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Increasing children's lunchtime consumption of fruit and vegetables: an evaluation of the Food Dudes programme

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Abstract

Objectives: Although previous research has shown that the Food Dudes programme increases children's fruit and vegetable consumption at school, there has been limited evaluation of the extent to which changes are maintained in the long term. Furthermore, despite knowledge that the nutritional content of home-supplied meals is lower than that of school-supplied meals, little consideration has been given to the programme's impact on meals provided from home. The present study therefore assessed the long-term effectiveness of the Food Dudes programme for both school- and home-supplied lunches.
Design: Two cohorts of children participated, one receiving the Food Dudes intervention and a matched control group who did not receive any intervention. Consumption of fruit and vegetables was assessed pre-intervention, then at 3 and 12 months post-intervention. Consumption was measured across five consecutive days in each school using weighed intake (school-provided meals) and digital photography (home-provided meals).
Setting: Fifteen primary schools, six intervention (*n* 1282) and seven control schools (*n* 1151).
Subjects: Participants were children aged 4–11 years.
Results: A significant increase in the consumption of fruit and vegetables was found at 3 months for children in the intervention schools, but only for those eating school-supplied lunches. However, increases were not maintained at 12 months.
Conclusions: The Food Dudes programme has a limited effect in producing even short-term changes in children's fruit and vegetable consumption at lunchtime. Further development work is required to ensure the short- and long-term effectiveness of interventions promoting fruit and vegetable consumption in children such as the Food Dudes programme.

Keywords
Child
Fruit
Health behaviour
Vegetables

The health-related benefits of eating a diet rich in fruit and vegetables are well documented. Evidence suggests that increased fruit and vegetable consumption significantly reduces the risk of CVD and stroke[1–4] and offers protective effects against some forms of adult cancer[5,6]. Despite the positive health outcomes associated with consuming fruit and vegetables and recommendations that children over 2 years of age should consume five portions of fruit and vegetables daily, most children in the UK fail to meet recommended levels of intake[7]. Since evidence from longitudinal studies suggests that food preferences established in childhood and adolescence are likely to persist into adulthood[8–10], it is clear that interventions to increase children's consumption of fruit and vegetables would be beneficial.

As children spend a large proportion of their time in school, the school environment is a logical setting for targeting nutrition behaviours. Interventions to promote fruit and vegetable consumption in the school environment are varied in their approach and effectiveness. However, three strategies that have been shown to have a reliable effect on children's fruit and vegetable consumption are taste exposure, peer modelling and rewards[11]. One evidence-based intervention which incorporates these three core principles is the Food Dudes[12]. This programme is aimed at primary-school children and is designed to increase consumption of fruit and vegetables both at school and at home. The programme also aims to help children develop a liking for fruit and vegetables, reduce their snack consumption, think of themselves as healthy eaters and establish a whole-school healthy eating culture[13].

Research has suggested that the Food Dudes programme is effective in producing increases in children's fruit and vegetable consumption at school[14–19] and at home[14,15]. Evidence also suggests that the programme encourages an increased liking for fruit and vegetables[14]. However, only one evaluation study[16] has investigated the impact of the intervention beyond a 6-month follow-up; thus the

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effectiveness of the programme in facilitating long-term behaviour change is unclear. Furthermore, UK studies of lunchtime consumption have focused mainly upon school-supplied meals, neglecting those supplied from home. It is known that the nutritional content of packed lunches is far lower than that of school-supplied meals[20], containing only half the recommended amount of fruit and vegetables[21]. It is therefore important that the effectiveness of the Food Dudes programme in increasing fruit and vegetable consumption for all children, including those eating home-supplied lunches, is established.

The aims of the present study were therefore twofold: first, to investigate the effectiveness of the Food Dudes programme in increasing primary-school children's fruit and vegetable consumption for both home- and school-supplied meals; and second, to establish the extent to which the programme is able to influence long-term maintenance (12 months post-intervention) of any behaviour changes which were observed.

Experimental methods

Design

A between-group analysis was conducted of two cohorts of children participating in the study; one receiving the Food Dudes intervention and a matched control group who did not receive the intervention. The impact of the Food Dudes programme on fruit and vegetable consumption was assessed at baseline (prior to the intervention), at 3-month follow-up (post-intervention) and at 12-month follow-up.

Participants

The programme was evaluated in fifteen primary schools in the West Midlands, predominantly in areas of high deprivation. Participants were 2433 children aged 4–11 years, 1282 in the intervention schools (690 boys and 592 girls) and 1151 in the control schools (596 boys and 555 girls). Power calculations, using G Power, were computed to determine necessary sample size. Intervention schools were selected by the local health authority and control schools matched as far as possible in terms of school size, proportion of children entitled to free school meals and proportion of children from ethnic minorities. Characteristics of the study sample are shown in Table 1.

Food Dudes intervention

The Food Dudes programme consists of an initial 16 d intervention phase during which children watch a series of DVD episodes of the Food Dudes' adventures. The Food Dudes are four super-heroes who gain special powers by eating their favourite fruit and vegetables that help them maintain the life force in their quest to defeat General Junk and the Junk Punks. The Dudes encourage children to 'keep the life force strong' by eating fruit and vegetables every day. Class teachers also read letters to the children from the Food Dudes to reinforce the DVD messages. During the first four days of the intervention, children are given rewards for tasting both the target fruit and vegetables and then for consuming both foods for the remaining 12 d. Following the intervention, a maintenance phase is implemented during which fruit and vegetable consumption is encouraged, but with less intensity than the intervention phase (a full description of the rationale behind the intervention and details of the Food Dudes programme is given elsewhere[14]).

Procedure

The same procedure was employed in both the intervention and control schools at each study phase and measures were recorded across five consecutive days in each school. As the study employed an ecological design, no changes were implemented to school practices which could impact upon the everyday experience and choices

Table 1 Demographic characteristics of the study sample: primary-school children aged 4–11 years from fifteen schools, West Midlands, UK

Group	*n*	Boys (*n*)	Girls (*n*)	IMD	Rank (%)	FSM (%)	Ethnic minorities (%)
Intervention							
1	125	64	61	1768	5·44*	40·7	22
2	61	34	27	1217	3·75*	39·0	27
3	149	82	67	7242	22·30	13·2	10
4	167	98	69	3639	11·20	30·5	82
5	49	34	15	1768	5·44*	57·9	14
6	296	148	148	2822	8·69*	25·9	18
7	265	162	103	20 609	63·45	7·8	74
8	209	88	121	20 609	63·45	8·7	71
Control							
9	125	57	68	2528	7·78*	36·6	25
10	188	94	94	3432	10·57	28·0	15
11	104	48	56	8199	25·24	35·8	10
12	284	158	126	26 581	81·83	2·8	10
13	222	128	94	9748	30·01	35·5	80
14	135	67	68	6195	19·07	7·8	51
15	95	46	49	14 977	46·11	14·5	10

IMD, Index of Multiple Deprivation (1 = most deprived, 32 482 = least deprived); FSM, free school meals.
*Schools within 10 % of most deprived areas.

of children, i.e. school lunchtime menus remained as prescribed by the local education authority. However, food standards developed by the School Food Trust[22] require that at least one portion of fruit and one portion of vegetables or salad must be provided per pupil per day, thus ensuring consistency in fruit and vegetable provision both between menus and schools across the UK.

In line with guidelines developed by the Health Promotion Agency[23], a child's portion of fruit or vegetables was defined as 40 g. Control schools remained under baseline conditions during the 16 d intervention phase.

Lunchtime consumption

School-provided lunches

Consumption at lunchtime for children having school-provided meals was assessed using the weighed intake method, the 'gold standard' method for measuring dietary intake[24]. Prior to lunchtime, each child was given a label with his/her identification number, name and class. Due to the time frame of lunchtime service and the number of participants in the study, mean portion size was obtained to provide an accurate measure of dietary intake. Average portions of all fruit and vegetables on the school menu were taken and five weights of each food recorded to obtain a mean weight. At the beginning of the lunchtime period, children's food choices were recorded on a spreadsheet and, once the children had finished their lunch, the weight of any food waste for each child was recorded. The weighing area was located next to the rubbish bin and the return of trays monitored by the research team to ensure that children did not throw away any uneaten food. Salter digital scales were used, accurate to 1 g. The amount of fruit and vegetables consumed was calculated by subtracting the leftover weight from the average portion weight recorded. In cases where a negative value was obtained, it was assumed that the child did not consume that particular food item and a value of zero was reported.

Home-provided lunches

At the start of the day, lunchboxes were labelled with the child's identification number, name and class and a digital photograph taken of lunchbox contents after morning break. Following lunchtime, lunchboxes were collected and a photograph taken of any leftovers. Lunchtime staff instructed children to leave any uneaten food or packaging in their lunchboxes at the end of lunchtime. All rubbish bins were located away from tables to ensure that the children did not throw any food items away and also enabling close monitoring of food disposal by the research team.

The number of portions of fruit, and vegetables consumed was visually estimated on a five-point Likert scale (0, 1/4, 1/2, 3/4, 1) using previously validated guidelines[25]. Inter-rater reliability analysis was performed using correlation to determine consistency among raters. Agreement was calculated for 25 % (n 80) of the study sample at baseline and was found to be excellent ($r(78) = 0{\cdot}98$, $P < 0{\cdot}01$).

Ethical approval

The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the University of Worcester Institute of Health and Society Ethics Committee. Informed consent was obtained from the head teacher at each school. Consent was sought from head teachers acting *in loco parentis*, supplemented by parental 'opt-out' consent whereby children are included in the study unless their parents withdraw them[26].

Data analysis

Mean values were computed for each child to provide an indication of average daily consumption of fruit and vegetables for children who (i) consumed school-supplied lunches and (ii) consumed home-supplied lunches. In cases where children consumed both school- and home-supplied lunches during the same study phase or across study phases, children were classified according to the predominant mode of supply (school or home), with the criterion that children consumed exclusively school- or home-supplied lunches on a minimum of 3 d during each phase. Data were analysed using the statistical software package IBM SPSS Statistics 19·0 and differences in consumption tested using repeated-measures ANOVA. Paired t tests determined the source of any variance and effect sizes, using Cohen's d, were calculated to measure the practical significance of any changes in fruit and vegetable consumption. An α level of 0·05 was used in all statistical analyses.

Results

Description of the study sample

A total of 2433 children participated at baseline, 1696 at 3-month follow-up (30 % attrition from baseline) and 1470 at 12-month follow-up (13 % attrition from the second time point). Two intervention schools only completed the baseline phase for reasons unconnected with the study. The analyses presented are for children from whom data were available on at least three consecutive days and at each time point in the study. A multivariate ANCOVA was undertaken to establish the potential impact of age, sex, ethnicity and Index of Multiple Deprivation on children's fruit and vegetable consumption. Analysis determined that differences were not significant for age ($F(2, 33) = 1{\cdot}05$, $P > 0{\cdot}05$), sex ($F(2, 33) = 5{\cdot}99$, $P > 0{\cdot}05$), ethnicity ($F(2, 33), = 2{\cdot}17$, $P > 0{\cdot}05$) or Index of Multiple Deprivation ($F(2, 33), = 1{\cdot}75$, $P > 0{\cdot}05$).

Lunchtime consumption

School-provided meals

Figure 1 displays lunchtime consumption of fruit and vegetables in the intervention and control schools. Analysis of fruit and vegetable consumption identified a

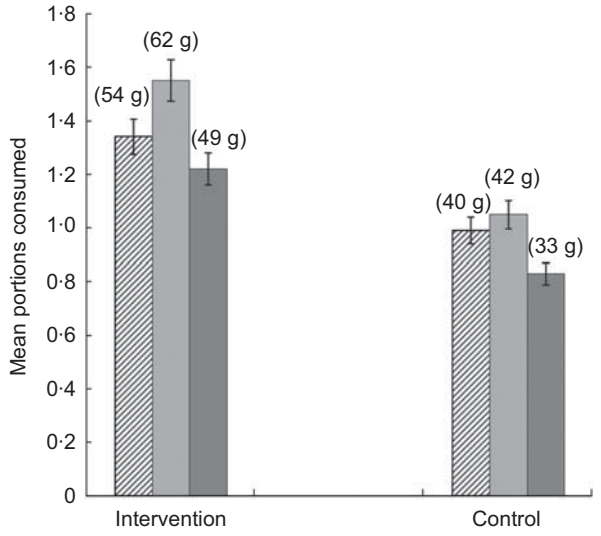

Fig. 1 Portions of fruit and vegetables consumed at lunchtime (amount in grams in parentheses) in the intervention and control schools (school-provided meals) at baseline (▨), 3-month follow-up (▩) and 12-month follow-up (■); primary-school children aged 4–11 years, Food Dudes programme, West Midlands, UK. Values are means with 95 % confidence intervals represented by vertical bars

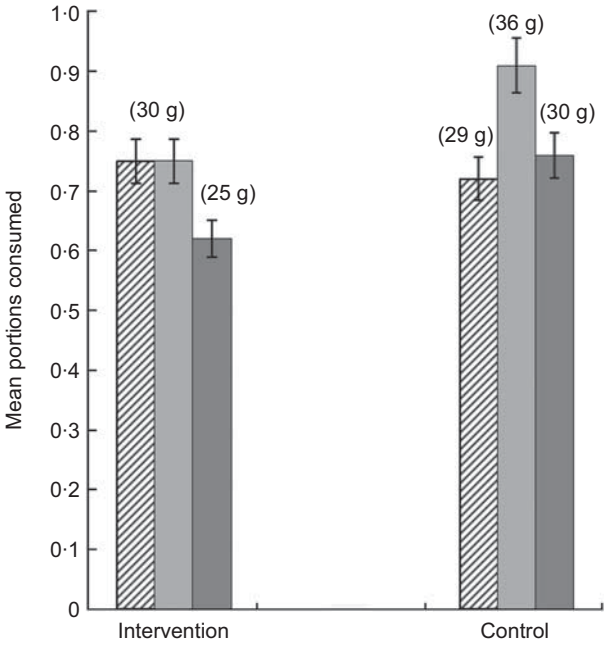

Fig. 2 Portions of fruit and vegetables consumed at lunchtime (amount in grams in parentheses) in the intervention and control schools (home-provided meals) at baseline (▨), 3-month follow-up (▩) and 12-month follow-up (■); primary-school children aged 4–11 years, Food Dudes programme, West Midlands, UK. Values are means with 95 % confidence intervals represented by vertical bars

significant main effect of study phase ($F(2, 519) = 14{\cdot}26$, $P < 0{\cdot}01$, $\eta_p^2 = 0{\cdot}02$) and school setting ($F(1, 519) = 45{\cdot}83$, $P < 0{\cdot}001$, $\eta_p^2 = 0{\cdot}09$). However, there was no significant interaction between study phase and school setting ($F(2, 519) = 1{\cdot}20$, $P > 0{\cdot}05$, $\eta_p^2 = 0{\cdot}005$). Paired-samples t tests demonstrated that fruit and vegetable consumption in the intervention schools was statistically higher at 3-month follow-up than baseline and of small practical significance ($t = -2{\cdot}54$, $P < 0{\cdot}05$, $d = 0{\cdot}26$, 95 % CI $-5{\cdot}39$, $6{\cdot}10$) but not in the control schools ($t = -0{\cdot}97$, $P > 0{\cdot}05$, $d = 0{\cdot}07$, 95 % CI $-4{\cdot}46$, $4{\cdot}01$). A statistically significant decrease was evident in the intervention and control schools at 12-month follow-up but was of greater practical significance for the control group ($t = 1{\cdot}40$, $P < 0{\cdot}05$, $d = -0{\cdot}14$, 95 % CI $-5{\cdot}46$, $5{\cdot}71$ and $t = 2{\cdot}63$, $P < 0{\cdot}05$, $d = -0{\cdot}21$, 95 % CI $-3{\cdot}57$, $3{\cdot}73$, respectively).

Home-provided lunches

Mean portions of fruit and vegetables consumed are shown in Fig. 2. Results of lunchtime fruit and vegetable consumption showed a significant main effect of study phase ($F(2, 343) = 3{\cdot}52$, $P < 0{\cdot}05$, $\eta_p^2 = 0{\cdot}01$) but not school setting ($F(1, 343) = 1{\cdot}52$, $P > 0{\cdot}05$, $\eta_p^2 = 0{\cdot}004$). The interaction between study phase and school setting was also non-significant ($F(2, 343) = 1{\cdot}65$, $P > 0{\cdot}05$, $\eta_p^2 = 0{\cdot}005$), suggesting that changes in consumption over time were not due to school setting (intervention or control). No short-term changes in fruit and vegetable consumption were found in the intervention schools; however, decreases evident at 12-month follow-up were not statistically or practically significant ($t = 1{\cdot}37$, $P > 0{\cdot}05$, $d = -0{\cdot}16$, 95 % CI $-0{\cdot}30$, $0{\cdot}01$). In the control schools, fruit and vegetable consumption was statistically higher at 3-month follow-up compared with baseline, however of small practical significance ($t = -2{\cdot}55$, $P < 0{\cdot}05$, $d = 0{\cdot}26$, 95 % CI $-0{\cdot}12$, $0{\cdot}38$), but not at 12-month follow-up ($t = -0{\cdot}48$, $P > 0{\cdot}05$, $d = 0{\cdot}05$, 95 % CI $-0{\cdot}08$, $0{\cdot}16$; see Table 2).

Discussion

The present study demonstrated that the Food Dudes programme has a limited effect in producing even short-term increases in children's consumption of fruit and vegetables at lunchtime. Although significant increases were found at 3-month follow-up in the intervention but not in the control group for school-provided lunches, the non-significant interaction effect suggests any changes were not the result of the intervention. Likewise, no short-term increases were found in the intervention schools for children who consumed home-provided lunches although significant increases at 3-month follow-up were observed in the control schools. This indicates that children who did not receive the intervention still increased their fruit and vegetable consumption in the short term. Once again this may be explained by the non-significant interaction effect observed for children consuming home-supplied lunches, which suggests that changes in consumption between study phases did not reflect a programme effect. Previous research has

Table 2 Short- and long-term changes in mean portions of fruit and vegetables consumed (grams in parentheses); primary-school children aged 4–11 years, Food Dudes programme, West Midlands, UK

	School provided		Home provided	
	FU_1	FU_2	FU_1	FU_2
Intervention	0·21 (8 g)*	−0·12 (5 g)*	− (±0)	−0·13 (5 g)
Control	0·06 (2 g)	−0·16 (7 g)*	0·19 (7 g)*	0·04 (1 g)

FU_1 = 3-month follow-up − baseline; FU_2 = 12-month follow-up − baseline.
*Significant at $P < 0·05$.

found the programme to be effective in increasing children's lunchtime consumption of fruit and vegetables[14,15,17]; however, this has focused almost exclusively upon school-supplied meals and not those supplied from home. While one study[16] found the intervention to be effective in increasing the consumption of home-supplied fruit and vegetables, the sample size was small (forty-nine children in the intervention and fifty-three in the control group[27]) and thus may have limited power to detect a significant effect. The findings of that study have yet to be replicated and there remains a lack of evidence for the effectiveness of the programme in increasing fruit and vegetable consumption particularly for home-provided meals. In contrast to school-provided meals which are required to conform to food- and nutrition-based standards[22], there is arguably greater potential for variation in the provision of fruit and vegetables for meals provided from home[28]. Consequently, the potential of the programme to change eating behaviours for children consuming home-supplied lunches may be more difficult.

The present findings offer limited support for the role of repeated tasting, peer modelling and rewards alone in producing short- or long-term increases in fruit and vegetable consumption. The development and manifestation of eating behaviours is embedded within a system of influences including intrapersonal (food preferences[29,30]), social (family eating habits[31]) and cultural factors[32], along with aspects of the physical environment such as availability and accessibility[28,33]. Consequently, children's fruit and vegetable consumption is likely to be the result of an interaction between various levels of these ecological systems[34]. Availability is an important factor in determining consumption of fruit and vegetables[35] at school, for both those meals prepared in school and those brought from home. If children are not provided with fruit and vegetables then this will inevitably impact upon their levels of consumption. Indeed, research[28] has found that home availability of fruit and vegetables was associated with increased levels of consumption and suggested that this could be easily manipulated in order to increase children's fruit and vegetable intake. Furthermore, it is important that schools work with parents and children to increase awareness of what constitutes a healthy lunch[21] and educating parents about the nutritional content of home-provided lunches is therefore essential[36]. Collectively, this may enhance the effectiveness of the programme in increasing consumption of fruit and vegetables for children who consume home-provided lunches. Availability of fruit and vegetables is also likely to impact upon consumption of school-provided meals. In each of the schools that participated in the study, it was observed that older children (aged 7–11 years) typically enter the dining hall towards the end of lunchtime service when fruit and vegetables may not always still be available. Caterers should take this factor into account when planning menus and ensure that sufficient portions of fruit and vegetables are available for each child. School policies around healthy eating are also likely to mediate consumption. Recent research[37] identified that schools can effectively impact upon children's eating behaviour by increasing availability of fruit and vegetables; however, the availability of unhealthy foods offered in competition with healthier options undermines this effect. Habit has also been highlighted as a strong predictor of fruit and vegetable consumption in children[33]. In order to facilitate long-term behaviour change, it may be argued that healthy eating behaviours, such as fruit and vegetable consumption, need to become habitual, i.e. behaviour determined by automaticity and executed without awareness[38,39]. Further development of the Food Dudes programme could focus on encouraging habitual intake and take account of the ecological factors that mediate fruit and vegetable consumption. Indeed, the programme is currently being developed further to support the long-term maintenance of consumption.

Comparison between the present findings and those from previous Food Dudes evaluation studies is difficult due to differences in the definition of portion size, particularly regarding lunchtime consumption. For example, a child's portion of fruit and vegetables has been defined as 80 g and 60 g, respectively, which are likely to be larger than appropriate for children of primary school age[14]. Variations in study design also present difficulties. First, previous evaluation studies typically assess the impact of the programme during the 16 d intervention phase[14,16,17]; therefore it is likely that increases in consumption will be more pronounced while the intervention procedures are still in place. Second, existing studies provide an evaluation based upon experimental design rather than an ecological approach as reported here. To maximise the effectiveness of interventions, assessment of intake should be conducted in a way that is ecologically valid, an important consideration within the context of public health. The stringent control evident in the literature[14,15], while necessary to guide intervention development, is not conducive to the eating context of the school setting. The social context of the eating environment can have a large impact on children's behaviour and, given limited attention capacities of children, tightly controlled exposure may result in increased attention on the target stimuli and increased

consumption[40]. This may account for the differences in the findings between the present study and previous evaluations of the programme.

A particular strength of the present study is the use of validated measures of dietary intake. As noted by Klepp *et al.*[41], evaluations of such interventions should be based upon robust measures of dietary intake. Many evaluations of interventions designed to increase children's fruit and vegetable consumption rely on self-report measures, which are clearly limited by the ability of respondents (in this case children) to accurately recall and record consumption. In contrast, the present study used weighed intake of foods, the 'gold standard' assessment tool, to measure consumption of school-provided meals. It was not practical to employ this method for home-supplied lunches, so these were assessed using digital photography, which offers a pragmatic and reliable tool for assessing consumption in the school setting[42]. This method is particularly effective for studies that require rapid acquisition of data and minimal disruption to the eating environment such as the study reported here[43].

Conclusions

The present results offer limited support for the effectiveness of the Food Dudes intervention in increasing the fruit and vegetable consumption of primary-school children. Clearly, further development work is required to ensure both the short- and long-term effectiveness of interventions promoting fruit and vegetable consumption in children such as the Food Dudes programme[44]. The Food Dudes Forever phase of the programme currently underway is one approach that may enhance the short- and long-term effects of the programme on children's eating habits.

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