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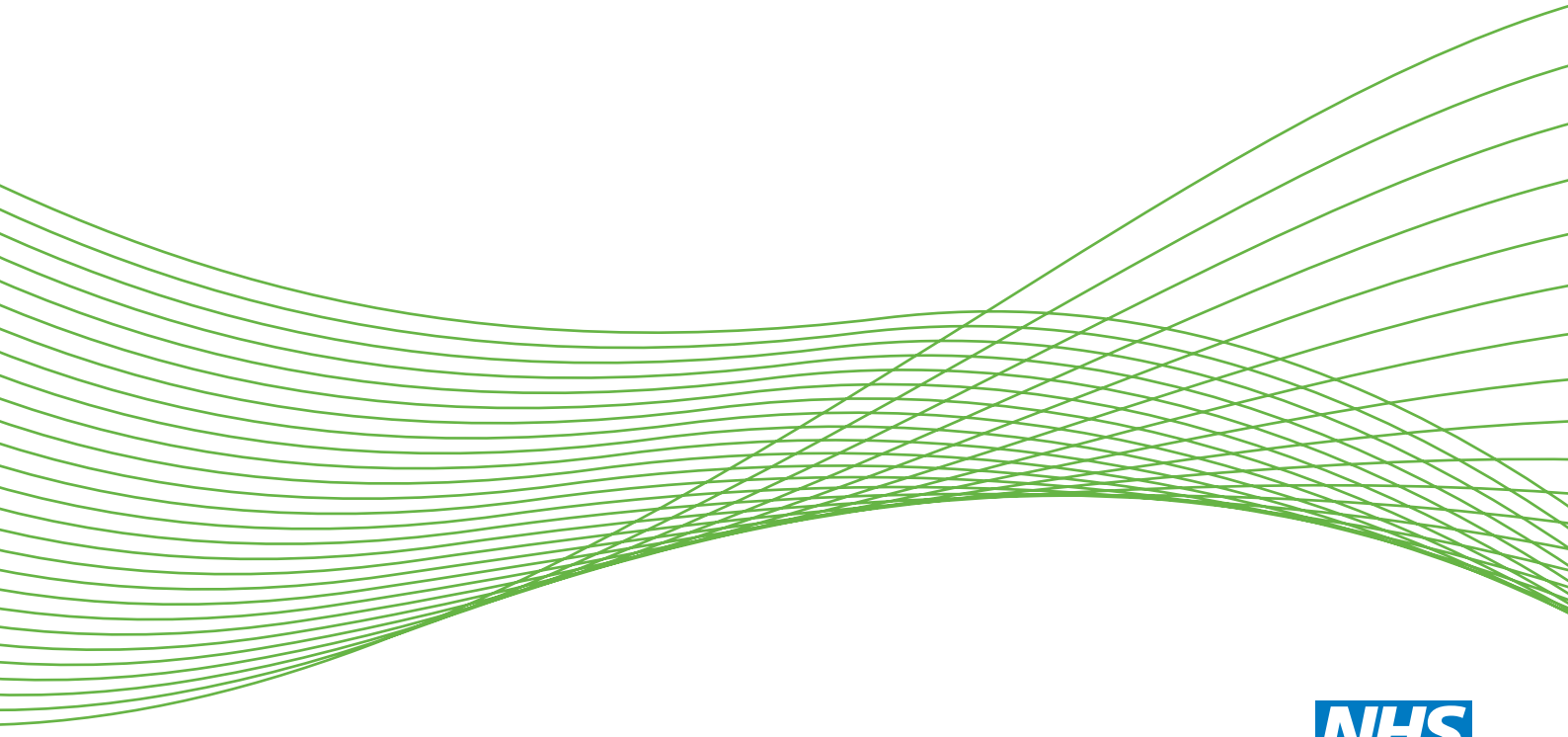

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Abstract

Does the Royal Horticultural Society Campaign for School Gardening increase intake of fruit and vegetables in children? Results from two randomised controlled trials

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Background: Children's fruit and vegetable intake in the UK is low. Changing intake is challenging. Gardening in schools might be a vehicle for facilitating fruit and vegetable intake.

Objectives: To undertake the first clustered randomised controlled trials (RCTs) of a gardening intervention. To evaluate the impact of a school gardening programme, the Royal Horticultural Society (RHS) Campaign for School Gardening, on children's fruit and vegetable intake.

Methods: Primary school children aged 8–11 years from eight London boroughs were included in one of two related RCTs. Trial 1 consisted of 23 schools, randomised to receive either a RHS-led or teacher-led intervention. Trial 2 consisted of 31 schools, randomised to either the teacher-led intervention or a comparison group. A 24-hour food diary [the Child And Diet Evaluation Tool (CADET)] collected baseline and follow-up dietary intake. Questionnaires measured children's knowledge and attitudes towards fruit and vegetables and assessed intervention implementation. Data were collected by fieldworkers who were blind to the original allocation of the school. The primary outcome was change in fruit and vegetable intake analysed using a random effects model, based on intention to treat.

Results: Total sample size at baseline for both trials (2529 children) was lower than the original aim of 2900 children. The final sample size was 1557, with 641 children completing trial 1 (RHS-led, $n = 312$; teacher-led, $n = 329$) and 916 children completing trial 2 (teacher-led, $n = 488$; control, $n = 428$). The response rate at follow-up for the two combined was 62%.

Baseline analysis of children's fruit and vegetable intake showed that eating a family meal together, cutting up fruit and vegetables, and parental modelling of fruit and vegetable intakes were all associated with higher intakes of fruit and vegetables in children.

The primary trial outcome, combined fruit and vegetable intake, showed that in trial 1 the teacher-led group had a mean change in intake of 8 g [95% confidence interval (CI) –19 to 36 g], compared with a mean of –32 g (95% CI –60 to –3 g) in the RHS-led group. However, this difference was not significant (intervention effect –43 g, 95% CI –88 to 1 g; $p = 0.06$). In trial 2, the teacher-led group consumed 15 g (95% CI –36 to 148 g) more fruit and vegetables than the comparison group; this difference was not significant. No change was found in children's knowledge and attitudes. However, if schools improved their RHS gardening score by three levels, children had a higher intake of 81 g of fruit and vegetables (95% CI 0 to 163 g; $p = 0.05$) compared with schools with no change in gardening score.

Conclusion: Results from these trials provide little evidence that school gardening alone can improve children's fruit and vegetable intake. In both trials, gardening levels increased across all groups from baseline to follow-up, with no statistically significant difference between groups in terms of improvement in gardening level. This lack of differentiation between groups is likely to have influenced the primary outcome. However, when the gardening intervention was implemented at the highest intensities there was a suggestion that it could improve children's fruit and vegetable intake by a portion. Analysis of the baseline data showed that family support for fruit and vegetable intakes was associated with higher intakes of fruit and vegetables in children. This study highlights the need for more sophisticated and accurate tools to evaluate diet in children. Future intervention designs should include a greater level of parental involvement in school interventions, along with related components such as cooking, to substantially improve children's fruit and vegetable intake. In addition, the home environment has been demonstrated to be an important focus for intervention.

Trial registration: Current Controlled Trials ISRCTN11396528.

Funding: This project was funded by the National Institute for Health Research (NIHR) Public Health Research programme and will be published in full in *Public Health Research*; Vol. 2, No. 4. See the NIHR Journals Library website for further project information.

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List of abbreviations

CADET	Child And Diet Evaluation Tool	OR	odds ratio
CI	confidence interval	RCT	randomised controlled trial
DANTE	Diet And Nutrition Tool for Evaluation	RHS	Royal Horticultural Society
EAL	English as an additional language	SCT	social cognition theory
IMDS	Index of Multiple Deprivation score	SD	standard deviation
ITT	intention to treat	SE	standard error
NDNS	National Diet and Nutrition Survey	WHO	World Health Organization

Plain English summary

Children's fruit and vegetable intake in the UK is low. Gardening in schools might help to increase intake. We have undertaken the first trials of a gardening intervention, the Royal Horticultural Society (RHS) Campaign for School Gardening, to assess the impact on children's fruit and vegetable intake.

Primary school children aged 8–11 years from eight London boroughs were included in one of two related trials. Trial 1 included 23 schools, randomised to receive either the RHS-led or a teacher-led gardening intervention. Trial 2 consisted of 31 schools, randomly allocated to either the teacher-led intervention or a comparison group which did not receive the RHS gardening support.

At the start of the trials, we found that eating a family meal together, cutting up fruit and vegetables for children and daily intake of fruit and vegetables by parents were all associated with a higher intake of fruit and vegetables in children.

The main trial results found only very small differences in fruit and vegetable intakes between groups. No change was found in children's knowledge and attitudes. However, we did find a general increase in gardening activity across schools during the time of the study, and so we were not able to show big differences between groups in gardening activity at follow-up. This probably influenced our primary findings. A secondary analysis found that, irrespective of their allocated group, if schools greatly increased the amount of gardening that they did, children ate on average one more portion of fruit and vegetables per day compared with those whose schools did not increase their gardening activity.

Very little evidence was found to support claims that school gardening alone can improve children's fruit and vegetable intake.

Scientific summary

Background

Children's fruit and vegetable intake in the UK is low, at around 2.8 servings per day. Changing intake is challenging. There is increasing evidence to suggest that gardening might be a vehicle for facilitating fruit and vegetable intake. School gardening programmes provide an interactive environment with the potential to change children's self-efficacy and willingness to try different fruits and vegetables. These changes in attitudes towards fruit and vegetables may potentially lead to an increase in consumption.

Objectives

To undertake the first clustered randomised controlled trials (RCTs) of a gardening intervention. To evaluate the impact of a school gardening programme, the Royal Horticultural Society (RHS) Campaign for School Gardening, on children's fruit and vegetable intake.

- To adapt an existing dietary assessment tool [the Child And Diet Evaluation Tool (CADET)] to include age- and gender-specific food portions.
- To describe children's fruit and vegetable intake, broken down by meal event, lunch type (packed or school meal) and gender.
- To explore how the home food environment and parental attitudes and values affect children's fruit and vegetable intake at baseline.
- To evaluate the impact of the RHS's Campaign for School Gardening on the change in intake of fruit and vegetables in children.
- To assess changes in children's knowledge of, and attitudes towards, fruit and vegetables between baseline and follow-up.
- To identify process measures relating to the delivery of the intervention which may affect results.

Methods

Royal Horticultural Society policy is to provide support to all schools that register an interest in the campaign. As a consequence of this, two linked trials were required. All schools in the London boroughs supported by the RHS would be given access to either the regional advisor or twilight teacher training sessions. A second set of schools from adjacent boroughs were recruited by the research team into trial 2, and randomised to receive the twilight teacher training or no RHS gardening intervention. Primary schools from eight London boroughs were invited to take part in one of two related RCTs.

Twenty-six schools from four boroughs in London (Wandsworth, Tower Hamlets, Greenwich and Sutton) were recruited for trial 1. Of the 26 schools, 10 were randomly allocated to receive the RHS-led intervention and 16 to receive the teacher-led intervention. All schools were allocated at the same time. The primary aim of trial 1 was to determine whether or not children who participate in the RHS-led gardening intervention increased their fruit and vegetable consumption more than those participating in the teacher-led gardening intervention.

Thirty-two schools from four other boroughs in London (Lewisham, Lambeth, Merton and Newham) were recruited for trial 2. These boroughs are adjacent to the trial 1 boroughs. Of these schools, 16 were randomly allocated to receive the teacher-led intervention and 16 were used as comparison schools. The comparison schools received no active intervention during the trial. However, they were informed that

once the study had ended follow-up collection in February 2012, they would be able to attend the twilight sessions offered to the teacher-led schools. The primary aim of trial 2 was to determine whether or not children who participate in the low intensity, teacher-led gardening intervention increase their mean fruit and vegetable consumption more than those in the control group.

Cluster randomisation with school location and borough to identify each cluster was used to randomise the schools. The schools were randomised by geographic location of their London borough. From each primary school, one Year 3 class and one Year 4 class was asked to consent to be part of the trial. Classes were randomly selected if there was more than one class in that particular year group.

It was not possible to blind the schools to their intervention group owing to the nature of the intervention. The fieldworkers were blinded to the allocation of schools to the intervention (RHS-led or teacher-led) and comparison arms of the study.

A 24-hour food diary (CADET) collected baseline and follow-up dietary intake. Questionnaires were designed to measure children's knowledge of, and attitudes towards, fruit and vegetables and to assess intervention implementation. Data were collected from each school by fieldworkers who were blind to the original allocation of the school. The primary outcome was change in fruit and vegetable intake from baseline to postintervention follow-up.

Baseline collection of the school food diary, home food diary, child questionnaire and school gardening telephone interviews took place between April and July 2010. The baseline process measures e-mails were sent out in November 2010 with reminders sent in December 2010. Follow-up collection of the school food diary, home food diary, child questionnaire and school gardening telephone interviews took place from October 2011 to January 2012. The follow-up process measures e-mails were sent out in December 2011 and reminders were sent in January 2012.

Ethical approval was obtained through the University of Leeds Research Ethics Committee in 2009. Written informed consent was obtained first from all schools and then from all parents whose children were in the classes chosen to participate in the trial data collection. Parents were given the opportunity to opt out of the study if they did not wish their child to take part. In this case, the child was still able to take part in the growing activities in the class; however, his or her food intake and child attitude and knowledge questionnaire were not recorded.

Statistical analysis

Baseline analysis explored key nutrients, foods, fruits and vegetables by meal event and demographic characteristics. An additional variable based on the NHS '5 A DAY' guidelines was created to evaluate how many children were achieving the UK government's fruit and vegetable target. Clustered multilevel regression models were used to explore differences between boys and girls, and the home environment for nutrients and food items. These models were first conducted unadjusted, and then adjusted for ethnicity and Index of Multiple Deprivation score (IMDS).

The main analyses used a random effects model, based on intention to treat, with change in total fruit and vegetable intake as the primary outcome; results were reported both unadjusted and adjusted for baseline intake. A random effects model was used to determine any differences between schools.

Results

Baseline analysis of the 2389 children who had completed the dietary assessment checklist found that children consumed on average 293 g [95% confidence interval (CI) 287 to 303 g] of fruit and vegetables per day. Children of families who reported 'always' eating a family meal together at a table consumed 125 g (95% CI 92 to 157 g) more fruit and vegetables per day than those from families who never ate a

meal together. Daily consumption of fruit and vegetables by parents was associated with higher fruit and vegetable intake in children; these children consumed 87 g (95% CI 37 to 138 g) more fruit and vegetables per day than those whose parents rarely or never consumed fruit and vegetables. Cutting up fruit and vegetables for children was also associated with higher consumption. The children of families who reported always cutting up fruit and vegetables for their children had 44 g (95% CI 18 to 71 g) more fruit and vegetables per day than those from families who reported never cutting up fruit and vegetables.

In trial 1, 1138 children were randomised to receive either the RHS-led ($n = 529$) or teacher-led ($n = 609$) intervention. Of these, 312 children from the RHS-led and 329 from the teacher-led arm provided data for the primary analysis. In trial 2, 1391 children were randomised to receive either the teacher-led ($n = 698$) or comparison ($n = 693$) intervention. Of these, 488 children from the teacher-led and 428 from the comparison arm provided data for the primary analysis. Sample size calculations had estimated that to have 90% power to detect a one-portion difference in fruit intake (one portion = 80 g), a final sample of 482 per group was required, i.e. about 10 schools. The achieved sample size has reduced the power to detect a difference of one portion of fruit and vegetables from 90% to 83%.

Results from the RCTs found that in trial 1, for combined fruit and vegetable intake, the teacher-led group had a higher mean change of 8 g (95% CI –19 to 36 g) compared with the RHS-led group change of –32 g (95% CI –60 to –3 g). However, after adjusting for possible confounders this difference was not significant (intervention effect –43 g, 95% CI –88 to 1 g; $p = 0.06$). In trial 2, the teacher-led group consumed on average 15 g (95% CI –36 to 148 g) more fruit and vegetables than the comparison group; this difference was also not statistically significant. However, exploration of the process measures revealed that all schools had increased their gardening activity between baseline and follow-up, with no statistically significant difference between groups. Schools which had improved their RHS gardening score by three levels between baseline and follow-up found that, on average, children increased their intake of fruit and vegetables by 81 g (95% CI 0 to 163 g; $p = 0.05$) compared with children attending schools that had no change in gardening score, after adjusting for confounders.

Over 90% of the children at both baseline and follow-up agreed that they enjoyed eating fruit, whereas 60–70% agreed that they enjoyed vegetables, and only 50–60% agreed that they liked trying new vegetables. No change was found in children's knowledge and attitudes between baseline and follow-up. In trial 1, the RHS-led gardening group showed an increase in the total number of different vegetables recognised; this difference was not significant after adjustment for baseline measurement and confounders.

At baseline, the response rate was 92%, with 46% speaking English as an additional language (EAL) and 59% having a member of the family educated to at least degree level. This compares to a total of 55% of primary school children in London speaking EAL in 2012 and 38% having a family member with a degree, suggesting that the responding sample may be more advantaged than the general London population. This could be reflected in the results obtained, with high levels of child knowledge of fruits and vegetables and higher intakes of fruit and vegetables than were observed in the National Diet and Nutrition Survey (NDNS).

Conclusions

Results from these trials provide little evidence that school gardening alone can improve children's fruit and vegetable intake. In both trials, gardening levels increased across all groups from baseline to follow-up, with no statistically significant difference between groups in terms of improvement in gardening level. This lack of differentiation between groups is likely to have influenced the primary outcome. However, when the gardening intervention was implemented at the highest intensities there was a suggestion that it could improve children's fruit and vegetable intake by a portion per day. Analysis of the cross-sectional baseline data showed that family support for fruit and vegetable intakes through eating together, preparation of

fruit and vegetables and parental consumption was associated with higher intakes of fruit and vegetables in children. This study highlights the need for more sophisticated and accurate tools to evaluate diet in children. Future intervention designs should include a greater level of parental involvement in school interventions, along with related components, such as cooking, to substantially improve children's fruit and vegetable intake. In addition, the home environment has been demonstrated to be an important focus for intervention.

Trial registration

This trial is registered as ISRCTN11396528.

Funding

Funding for this study was provided by the Public Health Research programme of the National Institute for Health Research.

Chapter 1 Introduction

Fruit and vegetables are fundamental components of a healthy diet, providing vital micronutrients. The World Health Organization (WHO) recommends that we should eat at least 400 g of a variety of fruit and non-starchy vegetables every day.[1] A standard portion of fruit or vegetables is assumed to be 80 g.[1] Consuming low energy density foods such as vegetables could help prevent obesity.[2]

Epidemiological evidence indicates that, in adults, a diet rich in fruit and vegetables can decrease the risk of developing cardiovascular disease, stroke, hypertension, type 2 diabetes mellitus, obesity and several forms of cancer.[3,4] A diet low in fruit and vegetables is one of the top 10 risk factors for global mortality.[5] Research has also revealed that dietary habits are developed in childhood and persist throughout life; therefore, it is vital that children at a young age consume adequate levels of fruit and vegetables.[6,7] Several studies indicate that children's fruit and vegetable intake is positively associated with their parents' intake.[8]

The impact of poor nutrition in children is causing major public health concerns across the globe.[4] Of particular public concern is the rise of obesity in children.[9] Diet plays a fundamental role in weight management; having a healthy diet rich in fruit and vegetables, which have a low energy density, could help tackle the obesity epidemic.[10] A diet rich in fruit and vegetables is key for children to develop mentally and physically.[4] The importance of childhood eating patterns has been illustrated through longitudinal research concluding that eating fruit and vegetables in childhood has positive health benefits in terms of cardiovascular disease, asthma and other respiratory diseases.[11–14] Public health interventions need to change children's lifestyles to reduce the intake of non-essential foods which are high in fat, sugar and salt, and to encourage increased intake of a variety of fruit and vegetables. Strategies to reduce obesity in children are urgently required.[15]

Current consumption levels

Currently, children's consumption of fruit and vegetables is low in the USA, Australia and most European countries.[12,16,17] The average intake of fruit and vegetables for children in the UK is around 2.8 servings per day – approximately 224 g.[18] In British children, the main sources of energy intake are chips, biscuits and crisps;[19] the need for public health intervention to improve children's overall diet habits is evident.[20] Children from low-income families consume even less fruit and vegetables than the average. Boys consume only 64 g, or 0.8 of a portion, and girls consume 1.1 portions (approximately 88 g) of fruit and vegetables daily.[19]

Interventions to improve children's fruit and vegetable intake from across the globe: what is already known?

Nutrition education programmes have been developed for school, home and community settings in an attempt to improve children's diets.[21–28] Evidence suggests that the most effective interventions are multicomponent, with both school- and home-based components.[29–31] Successful intervention studies have included a variety of components: integrating teaching about fruit and vegetables into the curriculum;[23,29,30,32–34] training teachers in theories of behaviour change and nutritional education;[35,36] increasing fruit and vegetable availability at school and in school meals;[34,36,37] training of catering staff (verbal encouragement);[29,30,37] hands-on exposure (tasting and preparation sessions);[23,33,35] parental involvement through newsletters and homework activities;[23,29,30,33,34] a whole-school approach (developing a nutrition policy, evening activities)[30,36,37] and community involvement (involving the local fruit and vegetable industry).[23,29,34] These intervention programmes report a moderate increase in children's fruit and vegetable consumption of approximately one-third of a portion of fruit and/or vegetables per day.[22,38,39]

The psychological theory behind school gardens is based on the social cognition theory (SCT), which works on the assumption that to successfully change a person's behaviour requires changing their knowledge, values and beliefs.[40] It is believed that rather than being a quantitative effect, active engagement in gardening activities can reinforce healthy messages about eating, and increase children's willingness to try different fruit and vegetables. Planting, growing and eating vegetables can improve children's consumption patterns. However, there is now a gap between the implementation of school gardens and the academic evaluation of their effectiveness. Previous studies of school gardening are limited and none have been randomised controlled trials (RCTs). Studies have had issues with their design and the use of convenience sampling with relatively small sample sizes.[41–43] A number of the trials only had one school or club implementing the intervention.[41,44,45] Statistical analysis was also limited, with only three studies[46–48] using a statistical methodology that adjusted for baseline differences. None of the studies took into consideration the hierarchical structures of school data through multilevel analysis. These factors could compromise reliability of statistical outcomes, limiting the generalisability of the results.

Potential barriers to changing children's fruit and vegetable consumption

Changing children's fruit and vegetable consumption is a challenging task. Academic literature shows that the main barriers to increasing children's fruit and vegetable intake are availability, accessibility, convenience, taste preferences, peer pressure, parental/school support and knowledge.[49] The successful implementation of an intervention is often determined by the time allocated to the programme and the perception of its importance by teachers and parents. For teachers, the main barrier to implementing school-based interventions is preparation time. For parents, the cost of fruit and vegetables is often cited as being too high, with many opting to buy items of food that are less nutrient rich but are guaranteed to be consumed, such as biscuits, sweets and crisps.[50]

Research has attempted to design complex interventions to improve the understanding and education of children regarding the importance of healthy eating. The complexity of these interventions is matched by the complexity of our relationship with food. Children's desires, and their understanding and knowledge of nutrition, come not only from the school and family environments, but also from different types of media, supermarkets, packaging and television advertising, all of which influence their nutritional preferences. Literature suggests that in highly populated areas, such as inner cities, a gap has been created between children's understanding of the processes of agriculture and the end result – the supermarket.[51,52] To increase children's intake of fruit and vegetables, it is necessary to increase children's general knowledge of fruit and vegetables. There is increasing evidence to suggest that gardening might be a vehicle for facilitating fruit and vegetable intake.[52–55]

Barriers to implementing a school garden

School gardens require long-term commitment from the schools, and often need community assistance from parents if they are to be sustained.[54] Another issue found is that some schools under study took too long to establish their school gardens, affecting the period of time available during the studies for plants to germinate and grow edible fruit or vegetables.[54] Environmental factors will also play an important role in the amount of food harvested. Schools are closed over the summer, which is the peak harvesting season; without organising staff to water the garden and carry out general garden maintenance, the hard work during term time can be lost. The length of time spent in the interventions will also affect the chances of long-term change in children's fruit and vegetable intake. Their consumption patterns are unlikely to be affected if their involvement in the actual intervention is limited.

The Royal Horticultural Society 'Campaign for School Gardening'

This report describes two RCTs designed to evaluate an existing gardening programme run by the Royal Horticultural Society (RHS) in England. The RHS is the largest gardening charity in the UK and has existed for over 200 years.[56] The 'Campaign for School Gardening' programme was launched in 2007, and since then has recruited over 11,500 primary schools in England. The main aims of the programme are to encourage schools to be involved in growing fruit and vegetables, to enrich the curriculum activities of the schools and to educate children in the values of gardening, such as 'healthy living' and 'sustainability of the natural world'.[56] The RHS intervention is delivered using two different approaches: a trained RHS advisor or class teachers. The RHS advisor provides intensive, hands-on support to a small number of schools. The advisor also trains class teachers to develop the school garden in twilight after-school training sessions.

Figure 1, based on the work conducted by Krølner *et al.*,[57] illustrates the theoretical foundation for this study. It explores some of the factors that could assist or prevent the success of the intervention in affecting the primary outcome, highlighting important environmental, social and personal determinants that affect children's nutritional behaviour. There are several determinants that are essential to changing a person's health behaviour.[58] Without changing a child's environment and access to fruit and vegetables, it would not be possible to change his or her overall intake. Watching parents, peers and teachers eating fruit and vegetables is pivotal in influencing children's dietary habits and preferences.[59] In addition, nutrition education, presented in the form of a gardening intervention, should aim to increase children's knowledge, creating the mechanisms necessary to increase overall intake.[60]

Nevertheless, to be able to determine the effect of the intervention it is necessary to explore its implementation. The method by which the intervention is implemented, in this case delivered to the schools by the RHS advisor or conducted by the teacher, can have an influence on the primary outcome. Understanding the degree of implementation of the intervention in each school is fundamental in explaining the effect of the intervention.[61] Finally, the information in *Figure 1* also illustrates the possible confounders (gender, age, ethnicity and socioeconomic status) that are associated with an effect on children's fruit and vegetable intake.

Summary

School gardening programmes may provide an interactive environment with the potential to change children's self-efficacy and willingness to try different fruit and vegetables. These changes in attitudes towards fruit and vegetables could lead to an increase in their actual consumption. Limitations of the existing research are the lack of RCTs and evaluation tools, and inadequate follow-up time. With the variability in quality of study design and validated tools to measure children's nutritional intake, further research is needed to determine the potential impact gardening interventions have on children's diets.

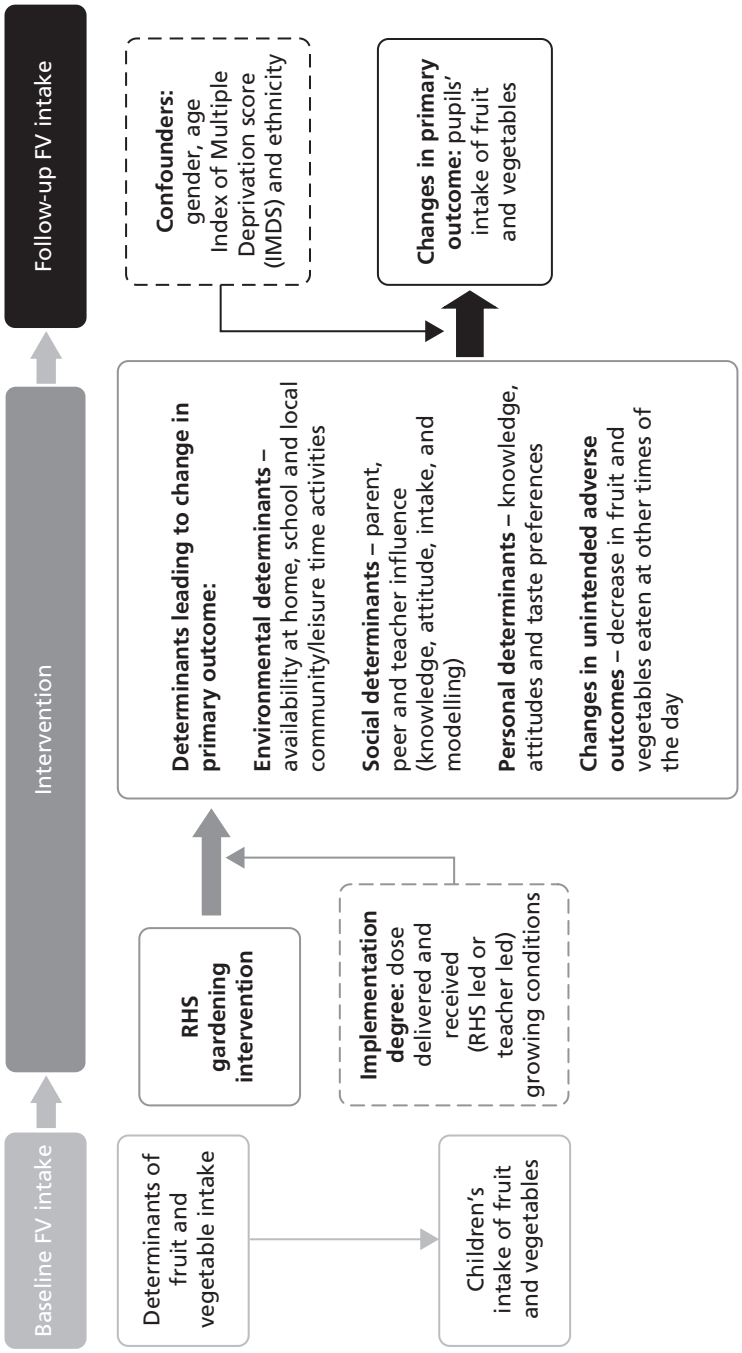

FIGURE 1 Path analysis diagram showing how the intervention could change children's fruit and vegetable consumption. FV, fruit and vegetable.

Chapter 2 Development and piloting of questionnaires

This chapter outlines the development of, modifications to and piloting of the data collection tools used in this study: the dietary assessment tool and DVD, child knowledge and attitudes questionnaire and the gardening process measures. It describes in detail the tools used to assess the primary and secondary outcome measures of the two trials. It also describes a pilot study conducted to confirm the suitability of language used in the questionnaires and to confirm the final data collection methodology for the trials.

The development of the data collection tools took place over two months from December 2009 until the end of January 2010. Ethical approval for the two trials was granted by the Leeds Institute of Health Sciences and the Leeds Institute of Genetics, Health and Therapeutics (LIHS/LIGHT) Joint Ethics Committee on 10 December 2009 (ref. number HSLT/09/012). The pilot study took place in two primary schools in Leeds in November 2009.

Primary outcome questionnaire

The Child And Diet Evaluation Tool

The primary aim of the two linked trials is to determine whether or not children who participate in the RHS advisor-led gardening intervention increase their fruit and vegetable consumption more than those who receive the teacher-led gardening intervention; or whether the teacher-led intervention increases their fruit and vegetable consumption more than no intervention at all. The effectiveness of either intervention (RHS advisor-led or teacher-led) will be determined by an increase in mean intake of one of the following: mean intake of fruit, mean intake of vegetables, or mean intake of fruit and vegetables at follow-up, after adjusting for baseline intake. Dietary intake, with a focus on fruit and vegetable intake, was measured using a modified version of the Child And Diet Evaluation Tool (CADET) questionnaire.[62] The main aim of the CADET diary is to collect accurate information on children's fruit and vegetable intake, whilst also collecting information on all foods that the children consumed in a 24-hour period.

Part one of the CADET diary comprises a list of 115 separate food and drink types, divided into 15 categories. The categories of foods are cereal (five items); sandwich/bread/cake/biscuit (10 items); spreads/sauces/soup (seven items); cheese/egg (six items); chicken/turkey (three items); other meat (nine items); fish (five items); vegetarian (three items); pizza/pasta/rice (eight items); desserts/puddings (three items); sweets/crisps (four items); vegetables and beans (18 items); potato (two items); fruit (13 items); and drinks (nine items). Part two consists of food-related questions to identify daily consumption of milk, bread, sugar, spreads and fruit juice. It also includes general demographic questions about the family household, questions about the children's and parents' attitudes towards fruit and vegetables, and the availability of fruit and vegetables at home.

Data collection methodology

To complete the diary, participants tick each item consumed under the appropriate mealtime heading within the 24-hour period. In previous research with children aged 3–7 years, trained fieldworkers filled in the CADET diary during the school day, and parents were asked to complete the diary for evening and morning food consumption.[63,64] CADET has been validated for use in children aged 4–7 years in comparison with a semi-weighed food diary collected on a school day, but it has not been used in children

aged 8–11 years, the age group of children in this study. After evaluation of previous studies,[63,65] the following modifications to the data collection methodology were made:

- The CADET diary was split into two: a school diary to record all food consumed at school, and a home diary to record all food consumed at home. These two versions of CADET were renamed as the school food diary and home food diary.
- Additional demographic questions were added to explore the home food environment.
- On the day after the food-recording day, the fieldworker went back to the school to collect the home food diary, and checked that it had been completed accurately. If a child forgot to return the home food diary a retrospective recall was taken by the fieldworker to record all evening meals and breakfast.

Justification for these changes came from the response rate of a previous study, 'Project Tomato'.[66] At baseline of Project Tomato, 3159 children took part in the study. Of these children, 280 never returned the CADET diary after it was sent home to be completed by their parents. This meant that the data collected during the whole day were lost, and no data were collected on these children. An additional 170 CADET diaries sent home to be completed by parents were returned without any of the sections completed. This reduced the sample size to 2709 – a loss of 450 children or 14%. Furthermore, when analysing the data collected from this study, children with a total energy intake of < 500 kcal or > 3500 kcal on the day of CADET administration were excluded. This led to a further 179 children being excluded. It was anticipated that some of these errors in data collection would be rectified after splitting the CADET diary into two diaries and having the fieldworker revisit the school to check that the home food diary had been completed.

Portion sizes for children aged 8–11 years

The dietary information from the CADET diary was transferred to a Microsoft Access spreadsheet (Microsoft Corporation, Redmond, WA, USA) using our established in-house software, named Diet And Nutrition Tool for Evaluation (DANTE) (Nutritional Epidemiology Group, Leeds). This used standard predefined algorithms to convert food items into total daily nutrient values for each child, based on the composition of foods.[67] Although the CADET diary upon which the school and home food diaries were based has previously been validated in children aged 3–7 years, it has not been used to collect dietary information in 8- to 11-year-olds. As this study includes children aged 7–10 years, it was necessary to change the standard portion sizes in DANTE to reflect the children's intake for each year of age (i.e. 8, 9, 10 and 11 years), and to account for differences in intake for boys and girls.

Methodology

Protocol for determining portion sizes for children aged 8, 9, 10 and 11 years

The portion sizes for ages 8, 9, 10 and 11 years were obtained from the National Diet and Nutrition Survey (NDNS) of young people aged 4–18 years.[68] The NDNS was conducted to explore food consumption and nutrient intake in the general population living in privately owned houses across Britain. The NDNS data are based on an interview and a 4-day food diary as well as blood and urine samples. The NDNS is the most detailed nutrition survey conducted across Britain. A recent update of the report (2008/09–2009/10) confirmed that the overall diet intake was similar to the previous findings. Owing to the validity of these data, it was decided that they would be used to update the CADET portion sizes for older children.[18]

From the NDNS data, the mean portion size, number of participants, standard deviation (SD), and maximum and minimum values were extracted. Nearly all the food items used in the CADET were available from the NDNS data and were then further broken down into each age category by gender. Whereas commonly consumed items such as apples and bananas were consumed by, on average, a higher number of participants in each age group (32 and 24 children on average per age group, respectively), several items were consumed by, on average, fewer than five participants per age group. For these foods, the portions had notably higher variation compared with those foods with a higher number of observations.

The likelihood that these portion sizes reflected those of the general population that consumed them was questionable. Furthermore, some food items, once broken down into age/gender categories, were found to have missing data. To improve the validity of those foods with low or missing numbers of participants, the rules in the following sections were applied.

Missing data

If any foods included in the CADET dairy were not available as specific codes/items on the NDNS database, then a similar food item was substituted.

Food items with, on average, fewer than five participants per age/gender category

If the item was consumed by fewer than five participants, on average, per age/gender category, an appropriate nutritionally similar food with an average of 10 or more participants per age/gender category would be obtained. The average of the two means would then be calculated in an attempt to reflect actual intake for each category.

An example of this is kiwi, which had, on average, only one person per age/gender category. It also had no value for girls aged 8 years. For kiwi, an average of kiwi and peach, nectarine, plum, apricot and mango was used to ensure a better representation of the average portion sizes for the different age groups consuming them, based on gender. The aim was to smooth out the data where there were extreme values based on one person, and to gain a more valid estimation of intake. For each food that was changed, a line graph was produced containing both the pre-existing food, for example 'kiwi', and the modified food, for example 'average of kiwi and peach, nectarine, plum, apricot and mango', to visually confirm that the portion sizes looked appropriate. The reason for doing so was to confirm the direction of change in consumption, as at different ages and for different foods, children can not only increase, but also decrease their consumption. *Tables 1* and *2* along with *Figures 2* and *3* show the portion sizes for children aged 3–11 years, to demonstrate the overall change in portion sizes by age.
The calculations of portion sizes as consumed were made only for children aged 8–11 years.

TABLE 1 Portion sizes for kiwi fruit as consumed, by age (girls)

	Portion size (g)								
Food item	Age 3 years	Age 4 years	Age 5 years	Age 6 years	Age 7 years	Age 8 years	Age 9 years	Age 10 years	Age 11 years
Kiwi fruit ($n = 8$)	46	74	43	70	63	93	68	75	0
Peach, nectarine, plum, apricot and mango ($n = 21$)	55	86	63	109	101	79	68	78	48
Average ($n = 29$)	46	74	43	70	63	86	68	76	48

TABLE 2 Portion sizes for kiwi fruit as consumed, by age (boys)

	Portion size (g)								
Food item	Age 3 years	Age 4 years	Age 5 years	Age 6 years	Age 7 years	Age 8 years	Age 9 years	Age 10 years	Age 11 years
Kiwi fruit ($n = 4$)	60	94	26	68	120	76	72	0	72
Peach, nectarine, plum, apricot and mango ($n = 23$)	92	80	94	69	83	79	60	48	60
Average ($n = 27$)	76	87	60	69	102	74	66	48	69

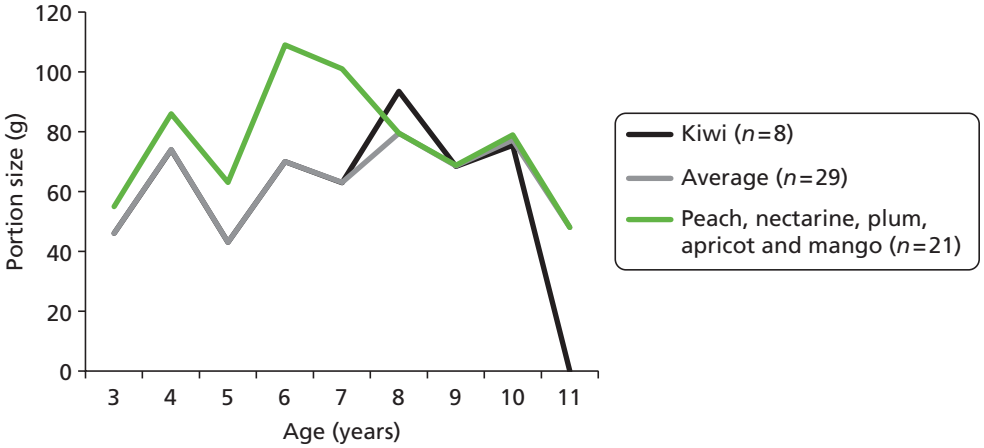

FIGURE 2 Girls' portion sizes by age, for different fruits in CADET.

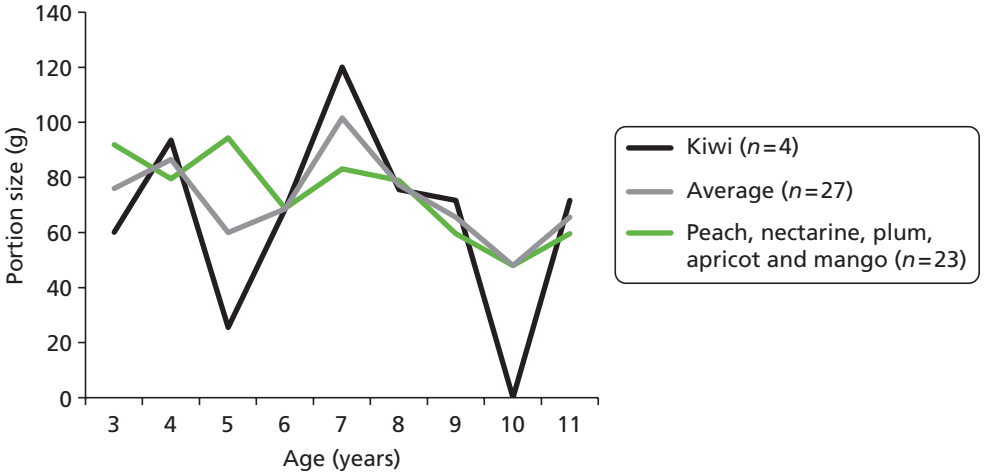

FIGURE 3 Boys' portion sizes by age, for different fruits in CADET.

Modifications

Of the 115 foods in the school and home food diaries, 21 had no dietary examples from the NDNS data and 16 had an average sample size of fewer than five participants. *Table 3* lists the food items from CADET that did not have a NDNS portion size, and the food groups used as a substitute to create an appropriate portion size for consumers. *Table 4* lists the foods with an average of five or fewer participants per age group in the NDNS data, and the food groups that were used as a substitute.

Table 5 shows the final portion sizes for all vegetables, as used in DANTE for the CADET diaries, for boys and girls across the different age groups. Overall, there is a general trend towards a small increase in vegetable consumption for both boys and girls. However, there is more variability between the different ages for both boys and girls in fruit intake (*Table 6*). Melon and watermelon portion sizes vary greatly between year groups; this could be a consequence of the infrequent consumption of both of these fruits. It was decided not to overmanipulate the data and to leave these portion sizes as they are, as the NDNS data are based on weighed intakes from a nationally representative sample.

TABLE 3 Foods in CADET with no portion size data from the NDNS for 8- to 11-year-olds, and the food and portions substituted

Food group	Substitute food portion	Portion size (g)							
		Boys aged 8 years	Girls aged 8 years	Boys aged 9 years	Girls aged 9 years	Boys aged 10 years	Girls aged 10 years	Boys aged 11 years	Girls aged 11 years
Chapatti/pitta bread/ wrap/roti	Bread sticks and garlic bread/naan/paratha	42	23	32	44	31	52	26	45
Cottage cheese	Cheese spread, triangles	26	22	24	22	26	23	36	25
Chicken in a creamy sauce	Other meats: stew, casserole, mince, curry or keema	139	159	144	118	115	115	164	151
Vegetable pie/pasty	Sausage roll, meat pie, pasty, fried dumplings	118	126	126	127	138	122	148	143
Samosa/pakora/bhajee	Vegetable pie, pasty	118	126	126	127	138	122	148	143
Quorn™/vegetarian mince/sausages	Sausage roll, meat pie, pasty, fried dumplings	66	69	64	69	77	69	82	72
Paneer (cheese curry)	Other meats: stew, casserole, mince, curry or keema	139	159	144	118	115	115	167	151
Fried rice	Boiled rice	132	100	143	120	151	134	172	122
Pasta with meat/fish and sauce	Average of pasta with a cheese sauce and pasta with tomato sauce	164	155	170	231	238	160	144	185
Stir-fried vegetables	Average of carrots, cauliflower and peas	46	47	53	56	67	63	61	53
Courgettes	Average of carrots, cauliflower and peas	46	47	53	56	67	63	61	53
Spinach	Lettuces	19	16	21	35	25	22	22	28
Parsnips	Carrots	44	38	44	52	55	54	49	47
Radishes	Average of peppers and salad	11	11	12	10	24	22	26	36
Leeks	Onions	15	15	15	28	26	23	35	20

continued

TABLE 3 Foods in CADET with no portion size data from the NDNS for 8- to 11-year-olds, and the food and portions substituted (*continued*)

Food group	Substitute food portion	Portion size (g)							
		Boys aged 8 years	Girls aged 8 years	Boys aged 9 years	Girls aged 9 years	Boys aged 10 years	Girls aged 10 years	Boys aged 11 years	Girls aged 11 years
Other vegetables	Average of carrots, cauliflower and peas/sweetcorn	46	47	53	56	67	63	61	53
Lentils/dahl	Peas and sweetcorn	42	36	59	55	69	46	59	52
Other beans	Brussels sprouts	42	36	59	55	69	46	59	52
Pineapples	Grapes	84	58	61	105	40	90	85	90
Other fresh fruit	Peaches, nectarines, plums, apricots, mangoes and average of strawberries/grapes	100	92	111	72	88	89	71	97
Mousse/milk/ rice puddings	Custard	97	91	109	105	112	80	146	104

TABLE 4 Foods with an average of fewer than five NDNS participants per age group, and foods used to substitute the missing data

Food group	Substitute food	Portion size (g)							
		Boys aged 8 years	Girls aged 8 years	Boys aged 9 years	Girls aged 9 years	Boys aged 10 years	Girls aged 10 years	Boys aged 11 years	Girls aged 11 years
Croissants/waffles/ Pop-Tarts®	Crumpets/pikelets/scotch pancakes	52	54	52	53	67	57	65	52
Nuts	Dried fruit	35	54	23	36	31	38	49	34
Quiche	Sausage roll, meat pie, pasty, fried dumplings	77	80	77	79	76	81	79	84
Corned beef, luncheon meats/salami	Ham	52	31	32	39	64	52	49	40
White fish (not fried)	Fish in breadcrumbs and fishcakes	80	78	112	81	83	79	83	62
Shellfish, e.g. prawns/mussels	Tuna and other oily fish	44	33	56	50	54	54	45	47
Offal	Ham	24	18	28	27	63	47	38	39
Celery	Salad vegetables	27	8	17	33	24	22	26	36
Peppers (red, green, yellow)	Salad vegetables	15	8	15	38	23	19	16	25
Strawberries/raspberries	Grapes	107	104	128	105	93	99	82	90
Pears	Apples	130	123	127	95	108	114	123	115
Melons/watermelons	Bananas	199	167	138	220	171	133	102	140
Kiwi fruits	Peaches, nectarines, plums, apricots, mangoes	76	87	60	69	102	77	66	48
Sugar-coated cereals	High-fibre cereals, e.g. bran flakes, Weetabix®, Shreddies®	43	40	18	36	17	38	46	46

TABLE 5 Portion sizes of vegetables for boys and girls aged 8–11 years

Food	Portion size (g)							
	Boys aged 8 years	Girls aged 8 years	Boys aged 9 years	Girls aged 9 years	Boys aged 10 years	Girls aged 10 years	Boys aged 11 years	Girls aged 11 years
Baked beans	95	97	112	97	113	92	104	104
Broccoli, Brussels sprouts, cabbages	50	59	53	52	68	56	60	67
Carrots	42	32	40	58	54	56	41	42
Cauliflowers	52	66	54	61	78	88	75	61
Celery	27	8	17	33	24	22	26	36
Coleslaw	47	44	47	35	42	38	64	42
Courgettes	46	47	53	56	67	63	61	53
Cucumbers	32	27	25	34	23	31	25	28
Leeks	15	15	15	28	26	23	35	20
Lentils, dahl	42	36	59	55	69	46	59	52
Mixed vegetables	42	36	59	55	69	46	46	52
Other beans, pulses	42	36	59	55	69	46	59	52
Other salad vegetables	19	16	21	35	25	22	22	28
Other vegetables	46	47	53	56	67	63	61	53
Parsnips	44	38	44	52	55	54	49	47
Peas, sweetcorn	42	36	59	55	69	46	59	52
Peppers (red, green, yellow, etc.)	15	8	15	38	23	19	16	25
Radishes	11	11	12	10	24	22	26	36
Spinach	19	16	21	35	25	22	22	28
Stir-fried vegetables	46	47	53	56	67	63	61	53
Tomatoes	69	75	24	64	33	69	47	41

TABLE 6 Portion sizes of fruit for boys and girls aged 8–11 years

Food	Portion size (g)							
	Boys aged 8 years	Girls aged 8 years	Boys aged 9 years	Girls aged 9 years	Boys aged 10 years	Girls aged 10 years	Boys aged 11 years	Girls aged 11 years
Apples	123	117	117	122	120	114	123	115
Bananas	104	93	110	119	114	119	102	116
Dried fruit	35	54	23	36	31	38	49	67
Fruit salad (tinned or fresh)	107	104	128	105	93	99	82	90
Grapes	84	58	61	105	40	90	85	90
Kiwi fruits	76	87	60	69	102	77	66	48
Melons	199	167	138	220	171	133	102	140
Oranges, satsumas, etc.	132	160	117	137	105	140	84	57
Other fruit	100	92	111	72	88	89	71	97
Peaches, nectarines, plums, apricots, mangoes	92	80	94	69	83	79	60	48
Pears	130	123	127	95	108	114	123	115
Pineapples	84	58	61	105	40	90	85	90
Strawberries, raspberries, etc.	107	104	128	105	93	99	82	90

Additional demographic questions

There were several questions added to part two of the CADET diary. The first set of questions explored the availability of fruit and vegetables at home, and children's and parents' fruit and vegetable consumption habits. An example question is 'do you buy a specific fruit/vegetable because your child asked for it?' The parents were presented with the response options of 'yes, always', 'yes, most days/often', 'sometimes', 'rarely' and 'never'. These questions were based on the existing literature.[69] This research explored the availability and accessibility of fruit and vegetables in the home environment. Test–retest reliability was conducted in five different European countries: Norway, Spain, Denmark, Portugal and Belgium. The intraclass correlation coefficient was 0.6, suggesting that it is a reliable tool to use in primary school-aged children.[70]

A second set of six questions was added regarding the family's fruit and vegetable intake. These questions were developed from a previous study,[71] and addressed parents' reasons for buying fruit and vegetables for their families and the importance of buying fruit and vegetables. One such question addressed the 'price of fruit and vegetables'; parents were provided with the options of 'very important', 'important', 'neither unimportant or important', 'unimportant' and 'very unimportant'.

The third and final question that was added to the home food diary was a request for an inventory of fruit and vegetables that were in the house on the evening the diary was completed. This question listed common fruit and vegetables consumed and asked the parents to tick any that were currently in their food cupboards or fridge. There was also a section designated 'other' for any items that were not listed.

These questions in part two were included to provide some understanding of the home food environment, providing us with insight into the availability of fruit and vegetables, and parents' attitudes towards fruit and vegetables. This insight is crucial, as the home food environment is a key influence on children's food intake.[72]

Development of the home food diary instruction DVD

Previous studies that have implemented the CADET diary to measure dietary intake have identified that parents and children with low literacy or English as a second language struggle to complete the diary.[64] Although the CADET diary had two pages of simple instructions on how to complete it, it was evident that some participants still did not understand what was required of them. Sometimes children or parents would complete the diary, ticking every item in the diary that the child liked, rather than only those foods that the child had eaten that day. Some did not complete the CADET at all, and simply did not return it to the school, despite several reminders. To improve accuracy and completion of the home food diary, the concept of creating an instructional DVD for parents and children to watch was developed (*Figure 4*).

The DVD script was written with the aim of encouraging children and parents to watch the DVD together. It used a cartoon character to explain each step of the diary, while showing the actual diary on-screen for parents and children to follow. The script was written by MSC with input from PhD supervisors, with the aim of introducing the study to the audience and explaining how to complete the home food diary, step by step. The main aims of the script were to introduce the study, remind the children to make sure their parents were watching, demonstrate how to complete the diary for each meal, explain what 'part two' questions consisted of and remind participants to return the diary to school the next day. It also provided a contact number for parents to ring if they had any queries.

It was decided that a cartoon character would be the narrator and would resemble the characters used by the Nintendo Wii™ console. The cartoon character was a tomato called 'Tom the Tomato', which had a head like a tomato and a red body, alive in a plant pot. The concept behind using a cartoon character was to make the DVD child-friendly so that hopefully children and parents would find it interesting.

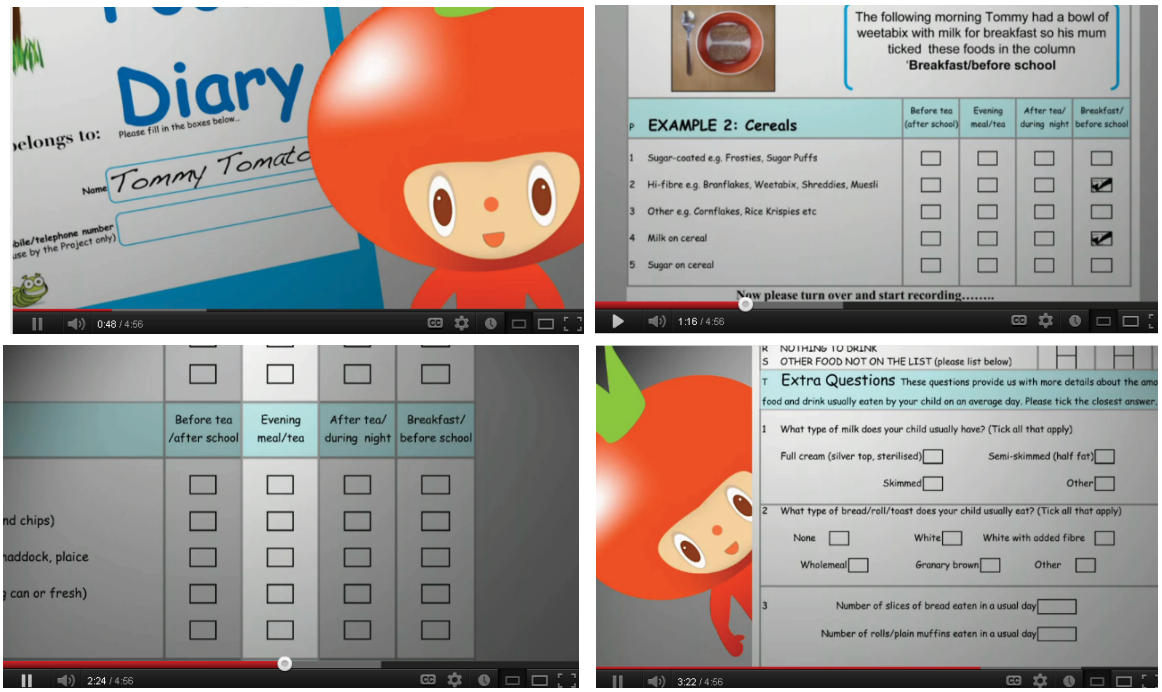

FIGURE 4 Images from the CADET DVD. © University of Leeds. Reproduced with permission.

To construct the DVD, Leeds Media Service were contracted. It was decided that the voice of Tom the Tomato would be a child's voice, and Emily Cade, who was 16 years of age, was recruited as she had a clear speaking voice with very little regional accent. The total length of the instruction DVD is 5 minutes. The end product is a useful tool for anyone completing the home food diary questionnaire as it both 'verbally tells you' and 'visually shows you' how to be complete the form (see https://youtube.googleapis.com/v/AIbzqaJiHq0%26hl=en_US%26fs=1%26rel=0%26hd=1).

Secondary outcome questionnaires

Development of the questionnaire on knowledge and attitudes towards fruit and vegetables

One of the secondary outcome measures was 'Can participating in a school gardening intervention improve children's ability to identify specific fruit and vegetables and their attitudes towards fruit and vegetables?'

Since the RHS gardening intervention is an educational resource that teaches children about fruit and vegetables through gardening, it has the potential to have an impact on children's general knowledge of fruit and vegetables. Therefore, one of the other main aims of this study was to explore change in children's knowledge and attitudes towards fruit and vegetables, to see if there was a difference from baseline to follow-up. A short questionnaire was developed to identify children's knowledge and attitudes towards fruit and vegetable consumption, and to assess gardening activity levels (see *Appendix 1*, *Child knowledge and attitudes questionnaire*). The knowledge questions assessed children's ability to recognise different fruit and vegetables. Children were presented with a list of 13 fruits, 17 vegetables and one herb, with a colour picture for each, and were asked to draw a line connecting each name with the right picture. The attitude questions were based on previously validated research.[73] Children were asked if they agreed or disagreed with ideas about fruit and vegetables, and were presented with a list of 10 statements, five of these about fruit and five about vegetables. An example is 'I enjoy eating fruit'. The children had to circle one of four options: 'agree a lot', 'agree a little', 'disagree a lot' or 'disagree a little'. Images of smiley, neutral or sad faces were presented above each statement to help the children work out their response.

The gardening questions assessed the children's gardening experience, in terms of what they have grown and what they have tasted. The children were asked to confirm if they had done any gardening ('yes' or 'no') and then write in the space provided if they had grown any fruit or vegetables. They were then asked to confirm if they had tasted any of the fruit or vegetables they had grown ('yes' or 'no') and to write down what they had tasted.

To assist with the varying levels of reading ability, this questionnaire was read out to the children as a class, to help them with any difficult words. Furthermore, the teachers and teaching assistants were encouraged to help those children who might struggle with this task, and children were encouraged to put their hands up if they had any questions.

Process measures questionnaires

There were two process measures components for this study; the first was a gardening telephone interview, to identify current level of gardening activities within the school (see *Appendix 1*); the second was a gardening activity process measures questionnaire to identify the gardening activities that had taken place in each academic year in each school.

School gardening questionnaire

The school gardening questionnaire was a telephone interview. It was designed to identify the school's baseline gardening level. This questionnaire was based on the RHS benchmarking scheme, which ranks schools in the following categories: (1) planning, (2) getting started, (3) growing and diversifying,

(4) sharing best practice and (5) celebrating with the wider community. The schools were asked a series of questions to identify different aspects of gardening currently occurring in their school garden. The questions were focused on the following aspects of gardening in schools: school culture and ethos, the school garden, teaching and learning, and community. Within each of these areas there were several questions that reflected different levels of development within school gardening relating to the five stages of developing a school garden. These questions were adapted as simple 'yes or no' questions to be used in a telephone interview. The interviewee was the school staff member who was most involved in the school garden within each school. The questions were structured according to the five categories.

Gardening activity process measures questionnaire

The aim of the gardening activity questionnaire was to identify the level of adherence to the intervention by the schools involved, and to identify any gardening activities that are being undertaken by the control schools. The main aim of the process evaluations was to capture which fruit and vegetables each school grows and harvests. They also aimed to identify which year groups had been involved in the garden each year, whether or not they had started a growing or environmental club, and to find out if the schools had any success or failure stories around the school garden. This information was captured via e-mail in September 2010 for trial years 1 and 2, and again in September 2011 for both trials.

For the schools involved in the RHS intervention, more in-depth information about their intervention activities was captured by the regional advisor and was used to outline changes in school gardening. From this, the level of involvement in the intervention by each school and their adherence to the intervention was identified, as well as success and failure stories reported by the regional advisor himself.

For trial 2 intervention schools, another process measure captured was the level of involvement in the twilight sessions, whereby the regional advisor kept a record of the teacher's attendance. With this type of intervention, schools were expected to tailor the intervention to their individual needs. By monitoring what activities are undertaken in the school garden, aspects of the intervention that could be associated with dietary change were identified.

Questionnaire development summary

The main aim of the dietary assessment tool was to collect information on children's fruit and vegetable intake, while also collecting information on all the food the children consumed in one 24-hour period. Whereas one 24-hour food diary has been used previously, for this study CADET was changed and modified into a school food diary and a home food diary, to improve the response rate for the home food diary. Furthermore, the portion sizes used to analyse the children's food intake were changed to reflect the age- and gender-related portion sizes of the sample. A DVD was also designed to help parents and children understand how to complete the home food diary. The final modification was a change in the administration of the diaries, with the fieldworkers returning to each school the day after collection, to collate and check the diaries and to identify any that had not been completed properly. An additional step was to collect a dietary recall of food and drink consumed at home from children who had not returned their diaries that day.

To ensure that these portion sizes reflected actual dietary intake, it was necessary to test this instrument – the home and school food diaries – against an appropriate reference measurement, such as a 1-day weighed record in children of the relevant ages in Years 3, 4, 5 and 6.[19,74]

Additional questionnaires were designed to measure the secondary outcome measures for this study:

- a child knowledge and attitudes questionnaire
- a gardening telephone interview questionnaire
- a gardening in schools process measures questionnaire.

These questionnaires were designed to capture important information to evaluate the effectiveness of the RHS gardening intervention, through evaluating children's learning and knowledge with a focus on fruit and vegetables, capturing change in schools' gardening involvement based on RHS gardening levels and assessing implementation of the intervention or other gardening activities in schools. Examples of all questionnaires can be found in *Appendix 1*.

Piloting baseline materials

Owing to the changes made to the original CADET diary, the collection method and the development of the new questionnaires (including the child knowledge and attitudes questionnaire) as well as the instruction DVD, it was necessary to pilot these materials. Two primary schools in West Yorkshire were recruited to be involved in a pilot study of the collection procedure and the new materials, namely the school and home food diaries, the child knowledge and attitudes questionnaire, the school gardening questionnaire and the instructional DVD.

The aims and objectives of the pilot study were:

- to determine whether the DVD should be shown in the classroom at school, or sent home with the children for them and their parents to watch together
- to confirm that the questionnaire was age-appropriate in terms of language used and layout, and to identify whether or not there were any questions that children struggled to answer
- to test the new data collection protocol and explore the potential benefits of having the fieldworkers check the home food diary the following day.

Methodology

Study population

A total of 74 Year 3 and 4 children from two local primary schools in Leeds (mean age 8.4 years) participated in the pilot study. This involved three different class groups: one Year 3, one Year 4 and a mixed Year 3 and 4 class. To evaluate whether the DVD should be sent home or viewed in school, one class was allocated to receive the DVD to watch in class, another was allocated to be given the DVD to take home and the third class was allocated not to receive the DVD at all.

Masters students in nutrition were recruited and trained to administer the CADET diaries and the child knowledge and attitudes questionnaire. The students were asked to record everything the children ate at school by completing the school food diary, and then to go through the child knowledge and attitudes questionnaire as a class. At the end of the school day, one class of children was given the home food diary, one class was asked to watch the DVD before they were given the home food diary, and the final class was given the DVD and the home food diary and asked to watch the DVD with their parents.

Results

A total of 74 children were invited to participate in the pilot study, of which 62 parents agreed to let their children participate. The results from this study are presented in *Table 7*.

Home food diary and instruction DVD

One of the aims of the pilot study was to evaluate whether the DVD should be shown in the classroom at school, or sent home with the children for them and their parents to watch together; there were concerns about children forgetting to return the DVD to the school the next day, and losing the DVD. The results indicated that children who received the DVD to take home and watch with their parents had a higher home food diary return rate (83%) compared with those who watched the DVD in class (73%) or did not receive the DVD (52%). Of those parents who confirmed that they had watched the DVD, all completed the home food diary correctly. Therefore, it was decided that all children should receive the DVD to take home and watch with their parents to improve the quality of the data collected.

School food diary

The fieldworkers were also required to complete the school food diary for all the children in the pilot study. It was brought to our attention that Yorkshire pudding was not included in the school food diary, as one school had it as part of its school dinners; it was then added to both the school and home food diaries. There was also a comment from one of the parents about the home food diary; they stated that they would prefer their ethnicity to be classified as 'British Asian' rather than 'Asian British'. This was rectified.

Data collection protocol

On the second day of data collection, the fieldworkers had two tasks: (1) to check that the home food diary was completed properly, and (2) to complete a diet recall for those children who did not return the home food diary. These results reveal that 25% of the total sample did not return the home food diary. Of the children who were allocated to watch the DVD with their parents, only 17% needed a diet recall to be taken, compared with 27% of those who watched the DVD at school and 42% of those who did not receive the DVD.

TABLE 7 Pilot study results

Allocation of DVD	Response rate, *n* (%)	Boys, *n* (%)	Year level	Returned the home food diary, *n* (%)	Home food diary recalls, *n* (%)	5 A DAY 'correct' answer, *n* (%)[a]
Received the DVD to take home ($n = 33$)	30 (90)	13 (43)	3 and 4	25 (83)	5 (17)	19 (63)
Watched the DVD at school ($n = 22$)	15 (68)	9 (60)	3	11 (73)	4 (27)	8 (53)
No DVD given ($n = 19$)	17 (89)	10 (59)	4	8 (42)	9 (53)	9 (53)

a Children who reported consuming at least five portions of fruit or vegetables per day in the child knowledge and attitudes questionnaire.

Knowledge and attitudes questionnaire results

To assist with the psychological questions and the variability in children's reading ability, the knowledge and attitudes questionnaire was read aloud to the children and completed together as a class. Teachers were encouraged to assist any children who they thought might struggle with completing the questionnaire.

Administration of the questionnaires was successfully completed. There were six different sections in the child questionnaire. There was only one section which children struggled to complete; this was section 4, containing psychological questions about gardening and fruit and vegetable self-efficacy. Children were asked to respond 'agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot' to each of these questions (presented in *Table 8*). In view of the feedback from fieldworkers, five of the questions were removed. Furthermore, a smiley face or sad face was added under the different options ('agree a little', etc.) to help children choose how to respond to each of these questions.

The results also revealed that, on average, when asked how many fruit and vegetables one should eat every day to stay healthy, 52% of the children were not aware that they should consume at least five portions of fruit and vegetables a day.

TABLE 8 Psychological questions included on the child knowledge and attitudes questionnaire

Question	Question removed?
I like trying new fruits	No
I like trying new veg	No
Eating fruit and veg every day keeps me healthy	No
Most fruit tastes bad	Yes
We have veg with dinner most nights	Yes
There's usually lots of fruit and veg snacks at home	Yes
I'm good at preparing fruit and veg	No
I like raw veg	Yes
We grow fruit or veg at home	Yes
My parents encourage me to eat fruit and veg	No
I enjoy eating fruit	No
I enjoy eating vegetables	No
I try to eat lots of fruit	No
I try to eat lots of vegetables	No
I find it easy to eat lots of fruit	No
I find it easy to eat lots of vegetables	No

Discussion

Accurately measuring children's energy and nutrient intake is challenging, especially in a large trial such as this, as there are always benefits and limitations of any nutritional assessment tool. Research suggests that children are aware of what they consume from around 8 years old.[75] For primary school-aged children, parents are often used to collect the dietary information as the children themselves are considered too young to collect accurate dietary data. However, dietary analysis is prone to many forms of measurement error.[76] CADET has been validated in an ethnically diverse population[62] and has been used to evaluate large intervention studies. These include the national free school fruit scheme in primary school children,[63] and a large national RCT of an intervention to maintain fruit and vegetable eating in Year 3 children once they are no longer eligible for free fruit.[77,78] The style of CADET, using a simple tick-box list, is considered an appropriate tool for people with low literacy who struggle to record or weigh what they eat. The main benefit of using a 24-hour tool is that it is easy to complete in a large sample at a relatively low cost.[79] This style of nutrition analysis will capture the mean intake of a population, and is the standard method used for intervention evaluation. The disadvantage of 24-hour data is that they cannot be used to analyse individual intake, as the instrument is not sensitive enough to identify individual differences in dietary patterns.[50,79] Nevertheless, CADET has been proven to be a valid tool for evaluating intervention studies in trials,[62,64,77] and it is an effective way to capture fruit and vegetable intake in children.

There were three main aims of the pilot study. The first was to determine whether the children should take the DVD home to watch, or watch it at school. The results revealed that children and parents who watched the DVD together had a higher response rate than children who watched the DVD at home on their own, or who did not watch the DVD at all. The second aim was to test the child knowledge and attitudes questionnaire, to confirm that the questionnaire was age-appropriate in terms of language used and to identify whether or not there were any questions that children struggled to answer. This identified that children struggled with some of the psychological questions, such as 'We have veg with dinner most nights' and 'There's usually lots of fruit and veg snacks at home'; therefore, these questions were removed. The final aim of the pilot study was to test the new protocol methodology. On the second day of data collection, 18 (25%) of the children did not bring back a home food diary; if the fieldworkers had not conducted a recall, then 25% of the sample diet data would have been lost. The fieldworkers also provided positive comments regarding conducting the diet recall. This is supported by other research which states that children are aware of what they consume from around 8 years of age, the mean age of the trial children.[80]

Overall, the aims of the pilot study were achieved, and the results were able to provide important feedback in the development of the necessary tools needed to evaluate the RHS gardening intervention.

Summary

This chapter has discussed the methodology used in designing the data collection tools for this study. It also discussed the pilot study conducted in Leeds and the changes made as a consequence of this process.

The pilot study revealed that it was beneficial for parents to watch the DVD at home with their children, when compared with children who watched the DVD at school or not at all. It also highlights some of the psychological questions that children in Years 3 and 4 struggled to understand, and some minor changes made to the food diaries. These changes and additions to the collection methodology aim to improve the overall response rate and quality of the data collected.

Chapter 3 Methodology

This chapter outlines the general methodological components that applied to both trials. It will discuss:

- sampling and recruitment of schools (inclusion and exclusion criteria)
- sample size calculation
- randomisation methodology
- training of fieldworkers to collect the baseline and follow-up data
- the two interventions: RHS-led and teacher-led
- data cleaning methodology.

It should also be noted that this chapter is based on a published protocol written by MSC.[81]

Sampling and recruitment of schools

It is RHS policy to provide support to all schools that register an interest in the campaign. As a consequence of this, two linked trials were required. All schools in the London boroughs supported by the RHS (Tower Hamlets, Greenwich, Wandsworth and Sutton) would be given access to either the regional advisor or twilight teacher training sessions. These boroughs represent two relatively deprived areas and two less deprived regions in London. A second set of schools from adjacent boroughs was recruited by the research team into trial 2 and randomised to receive the twilight teacher training or no RHS gardening intervention.

Addresses of all schools were supplied by the local education authority of the nominated London boroughs for each trial; the schools were then sent a recruitment letter (see example provided in *Appendix 2*). Schools were asked to reply, providing information on their gardening activities. These responses were checked by both the University of Leeds team and the RHS Campaign for School Gardening manager before randomising the schools to one of the interventions or the comparison group.

Trial 1: Royal Horticultural Society-led intervention versus teacher-led intervention

The RHS introduced its Campaign for School Gardening to schools in the London region in the autumn of 2009. The RHS campaign provided intensive support to 10 schools in each region through support from an RHS School Gardening Regional Advisor (the RHS-led intervention). The remaining schools had access to support through twilight training sessions for staff and other activities (the teacher-led intervention). A sample size of 10 schools received the RHS-led intervention, as this was the maximum number of schools that could be supported by one regional advisor. Further details of the intervention components are discussed later in this chapter.

Twenty-six schools from four boroughs in London (Wandsworth, Tower Hamlets, Greenwich and Sutton) were recruited for trial 1. Of the 26 schools, 10 were randomly allocated to receive the RHS-led and 16 to receive the teacher-led intervention. The allocation sequence was generated using Stata Version 11 (StataCorp LP, College Station, TX, USA). All schools were allocated at the same time. It was not possible to randomise schools in trial 1 to receive no intervention at all owing to RHS policy.

Rationale for trial 2

In trial 1 it was not possible to randomise schools to receive no intervention at all (control/comparison group) as it is RHS policy to provide support to all schools who register an interest in the campaign. As a consequence of this, the second set of schools was recruited into a linked trial, trial 2, to provide a 'no intervention' arm, i.e. a comparison group.

Trial 2: teacher-led versus delayed intervention

Thirty-two schools from four boroughs in London (Lewisham, Lambeth, Merton and Newham) were recruited for trial 2. These boroughs are adjacent to the trial 1 boroughs. Of these schools, 16 were randomly allocated to receive the teacher-led intervention and 16 were used as comparison schools. The comparison schools received no active intervention during the trial. However, they were informed that once the study ended follow-up collection in February 2012, they would be able to attend the twilight sessions offered to the teacher-led schools.

It was not possible to blind the schools to their intervention group because of the nature of the intervention. The fieldworkers were blinded to the allocation of schools to the intervention (RHS-led or teacher-led) and comparison arms of the study.

Study population

Trial 1 inclusion criteria

All non-fee-paying primary schools within four London boroughs (Wandsworth, Tower Hamlets, Greenwich and Sutton) with classes in Key Stage 2 (Years 3–6; children aged 8–11 years) were invited to take part in the study.

Trial 2 inclusion criteria

All non-fee-paying primary schools within four London boroughs (Lewisham, Lambeth, Merton and Newham) with classes in Key Stage 2 (Years 3–6; children aged 8–11 years) were invited to take part in the study.

Exclusion criteria for trials 1 and 2

Independent schools, special schools, schools without all four year groups in Key Stage 2 at primary school (Years 3–6) and small schools with fewer than 15 pupils per year group were excluded.

Proposed sample size

Based on our previous school-based trial, Project Tomato,[65] the SD for daily consumption in this age group was estimated to be 85 g for vegetables and 143 g for fruit, with an associated intraclass correlation coefficient of 0.125 for vegetables and 0.114 for fruit. With the proposed sample of one Year 3 class and one Year 4 class from each school, the sample size needed to detect a half-portion (40 g) difference in vegetable intake with 90% power would be 627 children per group, approximately 13 schools.[82] To have 90% power to detect a one-portion difference in fruit intake (one portion = 80 g), 482 children per group would be required, i.e. about 10 schools.

The Project Tomato research identified that approximately 75% of participants completed the dietary questionnaire at baseline and follow-up; therefore, to allow for possible withdrawals and children changing schools, it was decided that 16 schools would be randomly allocated to each group, except for the RHS-led intervention, where the sample size requirements were determined by the staffing levels at the RHS. As a consequence, the RHS-led group had a sample size of 10 randomised schools only, which was carried out by the trial research team.

Discontinuation criteria

Analysis followed the principle of intention to treat. Therefore all schools and children are included in the analysis according to the group to which they were initially randomised. All reasonable and ethical steps were taken to ensure completeness of follow-up of outcome measures.

School withdrawal

If a school wished to withdraw from the trial, the study team would post a data collection form to the head/class teacher along with a freepost envelope. The data collection form would record the following: reasons for withdrawal; whether or not anything could have been done to make taking part in the study easier; confirmation that they no longer wanted to take part in the intervention and receive information/training/materials; and whether or not they still allowed us to use data collected to date and to collect data at round two (i.e. follow-up collection) in October 2011.

Child withdrawal

This occurred if a parent requested to remove their child from the trial. It was anticipated that this request would go to the school, the RHS or the study team at the University of Leeds. Whoever was the first point of contact with the parent was required to inform the other relevant groups (school/RHS/University of Leeds) by telephone, letter or e-mail. A record of any child withdrawals was kept in the database. On receipt of this information, the study team would send a letter to inform the class teacher that the child was to be withdrawn from the study. A data collection form and freepost envelope would be sent via the class teacher to the parent. A covering letter would make it clear to the parent that although the child would not receive any self-study or home-based materials, he or she would not be left out of whole-class activities, as to do so would involve taking the child out of the class while these activities were occurring. The parent would be asked to complete the data collection form and post it back to the Nutritional Epidemiology Group at the University of Leeds in the freepost envelope.

Assessment of harm

On rare occasions, children or schools may need to discontinue the randomised intervention. This may, in most cases, be only a temporary withdrawal; for example, if a child injures him or herself with a spade. Minor adverse reactions were not considered grounds for discontinuing. However, these events were captured either by the RHS regional advisor for the RHS-led schools, or by the Nutritional Epidemiology Group team, through the process measures e-mail, for the teacher-led schools. All adverse events were reported to the Trial Steering Committee. The same notification procedures applied for school or individual withdrawal.

Interim analysis and stopping rules

No interim analyses of trial outcomes were planned.

Randomisation

Cluster randomisation, with school location and borough to identify each ‘cluster’, was used to randomise the schools. The schools were randomised by the study team by geographic location of their London borough and using Stata. From each primary school, one Year 3 class and one Year 4 class was asked to consent to be part of the trial. These classes were randomly selected if there was more than one class in that particular year group.

General considerations

All data collected from these two trials have been reported and presented according to the revised CONSORT statement in *Chapter 6*.[83]

Ethical approval

Ethical approval was obtained through the University of Leeds Research Ethics Committee in 2009. Written informed consent was obtained first from all schools and then from all parents whose children were in the classes chosen to participate in the trial data collection. Schools and parents were informed about the potential risks and benefits of participating in the trial through the information sheet. Participants’ parents gave informed consent, with the opportunity to ‘opt out’ of the study if they did not wish their child to take part. If the parents did not wish their child to participate in the study, the child was still able to take part in the growing activities in the class; however, his or her food intake and child knowledge and attitudes questionnaire were not recorded.

The intervention: the Royal Horticultural Society Campaign for School Gardening

Intervention definitions

- *RHS-led intervention* These schools received an intervention delivered by the RHS regional advisor.
- *Teacher-led intervention* Staff from these schools attended twilight sessions of the garden programme at a nearby participating school. The twilight sessions were run by the RHS regional advisor.

The Campaign for School Gardening aims to:

- inspire and empower schools to get growing and to give children the chance to grow and create gardens
- demonstrate the value of gardening in enriching the curriculum, teaching life skills and contributing to children's mental and physical health
- convince everyone involved with education in schools of the value of gardening in developing active citizens and carers for the environment
- understand the importance of plants and show how gardening can contribute to a sustainable environment.

The Royal Horticultural Society-led intervention

The RHS Campaign for School Gardening consisted of two programmes. The RHS-led intervention schools received the following:

- a day visit from the RHS regional advisor each half-term to work in the garden with teachers and children (summer term 2010 to summer term 2011 inclusive)
- follow-up visits to aid planning by the teachers who were leading the gardening activity (autumn term 2011 to autumn term 2012)
- general ongoing advice on the school garden, and free seeds and tools
- one twilight teacher training session each term (summer term 2010 to summer term 2011 inclusive), based on seasonal tasks in the school garden (open to RHS-led schools' teachers and others from local schools)
- free access to a wide range of teacher resources at www.rhs.org.uk/schoolgardening/.

The role of the regional advisor was to assist the schools in developing a successful garden, through working directly with teachers and pupils to give them support and practical advice (*Figure 5*).

FIGURE 5 The RHS regional advisor seed sowing at one of the RHS-led schools. Photograph © RHS. Reproduced with permission.

They were also expected to help overcome barriers to developing gardening within schools. The regional advisor had the expertise and experience to tie in gardening and growing activities with the national curriculum and to run staff training sessions for teachers. The key tasks of the regional advisor were to:

- deliver advice and support to schools in setting up school gardens and growing projects
- promote the RHS Campaign for School Gardening by contacting schools, local education authorities and partner organisations and by giving talks and demonstrations
- train teachers in practical skills to grow plants and harvest crops
- build community links and recruit volunteers to enable the wider community to support and get involved in school growing projects
- contact, advise and support schools within the region by means of visits, e-mails and phone calls
- make links with partner organisations and recruit volunteers to support schools in setting up school gardens and growing plants
- run termly twilight training session courses at 10 school venues throughout the year.

An example of some of the work conducted in one of the RHS-led schools is described below.

- Embedding gardening in the school in order to attain all the benefits which that brings (e.g. most pupils never have access to gardening, as they do not have gardens themselves).
- Establishing a community garden which helps to deal with some of the difficult issues faced in the 'forgotten estate'.
- Redeveloping the school garden (to be used for class growing).
- Creating simple beds, paths, a fence, and later possibly a greenhouse.
- Digging a pit for the nursery to prevent the raised bed being 'dug'.
- Clearing the community allotment garden ('secret garden'). The community garden is to be used for project work, teaching (e.g. about life cycles in a wildlife area) and community beds, and for use by learning mentors to work with children who have learning difficulties and/or behavioural issues.

The two images in *Figure 6* below demonstrate the before-and-after effect of the RHS-led intervention in one of the 10 RHS-led schools.

The teacher-led intervention ('teacher-led schools')

The teacher-led intervention schools worked with the RHS by attending termly twilight training at a nearby RHS-led school, to help support them in developing and using their school gardens. Unlike the RHS-led schools, the teacher-led schools did not have direct support from the regional advisor. The regional advisor ran these twilight sessions for them, and provided the teacher-led schools with advice as needed for their school gardens. The following is an example of some of the topics taught in the twilight sessions.

Summer term 2010

- Planning your school garden.
- What and when to grow for the school term.
- Watering in the school garden.
- Introduction to garden pests.

Autumn term 2010

- Garden site assessment and plans.
- Bulb planting (including practical session, with free bulbs supplied).
- School garden risk assessment templates.
- Soil types and texture.

FIGURE 6 Before-and-after images of the development of the school garden at a RHS-led school. Photographs © RHS. Reproduced with permission.

Spring term 2011

- Safe tool use.
- Seed sowing.
- Growing for the school years.
- Composting.

Summer term 2011

- Watering.
- Pricking out.
- Garden tours.

Trial 1 consisted of schools participating in both intervention groups mentioned above, whereas for trial 2 schools were involved in either the teacher-led intervention or a comparison group. The comparison group did not receive any support from the regional advisor during the period of the trial. However, these schools were able to receive the twilight sessions for the summer of 2012, once the study had completed follow-up data collection.

Data collection methods

Data sources

The data used in this study came from the following sources.

Child-level data

- School food diary, April 2010.
- Home food diary, April 2010.
- Child knowledge and attitudes questionnaire, April 2010.

School-level data

- School gardening level questionnaire, June 2010.
- Gardening in schools – process measures e-mail dated October 2010.
- Information collated from the RHS advisor on school gardening in the intervention schools.

The main outcome measurements were collected at baseline in May and June 2010, when the children were in Years 3 and 4 (aged 7–8 years). The follow-up measurements were collected between October 2011 and January 2012, when the children were in Years 5 and 6 (aged 9–11 years). A breakdown of the different phases of these two trials is illustrated in *Figure 7*.

Training the fieldworkers: nutrition students

The primary schools were spread throughout London, and therefore a large sample of undergraduate or masters nutrition students were recruited to undertake baseline collection. These sessions were designed and led by MSC with assistance from one of the research assistants on the trial. The students were recruited from King's College London and Roehampton University. The students were offered £70 payment per school, and were informed that in order to participate it would be necessary for them to attend one of the two training sessions offered in London. The first training session was at Roehampton University on 9 April 2010; the second was at King's College London on 12 April 2010. Baseline collection took place from mid-April to July 2010. The students were not informed as to which intervention group the schools they visited were allocated.

Most of the students who registered an interest in the study were dietetic students, who had little data collection experience. In order to ensure that the standard of data collected was consistently high, training was provided to the students to teach them how to complete not only the school and home food diaries, but the child knowledge and attitudes questionnaire as well.

An important quality needed to work with children is presentation skills, the ability to speak confidently in a room full of young children. To assess the students on their ability to complete the baseline collection, the first part of the training required them to introduce themselves and explain how to play one of their favourite childhood games.

The next component of the training was a presentation by MSC introducing the students to the study, and what exactly their tasks would be if they were involved in the data collection. This was the first time the students had seen the questionnaires, so each section was explained to them in detail to help them familiarise themselves with the questionnaires. They were also shown the instructional DVD. The main part of the training consisted of two activities which are explained in detail below.

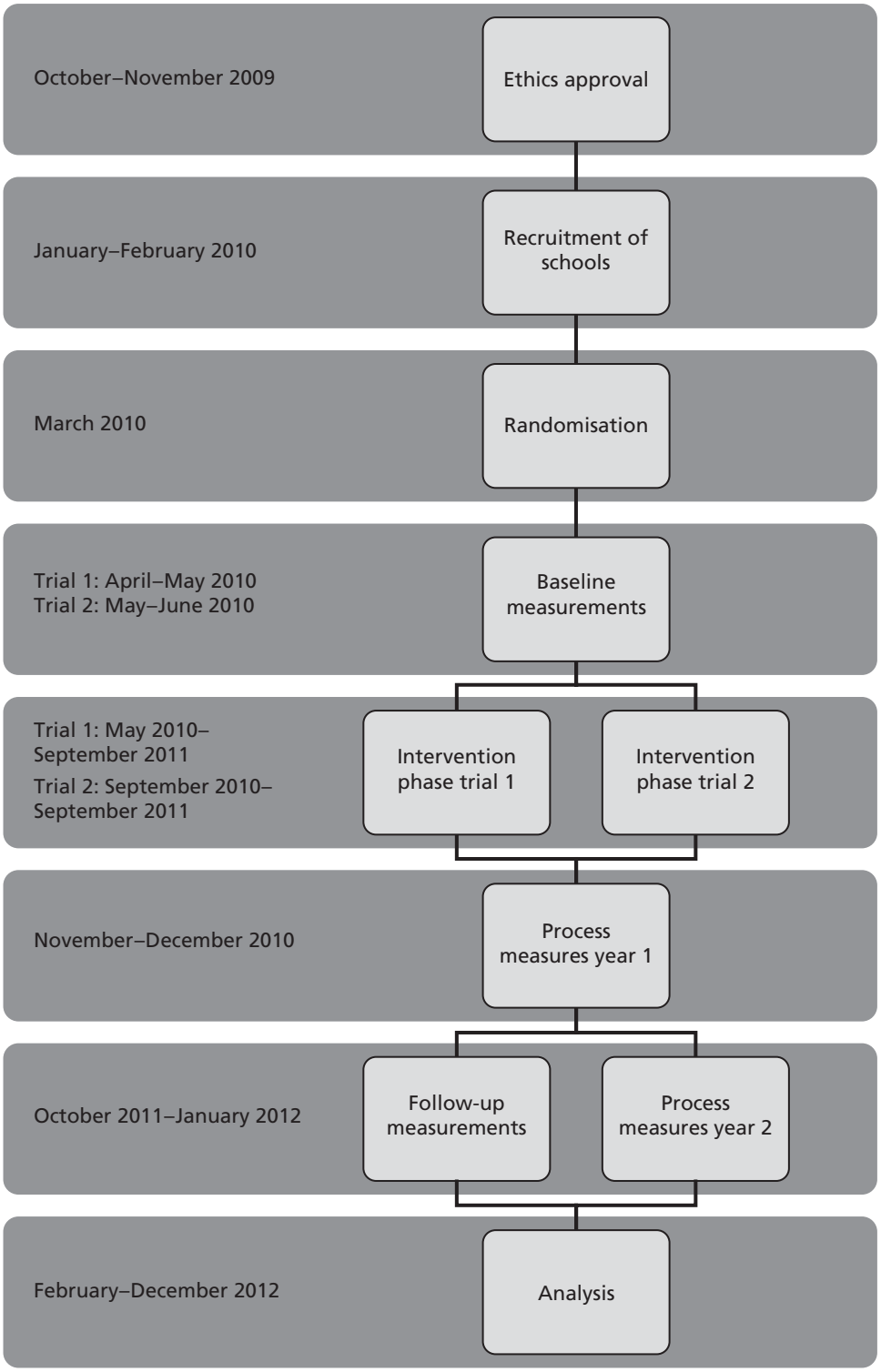

FIGURE 7 Trial phases.

Sample diet exercise

This exercise involved giving the students examples of children's food intake for the whole day. The aim was for the students to correctly code each food and categorise it in the right section of either the school or home food diary. An example of a child's diet is presented in *Table 9*, shown with the correct school food diary codes. There were always some challenging food items included, which were typical for children to eat but not adults, such as the Dairylea Lunchables and Dunkers ham wrap.

Right or wrong

In the second activity, the students were presented with 10 completed home food diaries and were asked to identify whether the diaries had been completed by the parents correctly or incorrectly. The aim of this exercise was to show the students what to expect on day 2 of the baseline collection, and to identify when it is necessary to take a recall from a child due to serious errors in completion of the home food diary.

At the end of the session, the students had the opportunity to ask questions and raise queries about completing the different questionnaires and the overall structure of the data collection process.

Baseline collection

Baseline collection of the school and home food diaries, child questionnaire and school gardening telephone interview took place between April and July 2010. The baseline process measures e-mails were sent out in November 2010 followed by reminders in December 2010.

The sample consisted of 52 schools with a possibility of up to 2731 children being surveyed. The actual number of children that participated in the baseline collection was 1163 for trial 1 and 1417 for trial 2, giving a total of 2580 children before data cleaning, with 2529 children providing complete data for analysis. Two schools withdrew from the study, one because of teaching problems and another over concerns about Criminal Records Bureau checks, despite the fact that the students who were assigned to visit this school had been checked. The duration of the baseline collection was longer than anticipated owing to a volcanic eruption in Iceland delaying flights during the Easter break, leaving many schools understaffed. The undergraduate students trained to collect the data were efficient, though a small number withdrew from collecting data from a school at late notice. To prevent this occurring at follow-up the students were asked to sign a contract outlining their expectations in writing.

TABLE 9 Example diets and correct answers

Breakfast/ before school	Morning break	Lunchtime	Before tea/ after school	Evening meal/tea	After tea/ during night
White bread toasted (C1)[a] with Utterly Butterly® (D1) Glass of apple juice (A6)	Fruit and nut bar (B3)	Tropical-flavoured spring water (A4) Cheese and onion crisps (B1) Dairylea Lunchables – ham (E2, B5, G5)	Satsuma (M5)	Chicken nuggets (F2) Chips (L2) Tomato ketchup (D2) Salt Vinegar	Jaffa cakes (N5) White bread toasted (C1) with Utterly Butterly® (D1)

a Codes within parentheses denote the corresponding food group and number in the CADET diary.

Follow-up collection

Follow-up collection of the school and home food diaries, child questionnaire and school gardening telephone interview took place from October 2011 to January 2012. The same process for recruiting students as that used at baseline was conducted for follow-up collection. All students who participated in follow-up collection attended a training session.

The follow-up process measures e-mails were sent out in December 2011 and a reminder was sent in January 2012. A number of the students who participated in baseline collection also participated in follow-up.

Data handling

Blinding

The project statistician (CE) allocated a random code for the different intervention groups and the control group involved in both trials. This was done to blind MSC to the intervention allocation while she was conducting the data cleaning and initial primary analysis, to ensure that there was no bias in the data cleaning method. Once the primary analysis was completed, the project statistician informed MSC of the code, so that she could finalise the secondary outcomes and final results. The details of school allocation for both trials was sealed in an envelope and kept in the principal investigator's office.

Food and nutrient data

Data from baseline and follow-up school and home food diaries, based on CADET, were entered by Swift Research Ltd. The dietary information in the diaries was converted to a Microsoft Access spreadsheet providing the number of portions of 95 food types consumed at each of seven possible meal/snack events (breakfast/before school, morning break, lunchtime, afternoon break, before tea/after school, evening meal/tea and after tea/during night). For example, on the diary a child could tick sugary cereals at breakfast time. The database manager used predetermined age-related portion sizes to estimate the weight of all food types consumed. The database manger then used established in-house software named DANTE, based on the composition of foods[67] and using standard predefined algorithms, to convert weights of foods into total daily nutrient values for each child. The 42 nutrients included total energy intake, macronutrients, vitamins and minerals, of which only those associated with fruit and vegetable intake were analysed further. These included total energy, fats, sugars, carbohydrates, fibre (non-starch polysaccharides), carotene, vitamin C, folate, zinc and iron. The 115 food types were reduced further to 14 categories, one of which was fruit (group M) and one of which was vegetables excluding potato (group L). Fruit juice was categorised as one category of group A (drinks). The weights of all types of fruit were summed to give the total weight for fruit, in addition to the total number of portions of fruit (one portion = 80 g). The weights of all types of vegetables were summed to give the total weight for vegetables, in addition to the total number of portions of vegetables.

Each child was given a unique identification code containing information on the school and the child. Follow-up and baseline data were combined using the unique identification codes for the children; therefore, no names or identifying information were included. The database was password protected so that only the database manager, project assistant and administrator and MSC could access the data. Any Microsoft Excel spreadsheets (Microsoft Corporation, Redmond, WA, USA) with children's names included (these were needed to identify the children for follow-up collection) also contained a password. Only MSC, the project assistant and administrator had access to this password.

Data cleaning

Values for non-dietary data collected at the follow-up phase were checked to ensure that all values were within plausible predetermined ranges. Out-of-range values were checked against original data to identify data entry errors. Errors due to data collection methods were recorded as missing.

Baseline and follow-up data were checked for completeness. Missing data for participants, such as date of birth and gender, were obtained from schools, where possible, by the project administrator. If these details were not available, children who had missing age data were given the mean age of children in their year group (Year 3, 4, 5 or 6). Where gender data were missing, they were given mean portion sizes, based on an average of boys and girls for that particular age group. Where both age and gender data were missing, then both steps above were applied.

The school and home food diaries were entirely tick box-based and were scanned; therefore, they were free of data entry errors. However, it was possible that there were scanning errors, such as diaries scanned the wrong way round or not lined up properly, or random marks mistaken for ticked boxes. Accurate scanning of diaries was initially checked by Swift Research Ltd. On arrival at the Nutritional Epidemiology Group, a random sample of the scanned diaries (approximately 10% of home diaries and 10% of school diaries) was inspected by MSC to provide a further check that the scanning process was accurate. Based on previous research into children's diet diaries that have mean energy and/or total fruit and vegetable intake, ± three times the SD were identified as outliers and excluded.

Also, it was noticed from inspecting the baseline data that when a child ate fruit salad, several other types of fruit (more than three) were also ticked for that particular mealtime. It was decided to clean this data so that only fruit salad was recorded, as the fruit intake for that particular meal was considered too high for the majority of children.

Summary

This chapter has described the general methodological aspects that apply to both trials. It has explored how the schools were recruited and randomised, identified when the different data were collected, described the interventions and outlined the methods used to collate both baseline and follow-up data. Further descriptions of the statistical analysis will be described in detail in the relevant chapters exploring the results.

Chapter 4 Baseline food and nutrient characteristics

This chapter will explore the nutrient and food data from the home and school food diaries for all children in trials 1 and 2 combined. It will also explore children's fruit and vegetable intake broken down by meal event and lunch type (packed or school meal) and the differences between boys and girls for key nutrients and food. In addition, it will explore how the home food environment and parental attitudes and values affect children's fruit and vegetable intake.

Regression analysis

Linear regression analysis

Linear regression analysis explores the dependency of one variable – in this case, total fruit and vegetables consumed – on one or more other variables, such as gender, by fitting a linear equation to the observed data. Although the fundamental principles of regression remain the same, owing to the cluster randomisation of participants by school, multilevel regression methodology was applied to all statistical analyses in this chapter.[84]

Clustered multilevel regression analysis

Multilevel regression analysis is often used for education-based data as it takes into consideration the hierarchical structure of school data.[85] In this study, level one is the individual child and level two is the school. Level 1, the individual level, is considered to be nested within the higher level, i.e. the school. It is based on the theory that all children's food consumption within a school is similar; for example, children who eat a school meal will all have the same options or choice on any given day at that particular school, and are therefore more likely to consume similar foods. The benefit of this technique is that the means and confidence intervals (CIs) for the different foods and nutrients will be more accurate, if there is variation at school level. As children within a school have more similar food consumption to each other, there will be less variability in the sample from each school compared with a random sample from the whole population.[86] Also, multilevel modelling is not focused on the individual schools within the sample, but on estimating the patterns of variation within the population of schools.[86] If a single-level model was used instead for this analysis, ignoring the hierarchical structures within the data, this would lead to inaccurate or misleading results. The CIs would be too narrow, potentially leading to different conclusions.[86]

Methods

Study population

This study includes baseline measurements from the children in both trials. These were children from 52 primary schools in the following London boroughs: Wandsworth, Tower Hamlets, Greenwich, Sutton, Lewisham, Lambeth, Merton and Newham.

Variables

The descriptive analysis uses results from the CADET school and home food diaries to describe food and nutrient intakes.

Further analysis used questions in section 2 of the home food diary, which asked about the child's fruit and vegetable intake and the home environment. The responses were completed by the parent or carer. These questions explored fruit and vegetable habits in the family home:

- Do you have different kinds of fruit/vegetables at home?
- Do you buy a specific fruit/vegetable because your child asks for it?
- Do you cut up fruit/vegetables for your child to eat?

- Do you (parents) eat fruit/vegetables every day?
- Do you eat fruit/vegetables together with your child?
- Do you have to ask your child to eat their fruit or vegetables?
- Do you allow your child to eat as much fruit/vegetables as she/he likes?

The responses to these questions were collected as 'yes/always', 'yes most days/often', 'sometimes', 'rarely' and 'never'. General summary statistics, including box plots and histograms of the different categories, were first analysed to identify the best method of coding the data. Based on the frequency of responses to these questions, they were then categorised 'never/rarely', 'sometimes', or 'always'.

Four questions were designed to identify the factors associated with consumption habits of the family:[72]

- the money I have available to spend on fruit and vegetables
- the price of fruit and vegetables
- the time I have available to prepare fruit and vegetables
- likes and dislikes of my family for fruit and vegetables.

The responses to these questions were collected as 'very important', 'important', 'neither important or unimportant', 'unimportant' and 'very unimportant'. Correlation tests indicated that these questions were highly correlated. These were recoded into a scale of 1 (not important at all) to 5 (very important).

In addition to these questions, the home inventory question 'Please tick if you have any of the following fruit or vegetables in your fridge/freezer or cupboards' was collected to identify the variety of fruit and vegetables in the home. The question 'How many nights a week does your family eat together at a table?' was asked to explore how the family meal habit affects children's fruit and vegetable intake. As the response to this question can only be 0–7 it is considered a multinomial variable; therefore, it cannot be treated as a continuous variable. Total fruit and vegetable intake by the eight possible responses was explored. Owing to the similarity in total fruit and vegetable intake, in grams, for people who ate together at a table 1–6 nights a week, the data were recoded into the following: 'never' (0 nights a week), 'sometimes' (1–6 nights a week) and 'always' (7 nights a week).

Statistical analysis

All statistical analysis was performed using Stata version 12. The descriptive statistics were performed for all key nutrients, foods, fruit and vegetables by meal event and demographic characteristics. An additional variable, based on the NHS 5 A DAY guidelines (www.nhs.uk/Livewell/5ADAY/Pages/5ADAYhome.aspx), was created to explore how many children were achieving the UK government's fruit and vegetable target. This variable included all fruit and vegetables consumed, plus one portion (80 g) if pure fruit juice was consumed and one portion (80 g) if baked beans were consumed.

Analysis was then performed using clustered multilevel regression models to explore the differences between boys and girls for nutrients and food items. These models were first conducted unadjusted, and then adjusted for ethnicity and Index of Multiple Deprivation score (IMDS). The IMDS is a weighted measure based on the following categories: education, income, employment, health and/or disability, barriers to housing and services, crime and living environment. Where possible, the pupils' postcodes were used to generate the IMDS; however, for those whose postcode was missing the school postcode was used. The output generated for the primary analysis was effect size, SD, 95% CIs and *p*-values, with a *p*-value of $< 0.05\%$ taken to represent statistical significance for all of the analyses. Mean values are presented in the tables, in some instances rounding has occurred when differences are referred to in the text. The same statistical methodology was applied to explore how home environment habits affect children's mean nutrient intake.

The model fit was assessed by checking skewness and kurtosis (sktest), and q-normal probability plots and residuals. The sktest explores the skewness and kurtosis of the variables against the null hypothesis that the variable is normally distributed.[87] The skewness and kurtosis statistics describe the shape of the distribution. A score of 3 for the kurtosis statistic indicates that the variable is normally distributed, < 3 indicates that the distribution is flatter than a normal distribution and > 3 indicates that the distribution is higher pitched than a normal distribution. A symmetrical distribution should have a skewness of zero.

Results of baseline food and nutrient intakes

Basic characteristics

A total of 2529 children were asked to participate in the study, from 52 schools. After excluding school withdrawal and parents who did not consent, 2420 children received the intervention. After excluding children who did not complete both the home and school food diaries or who had a total energy and/or total fruit and vegetable intake more than three times the SD of the mean, the final sample size for baseline analysis was 2393, and the response rate was 94%. The mean age of the children (1188 girls and 1205 boys) was 8.3 years (95% CI 8.2 to 8.3 years). Of all the children in the sample, 29% received free school meals and 33% ate a packed lunch. English was spoken as an additional language by 46%, while 59% of children had a member of the family educated to degree level or higher. These results are presented in *Table 10*.

Children's nutrient intake

The mean, standard error (SE) and 95% CI for key nutrient intakes for the whole sample are presented in *Table 11*. The only nutrient not above the recommended mean was vitamin A, which was 100 µg lower than the recommended intake (mean 406 µg, 95% CI 388 to 424 µg). The mean energy intake for all children was 2018 kcal (95% CI 1990 to 2047 kcal). Total fat was 13 g higher than the recommended intake (mean 81 g, 95% CI 79 to 83 g), and sodium was 1508 mg higher than the recommended intake for this age group (mean 2658 mg, 95% CI 2604 to 2711 mg).

TABLE 10 Sample characteristics of 2393 children participating in the linked trials

Baseline characteristics	*n* (%)
Boys	1205 (50)
Received free school meals	693 (29)
Ate packed lunch	781 (33)
Spoke EAL	1147 (48)
Family member with degree	1410 (59)
Ethnicity	
White	575 (24)
Mixed	200 (8)
Asian or British Asian	317 (13)
Black or black British	419 (18)
Chinese or other ethnic group	72 (3)
Prefer not to say	810 (34)

EAL, English as an additional language.

TABLE 11 Baseline nutrient intakes of 2393 children enrolled in the RHS Campaign for School Gardening evaluation trials

				Estimated average requirement/reference nutrient intake (age 7–10 years)[a]	
Nutrient	Mean	SE	95% CI	Girls	Boys
Energy (kcal)	2018	15	1990 to 2047	1740	1970
Energy (KJ)	8488	61	8369 to 8608	7280	8245
Protein (g)	73	0.6	72 to 74	28	28
Carbohydrate (g)	264	1.7	260 to 267	265	322
Fibre (Englyst) (g)	12	0.1	12 to 12	18	18
Fat (g)	81	0.8	79 to 83	68	77
Total sugars (g)	130	1.0	128 to 132	123	140
Iron (mg)	11	0.1	10 to 11	8.7	8.7
Calcium (mg)	853	7.7	838 to 868	550	550
Potassium (mg)	2727	20.3	2687 to 2767	2000	2000
Sodium (mg)	2658	27.3	2604 to 2711	1200	1200
Folate (µg)	226	1.9	222 to 230	150	150
Carotene (µg)	2077	35	2007 to 2146	1700	1700
Vitamin A (retinol equivalent) (µg)	406	9.3	388 to 424	500	500
Vitamin C (mg)	111	1.4	108 to 114	30	30

a Sources: Food and Agriculture Organization (FAO)/WHO/United Nations University (UNU) 1985,[88] Department of Health 1991,[89] Australian National Health and Medical Research Council (NHMRC) 2006.[90]

Children's key food and drink intake

The mean, SE and 95% CI for key foods for the whole sample are presented in *Table 12*. On average, children consumed 94 g of vegetables and 200 g of fruit, with a combined mean of 295 g of fruit and vegetables at baseline. *Table 12* also shows the number (%) of children who consumed different foods and the mean intake of this subsample. From this analysis it is evident that 84% of the sample consumed some vegetables on the day of collection and 80% consumed some fruit, with 95% of the children eating either fruit or vegetables. The other most commonly consumed items were drinks; fizzy pop/squash was consumed by 53%, fruit juice by 51% and milk by 43% of the sample.

Fruit and vegetable intake by meal event

Further analysis was conducted to explore fruit and vegetable consumption by lunch type. These results are presented in *Table 13* for the whole sample and for consumers only; 2269 children consumed fruit or vegetables during the day, meaning that only 124 children did not consume any at all. The most common times to consume fruit were lunch and before tea/after school, with the largest proportion of children, 38%, consuming fruit at lunchtime. Lunch was also one of the most common mealtimes to consume vegetables, with the largest proportion of children, 58%, consuming vegetables with their evening meal.

TABLE 12 Baseline food intake of children enrolled in the RHS Campaign for School Gardening evaluation trials

	Total sample ($n = 2393$)			Consumers only				
Food	Mean	SE	95% CI	*n*	%	Mean	SE	95% CI
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	94	1.7	91 to 98	2006	84	113	1.7	109 to 116
Pulses, beans, seeds (g)	16	0.8	14 to 17	455	19	85	2.4	73 to 86
Total fruit (g)	200	3.5	193 to 206	1909	80	251	3.5	244 to 257
Fruit (non-dried) (g)	199	3.4	192 to 206	1900	79	251	3.5	244 to 258
Dried fruit (g)	2	0.2	1.3 to 2.0	103	4	38	1.7	35 to 41
Total fruit and vegetables (excluding pulses and beans) (g)	295	4.1	286 to 303	2269	95	311	4.1	303 to 319
5 A DAY portions (80 g)	4	0.1	4 to 4	2336	98	4	0.3	4 to 4
Sweets, toffees, mints (g)	4	0.2	3 to 4	380	16	26	0.5	25 to 27
Chocolate bars (g)	7	0.3	6 to 8	446	18	39	0.6	38 to 40
Crisps, savoury snacks (g)	11	0.3	10 to 12	916	38	30	0.3	29 to 30
Nuts (g)	1	0.1	1 to 2	93	4	37	1.6	34 to 40
Milk or milky drinks (ml)	108	2.9	102 to 114	1028	43	253	3.6	146 to 260
Fizzy pop, squash, fruit drinks (ml)	185	4.5	176 to 194	1259	53	352	5.2	342 to 362
Fruit juice (pure) (ml)	123	3.0	117 to 129	1222	51	241	3.5	235 to 248

TABLE 13 Daily fruit and vegetable intake by type of lunch

	Whole sample				Mean consumption: consumers only				
Type of lunch	*n*	Mean (g)	SE (g)	95% CI (g)	*n*	%	Mean (g)	SE (g)	95% CI (g)
Fruit intake									
School meal	1571	189	4.1	140 to 243	1396	58	243	4.2	234 to 251
Packed lunch	772	231	6.4	218 to 243	567	24	267	6.3	255 to 280
Vegetable intake									
School meal	1571	106	2.1	102 to 110	1208	50	119	2.2	115 to 123
Packed lunch	772	73	2.7	67 to 78	665	28	99	3.0	93 to 105

Difference in fruit and vegetables between packed lunches and school meals

At lunchtime, children can have either a school meal (provided by the school) or a packed lunch (provided by the parents). *Table 13* displays the breakdown of fruit and vegetables based on lunch type. These results show that fruit intake was, on average, 42 g higher in children who had packed lunch meals compared with children who had school meals, and vegetable intake was 33 g higher in children who had school meals compared with children who had a packed lunch.

Differences in key nutrient intake between boys and girls

Multilevel regression analysis was conducted to explore the differences between boys and girls in this sample. *Table 14* displays the means and SDs/SEs for boys and girls, and the unadjusted and adjusted regression results. These results identified that there is a significant difference between boys and girls for fibre, potassium, sodium, carotene and vitamin C, after adjusting for ethnicity and IMDS.

Differences in key food and drink intake between boys and girls

Further analysis was conducted only on boys and girls who consumed particular foods or drinks (*Table 15*). Girls, on average, consumed 20 g (95% CI 12 to 25 g) more vegetables, 14 g (95% CI 10 to 17 g) more dried fruit, 37 g (95% CI 20 to 54 g) more total fruit and vegetables (excluding pulses and beans), 19 g (95% CI 13 to 25 g) more nuts and 11 ml (95% CI –3 to 25 ml) more fruit juice. Boys, on average, consumed 5 g (95% CI 3 to 8 g) more sweets and 63 ml (95% CI 45 to 81 ml) more fizzy pop than girls.

Differences in fruit and vegetable intake by meal event between boys and girls

The differences, by meal events, between boys and girls who consumed fruit and vegetables are presented in *Table 16*. On average, girls consumed 7 g (95% CI 3 to 11 g) more vegetables at lunchtime and 10 g (95% CI 4 to 15 g) more vegetables with their evening meal than boys, after adjusting for ethnicity and IMDS.

TABLE 14 Nutrient intake by gender of children enrolled in the evaluation trials

	Girls ($n = 1189$)			Boys ($n = 1205$)			Unadjusted		Adjusted for ethnicity and IMDS			
Nutrient	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	Mean difference	SE	95% CI	*p*-value
Energy (kcal)	2015	19	1977 to 2052	2023	22	1980 to 2066	–8	30	–13	28	–70 to 43	0.6
Energy (KJ)	8472	81	8314 to 8630	8506	91	8326 to 8685	–34	129	–55	118	–292 to 182	0.6
Protein (g)	73	0.8	72 to 75	74	1.0	72 to 76	–1	1	–1	1	–4 to 2	0.3
Carbohydrate (g)	265	2.4	261 to 270	263	2.4	258 to 268	2	4	1	5	–6 to 8	0.8
Fibre (Englyst) (g)	13	0.2	13 to 13	12	0.2	12 to 13	1	0	1	0	0 to 1	< 0.001
Fat (g)	81	1.0	79 to 83	82	1.4	80 to 85	–1	2	1	2	–4 to 8	0.3
Total sugars (g)	132	1.4	129 to 134	130	1.5	127 to 133	2	2	1	2	–4 to 5	0.7
Iron (mg)	11	0.1	11 to 11	11	0.1	11 to 11	0	0	0	0	0 to 0	0.7
Calcium (mg)	865	10.3	845 to 886	843	11.4	820 to 865	23	16	19	16	–12 to 51	0.2
Potassium (mg)	2809	29	2753 to 2864	2648	29	2591 to 2704	161	44	147	43	61 to 234	0.001
Sodium (mg)	2592	30	2532 to 2651	2724	45	2636 to 2813	–133	56	–131	53	–238 to –24	0.01
Folate (µg)	228	2.5	223 to 233	225	2.9	219 to 230	3	4	2	4	–6 to 11	0.5
Carotene (µg)	2250	54	2153 to 2366	1898	45	1809 to 1986	352	89	345	90	164 to 526	< 0.001
Vitamin A (retinol equivalent) (µg)	389	10	368 to 409	424	15	394 to 453	–35	18	–29	17	–63 to 4	0.08
Vitamin C (mg)	119	2	116 to 123	104	1.9	100 to 107	16	3	15	3	8 to 20	< 0.001

TABLE 15 Dietary intake of children who consumed particular food items

	Girls			Boys			Unadjusted		Adjusted for ethnicity and IMDS			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	Mean difference	SE	95% CI	*p*-value
Total vegetables (excluding pulses, beans, lentils, dahl and seeds) (g)	105	2.5	100 to 110	85	2.3	80 to 89.4	20	4	20	4	12 to 25	< 0.001
Pulses, beans, seeds (g)	80	3.3	74 to 86.7	92	3.5	85 to 98.6	–12	5	–11	5	–20 to –2	0.02
Total fruit (g)	211	4.9	201 to 221	190	4.9	180 to 199	21	6	18	7	4 to 32	0.01
Fruit (non-dried) (g)	254	4.9	244 to 263	249	5.1	239 to 258	5	5	3	6	–9 to 15	0.6
Dried fruit (g)	44	2.3	39 to 48	29	1.1	27 to 31	14	2	14	2	10 to 17	< 0.001
Total fruit and vegetables (excluding pulses and beans) (g)	316	5.8	305 to 327	274	5.8	263 to 286	41	8	37	9	20 to 54	< 0.001
Number of 5 A DAY portions (80 g)	4.6	0.08	4.5 to 4.8	4.1	0.08	3.9 to 4.3	0.5	0	0.5	0	0.2 to 0.7	< 0.001
Sweets, toffees, mints (g)	25	0.8	22 to 26	30	0.6	28 to 31	–5	1	–5	1	–8 to –3	< 0.001
Chocolate bars (g)	38	0.9	38 to 41	39	0.8	37 to 41	0.9	1.0	1.1	1.1	–1.0 to 3.3	0.3
Crisps, savoury snacks (g)	31	0.5	30 to 32	29	0.4	29 to 30	2	1	2	1	1 to 3	0.004
Nuts (g)	48	2.4	43 to 52	29	0.9	26 to 30	20	3	19	3	13 to 25	< 0.001
Milk or milky drinks (ml)	251	4.8	242 to 260	256	5.3	245 to 266	–5	7	–3	7	–17 to 10	0.6
Fizzy pop, squash, fruit drinks (ml)	318	6.4	305 to 330	382	7.7	366 to 397	–63	10	–63	9	–81 to 45	< 0.001
Fruit juice (pure) (ml)	248	5.0	238 to 257	235	4.8	226 to 245	12	7	11	7	–3 to 25	0.1

TABLE 16 Fruit and vegetable intake by gender and mealtime

	Girls				Boys				Unadjusted		Adjusted for ethnicity and IMDS			
Mealtime	*n*	Mean (g)	SE (g)	95% CI (g)	*n*	Mean (g)	SE (g)	95% CI (g)	Mean difference (g)	SE (g)	Mean difference (g)	SE (g)	95% CI (g)	*p*-value
Fruit intake														
Breakfast/before school	202	134	4.9	125 to 144	158	130	5.4	120 to 141	3.6	7.6	14	7.6	14 to 17	0.8
Morning break	244	110	2.5	105 to 115	189	112	2.5	107 to 117	–2.0	4.0	–1.3	3.9	–9 to 7	0.7
Lunchtime (all children)	461	132	3.0	126 to 138	444	126	2.6	121 to 131	5.7	3.6	6.3	3.4	–1 to 13	0.07
Afternoon break	27	179	19.5	139 to 219	28	182	21.8	138 to 227	–3.3	30.5	–2.9	32.5	–70 to 64	0.9
Before tea/after school	415	145	4.3	136 to 154	366	155	4.9	145 to 165	–9.6	5.5	–10.9	5.6	–22 to 1	0.05
Evening meal/tea	264	133	4.7	124 to 142	259	136	4.6	127 to 145	–3.4	7.0	–2.5	7.2	–16 to 51	0.7
After tea/during night	278	136	4.5	127 to 144	239	141	5.2	131 to 152	–5.6	6.4	–7.5	6.5	–20 to 5	0.2
Vegetable intake														
Breakfast/before school	25	61	8.3	44 to 79	31	44	3.7	36 to 51	17.7	7.0	16.3	6.3	3 to 29	0.01
Morning break	21	69	9.5	31 to 126	14	78	22.0	31 to 126	–8.8	34.1	–19.8	38.3	–102 to 62	0.6
Lunchtime (all children)	724	66	37.7	64 to 69	661	60	34.5	57 to 62	6.9	2.1	7.2	2.1	3 to 11	0.001
Afternoon break	12	87	26.1	30 to 145	11	103	30.9	34 to 172	–15.6	33.1	–76.5	30.0	–143 to –10	0.02
Before tea/after school	141	61	3.4	55 to 68	124	64	5.1	54 to 74	–2.2	6.5	–1.6	6.5	–14 to 11	0.8
Evening meal/tea	736	83	2.0	80 to 87	655	74	2.0	70 to 78	9.5	2.6	9.5	2.8	4 to 15	0.001
After tea/during night	64	62	5.5	51 to 74	59	57	3.8	50 to 64	5.3	5.6	5.4	5.7	–6 to 17	0.01

Family meals can help children reach their 5 A DAY: further analysis of the baseline data

Epidemiological evidence indicates that a diet rich in fruit and vegetables can decrease the risk of developing cardiovascular disease, stroke, hypertension, type 2 diabetes mellitus, obesity and several forms of cancer.[3,4,91–94] A diet low in fruit and vegetables is one of the top 10 risk factors for global mortality.[16] Of particular public health concern is the rise of obesity in children.[95] In the UK, 1 in 10 children aged 2–10 years is obese.[10] Diet plays a fundamental role in weight management. Having a healthy diet rich in fruit and vegetables, which are low energy density foods, could potentially help tackle this epidemic. In the last 4 years the Department of Health has spent over £3.3M on the 5 A DAY campaign and £75M on the Change4Life campaign to rectify poor diets.[96] However, these campaigns do not directly address family mealtime behaviour. With the average child in the UK consuming less than the recommended intake of fruit and vegetables, it is important to identify influential factors associated with improving children's overall nutrition.

There is evidence that dietary habits are developed in childhood and persist throughout life; therefore, it is vital that children at a young age consume adequate levels of fruit and vegetables.[6,7] Parents are the most influential factor in determining the quality of a child's diet.[97,98] Parents' attitudes and beliefs determine what food is offered to their children. Several studies have also indicated that children's fruit and vegetable intake is positively associated with their parents' intake.[8,99] Part of the influence that parents have on their children's food intake is through modelling. Modelling is an important way for children to learn about eating; watching the way their parents eat and the different types of food they eat is pivotal in creating their own food habits and preferences.[59] Children need to see adults eating fruit and vegetables to help demonstrate positive behaviour.[100] However, there are few studies conducted in the UK that explore how the provision of fruit and vegetables in the home environment affects children's overall intake. Using a large sample of children from London, this study aims to further explore and identify characteristics of the home food environment associated with children's fruit and vegetable intake.

Children's fruit and vegetable consumption and the home food environment

Clustered (by school) multilevel regression models, with total fruit and vegetable consumption as the primary outcome, were conducted to explore how the home food environment affects children's fruit and vegetable intake. *Table 17* displays the results, unadjusted and adjusted for children's gender, ethnicity and IMDS.

Mealtime behaviour

Children from families who reported 'always' eating a family meal together at a table consumed, on average, 125 g (95% CI 92 to 157 g) more fruit and vegetables than those from families who reported 'never' eating a meal together. Children from families who reported 'sometimes' eating a family meal together ate, on average, 95 g (95% CI 57 to 133 g) more fruit and vegetables than those children who never ate a family meal together at a table.

Parental role modelling and fruit and vegetable consumption

The children of parents who eat fruit and vegetables every day consumed, on average, 87 g (95% CI 37 to 138 g) more fruit and vegetables than children whose parents never/rarely eat fruit and vegetables. Having different types of fruit and vegetables at home was also associated with increased fruit and vegetable intake. 'Always' having to ask a child to eat his or her fruit and vegetables had a non-significant inverse relationship with overall intake.

TABLE 17 The effect of the home food environment on children's fruit and vegetable intake

		Unadjusted model			Adjusted model			
Question	*n*	Fruit and vegetable amount (g)	p^{diff}	*p*-trend	Fruit and vegetable amount (g)	95% CI (g)	p^{diff}	*p*-trend
How often do you eat together as a family at a table?								
Reference category: never	92	1			1			
Sometimes	768	96	< 0.001		95	57 to 133	< 0.001	
Always	656	126	< 0.001	< 0.001	125	92 to 157	< 0.001	< 0.001
Do you cut up fruit and vegetables for your child to eat?								
Reference category: never	255	1			1			
Sometimes	495	28	0.04		21	–6 to 49	0.1	
Always	820	55	< 0.001	< 0.001	44	18 to 71	0.001	< 0.001
Do you eat fruit and vegetables together with your child?								
Reference category: never	109	1			1			
Sometimes	439	8	0.7		10	–36 to 57	0.6	
Always	1018	42	0.05	< 0.001	39	–2.5 to 80	0.04	0.03
Do you (parent/carer) eat fruit and vegetables every day?								
Reference category: never	58	1			1			
Sometimes	258	48	0.1		43	–14 to 99	0.1	
Always	1260	93	< 0.001	< 0.001	87	37 to 138	0.001	< 0.001
Do you have different kinds of fruit and vegetables at home?								
Reference category: never	28	1			1			
Sometimes	214	36	0.3		24	–54 to 101	0.5	
Always	1368	75	0.03	0.01	66	–2 to 135	0.05	0.01
Do you buy specific fruit and vegetables because your child asks for it?								
Reference category: never	166	1			1			
Sometimes	542	21	0.3		15	–24 to 53	0.4	
Always	873	27	0.1	0.3	20	–17 to 57	0.2	0.5

continued

TABLE 17 The effect of the home food environment on children's fruit and vegetable intake (*continued*)

		Unadjusted model			Adjusted model			
Question	*n*	Fruit and vegetable amount (g)	p^{diff}	*p*-trend	Fruit and vegetable amount (g)	95% CI (g)	p^{diff}	*p*-trend
Do you have to ask your child to eat their fruit and vegetables?								
Reference category: never	582	1			1			
Sometimes	477	–12	0.4		–12	–43 to 19	0.4	
Always	513	–21	0.1	0.4	–27	–57 to 5	0.09	0.2
Do you allow your child to eat as much fruit and vegetables as they like?								
Reference category: never	78	1			1			
Sometimes	180	12	0.6		5	–52 to 62	0.8	
Always	1324	34	0.1	0.2	24	–25 to 73	0.3	0.4

Provision of fruit and vegetables

Children whose parents always cut up fruit and vegetables for them consumed, on average, half a portion more (44 g, 95% CI 18 to 71 g), and those whose parents sometimes cut up fruit and vegetables an average of 21 g (95% CI –6 to 49 g) more, than the children of parents who never cut up their fruit and vegetables. There were no significant differences in fruit and vegetable consumption if parents bought specific fruit and vegetables for their children.

Clustered (by school) multilevel regression models, with total fruit and vegetable intake as the primary outcome, were conducted to explore the effect of the number of different types of fruit and vegetables that people had in their households on the questionnaire completion day. The results indicated that for every additional type of fruit or vegetable in the house, children's fruit and vegetable intake increased by 5 g (95% CI 4 to 6 g, $p < 0.001$), after adjusting for sex, ethnicity and IMDS. Further analysis was conducted to explore whether or not there was an association with preparation time and cost of fruit and vegetables on a scale of 1 (unimportant) to 10 (very important). The models showed that there were no significant differences (preparation time: 3 g, 95% CI 0 to 6 g, $p = 0.9$; cost: 3 g, 95% CI –1 to 6 g, $p = 0.9$).

Children's nutrient intake and key foods

Multilevel modelling was conducted to explore whether or not there was any difference in mean nutrient intake depending on family mealtime behaviour. These results are presented in *Table 18*. The results show that there was a significant difference in mean carbohydrates, fat, sugar, folate, carotene, vitamin C, fruit and vegetable intake and 5 A DAY portions, with higher intakes in families who reported always eating together. For families who reported always eating together at a table, children met the government recommendations for 5 A DAY (5.0 portions, 95% CI 4.8 to 5.2 portions), compared with families who reported sometimes eating together (4.6 portions, 95% CI 4.5 to 4.8 portions) and families who reported never eating together at a table (3.3 portions, 95% CI 2.8 to 3.8 portions).

TABLE 18 Mean nutrient and food intake by frequency of eating a family meal together at a table

	Frequency of eating together as a family at a table												
	Never ($n = 92$)			Sometimes ($n = 768$)			Always ($n = 656$)				All children ($n = 2389$)		
Nutrient or food	Mean	SE	95% CI	Mean	SE	95% CI	Mean	SE	95% CI	p-trend[a]	Mean	SE	95% CI
Nutrient													
Energy (kcal)	1960	75.5	1810 to 2110	2078	25.9	2027 to 2129	2115	27.6	2061 to 2170	0.1	2019	14.5	1990 to 2047
Energy (KJ)	8240	316.2	7612 to 8868	8740	108.5	8526 to 8953	8896	115.5	8669 to 9123	0.1	8489	60.8	8370 to 8608
Protein (g)	72	3.9	65 to 80	75	1.1	73 to 77	77	1.2	75 to 80	0.1	74	0.6	72 to 75
Carbohydrate (g)	250	7.5	235 to 265	273	3.0	267 to 278	279	3.2	273 to 285	< 0.001	264	1.7	261 to 267
Fibre (Englyst) (g)	11	0.5	10 to 12	13	0.2	12 to 14	14	0.2	13 to 15	0.6	13	0.1	12 to 13
Fat (g)	82	4.6	73 to 91	84	1.5	81 to 87	85	1.6	82 to 88	0.01	82	0.8	80 to 83
Total sugars (g)	120	5.0	110 to 130	137	1.9	133 to 141	140	2.0	136 to 144	0.01	131	1.0	129 to 133
Iron (mg)	11	0.5	9 to 12	11	0.2	11 to 12	12	0.2	11 to 12	0.1	11	0.09	10 to 11
Folate (µg)	217	10.6	196 to 238	236	3.5	229 to 243	246	3.7	238 to 253	0.02	226	2.0	222 to 230
Carotene (µg)	1744	181.4	1384 to 2104	2139	63.2	2014 to 2263	2412	70.5	2274 to 2551	< 0.001	2077	35.2	2008 to 2147
Vitamin C (mg)	97	6.0	85 to 109	119	2.6	114 to 124	125	2.7	111 to 130	< 0.001	111	1.4	109 to 114
Food													
Total vegetables (excluding pulses, beans, lentils or seeds) (g)	68	7.1	54 to 82	99	3.1	93 to 105	113	3.5	106 to 119	< 0.001	95	1.7	92 to 98
Pulses, beans, seeds (g)	15	4.0	7 to 23	17	1.3	14 to 19	20	1.8	17 to 24	0.2	86	2.4	81 to 91
Total fruit (g)	148	14.7	119 to 177	213	6.4	200 to 226	229	6.8	216 to 242	< 0.001	200	3.5	193 to 207
Dried fruit (g)	35	8.4	7 to 61	41	2.8	36 to 47	36	2.6	31 to 41	0.5	39	17.2	35 to 42
Total fruit and vegetables (excluding pulses and beans): number of 80 g portions	2.7	0.2	2.3 to 3.1	3.9	0.1	3.7 to 4.1	4.3	0.1	4.1 to 4.5	< 0.001	3.7	0.1	3.6 to 3.8
Number of 5 A DAY portions (80 g)	3.3	0.2	2.8 to 3.8	4.6	0.9	4.5 to 4.8	5.0	0.1	4.8 to 5.2	< 0.001	4.3	0.1	4.3 to 4.5
Fruit juice, pure (ml)	112	14.2	84 to 140	138	5.7	126 to 149.2	138	6.0	126 to 149	0.2	124	3.0	117 to 130

a Adjusted for sex, ethnicity and IMDS.

Discussion

Overall, the nutrient levels of all children in this sample were adequate when compared against the Department of Health recommendations,[89] with children's mean iron, folate and carotene levels all meeting recommended levels.[101] Children's mean fat and sodium intakes were above the recommended levels. With rising rates of obesity in children,[102] consumption of high energy density foods needs to be reduced. Diet plays a fundamental role in weight management; having a healthy diet consisting of high levels of low energy density foods could help tackle this epidemic.[28,103] Our results reflect those found in the 1999–2000 NDNS analysis,[68] in which children's fat and iron intakes were above the maximum requirements set by the Scientific Advisory Committee on Nutrition.[104]

Overall energy levels were appropriate for children of this age group. These results identified that there were some differences between boys and girls for fibre, potassium, sodium, carotene and vitamin C, after adjusting for ethnicity and IMDS. A difference was also found in the types of food that boys and girls consumed. On average, girls consumed more vegetables, dried fruit and fruit juice than boys, whereas boys consumed, on average, more sweets and fizzy drinks. Furthermore, girls tended to consume more fruit and vegetables than boys in the lunchtime meal and in their evening meal. This difference remained significant after adjusting for ethnicity and IMDS. These gender differences in fruit and vegetable consumption have also been found in previous research conducted in the same age group.[105] With dietary patterns established in childhood tending to persist throughout adulthood,[6,7] this pattern of girls consuming more fruit and vegetables can also be seen in a teenage population[106] and in the adult population.[68] This difference in fruit and vegetable intake between boys and girls needs to be addressed in future public health interventions. More research should be conducted to try and identify ways of encouraging boys to consume more fruit and vegetables.

The second half of this chapter explored the association between primary school children's fruit and vegetable intake and their home food environment. This is the first large survey of London children to explore this association. We found that eating a family meal together at a table had the biggest effect on children's fruit and vegetable intake. Children in families who stated that they ate together every day had one and a half more portions of fruit and vegetables daily than those from families who reported never eating together at a table, after adjusting for possible confounders. The survey also found that sometimes eating at a table together increased children's fruit and vegetable consumption by more than one portion. The importance of the family meal is supported by previous research in preschool children[99] and primary school children.[77,107,108] The majority of literature conducted in this area is from the USA.[107–113] One study has explored this association in the UK;[77] this was a relatively small study with only 102 participants. It does, however, support our findings here, reporting that frequency of family meals can increase children's fruit and vegetable consumption.

Family mealtime behaviour not only affects fruit and vegetable intake, but may also be a predictor of the general quality of a child's diet.[114] McIntosh *et al.*[113] explored mothers' planning behaviour around cooking and their attitudes towards the family meal, identifying that mothers' belief in the family meal determined the frequency of this behaviour. Also, mothers who have a higher belief in the importance of eating a meal together were more likely to be motivated to plan their food shopping around cooking for a family meal. These results are similar to those of Jones *et al.*,[98] who found that maternal intake was a predictor of children's fruit and vegetable intake. The regularity of parents' fruit and vegetable consumption and the availability of fruit and vegetables in the home[99,115,116] are considered important predictors of children's intake.[65,107] There has also been research in older children (aged 9–14 years) which found that eating a family meal together was inversely associated with obesity in children in the USA.[117]

There are benefits other than improving the family's nutritional status to having a family meal together. It provides conversational time for families,[77] incentives to plan a meal[107] and an ideal environment for parents to model appropriate mealtime behaviour. As dietary habits are established in childhood,

the importance of the family meal needs to be promoted in public health campaigns such as the 'Every Contact Counts' campaign,[118] raising health consciousness using brief interventions.

This research also supports previous studies on preschool-age children which found that parental intake is strongly associated with children's intake.[119,120] The more frequently parents consumed fruit and vegetables, the higher the consumption by their children. Parents eating fruit and vegetables with their children was also associated with higher child consumption. The relationship between parental intake and child's intake can be explained through behaviour modelling, and the child's simple desire to imitate his or her parents.[59,112,113] Increased availability would increase children's familiarisation with different fruits and vegetables, which is considered to be a key determinant of children's consumption.[17,19] Availability of different types of fruit and vegetables in the home could simply be providing children with the visual cue to eat a piece of fruit or vegetable.[17,121] Future interventions could be tailored towards improving parental intake of fruit and vegetables, to facilitate their children's intake.

Another important public health message, but one that is simple to implement, is that cutting up fruit and vegetables facilitates children's intake. If children have access to prepared fruit and vegetables at home, they are more likely to eat them. Research supporting this finding has been conducted in older children.[101,122] This study is the first conducted in primary school children in the UK to support such findings.

The importance of a family eating together at a table becomes evident when exploring the differences between the key foods, with the mean fruit and vegetable intake for families who always eat an evening meal at a table reaching the government guidelines of five portions a day.[89] The 5 A DAY definition includes one portion of fruit juice and one portion of beans, as well as any fruit or vegetables consumed. One-third of the children in this sample report achieving this target. It is evident that eating a family meal together plays a vital role in improving children's diets. There were also several macronutrients which were significantly higher in the families that always ate together at a table, such as folate, carotene, vitamin C and iron, all found in fruit and vegetables. Energy intake did not differ between families who ate together and those who did not; nevertheless, sugar and fat intakes were higher in those who ate together. However, the percentage of energy derived from fat was lower in those who always ate together (36% energy from fat) than in those who never ate together (38% energy from fat).

Strengths and limitations

There were some limitations of this study. There were 887 parents (36%) who did not complete the additional questions, and of these, 23% did not return the home food diary; therefore, the results are potentially subject to response bias. However, no differences were found when analysing with or without the missing participants. The CADET questionnaire was completed by trained fieldworkers in school hours, and by parents for the evening meal and breakfast. Parents and children might be inclined to give socially desirable responses, leading to an overestimation of the association between the home food environment and children's fruit and vegetable intake. Reverse causation is also possible, in that children with good behaviour at mealtimes may encourage family eating, whereas fussy children might be left to eat alone. This type of dietary assessment has limitations; the portion size assumed for each item in CADET is based on weighed intakes from UK children. A 1-day tick list may not reflect true nutrient intake in the longer term.

Nevertheless, this study is particularly interesting as its population is from London, a highly diverse population in terms of ethnicity and socioeconomic groups. Response at baseline was high at 92%. Although the London boroughs chosen to sample were some of the more disadvantaged, we found that 46% of families spoke English as an additional language (EAL) and 59% had a family member educated to at least degree level. This is higher than the London average, with 55% of primary school children in London speaking EAL in 2012 and 38% of families including someone with a degree.[123] The responding sample may be more advantaged than the general London population. This could have influenced the results obtained, with higher intakes of fruit and vegetables than those found in the NDNS.[18]

The dietary data were collected using the previously validated 24-hour food tick list, CADET. The strength of the CADET diary is that it uses age- and gender-specific food portion sizes to calculate food and nutrient intake. A 1-day tick list is an economically effective way of gathering nutrient information from children. Furthermore, all the results were conducted using multilevel analysis. The benefit of this technique is that the means and CIs for the different foods and nutrients will be more accurate; children within a school are more similar to each other in terms of their food consumption, with less variability within the sample compared with a random sample from the whole population.[86,124] In addition to previous research using this tool, a DVD with instructions for completing the questionnaire was sent home for parents/carers and children to watch, and a trained fieldworker reviewed the diary with the children to improve the home food data quality.

Conclusion

This analysis demonstrates a positive impact of the home environment on children's fruit and vegetable intake. This could not only improve children's dietary habits, but also those of parents. The key message from this research is for families to eat fruit and vegetables together at mealtimes. Cutting up fruit or vegetables for children facilitates their intake. Eating fruit and/or vegetables with children will increase their consumption, and could help them achieve the national recommendation. Successful public health interventions are needed to improve family food-related behaviour.

Summary

CADET found that children consumed, on average, 293 g (95% CI 287 to 303 g) of fruit and vegetables per day. The first half of this chapter described the energy and nutrient intake for all children from the RHS baseline collection. It also explored the differences between boys and girls in this sample. The second half of the chapter explored how the home environment affects children's fruit and vegetable intake. Children of families who reported 'always' eating a family meal together at a table consumed 125 g more fruit and vegetables than those from families who never ate a meal together. Children of parents who consume fruit and vegetables daily had an intake 87 g higher than those whose parents rarely/never consume fruit and vegetables. Cutting up fruit and vegetables for children was associated with higher consumption. Families who reported always cutting up fruit and vegetables for their children consumed 44 g more fruit and vegetables than those who reported never cutting up fruit and vegetables. This chapter identified that cutting up fruit and vegetables and family meal consumption of fruit and vegetables facilitate children's intake. Eating a family meal together regularly could increase children's fruit and vegetable consumption and help them achieve the recommended intake.

Chapter 5 Evaluation of the impact of a school gardening intervention on children's fruit and vegetable intake: results from two randomised controlled trials

Previous research into the impact of school gardening on children's food intake has been hampered by variability in the quality of study design and the use of invalidated tools to measure children's nutritional intake. This study used a robust methodology through two RCTs to explore how two different gardening interventions affect children's fruit and vegetable consumption. This chapter addresses the primary outcome for both trials and the following aims for trials 1 and 2.

Primary outcome

- Can the RHS Campaign for School Gardening lead to increases in vegetable and fruit intake in children aged 8–9 years?

The effectiveness of the RHS-led intervention compared with the teacher-led intervention (trial 1), or the teacher-led intervention compared with the comparison group (trial 2), would be determined by an increase in mean intake of fruit, vegetables, or fruit and vegetables at follow-up, after adjusting for baseline.

Secondary aims

- What is the effect of the RHS-led intervention compared with the teacher-led intervention, or the teacher-led intervention compared with the comparison schools, on intake of key nutrients (fat, carbohydrate, protein, vitamin C, carotene, iron, sodium, folate)?
- Is there an interaction between gender and the intervention?

Methodology

Details regarding the sampling methodology, ethics, data collection tools, randomisation, data cleaning and interventions are described in *Chapter 3*.

Study population

Trial 1 included 23 schools from the following London boroughs: Wandsworth, Tower Hamlets, Greenwich and Sutton. Trial 2 included 31 schools from the following London boroughs: Lewisham, Lambeth, Merton and Newham.

Statistical analysis

Variables

The primary objective of the trials was to evaluate the RHS Campaign for School Gardening by measuring the change in mean intake of daily portions of fruit and vegetables, daily portions of fruit and daily portions of vegetables, using data derived from the school and home food diaries.

- All three variables are continuous and derived from the nutrient software dietary nutrition tool for evaluation (DANTE).
- These measurements were taken at baseline (April 2010) and again at follow-up (15 months later).

Secondary aims measures

Nutrients

- Total energy intake (MJ/day).
- Fat intake (g/day).
- Saturated fat intake (g/day).
- Salt intake (g/day).
- Sugars (g/day) including non-milk extrinsic sugars.
- Carotene intake (mg/day).
- Vitamin C intake (mg/day).
- Vitamin D intake (mg/day).
- Iron intake (μg/day).
- Fibre intake (non-starch polysaccharides) (g/day).
- Zinc intake (μg/day).
- Carbohydrate intake (g/day).
- Folate intake (μg/day).

Foods

- Intake of foods that are high in fat, salt or sugar, and sugar-sweetened beverages.

General participant descriptive statistics and summary of primary and secondary outcomes/aims measures were tabulated for each intervention/control group within the two trials.

Comparison of intervention and control groups at baseline

School-level baseline characteristics were compared between groups for trials 1 and 2. This was performed to confirm that randomisation had resulted in broadly similar groups, in terms of weights of foods and nutrients and individual and school-level characteristics. Balance of school/class- and child-level variables between the two intervention groups was assessed using the following variables.

School/class level

- Percentage of children with EAL.
- Percentage of non-white children.
- Percentage of children with free school meals eligibility.

Child level

- Sex.

Primary outcome analysis of the trial

The variability between the schools determined which type of model should be used for this analysis. The main analysis used a cluster randomised regression random effects model, with change in total fruit and vegetables as the primary outcome to explore the study aims and objectives; results were reported both as unadjusted and adjusted for baseline intake. Analyses using random effects models were used to determine any differences between schools. This analysis was based on the theory of intention-to-treat (ITT) analysis, where all participants are analysed based on their randomised condition at baseline.
The output that was generated for the primary analysis included effect size, SE, 95% CIs and *p*-values, with a *p*-value of $< 0.05\%$ taken to represent statistical significance. Mean values are presented in the tables, in some instances rounding has occurred when differences are referred to in the text.

Description of means of food types and nutrients by intervention status

In addition to comparison of baseline variables, the mean weight (g) of fruit and vegetables consumed on the follow-up CADET data collection day, with SE and 95% CIs, was recorded for all children. This was reported both with and without adjustment for baseline fruit and vegetable levels.

Secondary outcome analysis of the trial

Subgroups were compared by gender, including as an interaction term. A *p*-value of 0.01 was used to take into account multiple testing. These analyses answer plausibility questions, i.e. whether or not the intervention effect differs by gender.

Sensitivity analysis

This is an epidemiology-based RCT, and therefore it is typical that dropout would occur; approximately 25% of the baseline sample did not complete the trial. Reasons why participants dropped out were described in *Chapter 4*. Sensitivity analyses were carried out using baseline data brought forward to explore the effect on the primary outcome.

Results

Sample size

Ten schools were randomised to receive the RHS-led intervention and 13 schools to receive the teacher-led intervention in trial 1. In trial 2, 16 schools were allocated to receive the teacher-led and 15 to receive the comparison interventions. Our sample size at baseline for both trials (2529 children allocated to the intervention groups) was less than the original aim of 2900 children. The final sample size reduced to 1554, with only 641 children in total completing trial 1 (RHS-led: 312; teacher-led: 329); similar results were found in trial 2, with 916 children in total completing the trial (teacher-led: 488; control: 428).
The response rate at follow-up for the two combined was 62%. This reduced the average group size to approximately 388, which was 94 children fewer than the proposed sample size of 482. This has reduced the power to detect the difference of one portion of fruit and vegetables from 90% to 83%.

The flow of schools and children through both trials is presented in the following four CONSORT diagrams (*Figures 8–11*).

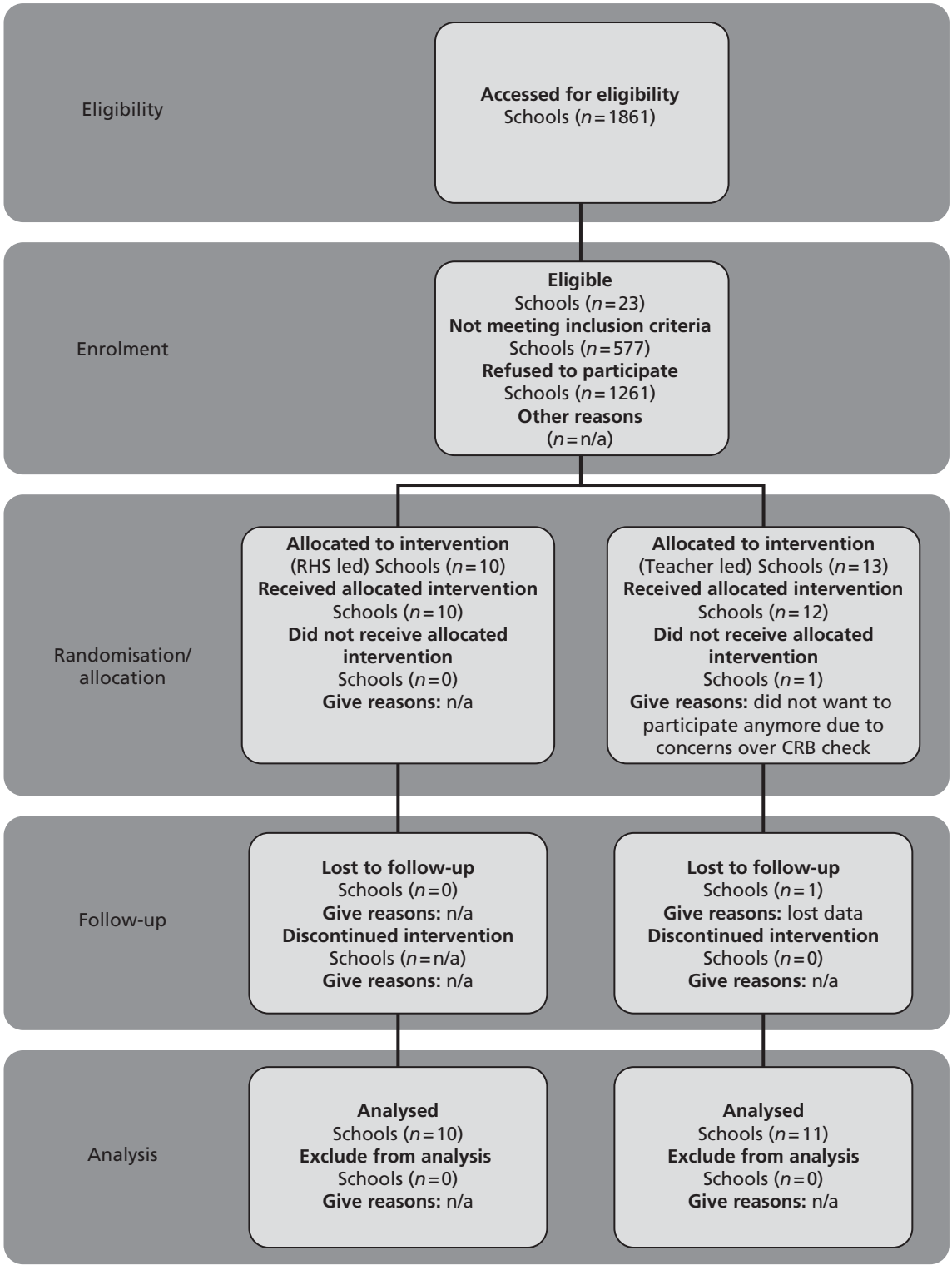

FIGURE 8 Trial 1: CONSORT flow chart of schools. CRB, Criminal Records Bureau; n/a, not applicable.

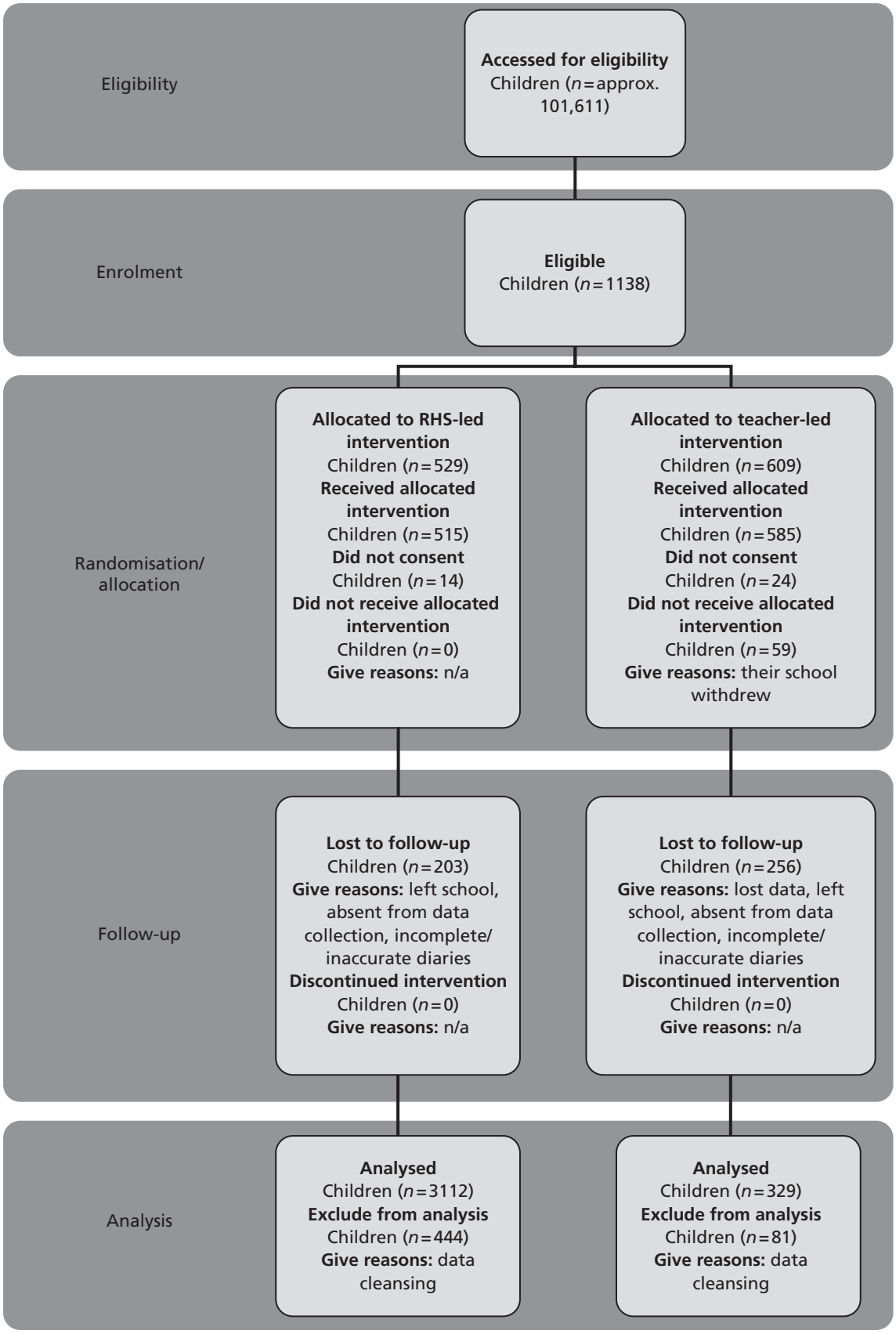

FIGURE 9 Trial 1: CONSORT flow chart of children. n/a, not applicable.

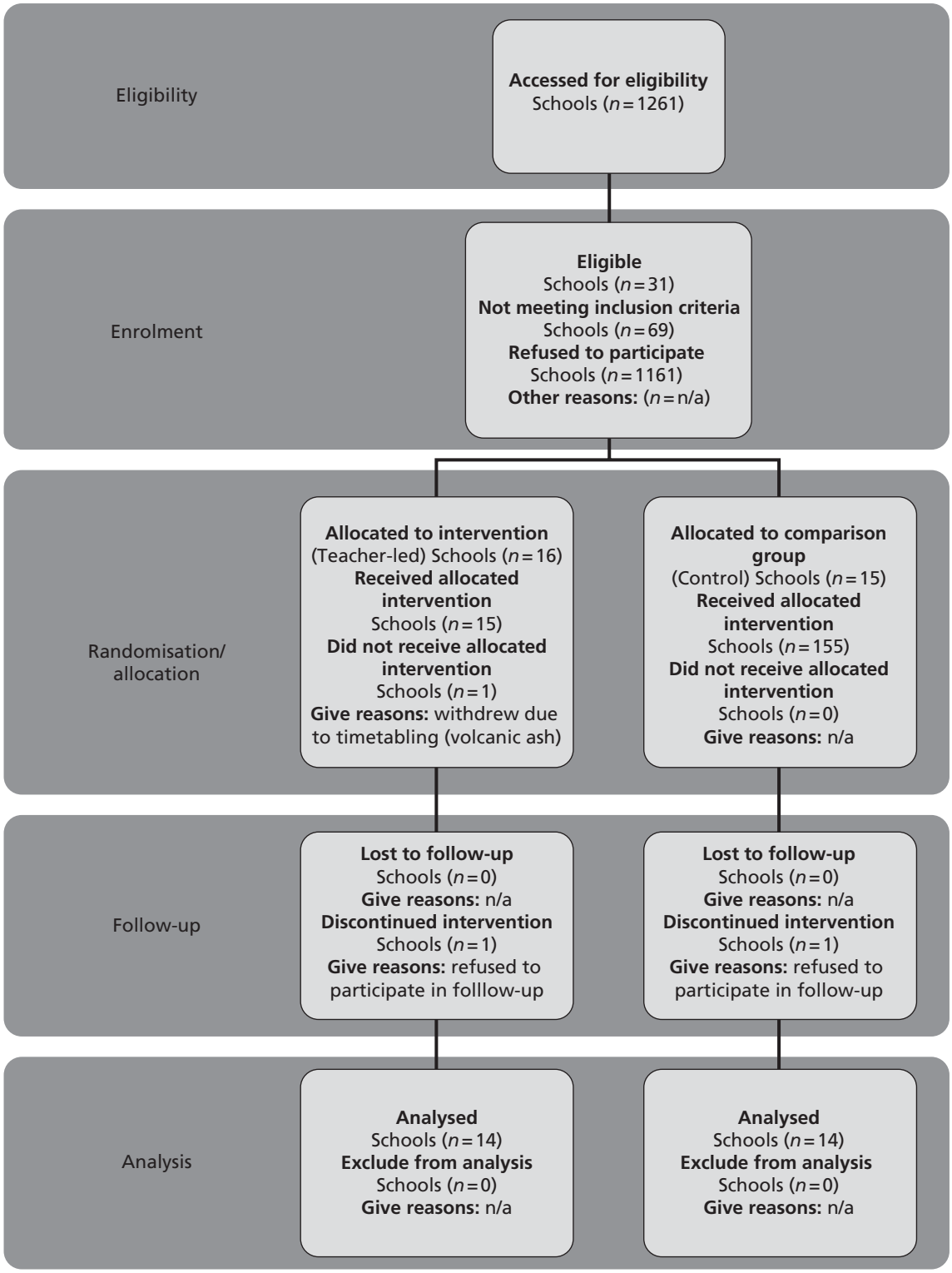

FIGURE 10 Trial 2: CONSORT flow chart of schools. n/a, not applicable.

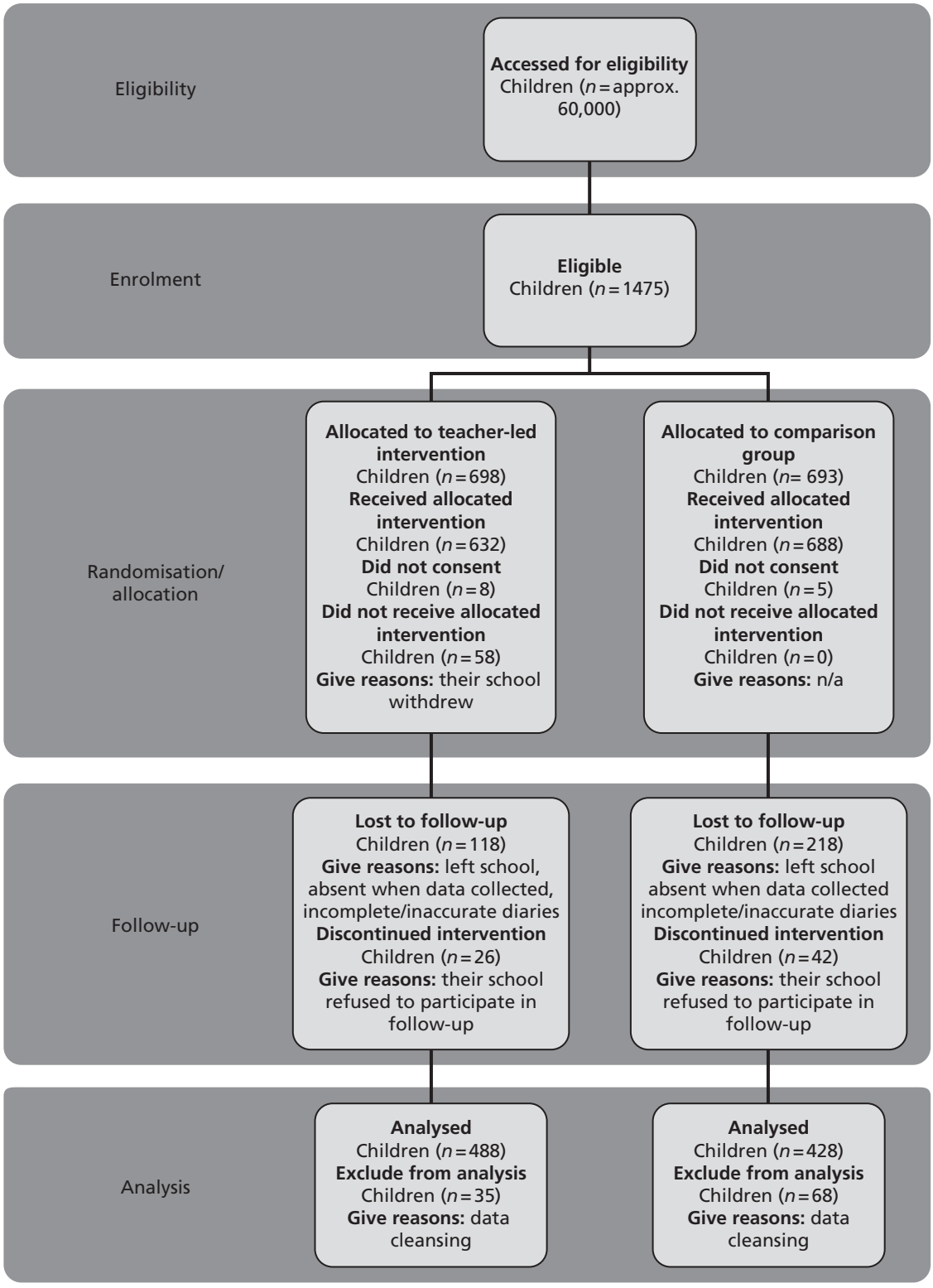

FIGURE 11 Trial 2: CONSORT flow chart of children. n/a, not applicable.

Regression assumptions

The primary analysis for these trials explored fruit and vegetable intake using multilevel regression analysis, which requires the primary outcome to be broadly normally distributed and the residuals of the regression to be normally distributed. For children, fruit and vegetable intake is rarely normally distributed, as often a percentage of children do not consume any fruit or vegetables on a particular day. This leads to a negatively skewed distribution. *Figure 12* shows the possible transformations that might improve the distribution of combined fruit and vegetable intake at follow-up. It is evident from the transformation options that none of these improve the general distribution of follow-up fruit and vegetable intake. Please note that the histogram labelled *identity* is the distribution without any transformation.

In addition to exploring the histogram of the distribution of follow-up fruit and vegetable intake, a plot of the residuals was explored to determine if it would be appropriate to use follow-up fruit and vegetable intake, adjusted for baseline fruit and vegetable intake, in the analysis. *Figure 13* displays the plot of the residuals for follow-up fruit and vegetable intake from the primary multilevel regression analysis. From the figure it is evident that the distribution is skewed. Therefore, if the analysis was conducted using follow-up fruit and vegetable intake as the primary outcome, the regression assumptions would not be met.

In an attempt to better meet the regression assumptions, a change in the fruit and vegetable intake (follow-up intake minus baseline intake) variable was created. *Figure 14* displays the histogram of the mean change in combined fruit and vegetable intake. It is evident from the histogram that the distribution of change in fruit and vegetable intake is much closer to a normal distribution than follow-up fruit and vegetable intake.

Further analysis of the residuals of mean change in combined fruit and vegetable intake is presented in *Figure 15*. The plot of the residuals illustrates that change in mean difference in fruit and vegetable intake is broadly normally distributed, making it suitable for multilevel regression analysis.

Change at follow-up has been used before to analyse RCTs. However, it is necessary to assess if there is a baseline imbalance between the two groups in these trials, to determine if it is appropriate to use change instead of adjusting for baseline. As there appeared to be little imbalance at baseline for fruit and vegetables in either trial, change in fruit and vegetable intake was used to analyse the primary outcome for both these trials.

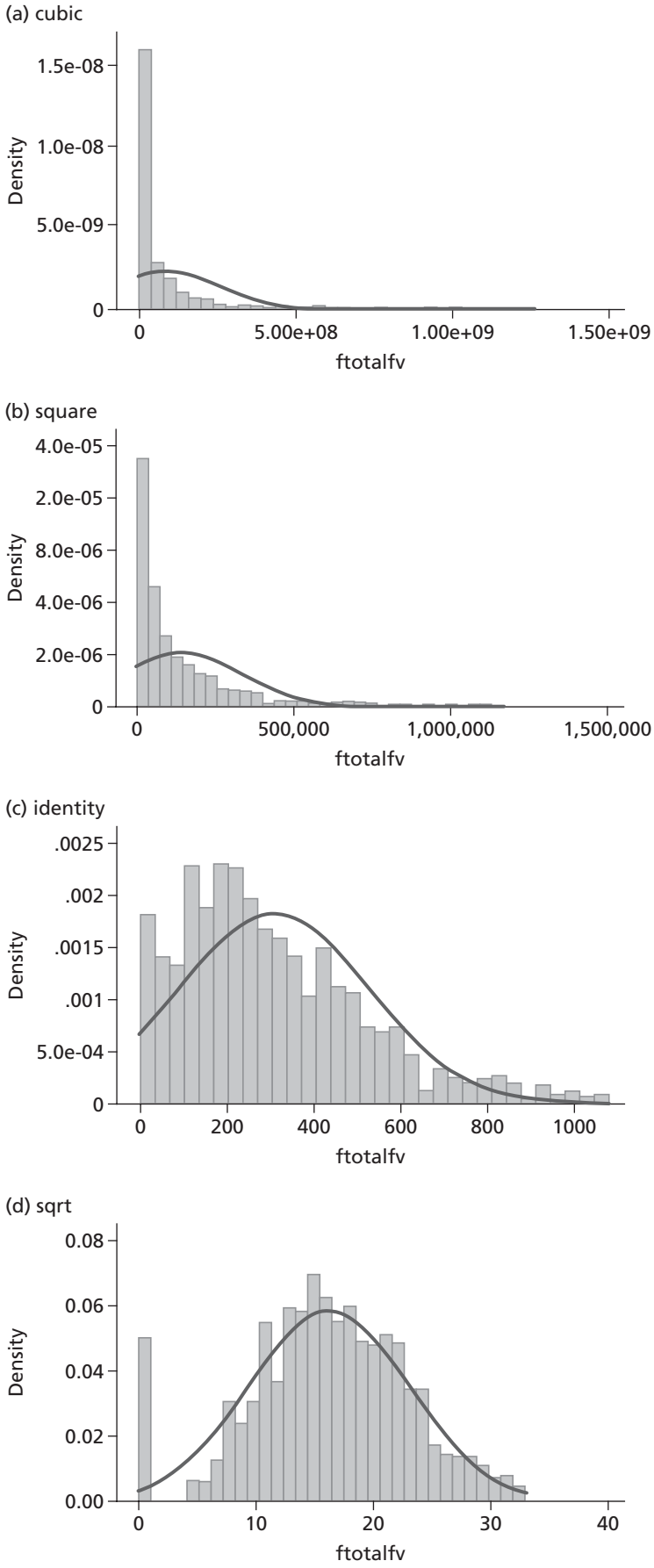

FIGURE 12 Output exploring if there is a suitable transformation for follow-up total fruit and vegetable intake (ftotalfv).

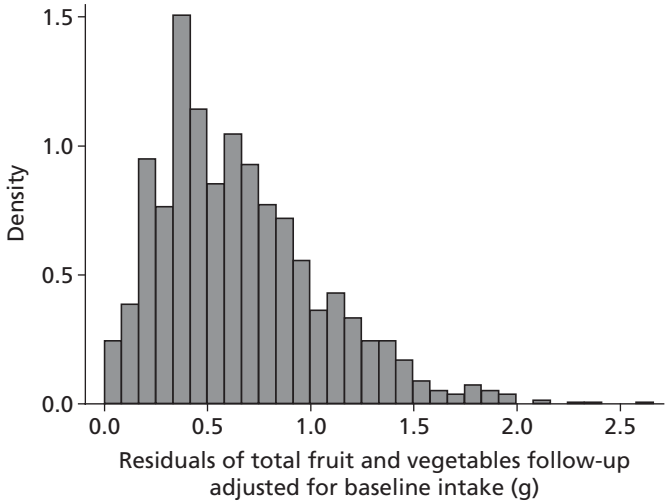

FIGURE 13 Residuals for total fruit and vegetable intake adjusted for baseline intake.

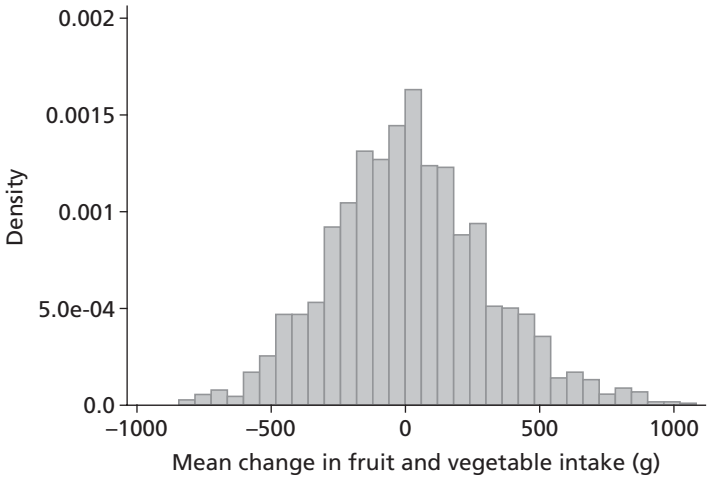

FIGURE 14 A histogram of mean change in fruit and vegetable intake.

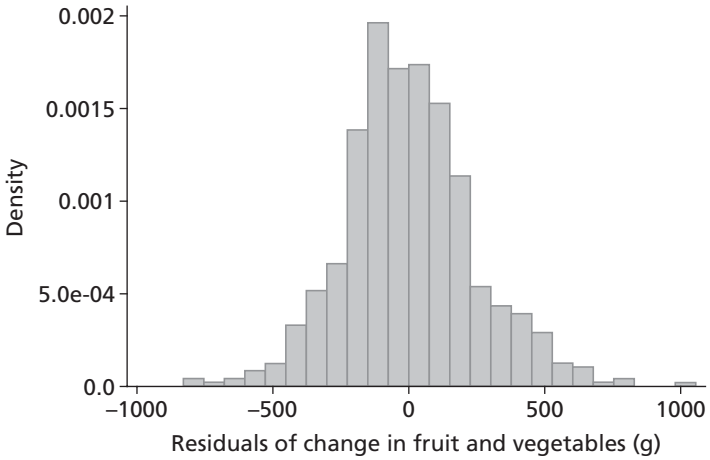

FIGURE 15 The residuals for change in mean fruit and vegetable intake.

General descriptive

Table 19 describes the demographic details for the children who completed trial 1. The children's age (RHS-led mean 8.2 years, 95% CI 8.1 to 8.4 years; teacher-led mean 8.1 years, 95% CI 8.0 to 8.3 years), percentages of boys and girls and ethnicity were very similar between the two intervention groups. There was a difference in the percentage of children eligible for free school meals; in the RHS-led group, 33% received a free school meal, compared with 24% in the teacher-led group. The percentage of children with EAL also differed.

Table 20 describes the demographic details for the children who completed trial 2. The children's age (comparison mean 8.2 years, 95% CI 8.2 to 8.3 years; teacher-led mean 8.3 years, 95% CI 8.2 to 8.3 years), percentages of boys and girls and ethnicity were very similar between the two groups. Again, the ethnic diversity of this sample is illustrated by trial 2. In trial 1 it was evident that there was a difference in free school meal eligibility between the two groups; however, for trial 2 there is very little difference in percentage receiving free school meals, IMDS and percentage of children with EAL.

Table 21 shows the baseline nutrient and food intake for all children in trial 1, broken down by intervention allocation (RHS-led and teacher-led). At baseline, values for key foods, nutrients and energy were all closely matched across the two intervention groups; the mean energy intake for the RHS-led group was 2085 kcal (95% CI 1971 to 2103 kcal) compared with the teacher-led mean intake of 2046 kcal (95% CI 1987 to 2103 kcal). There was only 5 g difference in mean carbohydrates intake (RHS-led mean: 265 g, 95% CI 257 to 272 g; teacher-led mean: 270 g, 95% CI 263 to 277 g); and 5 mg difference in vitamin C intake (RHS-led mean: 108 mg, 95% CI 102 to 114 mg; teacher-led mean: 103 mg, 95% CI 97 to 108 mg). There was a very small difference in fruit and vegetable intake, with the teacher-led group consuming on average more vegetables (RHS-led mean: 86 g, 95% CI 78 to 93 g; teacher-led mean: 101 g, 95% CI 94 to 106 g) and more total fruit (RHS-led mean: 190 g, 95% CI 174 to 204 g; teacher-led mean: 201 g, 95% CI 195 to 224 g).

TABLE 19 Follow-up demographics for children in trial 1

Characteristic	RHS-led ($n = 312$)	Teacher-led ($n = 329$)
Child		
Boys (%)	50	51
Ethnicity, *n* (%)		
White	92 (30)	117 (35)
Mixed	18 (6)	22 (7)
Asian or British Asian	72 (23)	39 (12)
Black or British black	38 (12)	55 (17)
Chinese or other ethnic group	10 (3)	8 (2)
Prefer not to say	82 (26)	88 (27)
School		
FSME (%)	33	24
IMDS	34	30
Children with EAL (%)	54	38

FSME, free school meals eligibility.

TABLE 20 Follow-up demographics for children in trial 2

Characteristic	Comparison group ($n = 488$)	Teacher-led ($n = 428$)
Child		
Boys (%)	48	52
Ethnicity, *n* (%)		
White	74 (17)	111 (23)
Mixed	47 (11)	42 (9)
Asian or British Asian	35 (8)	68 (14)
Black or British black	85 (20)	100 (20)
Chinese or other ethnic group	7 (2)	21 (4)
Prefer not to say	177 (42)	146 (30)
School		
FSME (%)	23	24
IMDS	33	33
Children with EAL (%)	42	47

FSME, free school meals eligibility.

TABLE 21 Baseline nutrient and food intake for all children enrolled in trial 1

	RHS-led ($n = 465$)			Teacher-led ($n = 563$)		
Nutrient or food	Mean	SE	95% CI	Mean	SE	95% CI
Nutrient						
Energy (kcal)	2038	33.4	1971 to 2103	2046	29.7	1987 to 2103
Energy (KJ)	8568	140.0	8293 to 8843	8603	124.6	8358 to 2103
Protein (g)	75	1.6	71 to 78	74	1.3	71 to 76
Carbohydrate (g)	265	3.8	257 to 271	270	3.6	263 to 277
Fibre (Englyst) (g)	13	0.3	12 to 13	14	0.2	13 to 14
Fat (g)	83	1.9	79 to 86	82	1.6	78 to 84
Total sugars (g)	130	2.4	125 to 135	132	2.2	127 to 136
Iron (mg)	11	0.2	10 to 11	11	0.2	11 to 11
Calcium (mg)	862	17.8	827 to 897	871	15.3	841 to 901
Potassium (mg)	2778	47.4	2685 to 2871	2792	72.0	2709 to 2874
Sodium (mg)	2686	66.4	2555 to 2816	2646	51.7	2544 to 2747
Folate (µg)	228	4.5	218 to 236	226	3.9	218 to 233
Carotene (µg)	1922	79.3	1766 to 2078	2249	75.8	2099 to 2397
Vitamin A (retinol equivalent) (µg)	408	21.5	365 to 449	412	16.8	379 to 445
Vitamin C (mg)	108	3.1	102 to 114	103	2.6	97 to 108
Food						
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	86	3.6	78 to 93	101	3.2	94 to 106
Pulses, beans, seeds (g)	20	2.2	15 to 24	19	1.7	15 to 22
Fruit (non-dried) (g)	190	7.6	174 to 204	210	7.3	195 to 224
Total fruit (g)	192	7.7	176 to 206	208	7.3	193 to 222
Dried fruit (g)	2	0.4	1 to 2	2	0.4	1 to 3
Total fruit and vegetables (excluding pulses and beans) (g)	276	8.9	258 to 293	310	8.4	293 to 326
Sweets, toffees, mints (g)	5	0.5	3 to 5	4	0.4	3 to 5
Chocolate bars (g)	8	0.8	6 to 9	8	0.7	8 to 9
Crisps, savoury snacks (g)	12	0.8	10 to 13	10	0.6	9 to 11
Nuts (g)	1	0.4	0.5 to 2	1	0.3	0.6 to 1
Milk or milky drinks (ml)	131	7.2	117 to 145	105	5.7	94 to 116
Fizzy pop, squash, fruit drinks (ml)	166	9.4	147 to 184	167	8.8	150 to 184
Fruit juice (pure) (ml)	122	7.0	108 to 135	104	5.5	93 to 114

Table 22 shows the baseline nutrient and food intake for all children in trial 2 broken down by intervention allocation (teacher-led and comparison group). At baseline, values for key foods, nutrients and energy were all closely matched across the two groups. Compared with trial 1, there was a small difference in mean energy intake between the two groups, with the teacher-led group consuming on average 2034 kcal (95% CI 1979 to 2089 kcal) and the comparison group consuming on average 1970 kcal (95% CI 1917 to 2021 kcal). There was a small difference of 11 g in mean carbohydrates intake (teacher-led mean: 267 g, 95% CI 260 to 273 g; comparison group mean: 256 g, 95% CI 250 to 262 g), and a 2 mg difference in vitamin C intake (teacher-led mean: 115 mg, 95% CI 109 to 120 mg; comparison mean: 117 mg, 95% CI 111 to 121 mg). However, unlike the small differences in trial 1 for vegetable intake, in trial 2 there was almost no difference in consumption, with the teacher-led group consuming on average 93 g of vegetables (95% CI 86 to 99 g) and the comparison group consuming on average 98 g (95% CI 90 to 104 g). There was a small difference of 8 g in fruit consumption, with the comparison group consuming slightly more fruit than the teacher-led group (teacher-led mean: 204 g, 95% CI 190 to 216 g; comparison group mean: 196 g, 95% CI 183 to 208 g).

The nutrient and food intake for all children who completed trial 1, compared with children who did not complete the whole trial, is shown in *Table 23*. Overall, these results reveal that there was very little difference for key nutrients and foods between children who completed trial 1 baseline and follow-up and children who did not complete follow-up. The most noticeable difference was for mean energy intake, with children who completed the trial consuming, on average, 196 kcal less than children who did not complete the trial (completers: 1936 kcal, 95% CI 1879 to 1994 kcal; non-completers: 2090 kcal, 95% CI 2010 to 2169 kcal). However, there was very little difference in mean vitamin C intake (completers: 102 mg, 95% CI 97 to 107 mg; non-completers: 103 mg, 95% CI 97 to 110 mg) and mean vegetable consumption (completers: 91 g, 95% CI 85 to 97 g; non-completers: 93 g, 95% CI 85 to 100 g). There was a small difference of 11 g in mean fruit intake, with the children who completed the trial consuming, on average, more fruit than children who did not complete the trial (completers: 200 g, 95% CI 187 to 213 g; non-completers: 189 g, 95% CI 172 to 206 g).

Additional descriptive analysis was conducted to explore the baseline nutrient and food intake for children who did not complete follow-up by intervention allocation. These results again revealed very little difference for children who did not complete trial 1 by intervention allocation. As expected, there was a slight difference in energy consumption, with the teacher-led group consuming more than the RHS-led group (RHS-led mean: 2046 kcal, 95% CI 1922 to 2169 kcal; teacher-led mean: 2119 kcal, 95% CI 2015 to 2223 kcal). Similar findings were found for the primary outcome measures of fruit and vegetable intake, with the teacher-led group consuming slightly more (for vegetables, RHS-led mean: 85 g, 95% CI 71 to 97 g; teacher-led mean: 98 g, 95% CI 88 to 107 g, and for fruit, RHS-led mean: 167 g, 95% CI 140 to 192 g; teacher-led mean: 204 g, 95% CI 181 to 226 g).

The nutrient and food intake for all children who did not complete follow-up in trial 2 by intervention allocation revealed very little difference for children who did not complete the trial. There was, on average, only 10 kcal difference between the teacher-led and comparison groups (teacher-led mean: 2020 kcal, 95% CI 1912 to 2126 kcal; comparison group mean: 2030 kcal, 95% CI 1943 to 2116 kcal). Similar results were found for the primary outcome measures of fruit and vegetable intake, with the teacher-led group consuming slightly more (for vegetables, teacher-led mean: 95 g, 95% CI 85 to 104 g; comparison group mean: 87 g, 95% CI 74 to 99 g, and for fruit, teacher-led mean: 199 g, 95% CI 177 to 219 g; comparison mean: 195 g, 95% CI 170 to 218 g).

TABLE 22 Baseline nutrient and food intake for all children enrolled in trial 2

Nutrient or food	Teacher-led ($n = 667$)			Comparison group ($n = 698$)		
	Mean	SE	95% CI	Mean	SE	95% CI
Nutrient						
Energy (kcal)	2034	28.0	1979 to 2089	1970	26.4	1917 to 2021
Energy (KJ)	8554	117.4	8323 to 8784	8281	110.3	8064 to 8497
Protein (g)	74	1.2	71 to 76	72	1.2	69 to 73
Carbohydrate (g)	267	3.3	260 to 273	256	3.0	250 to 262
Fibre (Englyst) (g)	13	0.2	12 to 13	12	0.2	11 to 12
Fat (g)	82	1.6	78 to 85	80	1.6	77 to 83
Total sugars (g)	133	1.9	128 to 136	128	1.9	123 to 131
Iron (mg)	11	0.2	10 to 11	11	0.2	10 to 11
Calcium (mg)	873	14.8	843 to 902	816	14.1	788 to 843
Potassium (mg)	2723	39.2	2646 to 2800	2645	36.0	2574 to 2715
Sodium (mg)	2710	51.7	2608 to 2811	2601	51.2	2500 to 2701
Folate (µg)	232	3.9	224 to 239	220	3.5	212 to 226
Carotene (µg)	1979	63.7	1853 to 2103	2137	66.5	2006 to 2267
Vitamin A (retinol equivalent) (µg)	408	17.3	373 to 441	399	18.6	362 to 435
Vitamin C (mg)	115	2.7	109 to 120	117	2.5	111 to 121
Food						
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	93	3.3	86 to 99	98	3.4	90 to 104
Pulses, beans, seeds (g)	18	1.7	14 to 21	10	1.1	7 to 11
Total fruit (g)	204	6.6	190 to 216	196	6.5	183 to 208
Fruit (non-dried) (g)	203	6.6	190 to 216	195	6.5	181 to 207
Dried fruit (g)	1	0.3	0.6 to 1	1	0.3	0.7 to 1
Total fruit and vegetables (excluding pulses and beans) (g)	297	7.8	281 to 312	294	7.7	278 to 308
Sweets, toffees, mints (g)	4	0.4	3 to 4	4	0.4	3 to 5
Chocolate bars (g)	6	0.6	5 to 8	6	0.6	5 to 7
Crisps, savoury snacks (g)	12	0.6	10 to 12	12	0.6	10 to 13
Milk or milky drinks (ml)	111	5.6	99 to 121	95	5.5	84 to 105
Fizzy pop, squash, fruit drinks (ml)	192	8.8	174 to 208	207	8.9	189 to 224
Fruit juice (pure) (ml)	134	6.5	122 to 146	130	5.7	118 to 141

TABLE 23 Baseline nutrient and food intake of all children who completed trial 1 vs. children who did not complete trial 1

	Participants who completed both baseline and follow-up collection ($n = 641$)			Participants who did not complete follow-up (baseline only) ($n = 388$)		
Nutrient or food	Mean	SE	95% CI	Mean	SE	95% CI
Nutrient						
Energy (kcal)	1936	29.0	1879 to 1994	2090	40.3	2010 to 2169
Energy (KJ)	8104	121.8	7908 to 8386	8787	168.9	8455 to 9119
Protein (g)	71	1.2	68 to 73	76	1.8	72 to 79
Carbohydrate (g)	256	3.5	249 to 263	269	4.6	260 to 278
Fibre (Englyst) (g)	12	0.2	12 to 13	13	0.3	12 to 14
Fat (g)	76	1.5	73 to 79	86	2.3	81 to 90
Total sugars (g)	128	2.1	123 to 132	128	2.7	123 to 134
Iron (mg)	10	0.1	10 to 11	11	0.2	10 to 11
Calcium (mg)	827	15.0	797 to 856	880	19.8	841 to 919
Potassium (mg)	2673	41.4	2591 to 2754	2799	55.9	2689 to 2909
Sodium (mg)	2503	49.5	2406 to 2600	2767	76.1	2617 to 2916
Folate (µg)	216	3.7	207 to 224	229	5.2	219 to 240
Carotene (µg)	2078	69.9	1941 to 2215	2004	87.5	1831 to 2176
Vitamin A (retinol equivalent) (µg)	386	16.5	354 to 419	424	22.0	381 to 467
Vitamin C (mg)	102	2.5	97 to 107	103	3.3	97 to 110
Food						
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	91	3.0	85 to 97	93	4.0	85 to 100
Pulses, beans, seeds (g)	18	1.6	15 to 21	21	2.5	15 to 25
Total fruit (g)	200	6.6	187 to 213	189	8.7	172 to 206
Fruit (non-dried) (g)	198	6.5	185 to 210	191	8.9	173 to 208
Dried fruit (g)	3	0.4	2 to 3	1	0.2	0.1 to 1.1
Total fruit and vegetables (excluding pulses and beans) (g)	303	7.6	287 to 317	282	10.2	261 to 302
Sweets, toffees, mints (g)	4	0.4	3 to 5	4	0.5	3 to 5
Chocolate bars (g)	8	0.6	6 to 9	9	0.9	7 to 10
Crisps, savoury snacks (g)	11	0.6	9 to 12	11	0.8	9 to 12
Milk or milky drinks (ml)	117	5.7	105 to 128	110	7.1	95 to 123
Fizzy pop, squash, fruit drinks (ml)	157	8.0	141 to 172	172	102.3	152 to 192
Fruit juice (pure) (ml)	111	5.5	99 to 121	107	6.9	93 to 120

Mean nutrient and food intake at baseline for all children who completed trial 2 compared with children who did not complete the trial (*Table 24*) found similar results to trial 1. Overall, these results reveal that there was very little difference for key nutrients and foods between children who completed trial 2 baseline and follow-up and children who did not complete follow-up. Similar to trial 1, the most noticeable difference was for mean energy intake, with children who completed the trial consuming, on average, 135 kcal less than children who did not complete the trial (completers: 1891 kcal, 95% CI 1839 to 1942 kcal; non-completers: 2026 kcal, 95% CI 1959 to 2092 kcal). This difference, however, was smaller than the difference in kcal intake seen in trial 1. Again, for trial 2 there was very little difference in mean vitamin C intake, in this case only 1 mg (completers: 112 mg, 95% CI 107 to 116 mg; non-completers: 111 mg, 95% CI 105 to 117 mg); and there was no difference in mean vegetable consumption (completers: 92 g, 95% CI 86 to 98 g; non-completers: 92 g, 95% CI 84 to 99 g). There was, however, a small difference of 9 g in mean fruit intake, with the children who completed the trial consuming, on average, more fruit than children who did not complete the trial (completers: 190 g, 95% CI 179 to 201 g; non-completers: 199 g, 95% CI 182 to 214 g).

The baseline nutrient and food intake for all children who did complete baseline and follow-up in trial 1 showed small differences (*Table 25*), with a mean energy intake for the RHS-led group of 2034 kcal (95% CI 1956 to 2111 kcal) compared with the teacher-led mean intake of 1993 kcal (95% CI 1925 to 2059 kcal). There was only 2 g difference in mean carbohydrates intake (RHS-led mean: 265 g, 95% CI 256 to 273 g; teacher-led mean: 267 g, 95% CI 259 to 275 g) and 3 mg difference in vitamin C intake (RHS-led mean: 108 mg, 95% CI 100 to 115 mg; teacher-led mean: 105 mg, 95% CI 98 to 112 mg). There was a small difference in fruit and vegetable intake, with the teacher-led group consuming on average more vegetables (RHS-led mean: 87 g, 95% CI 78 to 95 g; teacher-led mean: 102 g, 95% CI 93 to 110 g) and more total fruit (RHS-led mean: 201 g, 95% CI 183 to 219 g; teacher-led mean: 214 g, 95% CI 195 to 232 g). This difference in intake was also noted in the 5 A DAY variable (RHS-led mean: 342 g, 95% CI 319 to 364 g; teacher-led mean: 374 g, 95% CI 347 to 382 g). The baseline nutrient and food intakes overall, however, are very similar in terms of levels of nutrients; this would suggest there was no evidence of imbalance between the groups.

Table 26 shows the baseline nutrient and food intake for all children who did complete baseline and follow-up for trial 2. At baseline, the values for key foods, nutrients and energy were all closely matched across the two groups. Similar to trial 1, there was a small difference in mean energy intake between the two groups, with the teacher-led group consuming, on average, 2039 kcal (95% CI 1974 to 2103 kcal) and the comparison group consuming, on average, 1932 kcal (95% CI 1867 to 1996 kcal). There was only 13 g difference in mean carbohydrates intake (teacher-led mean: 267 g, 95% CI 259 to 275 g; comparison group mean: 254 g, 95% CI 246 to 275 g) and no difference in vitamin C intake (teacher-led mean: 118 mg, 95% CI 111 to 124 mg; comparison mean: 118 mg, 95% CI 111 to 124 mg). Again, there were similar results for the groups in trial 2 for fruit and vegetable consumption, with only small differences between the groups. The teacher-led group consumed, on average, less vegetables (teacher-led mean: 95 g, 95% CI 87 to 102 g; comparison group mean: 100 g, 95% CI 90 to 108 g) and more fruit (teacher-led mean: 206 g, 95% CI 190 to 221 g; comparison group mean: 193 g, 95% CI 177 to 209 g).

TABLE 24 Baseline nutrient and food intake of all children who completed trial 2 vs. children who did not complete trial 2

	Participants who completed both baseline and follow-up collection ($n = 916$)			Participants who did not complete follow-up (baseline only) ($n = 443$)		
Nutrient or food	Mean	SE	95% CI	Mean	SE	95% CI
Nutrient						
Energy (kcal)	1891	26.1	1839 to 1942	2026	34.1	1959 to 2092
Energy (KJ)	7952	109.5	7736 to 8166	8517	142.5	8237 to 8797
Protein (g)	68	1.1	66 to 70	74	1.5	71 to 77
Carbohydrate (g)	248	3.2	215 to 254	262	3.9	254 to 269
Fibre (Englyst) (g)	12	0.2	11 to 12	12	0.3	11 to 13
Fat (g)	76	1.4	73 to 79	83	2.0	78 to 86
Total sugars (g)	124	1.8	120 to 127	130	2.5	125 to 134
Iron (mg)	10	0.2	10 to 10	11	0.2	10 to 11
Calcium (mg)	804	13.3	778 to 830	839	17.9	803 to 874
Potassium (mg)	2531	35.2	2461 to 2599	2726	49.1	2629 to 2822
Sodium (mg)	2535	45.1	2443 to 2620	2634	66.9	2502 to 2765
Folate (µg)	216	3.4	209 to 223	222	4.7	212 to 231
Carotene (µg)	1953	55.0	1844 to 2060	2070	81.8	1908 to 2230
Vitamin A (retinol equivalent) (µg)	368	13.6	341 to 394	438	26.1	386 to 488
Vitamin C (mg)	112	2.3	107 to 116	111	3.1	105 to 117
Food						
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	92	2.9	86 to 98	92	3.8	84 to 99
Pulses, beans, seeds (g)	13	1.0	10 to 14	15	2.2	10 to 19
Total fruit (g)	190	5.6	179 to 201	199	8.0	182 to 214
Fruit (non-dried) (g)	190	5.6	178 to 200	197	8.0	181 to 212
Dried fruit (g)	1	0.2	0.6 to 1	2	0.4	0.7 to 2
Total fruit and vegetables (excluding pulses and beans) (g)	297	6.7	284 to 310	290	6.7	271 to 309
Sweets, toffees, mints (g)	4	0.3	3 to 4	4	0.5	2 to 4
Chocolate bars (g)	6	0.5	4 to 6	8	0.8	6 to 9
Crisps, savoury snacks (g)	11	0.5	9 to 11	13	0.8	11 to 14
Milk or milky drinks (ml)	94	4.5	84 to 102	110	7.4	95 to 124
Fizzy pop, squash, fruit drinks (ml)	186	7.2	171 to 199	208	11.3	185 to 230
Fruit juice (pure) (ml)	133	5.1	122 to 142	116	6.7	103 to 129

TABLE 25 Baseline nutrient intake for all children who completed baseline and follow-up collection for trial 1

	RHS-led ($n = 312$)			Teacher-led ($n = 329$)		
Nutrient or food	Mean	SE	95% CI	Mean	SE	95% CI
Nutrient						
Energy (kcal)	2034	39.4	1956 to 2111	1993	34.1	1925 to 2059
Energy (KJ)	8552	164.9	8227 to 8876	8375	143.0	8103 to 8666
Protein (g)	75	1.8	71 to 78	73	1.5	69 to 75
Carbohydrate (g)	265	4.4	256 to 273	267	4.3	259 to 275
Fibre (Englyst) (g)	13	0.3	12 to 13	13	0.3	12 to 13
Fat (g)	82	2.3	77 to 86	78	1.7	74 to 81
Total sugars (g)	132	2.9	126 to 137	134	2.6	128 to 138
Iron (mg)	11	0.2	10 to 11	11	0.2	10 to 11
Calcium (mg)	861	21.6	818 to 903	858	18.7	821 to 895
Potassium (mg)	2771	54.7	2663 to 2878	2784	51.3	2683 to 2884
Sodium (mg)	2632	76.3	2481 to 2782	2572	57.6	2458 to 2685
Folate (µg)	227	5.3	216 to 237	224	4.5	214 to 232
Carotene (µg)	1956	98.8	1765 to 2146	2352	101.7	2152 to 2552
Vitamin A (retinol equivalent) (µg)	400	25.1	350 to 449	403	22.7	358 to 448
Vitamin C (mg)	108	3.7	100 to 115	105	3.5	98 to 112
Food						
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	87	4.4	78 to 95	102	4.3	93 to 110
Pulses, beans, seeds (g)	16	2.2	12 to 20	21	2.4	16 to 25
Total fruit (g)	201	9.3	183 to 219	214	9.5	195 to 232
Fruit (non-dried) (g)	201	9.1	182 to 218	211	9.5	191 to 229
Dried fruit (g)	3	0.6	1 to 3	3	0.7	2 to 4
Total fruit and vegetables (excluding pulses and beans) (g)	269	10.7	248 to 290	300	10.5	278 to 320
Sweets, toffees, mints (g)	5	0.7	3 to 6	4	0.5	2 to 4
Chocolate bars (g)	9	1.0	6 to 10	7	0.9	5 to 9
Crisps, savoury snacks (g)	12	1.0	10 to 14	10	0.8	8 to 11
Milk or milky drinks (ml)	138	8.9	120 to 153	106	7.6	91 to 120
Fizzy pop, squash, fruit drinks (ml)	163	11.4	141 to 185	163	11.8	139 to 185
Fruit juice (pure) (ml)	119	8.5	102 to 135	112	7.6	95 to 126

TABLE 26 Baseline nutrient intake for all children who completed baseline and follow-up collection for trial 2

	Teacher-led (*n* = 488)			Comparison group (*n* = 428)		
Nutrient or food	Mean	SE	95% CI	Mean	SE	95% CI
Nutrient						
Energy (kcal)	2039	32.7	1974 to 2103	1932	32.8	1867 to 1996
Energy (KJ)	8576	137.3	8306 to 8845	8125	137.3	7854 to 8394
Protein (g)	75	1.4	71 to 77	69	1.4	66 to 72
Carbohydrate (g)	267	4.0	259 to 275	254	3.6	246 to 261
Fibre (Englyst) (g)	13	0.3	12 to 13	12	0.2	11 to 12
Fat (g)	82	18.0	78 to 85	78	2.0	74 to 82
Total sugars (g)	133	2.3	128 to 137	127	2.4	122 to 132
Iron (mg)	11	0.2	10 to 11	11	0.2	10 to 11
Calcium (mg)	877	17.6	842 to 911	810	17.5	775 to 844
Potassium (mg)	2730	45.0	2642 to 2818	2585	43.4	2499 to 2670
Sodium (mg)	2742	58.4	2627 to 2990	2575	64.2	2448 to 2700
Folate (µg)	235	4.5	225 to 243	220	4.3	211 to 228
Carotene (µg)	2024	74.9	1876 to 2170	2089	83.9	1924 to 2254
Vitamin A (retinol equivalent) (µg)	398	19	361 to 434	374	21.1	332 to 415
Vitamin C (mg)	118	3.2	111 to 124	118	3.2	111 to 124
Food						
Total vegetables (excluding pulses, beans, lentils, dahl or seeds) (g)	95	3.8	87 to 102	100	4.7	90 to 108
Pulses, beans, seeds (g)	16	1.6	12 to 19	10	1.4	7 to 13
Total fruit (g)	206	7.9	190 to 221	193	8.2	177 to 209
Fruit (non-dried) (g)	206	7.9	190 to 221	192	8.2	176 to 208
Dried fruit (g)	1	0.3	0.5 to 1	1	0.3	0.4 to 1
Total fruit and vegetables (excluding pulses and beans) (g)	299	8.9	282 to 317	296	9.6	277 to 314
Sweets, toffees, mints (g)	4	0.5	3 to 5	4	0.6	3 to 5
Chocolate bars (g)	6	0.7	4 to 7	6	0.7	4 to 7
Crisps, savoury snacks (g)	12	0.7	10 to 13	11	0.7	9 to 12
Milk or milky drinks (ml)	101	6.2	89 to 113	97	7.0	82 to 110
Fizzy pop, squash, fruit drinks (ml)	189	10.1	168 to 208	203	11.1	181 to 224
Fruit juice (pure) (ml)	141	7.4	126 to 155	138	7.5	123 to 152

Change in fruit and vegetable intake: trial 1

Table 27 displays the changes in fruit intake, vegetable intake and combined fruit and vegetable intake (follow-up minus baseline) and the intervention mean difference for trial 1, both unadjusted and adjusted for IMDS, age, gender and ethnicity. For both groups, there was a small decrease in fruit intake after adjusting for possible confounders (RHS-led mean: 8 g, 95% CI: –69 to 52 g; teacher-led mean: 20 g, 95% CI –36 to 77 g). For vegetable consumption there were no significant differences found between the unadjusted and adjusted models (intervention effect: –13 g, 95% CI –39 to 11 g). The teacher-led group did have, on average, a higher mean change in vegetable consumption, of 29 g (95% CI –6 to 66 g) compared with 16 g (95% CI –11 to 38 g) in the RHS-led group.

For combined fruit and vegetable intake there was a borderline significant difference in the unadjusted model (intervention effect: 40 g, 95% CI –1 to 80 g; $p = 0.05$), with the teacher-led group having a higher mean change of 8 g (95% CI –19 to 36 g) and the RHS-led group a mean change of –32 g (95% CI –60 to –3 g). However, after adjusting for possible confounders this difference was not significant (intervention effect: –42 g, 95% CI –88 to 1 g; $p = 0.06$).

The plot of the school residuals with their 95% confidence limits are presented in ascending order in *Figure 16*. All of the schools do pass through zero, indicating that the schools do not differ significantly from the average line at the 5% level. From the adjusted model, results state that 1.2% of the variance in change in mean fruit and vegetable intake can be attributed to the difference between schools.

TABLE 27 Intervention effect on change in fruit and vegetable intake for trial 1

	RHS-led ($n = 312$)			Teacher-led ($n = 328$)			Intervention effect			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Change in fruit intake (g)	–33	11.8	–56 to –10	–6	11.5	–28 to 16	27	16.4	–5 to 59	0.1
Change in vegetable intake (g)	2	9.0	–15 to 20	16	8.6	–1 to 32	–13	12.4	–38 to 11	0.3
Change in combined fruit and vegetable intake (g)	–32	14.5	–60 to –3	8	14.0	–19 to 36	40	20.2	–1 to 80	0.05
Adjusted[a]										
Change in fruit intake (g)	–8	30.8	–69 to 52	–20	29.0	–36 to 77	–28	16.4	–60 to 3	0.08
Change in vegetable intake (g)	16	19.6	–11 to 38	29	18.2	–6 to 66	–13	12.8	–39 to 11	0.2
Change in combined fruit and vegetable intake (g)	1	39.4	–75 to 78	44	36.7	–27 to 116	–43	22.8	–88 to 1	0.06

a Adjusted for gender, age, ethnicity and IMDS.

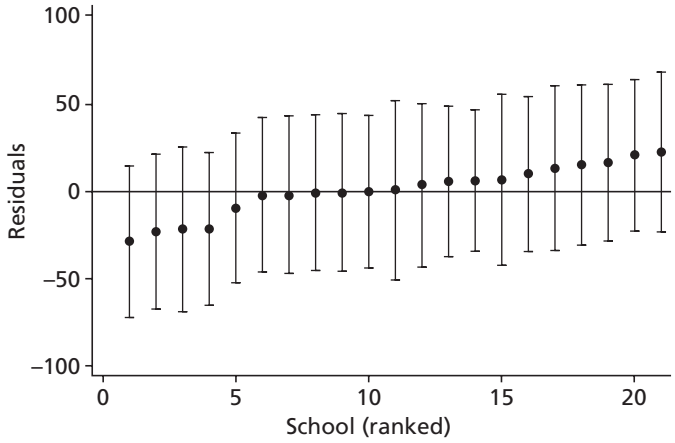

FIGURE 16 Plot of the school residuals for change in fruit and vegetable intake in trial 1, in ascending order with their 95% confidence limits.

Change in fruit and vegetable intake: trial 2

Table 28 displays the changes in fruit intake, vegetable intake and combined fruit and vegetable intake at baseline and follow-up and the intervention mean difference for trial 2, both unadjusted and adjusted for IMDS, age, gender and ethnicity. For mean change in fruit intake, the teacher-led group (mean change 44 g, 95% CI –28 to 118 g) increased their consumption, on average, by 22 g more than the comparison group (mean change 22 g, 95% CI –50 to 94 g). However, these differences in mean change for fruit intake were not significant in the unadjusted or adjusted models. For vegetable intake, the comparison group consumed, on average, more vegetables (mean change 17 g, 95% CI –30 to 21 g) compared with the teacher-led group (mean change 10 g, 95% CI –36 to 52 g). However, this difference was not significant.

As a result of having a higher intake of fruit, the teacher-led group consumed on average 15 g (95% CI –36 to 148 g) more fruit and vegetables than the comparison group. This difference was not significant in either the adjusted or the unadjusted model.

The plots of the residuals with their 95% confidence limits are presented in ascending order in *Figure 17*. It is evident that the majority of the schools do pass through zero, indicating that they do not differ significantly from the average line at the 5% level. The adjusted model of mean change in combined fruit and vegetable results shows that 7.3% of the variance in mean change in fruit and vegetable intake can be attributed to the difference between schools.

TABLE 28 Intervention effect on change in fruit and vegetable intake for trial 2

	Teacher-led ($n = 488$)			Comparison group ($n = 428$)			Intervention effect			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Change in fruit intake (g)	13	17.6	–20.9 to 48.2	–12	17.1	–45.9 to 21.0	26	24.5	–21.0 to 74.0	0.3
Change in vegetable intake (g)	16	10.2	–3.8 to 36.1	22	9.9	1.9 to 40.7	–5	14.2	–22.7 to 33.0	0.7
Change in combined fruit and vegetable intake (g)	29.8	23.0	–15.3 to 74.9	9.0	22.4	–34.8 to 52.8	20	32.1	–83.7 to 42.1	0.5
Adjusted[a]										
Change in fruit intake (g)	44	37.5	–28 to 118	22	36.9	–50 to 94	–22	24.3	–70 to 24	0.3
Change in vegetable intake (g)	10	21.3	–36 to 52	17	20.9	–30 to 21	–7	14.2	–35 to 20	0.6
Change in combined fruit and vegetable intake (g)	56	47.1	–36 to 148	40	46.4	–50 to 131	15	32.0	–36 to 148	0.6

a Adjusted for gender, age, ethnicity and IMDS.

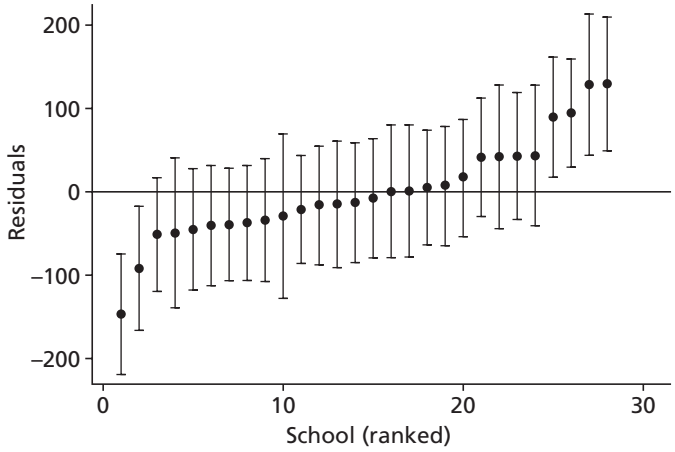

FIGURE 17 Plot of the school residuals for change in fruit and vegetable intake in trial 2, in ascending order with their 95% confidence limits.

Differences in nutrients and key foods

For both trials, the differences in key nutrients and foods were explored to see if there was an effect of either intervention on their mean intakes. Results are presented for trials 1 (*Table 29*) and 2 (*Table 30*), both unadjusted and adjusted for age, gender, ethnicity and IMDS. Overall, there was very little difference in either trial for these key nutrients and foods. The mean differences were small for nearly all nutrients and foods, except for energy and carotene intake. Although there were differences in mean intakes for these two, they were not significant. The only significant difference was found in trial 1 for vitamin C intake in the adjusted model. Once the adjustments were made there was a 12.7-mg-per-day difference between the RHS-led and teacher-led groups, with the teacher-led group having a significantly higher intake of vitamin C.

Differences in food and drink intake

An additional analysis was conducted to determine if there were differences in non-essential food intake (sweets, toffees, mints, chocolate bars, crisps, savoury snacks) and commonly consumed drinks (milk; fizzy pop, squash, fruit drink and pure fruit juice). For both trials, no differences were found in intakes of non-essential foods or drinks, after adjusting for age, gender, ethnicity and IMDS. Overall, there was very little difference between the different intervention groups. In trial 1, the RHS-led group consumed, on average, 19 ml less milk (95% CI –49 to 11 ml) than the teacher-led group. However, this difference was not significant.

TABLE 29 Intervention effect on essential nutrient intake in trial 1 (unadjusted and adjusted)

	RHS-led ($n = 312$)			Teacher-led ($n = 329$)			Intervention effect			
Nutrient intake	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Total energy (KJ/day)	7266	525	6238 to 8294	7389	506	6396 to 8381	–123	435	–730 to 976	0.8
Total energy (kcal/day)	1730	124.8	1485 to 1974	1758	120	1522 to 1994	–28	104	–175 to 232	0.8
Fat (g/day)	75.3	5.4	64.8 to 85.8	73.3	5.1	63.4 to 83.2	2.0	5.5	–12.8 to 8.7	0.7
Salt (mg/day)	2426	179.2	2075 to 2777	2395	171	2060 to 2729	31	189	–401 to 339	0.9
Sugars (g/day) including non-milk extrinsic sugars	87.4	6.7	74.2 to 100.5	96.3	6.7	83.2 to 109.5	9	5.2	–1.2 to 19.2	0.08
Carotene (µg/day)	1788	189	1417 to 2159	1968	188	1599 to 2337	144	232	–340 to 629	0.4
Vitamin C (mg/day)	74.8	6.1	62.9 to 86.7	87.8	5.9	76.3 to 99.4	13.0	5.7	1.8 to 24.2	0.2
Iron (µg/day)	9.1	0.7	7.8 to 10.5	9.4	0.7	8.1 to 10.7	–0.3	0.3	–0.9 to 1.4	0.8
Fibre (g/day)	11.7	0.9	1.0 to 13.4	12.8	0.9	11.1 to 14.5	–1.2	0.8	–0.5 to 2.8	0.2
Carbohydrates (g/day)	213.7	15.4	183.6 to 243.9	219.3	15.3	189.3 to 249.2	–5.5	10.8	–15.5 to 26.6	0.6
Folate (µg/day)	180.0	12.5	155.4 to 204.5	189.8	12.1	166.0 to 213.6	–9.9	10.9	–11.3 to 31.1	0.4
Protein (g/day)	64.4	4.7	55.1 to 73.6	69.6	4.5	60.8 to 78.3	5.2	4.7	–4.0 to 14.3	0.3

TABLE 29 Intervention effect on essential nutrient intake in trial 1 (unadjusted and adjusted) (*continued*)

	RHS-led ($n = 312$)			Teacher-led ($n = 329$)			Intervention effect			
Nutrient intake	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Adjusted[a]										
Total energy (KJ/day)	6387	749	4920 to 7855	6587	708	5199 to 7974	–199	430	–1043 to 644	0.6
Total energy (kcal/day)	1520	178	1171 to 1870	1567	168	1237 to 1897	–46	103	–247 to 154	0.6
Fat (g/day)	65	8.2	49 to 81	64	7.7	49 to 79	1	5.2	–9 to 11	0.8
Salt (g/day)	2272	286	1711 to 2833	2257	267.7	1732 to 2781	16	190.4	–357 to 388	0.9
Sugars (g/day) including non-milk extrinsic sugars	90	10.5	70 to 111	99	10.0	80 to 118	–8	5.1	–18 to 2	0.1
Carotene (µg/day)	1694	213	1249 to 2139	1834	262	1288 to 2380	–140	199	–2752 to 556	0.5
Vitamin C (mg/day)	113	31.7	51 to 175	125	31	64 to 187	13	5.5	2.0 to 23.5	0.02
Iron (µg/day)	8	1.0	6 to 10	8	0.9	6 to 10	–0.4	0.6	–1 to 0.9	0.5
Fibre (g/day)	10	1.3	7 to 13	11	1.3	9 to 14	–1	0.8	–3 to 1	0.1
Carbohydrates (g/day)	186	21.5	144 to 228	193	20.6	153 to 234	–7	10.9	–28 to 14	0.5
Folate (µg/day)	169	19.7	131 to 208	180	18.6	144 to 217	–11	10.9	–32 to 10	0.3
Protein (g/day)	58	7.1	44 to 72	64	6.7	51 to 77	–6	4.8	–15 to 3	0.2

a Adjusted for gender, age, ethnicity and IMDS.

TABLE 30 Intervention effect on essential nutrient intake in trial 2 (unadjusted and adjusted)

	Teacher-led ($n = 488$)			Comparison group ($n = 428$)			Intervention effect			
Nutrient intake	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Total energy (KJ/day)	7848	454	6958 to 8739	7807	464	6898 to 8715	42	404	–833 to 749	0.9
Total energy (kcal/day)	1868	108	1657 to 2080	1860	110	1642 to 2075	10	96	–198 to 179	0.9
Fat (g/day)	81.5	4.5	72.7 to 90.3	82.2	4.5	73 to 91	–1	4.9	–8.9 to 10.3	0.9
Salt (mg/day)	2708	145	2424 to 2991	2746	146	2459 to 3032	–38	158	–262 to 338	0.8
Sugars (g/day) including non-milk extrinsic sugars	88	6.7	75.0 to 101.2	87	6.8	74 to 100	1.2	5.8	–12.7 to 10.2	0.8
Carotene (µg/day)	2032	223	1567 to 2480	2358	246	1853 to 2862	–335	301	–952 to 282	0.2
Vitamin C (mg/day)	92.6	6.1	80.6 to 104.5	90.9	5.9	79 to 103	–1.7	6.3	–14.0 to 10.6	0.8
Iron (µg/day)	10.7	0.6	9.5 to 11.8	10.5	0.6	9 to 11	0.1	0.6	–1.3 to 10	0.8
Fibre (g/day)	11.9	0.8	10.5 to 13.4	11.6	0.8	10 to 13	0.3	0.8	–1.8 to 1.2	0.7
Carbohydrates (g/day)	219.0	14.0	191.6 to 246.4	216.4	14.3	188 to 244	3	11.4	–24.9 to 19.7	0.8
Folate (µg/day)	201.5	10.7	180.4 to 222.5	198.1	10.9	177 to 219	3.4	10.2	–23.3 to 16.6	0.7
Protein (g/day)	70.7	3.9	63.2 to 78.3	68	3.9	61 to 76	2	3.9	–9.5 to 5.7	0.6

TABLE 30 Intervention effect on essential nutrient intake in trial 2 (unadjusted and adjusted) (*continued*)

	Teacher-led ($n = 488$)			Comparison group ($n = 428$)			Intervention effect			
Nutrient intake	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Adjusted[a]										
Total energy (KJ/day)	7761	720	6349 to 9174	7719	717	6313 to 9125	42	404	–751 to 835	0.9
Total energy (kcal/day)	1845	172	1509 to 2182	1836	170	1501 to 2170	9	95.5	–179 to 198	0.9
Fat (g/day)	76	7.9	60 to 91	77	7.9	61 to 92	–1	4.8	–10 to 8	0.8
Salt (g/day)	2621	259	2113 to 3129	2656	257	2152 to 3159	–34	152	–332 to 263	0.8
Sugars (g/day) including non-milk extrinsic sugars	108	11.4	75 to 126	107	11.3	85 to 129	1	5.7	–10 to 12	0.8
Carotene (µg/day)	1841	299	1227 to 2456	2168	329	1493 to 2843	–327	295	–932 to 279	0.2
Vitamin C (mg/day)	75	30.2	16 to 134	73	30	14 to 132	2	6	–14 to 9	0.7
Iron (µg/day)	10	0.9	8 to 12	10	0.9	8 to 12	0.1	0.6	–1 to 1.2	0.8
Fibre (g/day)	12	1.2	9 to 14	11	1.2	9 to 14	0.3	0.8	–1 to 2	0.6
Carbohydrates (g/day)	227	21.7	184 to 270	225	21.6	182 to 267	2	11.4	–20 to 24	0.8
Folate (µg/day)	192	18.9	155 to 229	188	18.8	151 to 225	4	10.2	–15 to 24	0.6
Protein (g/day)	70	6.5	58 to 83	68	6.4	56 to 81	2	3.9	–6 to 9	0.6

a Adjusted for gender, age, ethnicity and IMDS.

Sensitivity analysis

Baseline values brought forward

Sensitivity analysis was carried out using baseline data brought forward to explore the effect on the primary outcome. The results from this analysis are presented for trial 1 in *Table 31* and for trial 2 in *Table 32*. The same methodology used to explore the intervention effect in the main analysis was applied to baseline values brought forward. There was very little difference in the results for baseline brought forward compared with the main trial analysis for trial 1. Instead of having a decrease in mean change in fruit intake, there is almost no change (2.0 g) for the RHS-led group and a change of 10.7 g for the teacher-led group. The mean difference in vegetable intake increases from 13 g to 35 g; however, after the adjustments are made this difference is not significant. The difference in combined change in fruit and vegetable intake was negligible between the main ITT model and baseline brought forward for trial 1.

The plots of the residuals with their 95% confidence limits are presented in ascending order in *Figure 18*. There was even less divergence from zero for all the schools, indicating that the schools do not differ significantly from the average line at the 5% level. From the adjusted model of the mean change in combined fruit and vegetable intake, results state that 0.1% of the variance in change in mean fruit and vegetable intake can be attributed to the difference between schools.

For trial 2, displayed in *Table 32*, differences in the main analysis and the baseline brought forward are minor, with only a slight decrease in all three mean differences for fruit, vegetables and combined fruit and vegetable intake. Again, once adjusted for the covariates, these differences in mean intakes were not significant.

Figure 19 shows very little difference compared with the main analysis. The overall plot shows the majority of the schools do pass through zero, indicating that the schools do not differ significantly from the average line at the 5% level. From the adjusted model of the mean change in combined fruit and vegetable intake, results state that 3.8% of the variance in change in mean fruit and vegetable intake can be attributed to the difference between schools.

Differences between boys and girls by intervention allocation

Differences in fruit and vegetable intake between boys and girls by intervention allocation were explored. There is very little difference between boys and girls in the RHS-led group, with both showing a mean decrease in fruit consumption (girls: –34 g, 95% CI –68 to –1 g; boys: –31 g, 95% CI –64 to 2 g) and for vegetable consumption, almost no difference (girls: –1 g, 95% CI –17 to 30 g; boys: 5 g, 95% CI –14 to 25 g) (*Table 33*). For the combined mean change in fruit and vegetables, boys in the RHS-led group decreased their consumption less than girls (girls: –37 g, 95% CI –76 to 1.2 g; boys: –26 g, 95% CI –65 to 12 g). Results for the teacher-led schools revealed that the girls tended to consume more vegetables than boys (girls: mean change 28 g, 95% CI 6 to 49 g; boys: mean change 5 g, 95% CI –16 to 26 g). This difference was also reflected in combined fruit and vegetable intake, with girls on average having a mean change of 15 g (95% CI –63 to 55 g) in fruit and vegetable consumption, compared with 2 g change for boys (95% CI –36 to 63 g).

TABLE 31 Intervention effect on change in fruit and vegetable intake for trial 1 (sensitivity analysis baseline observation carried forward)

	RHS-led ($n = 465$)			Teacher-led ($n = 563$)			Intervention effect			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Change in fruit intake (g)	2	6.9	–11.5 to 15.4	10.7	6.2	–1.4 to 22.9	–8.8	9.3	–9.4 to 27.0	0.3
Change in vegetable intake (g)	177	15.7	146.3 to 207.9	212.1	14.2	184.2 to 240.0	–35.0	21.2	–76.5 to 6.6	0.1
Change in combined fruit and vegetable intake (g)	–14.1	8.8	–31.3 to 3.1	5.2	7.9	–10.4 to 20.7	–19.2	11.8	–42.4 to 4.0	0.1
Adjusted [a]										
Change in fruit intake (g)	17	17.2	–16 to 51	27	16.7	–5 to 60	–10	9.2	–28 to 7	0.2
Change in vegetable intake (g)	141	29.3	84 to 199	180	28.1	125 to 506	–38	22.0	–81 to 4.8	0.08
Change in combined fruit and vegetable intake (g)	172	71.3	33 to 312	195	71.4	55 to 335	–22	12.0	–46 to 1	0.06

a Adjusted for gender, age, ethnicity and IMDS.

TABLE 32 Intervention effect on change in fruit and vegetable intake for trial 2 (sensitivity analysis baseline observation carried forward)

	Teacher-led ($n = 667$)			Comparison group ($n = 698$)			Intervention effect			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Change in fruit intake (g)	27.4	10.0	7.9 to 46.9	12.5	10.0	–7.2 to 32.2	–14.9	14.1	–42.6 to 12.8	0.3
Change in vegetable intake (g)	224.2	12.7	199.4 to 249.1	211.5	12.8	186.4 to 236.6	12.7	18.0	–48.0 to 22.6	0.5
Change in combined fruit and vegetable intake (g)	28.3	13.7	1.4 to 55.2	8.8	13.8	–18.3 to 36.0	–19.5	19.5	–57.7 to 18.7	0.3
Adjusted [a]										
Change in fruit intake (g)	44	23.8	–2 to 91	32	23.6	–14 to 78	13	14.0	–14 to 40	0.3
Change in vegetable intake (g)	227	30.8	166 to 287	208	30.6	148 to 268	18	17.9	–16 to 54	0.3
Change in combined fruit and vegetable intake (g)	49	31.8	–12 to 112	32	31.6	–29 to 94	17	19.2	–20 to 55	0.4

a Adjusted for gender, age, ethnicity and IMDS.

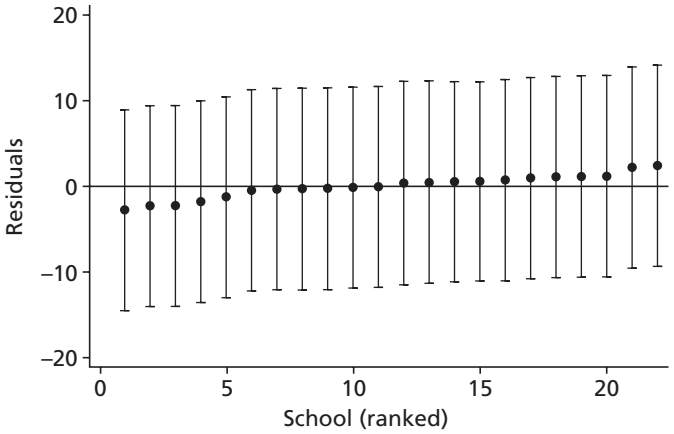

FIGURE 18 Plot of the school residuals for change in fruit and vegetable intake in ascending order with their 95% confidence limits, for trial 1 baseline values brought forward.

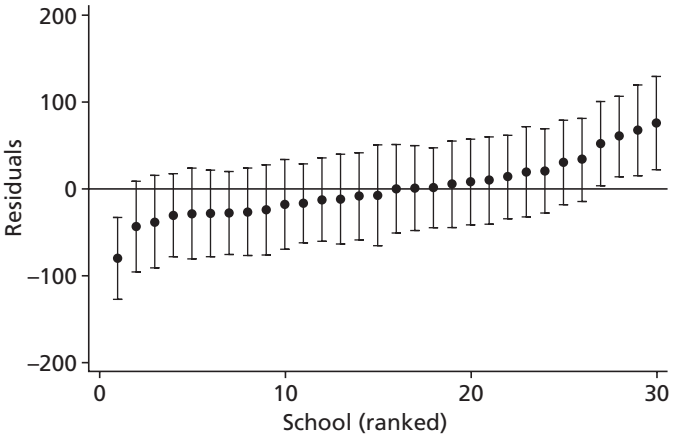

FIGURE 19 Plot of the school residuals for change in fruit and vegetable intake in ascending order with their 95% confidence limits, for trial 2 baseline values brought forward.

TABLE 33 Trial 1: Difference in fruit and vegetable intake for boys and girls, adjusted for baseline intake, ethnicity, gender and IMDS

	Girls			Boys		
Food	Mean	SE	95% CI	Mean	SE	95% CI
RHS-led						
Change in fruit intake (g)	–34	16.9	–68 to –1	–31	16.8	–64 to 2
Change in vegetable intake (g)	–1	10.1	–17 to 30	5	10.1	–14 to 25
Change in combined fruit and vegetable intake (g)	–37	19.9	–76 to 1.2	–26	19.7	–65 to 12
Teacher-led						
Change in fruit intake (g)	–10	16.2	–42 to 21	–2	15.7	–32 to 28
Change in vegetable intake (g)	28	11.0	6 to 49	5	10.8	–16 to 26
Change in combined fruit and vegetable intake (g)	15	20.7	–63 to 55	2	20.1	–36 to 63

For trial 2, there was very little difference between the two groups in either the teacher-led intervention or the comparison group, with the teacher-led girls having a slightly higher mean change of 32 g (95% CI –27 to 91 g) in fruit and vegetable intake, compared with the boys' mean change of 27 g (95% CI –32 to 87 g) (*Table 34*). In the comparison group there was a difference in fruit intake between boys and girls, with the girls having a decrease in mean intake of 9 g (95% CI –46 to 28 g) and the boys having a mean change of –17 g (95% CI –50 to 14 g). However, their vegetable and combined fruit and vegetable intakes were very similar.

Differences between boys and girls interaction effect

Additional analysis was conducted to explore whether or not there was an interaction between gender and the intervention. The results from this analysis are presented in *Tables 35* and *36*. After adjusting for age, ethnicity and IMDS, no interaction effect of gender was detected.

Discussion

Fruit and vegetable consumption

The results from these trials revealed that there was very little difference in children's mean change in fruit, vegetable or combined fruit and vegetable intake. For both trials, the teacher-led group had slightly higher mean intakes of vegetables and combined fruit and vegetables than the RHS-led or comparison group; however, there was no significant intervention effect after taking into consideration the adjustment for possible confounders. Only five other studies measured the relationship between children's fruit and vegetable intake and a gardening intervention.[14,47,48,125,126] The results from these five studies were mixed, with two studies revealing a significant difference for fruit and vegetable intake,[14,48] one[125] finding that boys had a higher consumption of fruit and vegetables compared with girls, and one reporting a significant increase in vegetable consumption,[126] while the fifth study found no differences in fruit or vegetable intake (measured separately only).[47]

TABLE 34 Trial 2: Difference in fruit and vegetable intake for boys and girls, adjusted for baseline intake, ethnicity, gender and IMDS

	Girls			Boys		
Food	Mean	SE	95% CI	Mean	SE	95% CI
Teacher-led						
Change in fruit intake (g)	15	23.3	–43 to 38	12	20.9	–38 to 43
Change in vegetable intake (g)	17	13.3	–8 to 20	15	13.4	–10 to 41
Change in combined fruit and vegetable intake (g)	32	30.4	–27 to 91	27	30.5	–32 to 87
Comparison group						
Change in fruit intake (g)	–9	15.9	–46 to 28	17	16.6	–50 to 14
Change in vegetable intake (g)	24	9.3	6 to 42	18	9.0	0 to 36
Change in combined fruit and vegetable intake (g)	9	19.4	–29 to 46	6	20.1	–33 to 46

TABLE 35 Intervention effect on fruit and vegetable intake for boys and girls in trial 1, adjusted for age, ethnicity and IMDS

	RHS-led ($n = 312$)			Teacher-led ($n = 329$)			Interaction			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Change in fruit intake (g)	4	23.5	–42 to 49	9	22.9	–36 to 53	5	32.8	–59 to 69	0.8
Change in vegetable intake (g)	6	12.1	–1 to 58	–22	11.7	–45 to 0	29	16.8	–3 to 62	0.08
Change in combined fruit and vegetable intake (g)	11	27.5	–43 to 64	–13	26.8	–65 to 39	24	38.4	–76 to 2	0.06
Adjusted[a]										
Change in fruit intake (g)	11	23.3	–34 to 56	15	22.6	–29 to 59	3	32.3	–66 to 16	0.9
Change in vegetable intake (g)	8	11.9	–15 to 31	–21	11.6	–44 to 0	29	16.6	–3 to 62	0.07
Change in combined fruit and vegetable intake (g)	18	27.1	–34 to 72	–6	26.3	–57 to 45	24	37.7	–49 to 98	0.5

a Adjusted for gender, age, ethnicity and IMDS.

TABLE 36 Intervention effect on fruit and vegetable intake for boys and girls in trial 2, adjusted for age, ethnicity and IMDS

	Teacher-led ($n = 488$)			Comparison group ($n = 428$)			Interaction			
Food	Mean	SE	95% CI	Mean	SE	95% CI	Mean difference	SE	95% CI	*p*-value
Unadjusted										
Change in fruit intake (g)	–3	20.7	–43 to 37	9	19.4	–28 to 47	–12	28.4	–68 to 43	0.6
Change in vegetable intake (g)	–2	11.3	–24 to 20	–7	10.5	–27 to 14	4	15.5	–26 to 34	0.7
Change in combined fruit and vegetable intake (g)	–5	25.1	–54 to 44	3	23.4	–42 to 49	–8	34.4	–42 to 57	0.7
Adjusted[a]										
Change in fruit intake (g)	5	20.4	–35 to 46	16	19.0	–20 to 53	–11	27.8	–66 to 42	0.6
Change in vegetable intake (g)	–3	11.4	–24 to 40	–5	10.6	–25 to 16	2	15.5	–28 to 32	0.9
Change in combined fruit and vegetable intake (g)	2	24.9	–46 to 50	12	23.1	–33 to 57	–10	33.8	–76 to 56	0.7

a Adjusted for gender, age, ethnicity and IMDS.

Of the four studies that did show an effect on fruit or vegetable intake, two used self-selection to determine which school received the intervention.[48,126] In one study, the teacher was able to choose whether they received the intervention or not,[126] and the other was based on existing gardening activities within the schools.[48] One study[47] stated that the head teacher chose which classes would receive the intervention, and the fourth study[14] used convenient sampling for the three schools involved; two of the three schools were randomly assigned, whereas the third school was assigned based on garden availability. However, for both of the current trials, gardening area or existing activities was not a requirement and all schools were randomly assigned to their intervention group.

Nutrient consumption

For both trials, the differences in key nutrients and foods were explored to see if there was an effect of either intervention on their mean intakes. Overall, there was very little difference in either trial for these key nutrients and foods. The only significant difference was in trial 1 for vitamin C intake in the adjusted model. Once the adjustments were made there was a 13.0-mg-per-day difference between the RHS- and teacher-led groups, with the teacher-led group having a significantly higher intake of vitamin C. A previous study[14] explored key nutrients, identifying significant increases in dietary fibre and vitamins A and C in the gardening intervention group compared with the control group.

Potential barriers to changing children's fruit and vegetable consumption

Changing children's fruit and vegetable consumption patterns is a challenging task. The main barriers to increasing children's fruit and vegetable intake are availability, convenience, taste preferences, peer pressure, parental/school support and knowledge.[49] Successful implementation of an intervention is often determined by the time allocated and the teachers' and parents' perceptions of its importance. The main barrier for teachers in implementing school-based interventions is preparation time.[127] The teacher's willingness to teach the intervention and own beliefs in the importance of the garden could explain the current findings that, although not significant, the teacher-led intervention tended to have a higher increase in fruit and vegetable consumption compared with the RHS-led intervention and the comparison group. Another important geographical component to acknowledge when evaluating the success of a gardening intervention is that all of the successful interventions were located in the USA, in areas where fruit and vegetables could be grown all year round. In the current research, the length of the growing season may have had an effect on the outcome. Further analysis exploring how the delivery and implementation of the intervention may have affected the primary outcome is described in subsequent chapters.

Limitations and strengths

One of the disadvantages of the design of this research was having two trials instead of one. Therefore, the difference between the RHS-led intervention and the comparison group could not be analysed. However, for both trials the study design was robust, using randomisation to determine which schools received the different interventions. This is the first clustered RCT to evaluate the effectiveness of a school gardening intervention on children's fruit and vegetable consumption. One of the main limitations of previous studies in this area was their study design and the use of convenience sampling.[41–43] The strength of the current study is that schools were randomised to either one of the intervention groups or the comparison group; therefore, there was no possibility of introducing selection bias into the study. One of the fundamental problems with previous research in this area is that schools were selected based on their having or not having a garden; those without a garden were used as control schools.[14,44] Other biases included constraints of the school district and characteristics such as pupil numbers,[46] self-selection and teachers being given the option to choose their condition group.[47,48,126]

The sample size at baseline for both trials was lower than anticipated, with the response rate at follow-up for both trials combined being 62%. This reduced the average group size to approximately 388, 94 children fewer than the proposed sample size of 482, reducing the power of the study. Small sample sizes can lead to an underestimation of the SEs and affect the sensitivity of the tests used to determine the statistical differences between the groups. The sensitivity analysis (baseline brought forward) was conducted to explore whether or not the reduced sample size had an effect on the primary outcome. The results were very similar to those of the main analysis, suggesting that the reduced sample size did not affect the primary analysis of the trial. Furthermore, these trials are the largest trials to evaluate school gardening to date. Some of the studies in this area had a very small sample size, with some only involving a few schools or one school implementing the intervention.[41,42,44,125,128,129] Furthermore, the current trials involved a highly diverse population in terms of ethnicity and socioeconomic groups.

The dietary data were collected using a validated 24-hour food tick list (CADET) for children aged 3–11 years. The strength of the CADET diary is that it uses age- and gender-specific food portion sizes to calculate food and nutrient intake. A 1-day tick list is an economically effective way of gathering nutrient information from children. However, the disadvantage of using a 24-hour food frequency questionnaire is that it uses pre-allocated portion sizes for each item in CADET, based on average weighed intakes from UK children.[62] A 1-day tick list may not reflect true nutrient intake in the longer term. This study attempted to improve the quality of the data by providing parents and children with an instruction DVD to help explain how to complete the CADET home food diary. In this study, the trained fieldworkers also collected and reviewed all home food diaries. This was for two reasons: to reduce errors in the data collected to make sure that children did consume everything ticked on the diary, but also to obtain a retrospective recall for children who did not return the home food diary. The CADET diary does avoid these issues with child self-reported food intake, and is less of a burden on participants than the most commonly used alternative, a weighed 4-day food diary.

All the results were analysed using a robust statistical methodology, multilevel analysis. The benefit of this technique is that the means and CIs for the different foods and nutrients will be more accurate, as the children within a school are more similar to each other in terms of their food consumption, with less variability within the sample, compared with a random sample from the whole population.[86,124] The primary outcome measuring children's fruit and vegetable consumption, using multilevel regression analysis, was originally intended to explore differences in follow-up intake, adjusting for baseline intake. However, owing to the negative distribution of the residuals for follow-up fruit and vegetable intake, a change score was calculated by subtracting baseline fruit and vegetable intake from follow-up intake. For both trials there was no imbalance between intervention and comparison groups for baseline intake of fruit and vegetables, suggesting that this was an appropriate methodology.[130]

Conclusion

This is the first clustered RCT to explore whether or not a gardening intervention can increase children's fruit and vegetable intake. The results showed that there was no change in children's fruit and vegetable intake after receiving either the RHS-led or the teacher-led intervention.

Summary

This chapter has explored the primary outcome for both trials, asking 'Can the RHS Campaign for School Gardening lead to increases in vegetable and fruit intake in children aged 8–9 years?' It is evident that children's fruit and vegetable intake did not significantly increase after participating in either the RHS- or teacher-led interventions. For both trials, the teacher-led intervention group had, on average, a higher mean change in fruit and vegetable intake compared with the RHS-led or comparison group. Further chapters will explore the adherence to the different interventions (RHS-led and teacher-led) and identify how the different types of interventions implemented affected the primary outcome of children's fruit and vegetable intake.

Secondary outcomes were also explored: the effect of the RHS campaign on intake of key nutrients (fat, carbohydrate, protein, vitamin C, carotene, iron, sodium and folate), and whether or not there was an interaction effect between the intervention and gender. The only significant difference found in the secondary outcomes was for vitamin C intake in trial 1. Once the adjustments were made, there was a 13.0-mg-per-day difference between the RHS- and teacher-led groups, with the teacher-led group having a significantly higher intake of vitamin C.

Chapter 6 Impact of a school gardening intervention on children's knowledge of and attitudes towards fruit and vegetables

Introduction

The psychological theory behind school gardens is based on the SCT.[131] The SCT is based on the assumption that to successfully change a person's behaviour requires changing their knowledge, values and beliefs.[132] SCT has been used to design several gardening interventions.[41,43,44,46,47,133] Personal factors such as nutrition knowledge, food preferences (including willingness to taste), attitudes towards food and self-efficacy in eating and preparing food have already been associated with increased fruit and vegetable consumption in children and adolescents in non-gardening research.[134] Overall, gardening interventions have been associated with an increase in children's nutrition knowledge in the majority of the studies which assessed this,[42,44–47,73,126,133] though not in all.[41,43]

In order to assess children's knowledge and attitudes towards fruit and vegetables, a short questionnaire was developed and administered at baseline before and after the RHS interventions were implemented in the two trials. The aim of this chapter was to compare the effects of teacher-led gardening with those of the RHS-led school gardening intervention and no intervention at all, in terms of impact on children's knowledge of and attitudes towards fruit and vegetables.

Method

All schools were provided with two copies of the child questionnaire for each child to complete individually, at baseline and then at follow-up after two growing seasons.

Fruit and vegetable knowledge

To assess knowledge of the 5 A DAY fruit and vegetable campaign, children were asked to circle on the child questionnaire a number between 1 and 8 in answer to the question 'How many servings of fruit and vegetables do you think you should eat every day to stay healthy?' To test children's ability to recognise different fruit and vegetables, they were asked to draw a line from the names of 12 fruits and 16 vegetables to a colour photo of each item. Apple was provided as an example. All the fruits were listed and pictured on one page; these were raspberries, blackberries, pears, blueberries, plums, bananas, grapes, orange, pineapple, nectarine, watermelon and kiwi fruit. The following vegetables were listed on another page: courgettes, spinach, French beans, parsley, lettuces, parsnips, radish, sweetcorn, carrots, leeks, spring onions, broccoli, peppers, cucumber, tomatoes and garlic (see *Appendix 1*). For each item, correct responses were coded 1 and incorrect responses were coded 0.

Attitudes towards fruit and vegetables

To assess attitudes towards fruit and vegetables, the children were asked to circle responses indicating whether they agreed a lot, agreed a little, disagreed a little or disagreed a lot with 10 questions (*Table 37*), such as 'I enjoy eating fruit' or 'I like trying new fruit', which relate to perceived barriers to consumption. Self-efficacy was assessed using 'I try to eat lots of fruit' and 'I'm good at preparing fruit and vegetables'. Perceived social influences and availability in the home environment were evaluated with the questions 'My family encourages me to eat fruit and vegetables' and 'There's usually lots of fruit and vegetables to eat at home'.

TABLE 37 Attitudes towards fruit and vegetables for trial 1

	Percentage of children who agreed[a]				Odds of agreeing (95% CI) at follow-up using MLM to compare interventions		
	RHS-led ($n = 366$)		Teacher-led ($n = 394$)				
Attitudes and perceptions	Baseline	Follow-up	Baseline	Follow-up	Unadjusted	Adjusted for baseline	Additional adjustment[b]
I enjoy eating fruit	94.5	91.8	96.4	96.2	0.4 (0.2 to 1.0)	0.5 (0.2 to 1.1)	0.4 (0.1 to 1.0)
I like trying *new* fruits	78.0	76.3	83.3	86.6	0.5 (0.2 to 0.9)	0.5 (0.2 to 0.9)	0.5 (0.2 to 0.9)
I try to eat lots of fruit	83.0	81.3	86.7	90.1	0.4 (0.2 to 0.8)	0.4 (0.2 to 0.8)	0.4 (0.2 to 0.9)
I enjoy eating vegetables	65.6	64.7	66.9	65.9	1.0 (0.5 to 1.8)	1.0 (0.5 to 1.9)	1.1 (0.6 to 1.9)
I like trying *new* vegetables	58.9	58.0	61.0	60.0	0.9 (0.6 to 1.4)	0.9 (0.6 to 1.4)	1.0 (0.7 to 1.5)
I try to eat lots of vegetables	64.6	70.9	66.7	69.6	1.1 (0.6 to 1.9)	1.1 (0.7 to 1.8)	1.1 (0.7 to 1.7)
Eating fruit and vegetables every day keeps me healthy	93.5	94.1	94.1	97.2	0.5 (0.2 to 1.8)	0.5 (0.1 to 1.7)	0.6 (0.2 to 1.6)
There's usually lots of fruit and vegetables to eat at home	89.2	89.8	87.6	94.1	0.5 (0.2 to 1.0)	0.5 (0.2 to 1.0)	0.4 (0.2 to 0.9)
I'm good at preparing fruit and vegetables[c]	71.8	74.7	81.3	83.6	0.6 (0.3 to 0.9)	0.6 (0.3 to 1.4)	0.6 (0.3 to 1.1)
My family encourages me to eat fruit and vegetables	87.1	90.7	88.3	93.7	0.7 (0.3 to 1.4)	0.7 (0.3 to 1.5)	0.7 (0.3 to 1.5)
Percentage who knew that five fruit and vegetables per day are needed to stay healthy	76.2	79.0	72.7	79.0	0.9 (0.4 to 1.1)	0.8 (0.6 to 1.5)	0.9 (0.4 to 1.6)
Percentage who had tasted their own fruit and vegetables at follow-up	62.3	62.1	52.4	67.8	0.8 (0.4 to 1.2)	–	0.8 (0.5 to 1.4)

MLM, multilevel models.
a Agree = percentage of children who agreed a little or a lot.
b MLM adjusted for gender, ethnicity, IMDS and baseline answers.
c Significant difference between interventions at baseline.

Gardening experience

To determine gardening experience, the children were asked to circle 'yes' or 'no' in answer to 'We grow fruit and vegetables in our garden or allotment'. They were then asked 'What fruit or vegetables have you grown?'. For each child the number of different types of fruit and vegetables listed were coded as two separate variables. Finally, they were asked 'Have you tasted any fruit or vegetables from your garden or allotment?' ('yes' or 'no'), and 'What fruit or vegetables have you tasted?'. Each child's list of tasted items was compared with his or her list of own-grown fruit and vegetables, and recorded for analysis as 'none', 'some' or 'all fruit and vegetables grown'.

Statistical analysis

Differences between intervention groups for descriptive variables were analysed using chi-squared tests for categorical variables and *t*-tests for continuous variables.

Multilevel mixed-effects logistic regression analyses were used to determine whether or not there were significant differences between intervention groups at follow-up, relating to knowledge of the five fruit and vegetables a day needed to remain healthy. This method was also used to analyse differences relating to the percentage of children who agreed (a little or a lot) and the percentage of those who disagreed (a little or a lot) with the attitude statements. Odds ratios (ORs) were presented unadjusted, and also adjusted for baseline answers. Further analysis on > 90% of the children also adjusted for gender, ethnicity and IMDS. In these mixed-effects analyses, the fixed effects variable was the gardening intervention and the random effects variable was the school. The percentages of children who correctly identified 5 A DAY requirements and the individual fruit and vegetables, and the percentage who agreed with the attitude statements were also tabulated. Multilevel mixed-effects logistic regression models were also used to compare, between interventions, the percentage of children able to identify individual fruit and vegetables.

The change from baseline to follow-up in the total numbers of fruit and vegetables recognised was also calculated for each qualifying child, and compared between interventions for both trials using independent samples *t*-tests. *p*-values from multilevel mixed-effects regression analysis, adjusted for gender, ethnicity and IMDS, were also tabulated. These methods were used to assess the change between baseline and follow-up in the number of types of fruit or vegetables children listed as own-grown.

Multilevel mixed-effects regression analysis was used to determine whether or not there was an association between the change in knowledge of fruit and vegetables and the change in actual mean fruit and vegetable intake derived from the school and home food diaries. Analyses were presented unadjusted and adjusted for gender, ethnicity and IMDS. Only children who completed both the baseline and the follow-up questions of the appropriate section of the child questionnaire were included in these analyses. Statistical analyses was performed using Stata version 12. *p*-values of < 0.05 were taken to represent statistical significance for all analyses, except that relating to the recognition of individual fruit and vegetables, where *p*-values of < 0.01 were taken as statistically significant because of multiple testing.

Results

Response rate

In trial 1, 404 children (69%) from the teacher-led group and 373 (70%) from the RHS-led intervention attempted parts of both the baseline and follow-up child knowledge and attitudes questionnaire. In trial 2, 559 children (77%) from the teacher-led intervention and 541 (71%) from the control group attempted this. Not all of these children completed every section of the questionnaire. The numbers of children with completed dietary data were 329 (56%) from the teacher-led group and 323 (61%) from the RHS-led group in trial 1, and 500 (69%) from the teacher-led group and 431 (57%) from the comparison group in trial 2.

Attitudes towards fruit and vegetables

In relation to children's attitudes towards and perceptions about fruit and vegetables, > 90% of the children from the two trials at both baseline and follow-up agreed that eating vegetables every day kept them healthy and that their parents encouraged them to eat these. Over 90% of the children at both baseline and follow-up agreed that they enjoyed eating fruit, whereas 60–70% agreed that they enjoyed eating vegetables, and only 50–60% agreed that they liked trying new vegetables (see *Table 37*). In trial 2 (*Table 38*), children in the gardening intervention group were significantly more likely to agree that they enjoyed eating vegetables at follow-up compared with the control group (69.5% vs. 61.7%), even after adjusting for baseline answers (OR = 1.3, 95% CI 1.0 to 1.8); however, this was not significant after adjusting for gender, ethnicity or IMDS (OR = 1.2, 95% CI 0.9 to 1.6, $p = 0.1$). There were no other significant differences in trial 2 for this section of the questionnaire, and there were no significant differences relating to vegetables in trial 1 with regards to answers at follow-up. However, children in the RHS-led group in trial 1 were significantly less likely to agree that they tried to eat lots of fruit or liked to try new fruit than those in the teacher-led group, even after baseline adjustments (OR = 0.4, 95% CI 0.2 to 0.8, $p = 0.009$ and OR = 0.5, 95% CI 0.2 to 0.9, $p = 0.05$ respectively). In addition, after further adjustment for sociodemographic factors (including deprivation score), children in the RHS-led group were significantly less likely than those in the teacher-led group to agree that there were lots of fruit and vegetables to eat at home (OR = 0.4, 95% CI 0.2 to 0.9, $p = 0.02$).

At baseline a high proportion of children (> 67%) knew that five servings of fruit and vegetables should be eaten every day to stay healthy. Of the children who answered this question at both baseline and follow-up, there was no significant difference in the proportion giving correct answers at follow-up between the RHS- and teacher-led groups in trial 1 (79% vs. 79%). However, there was a significant difference between the intervention groups in trial 2 at follow-up, with the teacher-led group giving more correct answers than the comparison group (79% vs. 68%). From the multilevel logistic regression analyses, a significant difference remained (OR = 1.7, 95% CI 1.1 to 2.6, $p = 0.006$) after adjusting for baseline answers (which were significantly different between groups) and also after further adjustment for sociodemographic factors (OR = 1.7, 95% CI 1.1 to 2.5, $p = 0.004$).

Additionally, there was no evidence that the school gardening interventions significantly increased the likelihood of children tasting their own-grown fruit and vegetables.

The children's ability to recognise different fruit was already very good at baseline. *Table 39* reports the mean number of fruit and vegetables recognised at baseline and follow-up for both trials. It is evident when comparing the change in total fruit recognised from baseline to follow-up that there was no significant difference between intervention groups, in either trial 1 or trial 2, in the unadjusted independent *t*-test analyses or after adjustment for sociodemographic variables in multilevel analyses. Similarly, there was no significant difference in the change in total vegetables recognised between intervention groups in trial 2. However, in trial 1 there was a significantly larger increase in the number of different vegetables recognised from baseline to follow-up for the RHS-led group compared with the teacher-led group (a mean increase of 2.44 vs. 1.65 out of a total of 16 vegetables). This was statistically significant ($p = 0.03$) in multilevel analysis after additionally adjusting for sociodemographic factors.

Similarly, in trial 1 there was a significantly larger increase in the total number of fruits and vegetables recognised from baseline to follow-up for the RHS-led group compared with the teacher-led group ($p = 0.007$ in the *t*-test), but this was not significant after adjusting for sociodemographic variables in multilevel models.

TABLE 38 Attitudes towards fruit and vegetables in trial 2

Attitudes and perceptions	Percentage of children who agreed[a]				Odds of agreeing at follow-up (95% CI) using MLM to compare interventions		
	Teacher-led ($n = 537$)		Control group ($n = 498$)				
	Baseline	Follow-up	Baseline	Follow-up	Unadjusted	Adjusted for baseline	Additional adjustment[b]
I enjoy eating fruit	96.7	97.6	96.8	97.0	1.2 (0.5 to 2.8)	1.1 (0.5 to 2.7)	1.1 (0.4 to 2.9)
I like trying *new* fruits	86.0	84.0	84.5	80.4	1.2 (0.8 to 1.9)	1.2 (0.8 to 1.9)	1.2 (0.7 to 1.9)
I try to eat lots of fruit[c]	87.2	88.2	82.7	85.8	1.2 (0.7 to 1.8)	1.1 (0.7 to 1.8)	1.0 (0.6 to 1.6)
I enjoy eating vegetables	68.8	69.5	64.2	61.7	1.4 (1.0 to 1.8)	1.3 (1.0 to 1.8)	1.2 (0.9 to 1.6)
I like trying *new* vegetables	62.8	59.5	60.5	56.9	1.1 (0.8 to 1.4)	1.0 (0.8 to 1.4)	0.9 (0.7 to 1.2)
I try to eat lots of vegetables[c]	72.8	75.5	66.7	68.6	1.4 (0.9 to 2.0)	1.3 (0.9 to 1.9)	1.2 (0.8 to 1.8)
Eating fruit and vegetables every day keeps me healthy	94.9	97.0	96.2	96.4	1.2 (0.5 to 2.7)	1.2 (0.5 to 2.7)	1.2 (0.5 to 2.8)
There's usually lots of fruit and vegetables to eat at home	89.6	92.8	88.9	89.5	1.5 (0.9 to 2.3)	1.5 (0.9 to 2.3)	1.5 (0.9 to 2.5)
I'm good at preparing fruit and vegetables	79.3	78.1	77.9	79.3	0.9 (0.6 to 1.2)	0.9 (0.6 to 1.2)	0.8 (0.6 to 1.1)
My family encourages me to eat fruit and vegetables	89.9	92.8	87.7	91.9	1.1 (0.7 to 1.7)	1.1 (0.6 to 1.7)	0.9 (0.5 to 1.6)
Percentage who knew that five fruit and vegetables per day are needed to stay healthy[c]	73.6	79.1	67.3	67.5	1.8 (1.2 to 2.8)	1.7 (1.1 to 2.6)	1.7 (1.1 to 2.5)
Percentage who had tasted their own fruit and vegetables at follow-up	60.1	66.4	56.0	58.1	1.4 (0.8 to 2.4)	1.4 (0.8 to 2.4)	1.4 (0.8 to 2.4)

MLM, multilevel models.
a Agree = percentage of children who agreed a little or a lot.
b MLM adjusted for gender, ethnicity, IMDS and baseline answers.
c Significant difference between interventions at baseline.

TABLE 39 Mean number of fruit and vegetables recognised at baseline and follow-up, including only those children who completed sheets at both time points

Trial and intervention	*n*	Baseline mean (95% CI)	Follow-up mean (95% CI)	Mean change (95% CI)	p^a	p^b
Trial 1						
Fruit						
RHS-led	373	10.6 (10.5 to 10.8)	11.0 (10.9 to 11.2)	0.37 (0.16 to 0.58)	0.7	0.9
Teacher-led	404	10.9 (10.8 to 11.1)[c]	11.2 (11.1 to 11.4)	0.31 (0.14 to 0.48)		
Vegetables						
RHS-led	369	10.4 (10.1 to 10.7)	12.9 (12.6 to 13.1)	2.44 (2.01 to 2.83)	0.002	0.03
Teacher-led	404	11.3 (10.9 to 11.6)[c]	12.9 (12.6 to 13.2)	1.65 (1.34 to 1.98)		
Total fruit and vegetables						
RHS-led	372	20.9 (20.5 to 21.4)	23.9 (23.5 to 24.2)	2.79 (2.32 to 3.26)	0.007	0.08
Teacher-led	404	22.1 (21.8 to 22.6)	24.2 (23.8 to 24.5)	1.96 (1.59 to 2.34)		
Trial 2						
Fruit						
Teacher-led	556	10.5 (10.3 to 10.6)	11.0 (10.8 to 11.1)	0.51 (0.35 to 0.67)	0.2	0.3
Control	535	10.4 (10.3 to 10.6)	11.1 (11.0 to 11.2)	0.67 (0.49 to 0.85)		
Vegetables						
Teacher-led	552	10.8 (10.5 to 11.0)	12.4 (12.1 to 12.7)	1.65 (1.36 to 1.95)	0.3	0.6
Control	532	10.7 (10.4 to 11.0)	12.1 (11.9 to 12.4)	1.45 (1.17 to 1.72)		
Total fruit and vegetables						
Teacher-led	558	21.1 (20.7 to 21.5)	23.3 (23.0 to 23.7)	2.15 (1.78 to 2.51)	0.8	0.9
Control	536	21.0 (20.7 to 21.4)	23.1 (22.8 to 23.5)	2.10 (1.74 to 2.45)		

a Used independent *t*-test to test the difference between interventions in mean change between baseline and follow-up.
b Used multilevel mixed regression to test the difference between interventions in mean change between baseline and follow-up, adjusting for gender, ethnicity and IMDS.
c Significant differences in mean number of items recognised between different interventions at baseline using *t*-tests.

In both trials (*Tables 40* and *41*; *Figures 20–23*), ≥ 80% of children were able to identify each type of fruit on the questionnaire, apart from blackberries, blueberries, plums and nectarines, which were identified by only ≥ 64% of children. Over 90% of the children could identify pears, bananas, grapes, oranges, pineapples and watermelons. In contrast, the ability to recognise vegetables was more varied, with 90% of children recognising sweetcorn, carrots, peppers and tomatoes, but only 50% identifying spinach, parsley, leeks and spring onions.

Nevertheless, about 30% of children in trial 1 and > 20% of children in trial 2 identified these last four vegetables correctly for the first time at follow-up, after the gardening intervention. The figures, however, show that a fair proportion of children could not identify these and other items (such as blackberries, blueberries, plums and nectarines) at follow-up after previously identifying them correctly at baseline, as some of the answers were probably guesses.

In trial 1 there were no differences at follow-up between RHS-led and teacher-led interventions which were significant at $p < 0.01$. In trial 2, significant differences at follow-up between the teacher-led intervention and the control group were found only in relation to nectarines in both chi-squared tests and multilevel models adjusting for baseline, and additionally for sociodemographic variables (at $p < 0.001$). Children in the control group were more likely to identify nectarines than those in the teacher-led intervention. Children in the teacher-led intervention, however, were significantly more likely to be able to identify leeks at follow-up than those in the control group, but this was not significant after baseline adjustments in multilevel models.

Using multilevel mixed-effects regression analysis, there was no significant evidence in any of the gardening groups of an association between the change in fruit or vegetables, or total fruit and vegetables, identified from baseline to follow-up, and the change in actual intake of fruit or vegetables derived from the school and home food diaries. Although the results for trial 1 showed decreases in fruit intake these were not statistically significant. Conversely, point estimates for trial 2 indicated an increase in intake with increased recognition for vegetables in the teacher-led gardening group, though again this was not statistically significant (*Table 42*).

There was no significant difference between the RHS- and teacher-led groups in trial 1 in the change between baseline and follow-up for the number of types of fruit or vegetables children listed as own grown. However, in trial 2 there was a significant increase in the number of types of own-grown fruit listed by the teacher-led group compared with the control group (mean = 0.3, 95% CI 0 to 0.6), but a significant decrease in the number of types of vegetables listed. After adjusting for gender, ethnicity, IMDS and baseline, however, these differences were no longer significant (*Table 43*).

Using multilevel mixed-effects regression analysis there was no significant evidence in any of the gardening groups of an association between the change in fruit or vegetable intake, and growing fruit and vegetables at home or tasting fruit and vegetables grown at home. This analysis is presented in *Table 44* with the unadjusted and adjusted models.

TABLE 40 Trial 1: percentage of children who correctly identified different fruit and vegetables

	Percentage of children who recognised the item								
	RHS-led intervention ($n = 372$)		Teacher-led intervention ($n = 404$)		Percentage-point difference at follow-up (RHS-led minus teacher-led)	Difference in change between baseline and follow-up (%)	Chi-squared test: *p*-value for difference at follow-up	*p*-value for difference at follow-up using MLM logistic regression	
Fruit or vegetable	Baseline	Follow-up	Baseline	Follow-up				Adjusted for baseline[a]	Further adjusted[b]
Raspberries	84.7	90.9	89.9	94.8	–3.9	1.2	0.3	0.08	0.03
Blackberries	82.5	86.8	83.9	90.3	–3.5	–2.0	0.1	0.5	0.6
Pears	93.8	96.8	96.5	97.8	–1.0	1.7	0.4	0.4	0.5
Blueberries	76.9	81.7	82.2	88.1	–6.4	–1.1	0.01	0.4	0.7
Plums	80.4	82.0	82.6	84.2	–2.2	0.1	0.4	0.6	0.7
Bananas[c,d]	96.8	98.9	99.5	99.0	–0.1	2.6	0.9	–	–
Grapes	91.9	96.0	94.8	97.5	–1.6	1.3	0.2	0.3	0.5
Oranges	96.5	96.8	97.5	96.5	0.2	1.3	0.9	0.8	1.0
Pineapples	96.5	96.8	96.0	98.0	–1.2	–1.7	0.3	0.3	0.5
Nectarines	70.7	76.9	75.7	81.4	–4.6	0.5	0.1	0.3	0.5
Watermelons[d]	98.7	99.5	98.8	98.5	0.9	1.1	0.2	0.3	0.3
Kiwifruit	95.4	98.1	95.1	97.8	0.3	0.0	0.7	0.6	0.8
Courgettes	46.7	72.0	55.3	74.8	–2.9	5.7	0.4	0.9	0.7
Spinach	39.7	63.9	43.4	62.8	1.1	4.8	0.8	0.5	0.9
French beans	71.7	83.7	76.9	83.4	0.3	5.5	0.9	0.6	0.8
Parsley[c]	27.5	52.0	36.2	49.1	2.9	11.7	0.4	0.2	0.2
Lettuces	78.5	90.8	82.6	91.3	–0.6	3.5	0.8	0.9	1.0

TABLE 40 Trial 1: percentage of children who correctly identified different fruit and vegetables (*continued*)

Fruit or vegetable	Percentage of children who recognised the item				Percentage-point difference at follow-up (RHS-led minus teacher-led)	Difference in change between baseline and follow-up (%)	Chi-squared test: *p*-value for difference at follow-up	*p*-value for difference at follow-up using MLM logistic regression	
	RHS-led intervention ($n = 372$)		Teacher-led intervention ($n = 404$)						
	Baseline	Follow-up	Baseline	Follow-up				Adjusted for baseline[a]	Further adjusted[b]
Parsnips[c]	38.9	62.0	51.9	65.0	–3.1	9.9	0.4	0.9	1.0
Radishes	52.7	74.7	61.0	75.7	–1.0	7.3	0.7	0.7	0.8
Sweetcorn[d]	96.2	98.4	98.0	99.5	–1.1	0.7	0.1	0.1	–
Carrots[d]	94.6	99.2	97.5	98.8	0.4	3.4	0.6	0.5	0.3
Leeks	38.0	56.5	41.7	62.3	–5.8	–2.1	0.1	0.4	0.3
Spring onions	38.9	59.2	40.7	61.5	–2.3	–0.5	0.5	0.9	0.6
Broccoli[c]	88.6	96.2	94.8	94.0	2.2	8.4	0.2	0.2	0.2
Peppers	90.2	97.3	95.0	97.3	0.0	4.8	1.0	0.8	0.9
Cucumbers	73.1	89.1	80.7	89.6	–0.5	7.1	0.8	0.9	0.6
Tomatoes	97.0	98.1	98.3	98.2	–0.2	1.1	0.9	–	–
Garlic	68.2	93.2	71.6	88.1	5.1	8.5	0.02	0.03	0.04

MLM, multilevel models.

a *p*-value for difference between interventions from multilevel mixed logistic regression testing the odds of children correctly identifying fruit items at follow-up, adjusting for ability to identify fruit at baseline.

b *p*-value for difference between interventions from multilevel mixed logistic regression testing the odds of children correctly identifying fruit items at follow-up, adjusting for ability to identify fruit at baseline, gender, ethnicity and IMDS.

c Significant differences between different interventions ($p \leq 0.01$) were found using chi-squared tests for the percentage of children who could identify individual items at baseline.

d Fisher's exact test was used instead of chi-squared tests as there were less than five children in > 20% of the compared groups.

TABLE 41 Trial 2: percentage of children who correctly identified different fruit and vegetables

Fruit or vegetable	Percentage of children who recognised the item				Percentage-point difference at follow-up (teacher-led minus control group)	Difference in change between baseline and follow-up (%)	Chi-squared test: *p*-value for difference at follow-up	*p*-value for difference at follow-up using MLM logistic regression	
	Teacher-led intervention ($n = 556$)		Control group ($n = 535$)						
	Baseline	Follow-up	Baseline	Follow-up				Adjusted for baseline[a]	Further adjusted[b]
Raspberries	83.2	92.6	85.8	92.2	0.5	3.0	0.8	0.7	0.9
Blackberries	78.2	86.5	80.9	89.7	–3.2	–0.5	0.1	0.2	0.2
Pears	95.3	98.0	94.2	97.2	0.8	–0.3	0.4	0.4	0.4
Blueberries	73.9	84.2	74.4	83.6	0.6	1.1	0.8	0.8	1.0
Plums	74.5	79.0	74.4	83.6	–4.6	–4.7	0.05	0.08	0.06
Bananas	98.6	98.7	97.6	97.8	1.0	0.0	0.2	0.2	0.2
Grapes	93.5	96.4	91.2	96.6	–0.2	–2.5	0.8	0.8	0.4
Oranges	96.2	96.4	95.9	96.1	0.3	0.0	0.8	0.8	1.0
Pineapples	95.5	97.7	94.8	97.2	0.5	–0.3	0.8	0.7	0.5
Nectarines	64.9	71.4	64.5	78.5	–7.1	–7.5	0.007	0.006	0.001
Watermelons	97.5	98.6	95.9	99.1	–0.5	–2.1	0.4	0.4	0.2
Kiwifruit	94.2	96.9	92.9	97.9	–1.0	–2.3	0.3	0.4	0.3
Courgettes	50.4	66.7	47.5	61.8	4.9	1.9	0.1	0.4	0.5
Spinach	45.1	62.0	43.7	55.6	6.4	4.9	0.03	0.3	0.5
French beans	74.3	84.2	69.9	81.9	2.4	–2.0	0.3	0.8	0.7
Parsley	31.5	46.4	30.4	44.4	2.0	0.9	0.5	0.7	0.9

TABLE 41 Trial 2: percentage of children who correctly identified different fruit and vegetables (*continued*)

Fruit or vegetable	Percentage of children who recognised the item				Percentage-point difference at follow-up (teacher-led minus control group)	Difference in change between baseline and follow-up (%)	Chi-squared test: *p*-value for difference at follow-up	*p*-value for difference at follow-up using MLM logistic regression	
	Teacher-led intervention ($n = 556$)		Control group ($n = 535$)						
	Baseline	Follow-up	Baseline	Follow-up				Adjusted for baseline[a]	Further adjusted[b]
Lettuces	79.9	89.3	78.6	87.9	1.3	0.0	0.5	0.8	0.9
Parsnips	48.0	57.6	44.4	56.1	1.5	–2.1	0.6	1.0	0.8
Radishes	53.1	70.8	50.3	64.3	6.5	3.7	0.02	0.2	0.2
Sweetcorn	97.1	98.4	97.2	98.5	–0.1	–0.1	0.9	0.9	0.3
Carrots	95.7	96.9	95.8	98.5	–1.6	–1.4	0.09	0.1	0.5
Leeks	39.0	53.1	36.3	43.9	9.1	6.5	0.003	0.08	0.1
Spring onions	40.4	56.0	43.1	57.5	–1.5	1.2	0.6	0.7	0.6
Broccoli	89.5	93.3	91.3	94.7	–1.4	0.4	0.3	0.4	1.0
Peppers	90.8	94.9	92.6	96.2	–1.3	0.6	0.3	0.4	0.4
Cucumbers	76.1	86.1	79.2	89.0	–3.0	0.1	0.1	0.2	0.4
Tomatoes	96.2	98.2	96.8	96.8	1.4	2.0	0.1	–	–
Garlic	69.0	87.9	71.3	86.2	1.7	3.9	0.4	0.5	0.6

MLM, multilevel models.

a *p*-value for difference between interventions from multilevel mixed logistic regression testing the odds of children correctly identifying fruit items at follow-up, adjusting for ability to identify fruit at baseline.

b *p*-value for difference between interventions from multilevel mixed logistic regression testing the odds of children correctly identifying fruit items at follow-up, adjusting for ability to identify fruit at baseline, gender, ethnicity and IMDS.

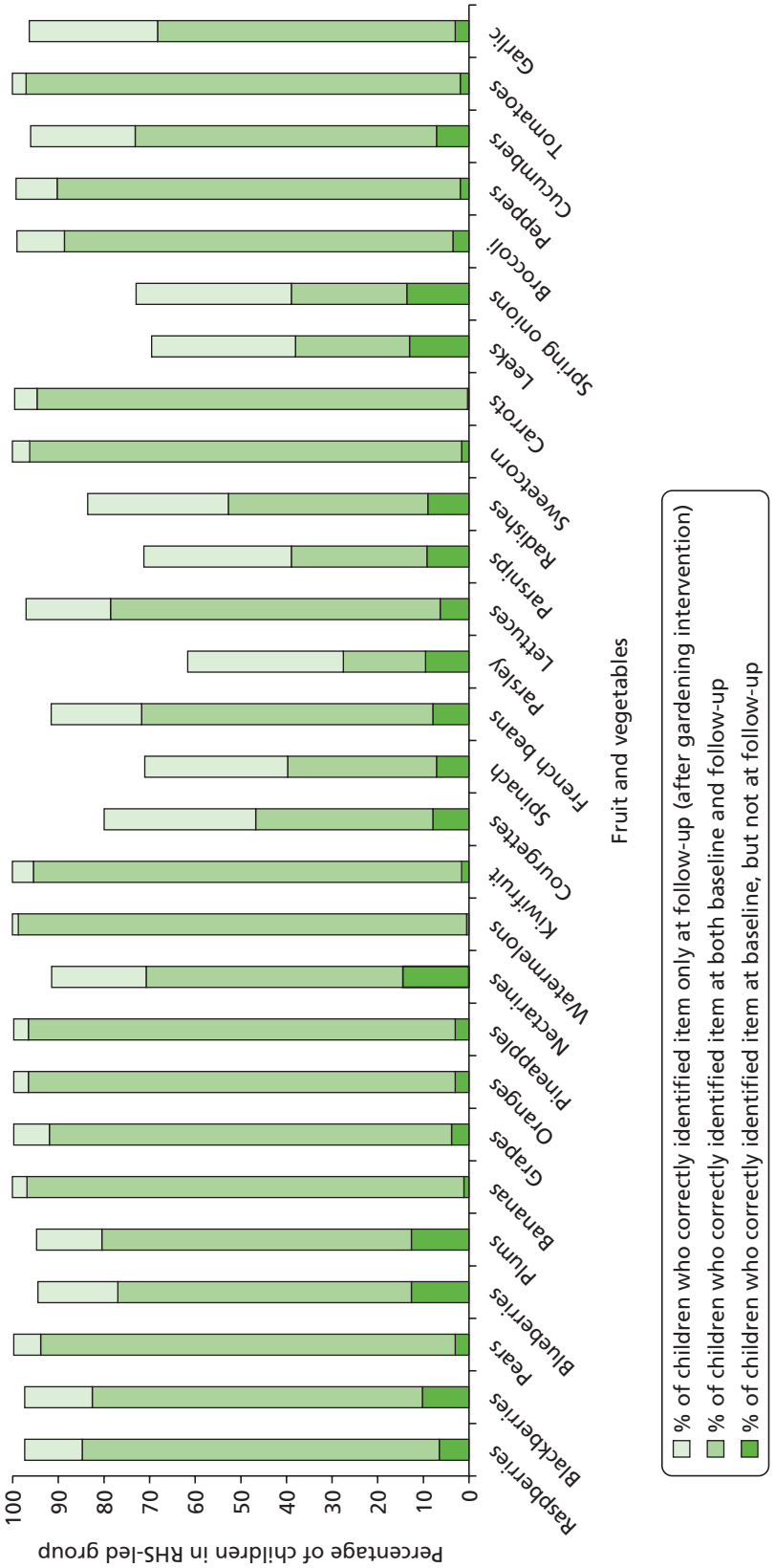

FIGURE 20 Trial 1: percentage of children in the RHS-led group who could identify different fruit and vegetables.

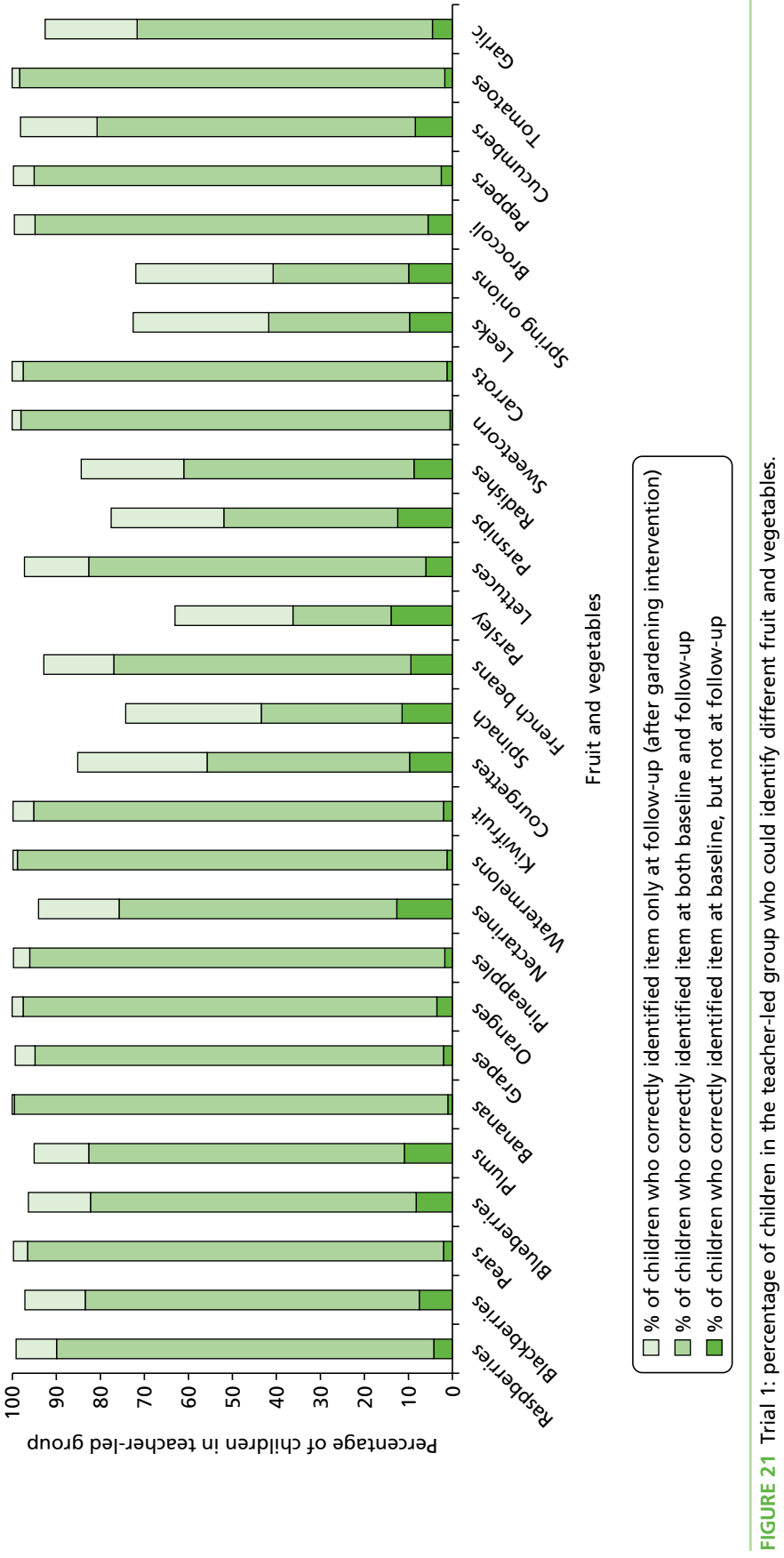

FIGURE 21 Trial 1: percentage of children in the teacher-led group who could identify different fruit and vegetables.

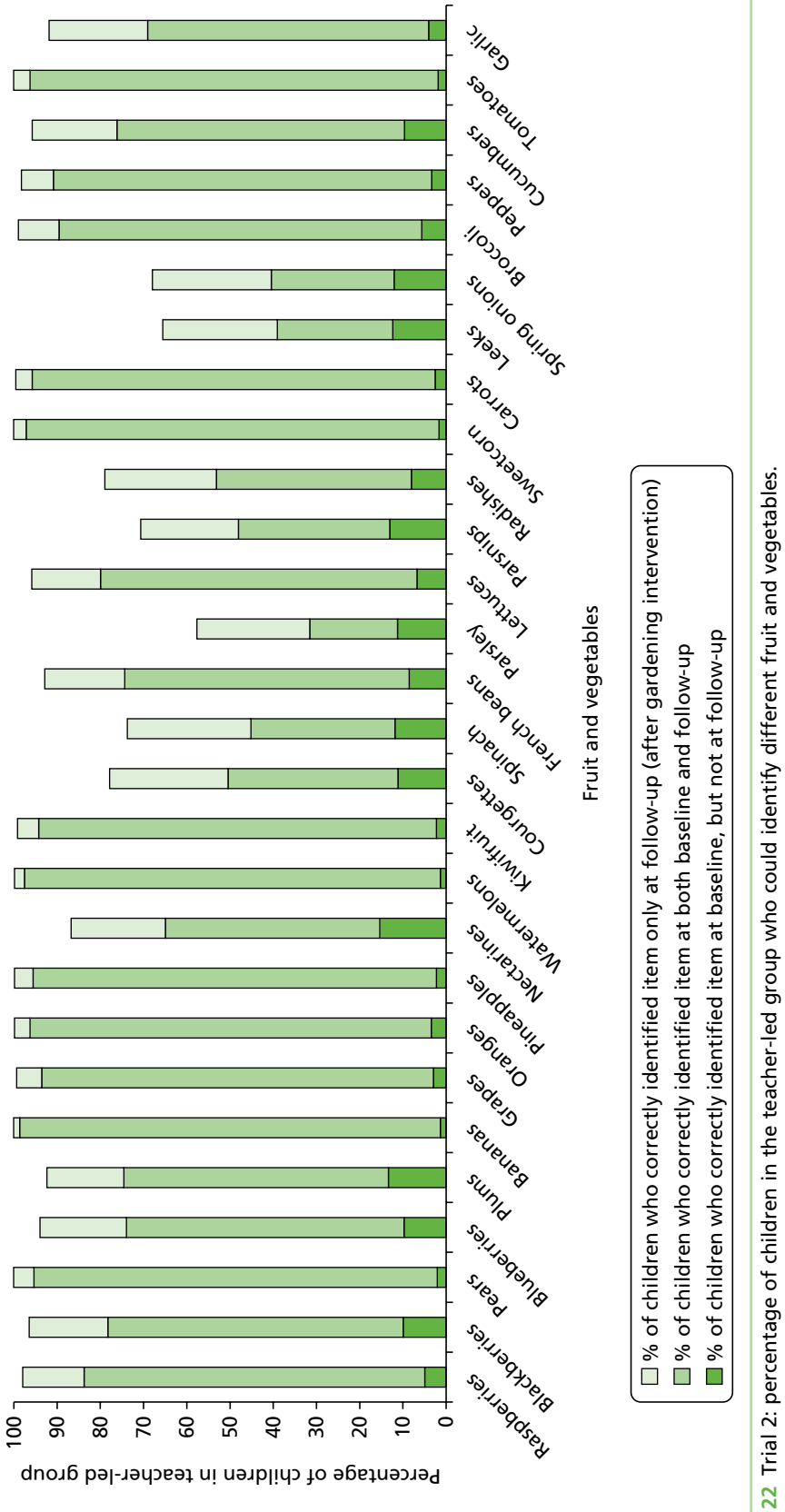

FIGURE 22 Trial 2: percentage of children in the teacher-led group who could identify different fruit and vegetables.

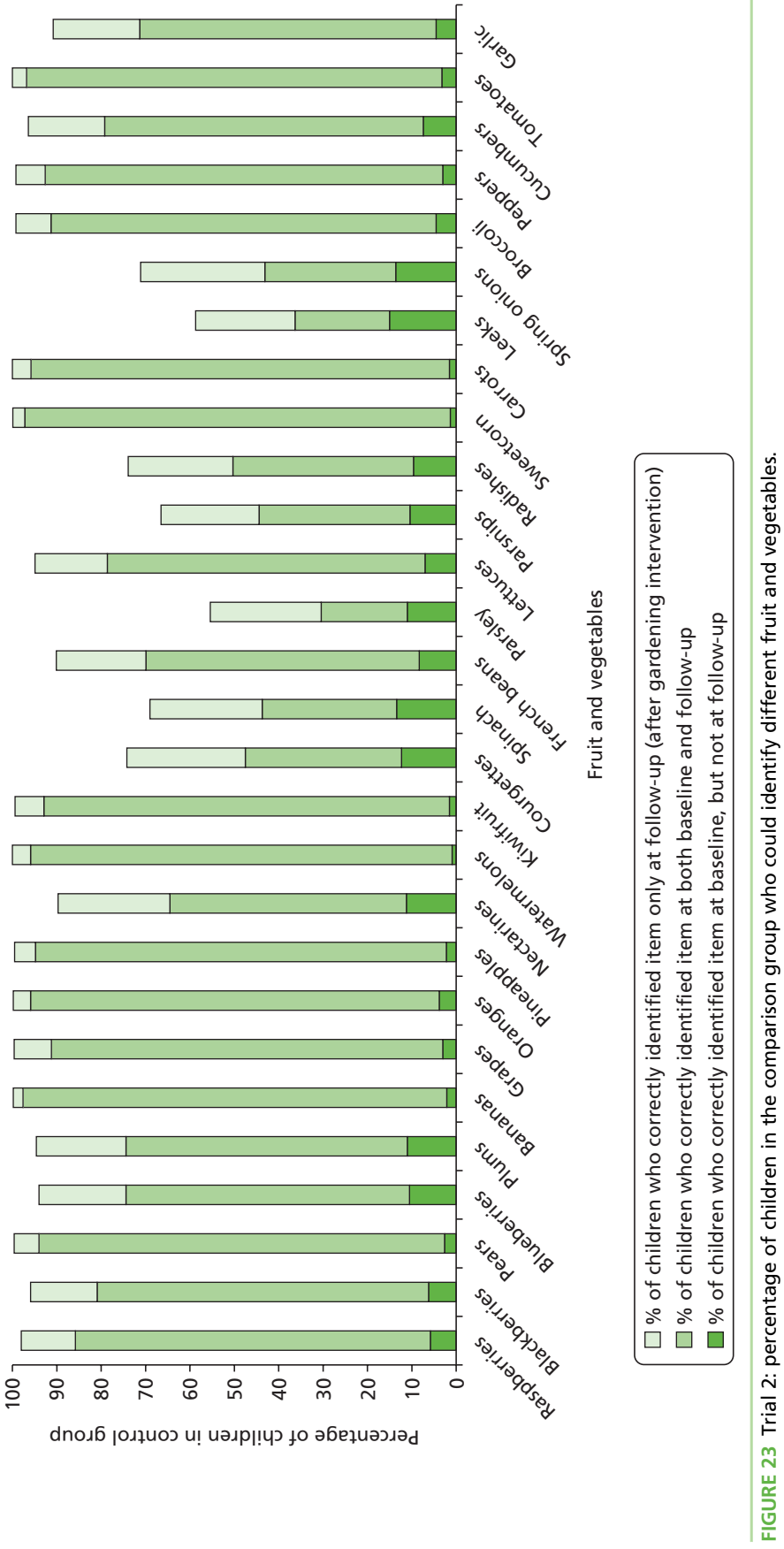

FIGURE 23 Trial 2: percentage of children in the comparison group who could identify different fruit and vegetables.

TABLE 42 Increase in fruit and vegetable intake associated with identifying one additional fruit or vegetable between baseline and follow-up

Trial and intervention	*n*	Unadjusted mean change in intake (g) (95% CI)	Adjusted mean change in intake (g) (95% CI)[a]	*p*-value
Trial 1				
Fruit				
RHS-led	295	–0.05 (–11.3 to 11.2)	–1.59 (–13.3 to 10.2)	0.8
Teacher-led	317	–4.71 (–17.7 to 8.25)	–3.62 (–16.3 to 9.03)	0.6
Vegetables				
RHS-led	293	0.43 (–2.69 to 4.55)	–0.29 (–3.07 to 3.01)	1.0
Teacher-led	312	1.35 (–2.27 to 4.97)	1.36 (–2.23 to 4.95)	0.5
Fruit and vegetables				
RHS-led	292	0.71 (–4.98 to 6.39)	0.03 (–5.71 to 5.78)	0.8
Teacher-led	312	–1.52 (–8.45 to 5.41)	–1.59 (–8.43 to 5.26)	0.7
Trial 2				
Fruit				
Teacher-led	467	–3.54 (–13.7 to 6.55)	–3.71 (–13.7 to 6.26)	0.5
Control	405	–1.24 (–10.7 to 8.18)	–2.19 (–11.7 to 7.30)	0.7
Vegetables				
Teacher-led	460	1.68 (–1.16 to 4.53)	1.77 (–1.08 to 4.61)	0.2
Control	403	–2.13 (–5.90 to 1.65)	–1.68 (–5.46 to 2.09)	0.4
Fruit and vegetables				
Teacher-led	459	–0.91 (–6.16 to 4.34)	–0.87 (–6.05 to 4.32)	0.7
Control	401	0.67 (–5.32 to 6.65)	0.82 (–5.21 to 6.84)	0.8

a Adjusted for gender, ethnicity and IMDS.

TABLE 43 Mean number of types of own-grown fruit and vegetables at baseline and follow-up, including only those children who completed this question at both time points

Trial and intervention	*n*	Baseline mean (95% CI)	Follow-up mean (95% CI)	Mean change (95% CI)	p^a	p^b
Trial 1						
Fruit						
RHS-led	77	1.9 (1.7 to 2.3)	1.8 (1.6 to 2.1)	–0.1 (–0.5 to 0.2)	0.3	0.9
Teacher-led	105	2.0 (1.8 to 2.3)	2.2 (1.9 to 2.5)	0.1 (–0.2 to 0.4)		
Vegetables						
RHS-led	120	2.4 (2.1 to 2.6)	2.6 (2.3 to 2.9)	0.3 (–0.1 to 0.6)	0.1	0.07
Teacher-led	169	2.7 (2.4 to 3.0)	2.6 (2.2 to 2.9)	–0.1 (–0.5 to 0.2)		
Trial 2						
Fruit						
Teacher-led	126	1.9 (1.6 to 2.1)	2.15 (1.9 to 2.4)	0.3 (0.0 to 0.6)	0.05	0.2
Control	121	2.1 (1.8 to 2.3)	1.91 (1.7 to 2.1)	–0.1 (–0.5 to 0.2)		
Vegetables						
Teacher-led	142	2.5 (2.2 to 2.7)	2.4 (2.2 to 2.6)	–0.1 (–0.3 to 0.2)	0.005	0.02
Control	221	2.0 (1.8 to 2.2)	2.5 (2.2 to 2.9)	0.5 (0.2 to 0.9)		

a Used independent *t*-test to test the difference between interventions in mean change between baseline and follow-up.
b Used multilevel mixed regression to test the difference between interventions in mean change between baseline and follow-up, adjusting for gender, ethnicity and IMDS.

TABLE 44 Mean change in children's fruit and vegetable intake and the effect of growing fruit and vegetables

Trial	*n*	Unadjusted mean change (g) (95% CI)	Adjusted mean change (g) (95% CI)	*p*-value
Do you grow your own fruit and vegetables?				
Trial 1	608	20 (–20 to 61)	21 (–10 to 74)	0.1
Trial 2	881	2 (–40 to 34)	3 (–34 to 41)	0.8
Have you tasted the fruit and vegetables you have grown?				
Trial 1	608	–3 (–44 to 37)	13 (–30 to 57)	0.7
Trial 2	881	22 (–8 to 71)	22 (–8 to 71)	0.1

Discussion

The results from the two RCTs provide very limited evidence that gardening interventions in schools increase children's knowledge and awareness of, or attitudes towards, eating fruit and vegetables.

Knowledge

In trial 1, the RHS-led gardening group was associated with an increase in the total number of different vegetables recognised; however, this difference was not significant after adjustment for baseline measurement (which was significantly different between interventions). In addition, compared with the teacher-led group, the RHS intervention was associated with negative effects. On average, children allocated to the RHS-led group were likely to be able to identify significantly more vegetables after the intervention than the teacher-led group; however, this may be explained by the fact that there was significantly more scope for improvement from baseline in the RHS-led intervention group. Furthermore, there were no significant increases in the ability to identify individual vegetables. Moreover, the increase in total vegetable recognition was not associated with an increase in vegetable intake.

In trial 2, there were a few significant increases that remained after adjustment for sociodemographic variables in the teacher-led school gardening intervention compared with the comparison group, which did not receive any assistance or support with gardening activities in school. The teacher-led children were more likely to have an increased awareness of the 5 A DAY recommendations for staying healthy, and more likely to recognise nectarines (though no other fruit or vegetables) and to report a decrease in own-grown fruit compared with the comparison group. Additionally, there was no evidence in any of the gardening intervention groups that, on average, an increase in the number of fruit and vegetables recognised was associated with an actual increase in consumption of fruit and vegetables.

Contrary to the results of the current trials, previous US and Australian studies which tested for the identification of individual vegetables found significant increases in the ability to identify them in the gardening interventions compared with controls, after taking into account pre-test scores.[47,126,133] However, in contrast to the current two trials, these studies used real vegetables and tested only a small number of items (five to six), as opposed to the 16 photos of vegetables used in this study. Furthermore, studies that identified successful change in children's nutrition knowledge combined health, science or nutrition education alongside the gardening component of their intervention studies. In our trials, the RHS- and teacher-led interventions focused solely on gardening education. This might explain the lack of significant findings in these trials. There were two previous studies that also found no significant change in children's knowledge after implementing a gardening intervention; however, one did not include a control group and was a relatively small study consisting of 56 children,[42] and the other[44] was conducted with younger children than those in this sample (Grade 1). One previous Australian study[73] used a larger number of pictures of fruit and vegetables to explore children's knowledge (31 in total) and found a significant difference between pre- and post-identification scores; however, the historical control design

was a weakness of the study. These previous studies involved only 320 or fewer children from one or two schools, compared with the 1867 children from 52 schools who took part in the pre- and post-fruit and vegetable identification tests in the current two studies. The majority of previous studies also involved older children, although they would have been more likely to produce a knowledge ceiling effect than the 8-year-olds in the current two studies.

Despite there being a greater increase in awareness of 5 A DAY in the teacher-led gardening intervention group compared with the comparison group, there were no significant differences in awareness among these children that eating fruit and vegetables kept them healthy. Other previous gardening intervention studies did not report awareness of 5 A DAY separately, although this question was included in the 'Health and nutrition from the garden' questionnaire[135] developed for children and used in some of the existing studies.[41–43] A previous study also found no evidence that gardening interventions were associated with children being aware that eating fruit and vegetables kept them healthy.[73]

Attitudes towards fruit and vegetables

Those in the RHS-led group appeared less willing to try to eat lots of fruit or to try new fruits than the teacher-led group, even after adjusting for baseline responses. Previous studies[43,73] have also reported a perceived barrier to eating fruit and vegetables, finding that the gardening intervention group did not like trying new fruits compared with controls.[73] This result, however, was not found for trial 2. In trial 2, children in the gardening intervention group were significantly more likely to agree that they enjoyed eating vegetables at follow-up compared with the control group, even after adjusting for baseline answers; however, this difference became non-significant after adjusting for gender, ethnicity or IMDS. It is possible that the additional exposure to gardening in the RHS-led intervention group may make the children more certain of their dislikes, as this additional exposure may produce greater contemplation of fruit and vegetables.[73]

In other studies, different approaches have been used to measure willingness to try new fruit and vegetables. In taste tests, gardening interventions were associated with an increased willingness to taste a small number of fruit and vegetables in kindergarten or first graders[44,45] in some studies, but not in older children,[46,133] though gardening was associated with an increased taste rating in older children in other studies.[47,126] Questionnaire assessment of preference/willingness to taste a larger list of fruits and vegetables showed that gardening interventions were associated with a preference for vegetables in some studies,[133,136,137] but not associated with fruit and vegetable preferences in other studies.[41,42,44]

In both the current trials there was no evidence of differences before or after adjustment for baseline answers in self-efficacy, specifically in the perceived ability to prepare fruit and vegetables. Older children in the intervention group were less confident than controls, but there were no significant differences between intervention groups in younger children.[73] The current research provides very limited evidence that gardening interventions in schools increase factors which may mediate behaviour change in consumption of fruit and vegetables based on the principles of SCT.

Limitations and strengths

There are some limitations. Despite randomisation of a large number of London schools there were some significant differences between intervention groups, not only those relating to baseline recognition and intake of fruit and vegetables. A large number of children from schools with children who spoke English as a second language could have resulted in many participants misunderstanding how to complete the questionnaires and could be a limitation of the study. Children for whom English is an additional language are less likely to know the names of less common fruits and vegetables, so differences between groups may result from different language acquisition. A large percentage of the children in the study (≈ 30%) did not attempt the child knowledge and attitudes questionnaire at both time points; therefore, the results are potentially subject to response bias, i.e. bias relating to self-selection. Finally, it is possible that some of the inconsistencies in the results are spurious in nature and are due to multiple testing.

Another limitation of measuring children's knowledge is that, naturally, children do guess if they do not know the right answer. There are very few validated tools to explore nutrition knowledge in children. A design fault of the current knowledge questionnaire was that it did not provide the children with the option of 'don't know'; this might have reduced the percentage of children guessing, and improved the questionnaire's ability to accurately measure knowledge.

Compared with previous studies, strengths of this study include the large sample size, the use of schools as a random effect variable in multilevel models and the randomisation of schools to the different interventions or comparison group. It has greater methodological strengths than the two studies on which some of the questions relating to attitudes, self-efficacy and home environment were based,[73,138] and adjustment was made for baseline responses and current controls rather than historical controls. Most previous studies had follow-up periods which were less than 1 year, some being 16 weeks or less,[43,47] whereas the follow-up period in this trial included two growing seasons and was 18 months in duration.

Conclusion

Compared with schools that do not garden with their children, some gardening activities in schools may increase some aspects of pupils' awareness of, and willingness to grow and eat, fruit and vegetables. Inconsistencies found, suggest that more research should be done in this area in UK schools. One of the fundamental aspects of gardening interventions that have shown a change in children's knowledge is that the interventions used contained a nutritional component combined with gardening. This would suggest that to improve children's knowledge of fruit and vegetables, gardening alone is not enough.

Summary

This chapter has explored whether or not participating in the RHS- or teacher-led school gardening interventions improved or affected children's knowledge of and/or attitudes towards fruit and vegetables. The results revealed very little evidence to support previous research that school gardening can improve children's knowledge of and attitudes towards fruit and vegetables. Further analysis of the components involved in the intervention will be discussed in the next chapter. The results from these two trials indicate that the RHS-led gardening intervention in schools does not provide extra benefits over the teacher-led intervention.

Chapter 7 Process evaluation of a randomised controlled trial of a school gardening intervention and children's fruit and vegetable intake

This chapter will discuss the process evaluation undertaken in the two trials to explore the adherence to the different interventions (RHS-led and teacher-led) and identify how the different types of interventions implemented affected the primary outcome, children's fruit and vegetable intake. This chapter captures gardening activity across all schools, including the control schools. With the nature of this type of intervention, schools will naturally tailor the intervention to their school's needs. Therefore, they were pragmatic trials exploring whether or not the intervention worked in real-life conditions. By monitoring what activities are undertaken in school gardening, it is possible to explore whether or not the implementation level of the intervention was associated with dietary change in children's fruit and vegetable intake.

Methodology

School gardening level interview

To identify the level of implementation and involvement of the schools in the RHS intervention, as well as identify if the control schools changed their level of involvement, the gardening telephone questionnaire was designed. The school gardening level is a measurement developed by the RHS to evaluate each school's involvement in gardening, based on the following scale:[56]

- level 0: no garden
- level 1: planning
- level 2: getting started
- level 3: growing and diversifying
- level 4: sharing best practice
- level 5: celebrating with the wider community.

To move from one level to the next, the school needs to demonstrate more involvement in school gardening, in terms of development, teaching and interacting with the wider community. At baseline, each school completed a telephone interview to assess their gardening level. This interview was completed again at follow-up to assess change in gardening level. The questions from this questionnaire were based on the criteria that the RHS used to evaluate and assess schools (see *Appendix 1*).

Gardening process measures questionnaires

The main aim of the process evaluation was to capture details about the gardening activity within each school, identifying which fruit and vegetables each school grows and harvests. A gardening process measures questionnaire was designed to identify the different gardening activities occurring in each school and which year groups were involved. This information was captured via e-mail in September 2010 for both trials, and again at follow-up via e-mail in December 2011. The process measures questions are presented in *Box 1*. Both trials received the same e-mail.

The information from this questionnaire was then collapsed into suitable variables to be used for analysis. Question 1 was broken into two variables. The variable of the question, 'Do you have a school garden?' was coded 'yes' or 'no'. The second variable, gardening type, was coded:

- 0 = small: pots only
- 1 = medium: one to two raised beds
- 2 = large: more than two raised beds or school garden or an allotment near the school.

BOX 1 Process measures e-mail

Dear Schools,

Thank you so much for participating in the Evaluation of the RHS Campaign for School Gardening. We now have just seven questions we would like you to answer about gardening activities at your school that have occurred in the past year.

1. Do you have a school garden, if yes please describe (e.g. garden at the school, a few pots for growing plants in or an allotment)?
2. Which year groups are involved in gardening at your school?
3. Do you have a growing club or environmental club? If yes, which year groups are involved?
4. What fruit and vegetables has your school grown/tried to grow this summer?
5. What did you harvest?
6. What were your success/failure stories in the school garden this summer?

It is vital for the study that we collect information about your school garden, and if you need any help feel free to contact myself on the number below.

Question 2 was used in two different ways. The first concerned how many year groups are involved in the school garden, and was coded:

- 0 = key stage 1
- 1 = key stage 2
- 2 = all year groups.

The second was created to confirm if the year groups involved in the study were involved in school gardening. This question was coded 'yes' or 'no'.

Question 3 was broken into two variables. Variable one, 'Do you have a growing club or environmental club?' was coded 'yes' or 'no'. Variable two, gardening clubs, was coded into three groups using the same method as for question 2:

- 0 = key stage 1
- 1 = key stage 2
- 2 = all year groups.

Question 4 was broken down into two continuous variables:

- frequency of different types of fruit grown – continuous
- frequency of different types of vegetables grown – continuous.

The following variables were then created, as they consisted of the most commonly grown fruit and vegetables: tomatoes, lettuces, carrots, beans, corn, strawberries, apples and cucumbers.

Question 5, frequency of successfully harvested vegetables and fruit, was coded:

- none
- some
- all fruit and vegetables grown were harvested.

Attendance of twilight sessions

The RHS regional advisor ran all of the twilight sessions; they were hosted at schools which received the RHS-led intervention, for the teacher-led intervention to attend. The RHS also provided Leeds University with information on the level of involvement in the twilight sessions of the teacher- and RHS-led schools.

Statistical analysis

Statistical analysis was performed using Stata version 12. Means and percentages for the process measures questions and general descriptive variables on the intervention implementation were generated.

School gardening level

The analysis was performed using clustered multilevel regression models with total fruit and vegetables as the primary outcome. The multilevel regression model was used to explore the difference in mean change in fruit and vegetable intake. These models were first conducted unadjusted, and then adjusted for gender, ethnicity and IMDS. The output generated for the primary analysis was mean, SE, 95% CI and *p*-value, with a *p*-value of < 0.05 taken to represent statistical significance for all of the analysis.

Results

Royal Horticultural Society-led school intervention gardening summary

The RHS-led schools all had major changes to their garden space over the course of the intervention. *Table 45* presents a descriptive summary of these changes by region. This information was provided by the RHS regional advisor.

Twilight sessions

For trial 1, all 10 of the RHS-led schools attended at least one twilight session, with a mean of 3.5 (SD 0.9) sessions attended. Of the schools which received the teacher-led intervention, only 4 out of 12 attended any of the twilight sessions, with a mean of 1.5 (SD 0.6) sessions attended. For trial 2, only two of the teacher-led schools attended any twilight sessions, with a mean of 1 (SD 0) session attended.

Implementation of gardening activities in schools in trial 1

For trial 1, at 6 months, four schools stated that they did not have a school garden (one from the RHS-led intervention group and three from the teacher-led intervention group). This was reduced to two schools in the teacher-led group and none in the RHS-led group by the end of the intervention period (*Table 46*). The number of vegetable types grown increased from 6 months to follow-up by an average of 1.3 for the RHS-led group, but there was no change in the number of fruits grown. In the teacher-led group, there was a decrease in number of types of fruits (0.9) and vegetables (1.7) grown from 6 months to follow-up. The number of schools that stated they had a large garden at 6 months was six for both groups; this increased to 7 out of 12 schools for the teacher-led group and 10 out of 10 schools for the RHS-led group at follow-up, showing an improvement in land allocated to school gardening. There was little change in the number of year groups involved in school gardening in either group, with eight schools in each having all year groups involved at follow-up. Schools were also asked to comment on the success of their fruit and vegetable harvest. These results show a decrease in success rate for the RHS-led schools, from four schools stating that they harvested all the fruit and vegetables they grew, to only two schools at follow-up. However, the teacher-led group had an increase from four schools to nine successfully harvesting all fruit and vegetables. This might explain in part why the teacher-led group had, on average, a higher change in combined fruit and vegetable intake compared with the RHS-led group.

TABLE 45 Description of the RHS school gardens at baseline and follow-up

School	Baseline	Follow-up
Greenwich		
1	There are two main areas: firstly, an allotment garden (derelict). This is a fairly large area currently set to grass at one end and also covered with landscape fabric and gravel. There are a few raised beds, and the last one-third of the area is blocked off by a solid wooden fence which is due to come down upon the completion of an adjacent building project. There is a large acer at both ends, with the one nearest the entrance providing shade for the grassed area. The second area is a sensory garden. This is in a courtyard area surrounded on three sides by high walls. It is in deep shade, and some thought should be taken as to planting	Now has raised beds (two groups of five RHS Wisley staff undertook team building days at the school and built 16 small raised beds and two large raised beds in a new garden area)
2	No specific 'garden' but there are planters/raised beds where growing is being carried out	Now has a fairly large school garden consisting of raised beds and a greenhouse. Bannockburn took part in the Hampton Court Flower Show's scarecrow competition, celebrating characters from Lewis Carroll's famous books *Alice's Adventures in Wonderland* and *Through the Looking Glass*. Their 'Mr Caterpillar' gained a very respectable third prize in a field of more than 20 schools
Tower Hamlets		
3	The school currently has a wildlife and vegetable garden complete with pond. This area is due to be demolished to create new classrooms for this expanding school	A willow tunnel has been created. A new garden was being built over the 2011 summer holidays
4	Various 'areas': an excellent wildlife garden. A thriving raised pond, a spider's web design wild flower meadow, plum tree, climbers, outdoor classroom. Key Stage 2 Years 3, 4, 5 and 6 have their own large planter in the playground. Key Stage 1 have four large planters. There are eight 1-m long beds. These are used by mums to grow stuff for the local co-op	Already had growing areas, but now have a shed and greenhouse yet to be erected. A Muslim Mums Group has taken part in two informal twilight sessions including seed sowing and pricking out seedlings
5	There is currently no gardening	Now has five raised beds for growing
Sutton		
6	A compact garden consisting of attractive gravel paths, four large raised beds and a fenced-off pond (including a small deck). There are other planters and beds around the school grounds, including some small planters in the Early Years playground planted up with herbs	In addition to their raised beds, now has a greenhouse
7	There is one main garden which has a number of beds and a thriving pond. A small newly cultivated bed in a shady area is planted up with a number of suitable plants. Due to fairly small total growing area, there is limited quantity, which affects the whole school exposure. There is currently no sheltered growing area to raise plants	Now has new beds built by parents (the school held two 'Get Your Grown-ups Growing' events over the winter, when parents took part in digging, and the construction of new beds)

TABLE 45 Description of the RHS school gardens at baseline and follow-up (*continued*)

School	Baseline	Follow-up
Wandsworth		
8	The current garden is extremely impressive, but there is little provision for the children to grow (in terms of growing beds). The delightful garden is known as the 'secret garden' and has many features: a 'human sundial' in the centre, a small lawn, wildlife area with properly layered hedge, trees, a bog area, various benches and one small vegetable area (approximately 1.5 m × 3 m). There are also some raised brick planters in the main playground, which have mainly permanent planting and herbs	Now has two new growing areas. Development on the school grounds is ongoing
9	There are a number of areas set out for growing: main garden comprises 10 raised beds/planters (four of which are thin planters approximately 40 cm). A polycarbonate greenhouse has been purchased and is to be built next to the nursery garden. There are three raised beds in a separate courtyard area which Year 1 uses	In addition to its eight raised beds, the school now has two large growing beds built by parents (the school held a 'Get Your Grown-ups Growing' event over the winter) and a greenhouse
10	A few small raised beds in the main school garden which have been neglected somewhat. The timber is starting to break as the beds are made of a number of compost bin kits. There is no fence around the garden which allows the children to play on and in the beds. The school has acquired a large allotment plot (1-minute walk from the school). The aim is to turn this into a community garden, and use the produce for the school kitchens. This plot is totally overgrown at present	In addition to developing its own thriving school garden, the school has taken responsibility for a plot of land on the adjacent housing estate. This is to be a school community garden. In conjunction with the Residents Association and with the support from the RHS, this area is gradually being developed. This process has been assisted by a team of five gardeners from RHS Wisley who spent a day on the site building beds and on another day by a team of three gardeners who removed a large tree from the centre of the site. Additional raised beds were gifted to the garden by M&G Investments who sponsored a Chelsea show garden designed by Bunny Guinness. Twelve children from the school had the opportunity to visit the Flower Show to see the garden in situ and meet with Bunny Guinness. The RHS regional advisor assisted with all elements of development, including the co-ordination of removal of the M&G garden from Chelsea to Battersea

TABLE 46 School gardening characteristics from 6 months to follow-up for trial 1

Trial 1 process measures	6 months		Follow-up	
	Teacher-led, *n* (*N* = 12)	RHS-led, *n* (*N* = 10)	Teacher-led, *n* (*N* = 12)	RHS-led, *n* (*N* = 10)
Do you have a school garden?				
No	3	1	2	0
Yes	9	9	10	10
Number of different fruits grown (mean; SD)	9 (2.2; 1.9)	8 (1.0; 1.1)	10 (1.3; 1.7)	10 (1.0; 1.2)
Number of different vegetables grown (mean; SD)	9 (7.0; 3.8)	8 (6.0; 2.7)	10 (5.3; 3.0)	10 (7.3; 2.9)
Size of garden				
Small	1	1	0	0
Medium	2	2	2	0
Large	6	6	7	10
Which year groups are involved?				
Reception–year 2	0	1	0	1
Years 3–6	1	0	2	1
All	7	8	8	8
Are years 3 and 4 involved (Yes)	7	8	9	9
Do you have a gardening club? (Yes)	6	6	6	7
Which year groups are involved in the gardening club?				
Reception–year 2	0	0	0	0
Years 3–6	1	3	1	4
All	3	3	3	2
Successfully harvested fruit and vegetables				
None	1	0	0	2
Some	2	4	0	6
All	4	4	9	2

Implementation of gardening activities in schools in trial 2

The results from the process measures e-mails for trial 2 are presented in *Table 47*. In the comparison group in trial 2, two schools were not involved in gardening at 6 months and this increased to three schools at follow-up. In the teacher-led group there was no change, with two schools stating that they did not have a school garden at 6 months and at follow-up. There was no change in the number of types of fruit grown in the comparison group and a marginal increase from 2.15 at 6 months to 2.33 at follow-up in the teacher-led group. There was more variation in number of vegetable types grown, with the mean in the comparison group increasing by 1.1 from 6 months to follow-up and the mean in the teacher-led group increasing by three. Again, there was little change in the comparison group in the number of schools that stated they had a large garden. However, this increased in the teacher-led group from 9 out of 15 schools at baseline to 12 at follow-up. Schools were also asked to comment on which year groups were involved in gardening. In three of the teacher-led schools, there was an increase from baseline to

TABLE 47 School gardening characteristics from 6 months to follow-up for trial 2

	6 months		Follow-up	
Trial 2 process measures	Comparison, *n* (*N* = 15)	Teacher-led, *n* (*N* = 15)	Comparison, *n* (*N* = 15)	Teacher-led, *n* (*N* = 15)
Do you have a school garden?				
No	2	2	3	2
Yes	13	13	12	13
Number of different fruits grown (mean; SD)	13 (1.0; 1.6)	13 (2.1; 2.6)	12 (1.0; 1.3)	12 (2.3; 2.1)
Number of different vegetables grown (mean; SD)	13 (4.6; 2.3)	12 (7.0; 4.9)	12 (5.7; 4.0)	11 (10; 7.9)
Size of garden				
Small	0	0	3	0
Medium	5	2	1	1
Large	8	9	7	12
Which year groups are involved?				
Reception–year 2	0	1	2	1
Years 3–6	4	5	1	2
All	9	7	8	10
Are years 3 and 4 involved? (Yes)	11	11	9	11
Do you have a gardening club? (Yes)	8	11	8	12
Which year groups are involved in the gardening club?				
Reception–year 2	0	1	1	1
Years 3–6	4	5	4	6
All	3	3	1	4
Successfully harvested fruit and vegetables				
None	1	0	2	0
Some	4	5	3	4
All	6	4	6	9

follow-up in the number of year groups involved in school gardening. Schools were also asked to comment on how successful their fruit and vegetable harvest was. These results show no increase in success rate for the comparison schools, with six schools on both occasions successfully harvesting all their fruit and vegetables. However, the teacher-led group had an increase from four to nine schools successfully harvesting all their fruit and vegetables.

School gardening level

Table 48 displays the change in school gardening level for the RHS- and teacher-led interventions in trial 1. At baseline, 50% of the RHS-led schools only achieved a level 1 rating, compared with 60% of the schools at follow-up achieving level 3. This shows a large improvement in the quality of the garden, and gardening being integrated into the curriculum. The mean gardening level at follow-up was 2.7 for the RHS-led group compared with 1.9 for the teacher-led group. There was slightly more movement between the levels in the RHS-led group compared with the teacher-led group (a mean increase of 1.6 compared to 0.5). Multilevel regression analysis revealed that the difference between mean change in gardening level for the RHS-led compared with the teacher-led group was not significant ($p = 0.06$).

In trial 2 (*Table 49*), there was less movement between the gardening levels from baseline to follow-up. Although there was some change for both the teacher-led and control groups, multilevel regression analysis revealed that the difference between mean change in gardening level for the comparison compared with the teacher-led group was not significant ($p = 0.7$).

TABLE 48 School gardening level at baseline and follow-up for trial 1

	Baseline		Follow-up	
Gardening level	RHS-led ($N = 10$)	Teacher-led ($N = 12$)	RHS-led ($N = 10$)	Teacher-led ($N = 12$)
Mean (SD)	1.1 (0.7)	1.4 (1.3)	2.7 (1.1)	1.9 (1.4)
0, *n* (%)	2 (20)	2 (17)	0 (0)	2 (17)
1, *n* (%)	5 (50)	7 (59)	2 (20)	3 (25)
2, *n* (%)	3 (30)	1 (8)	1 (10)	3 (25)
3, *n* (%)	0 (0)	1 (8)	6 (60)	3 (25)
4, *n* (%)	0 (0)	0 (0)	0 (0)	0 (0)
5, *n* (%)	0 (0)	1 (8)	1 (10)	1 (8)

TABLE 49 School gardening level at baseline and follow-up for trial 2

	Baseline		Follow-up	
Gardening level	Control ($N = 15$)	Teacher-led ($N = 15$)	Control ($N = 15$)	Teacher-led ($N = 15$)
Mean (SD)	1.3 (1.6)	1 (1.2)	1.8 (1.7)	1.8 (1.2)
0, *n* (%)	6 (40)	5 (32)	3 (20)	2 (14)
1, *n* (%)	5 (32)	7 (47)	6 (40)	4 (25)
2, *n* (%)	2 (14)	2 (14)	1 (6)	6 (40)
3, *n* (%)	2 (14)	1 (7)	2 (14)	2 (14)
4, *n* (%)	0 (0)	0 (0)	1 (6)	0 (0)
5, *n* (%)	0 (0)	0 (0)	2 (14)	1 (7)

Multilevel analysis

To explore whether or not change in gardening level from baseline to follow-up was associated with the primary outcome – combined fruit and vegetable intake – multilevel analysis was conducted using change in garden level score (follow-up minus baseline). These results are presented for trial 1 in *Table 50* and for trial 2 in *Table 51*. The reference category in this model was no change, meaning that the schools did not change or improve in gardening level from baseline to follow-up. The effects on children's fruit and vegetable intake after a change in one, two or three levels of gardening was compared with no change in gardening level. The results for all schools in trial 1 show that there was an increase in combined fruit and vegetable intake when schools improved by two levels or more. Increase by one level showed little or no change in children's fruit and vegetable intake, while increasing by two levels when compared with no change improved children's fruit and vegetable intake by 37 g, after adjusting for IMDS, ethnicity and gender. Change, however, was only significant when schools improved by three levels of the RHS gardening score; children from these schools increased their consumption of fruit and vegetables by 81 g, on average.

TABLE 50 Trial 1: mean change in fruit and vegetable intake and change in gardening level

			Unadjusted			Adjusted for IMDS, age, ethnicity and gender			
Change in gardening level	Number of schools	Number of pupils	Mean change in intake (g)	SE	*p*-value	Mean change in intake (g)	SE	95% CI (g)	*p*-value
No change (reference category)	8	312	1			1			
Improved by 1 level	4	132	–4	26.3	0.8	–5	26.9	–58 to 46	0.8
Improved by 2 levels	7	148	30	28.9	0.2	37	29.4	–19 to 96	0.1
Improved by 3 levels	2	49	68	41.8	0.1	81	42.0	0 to 163	0.05

TABLE 51 Trial 2: mean change in fruit and vegetable intake and change in gardening level

			Unadjusted			Adjusted for IMDS, age, ethnicity and gender			
Change in gardening level	Number of schools	Number of pupils	Mean change in intake (g)	SE	*p*-value	Mean change in intake (g)	SE	95% CI (g)	*p*-value
No change (reference category)	13	416	1			1			
Improved by 1 level	11	360	–24	33.6	0.4	–30	34.3	–98 to 36	0.3
Improved by 2 levels	2	72	–112	59.0	0.06	–111	60.9	–230 to 8	0.06
Improved by 3 levels	3	65	55	58.6	0.3	44	61.1	–74 to 164	0.4

However, this trend was not evident in trial 2. For change by one or two gardening levels there was a negative relationship between gardening level and children's fruit and vegetable intake. Again, when schools improved by three gardening levels, children consumed on average 44 g more fruit and vegetables combined than children whose schools had no change in gardening level. However, these differences were not significant. Whereas trial 1 had a large proportion of schools improving by one or two gardening levels at follow-up compared with baseline, trial 2 had a large proportion of schools improving by one level, with only a few schools improving by two or three gardening ratings. This is to be expected, as in trial 1 all schools received an intervention, whereas in trial 2 some of the schools received no intervention.

Discussion

This chapter has explored the process evaluation undertaken in the two trials, to identify adherence to the different interventions (RHS-led and teacher-led) and how the different types of interventions implemented affected the primary outcome, children's fruit and vegetable intake. The description of the 10 RHS-led intervention school gardens demonstrates a high level of involvement in the construction of gardening within these schools. This was observed in the change in school gardening level scores for these schools and the attendance rate for twilight sessions. In contrast, only 4 out of the 12 teacher-led schools in trial 1 attended any of the twilight sessions on offer to them, which might explain the lack of movement between the gardening levels. For trial 2, again, there was only a small amount of movement between the gardening levels for both the comparison and teacher-led groups. In both trials, there was no statistically significant difference between the intervention and control groups in terms of improvement in gardening level from baseline to follow-up. This is likely to have had an impact on the findings relating to fruit and vegetable intakes described in previous chapters.

Nevertheless, in all groups for both trials there were schools attempting to improve their gardening levels. In trial 1, 13 schools improved their gardening level and in trial 2, 16 schools improved their school gardening level by one level or more. This relationship with involvement in school gardening in trial 1 was associated with a significant change in children's fruit and vegetable intake. In schools that improved by three levels, children on average consumed 81 g more fruit and vegetables than those in schools with no change in school gardening. In contrast, for trial 2, although there was an increase in fruit and vegetable consumption when schools improved by three levels in school gardening, this difference was not significant.

Theory behind school gardening

The main objectives for implementing gardening in schools are to improve educational knowledge of the environment, nutrition, and psychosocial and physical outcomes.[53,139–142] A lack of access to fruit and vegetables is considered one of the main barriers to consumption. Increasing children's access to fruit and vegetables has been shown to increase consumption.[52] The school garden is considered an innovative way of teaching nutrition and health education; an alternative to classroom teaching that is hands-on and engages the children's attention.[127] Although school gardening may be beneficial in educating children about fruit and vegetables and potentially increasing awareness and knowledge, the results from this study suggest that knowledge was already high, and to show any effect on children's consumption levels, greater access and involvement in gardening may be needed.

Intervention design, elements and geographic location

Only five other studies have measured the relationship between children's fruit and vegetable intake and a gardening intervention.[14,47,48,125,126] The interventions used in these studies ranged in length from 10 weeks to 2 years. Very little of the development of the gardens is described in these trials; however, the school garden was described as being 7.6 m^2 in one study.[14]

The fundamental aim of the RHS interventions was to introduce children to the basic gardening skills, such as planting, watering, weeding and harvesting. However, the five successful gardening interventions in these studies all involved additional elements in other settings as well as the gardening activities. Three interventions included cooking,[47,48,125] two included nutrition education[14,126] and one included parental newsletters and homework tasks.[48] Both the RHS-led and teacher-led interventions, however, were only implemented into additional curriculum lessons at the school's desire. The primary focus of the RHS approach is to educate children in gardening. Including nutritional education or cooking alongside gardening might be required to achieve a positive change in children's fruit and vegetable consumption. In one study, one of the additional classes for the students was 'add a veggie to lunch day'.[14] These types of activities have shown positive results in improving children's fruit and vegetable consumption.[127]
It should also be noted that all of these successful gardening interventions have been implemented in countries with warmer climates than England – California, Minnesota, Alabama and Florida in the USA and Newcastle in Australia. Countries with sunnier summers may also be more successful because they can produce more for harvest, or because children can spend more time outside in the garden.

The interventions for this study were run by either the RHS regional advisor or teachers within each school. In some previously successful trials, teachers were used to implement the intervention.[47,48] If the classroom teacher is passionate about gardening, then this could assist with successful implementation of the intervention.[56] However, in other studies teachers not only taught the intervention but were also trained to complete the 24-hour food recall workbooks for the study.[14,126] Having the same people teach the intervention and collect the data could introduce bias into the results, as the teachers could have been motivated to demonstrate how well they have tried to implement the intervention. Only one study[125] had an external company, the Youth Farmers and Market Project, similar to the RHS, implement their intervention and therefore reducing the risk of bias.

Barriers to implementing a school garden

School gardens require long-term commitment from the schools, and often need community assistance from parents if they are to be sustained.[54] Another issue found was that some schools took too long to establish the school garden, affecting the period of time in the studies for plants to germinate and grow edible fruit or vegetables. Environmental factors will also play an important role in the amount of food harvested. Schools are closed over summer, which is the peak harvesting season; without organising staff to water the garden and carry out general garden maintenance, the hard work during term time can be lost. With regard to the RHS school gardening levels, having grounds staff, caretakers or a school grounds maintenance contractors involved in the maintenance of the garden was only required for schools from level 3 onwards. The length of time spent in the interventions could also affect the chances of long-term change in children's fruit and vegetable intake, with more sustained and intense intervention programmes more likely to have an impact on behaviour.

Limitations and strengths

There were limitations to the present study. The issues with the methodology of assessing dietary intake have been stated in previous chapters. Validity and reliability of the process measures questionnaires have not been tested; however, this is a common weakness with health interventions, as limited resources are allocated to process evaluations. For example, the question on harvesting success could have been interpreted in different ways by different teachers, with some perhaps interpreting success in terms of yield while others see it as involving all children in harvesting. Another limitation is that the study is subject to the well-established statistical problems of multiple comparisons or testing. This study was powered to analyse the main trial outcome, i.e. change in fruit and vegetable intake between children in the different treatment groups and, as a consequence, it may not be adequately powered for the process measures analysis. Furthermore, there was little apparent difference between groups in terms of gardening level improvement overall, potentially weakening the likelihood of detecting differences between groups as a result of gardening activity. It has to be recognised that these trials are being carried out in a 'real life'

situation, so that those schools that were not receiving the RHS- or teacher-led interventions may have opted for other sources of gardening advice and activity. This is particularly likely to have occurred during the build-up to the 2012 Olympics year. Two of the eight London boroughs which formed the sampling frame (one from trial 1 and one from trial 2) straddle the main Olympic Park, where gardening was made a feature of non-athletic activity and a number of parks and gardens were created. In addition, the weather experienced in the winter of 2010 included the coldest December since records began. The summer of 2011 was also cooler and wetter than average.

The main strength of the present study is that it uses measures undertaken at different time points: baseline, 6 months and final follow-up. This has assisted in identifying change in gardening practices in not only the intervention schools, but also the comparison schools. Few studies explore in detail the implementation of the intervention.

Conclusion

The results from this chapter have demonstrated that, while there was no significant difference in the primary outcome of these trials, when gardening in schools is implemented at a high level it can have a positive effect on children's fruit and vegetable intake. Previously successful gardening interventions indicate that future research needs to explore the involvement of additional activities to improve children's consumption levels. This could be through the inclusion of nutritional education or cooking lessons. Parental involvement and parental consumption levels have always been considered pivotal, and should be incorporated into intervention designs.

When an intervention is run by teachers, it will naturally be tailored to meet their school's needs. Nevertheless, the limitations to gardening interventions need to be acknowledged. Although gardening interventions might be able to assist in making small improvements in children's knowledge of the environment, nutrition, and psychosocial and physical outcomes,[53,139–142] additional intervention activities need to be integrated to produce lasting change in fruit and vegetable consumption.

Summary

In this chapter, the process evaluation undertaken in the two trials has been discussed. It has described the adherence to the different interventions (RHS-led and teacher-led) and has revealed that, for trial 1, if schools made substantial changes to their gardening level score from baseline to follow-up this could produce a positive effect on children's fruit and vegetable intake. Nevertheless, in relation to intervention design, as discussed in this chapter, future research into school gardening should implement additional elements alongside gardening education, as the results from the current trials indicate that gardening on its own has very little impact on children's fruit and vegetable intake.

Chapter 8 Summary discussion and recommendations for future research

Summary discussion

The interest in school gardening has grown over the past years, with some evidence that school gardening can provide children with a positive learning environment to help them improve their awareness and understanding of food and where it comes from, and possibly increase children's willingness to consume fruit and vegetables. However, the evidence supporting these claims is based on research evaluating short-term interventions using small sample sizes. Despite the lack of funding, gardening in schools has increased in popularity, with gardening being added to the UK curricula for children in Key Stages 1–3 from September 2014.[143] The current two trials have found very little evidence to support the claims that school gardening can improve children's fruit and vegetable intake (see *Chapter 5*). However, all groups had increased their gardening activity over the course of the study. The RHS-led group had increased the most, but there were no statistically significant differences between groups in gardening level at follow up. This lack of difference in gardening between groups may well have influenced the primary outcome. A high level of gardening, as characterised by the RHS levels, needs to be undertaken to produce a change in intake (see *Chapter 7*). The RHS considers that unless a head teacher is supportive of school gardening, despite their best efforts to improve children's knowledge and attitudes, the positive efforts will produce little or no results. School and community gardens do provide other benefits even if they do not improve children's fruit and vegetable intake, potentially improving psychological and social well-being in children.[139] Although these outcomes were not explored in the current study, it does demonstrate that, despite our findings relating to impact on diet, school gardens could be a useful educational tool.

In relation to improving children's knowledge of and attitudes towards fruit and vegetables as a result of participating in a school gardening intervention, these two trials provide limited evidence to suggest that such an improvement takes place (see *Chapter 6*). For trial 1, the RHS-led gardening intervention was associated with an increase in the total number of types of vegetables recognised; however, this difference was not significant after adjustment for baseline measurement and possible confounders. A limitation of researching children's knowledge of fruit and vegetables, or any other healthy nutrition education, is that there are very few validated tools.[144] More pilot research needs to be conducted to determine the reliability and validity of children's knowledge questionnaires, one of the fundamental components of the SCT.[132]

The process evaluations have provided some evidence to support previous research that school gardening can improve children's fruit and vegetable intake (see *Chapter 7*). The results from this chapter have demonstrated that when gardening in schools is implemented at a high level, it can have a positive association with children's fruit and vegetable intake. Previously successful gardening interventions suggest that future research needs to explore involving additional activities to improve children's consumption levels.[47,126] This could be through including nutritional education or cooking lessons. Parental involvement and parents' own consumption levels have always been considered pivotal, and should be incorporated into intervention designs. The RHS states that for a school garden to be successfully established, there are certain elements that are required.[145] The scheme must be supported in full by the head teacher. It is not suggesting that they need to be involved in the garden themselves; however, each school needs to identify how gardening will fit into the school day through including gardening in the school development plan. Examples of how this could be done would be ensuring that gardening is included across the curriculum, involving parents, identifying methods of linking in the community (such as through visiting a local allotment) and providing staff with the training necessary to be confident to teach gardening. Other examples are setting up a garden committee, as this will avoid pressure being placed on one teacher to maintain the garden, and helping to develop ongoing projects such as gardening clubs. Attempts need to

be made to link in school gardening with the school catering company and/or staff, so that any produce grown can be included in school dinners to encourage children to taste what they have grown and be proud of their achievement. In addition, schools should attempt to use the produce from gardening in cooking lessons, to help children learn how to prepare the food themselves.[56]

In addition to the RHS school gardening programme run in this study, the RHS is currently developing new resources for teachers to use in the classroom, with gardening-related themes such as 'grow your own food for your lunchbox'. The fundamental principle behind these developments is to teach gardening in the curriculum to help children develop a lifelong love of gardening, growing and their environment.[56] It is should be noted that improving children's fruit and vegetable intake is not one of the primary aims; nevertheless, the RHS hopes that educating children in gardening will in turn lead to an understanding of what they eat and where it comes from. Although gardening interventions may support small improvements in children's knowledge of the environment, nutrition, and psychosocial and physical outcomes,[53,139–142] additional intervention activities need to be integrated to produce lasting change in fruit and vegetable consumption.

Parents can help to facilitate change in their children's fruit and vegetable intake.[77] Exploring the nutrient information collected at baseline has identified a positive public health message for parents, which could improve not only their own dietary habits, but also their children's. This is the first large survey of London children to explore this association. It found that eating a family meal together at a table had the largest effect on children's fruit and vegetable intake. Children in families who stated that they ate together every day had 1.5 more portions of fruit and vegetables daily than those whose families reported never eating together at a table, after adjusting for possible confounders. It also found that sometimes eating at a table together increased children's fruit and vegetable consumption by more than a portion. The importance of the family meal is supported by previous research in preschool children[99] and primary school children.[77,107,108] Parental intake is strongly associated with children's intake,[119,120] as was found in this study. Parents stating that they consumed fruit and vegetables more frequently was associated with higher consumption in their children.

This is the first study in the UK to identify that cutting up fruit and vegetables facilitates primary school-aged children's intake.[77] If children have access to prepared fruit and vegetables at home, they are more likely to eat them. Research has been conducted in older children supporting this finding.[101,122] Future interventions could be tailored towards improving parental intake of fruit and vegetables, to facilitate children's intake.

There are some barriers to implementing a school gardening programme. School gardens require long-term commitment if they are to be successfully established.[54] It is important to have a supportive team involved in the school garden to help maintain it over the summer months when the school is closed. The length of time spent in the interventions will also affect the chances of long-term change in children's fruit and vegetable intake. Their consumption patterns are unlikely to be affected if their involvement in the actual intervention is limited.

The dietary assessment measurement used for these trials was a 24-hour recall tick list. The strength of the CADET diary is that it uses age- and gender-specific food portion sizes to calculate food and nutrient intake. The methodology used to administer the CADET diaries in schools was improved to help ensure completeness of the data collected. Children's intake at school was recorded in CADET by trained fieldworkers and intake at home was recorded by parents/carers. An instructional DVD was sent home for parents to watch, to help them understand how to complete the CADET diary. Also, after the school food diary collection day, the fieldworker returned to the schools to collect and check the diaries with all the children, and if necessary conduct a retrospective recall. A 1-day tick list is an economically effective way of gathering nutrient information from children; however, it may not reflect true nutrient intake in the longer term. The CADET diary does avoid the issues with child self-reported food intake, and is less of a burden on the participants than the most commonly used alternative, a weighed 4-day food diary.

All analyses were conducted using multilevel analysis, a robust statistical methodology. The benefit of this technique is that the means and CIs for the different foods and nutrients will be more accurate; as children within a school are more similar to each other in terms of their food consumption, there will be less variability within the sample compared with a random sample from the whole population.[86,124] This level of analysis is rarely applied to the secondary outcomes, such as children's knowledge and the process measures questionnaires.

Recommendations for future research

Despite the lack of evidence of a quantitative impact of school gardening on children's intake, anecdotally, school gardening may have positive attributes.[54] When a school garden is successfully integrated into the school environment, it can provide a link between the community and the school. Beyond investigating school gardening initiatives, in order to increase children's fruit and vegetable intakes, research needs to focus on intervention designs that tackle individual intake, family intake, school environment and the wider community.[54] The RHS believes that school gardening can provide vital links to members of the community who otherwise have little involvement with their child's education,[56] but this was not assessed in our study. This is supported in academic literature.[60,146] In order to fully appreciate how schools could be involved in improving children's diets, a full review of the mechanisms of change and the major constraints, and the impact of both the external and wider school environments, such as school meals and food policies, is warranted.[39]

Successful fruit and vegetable interventions in schools tended to have only a small impact on children's fruit and vegetable intakes.[31] School gardening interventions that have identified a change in children's diets have additional components. A recent systematic review of school-based interventions to improve children's inactivity and nutrition knowledge stated that, for interventions to be successful, the vital components were integrating the intervention into the school curriculum, parental involvement through homework activities and developing a whole school approach through influencing changes to school policy around nutrition and physical activity education.[147,148] In Australia, a school gardening and cooking programme, the Stephanie Alexander Kitchen Garden Program, has had government support to develop the required infrastructure.[149] This programme has been funded by national and state support between 2008 and 2012, with the government spending $12.8M, approximately £8.7M, over 650 schools to develop cooking and gardening facilities. The Australian government has also recently invested an additional $5.4M (approximately £3.6M) on this programme.[149] The evaluation of this intervention has shown positive results for changing children's behaviour in terms of fruit and vegetable intake, willingness to try fruit and vegetables and confidence in gardening and cooking skills. Future research into school gardening should be conducted with additional components such as cooking included, and parental involvement.

The WHO and the Food and Agriculture Organization believe that school-based interventions are a fundamental part of improving the population's fruit and vegetable intake.[150] Approaches to increase support from industry and governments, to improve access to fruit and vegetables in all the settings in which children spend time, should be explored.

Future research should also be conducted to explore the effect of community gardens on children's fruit and vegetable intake. Currently, there is a need for a robust study design to ascertain the role community gardens play as an intervention tool to improve children's diets. Similar to school gardening, there are other benefits of community gardening besides focusing on fruit and vegetable consumption. Again, as with school gardening, community gardens are seen as a positive place for bringing different sections of the community together, and can have positive effects on the social well-being of the people involved.[151] Some community gardens have also been linked to school distribution programmes,[52] while other studies have identified that community gardens can be used as a replacement for a school garden,[60] with the community gardeners providing support and time to help local schools develop children's knowledge of

gardening. Schools involved with a community garden could elevate the responsibility of the school in running and maintaining the garden, which might make school gardening easier to maintain.

In addition to school-based intervention studies, there needs to be more focus on the home environment. We have identified the importance of eating together as a family to improve children's fruit and vegetable intake.[77] Future intervention studies need to focus on parental involvement in supporting positive reinforcement and rewards around fruit and vegetable consumption, such as cutting up fruit and vegetables and eating fruit and vegetables together. A recent study stated that the barriers for parents are cost, family preferences and a limited choice of fruit and vegetables in restaurants. More pilot studies are needed that attempt to improve the home environment and to develop a suitable intervention to assist parents in overcoming these issues.[152]

The quality of the tools used to evaluate these programmes is a further research concern. There are very few validated tools to explore nutrition knowledge in children; testing and developing these tools is essential to accurately measure children's understanding of healthy dietary behaviour. Another limitation of measuring children's knowledge is that, naturally, children do guess if they do not know the right answer. The design of nutrition knowledge questionnaires should always provide children with the option to write 'don't know' – this could reduce the percentage of children guessing, and improve the questionnaire's ability to accurately measure knowledge. Furthermore, knowledge questionnaires should be assessed for reliability. A possible method would be to use children's school assessment scores and validity, through conducting a test–retest evaluation.

Conclusion

To conclude, this report has looked at the results from the first cluster RCTs designed to evaluate a school gardening intervention. The primary analysis from the two trials has found very little evidence to support the claims that school gardening alone can improve children's fruit and vegetable intake. In both trials, the gardening levels increased across all groups and there was no statistically significant difference between the intervention and control groups in terms of improvement in gardening level from baseline to follow-up. This lack of differentiation between groups is likely to have influenced the primary outcome. However, process measures evaluation found that when the gardening intervention was implemented at the highest intensities within the schools, there was a suggestion that it could improve children's fruit and vegetable intake by a portion. Improving children's fruit and vegetable intake remains a challenging task. This study highlights the need for more sophisticated and accurate tools to evaluate diet in children. Future intervention designs should include a greater level of parental involvement in school interventions, along with related components such as cooking, to substantially improve children's fruit and vegetable intake. In addition, the home environment has been demonstrated to be an important focus for intervention.

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Contributions of authors

Meaghan S Christian (research student, Nutritional Epidemiology Group) was responsible for development and organisation of the trials. She trained fieldworkers and undertook data collection. She developed and piloted the questionnaires, adapting CADET for use in this slightly older age group. She analysed the baseline data and the full trial analysis as well as the process measures analysis. She provided the majority of the text for this report and also wrote a PhD thesis as a result of this project 'Can a school gardening programme lead to improved fruit and vegetable intake in children?' PhD 2014, University of Leeds.

Dr Charlotte EL Evans (Lecturer in Nutrition, Nutritional Epidemiology Group) was responsible for overseeing the statistical analysis as the trial statistician. She supervised Meaghan Christian during the project.

Professor Janet E Cade (Professor of Nutritional Epidemiology and Public Health) conceived the idea of the project. She provided day-to-day oversight of the project activity. She supervised Meaghan Christian and provided input to the development of the methods and analysis.

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Appendix 1 Nutrition assessment tools and questionnaires

Child And Diet Evaluation Tool (CADET)

School Food Diary

This diary belongs to:

Name

Year Group

School

Fw

HOW TO FILL IN THE SCHOOL FOOD DIARY

Starting with the column headed **"Morning break"** tick all the items of food and drink that the child eats and drinks until lunch time.

In the next column, tick everything the child eats or drinks at **'lunchtime'**.

In the afternoon break, tick all the items of food and drink the child has eaten at school in the **"afternoon break"** column.

If they do not have anything to eat or drink at a mealtime, please tick **"nothing to eat"** and/or **"nothing to drink"** on page 8.

If the child attends a breakfast club, this information needs to be completed in the Home Food Diary.

If you cannot find the exact food or drink listed. Please tick the item you think is the closest match e.g.

Spaghetti Bolognese is: **pasta with meat, fish (and sauce)**
Popadom is: **crisps/savoury snack**

Here are some **EXAMPLES** of how to fill in the School Food Diary

Tommy had a cereal bar and 2 chocolate biscuits for morning break therefore ticked these foods in the column **"Morning break"**

B EXAMPLE: Snack Food	Morning break	Lunch time	Afternoon break
1 Crisps, savoury snacks (cheddars)	☐	☐	☐
2 Crackers, crispbread etc	☐	☐	☐
3 Cereal bar muesli bar, flapjack	☑	☐	☐
4 Chocolate biscuit	☑	☐	☐

A **Drinks**	Morning break	Lunch time	Afternoon break
1 Milk, milky drink, lassi	☐	☐	☐
2 Tea, coffee	☐	☐	☐
3 Drinking chocolate etc	☐	☐	☐
4 Fizzy drink (pop/cola), squash, fruit drink (e.g. Ribena)	☐	☐	☐
5 Diet, low calorie drink (including fizzy low calorie)	☐	☐	☐
6 Fruit juice (pure)/smoothies	☐	☐	☐
7 Water	☐	☐	☐

B **Snack Food**	Morning break	Lunch time	Afternoon break
1 Crisps, savoury snacks (mini cheddars)	☐	☐	☐
2 Crackers, crispbread etc	☐	☐	☐
3 Cereal bar, muesli bar, flapjack	☐	☐	☐
4 Chocolate biscuit	☐	☐	☐
5 Other biscuit	☐	☐	☐
6 Croissant, waffles, pop tarts	☐	☐	☐
7 Yoghurt, fromage frais	☐	☐	☐
8 Nuts	☐	☐	☐

C **Sandwich, bread**	Morning break	Lunch time	Afternoon break
1 Sandwich (tick filling separately). Bread, roll, toast crumpet	☐	☐	☐
2 Croissant, sweet waffles, pop tarts	☐	☐	☐

2

3 Garlic bread, naan, paratha	☐	☐	☐
4 Chapatti, pitta bread, wrap, roti etc	☐	☐	☐
5 Cracker, crispbread etc	☐	☐	☐

D **Spreads, Sauces, Soup**	Morning break	Lunch time	Afternoon break
1 Margarine, butter	☐	☐	☐
2 Tomato Ketchup, brown sauce	☐	☐	☐
3 Mayonnaise, salad cream	☐	☐	☐
4 Sweet spread e.g. jams, honey	☐	☐	☐
5 Savoury spread e.g. marmite, pate	☐	☐	☐
6 Gravy	☐	☐	☐
7 Soup	☐	☐	☐

E **Cheese, Eggs**	Morning break	Lunch time	Afternoon break
1 Hard cheese, e.g. Cheddar, Red Leicester	☐	☐	☐
2 Cheese spread, triangle, string	☐	☐	☐
3 Cottage cheese	☐	☐	☐
4 Quiche - meat, fish or vegetable	☐	☐	☐
5 Scrambled egg, omelette, fried egg	☐	☐	☐
6 Poached, boiled egg	☐	☐	☐

F **Chicken, Turkey**	Morning break	Lunch time	Afternoon break
1 .....sliced or plain	☐	☐	☐

3

2	.....nuggets, dippers, kiev, etc	☐	☐	☐
3	.....in a creamy sauce, curry e.g. korma or tikka masala	☐	☐	☐
G	**Other Meats e.g.**	Morning break	Lunch time	Afternoon break
1	.....sliced roast, steak, chops	☐	☐	☐
2	.....stew casserole, mince, curry lamb or keema	☐	☐	☐
3	.....beef burger, hamburger, doner kebab	☐	☐	☐
4	Bacon	☐	☐	☐
5	Ham	☐	☐	☐
6	Sausages	☐	☐	☐
7	Sausage roll, meat pie, pasty, fried dumplings	☐	☐	☐
8	Corned beef, luncheon meats, salami, pepperoni	☐	☐	☐
9	Offal e.g. liver, kidney	☐	☐	☐
H	**Fish**	Morning break	Lunch time	Afternoon break
1	Fish fingers	☐	☐	☐
2	Fried fish in batter (as in fish and chips)	☐	☐	☐
3	White fish (not fried) e.g. cod, haddock, plaice	☐	☐	☐
4	Tuna or other oily fish (including canned or fresh)	☐	☐	☐
5	Shellfish e.g. prawns, mussels	☐	☐	☐
I	**Vegetarian**	Morning break	Lunch time	Afternoon break
1	Vegetable pie, pasty	☐	☐	☐

2	Samosa, pakora bhajee	☐	☐	☐
3	Quorn, veggie mince, sausages etc	☐	☐	☐
4	Mixed vegetable curry	☐	☐	☐
5	Paneer (cheese curry)	☐	☐	☐
J	**Pizza, Pasta, Rice etc**	Morning break	Lunch time	Afternoon break
1	Pizza	☐	☐	☐
2	Boiled rice	☐	☐	☐
3	Fried rice	☐	☐	☐
4	Noodles	☐	☐	☐
5	Pasta-plain, cous cous	☐	☐	☐
6	Pasta with tomato sauce (no meat)	☐	☐	☐
7	Pasta with cheese sauce	☐	☐	☐
8	Pasta with meat, fish (and sauce)	☐	☐	☐
9	Yorkshire pudding, pancake	☐	☐	☐
K	**Vegetables & Beans**	Morning break	Lunch time	Afternoon break
1	Mixed vegetables	☐	☐	☐
2	Tomatoes	☐	☐	☐
3	Cucumber	☐	☐	☐
4	Coleslaw	☐	☐	☐
5	Other salad vegetables e.g. lettuce	☐	☐	☐
6	Stir-fried vegetables	☐	☐	☐
7	Broccoli, brussel sprouts, cabbage	☐	☐	☐

8	Courgettes	☐	☐	☐
9	Spinach	☐	☐	☐
10	Parsnips	☐	☐	☐
11	Radish	☐	☐	☐
12	Leeks	☐	☐	☐
13	Carrots	☐	☐	☐
14	Cauliflower	☐	☐	☐
15	Peas, sweetcorn	☐	☐	☐
16	Celery	☐	☐	☐
17	Peppers, red, green, yellow etc	☐	☐	☐
18	Other vegetable	☐	☐	☐
19	Baked beans	☐	☐	☐
20	Lentils, dahl	☐	☐	☐
21	Other beans	☐	☐	☐
22	Seeds e.g. sunflower, sesame	☐	☐	☐
L	**Potato**	**Morning break**	**Lunch time**	**Afternoon break**
1	Boiled, mashed, jacket	☐	☐	☐
2	Chips, roast, potato faces etc	☐	☐	☐
M	**Fruit**	**Morning break**	**Lunch time**	**Afternoon break**
1	Fruit salad (tinned or fresh)	☐	☐	☐

6

2	Apple	☐	☐	☐
3	Pear	☐	☐	☐
4	Banana	☐	☐	☐
5	Orange, satsuma etc	☐	☐	☐
6	Grapes	☐	☐	☐
7	Melon, watermelon	☐	☐	☐
8	Pineapple	☐	☐	☐
9	Strawberry, raspberry etc	☐	☐	☐
10	Peach, nectarine, plum, apricot, mango	☐	☐	☐
11	Kiwi	☐	☐	☐
12	Other fresh fruit	☐	☐	☐
13	Dried fruit	☐	☐	☐
N	**Desserts, Puddings Cakes etc**	**Morning break**	**Lunch time**	**Afternoon break**
1	Jelly, ice lolly	☐	☐	☐
2	Ice cream, frozen dessert (e.g. Vienetta)	☐	☐	☐
3	Cream, custard	☐	☐	☐
4	Mousse, milk puddings, e.g. rice pudding	☐	☐	☐
5	Cakes, buns, sponge pudding	☐	☐	☐
6	Sweet pies, tarts, crumbles	☐	☐	☐

7

O	Sweets	Morning break	Lunch time	Afternoon break
1	Sweets, toffees, mints	☐	☐	☐
2	Chocolate bars, e.g. Mars, Galaxy	☐	☐	☐

P	Cereals	Morning break	Lunch time	Afternoon break
1	Sugar-coated e.g. Frosties, Sugar Puffs	☐	☐	☐
2	Hi-fibre e.g. Branflakes, Weetabix, Shreddies, muesli	☐	☐	☐
3	Other e.g. Cornflakes, Rice Krispies etc	☐	☐	☐
4	Prridge, Ready Brek	☐	☐	☐
5	Milk on cereal	☐	☐	☐
6	Sugar on cereal	☐	☐	☐
Q	NOTHING TO EAT	☐	☐	☐
R	NOTHING TO DRINK	☐	☐	☐
S	OTHER FOOD NOT ON THE LIST (please list below)	☐	☐	☐

School Fruit and vegetable Scheme ☐

Packed Lunch ☐ School meal ☐

Home food diary

YR School

Home Food Diary

This diary belongs to: Please fill in the boxes below…

Name

Mobile/telephone number
(for use by the Project only)

Dear Parent or Carer,

Your child's school is helping us with a study to look at what children are eating. You have agreed to us recording everything your child eats and drinks for 24 hours - from 9am today to 9am tomorrow. The School staff have ticked what your child has eaten and drunk at school today on a separate questionnaire.

All you need to do is to tick the food and drink your child eats from when they get home from school, until 9am tomorrow morning. If your child ate or drank with someone else after school, ask your child or your child's carer what they ate and tick the foods and drinks they consumed.

HOW TO FILL IN THE HOME FOOD DIARY

Please look through the diary so that you know where to find each food.
Starting with the column headed **"Before tea (after school)"** tick all the food and drink that your child eats and drinks after finishing school today until their evening meal.

In the columns headed **"Evening meal/tea"**, tick all the items of food and drink your child had for their evening meal.

In the column headed **"After tea/during night"** tick all the items of food and drink your child had after their evening meal and during the night.

In the column headed **"Breakfast/before school"**, tick all the items of food and drink your child had at home before going to school the following morning (if your child eats anywhere else, this will be filled in by a teacher).

If they do not have anything to eat or drink at a mealtime, please tick **"nothing to eat"** and/or **"nothing to drink"** on page 9.

If you cannot find the exact food or drink listed. Please tick the item you think is the closest match e.g.

Spaghetti Bolognese is: **pasta with meat, fish (and sauce)**
Popadom is: **crisps/savoury snack**

If you cannot find a close match, please tick **"other food not on the list"** on page 9.

There are some additional questions that we would like you to complete at the end of the diary (page 12). When the diary is completed, please make sure it is placed in your child's bag and sent back to school.

1

Here are some **EXAMPLES** of how to fill in the Home Food Diary

Tommy had a cereal bar and 2 chocolate biscuits when he got home from school so his mum ticked these foods in the column '**Before tea/(after school)**'

B **EXAMPLE 1: Snack Food**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Crisps, savoury snacks (cheddars)	☐	☐	☐	☐
2 Crackers, crispbread etc	☐	☐	☐	☐
3 Cereal bar muesli bar, flapjack	☑	☐	☐	☐
4 Chocolate biscuit	☑	☐	☐	☐

The following morning Tommy had a bowl of weetabix with milk for breakfast so his mum ticked these foods in the column '**Breakfast/before school**'

P **EXAMPLE 2: Cereals**	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Sugar-coated e.g. Frosties, Sugar Puffs	☐	☐	☐	☐
2 Hi-fibre e.g. Branflakes, Weetabix, Shreddies, muesli	☐	☐	☐	☑
3 Other e.g. Cornflakes, Rice Krispies etc	☐	☐	☐	☐
4 Milk on cereal	☐	☐	☐	☑
5 Sugar on cereal	☐	☐	☐	☐

A **Drinks**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Milk, milky drink, lassi	☐	☐	☐	☐
2 Tea, coffee	☐	☐	☐	☐
3 Drinking chocolate etc	☐	☐	☐	☐
4 Fizzy drink (pop/cola), squash, fruit drink (e.g. Ribena)	☐	☐	☐	☐
5 Diet, low calorie drink (including fizzy low calorie)	☐	☐	☐	☐
6 Fruit juice (pure)/smoothies	☐	☐	☐	☐
7 Water	☐	☐	☐	☐

B **Snack Food**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Crisps, savoury snacks (cheddars)	☐	☐	☐	☐
2 Crackers, crispbread etc	☐	☐	☐	☐
3 Cereal bar, muesli bar, flapjack	☐	☐	☐	☐
4 Chocolate biscuit	☐	☐	☐	☐
5 Other biscuit	☐	☐	☐	☐
6 Croissant, waffles, pop tarts	☐	☐	☐	☐
7 Yoghurt, fromage frais	☐	☐	☐	☐
8 Nuts	☐	☐	☐	☐

C **Sandwich, bread**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Sandwich (tick filling separately). Bread, roll, toast crumpet	☐	☐	☐	☐
2 Croissant, sweet waffles, pop tarts	☐	☐	☐	☐

3 Garlic bread, naan, paratha	☐	☐	☐	☐
4 Chapatti, pitta bread, wrap, roti etc	☐	☐	☐	☐
5 Cracker, crispbread etc	☐	☐	☐	☐
D Spreads, Sauces, Soup	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Margarine, butter	☐	☐	☐	☐
2 Tomato Ketchup, brown sauce	☐	☐	☐	☐
3 Mayonnaise, salad cream	☐	☐	☐	☐
4 Sweet spread e.g. jams, honey	☐	☐	☐	☐
5 Savoury spread e.g. marmite, pate	☐	☐	☐	☐
6 Gravy	☐	☐	☐	☐
7 Soup	☐	☐	☐	☐
E Cheese, Eggs	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Hard cheese, e.g. Cheddar, Red Leicester	☐	☐	☐	☐
2 Cheese spread, triangle, string	☐	☐	☐	☐
3 Cottage cheese	☐	☐	☐	☐
4 Quiche - meat, fish or vegetable	☐	☐	☐	☐
5 Scrambled egg, omelette, fried egg	☐	☐	☐	☐
6 Poached, boiled egg	☐	☐	☐	☐
F Chicken, Turkey	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 ….sliced or plain	☐	☐	☐	☐

2 …..nuggets, dippers, kiev, etc	☐	☐	☐	☐
3 …..in a creamy sauce, curry e.g. korma or tikka masala	☐	☐	☐	☐
G Other Meats e.g.	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 …..sliced roast, steak, chops	☐	☐	☐	☐
2 …..stew casserole, mince, curry or keema	☐	☐	☐	☐
3 …..beef burger, hamburger, doner, kebab	☐	☐	☐	☐
4 Bacon	☐	☐	☐	☐
5 Ham	☐	☐	☐	☐
6 Sausages	☐	☐	☐	☐
7 Sausage roll, meat pie, pasty, fried dumplings	☐	☐	☐	☐
8 Corned beef, luncheon meats, salami, pepperoni	☐	☐	☐	☐
9 Offal e.g. liver, kidney	☐	☐	☐	☐
H Fish	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Fish fingers	☐	☐	☐	☐
2 Fried fish in batter (as in fish and chips)	☐	☐	☐	☐
3 White fish (not fried) e.g. cod, haddock, plaice	☐	☐	☐	☐
4 Tuna or other oily fish (including can or fresh)	☐	☐	☐	☐
5 Shellfish e.g. prawns, mussels	☐	☐	☐	☐
I Vegetarian	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Vegetable pie, pasty	☐	☐	☐	☐

2	Samosa, pakora bhajee	☐	☐	☐	☐
3	Quorn, veggie mince, sausages etc	☐	☐	☐	☐
4	Mixed vegetable curry	☐	☐	☐	☐
5	Paneer (cheese curry)	☐	☐	☐	☐
J	**Pizza, Pasta, Rice etc**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1	Pizza	☐	☐	☐	☐
2	Boiled rice	☐	☐	☐	☐
3	Fried rice	☐	☐	☐	☐
4	Noodles	☐	☐	☐	☐
5	Pasta-plain, cous cous	☐	☐	☐	☐
6	Pasta with tomato sauce (no meat)	☐	☐	☐	☐
7	Pasta with cheese sauce	☐	☐	☐	☐
8	Pasta with meat, fish (and sauce)	☐	☐	☐	☐
9	Yorkshire pudding, pancake	☐	☐	☐	☐
K	**Vegetables & Beans**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
1	Mixed vegetables	☐	☐	☐	☐
2	Tomatoes	☐	☐	☐	☐
3	Cucumber	☐	☐	☐	☐
4	Coleslaw	☐	☐	☐	☐
5	Other salad vegetables e.g. lettuces	☐	☐	☐	☐
6	Stir-fried vegetables	☐	☐	☐	☐
7	Broccoli, brussel sprouts, cabbage	☐	☐	☐	☐

K	**Vegetables & Beans**	Before tea /after school	Evening meal/tea	After tea/ during night	Breakfast/ before school
8	Courgettes	☐	☐	☐	☐
9	Spinach	☐	☐	☐	☐
10	Parsnips	☐	☐	☐	☐
11	Radish	☐	☐	☐	☐
12	Leeks	☐	☐	☐	☐
13	Carrots	☐	☐	☐	☐
14	Cauliflower	☐	☐	☐	☐
15	Peas, sweetcorn	☐	☐	☐	☐
16	Celery	☐	☐	☐	☐
17	Peppers, red, green, yellow etc	☐	☐	☐	☐
18	Other vegetable	☐	☐	☐	☐
19	Baked beans	☐	☐	☐	☐
20	Lentils, dahl	☐	☐	☐	☐
21	Other beans	☐	☐	☐	☐
22	Seeds e.g. sunflower, sesame	☐	☐	☐	☐
L	**Potato**	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
1	Boiled, mashed, jacket	☐	☐	☐	☐
2	Chips, roast, potato faces etc	☐	☐	☐	☐
M	**Fruit**	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
1	Fruit salad (tinned or fresh)	☐	☐	☐	☐
2	Apple	☐	☐	☐	☐

M Fruit	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
3 Pear	☐	☐	☐	☐
4 Banana	☐	☐	☐	☐
5 Orange, satsuma etc	☐	☐	☐	☐
6 Grapes	☐	☐	☐	☐
7 Melon, watermelon	☐	☐	☐	☐
8 Pineapple	☐	☐	☐	☐
9 Strawberry, raspberry etc	☐	☐	☐	☐
10 Peach, nectarine, plum, apricot, mango	☐	☐	☐	☐
11 Kiwi	☐	☐	☐	☐
12 Other fresh fruit	☐	☐	☐	☐
13 Dried fruit	☐	☐	☐	☐

N Desserts, Puddings, & Cakes etc	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Jelly, ice lolly	☐	☐	☐	☐
2 Ice cream, frozen dessert (e.g. Vienetta)	☐	☐	☐	☐
3 Cream, custard	☐	☐	☐	☐
4 Mousse, milk puddings, e.g. rice pudding	☐	☐	☐	☐
5 Cakes, buns, sponge pudding	☐	☐	☐	☐
6 Sweet pies, tarts, crumbles	☐	☐	☐	☐

O Sweets	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Sweets, toffees, mints	☐	☐	☐	☐
2 Chocolate bars, e.g. Mars, Galaxy	☐	☐	☐	☐

P Cereals	Before tea (after school)	Evening meal/tea	After tea/ during night	Breakfast/ before school
1 Sugar-coated e.g. Frosties, Sugar Puffs	☐	☐	☐	☐
2 Hi-fibre e.g. Branflakes, Weetabix, Shreddies, muesli	☐	☐	☐	☐
3 Other e.g. Cornflakes, Rice Krispies etc	☐	☐	☐	☐
4 Porridge, Ready Brek	☐	☐	☐	☐
5 Milk on cereal	☐	☐	☐	☐
6 Sugar on cereal	☐	☐	☐	☐
Q NOTHING TO EAT	☐	☐	☐	☐
R NOTHING TO DRINK	☐	☐	☐	☐
S OTHER FOOD NOT ON THE LIST (please list below)				
_____	☐	☐	☐	☐
_____	☐	☐	☐	☐

T **Extra Questions** These questions provide us with more details about the amounts and types of food and drink usually eaten by your child on an average day. Please tick the closest answer.

1 What type of milk does your child usually have? (Tick all that apply)

Full cream (silver top, sterilised) ☐ Semi-skimmed (half fat) ☐

Skimmed ☐ Other ☐

2 What type of bread/roll/toast does your child usually eat? (Tick all that apply)

None ☐ White ☐ White with added fibre ☐

Wholemeal ☐ Granary/brown ☐ Other ☐

3 Number of slices of bread eaten in a usual day ☐

Number of rolls/plain muffins eaten in a usual day ☐

4 How much pure fruit juice in total does your child usually drink at home on an average day? (One average child's beaker =1/4 pint)

None ☐ 1/4 pint ☐ 1/2 pint ☐ 3/4 pint ☐

1 pint ☐ More than 1 pint ☐

5 How much sugar, in total did your child have added to food or drink today at home?

none ☐ 1-2 teaspoons ☐ 3-4 teaspoons ☐ 5-6 teaspoons ☐

7 + teaspoons ☐

6 Where did your child eat today? (Tick all that apply)

Home ☐ School ☐ Friend/relative ☐ Childcare ☐ Other ☐

7 What does your child usually do at lunch time? (Tick one box only)

Have a school lunch/meal ☐ Take a packed lunch ☐

Go home for lunch ☐ Other ☐

The following questions are about what you and your child think about eating fruit and vegetables. Please tick the closest answer.

		Yes always	Yes, most days/often	Sometimes	Rarely	Never
8	Do you have different kinds of fruit/vegetables at home?	☐	☐	☐	☐	☐
9	Do you buy specific fruit/vegetable because your child asks for it?	☐	☐	☐	☐	☐
10	Do you cut up fruit/vegetables for your child to eat?	☐	☐	☐	☐	☐
11	Do you (parent/carer) eat fruit/vegetables every day?	☐	☐	☐	☐	☐
12	Do you eat fruit/vegetables together with your child?	☐	☐	☐	☐	☐
13	Do you have to ask your child to eat their fruit or vegetables?	☐	☐	☐	☐	☐
14	Do you allow your child to eat as much fruit/vegetables as he/she likes?	☐	☐	☐	☐	☐

		I fully agree	Yes, most days/often	Neither agree nor disagree	I disagree somewhat	I totally disagree
15	My child eats fruit every day	☐	☐	☐	☐	☐
16	My child eats vegetables every day	☐	☐	☐	☐	☐
17	My child eats enough fruit/vegetables	☐	☐	☐	☐	☐

How important are the following to you in deciding how much fruit and vegetables your family eats?

		Very important	Important	Neither unimportant or important	Unimportant	Very unimportant
18	The money I have available to spend on fruit and vegetables	☐	☐	☐	☐	☐
19	The price of fruit and vegetables	☐	☐	☐	☐	☐
20	My knowledge about ways to prepare fruit and vegetables	☐	☐	☐	☐	☐
21	The time I have available to prepare fruit and vegetables	☐	☐	☐	☐	☐
22	Likes and dislikes of my family for fruit and vegetables	☐	☐	☐	☐	☐
23	The quality of fruit and vegetables available	☐	☐	☐	☐	☐

24 How many people aged 18 years or over live in your household in total? ☐

25 How many people under 18 years live in your household in total? ☐

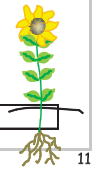
26 How many nights a week does your family eat together at a table? ☐

27 Does anyone in your household have any of the following qualifications? Tick all that apply

CSE ☐ GCE "O" Level ☐ GCSE ☐ City & Guilds ☐

"A" Levels ☐ Teaching Diploma, HNC ☐ Degree ☐

None of these ☐ Other ☐ Describe ☐



We would be very grateful if you could give us the following information. This information is used only to sort survey responses into groups and will not be used for any other purpose.

28 What is your postcode? ☐

Please tick if you have any of the following fruit or vegetables in your fridge/freezer or cupboards. If the fruit or vegetable is not listed please write in the space provided.

29 **VEGETABLES**

Baked beans ☐	Broccoli ☐	Brussel sprouts ☐	Cabbage ☐
Carrots ☐	Celery ☐	Courgettes ☐	Cucumber ☐
Leeks ☐	Lentils, Dahl ☐	Mushrooms ☐	Onions ☐
Parsnips ☐	Peas, beans, sweetcorn ☐	Peppers ☐	Radish ☐
Salad, lettuces ☐	Spinach ☐	Tomatoes ☐	

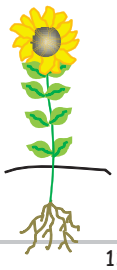
FRUIT

Apples ☐	Apricot ☐	Banana ☐	Berries ☐
Dried fruit ☐	Grapes ☐	Kiwi ☐	Mango ☐
Melon ☐	Orange, satsuma ☐	Peach, nectarine ☐	Pears ☐
Pineapple ☐	Plum ☐	**Other** ..... ☐	

30 How would you describe your child's ethnic background? Tick **one** box only

White	**Asian or British Asian**	**Chinese or other ethnic Group**
British ☐	Indian ☐	Chinese ☐
Irish ☐	Pakistani ☐	Any other ethnic group ☐
Any other White background ☐	Bangladeshi ☐	
	Any other Asian background ☐	

Mixed	**Black or Black British**
White & Black Caribbean ☐	Caribbean ☐
White & Black African ☐	African ☐
White & Asian ☐	Any other Black background ☐
Any other mixed background ☐	
	Prefer not to say ☐



12

Child Questionnaire.

ID:

Name: .....

School: .....

Age: .....

1. Are you a boy or girl?

Boy Girl

2. What are your 3 favourite fruit and vegetables?

1.....

2.....

3.....

What are your 3 least favourite fruit and vegetables?

1.....

2.....

3.....

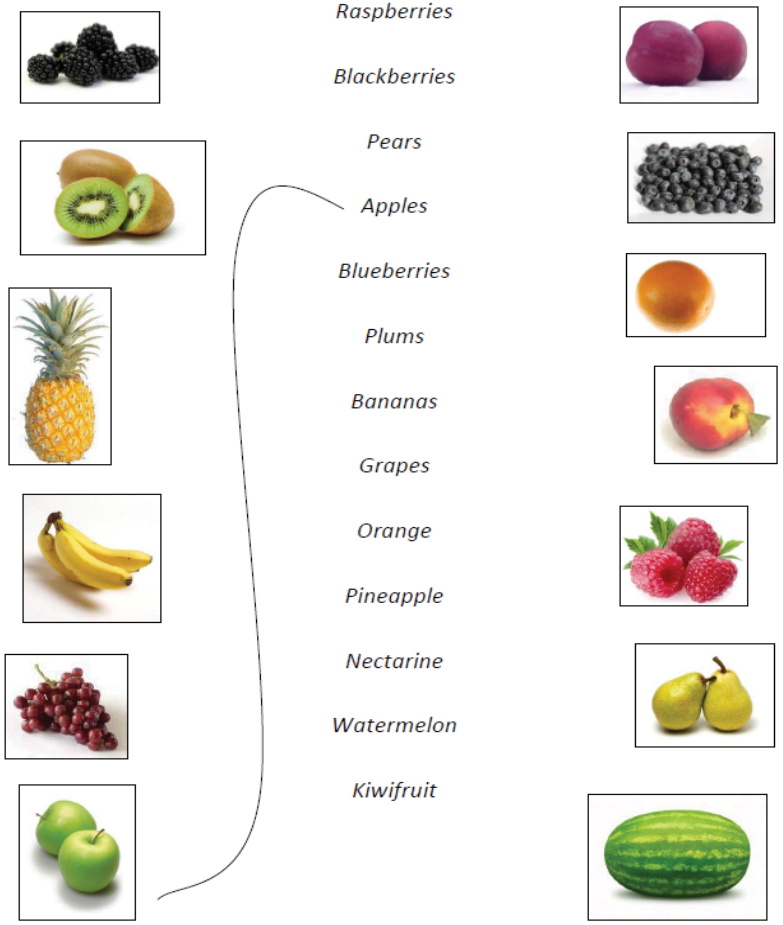
3. How many servings of fruit and vegetables do you think you should eat every day to stay healthy? Please circle one number only.

1 2 3 4 5 6 7 8

4. Do you agree or disagree with these ideas about fruit and vegetables? Circle one number on each row

Idea	Agree a lot	Agree a little	Disagree a little	Disagree a lot
I enjoy eating fruit.	1	2	3	4
I like trying new fruits.	1	2	3	4
I try to eat lots of fruit.	1	2	3	4
I enjoy eating vegetables.	1	2	3	4
I like trying new vegetables.	1	2	3	4
I try to eat lots of vegetables.	1	2	3	4
Eating fruit and vegetables every day keeps me healthy.	1	2	3	4
There's usually lots of fruit and vegetable to eat at home.	1	2	3	4
I'm good at preparing fruit and vegetables.	1	2	3	4
My family encourages me to eat fruit and vegetables	1	2	3	4

5. Please draw a line from the name of the fruit to vegetable to the matching picture.



Courgettes

Spinach

French Beans

Parsley

Lettuces

Parsnips

Radish

Sweet-corn

Carrots

Leeks

Spring onions

Broccoli

Peppers

Cucumber

Tomatoes

Garlic

6. The following questions are about gardening. Please circle either Yes or No for each question

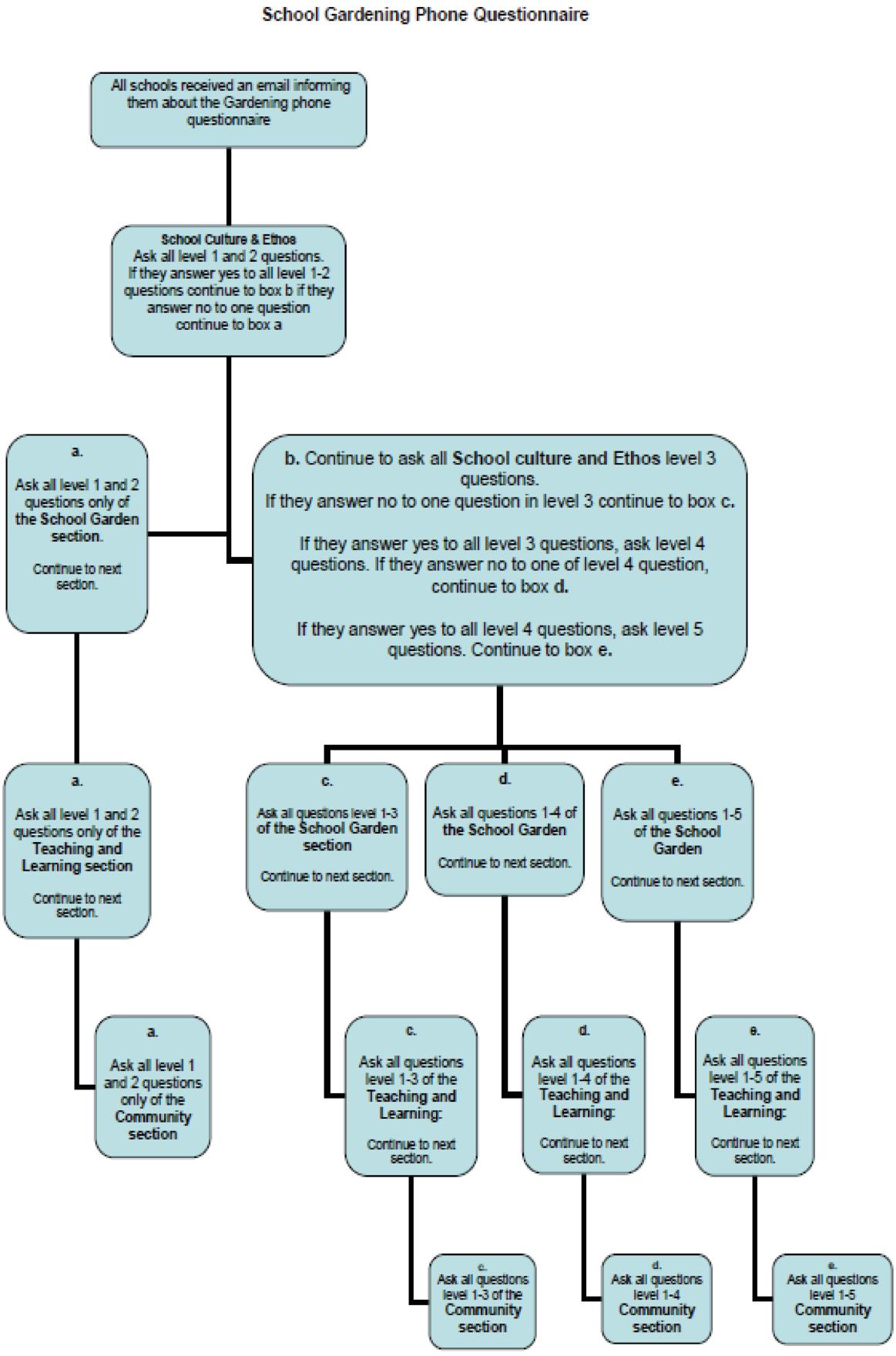
We grow our own fruit and vegetables **Yes** **No**

What fruit or vegetables have you grown?

Have you tasted any of the fruit or vegetables that you have grown? **Yes** **No**

What fruit or vegetables have you tasted?

School gardening questionnaire



School Culture & Ethos		Yes	No
1	Individual and or group within our school is interested in developing the school garden.		
1	We are considering fundraising options.		
2	A vision for gardening has been shared amongst members of our staff team.		
2	We have a gardening club or environmental club.		
2	We have started the fundraising process for the garden.		
3	The garden and its purpose are written into the school development plan.		
3	There is a team of staff responsible for implementing the garden project.		
3	The school grounds staff or caretaker are involved in the maintenance of the garden.		
3	Some pupils are participating in the design and development of the garden.		
3	A wide number and age range of pupils a involved in gardening activities in school lessons.		
3	We regularly raise funds for the garden through PTA and other channels.		
4	Our staff are implementing the garden project and are advocating its benefits to other schools.		
4	The design and development of the garden is led by pupils as well as teachers.		
4	Most pupils across the school are involved in gardening activities		
4	Fundraising or sourcing materials for the school garden takes place regularly.		
5	We see the garden as a key resource for Teaching and Learning, serving our pupils, our staff and our community.		
5	We regularly celebrate our achievements in the garden through our project work, assemblies and open days.		
The School Garden		**Yes**	**No**
1	We are already growing some plants inside or outside the classroom.		
1	We are conducting an audit of our school grounds.		
1	We are planning to do a risk assessment for our growing activities.		
2	A plan has been produced and an area identified for a school garden.		
2	Preparation work on the site has begun e.g. clearing the site, providing containers or raised beds, improving the soil.		
2	We have done a risk assessment for all activities carried out in the school garden.		
3	We grow a range of plants in our garden such as flowers, shrubs, trees, fruits and vegetables.		
3	We demonstrate care for the environment in our garden by gardening organically, reducing water use, using mulches and composting.		

3	A programme for caring for our garden in the holidays has been established.		
4	Our garden has a varied range of features and a good range of flowers, fruits, vegetables, shrubs and trees.		
4	We are able to demonstrate plants for different purposes, e.g. sensory, attracting wildlife, edible.		
4	We adopt good environmental and sustainable practices with regard to use of renewable resources e.g. composting, water consumption, treatment of pests and diseases.		
4	We have holiday maintenance regimes in place.		
4	We are making use of produce from the school garden in other school activities e.g. cooking		
5	We have an outstanding example of a school garden with regard to range of plants, sustainable practices and all year round care and maintenance.		
5	Our garden is considered to be an exemplar of best practice in the field of education.		
Teaching and Learning		**Yes**	**No**
1	We are looking at ways to teach our pupils gardening skills.		
1	We are auditing the skills of our teachers and will source Continuing Professional Development courses for our teachers as necessary.		
1	Our pupils are being introduced to the importance of plants in their lives.		
2	Some of our pupils have learnt basic gardening skills, including sowing, planting and watering.		
2	Our pupils have been taught to use a basic range of hand tools safely.		
2	Our pupils have been introduced to a few gardening terms		
2	One or more teachers co-ordinates gardening activities.		
3	Our pupils' gardening skills are progressing to include digging, soil preparation and weeding as well as sowing, planting and watering		
3	Our pupils have learnt how to use an increased range of tools safely including spades, forks, rakes, hoes and hand tools		
3	Our pupils are starting to become familiar with gardening vocabulary and can name and identify some crops and weeds.		
3	In addition to self-confidence, patience and nurturing skills, pupils are learning to work together in teams and develop skills of co-operation and respect for others and the world around them.		
3	Pupils are learning about where their food comes from and how to grow food for a healthier diet.		
3	Several staff have the necessary skills to manage horticultural aspects of and teach in the garden.		
3	The garden is being used as a resource to teach more than one curriculum subject.		

3	We have some signs and plant labels in the garden to build on the learning taking place there for children, parents and visitors to the school.		
4	Our pupils have more advanced skills including making seed drills, propagating from cuttings, as well as digging, soil preparation, weeding, sowing, planting and watering.		
4	Pupils have taken part in construction activities including making raised beds, compost bins, willow structures or plant supports.		
4	Our pupils have learnt how to use an increased range of tools safely and can select a tool appropriate to the task. Our pupils can clean and maintain their tools.		
4	We regularly use a good range of gardening vocabulary with our pupils and they can identify and name crops and weeds.		
4	In addition to self-confidence, patience, respect and the skills of nurturing, teamwork and co-operation, pupils are using the garden to develop their problem solving capabilities and to communicate effectively.		
4	Our pupils are made more aware of the importance of eating healthily by growing their own food.		
4	Older pupils sometimes act as mentors to younger children in the garden.		
4	Lead staff have sufficient gardening skill levels to train others within the school.		
4	Staff may have undertaken Continuing Professional Development workshops in gardening and are actively involved in training others.		
4	Lessons are being taught through the school garden in two or more curriculum subjects.		
4	There is a good level of information (signs and labels) in the garden to ensure that all aspects of learning are explained to the widest audience, e.g. a sign to explain how composting works and plant labels that include information about a particular plant.		
5	Our pupils are competent in all the horticultural skills required to prepare, plant, nurture and maintain the garden.		
5	Older pupils can plan ahead, understand seasonality and have the skills to design and construct elements of the garden.		
5	Our pupils use and care for a comprehensive range of tools.		
5	Older pupils are able to coach younger pupils within the school.		
5	Pupils can define a range of gardening terms and use them appropriately.		
5	Our pupils have gained many key skills and life skills through gardening including: self-confidence, patience, nurturing/caring, teamwork/ co-operation, respect for others, problem solving, communication, mentoring.		
5	Our pupils are keeping garden journals and can use the garden to plan do and review their own work.		
5	Some pupils are developing enterprise skills linked to the garden and its produce.		
5	We regularly hold briefings and planning meetings in the garden to maximise its use as a resource for teaching and learning.		
5	We are able to receive staff from other schools for mentoring/coaching.		

5	Most of the National Curriculum subjects are being taught by linking to the school garden		
5	We have produced a comprehensive range of interpretation materials, both in the garden and the classroom, to explain the work we do there.		
Community		**Yes**	**No**
1	We are planning to involve members of the wider school and/or local community in our gardening activities		
2	One or more parents or members of the wider school community help with gardening activities.		
2	The school governors are aware of our gardening activities and take an interest in them.		
3	Our governors and parents take an active interest in the garden and several participate regularly in gardening and related fundraising activities.		
4	An established team of volunteers from the local community (including parents and governors) regularly work alongside pupils in gardening activities.		
4	We encourage outside experts to come and share their skills with pupils and teachers in the school garden.		
5	A cross section of the whole community is involved with our school garden.		
5	We welcome outside experts to come and share skills.		
5	We host open days to our garden at least once a year for the local community.		
5	Our garden provides opportunities for adult (life-long) learning.		

One final question, who runs your school garden, is it a trained gardener, or teacher?

Appendix 2 School recruitment letter for trial 1 schools

February 2010

Dear Headteacher,

Work with the RHS to develop your school garden

Schools wanted in London Boroughs of Tower Hamlets, Sutton, Wandsworth and Greenwich!

Are you interested in developing your school garden with practical help from a trained RHS school gardening Advisor? Could your school benefit from professional training to help teachers develop horticultural skills and make best use of the garden to deliver the whole curriculum? Would you like free teacher resources, tools and seeds? Then please read on...

The **RHS** is bringing its national **Campaign for School Gardening** to London with a new schools advisor, James Bliss. A passionate and enthusiastic horticulturalist, Jim is the third of nine new Campaign Advisors who will be working across the regions of the UK to support schools in their gardening.

Jim's main role is one of teacher training, showing teachers how to grow plants from seed, to garden sustainably, to plan seasonally and to develop fruit and vegetable gardens to support healthy eating. The RHS wants teachers to discover just how versatile schools gardens can be; offering exciting learning opportunities across the curriculum and giving children new possibilities for their personal development. There will be plenty of opportunities for all school support staff and parent volunteers to join in too.

10 RHS-led Schools needed for 2010-2012

To reach the maximum number of teachers, the RHS is looking for ten RHS-led Schools across the boroughs who will be prepared to host twilight training events for local teachers once a term over the next two years. The selected RHS-led Schools will receive day-long visits every half term from Jim, helping them to build on practical skills and expertise while developing their gardens.

RHS-led schools will also be expected to participate in an evaluation of the scheme which will be conducted by researchers from the University of Leeds. The purpose of this research is to

find out whether the RHS School Gardening Campaign can improve children's fruit and vegetable intake and have an impact on their overall diet. More details of the research and how it will be carried out in the participating schools is explained in the enclosed 'Further Information' sheets from the University.

What do RHS-led Schools get?

- 1 day's visit from our Advisor each half term to work in the garden with teachers and children (Summer Term 2010 to Summer Term 2011 inclusive). **Please note that to accommodate the requirements of the research project, Years 3 and 4 must be involved in gardening activities, though this does not preclude the involvement of other year groups.**
- Follow up visits to aid lead teachers with planning (Autumn Term 2011 to Autumn Term 2012)
- General on going advice on the school garden, free seeds and tools
- 1 twilight teacher training session each term (Summer term 2010 to Summer term 2011 inclusive), based on seasonal tasks in the school garden (open to RHS-led School teachers and those from local schools)
- Free access to a wide range of teacher resources at **www.rhs.org.uk/schoolgardening/**

What do we need from RHS-led Schools?

- Access to a school garden area and identification of a teacher-co-ordinator
- A time commitment of 2 school days per term and one twilight session per term, with planning meetings as required
- An agreement to host training events and to help the RHS liaise with local schools
- Provision of appropriate supply cover so that teachers and children can work outside with our Advisor on two days per term in Year 1 of the project
- Attendance at a RHS-led Schools open forum event once a year
- A commitment to the school garden evidenced by adopting the RHS Campaign for School Gardening benchmarking scheme with full backing/involvement of the Head Teacher
- Incorporation of the garden into the School Development Plan.
- A commitment to working with the wider community to involve them as much as possible in the school garden

- A commitment to supporting the Leeds University research project as outlined in the accompanying Information sheet
- Permission to allow staff from the University of Leeds to visit your school on 2 occasions to collect information for the evaluation. This will be repeated after 2 growing seasons.

Timescales and Application Procedure

If you feel that you would be interested in becoming an RHS RHS-led School, then we would very much like to hear from you. An application form is enclosed with this letter.

We will be assessing applications during March 2010 with a view to starting work in Schools from April 2010. As part of our assessment we may need to telephone or visit you to obtain further information. We would therefore be grateful if you would kindly complete the enclosed registration form (on coloured paper) and return this in the Freepost envelope provided by **Friday 19 March 2010**. We will be looking to work with a cross section of schools, with a good socio-economic and ethnic mix. You do not need to have a fully established garden to apply; we will welcome applications from schools at all levels, provided that there is a vision to develop gardening as a teaching and learning resource.

Schools that are not selected to be RHS-led schools

Even if you are not selected to be a RHS-led school, you will be invited to termly twilight training at your nearby RHS-led school, to help support you in developing and using your school gardening. You may also still be invited to take part in the Leeds University research project and would be expected to support it in the same way as the RHS-led Schools.

We hope to hear from you very soon. Good luck with your gardening!

Yours faithfully

Deirdre Walton

Regions Manager

RHS Learning & Communities

Further information for head teachers about the evaluation of the RHS Campaign for School Gardening

Invitation paragraph

This is an invitation for your school to take part in a research study. The first part of this information tells you why we are carrying out the study and the second part goes into more detail about how it will be carried out. Please ask us if there is anything that is not clear or if you would like more details.

What is the RHS Campaign for school gardening?

The Royal Horticultural Society (RHS) Campaign for School Gardening promotes school gardening and growing of fruit and vegetables. The Campaign provides resources to help teachers set up and make the most of their school garden, teach the National Curriculum outdoors and inspire their pupils to live healthier lifestyles.

What has this to do with the University of Leeds?

The University of Leeds, Nutritional Epidemiology Group plans to evaluate the RHS program, to find out whether the RHS School Gardening program can improve children's fruit and vegetable intake and has an impact on their overall diet. They will conduct an evaluation of the program involving two linked randomised controlled trials.

Schools from London who wish to participate in the RHS Campaign for School Gardening will be randomised to receive an intensive (10 schools) or Teacher-led gardening program (16 schools).

Why has your school been chosen?

Due to your school's interest in the RHS Gardening Program, your school has been selected randomly from schools in London.

The study involves:

All children in year 3 and 4 completing a class based questionnaire with the teaching assistant and also a questionnaire to finish at home. These questionnaires will be repeated after 2 years when the children are in years 5 and 6.

Gardening Knowledge and Attitude Questionnaire

As a class, the children will be asked to complete a questionnaire asking about their knowledge of gardening, healthy eating and what fruit and vegetables they like.

Food Questionnaire

Trained researchers will use a standard questionnaire (food diary) to help children record what they have eaten that day. The children will then take the food diary home for a parent or carer to complete for the rest of the day and breakfast the next morning.

Benefits to taking part in the study

If you take part, you will be participating in a unique study to test the benefits of providing the RHS gardening program in schools. You have a chance of receiving information, help and support to try to improve the health of a cohort of your pupils. This approach is based on the best research evidence available from the UK and around the world. We will do our best to ensure there is minimal disruption in your school if you decide to take part.

What happens when the study stops?

All data collected in participating schools will be analysed and the findings written up and submitted for publication in academic journals. A summary of the final report will be available to participating schools.

What if there is a problem?

If during the course of the study you have any concerns or complaints you will be able to contact the study team using the contact details below.

Will our taking part in the study be kept confidential?

Yes. All the information collected from the children in your school will be kept strictly confidential. Once collected, the information will have the names and addresses of children removed so that no one can be identified. All data will be stored securely at the University of Leeds. Information will be entered onto a computer and will be password protected and encrypted. The findings from this study will be analysed and written up in such a way that the identity of your school, the staff, children and parents will not be revealed in any way. All the information provided by children and parents will be kept completely confidential.

What will happen to the results of the research study?

The findings from this study will be used to evaluate how well the RHS Campaign for School Gardening program is working. It will also help identify whether participating in the program improves fruit and vegetable consumption and the health of children. The results will be submitted for publication in scientific journals and presented at scientific conferences.

Who is organising and funding the research?

RHS will organise your involvement in the Campaign for School Gardening, whilst the University of Leeds will organise the research. The funding for the evaluation study was provided from the National Institute for Health Research.

Contact Details

If you have any queries about the evaluation please contact Meaghan Kitchen (PhD student) on 0113 3438907 or via email m.s.kitchen@leeds.ac.uk

Participant information and consent letter to parents for both trials 1 and 2

UNIVERSITY OF LEEDS

April 2010

Dear Parent,

I am writing to you today because your child's school has been chosen to take part in an important research product (evaluation of the RHS Campaign for School Gardening) and I would like your consent for your child to participate in this study.

The aim of the project is to find out if the RHS Campaign for School Gardening can improve children's fruit and vegetable intake. In order to do this I would like your child to fill in a School Food Diary and a Home Food Diary. The School Food Diary will be completed by the staff at school and your child will bring home the Home Food Diary for you to complete. They will also bring home a DVD for you to watch, explaining how to complete the Home Food Diary. This DVD is also available on you tube at

http://www.youtube.com/watch?v=AIbzqaJiHq0.

Your child then needs to return the diary and the DVD to school the next day. Your child will also complete a 'gardening questionnaire' in class. We have studied other public health prog in schools, and the children involved have enjoyed taking part.

The head teacher of your child's school is happy for pupils to participate. All information will be treated as confidential. Results of our study will not be reported for individual pupils or schools.

If you do ***not*** want your child to participate, please return the form below to school as soon as possible. If you **agree** to your child taking part **you do not need to do anything now**. If you would like to talk to someone before making your decision, please contact myself or my colleague Meaghan Kitchen on 0113 3438907. We hope that you will enjoy taking part in this important project. More information about the study is included on the next page.

Yours sincerely,

Dr Joan Ransley

Project Manager

✂……

If you would **NOT** like your child to take part in the study, please return this form on the next school day.

I ***do not*** wish my child to take part in the evaluation of the RHS Campaign for School Gardening.

Print child's name: . . . . . .

Signature of parent/carer: . . . . . Date: . . . . . .

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