

ORIGINAL ARTICLE

Increasing parental provision and children's consumption of lunchbox fruit and vegetables in Ireland: the Food Dudes intervention

PJ Horne¹, CA Hardman¹, CF Lowe¹, K Tapper², J Le Noury³, P Madden¹, P Patel¹ and M Doody⁴

¹School of Psychology, Bangor University, Bangor, UK; ²Department of Psychology, Swansea University, Swansea, UK; ³Department of Psychological Medicine, Ysbyty Gwynedd, Bangor, UK and ⁴Child and Family Centre, St Camillus' Hospital, Limerick, Ireland

Background/Objectives: Previous research in the United Kingdom, where there is a school canteen system, has shown that the Food Dudes intervention substantially increases children's fruit and vegetable consumption. The current study evaluated its effectiveness in Ireland where school meals are not provided and children bring food to school in lunchboxes.

Subjects/Methods: Participants were 4- to 11-year-old children attending two primary schools; the schools were randomly assigned to experimental or control conditions ($n=228$ and 207 , respectively). During the 16-day intervention in the experimental school, children watched video adventures featuring the heroic Food Dudes, and received small rewards for eating fruit and vegetables provided. In both schools, parental provision and children's consumption of fruit and vegetables in the lunchboxes were assessed at baseline and 12-month follow-up (Lunchbox measures). Fruit and vegetables were provided in both schools over an 8-day baseline phase and the 16-day intervention, and children's consumption was measured (school-provided food measures).

Results: Relative to baseline, consumption of the school-provided foods increased during the intervention in the experimental school ($P<0.001$), whereas in the control school it showed a significant decline. At 12-month follow-up, parents in the experimental school provided and their children consumed significantly more lunchbox fruit, vegetables and juice relative to baseline and to the control school ($P<0.001$ in all instances).

Conclusions: The Food Dudes intervention was effective in changing parental provision and children's consumption of lunchbox fruit and vegetables in Ireland.

European Journal of Clinical Nutrition advance online publication, 21 May 2008; doi:10.1038/ejcn.2008.34

Keywords: child; food habits; fruit; health promotion; parents; vegetables

Introduction

It is now well established that eating a diet rich in fruit and vegetables has numerous health benefits (Gillman, 1996; Key *et al.*, 1996). In Ireland however fewer than half of 11-year olds eat fruit and vegetables every day (World Health

Organization, 2004). Such eating habits are highly likely to contribute to the rising levels of child obesity in Ireland where there has been a two- to fourfold increase since 1990 (O'Neill *et al.*, 2007). Interventions to improve the diet of Irish children are clearly needed.

A series of studies conducted in UK primary schools indicate that a peer modelling and rewards intervention produces substantial increases in children's fruit and vegetable consumption (Horne *et al.*, 1995, 1998, 2004; Lowe *et al.*, 1998, 2004). The peer-modelling element centres on the 'Food Dudes' who are presented to children through a series of video adventures in which they frequently eat and extol the virtues of fruit and vegetables. Small rewards are also given to children for eating target amounts of the foods (for a full description of the theoretical rationale behind the intervention see Lowe *et al.*, 2004). Although this intervention

Correspondence: Dr CA Hardman, School of Psychology, Bangor University, Brigantia Building, Penrallt Road, Bangor, Gwynedd LL57 2AS, UK.
E-mail: c.hardman@bangor.ac.uk

Contributors: PJH and CFL were the principal investigators; they devised the intervention, directed its implementation and contributed to data analysis and interpretation, and to the writing of the paper. CAH drafted the paper. KT, JLN, PM, PP and MD contributed to programme development and implementation; data collection, analysis and interpretation; staff training; and editing of the paper. Chris Whitaker advised on statistical analyses.

Received 29 September 2007; revised 19 March 2008; accepted 29 March 2008

has been shown to be effective in a range of UK primary schools, its applicability and effectiveness in other countries has not yet been determined. For example, in the United Kingdom, the intervention was focused upon meals served by school canteens whereas in Ireland, as in many other countries, there is no school meals service and instead children bring food to school in their lunchboxes.

The need to improve the quality of food brought to school is particularly evident given recent UK research indicating that primary school packed lunches often consist of foods that are high in fat, sugar and sodium (Rogers *et al.*, 2007). The Caroline Walker Trust recommends that lunchtime meals should include one portion of fruit and one portion of vegetables (Crawley, 2005), yet the average packed lunch in Rogers *et al.*'s study contained only half this amount. Similarly, a study of 11- to 12-year olds in Northern Ireland found that just 14% of the packed lunches surveyed contained a piece of fruit (Douglas, 1999). The content of these lunches has implications for young people's health, and it has been shown that adolescents who eat packed lunches have higher levels of certain chronic disease risk factors than adolescents who eat school meals (Whincup *et al.*, 2005). Focusing on lunchboxes presents new challenges because, in addition to influencing children to consume healthful foods, it is also necessary to change parents' behaviour so that they provide these foods in the lunchboxes.

The aim of the present study was to evaluate the effectiveness of the Food Dudes intervention in the context of the Irish school system. To ensure that every child had equal opportunity to taste fruit and vegetables and could be rewarded for doing so, these foods were provided at school for 24 days, which comprised an 8-day baseline phase and the 16-day intervention. Once the children had learned to eat these school-provided foods, the next main objective of the study was to target the provision by parents of fruit and vegetables in their children's lunchboxes and to bring about long-term increases in the children's consumption of these foods.

Materials and method

Ethical approval

Granted by the School of Psychology Ethics Committee, Bangor University.

Participants

The participants were 4- to 11-year-old children attending two primary schools in Dublin. The schools were randomly assigned to either the experimental or control condition and were similar in terms of size (228 and 207 pupils, respectively) and deprivation level (medium, as defined by the Department of Education and Science in Ireland).

Study design and food presentation

In the baseline phase in both schools, parental provision of fruit and vegetables in children's lunchboxes, and the children's consumption of these foods (Lunchbox baseline measures) were measured on 5 consecutive days. Over the next 8 days of baseline, fruit and vegetables were provided free to both schools and the children's consumption of these foods was measured (School-provided foods baseline measures). Four different types of fruit (apples, pears, bananas and satsumas) and vegetables (celery, cherry tomatoes, cucumber and carrots) were presented in the classrooms just prior to the lunchtime break. Each day, a different food pair, one fruit and one vegetable, was presented on a 4-day cycle. Children aged 4–7 years were provided with half a piece of fruit and approximately 20 g of vegetables. Older children, aged 7–11 years, were provided with a whole piece of fruit and approximately 40 g of vegetables.

Following baseline, the 16-day intervention was introduced in the experimental school to target the children's consumption of the provided fruit and vegetables; over the same time period fruit and vegetables continued to be provided daily in the control school under baseline conditions, and consumption of these foods was measured in both schools. In order to sustain fruit and vegetable consumption in the experimental school over the longer term, a maintenance phase that targeted children's consumption of parent-provided (lunchbox) fruit and vegetables was introduced immediately after the intervention phase ended; no such procedures were conducted in the control school. At 12-month follow-up, the contents of the lunchboxes and food consumed were assessed over 5 days.

Table 1 provides an overview of the study design and food presentations. The lunchbox assessment at baseline and follow-up consisted of 2 habituation days and 3 measurement days. Measurements of the children's consumption of the school-provided foods were taken on the last 4 days of the baseline and intervention phases.

Intervention procedures (experimental school only)

Following training from the research team, the teacher in each class implemented the 16-day intervention. On each day just prior to the lunchtime break, the teacher showed the children one of the six Food Dude video episodes and/or read aloud a Food Dude letter. Each of the 6-min episodes featured the heroic 'Food Dudes', a group of two boys and two girls who frequently eat and extol the virtues of fruit and vegetables in order to save the world from the 'Junk Punks'. The letters, addressed from the Food Dudes to the children, provided praise and encouragement and reminded the children of the reward contingencies. Following the video and/or letter, the teacher gave each child a piece of fruit and portion of vegetables. Once children had finished eating, the teacher assessed consumption of the foods and distributed the rewards, which consisted of customized Food Dude items such as erasers, pens and pencil cases. Rewards were given for

Table 1 Duration of each phase of the study and food presentations

Schools	Baseline		Intervention ^a : school-provided foods (days)	Maintenance	12-Month follow-up: lunchbox foods (days)
	Lunchbox foods (days)	School-provided foods (days)			
Experimental	5	8	16	12 months	5
Control	5	8	16	Non-applicable	5

Note: all experimental phases were consecutive.

^aThe control school remained under baseline conditions during this phase.

tasting both fruit and vegetables on the first 4 days, and then for eating all fruit and vegetables on the next 12 days. On day 1 of the intervention, children were also given a homepack, which contained information and tips for parents on healthy eating and a chart for children to record the number of fruit and vegetable portions they had eaten at home. Completed charts were returned to school at the end of the intervention and teachers gave prizes to those children who had made an effort to eat fruit and vegetables at home.

The maintenance phase began immediately after the intervention. Food Dude fruit and vegetable containers were provided to encourage parents to supply children with fruit and vegetables in their lunchboxes now that these foods were no longer provided in school. Over the first month, teachers also distributed collectible stickers, one per day, to those children seen to be eating fruit and vegetables brought in from home. Thereafter, children who ate fruit and vegetables from their lunchboxes were given a sticker each day to stick onto a wall chart so that they could track their own progress over time and earn a reward whenever they had accumulated sufficient stickers over a specified number of weeks. As maintenance progressed, the children's consumption was rewarded with certificates (bronze, silver, gold and platinum) instead of other prizes and the reward schedule was thinned (a maximum of one reward per 5 weeks). During the 3-month summer break towards the end of the maintenance phase no rewards were presented.

Measures

Lunchbox measures. Teachers were asked to ensure that all food and drink brought to school was placed in each child's lunchbox. At the start of the day, researchers collected the lunchboxes, each of which was labelled with the child's name and participant number. UK Department of Health (2003) guidelines were used to record the fruit and vegetable portions in each lunchbox; exceptions were apples and pears, which were weighed before and after consumption. Vegetables, fresh fruit, pure juice (with no added ingredients counted as a maximum of one fruit portion) and fruit bars (if at least 90% fruit and no added sugar) were recorded. Where an item was exactly between a half and a whole portion, it was rounded down during the recording of the data.

Following assessment, lunchboxes were returned to the classrooms so they were available to the children for morning break and lunch. Lunchboxes were collected again after lunch and the researchers recorded the number of fruit and vegetable portions remaining using the above procedure. Children were instructed to leave all uneaten/waste food (including apple cores, wrappers, drinks cartons, and so on) in their lunchboxes.

Researchers were trained to estimate the portion sizes and inter-rater reliability was assessed on a daily basis with one lunchbox from each of the eight classes per school (approximately 3% of the sample). The lunchbox of the first child on each class register was used on day 1, the second child's lunchbox on day 2 and so on. Mean percentage agreement between all pairs of researchers was 99% (range, 80 to 100%). This procedure was carried out both before and after lunch.

School-provided food measures. On the designated measurement days, the researchers recorded the initial weight (in gram) of each child's piece of fruit and portion of vegetables. The foods were placed in polystyrene tubs, labelled with each child's name and participant number, and were delivered to the classes just prior to the lunchtime break. Once children had finished eating, the tubs containing all core/peel and unfinished food were collected. The researcher recorded the weight of any waste or unfinished fruit/vegetables for every child. The starting fruit/vegetable weight and the final fruit/vegetable weight were subsequently used to calculate the percentage eaten for each child, minus the average weight of the core or peel.

Data analysis

School-provided food measures. Mean scores were computed from each child's consumption of a minimum of three of the four fruits and three of the four vegetables provided during the baseline and intervention phases. The data were analysed using a four-way analysis of variance (ANOVA); the independent variables were school (experimental, control), phase (baseline, intervention), food (fruit, vegetable) and age (4- to 7-year olds, 7- to 11-year olds), whereas the dependent variable was the mean percentage of food consumed.

Lunchbox measures. Fruit, vegetable and juice (FVJ) portions were converted into average weight (in gram). Means were calculated for the amount of FVJ provided by parents in the lunchboxes (parental provision) and for the amount of FVJ consumed by the children at baseline and follow-up. To be included in the analysis, children needed to have valid data for at least two of the three measurement days during each phase. To normalize the distributions of data, scores for fruit, vegetables and juice were combined and a square root transformation was applied. Data were analysed using two separate three-way ANOVAs; the independent variables were school (experimental, control), phase (baseline, follow-up) and age (4- to 7-year olds, 7- to 11-year olds), whereas the dependent variables were (1) mean parental provision and (2) mean FVJ consumption (in gram).

Unless otherwise stated, an α -level of 0.05 was used for all statistical tests.

Results

School-provided foods

Consumption of the school-provided foods during the baseline and intervention phases is shown in Figure 1.

There were significant interactions between phase and school, $F(1, 250) = 198.4, P < 0.001$, and between phase, food and school, $F(1, 250) = 21.2, P < 0.001$. The interactions between phase, school and age, and between phase, food, school and age were not significant ($F(1, 250) = 3.6, P = 0.06$ and $F(1, 250) = 2.1, P = 0.15$, respectively). *Post hoc t*-tests

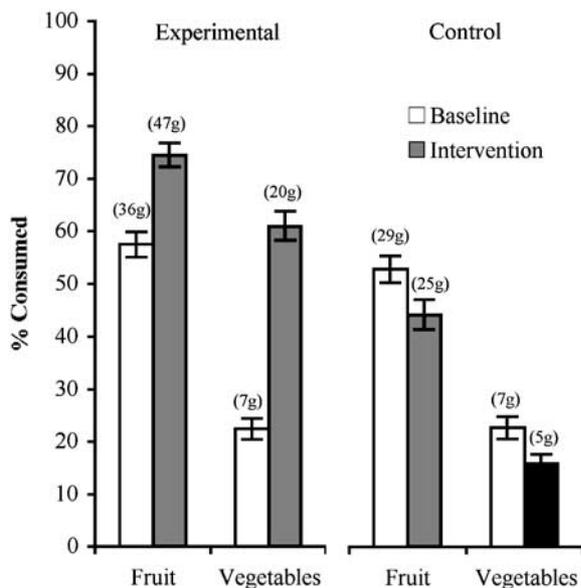


Figure 1 In the experimental school (left panel) and the control school (right panel), mean percentage of school-provided fruit and vegetables consumed by children at baseline and during the intervention (and the same time period in the control school). Error bars represent ± 1 s.e. of the mean. The numbers in parentheses at the top of each column indicate the amount consumed in grams.

(with Bonferroni adjustment to the significance level, $0.05/8 = 0.006$) indicated that, at baseline, the two schools did not differ significantly in consumption of either the fruit or vegetables ($t = 1.0, P = 0.31$ and $t = -0.3, P = 0.80$, respectively). During the last 4 days of the intervention phase, children in the experimental school consumed significantly more fruit and vegetables than did the control school over the same time period ($t = 8.3, P < 0.001$ and $t = 13.6, P < 0.001$, respectively). In the experimental school, consumption of both fruit and vegetables was significantly higher in the last 4 days of the intervention compared to baseline ($t = -7.8, P < 0.001$ and $t = -15.0, P < 0.001$, respectively), whereas in the control school, fruit and vegetable consumption was significantly lower over the same time period than at baseline ($t = 3.6, P = 0.001$ and $t = 4.1, P < 0.001$, respectively).

Lunchbox measures

Parental provision. The amount of FVJ provided by parents in the children's lunchboxes at baseline and follow-up is shown in Figure 2. There was a significant interaction between phase and school, $F(1, 220) = 22.2, P < 0.001$, but not between phase, school and age, $F(1, 220) = 2.6, P = 0.11$. *Post hoc t*-tests (with adjusted significance level, $0.05/4 = 0.0125$) indicated no significant difference between the

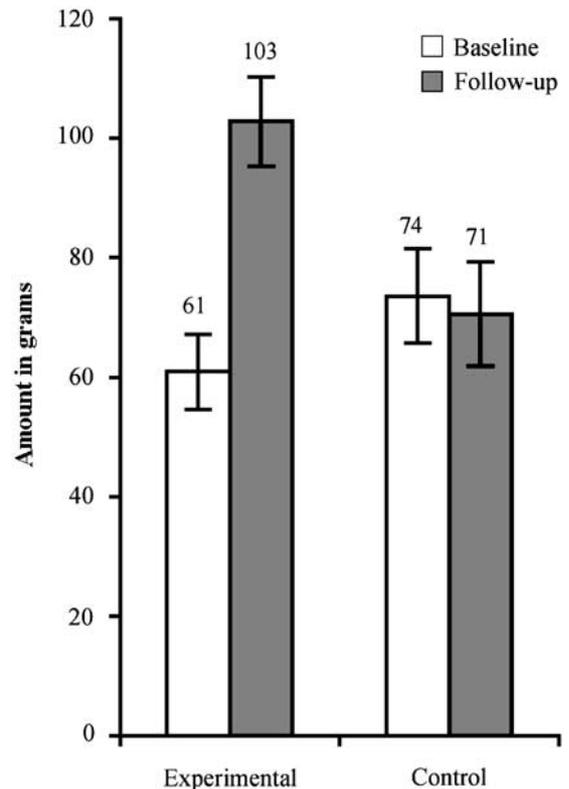


Figure 2 Mean grams of lunchbox fruit, vegetable and juice (FVJ) provided by parents in the experimental and control schools at baseline and follow-up. Error bars represent ± 1 s.e. of the mean.

experimental and control schools in the provision of lunchbox FVJ at baseline ($t = -1.4$, $P = 0.158$). At follow-up however, children in the experimental school were provided with significantly more FVJ in their lunchboxes than control children ($t = 3.5$, $P < 0.001$). Within-group comparisons showed that, in the experimental school, provision of lunchbox FVJ was significantly higher at follow-up compared to baseline ($t = -6.1$, $P < 0.001$). In the control school, provision of lunchbox FVJ did not differ significantly between the phases ($t = 0.7$, $P = 0.464$).

Children's consumption. The amount of lunchbox FVJ consumed by the children is shown in Figure 3. There was a significant interaction between phase and school, $F(1, 220) = 13.4$, $P < 0.001$ but not between phase, school and age, $F(1, 220) = 0.8$, $P = 0.38$. *Post hoc t*-tests (with adjusted significance level, $0.05/4 = 0.0125$) indicated no significant difference in consumption between the schools at baseline ($t = -0.15$, $P = 0.88$). At follow-up however, consumption of lunchbox FVJ was significantly higher in the experimental school compared to the control school ($t = 3.7$, $P < 0.001$). In the experimental school, consumption was significantly higher at follow-up compared to baseline

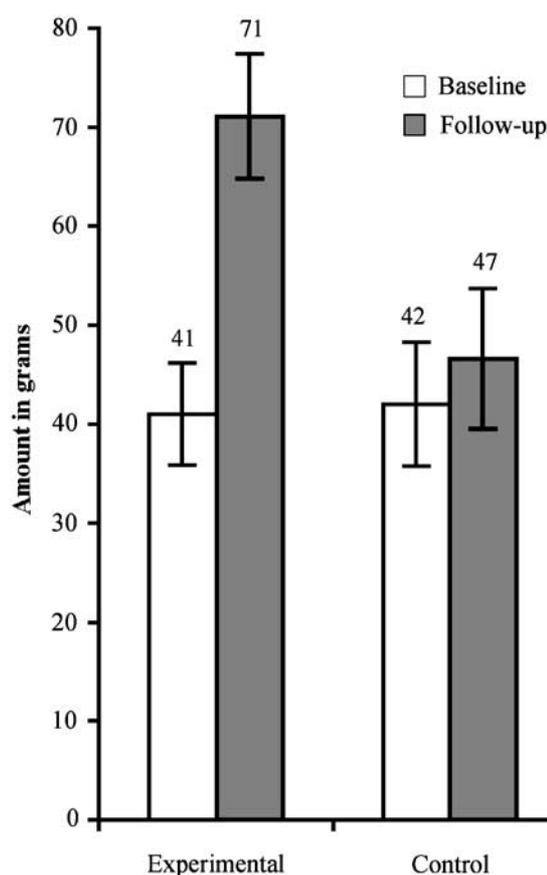


Figure 3 Mean grams of lunchbox fruit, vegetable and juice (FVJ) consumed by the children in the experimental and control schools at baseline and follow-up. Error bars represent ± 1 s.e. of the mean.

($t = -5.5$, $P < 0.001$), whereas in the control school there was no significant difference between the phases ($t = -0.1$, $P = 0.915$).

Discussion

The current results demonstrate that the Food Dudes intervention produced significant and lasting increases in fruit and vegetable consumption in an Irish primary school. During the 16-day intervention when children were exposed to the peer-modelling video and rewards, they ate significantly more of the school-provided fruit and vegetables, most notably the latter where consumption was almost treble that in baseline. In contrast, the control group showed a decline in consumption of both foods over the same time period. By 12-month follow-up, parents were providing significantly more fruit, vegetables and juice in the lunchboxes (103 g relative to 61 g at baseline) and crucially this was matched by the children's increased consumption of the foods (71 g relative to 41 g). In the control school, despite a total of 24 days of fruit and vegetable provision at school, subsequent parental provision and children's consumption of lunchbox fruit and vegetables did not change significantly over time. This is a longer follow-up period relative to our previous evaluations (4 months in Horne *et al.*, 2004) and thus provides a stronger indication of the effectiveness of the intervention over time. The current study is the first test of the whole-school intervention in a non-UK and non-canteen setting yet the results are remarkably consistent with our previous studies that focused on school-provided meals (Horne *et al.*, 2004; Lowe *et al.*, 2004). Because of their poor nutritional content (Rogers *et al.*, 2007) and possible links with risk factors for chronic disease (Whincup *et al.*, 2005), interventions to improve the content of packed lunches are essential. The current results indicate that the Food Dudes intervention was an effective means of first increasing children's consumption of fruit and vegetables so as to provide the impetus for a change in parental behaviour—the provision of these foods in their children's lunch boxes. It is this shift in parental practices maintained by children's newly established consumption of fruit and vegetables that is likely to be key to the intervention's long-term effectiveness.

The use of weighed and observational measures of fruit and vegetable intake is a strength of the current study. In future studies, dietary records could be collected from the older pupils in order to capture effects outside of school. Since this study was conducted, the Irish Government has adopted the programme and is currently making it available to all primary schools in Ireland. A recent questionnaire-based evaluation of the first 44 schools to participate in the national rollout has provided further insights into the effects on the wider home context (Delaney *et al.*, 2006; Maloney, 2006): 94% of parents reported that children were eating one or more additional portions of fruit and vegetables at home

and 85% reported that their children had asked them to buy more fruit and vegetables. In addition, 88% of parents reported increasing their own intake of fruit and vegetables as a result of the intervention. This is consistent with evaluations of the intervention in the United Kingdom, which employed parental recall measures and showed significant increases in the children's consumption of fruit and vegetables at home (Horne *et al.*, 2004; Lowe *et al.*, 2004). Thus, the results for lunchtime consumption presented in the current paper are likely to be conservative estimates of the actual impact of the intervention on children's diets.

The decline in consumption of the school-provided foods in the control school is consistent with our previous studies (Horne *et al.*, 2004; Lowe *et al.*, 2004). This clearly indicates that simply providing additional fruit and vegetables to children does not necessarily result in their being eaten and, if anything, leads to a decline in consumption following what is likely to be an initial novelty effect. On this basis, interventions that centre on the provision of fruit and vegetables to children would not be expected to produce any lasting effects on consumption. This prediction is supported by recent evaluations of the UK school fruit and vegetable scheme in which a free piece of fruit or vegetable is provided to 4- to 6-year-old children; there were however no longer-term effects once children had become ineligible for the scheme (Wells and Nelson, 2005; Ransley *et al.*, 2007).

In conclusion, the current study indicates that the Food Dudes intervention can be successfully implemented in primary schools in Ireland; it produces significant and durable increases in parental provision of fruit and vegetables and in the children's consumption of these foods. This intervention has great potential to bring about substantial health gains to children. The national rollout in Ireland provides opportunities for larger-scale evaluations of the Food Dudes intervention, which may, in time, be combined with our recently developed physical activity intervention (Horne *et al.*, 2007) to tackle the growing problem of child obesity (O'Neill *et al.*, 2007). Future research will also seek to investigate the feasibility and acceptability of the Food Dudes intervention in other countries and cultures worldwide.

Acknowledgements

We thank all the school staff, pupils and parents for their participation. The study was funded by Bord Bia, the Irish Food Board and we are particularly grateful to Michael Maloney for his support. We also thank Laurence Swan and Yffes plc, who provided the fruit and vegetables.

References

- Crawley H (2005). *Nutrient-Based Standards for School Food*. The Caroline Walker Trust and National Heart Forum: Abbots Langley, Hertfordshire, UK.
- Delaney L, Kelleher C, Wall P (2006). *An Updated Initial Evaluation of the Irish Food Dudes Initiative*. University College Dublin: Dublin.
- Department of Health (2003) 5 A Day portion information, http://www.dh.gov.uk/en/Policyandguidance/Healthandsocialcaretopics/FiveADay/FiveADaygeneralinformation/DH_4001494.
- Douglas L (1999). Contribution of 'packed lunches' to the dietary intake of 11–12-year-old children. *Nutr Food Sci* **4**, 181–186.
- Gillman MW (1996). Enjoy your fruits and vegetables. *BMJ* **313**, 765–766.
- Horne PJ, Hardman CA, Lowe CF, Rowlands AV (2007). Increasing children's physical activity: a peer-modelling, rewards and pedometer-based intervention. *Eur J Clin Nutr* advance online publication, 19 September 2007 (DOI: 10.1038/sj.ejcn.1602915).
- Horne PJ, Lowe CF, Bowdery M, Egerton C (1998). The way to healthy eating for children. *Br Food J* **100**, 133–140.
- Horne PJ, Lowe CF, Fleming PF, Doney AJ (1995). An effective procedure for changing food preferences in 5–7 year-old children. *Proc Nutr Soc* **54**, 441–452.
- Horne PJ, Tapper K, Lowe CF, Hardman CA, Jackson MC, Woolner J (2004). Increasing children's fruit and vegetable consumption: a peer-modelling and rewards-based intervention. *Eur J Clin Nutr* **58**, 1649–1660.
- Key TJ, Thorogood M, Appleby PN, Burr ML (1996). Dietary habits and mortality in 11 000 vegetarians and health conscious people: results of a 17 year follow up. *BMJ* **313**, 775–779.
- Lowe CF, Doney AJ, Horne PJ (1998). Changing what children eat. In: A Murcott (ed). *The Nation's Diet: The Social Science of Food Choice*. Longman: London. pp 57–80.
- Lowe CF, Horne PJ, Tapper K, Bowdery M, Egerton C (2004). Effects of a peer modelling and rewards-based intervention to increase fruit and vegetable consumption in children. *Eur J Clin Nutr* **58**, 510–522.
- Maloney M (2006). *Food Dudes Programme in Ireland*. Paper presented at the 5th International Symposium of the International Fruit and Vegetable Alliance: Ottawa, Canada.
- O'Neill JL, McCarthy SN, Burke SJ, Hannon EM, Kiely M, Flynn A *et al.* (2007). Prevalence of overweight and obesity in Irish school children, using four different definitions. *Eur J Clin Nutr* **61**, 743–751.
- Ransley JK, Greenwood DC, Cade JE, Blenkinsop S, Schagen I, Teeman D *et al.* (2007). Does the school fruit and vegetable scheme improve children's diet? A non-randomised controlled trial. *J Epidemiol Community Health* **61**, 699–703.
- Rogers IS, Ness AR, Hebditch K, Jones LR, Emmett PM (2007). Quality of food eaten in English primary schools: school dinners vs packed lunches. *Eur J Clin Nutr* **61**, 856–864.
- Wells L, Nelson M (2005). The National School Fruit Scheme produces short-term but not longer-term increases in fruit consumption in primary school children. *Br J Nutr* **93**, 537–542.
- Whincup PH, Owen CG, Sattar N, Cook DG (2005). School dinners and markers of cardiovascular health and type 2 diabetes in 13–16 year olds: cross sectional study. *BMJ* **331**, 1060–1061.
- World Health Organization (2004). *Young People's Health in Context: Health Behaviour in School-aged Children (HBSC) Study: International Report from the 2001/2002 Survey*. WHO: Copenhagen.