fruit or vegetables each day. Research showed that five weeks after the introduction of the scheme, fruit consumption had increased by 0.4 pieces per school day among children who subscribed and by 0.3 pieces among non-subscribers [28]. In Norway, where schoolchildren have been provided with free fruit and vegetables, research has also shown increases in consumption [29, 30, 31]. Three years after the introduction of this scheme, estimated increases in consumption were 0.38 portions per day for boys and 0.44 portions per day for girls [31].

Likewise, research carried out in a North American office cafeteria showed that over a 3 week period, increases in the availability of fruit and salad options, coupled with a reduction in the prices of these items, resulted in significant sales increases for these foods [32].

However, other studies examining the long term effects of increased availability of healthy foods have not been as positive. In English secondary schools, increasing the availability of healthy foods at lunchtime did not have significant, sustained effects on consumption of these foods when assessed over a 2 year period [33]. In primary schools, provision of free fruit resulted in no increases in consumption after 20 months [34]. And in American middle schools, provision of low-fat foods in school food outlets (combined with a limited amount of promotion) had no effect on fat intake when it was measured two years after the introduction of the changes [35]. Thus there are a very limited number of studies that have assessed the long term effects of increasing the availability of healthy foods in schools and the findings from these have been contradictory.

In addition, we know little about the mechanisms by which food availability impacts upon consumption. In some instances, it may be that consumption levels are restricted by a lack of availability and thus by increasing availability one simply removes this barrier. However, it is also possible that availability influences consumption via other variables such as group norms and preferences. For example, the peer group exerts a substantial amount of influence on children's behaviour [36]. In particular, there is evidence to show that if children observe a peer eating a food, they are more likely to do so themselves [37, 38, 39]. There is also evidence to show that the repeated tasting of particular foods ('taste exposure') leads to increased preference for those foods [40, 41, 42, 43, 44, 45]. This is important since food preferences predict consumption [16, 46]. Thus although increasing fruit and vegetable availability within the school environment might initially only raise consumption amongst a

minority of children, it is possible that such changes would eventually occur amongst other children due to processes of peer influence and taste exposure.

The present study examines the impact of school fruit tuck shops on children's diets. Fruit tuck shops can be an effective way of making fruit readily available to children. They require limited investment from government and are a relatively low-maintenance and sustainable initiative for schools. For these reasons, they are becoming increasingly popular as part of a drive towards healthy eating [47]. However, to date their efficacy in terms of dietary change has not been examined. The present study employs a randomised controlled trial design to examine their impact on children's consumption of both fruit and other sweet and savoury snacks. Consumption of these foods was assessed at school 9 months after the introduction of the tuck shops in relation to two time periods; the school day and the entire day. Although the tuck shops were introduced to the whole primary school (5-11 years), due to the difficulties associated with obtaining accurate dietary information from young children [48], consumption measures were taken with children aged 9-11 years only. Questionnaire measures of children's fruit consumption, peer group norms regarding fruit, and preference for fruit were also taken at follow-up. In addition, intervention schools were asked to keep a weekly record of fruit tuck shop sales.

Method

Participants and recruitment

Two-hundred and fifty-five primary and junior schools in eight local education authorities in south-west England and south Wales were identified as having a free school meal entitlement higher than the national average of 17%. These schools were contacted regarding tuck shop provision. If there was an existing tuck shop, selling any type of food, the school was excluded. The remaining 142 schools were asked if they would be willing to participate in the

study, bearing in mind that there was a 50% chance that they would be randomised to the control condition. Forty-three schools agreed to participate and were each promised a £50 donation on completion of the study to compensate for disruption to school activities. Prior to the study, letters were sent to parents informing them of the research and giving them the opportunity to withdraw their child from the data collection. Figure 1 shows that flow of schools and students through the study.

INSERT FIGURE 1 HERE

Sample size

Previous research indicated that primary school children in low income areas of south-west England consumed an average of 0.75 portions of fruit per day [49]. Assuming an average of 50 children per school, and intra-cluster correlations within schools of 0.02, a power calculation indicated that a sample size of 42 schools would provide 80% power to detect a 25% difference in fruit consumption between intervention and control schools.

Randomisation

After all 43 schools had been recruited, they were randomised to control and experimental groups using a minimisation strategy relating to the following variables; school size (above or below 40 children in year 6), country (England or Wales), existing policy on snacks at morning break (no food, fruit only or no restrictions) and expressed preference for allocation (preference for control, preference for intervention or no preference). Given the nature of the intervention, teachers , children and researchers were not blind to group allocation.

Measures

The primary outcome measure was consumption of fruit and other sweet and savoury snacks, assessed using a single-day computerised 24-hour recall questionnaire completed by children.

Previous research indicated that this measure showed acceptable levels of validity, reliability and sensitivity [49]. The questionnaire recorded the number of servings of i) fruit, ii) sweets, chocolate, biscuits, and iii) crisps consumed during the previous 24-hour period. For each of these three food types, two measures were computed; the number of servings consumed at school and the number of servings consumed throughout the whole day. All intervention schools were also asked to keep a weekly record of fruit tuck shop sales throughout the 9 month period.

Secondary outcomes were collected at follow-up only, using a brief pencil and paper questionnaire. These assessed whether the tuck shops influenced children's preference for fruit and their peer group norms regarding fruit. This questionnaire was also used as a means of identifying any small changes in fruit consumption that the computerised questionnaire may not have been sensitive enough to detect. Prior to its use, the questionnaire was piloted in a primary school that was not involved in the study and the final version of the questionnaire consisted of a series of closed questions to which children responded with one of two or three alternatives (see Results section).

Procedure

The computerised questionnaire was administered prior to the introduction of the tuck shops in the intervention schools (summer term, 1999) and at follow-up, 12 months later. The brief questionnaire was administered at follow-up only. On both occasions, one class of Year 5 children and one class of Year 6 children were randomly selected from each school to complete the questionnaire(s). Thus the study employed a repeated cross-section design, although many of the Year 5 children who provided data at baseline were re-surveyed at follow-up. On data collection days, laptop computers were set up in each school and children participated in groups of four to five. Two researchers were present to assist with any difficulties they had.

Throughout the study, both intervention and control schools were asked to continue with their existing curriculum and school meal arrangements. Intervention schools set up tuck shops that were not subsidised in any way, although some support and advice was available to schools from a project support officer. Schools were asked to offer a choice of fruit in the tuck shop, to price each item at 15 pence and to refrain from stocking sweets, crisps and other items as alternatives. Other than this, schools were relatively free to choose how they operated the tuck shop and this resulted in a variety of different approaches (Moe et al., 2001).

Data analysis

Primary outcomes were analysed using school level regression analysis. For each of the 6 outcomes, the baseline measure for each school was used as a covariate, in addition to the four minimisation variables. Models were estimated using weights calculated according to the formula described by Donner and Klar [50]. Secondary outcomes only collected at follow-up were analysed using random effects logistic regression [51]. Items with three alternative responses were dichotomised and the four minimisation variables were included as covariates.

Results

Computerised questionnaire measure

A total of 1902 children completed the questionnaire at baseline. However, 12 children did not provide complete data, and a further 258 were excluded as they reported eating over 8 servings of fruit [49]. This left a total of 1632 children; 918 in the 23 intervention schools and 714 in the 20 control schools (see Figure 1). Baseline characteristics were evenly distributed between the control and intervention groups (Table 1).

INSERT TABLE 1 HERE

A total of 1924 children completed the questionnaire at follow-up, of which 1612 were included in analysis; 921 intervention students and 691 control (see Figure 1). Reported levels of fruit and snack intake at follow-up are displayed in Table 2. These showed that in the intervention schools, children consumed an average of 0.74 servings of fruit at school and 2.54 servings throughout the whole 24 hour period. In the control schools, children consumed an average of 0.69 servings of fruit at school, and 2.51 servings throughout the whole 24 hour period. Consumption of other snacks was also similar across the intervention and control schools. For example, at school, children in the intervention schools consumed an average of 1.12 servings of sweets, chocolate and biscuits and 0.80 servings of crisps, whilst in the control schools they consumed an average of 1.01 servings of sweets, chocolate and biscuits and 0.68 servings of crisps.

INSERT TABLE 2 HERE

The results of the school-level regression models are shown in Table 3. For all six outcomes the intervention effect estimates were near zero, and the 95% confidence intervals were distributed fairly symmetrically over the null effect. Thus overall, the tuck shops had no effect on children's consumption of fruit or other snacks. It is also important to note that the confidence intervals were not wide (generally 0.3 serving), indicating that the absence of a statistically significant effect was not due to a lack of power.

INSERT TABLE 3 HERE

The data were then tested for interactions with school policy. Of the 6 analyses conducted there was a significant interaction effect only for fruit consumed at school, $F(2, 32) = 4.55$,

p<.02. In this model, estimates of the difference in fruit consumption between intervention and control school students were 0.37 portions (95% CI: 0.11, 0.64) greater consumption among schools with a fruit only policy; 0.14 (-0.30, 0.58) with a no food policy, and -0.13 (-0.33, 0.07), that is 0.13 fewer portions in those with no restrictions on food brought to school.

Fruit tuck shop sales

For many schools, the maintenance of the tuck shop sales records proved to be more onerous than the operation of the tuck shops themselves. In these cases, frequent reminders were required to obtain records, and the quality of the data received from schools was questionable. It was decided that the continued cooperation of schools (and operation of tuck shops) should not be jeopardised by strict enforcement of the quality and timeliness of the weekly sales record data. Thus, a detailed analysis of the sales data was not undertaken. Over the 23 schools, there were 5,600 students on the school rolls, which over an academic year totals approximately 1.1 million student school days. Fruit sales over the year in the 23 intervention schools were estimated to have been in the region of 70,000 fruits. This is the equivalent of 0.06 fruits per student per day, which in turn equates to approximately 1 in 4 children eating 1 piece of fruit per week, or 1 in 17 eating fruit every day. In general, fruit sales were highest in the first term of operation (Autumn term, 1999) and then declined, both as the Autumn term progressed, and during the spring and summer terms. By the end of the summer term, four out of the 23 tuck shops were permanently or temporarily closed.

Brief questionnaire measure

The brief questionnaire was completed by 1976 children. Table 4 shows the odds-ratios from the random effects regression models for the association between intervention group and a positive response to each question.

INSERT TABLE 4 HERE

Table 4 indicates that, with the exception of the final item, children in schools with fruit tuck shops were more likely to give positive responses to the items on the questionnaire. In relation to fruit consumption, children in intervention schools were significantly more likely to state that they would use a tuck shop ($p<.002$) and were significantly more likely to state that they often ate fruit as a snack at school ($p<.005$). They were also more likely to state that most of their friends ate fruit, but this was not statistically significant at conventional levels (i.e. $p<.05$). However, they were not more likely to choose fruit rather than chocolate or crisps as a snack at playtime, nor were they more likely to eat fruit as a snack at home. In relation to measures of preference for fruit and group norms relating to fruit, there was no evidence to indicate that children in the intervention schools were more likely to enjoy the taste of fruit or that they were more likely to think that it was cool to eat fruit. However, as described above, there was some evidence to indicate that children in intervention schools were more likely to state that most of their friends ate fruit.

The data were then tested for one interaction, which was that between the fruit tuck shop intervention and school food policy. Of the 7 analyses conducted results showed a significant effect for question 6 ('How many of your friends eat fruit?'), $chi2(2) = 9.99$, $p<.01$. Consistent with predictions, odds ratios for tuckshop versus no tuckshop schools were higher for those with a no food policy (4.44, 95% CI: 1.96, 10.0)) or a fruit only policy (1.35, 95% CI: 0.82, 2.23) compared to those with no food restrictions (1.05, 95% CI: 0.75, 1.47). For question 2 ('Do you eat fruit as a snack at school?') although the interaction test was less significant, $chi2(2) = 3.87$, $p = 0.14$, the same pattern was apparent with odds ratios for the intervention effect higher among schools with a no food policy (2.41, 95% CI: 1.12, 5.19)) or

a fruit only policy (1.89, 95% CI: 1.19, 3.01)) compared to those with no food restrictions (1.21, 95% CI: 0.88, 1.67).

Discussion

The present study examined the impact of a school fruit tuck shop scheme on the diets of children aged 9-11 years. The cost of the scheme was kept to a minimum and care was taken to ensure that the tuck shops were representative of the kind that could feasibly be operated in any primary school. For these reasons, the research is directly relevant to large-scale attempts to employ fruit tuck shops as a means of improving children's diet. The use of a randomised controlled trial design also ensured that the study provided an unbiased estimate of the intervention effect [52].

Self-reported measures of consumption were taken approximately 9 months after the introduction of the tuck shops using a 24-hour recall procedure. These showed that, overall, the tuck shops had no effect on children's consumption of fruit, sweets, chocolate, biscuits and crisps. However, this measure was designed to identify substantial changes in consumption and would not have been sensitive enough to detect smaller changes that may have occurred on an irregular basis or amongst a minority of children [49]. The questionnaire data found a statistically significant effect across all schools on children reporting that they often ate fruit as a snack at school. These findings combined are consistent with the tuck shop sales data which equated to approximately 1 in 4 children purchasing 1 piece of fruit a week, or 1 in 17 children buying fruit every day.

Further analysis of the data revealed a significant interaction between intervention condition and school food policy. That is, in schools with a 'no food' or 'fruit only' policy the fruit tuck shop intervention had a greater impact than in schools with no restrictions. This was

apparent for fruit intake at school measured both by the computerised and paper questionnaires, and awareness of friends' regular consumption of fruit. Thus overall, the findings indicate that, when introduced in isolation, the tuck shops were likely to have had a limited impact on fruit consumption at school. However, when employed in conjunction with appropriate school policies their impact was more significant.

Similarly fruit only policies, in isolation, have not been found to increase children's consumption of fruit [49, 53], although restriction of foods allowed in school has been found to be associated with reduced consumption of foods high in fats and sugars [49, 54]. Together these results suggest that where children and their friends are not allowed to bring unhealthy snacks to school, their willingness to utilise the fruit tuck shops and eat fruit as a snack in school is greatly enhanced. These results highlight the importance of supporting school health interventions with appropriate school policies and provide further evidence of the potential effectiveness of 'whole school' or multi-component approaches to school-based health intervention (e.g., see [55, 56]).

Finally, an important aspect of the present study is that it demonstrated that it is feasible for schools to set up and operate fruit tuck shops without major disruption to the school routine. They also had wider benefits such as improved money transaction skills amongst children, a source of data for maths and science projects and stronger links with parents [47].

Conclusions

Although the research indicated that fruit tuck shops were not effective in bringing about substantial changes to children's diets, the data suggest that they did have a small positive impact on fruit consumption at school, and could be effective when used in conjunction with food restriction policies. In addition, tuck shops represent a cost-effective way of introducing

additional fruit into the school. Given that good quality fruit is frequently not available in schools, and that fruit availability is clearly a necessary condition for increased consumption, it seems likely that fruit tuck shops could be a valuable component of other interventions aimed at improving children's diets.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

LM was responsible for the study design, data analysis and overall coordination of the project. He also helped revise the manuscript. KT drafted the manuscript and both authors read and approved the final version.

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Figure 1. Flow of schools and students through the study.

Table 1

Baseline school and student characteristics and reported levels of fruit and snack intake.

	Intervention	Control
School location:	N (%)	N (%)
England	496 (54.0)	423 (59.2)
Wales	422 (46.0)	291 (40.8)
School food policy:		
No food	97 (10.6)	76 (10.6)
Fruit only	235 (25.6)	216 (30.3)
No restrictions	586 (63.8)	422 (59.1)
School size:		
<40 students in Year 6	509 (55.4)	355 (49.7)
>40 students in Year 6	409 (44.6)	359 (50.3)
Sex:		
Boys	456 (49.7)	339 (47.5)
Girls	462 (50.3)	375 (52.5)
Servings consumed at school:	Mean (median)	Mean (median)
Fruit	0.62 (0)	0.68 (0)
Sweets, chocolate, biscuits	1.14 (1)	1.09 (1)
Crisps	0.73 (1)	0.67 (1)
Servings consumed in 24 hours:		
Fruit	2.48 (2)	2.50 (2)
Sweets, chocolate, biscuits	3.98 (3)	3.68 (3)
Crisps	1.53 (1)	1.41 (1)

Table 2

Reported levels of fruit and snack intake in intervention and control schools at follow-up.

	Intervention Mean (median)	Control Mean (median)
Portions consumed at school:		
Fruit	0.74 (0)	0.69 (0)
Sweets, chocolate, biscuits	1.12 (1)	1.01 (1)
Crisps	0.80 (1)	0.68 (1)
Portions consumed in 24 hours:		
Fruit	2.54 (2)	2.51 (2)
Sweets, chocolate, biscuits	3.95 (3)	3.81 (3)
Crisps	1.60 (1)	1.45 (1)

Table 3

Multivariable models of fruit and snack consumption in schools (n=43) at follow-up (95% confidence intervals).

	Fruit	SCB[a]	Crisps
Portions consumed at school			
Intervention vs. control	+0.057	-0.116	-0.047
	(-0.100, 0.213)	(-0.289, 0.056)	(-0.153, 0.060)
Baseline consumption	+0.330	+0.684	+1.062
	(-0.086, 0.746)	(0.403, 0.966)	(0.804, 1.319)
Wales vs. England	-0.127	-0.009	+0.001
	(-0.029, 0.283)	(-0.189, 0.165)	(-0.104, 0.106)
Large vs. small	+0.033	+0.076	-0.012
	(-0.130, 0.196)	(-0.108, 0.260)	(-0.098, 0.122)
Fruit only vs. no food	-0.029	-0.211	+0.030
	(-0.212, 0.154)	(-0.418, -0.004)	(-0.124, 0.183)
No restrictions vs. no food	+0.016	-0.005	-0.024
	(-0.247, 0.279)	(-0.307, 0.297)	(-0.219, 0.171)
Portions consumed in 24 hours			
Intervention vs. control	+0.089	-0.137	-0.036
	(-0.199, 0.377)	(-0.527, 0.255)	(-0.249, 0.177)
Baseline consumption	+0.372	+0.064	+0.624
	(0.053, 0.691)	(-0.223, 0.351)	(0.264, 0.984)
Wales vs. England	+0.304	-0.038	+0.206
	(0.018, 0.590)	(-0.423, 0.348)	(-0.006, 0.418)

Large vs. small	+0.114	-0.084	-0.053
	(-0.183, 0.411)	(-0.493, 0.325)	(-0.274, 0.168)
Fruit only vs. no food	+0.097	-0.113	-0.153
	(-0.236, 0.431)	(-0.562, 0.335)	(-0.417, 0.111)
No restrictions vs. no food	-0.062	+0.163	-0.160
	(-0.513, 0.389)	(-0.456, 0.783)	(-0.522, 0.203)

[a]Sweets, chocolate and biscuits

Table 4

Children's responses to the brief questionnaire in intervention versus control schools

Item	Odds-ratio (95% confidence interval)	p-value (Wald test)
1. Would you use a tuck shop at your school?	2.00	0.002
Yes vs. no	(1.28, 3.12)	
2. Do you eat fruit as a snack at school?	1.49	0.003
Often vs. sometimes or not at all	(1.15, 1.95)	
3. What would you choose for a snack at playtime?	1.22	0.278
Fruit vs. chocolate or crisps	(0.85, 1.76)	
4. Do you eat fruit as a snack at home?	1.10	0.415
Often vs. sometimes or not at all	(0.87, 1.39)	
5. Do you like the taste of fruit?	1.01	0.893
A lot vs. a little or no	(0.83, 1.25)	
6. How many of your friends eat fruit?	1.33	0.056
Most vs. some or none	(0.99, 1.78)	
7. Do you think it is cool to eat fruit?	0.95	0.709
Yes vs. no	(0.71, 1.26)	