Public Health Nutrition: 14(2), 219–226 doi:10.1017/S1368980010001886

Free healthy breakfasts in primary schools: a cluster randomised controlled trial of a policy intervention in Wales, UK

Simon Murphy[1,*], GF Moore[1], K Tapper[2], R Lynch[1], R Clarke[1], L Raisanen[1], C Desousa[3] and L Moore[1]

[1]Cardiff Institute of Society and School of Social Sciences, Cardiff University, 1–3 Museum Place, Cardiff, CF10 3BD, UK: [2]School of Psychology, Swansea University, Swansea, UK: [3]Institute of Social and Economic Research, University of Essex, Colchester, UK

Submitted 26 October 2009: Accepted 10 May 2010: First published online 6 July 2010

Abstract

Objective: The present study evaluated the impact of a national school programme of universal free healthy breakfast provision in Wales, UK.

Design: A cluster randomised controlled trial with repeated cross-sectional design and a 12-month follow-up. Primary outcomes were breakfast skipping, breakfast diet and episodic memory. Secondary outcomes were frequency of eating breakfast at home and at school, breakfast attitudes, rest-of-day diet and class behaviour.

Setting: Primary schools in nine local education authority areas.

Subjects: A total of 4350 students (aged 9–11 years) at baseline and 4472 at follow-up in 111 schools.

Results: Students in intervention schools reported significantly higher numbers of healthy food items consumed at breakfast and more positive attitudes towards breakfast eating at 12 months. Parents in intervention schools reported significantly higher rates of consumption of breakfast at school and correspondingly lower rates of breakfast consumption at home. No other significant differences were found.

Conclusions: The intervention did not reduce breakfast skipping; rather, pupils substituted breakfast at home for breakfast at school. However, there were improvements in children's nutritional intake at breakfast time, if not the rest of the day, and more positive attitudes to breakfast, which may have implications for life-course dietary behaviours. There was no impact on episodic memory or classroom behaviour, which may require targeting breakfast skippers.

Keywords
Randomised controlled trial
Free breakfasts
Schoolchildren
Intervention

The poor quality of children's diets has received increased attention in recent years[1–3]. Specific concern has focused on the many schoolchildren who do not eat breakfast everyday[4], given its association with a wealth of deleterious health outcomes[5–7], such as poorer overall nutritional adequacy[8–9], detrimental effects upon memory and concentration[8–12] and obesity[13]. Furthermore, studies conducted in the UK have highlighted social patterning in breakfast eating that may contribute to health inequalities, with children from more deprived backgrounds more likely to skip breakfast and to have less positive attitudes to breakfast than their wealthier counterparts[14–16].

Poor dietary behaviours in childhood have also received increased attention due to their potential impact in later life. Habitual behaviours developed in childhood may track into adulthood[19], as repeated exposure to healthier foods at an early age has been shown to increase the intrinsic rewards associated with their consumption as children develop[20–23]. Efforts to facilitate change in such dietary behaviours have been directed towards schoolchildren in particular due to the capacity of such approaches to reach large numbers of children simultaneously[17–18]. Appropriate manipulation of the school environment may therefore offer an efficient means of improving the health of the population, addressing inequalities and improving educational achievement[24]. Recognition of these potential benefits led to the introduction of breakfast initiatives in the USA[26], and by 2006, 9·7 million children were attending a school breakfast club each day[27].

Previous evaluations of universal free breakfast programmes in the USA have identified a range of dietary, cognitive and educational benefits, but have suffered from a number of methodological shortcomings, including a lack of randomisation and the provision of appropriate control groups[28–29]. A recent randomised controlled trial (RCT) of a 3-year school breakfast programme, supported by the US Department of Agriculture, Food and Nutrition Service, employed a more rigorous methodology to assess a range of outcomes including diet and nutrition, school

*Corresponding author: Email Murphys7@cf.ac.uk

Box 1 Core components of the Primary School Free Breakfast Initiative

- Schools and students have the opportunity to have a free 'healthy breakfast'.
- Breakfast provision takes place before the start of school each day.
- Students should be provided with one item from each of four food groups; milk-based drinks or products, cereal (not sugar coated), fruit and breads.
- Schools are also encouraged to consider incorporating optional play and educational activities.
- Each participating school has a scheme coordinator and supervision of the sessions is provided by teaching staff, kitchen staff, lunchtime supervisors, parent helpers or learning support assistants.
- Schools are advised to consult with parents at an early stage of development and encourage children to become involved in the planning and running of the sessions.
- The scheme is promoted and supported by a local authority co-ordinator who administered the funding for the scheme.
- The Welsh Assembly Government provides schools with £2·5 per child for each breakfast with separate funding for staff.
- The initiative aims to help encourage a healthy pattern of eating for life, improve concentration of students and to assist in the raising of standards of learning and attainment.

behaviour, academic achievement and attendance[30]. The study found significant improvements in students' consumption of nutritious breakfasts in intervention schools[31], but no significant differences in breakfast skipping, school behaviour, academic achievement and attendance were observed[30].

In the UK, the introduction of breakfast programmes has occurred more recently, with the Department of Health introducing a pilot initiative in 1999. Despite a variation in the objectives of schemes[25], there is evidence to suggest that school breakfast programmes can help improve nutrition and in some cases may also be associated with improvements in school attendance, academic performance and behaviour[10,32–35]. However, previous evaluations have been unable to address the confounding pre-intervention variables, incorporate appropriate control groups[36] or have suffered contamination between trial arms[35]. Thus, although evidence suggests that there is good reason to believe that breakfast programmes can have beneficial dietary and educational outcomes, this has yet to be convincingly shown at a policy level in the UK.

The Welsh Assembly Government's Primary School Free Breakfast Initiative (PSFBI) arose from a manifesto commitment to make free healthy breakfasts available to all state-maintained primary schools in Wales, UK. The core components of the PSFBI are highlighted in Box 1.

Here, we report findings from a cluster RCT of this policy intervention in which schools in the intervention group were asked to set up a breakfast scheme, following the guidance issued by the Welsh Assembly Government; schools in the control condition were asked to refrain from setting up a breakfast scheme during the 12-month evaluation period. The Welsh Assembly Government provided support and assistance in facilitating the evaluation design within the policy roll-out. The design included a nested qualitative process evaluation to address issues concerning the context and implementation of the initiative. The present study received ethical approval from the Cardiff University Social Science Ethics Committee. The detailed design of the trial and results of the process evaluation are reported elsewhere[37–39].

Methods

Study design

The present study was a cluster randomised controlled trial, using a repeated cross-section design, with repeat samples of Year 5 and Year 6 students (9–11 years) sampled from the same 111 schools pre- and post-intervention.

Recruitment and data collection

All primary schools in nine local education authorities (LEA) were invited to participate in the trial in the academic years beginning in autumn 2004 and 2005. Recruitment took place in two phases that matched the national implementation of the scheme. In the first year, 152 schools in 'Communities First' areas were invited. The Welsh Assembly Government classifies these areas as being prioritised for social and economic programmes. The definition of areas is based on the Welsh Index of Multiple Deprivation. In the second year, the remaining 456 schools in non-'Communities First' areas in these LEA were approached. Head teachers were asked to sign an agreement to participate in the data collection activities and to be randomised to either the control or intervention condition. Once all schools had been recruited within each phase, stratified block randomisation with concealment of allocation was used with strata defined by LEA, school size, free school meal entitlement and Welsh language medium. Schools, students and data collection staff were not blind to treatment condition although data entry, cleaning and analysis were conducted blind to treatment condition.

The trial assessed the impact of the scheme in four key domains at 12-month follow-up: students' breakfast eating behaviour and attitudes, cognitive performance, classroom behaviour and their dietary habits throughout the day. As the scheme represented a complex intervention, a pre-specified analysis plan identified four primary outcomes: the proportion of students consuming two breakfasts over 2 d to assess breakfast skipping; number of 'healthy' food items (bread, cereal, milk and fruit) consumed at breakfast, number of 'unhealthy' food items (sweets and crisps) consumed at breakfast and episodic

memory. The most consistent effects of breakfast upon cognition, in experimental conditions, have previously been observed for episodic memory, which was therefore selected as the primary outcome as an indicator of cognitive performance[40,41]. Secondary outcomes were identified as attitudes towards eating breakfast; rest-of-day healthy food items; rest-of-day unhealthy food items; scores on the hyperactivity scale of a teacher-reported strength and difficulties questionnaire; and parental reports of frequency of eating breakfast at home and at school.

In each school, at each time point (baseline and 12-month follow-up), one Year 5 (aged 9–10 years) and one Year 6 (aged 10–11 years) class were randomly selected. Using a dietary recall questionnaire validated for use within the present study[42], children were asked to list all foods and drinks consumed at chronologically ordered time points throughout the day. Details of breakfast on the day of reporting were collected first, followed by details of the previous day's intake. This provided the primary measures of the number of healthy food items (fruit, bread, cereal and milk products) and number of unhealthy food items consumed at breakfast (sweets and crisps), and the number of days on which breakfast was consumed in the past 2 d (0, 1 or 2). It also provided the secondary outcomes of the number of healthy (fruit and vegetables) and unhealthy food items (sweets and crisps) consumed the previous day, excluding previous breakfast.

At each of the two time points, a validated attitudes questionnaire[43] and memory tests were also completed between 09.00 and 12.00 hours as supervised classroom exercises. The strengths and difficulties questionnaire (SDQ)[44] was completed by teachers to assess the classroom behaviour of a randomly selected subsample of five students in each year group (i.e. ten in each school at each time point). This measure assesses five dimensions of behaviour, with the hyperactivity/inattention dimension hypothesised to be potentially influenced by breakfast due to its relationship to on-task behaviour[45]. In each school at each time point, thirty-five children were randomly selected, stratified by year group across the full age range of each school, and their parents were sent a questionnaire about their child's dietary behaviour, with particular focus on breakfast eating throughout the week. Non-respondents were followed up with a reminder and duplicate questionnaire.

Sample size requirements were calculated using effect sizes, assuming an intra-cluster correlation of 0·02, 80 % power and a two-tailed α of 0·05. With 111 schools in the trial, for student outcomes from the dietary recall questionnaire and memory tests, assuming an average of fifty responses per school, there would be power to detect an effect size of 0·11. For parent reports of breakfasting behaviour, assuming twenty responses per school, there would be power to detect an effect size of 0·15. For the teacher-reported SDQ, there would be power to detect an effect size of 0·2.

Participant flow

Of the 608 schools invited to participate, 154 expressed an interest and were visited by the research team, of which 111 agreed to be randomised and participate in data collection activities. Schools were asked to indicate a reason for non-participation. Of the 497 invited schools that did not participate, 259 did not provide a reason. Of the remaining 238 schools, they were most likely to cite anticipated staffing difficulties in setting up the intervention (29 %). None of the 111 randomised schools withdrew from the study, although five schools randomised to the control group set up a free breakfast scheme before the 12-month follow-up, and ten schools randomised to the intervention group did not set up the scheme within the follow-up period.

Figures 1 and 2 indicate the flow of schools through the study and the number of eligible and responding participants at each stage: Fig. 1 for the classroom-administered measures among students, and Fig. 2 for the teacher- and parent-completed measures. An examination of the baseline characteristics in Table 1 indicates that there was a good balance between the two experimental groups in terms of both the school- and student-level variables.

Analysis

For each outcome variable, the primary analysis was a school-level weighted linear regression model in which each observation was a school-level mean (or proportion for categorical outcomes) with models weighted by inverse variance weights to adjust for variability and sample size in each school[46]. All models included the baseline score of the respective outcome measure and the four stratification variables as covariates. These primary analyses were conducted on an intention-to-treat (ITT) basis, in which each school was coded according to the treatment condition to which it had been randomised (control = 56, intervention = 55). A second analysis was undertaken for each outcome, in which the treatment group was coded according to whether or not a free breakfast scheme was actually set up before outcome measurement. Regression coefficients and 95 % CI are presented.

Results

Table 2 indicates the results of the ITT analyses for each of the primary and secondary outcomes at 12-month follow-up. For primary outcomes, students in intervention schools reported significantly higher numbers of healthy food items consumed at breakfast (+0·23, 95 % CI 0·09, 0·37), but there were no differences in breakfast skipping, unhealthy food items consumed at breakfast or episodic memory. For secondary outcomes, students in intervention schools had more positive attitudes towards breakfast eating (+0·74, 95 % CI 0·05, 1·43) than their counterparts

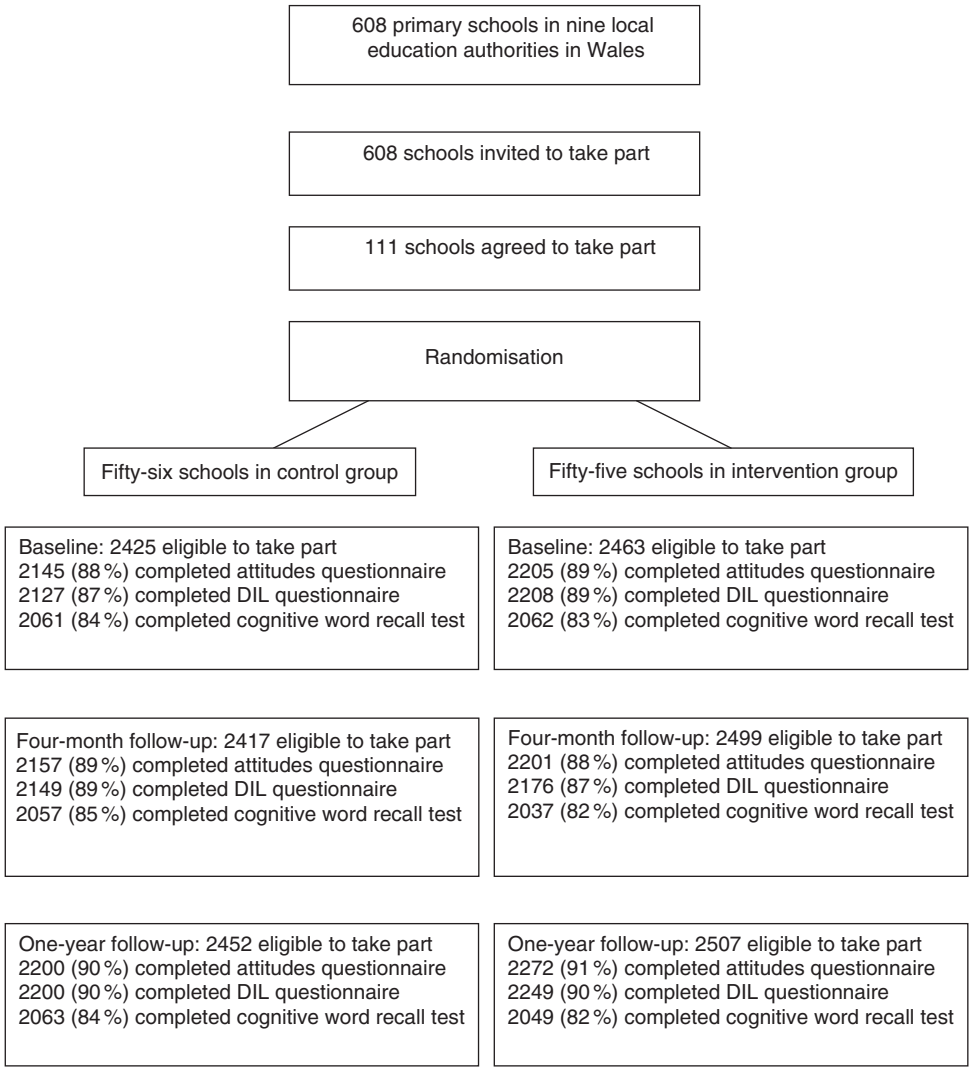

Fig. 1 Flow of schools through study and response rates: classroom-administered student measures (DIL questionnaire, day in the life questionnaire)

in control schools. Parents of students at intervention schools not only reported significantly higher rates of students' consumption of breakfast at school (+0·19, 95 % CI 0·12, 0·26), but also a correspondingly lower proportion of students reported by their parents to be eating breakfast at home (−0·15, 95 % CI −0·21, −0·10).

There were no differences in either healthy or unhealthy items consumed during the rest of the day or hyperactivity/inattention measures. In the secondary per protocol analyses that coded schools according to whether or not the breakfast scheme had been implemented within the 12-month follow-up period, the magnitude and statistical significance of each of the significant effects were increased. Among students in intervention schools where the scheme had been implemented by a 12-month follow-up, 41 % (700 of 1693) stated that they attended the breakfast scheme at least once a week. Of these, 499 (30 %) reported attending the scheme 5 d/week, with the remaining 201 attending on 1–4 d/week. Frequency of attendance was positively associated with frequency of breakfast consumption, positive attitudes towards eating breakfast and consumption of healthy food items at breakfast (all $P < 0{\cdot}01$), and negatively associated with the consumption of unhealthy food items at breakfast ($P < 0{\cdot}05$).

Conclusion

Support for trials of the UK policy initiatives is a relatively recent phenomenon[47–48]. The PSFBI study therefore represents a relatively rare example of a UK RCT evaluation of a national policy initiative that aimed to increase the opportunity of primary-school students receiving a free healthy breakfast at school. As such, it provides not only important information for national policy developments but also the opportunity for a cross-cultural comparison of

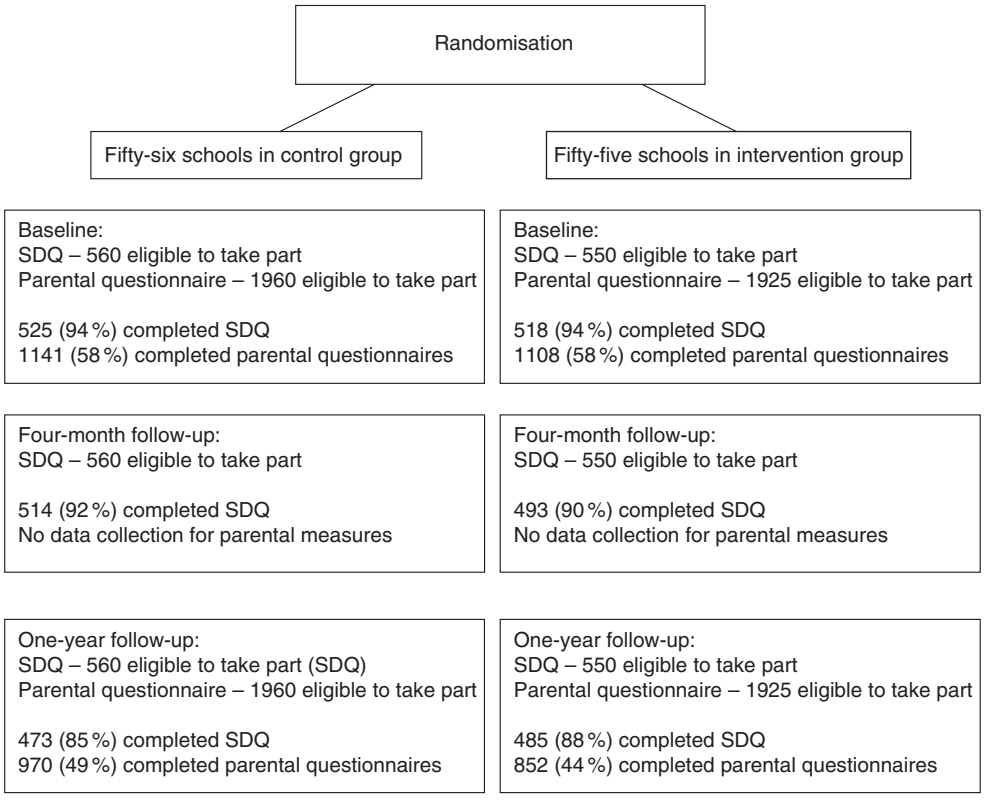

Fig. 2 Response rates: teacher-completed strengths and difficulties questionnaire (SDQ) and parent questionnaires

universal free breakfast provision in the UK and USA, where a similar initiative has been evaluated using a comparable design[30].

The current trial design was in part determined by policy and practice constraints, rather than by conforming to evaluation frameworks[49] that recommend theory, modelling and exploratory trial phases before the conduct of a definitive trial. Nevertheless, the present study addressed a number of methodological shortcomings identified in previous UK studies, including a lack of randomisation, the provision of appropriate control groups and contamination between trial arms[35]. In the present study, the scheme started in five of the fifty-six control schools within the study period, while ten of the fifty-five intervention schools failed to set up the scheme. The primary ITT analysis of this pragmatic trial is not invalidated by this, and the per protocol analysis allows an assessment of the extent to which the primary analysis underestimates the potential impact of the scheme. The study also gained strength from the provision of a preliminary research and review phase that assessed the intervention content and implementation issues and determined outcome measures[37] and a nested process evaluation[38] to determine what works, for whom and in what circumstances[50]. It also included a relatively long-term outcome measure at 12 months compared with previous studies[35]. Confidence in the robustness of these findings is also enhanced by the high response rates of students achieved at each data collection point, although it should be noted that parental measures are based on a much lower response rate. In addition, the strengths lie in the diversity of schools involved in terms of free school meal entitlement, size and deprivation of local area and the retention of all schools for the duration of the trial. The main limitation of the study is its dependence upon self-reported outcomes of dietary behaviour, although these were validated among the target population[40].

The findings provide partial support for the PSFBI as a dietary intervention and closely replicate results from the study conducted in the USA[30–31]. In both studies, breakfast skipping was at a similar level in intervention and control schools, and in each case the availability of universal free breakfast shifted the source of breakfast from home to the school in intervention schools. For educational and behavioural effects, results from the US study showed no differences in student behaviour, attendance or academic achievement. Similarly, the PSFBI was shown to be ineffective in influencing episodic memory or classroom behaviour, despite previous studies suggesting such effects[10,33–34] and process evaluation results for the present study[38] that highlighted consistent implementer reports of changes in learning and school behaviour. Given that the impact of differences in meal composition is less easily shown in generally well-nourished rather than malnourished children[51], such improvements may require the scheme to address breakfast skipping more

Table 1 Baseline characteristics (intention-to-treat) of intervention and control groups: school- and student-level variables (means of aggregated values for each school)

	Control (*n* 56)		Intervention (*n* 55)	
Variables	*n*	%	*n*	%
Percentage of students entitled to free school meals				
Below national average (<17)	13	23	13	24
Above national average (≥17)	43	77	42	76
School size				
Number of students				
Mean	189·2		197·9	
SD	96·1		92·7	
Minimum	23·0		23·0	
Maximum	445·0		540·0	
Language of teaching				
English or both	52	93	51	93
Welsh	4	7	4	7
LEA				
1	3	5	2	4
2	5	9	6	11
3	5	9	5	9
4	10	18	9	16
5	7	13	10	18
6	4	7	4	7
7	6	11	6	11
8	13	23	10	18
9	3	5	3	6
Community First area				
Non-Community First	27	48	26	47
Community First	29	52	29	53
Baseline primary-school student outcome means				
Proportion of students consuming two breakfasts over 2 d	0·80		0·79	
Number of healthy food items consumed at breakfast	2·3		2·3	
Number of unhealthy food items consumed at breakfast	0·3		0·3	
Cognitive performance – episodic memory	5·8		5·8	
Baseline secondary student outcome means				
Attitudes towards eating breakfast	35·9		35·8	
Rest of day – number of healthy food items consumed yesterday	0·8		0·8	
Rest of day – number of unhealthy food items consumed yesterday	1·3		1·3	
SDQ – hyperactivity/inattention	3·1		3·3	
Proportion of students eating breakfast at home 5 d in a week	0·9		0·9	
Proportion of students eating breakfast in school at least 2 d in a week	0·04		0·03	

LEA, local education authority; SDQ, strengths and difficulties questionnaire.

Table 2 Intervention effects for student measures from school-level weighted regression analyses

Variables	Effect estimate	95 % CI
Primary outcomes		
Proportion of students consuming two breakfasts over 2 d	0·01	−0·02, 0·03
Number of healthy food items consumed at breakfast	0·23**	0·09, 0·37
Number of unhealthy food items consumed at breakfast	0·01	−0·04, 0·06
Cognitive performance – episodic memory (107 schools)	0·11	−0·13, 0·36
Secondary outcomes		
Average attitudes towards eating breakfast	0·74*	0·05, 1·43
Rest of day – number of healthy food items consumed yesterday	−0·10	−0·22, 0·01
Rest of day – number of unhealthy food items consumed yesterday	−0·07	−0·17, 0·03
SDQ – hyperactivity/inattention (ninety-three schools)	0·18	−0·30, 0·65
Proportion of students eating breakfast at home 5 d in a week	−0·15**	−0·21, −0·10
Proportion of students eating breakfast in school at least 2 d in a week	0·19**	0·12, 0·26

SDQ, strengths and difficulties questionnaire.
*$P < 0·05$, **$P < 0·01$.

effectively. Achieving higher levels of student uptake and greater reach among breakfast skippers will require increased engagement by the scheme with those families and students who are most in need.

Although not impacting on the rest-of-day diet or unhealthy items consumed at breakfast, the PSFBI also improved the quality of children's breakfasts by increasing the consumption of food items such as fruit, and

while the type of bread could not be measured given the inability of children to reliably recall intake at this level of detail, only wholemeal bread was served within PSFBI, very likely improving the intakes of healthier forms of bread. It was also effective in promoting positive attitudes to breakfasts, which may represent important mediating targets for dietary interventions[15]. In this respect, it again reflects findings from the USA, where students participating in the intervention were more likely to consume a nutritionally substantive breakfast, although intake over the course of the day was essentially the same[31]. Given the high levels of implementer support for the initiative[38], the PSFBI therefore has the potential to support a range of policy initiatives[52–53] that address healthy eating. Indeed, given that many of the intrinsic rewards and habitual behaviours associated with food consumption develop at this age[19–23], it may represent an effective approach for addressing population dietary behaviour in the long term. Given the increasing recognition of the role of the obesogenic environment[3] on dietary behaviours, however, this is only likely to be effective within an ecological approach that works to support and maintain healthy dietary habits at multiple levels and throughout the early life course.

Acknowledgements

The present study was an independent evaluation funded by the Welsh Assembly Government. Janine Hale, Ruth Conway and Chris Roberts of the Welsh Assembly Government provided support and assistance in facilitating the evaluation design within the policy roll-out. The authors declare that there are no competing interests. S.M., L.M. and K.T. led the design of the trial. S.M. managed the overall conduct of the study with the support of G.F.M. and R.L., L.M. oversaw the statistical analysis, which was conducted by C.D., R.L. and S.M. designed and undertook the process evaluation. All authors contributed to re-drafts of the present paper. S.M. acts as guarantor. The authors thank Rowan Brockman, Emily Harrop, Deborah Lancastle, Claire Pimm, Emily Warren, Iolo Madoc-Jones and Julian Buchanon for help with data collection, Zoe Macdonald, Hannah Lynch, Lorelei Simon, Fiona West and Andrew Rodgers for administrative assistance, Andy Smith for advice and support on cognitive tests and Odette Parry for contributions to project management and data collection. The authors also thank members of our advisory group, and gratefully acknowledge the cooperation of all school staff, students and parents for participating in the present study.

References

1. Smithers G, Gregory J, Bates C *et al.* (2000) The National Diet and Nutrition Survey: young people aged 4–18 years. *Nutr Bull* **25**, 105–111.
2. McCann D, Barrett A, Cooper A *et al.* (2007) Food additives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: a randomised, double-blinded, placebo-controlled trial. *Lancet* **370**, 1560–1567.
3. Foresight (2007) *Tackling Obesity: Future Choices*. London: Government Office for Science.
4. Balding J (2001) Food choices and weight control. In *Young People in 2000*, pp. 1–12 [J Balding, editor]. Exeter: Schools Health Education Unit.
5. Berkey CS, Rockett HRH, Gillman MW *et al.* (2003) Longitudinal study of skipping breakfast and weight change in adolescents. *Int J Obes* **27**, 1258–1266.
6. Bruno-Ambrosius K, Swanholm G & Twetman S (2005) Eating habits, smoking and tooth brushing in relation to dental caries: a 3-year study in Swedish female teenagers. *Int J Paediatr Dent* **15**, 190–196.
7. Fujiwara T (2003) Skipping breakfast is associated with dysmenorrhea in young women in Japan. *Int J Food Sci Nutr* **54**, 505–509.
8. Nicklas TA, Bao W, Webber LS *et al.* (1993) Breakfast consumption affects adequacy of total daily intake in children. *J Am Diet Assoc* **93**, 886–889.
9. Sjoberg A, Hallberg L, Hoglund D *et al.* (2003) Meal pattern, food choice, nutrient intake and lifestyle factors in The Goteborg Adolescence Study. *Eur J Clin Nutr* **57**, 1569–1578.
10. Pollitt E (1995) Does breakfast make a difference in school? *J Am Diet Assoc* **95**, 1134–1139.
11. Pollitt E, Gersovitz M & Gargiulo M (1978) Educational benefits of the United States school feeding program: a critical review of the literature. *Am J Public Health* **68**, 477–481.
12. Rampersaud GC, Pereira MA, Girard BL *et al.* (2005) Review – breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *J Am Diet Assoc* **105**, 743–760.
13. Elgar FJ, Roberts C, Moore L *et al.* (2005) Sedentary behaviour, physical activity and weight problems in adolescents in Wales. *Public Health* **119**, 518–524.
14. Keski-Rahkonen A, Kaprio J, Rissanen A *et al.* (2003) Breakfast skipping and health-compromising behaviors in adolescents and adults. *Eur J Clin Nutr* **57**, 842–853.
15. Moore GF, Tapper K, Murphy S *et al.* (2007) Associations between deprivation, attitudes towards eating breakfast and breakfast eating behaviours in 9–11 year olds. *Public Health Nutr* **10**, 582–589.
16. O'Dea JA & Caputi P (2001) Association between socioeconomic status, weight, age and gender, and the body image and weight control practices of 6 to 19-year-old children and adolescents. *Health Educ Res* **16**, 521–532.
17. James J, Thomas P, Cavan D *et al.* (2004) Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomised controlled trial. *BMJ* **328**, 1237.
18. Moore L, Tapper K, Dennehy A *et al.* (2005) Development and testing of a computerised 24-h recall questionnaire measuring fruit and snack consumption among 9–11 year olds. *Eur J Clin Nutr* **59**, 809–816.
19. Mikkila V, Rasanen L, Raitakari OT *et al.* (2004) Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The Cardiovascular Risk in Young Finns Study. *Eur J Clin Nutr* **58**, 1038–1045.
20. Birch LL & Marlin DW (1982) I don't like it; I never tried it: effects of exposure on 2-year-old children's food preferences. *Appetite* **3**, 353–360.
21. Birch LL, McPhee L, Shoba BC *et al.* (1987) What kind of exposure reduces children's food neophobia? Looking vs tasting. *Appetite* **9**, 171–178.
22. Sullivan SA & Birch LL (1990) Pass the sugar, pass the salt – experience dictates preference. *Dev Psychol* **26**, 546–551.

23. Wardle J, Herrera ML, Cooke L *et al.* (2003) Modifying children's food preferences: the effects of exposure and reward on acceptance of an unfamiliar vegetable. *Eur J Clin Nutr* **57**, 341–348.
24. Bellisle F (2004) Effects of diet on behaviour and cognition in children. *Br J Nutr* **92**, S227–S223.
25. Shemilt I, O'Brien M, Thoburn J *et al.* (2003) School breakfast clubs, children and family support. *Child Soc* **17**, 111–112.
26. Friedman BJ & Hurd-Crixell SL (1999) Nutrient intake of children eating school breakfast. *J Am Diet Assoc* **99**, 219–221.
27. US Department of Agriculture (2007) *The School Breakfast Programme*. Alexandria, VA: US Department of Agriculture.
28. Fox MK, Hamilton W & Lin BH (2004) *Food Assistance and Nutrition Research Report* no. FANRR19-3. Washington, DC: USDA, Economic Research Service.
29. Murphy J (2007) Breakfast and learning: an updated review. *Curr Nutr Food Sci* **3**, 3–36.
30. Bernstein LS, McLaughlin JE, Crepinsek MK *et al.* (2004) *Evaluation of the School Breakfast Program Pilot Project: Final Report. Nutrition Assistance Program Report Series Report* no. CN-04-SBP. Alexandria, VA: The Office of Analysis, Nutrition, and Evaluation.
31. Crensek M, Singh A, Bernstein L *et al.* (2006) Dietary effects of universal free school breakfasts: findings from the evaluation of the school breakfast program pilot project. *J Am Diet Assoc* **106**, 1796–1803.
32. Belderson P, Brandon M, Camina M *et al.* (2001) *A National Evaluation of School Breakfast Clubs. Final Report.* Norwich: University of East Anglia.
33. Bro RT, Shank L, Williams R *et al.* (1994) The effects of an in-class breakfast program on attendance and on-task behaviour of high school students. *Child Fam Behav Ther* **16**, 1–8.
34. Murphy JM, Pagano ME, Nachmani J *et al.* (1998) The relationship of school breakfast to psychosocial and academic functioning. *Arch Pediatr Adolesc Med* **152**, 899–907.
35. Shemilt I, Harvey I, Shepstone L *et al.* (2004) A national evaluation of school breakfast clubs: evidence from a cluster randomized controlled trial and an observational analysis. *Child Care Health Dev* **30**, 413–427.
36. Ani C & Grantham-McGregor S (1999) The effects of breakfast on children's educational performance, attendance and classroom behaviour. In *Fit for School: How Breakfast Clubs Meet Health Education and Childcare Needs*, pp. 11–17 [N Donovan and C Street, editors]. London: New Policy Institute.
37. Roberts J & Murphy S (2005) *A Study of the Preliminary Phase of the Welsh Assembly Government 'Primary School Free Breakfast Initiative'*. Cardiff: Welsh Assembly Government.
38. Lynch R & Murphy S (2007) *A Process Evaluation of the Welsh Assembly Government's Primary School Free Breakfast Initiative*. Cardiff: Welsh Assembly Government.
39. Moore L, Moore GF, Tapper K *et al.* (2007) Free breakfasts in schools: design and conduct of a cluster randomised controlled trial of the primary school free breakfast initiative in Wales (ISRCTN18336527). *BMC Public Health* **7**, 258–270.
40. Smith AP, Kendrick AM & Maben AL (1993) Effects of breakfast and caffeine on performance and mood in the late morning and after lunch. *Neuropsychobiology* **26**, 198–204.
41. Benton D & Sargent J (1992) Breakfast, blood-glucose and memory. *Biol Psychol* **33**, 207–210.
42. Moore GF, Tapper K, Murphy S *et al.* (2007) Validation of a self-completion measure of breakfast foods, snacks and fruits and vegetables consumed by 9–11 year old school-children. *Eur J Clin Nutr* **61**, 420–430.
43. Tapper K, Murphy S, Lynch R *et al.* (2007) Development of a scale to measure 9–11 year olds' attitudes towards breakfast. *Eur J Clin Nutr* **62**, 511–518.
44. Goodman RPD (2001) Psychometric properties of the strengths and difficulties questionnaire. *J Am Acad Child Adolesc Psychiatry* **40**, 1337–1345.
45. Benton D & Jarvis M (2007) The role of breakfast and a mid-morning snack on the ability of children to concentrate at school. *Physiol Behav* **90**, 382–385.
46. Donner A & Klar N (2000) *Design and Analysis of Cluster Randomised Controlled Trials in Health Research*. London: Arnold.
47. Jowell R (2003) *Trying it Out: The Role of 'Pilots' in Policy-Making: Report of a Review of Government Pilots*. London: Strategy Unit.
48. Creegan C & Hedges S (2007) *Towards a Policy Evaluation Service: Developing Infrastructure to Support the Use of Experimental and Quasi-Experimental Methods*. London: Ministry of Justice.
49. Campbell M, Fitzpatrick R, Haines A *et al.* (2000) Framework for design and evaluation of complex interventions to improve health. *BMJ* **321**, 695–696.
50. Pawson R & Tilley N (1997) *Realistic Evaluation*. London: Sage Publications.
51. Grantham McGregor S (2005) Can the provision of breakfast benefit school performance? *Food Nutr Bull* **26**, 144–158.
52. Department of Health (2005) *Choosing a Better Diet: A Food and Health Action Plan*. London: Department of Health.
53. Welsh Assembly Government (2006) *Appetite for Life*. Cardiff: Welsh Assembly Government.