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108,9

706

Food hygiene knowledge and self-reported behaviours of UK school children (4-14 years)

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Abstract

Purpose – The purpose of this research is to show the evaluation of food hygiene knowledge and self-reported behaviours of school children, assessment of children's attitudes towards food hygiene and evaluation of barriers to the adoption of appropriate food hygiene behaviours.

Design/methodology/approach – The food hygiene knowledge and self-reported behaviours of pupils (4 and 14 years; Key Stages 1-3 in the English system – or Scottish equivalent) were determined using age-appropriate knowledge quizzes completed by 2,259 pupils across England, Scotland, Northern Ireland and Wales. Attitudes towards food hygiene and barriers to performing desirable hygiene-related behaviours were established through semi-structured interviews with 82 pupils who completed knowledge tasks in South East England.

Findings – Children generally had good knowledge of food hygiene. However, there were misconceptions about the nature of micro-organisms and how they affect food. In addition, a lack of reminders and practical food activities, especially at Key Stage 2 (7-11 years), coupled with poor hand-washing facilities, meant that children did not always adopt desirable behaviours. Children gave suggestions for ways to help others to remember good practice.

Originality/value – The study identified areas of weakness in pupils' hygiene knowledge and understanding and has determined barriers to adoption of desirable behaviours at all times. It has also suggested ways in which food hygiene education could be made more engaging for pupils, and other methods to encourage good practice.

Keywords Education, Food safety, Children (age groups), Behaviour

Paper type Research paper

Introduction

Cases of food poisoning increased steadily through the 1980's and 1990's, with reported incidences representing only a small proportion of actual cases (Wheeler *et al.*, 1999). In the UK total notifications peaked in 1998, at 93,932 cases, but have since dropped. In 2004 total notifications had dropped to 70,311 cases (HPA, 2006). The Food Standards Agency has committed itself to reducing the number of cases of food poisoning by 20 per cent by 2006. It has identified two major strategies to achieve this – one aimed at

This project was undertaken as part of study B20002, Getting Food Safety and Food Hygiene Messages into Schools, funded by the Food Standards Agency.

the foodservice sector, and the other targeted at consumers and domestic food preparation practices (FSA, 2006).

Studies have suggested that 50-80 per cent of foodborne *Salmonella* and *Campylobacter* infections occur in the home (Bloomfield, 2001; Scott, 2001). A variety of poor food hygiene practices have been observed when consumers prepare food in the home (Worsfold and Griffith, 1996, 1997), with 95.4 per cent failing to implement one or more basic food hygiene practices as a result of inadequate knowledge or failing to carry out known food safety procedures (Griffith *et al.*, 1998). It has been suggested that 99 per cent of cooks make at least one major food hygiene error when preparing food in a domestic kitchen (Daniels, 1998), and that a significant proportion of the public frequently implement unsafe food-handling practices (Redmond and Griffith, 2003). Others have suggested that complacency is an issue, with many people not believing that food hygiene is a problem (Bloomfield, 2001), or believing that there is little risk associated with the food that they have prepared (Griffith and Redmond, 2001; Haaple and Probart, 2004). It is thought that a significant number of infections could be prevented if the public could be engaged to improve hygiene practices in the home (Bloomfield, 2001).

Schools are acknowledged as important places for developing health promotion and influencing health-related behaviours (Sidebottom, 1995; Moon *et al.*, 1999; Haaple and Probart, 2004), including hygiene-related behaviours. School-based education should, in theory, reach all members of society. Input at this stage may intervene before poor habits are established, by providing direction as behaviours are learned for the first time, as well as providing an environment where young people can influence and be influenced by peers (Moon *et al.*, 1999; Curtis, 2001; Wills *et al.*, 2005). Wills *et al.* (2005) noted the importance of intervening early as behaviours are more easily changed at a young age (Patnoad and Pivarnik, 2000). Jonker *et al.* (1997) pointed to health concepts being formed in preadolescence, and thus the importance of incorporating health education in schools for 5 to 11 year olds. Once habits are established in adolescence they tend to be long lasting and difficult to alter in adulthood (Wills *et al.*, 2005). Pinfold (1999) found that non-compliance with a hygiene intervention amongst adults was associated with difficulty of changing habits.

Children educated in an effective way whilst at school may become adults who observe good hygiene practices. Children might also act as facilitators of good hygiene practices in the home through messages conveyed to family members (Pinfold, 1999), with young children being more willing to share knowledge with caregivers (Patnoad and Pivarnik, 2000). The school environment is also, in principle, an excellent one as it allows reinforcement of the hygiene messages through the years of compulsory education. Food safety is, however, not a specific requirement of the English (and Welsh) national curriculum and teachers report pressure on time owing to the number of subjects taught (Ridgewell, 1992; Griffith and Redmond, 2001; Jamison, 2001) and fragmentation of the subject leading to a lowering of its status (Sidebottom, 1995). Teachers' knowledge of food hygiene may also be no better than that of the general public (Griffith and Redmond, 2001). A study by OFSTED (2004) found that the most effective practice in teaching of food and nutrition in schools was associated with, amongst other things, the knowledge of the teachers. Ridgewell (1992) also pointed to inadequate food preparation facilities in primary schools. Linked to this is the apparent disappearance of cooking skills from the English national curriculum (replaced by Design and Technology) and also a lack of

cooking in the home, linked to a greater reliance on prepared foods (Caraher *et al.*, 2004). Thus opportunities to model good practices have diminished in two key environments.

Providing knowledge, however, does not necessarily result in behaviour change (Mederos *et al.*, 2001; Haaple and Probart, 2004) with many hygiene education programmes failing to deliver anticipated changes (Pinfold, 1999). For instance, Griffith and Redmond (2001) found that 47 per cent of consumers reported that they implemented hand-washing, but on observation, none did. Thus it is also important to determine the barriers to carrying out good hygiene practice. This study aimed to evaluate the food hygiene knowledge and self-reported behaviours of school children of different ages and to determine children's attitudes towards food hygiene and barriers to the adoption of appropriate food hygiene behaviours.

Method

The food hygiene knowledge and self-reported behaviours of pupils between the ages of 4 and 14 years (Key Stages 1-3 in the English and Welsh system - or Scottish/Northern Ireland equivalent) were determined using age-appropriate knowledge quizzes. Attitudes and barriers were established through semi-structured interviews with a sub-sample of those completing knowledge tasks.

Age-appropriate quizzes were designed with teachers to assess the pupils' knowledge and hygiene-related practices in relation to the expected learning outcomes at each Key Stage and to the Food Standards Agency (FSA) 4C's (cleanliness, cooking, chilling, and cross-contamination). Four quizzes were designed in total, one for 4-7 year olds (Key Stage 1), two quizzes for 7-11 year olds (Key Stage 2), Quiz A for the younger children, and Quiz B for the older children in this age group and one for 11-14 year olds (Key Stage 3). These Key Stages cover the years of compulsory education in the United Kingdom, before Key Stage 3 pupils select subjects for public examinations.

The quiz for the youngest age group did not rely on literacy or writing skills amongst the children, relying on pictorial and colouring exercises, and verbally conveyed instruction where necessary. Food hygiene booklets containing four activities were developed and piloted:

- (1) Activity 1 assessed knowledge of hand-washing occasions. The children indicated which of twelve children pictured engaged in various activities needed to wash hands by putting a sticker on that picture.
- (2) Activity 2 covered cleanliness when working with food. The children ticked boxes to identify pictures of good practice.
- (3) Activity 3 assessed knowledge of storing and washing food. The children indicated where six different pictured foods should be stored by drawing a line from each food to one of three pictured storage areas. They were then asked to colour pictures of foods that they thought must be washed before eating.
- (4) Activity 4 was used to establish when, of six occasions, the children remembered to wash hands. The children indicated the frequency of hand-washing behaviour by selecting "always" "sometimes" or "never". They were then asked to draw a quick picture of the person who usually tells them to wash hands.

The quiz topics included for children between the ages of 7 and 11 years included; cleanliness – including personal hygiene and kitchen cleanliness; cooking; chilling; and

micro-organisms and food poisoning. Quiz A consisted of twelve multiple choice knowledge questions, each with four possible answers. Quiz B included fourteen multiple choice knowledge questions, each with five possible answers. The additional questions on Quiz B reflected the learning outcomes related to micro-organisms at Key Stage 2 (or Scottish equivalent) and a greater level of literacy amongst this slightly older group. The answers included a “do not know” option to discourage guessing. Both quizzes included ten statements relating to self-reported behaviour (e.g. I wash my hands before I prepare food at school), each with three possible answers (“always”, “sometimes” and “never”, and five questions about the sources of food hygiene knowledge (e.g. teachers at school), each with three possible answers. Similar topics were covered in the quiz for the 11-14 year age group, with the addition of questions relating to cross contamination. The format of the quiz was the same as that for Key Stage 2 pupils.

All quizzes were piloted with children of an appropriate age in school settings with teacher input, and a number of changes made, particularly to the activities for the youngest age group.

Schools were sampled to include schools serving populations with different socio-economic characteristics (based on uptake of free school meals), schools from areas with different ethnic mixes, schools of different sizes and schools with different levels of academic achievement. The English element of the study was located in the South-East of England for practical reasons, and because the curriculum is the same across England, thus knowledge conveyed should be the same. All schools were offered £100 of book vouchers to participate in the research. The achieved sample of schools had different characteristics, including the number of children registered, uptake of free school meals, attainment and percentages of children from ethnic minority groups, reflecting the range of school characteristics across the United Kingdom. Parental consent was sought to enable children to take part in the quiz and interview. Where a whole class completed the quiz, only quizzes from those pupils who had returned a consent form were included in the data set.

Two researchers visited each of the 29 schools participating in the research in the South East of England, to complete the food hygiene booklets with the children and conduct in-depth interviews. The same food hygiene booklets were administered by teachers in Wales, Northern Ireland and Scotland. These teachers were fully briefed in the administration of the materials. For 4-7 year olds, researchers worked with groups of approximately five children. Classroom assistants and English as an Additional Language (EAL) support teachers helped the children to complete the activities. Quizzes for older children were conducted on a whole class basis. No time constraints were imposed on the children undertaking the quizzes. Table I shows the number of children completing knowledge and behaviour quizzes/activities in each region.

	4-7 years (KS1)	7-11 years (KS2)	11-14 years (KS3)	Total
England	428	403	410	1,241
Wales	74	131	80	285
Northern Ireland	118	144	88	350
Scotland	112	149	122	383
Total	732	827	700	2,259

Table I.
Number of children
completing knowledge
and behaviour
quizzes/activities

Two children from each school in the South East of England, who had returned consent forms, were randomly selected for in-depth interview. Thirty children aged between 5 and 7 years, 28 children between 7 and 11 years and 24 pupils between 11 and 14 years, took part in semi-structured face-to-face interviews after completing the food hygiene quizzes. These children provided insights into the barriers preventing adoption of desired food hygiene-related behaviours. The interview checklist was developed to assess attitudes to food hygiene by questioning them on the importance of food hygiene and to see if children understood the reasons for following desirable practices. It also examined barriers to them always conducting desirable hygiene-related behaviours and gained suggestions on the approaches that could be used to help others to follow good practice. The interview checklist was adapted for each interviewee, based on responses to the quizzes, and the reasons for not adopting desired behaviours probed. The children were interviewed in pairs, as pilot work had indicated that pupils were more at ease in this situation. When possible, a male and female were selected to reflect possible gender differences. Two researchers were present at each interview with one asking the questions whilst the other took notes. Each interview lasted for approximately half an hour.

Responses to the quizzes were categorised as right or wrong to establish the extent of knowledge amongst the children, and areas of misunderstanding. For Key Stages 2 and 3, responses were grouped against broad subject areas to determine scores for different broad topics. Frequencies were determined, using SPSS version 12. Comparisons between regions were made using Chi-square tests. Qualitative data were analysed in relation to key themes including attitudes to food hygiene and barriers to the adoption of good practice with the assistance of Nvivo, a qualitative data analysis package that assists in identifying themes in the data.

Findings

Key Stage 1 (4-7 years)

Hand-washing. Findings suggested that children aged 4-7 years had a very good knowledge of when hands should be washed; 98 per cent knew that it was important to wash hands after touching an animal and after going to the toilet. Eighty-one per cent of children self-reported “always” washing hands after visiting the toilet. Those interviewed recalled routines and verbal reminders helping them to remember. Concerns about reducing the transfer of germs also appeared to influence behaviour. Those (18 per cent) who did not “always” wash hands following a visit to the toilet simply forgot or had other things on their minds.

Hand-washing before touching food. Knowledge of food-related hand-washing was also good with 97 per cent correctly identifying “before eating lunch” and “before making a sandwich” as key hand-washing occasions. Ninety-six percent of pupils knew that hands should be washed before touching (any) food and 64 per cent self-reported “always” washing hands before eating lunch. The children interviewed recalled how seeing dirty hands and receiving hand-washing reminders from people at home helped them to remember. Children were most often reminded to wash hands by a parent (69 per cent) or other member of the family (8 per cent). Reminders were also received from teachers (13 per cent). Lack of time and forgetfulness were the reasons given for not washing hands prior to touching food.

Storing and washing food. The children's knowledge of food storage and washing of foods was also assessed. The foods requiring dry storage, cornflakes and crisps, were recognised by the majority of the children (96 per cent and 93 per cent respectively). There was more ambiguity concerning the foods needing cold storage (chicken, milk and ice cream) but it is possible that some children struggled to differentiate between the picture of the refrigerator and the freezer. Most of the children interviewed were able to explain the reasons for chilling perishable food. The children recognised raw foods requiring washing including apple (94 per cent), strawberry (94 per cent), tomato (87 per cent). Those interviewed understood that these foods could be dirty or contaminated with micro-organisms.

Working with food. The majority of the children are aware of the need for good practice when preparing food. Working on a clean table was recognised by 95 per cent of the children. Equally high numbers knew that sneezing on food (95 per cent) and touching one's nose (96 per cent) was not the right thing to do. Almost all (99 per cent) of the children completing food hygiene booklets knew that people making a sandwich should have clean hands. Those interviewed demonstrated a good knowledge of the problems associated with micro-organisms. They could identify sources of germs such as the nose and hands and some understood that poor practices can lead to illness.

Ideas about helping others to remember food hygiene. The children suggested ideas about what could help others to remember good food hygiene practice. It was felt that other children would benefit from hand-washing reminders and having the reasons for the importance of hand-washing explained. Many would like to see posters and pictures relating to food hygiene in school. Others cited videos, advertisements on television, and appealing hand-washing facilities such as nice soap.

Key Stage 2 (7-11 years)

Some differences emerged between the regions at Key Stage 2. Pupils in Northern Ireland appeared to have a better knowledge of food, but this was not always translated into self-reported implementation of desirable behaviours.

Results generally showed good knowledge in relation to cleaning, cooking and chilling, with knowledge scores in excess 67 per cent (Table II). Knowledge of micro-organisms and food poisoning was less strong.

Hand-washing. The majority of pupils in both Group A (7-9 years) and Group B (10-11 years) correctly identified when it was most important to wash hands (96 per cent and 98 per cent respectively), namely before touching food. When asked about the

Topic	Maximum score attainable		Average score $\pm$ sem* (%)	
	A	B	A	B
Cleaning	6	5	5.2 $\pm$ 0.05 (87)	4.2 $\pm$ 0.04 (85)
Cooking	2	3	1.7 $\pm$ 0.03 (83)	2.0 $\pm$ 0.04 (67)
Chilling	2	2	1.5 $\pm$ 0.03 (73)	1.7 $\pm$ 0.03 (83)
Micro-organisms and food poisoning	2	4	1.2 $\pm$ 0.03 (58)	1.9 $\pm$ 0.5 (48)
Food hygiene quiz	12	14	9.5 $\pm$ 0.10 (79)	9.8 $\pm$ 0.10 (70)

Note: *sem – standard error of mean

Table II.
Hygiene knowledge
scores of 7-11 year old
school children in
England, Scotland,
Northern Ireland and
Wales ($n = 827$)

frequency of washing hands after going to the toilet, 67 per cent of Group A and 72 per cent of Group B responded with “always”. A similar number of children in both age groups (29 per cent of A and 26 per cent of B) responded “sometimes”. Over half ($n = 16$) of those interviewed who reported “always” washing hands after visiting the toilet described hand-washing as part of a well-established toilet routine. Seeing hand-washing reminders such as posters and remembering knowledge of micro-organisms helped others to remember. The children who “sometimes” did not wash hands after visiting the toilet either forgot or did not think it was important on all occasions.

Hand-washing at home and school. Differences emerged between the frequency of hand-washing at home and at school for both Group A and Group B. At home 79 per cent of the children in Group A (7-9 years) reported “always” washing hands before preparing food; however, 67 per cent reported “always” washing hands before preparing food at school. For the 10-11 year old children in Group B, 74 per cent reported “always” washing hands before preparing food at home; this is reduced to 63 per cent “always” washing hands before preparing food at school. Interviews indicated that preparing food with people at home provided opportunities for the children to talk about food hygiene with adults. Helpful reminders and routines could explain why so many children reported frequent hand-washing before food preparation at home. Two-thirds of the children interviewed reported “always” washing hands before touching food at school. They washed hands before working with food at school because the class teacher insisted on it. Six of the children reporting to “sometimes” or “never” wash hands prior to food preparation described only working with food at school occasionally.

Hand-washing before lunch. For those in Group A (7-9 years), 52 per cent reported “always” washing hands before eating lunch at home, with a further 31 per cent “sometimes” washing hands. At school 44 per cent of Group A reported “always” washing hands before lunch, with 32 per cent “sometimes” washing hands and 19 per cent “never” washing hands. In Group B (10-11 years), 47 per cent of the pupils claimed to “always” wash hands before eating lunch at home and 38 per cent “sometimes” doing it. At school this is reduced to 28 per cent “always” washing hands and 52 per cent “sometimes”. Eighteen per cent of this group claim to “never” wash hands before eating lunch at school. Interviews indicated that hand-washing at home was easier for some children because they had reminders from adults, access to better facilities, and more opportunities to wash hands. Dirty or missing soap, difficulties operating taps, and ineffective hand drying facilities also discouraged some children from washing hands at school.

Kitchen cleanliness. Ninety-one per cent of the 7-9 year old pupils (Group A) knew that cats should not be on kitchen surfaces because of the risk of transfer of micro-organisms onto food. In the 10-11 year old group (Group B) 83 per cent correctly chose to clean a chopping board with hot water and disinfectant after it had been licked by a cat. Both groups were questioned about the correct procedure for surface cleaning. Cleaning the table with hot water and disinfectant was chosen by 68 per cent of the pupils in Group A and by 83 per cent of pupils in Group B. Wiping the table with a towel was the choice of 24 per cent and 16 per cent of pupils in Groups A and B respectively. Forty-nine per cent of those in Group A reported that they would “always” clean the work surface before preparing food at school, with 22 per cent

“sometimes” doing it and 22 per cent “never” doing it. Similar results were seen in Group B with 46 per cent reporting “always” cleaning the work surface, 29 per cent “sometimes” cleaning it and 21 per cent “never” cleaning it. Those interviewed that reported to “always” clean work surfaces understood the importance of surface cleaning. Others, who occasionally cleaned work surfaces, recalled cleaning them if the class had been painting and the tables appeared dirty. In some schools the adults helping with food preparation always cleaned the work surfaces for the children.

Cooking and chilling. Sneezing on food was identified as an inappropriate behaviour by 88 per cent of pupils in Group A (7-9 years). In Group B (10-11 years) 94 per cent knew that touching the mouth when cooking is poor practice. Twenty-five of the children interviewed reported never coughing or sneezing on food because it is unhygienic and might make another person ill. Most of these children reported “never” licking fingers when preparing food, understanding the possibility of transferring micro-organisms was the reason for this behaviour. The need to store cheese in a fridge was recognised by 93 per cent of the pupils in Group A and 96 per cent of those in Group B. When asked the most important reason for storing milk in the fridge 53 per cent of Group A answered that it would go sour, with 41 per cent deciding that it tastes better cool. Asked the same question 68 per cent of Group B chose that it will go sour and 25 per cent that it tastes better cool.

Micro-organisms and food poisoning. When the 7-9 year old group (Group A) were asked what germs require to grow, 45 per cent correctly identified food, with 26 per cent choosing slime. The response from the 10-11 year old group (Group B) to the same question was very similar; 49 per cent correctly identifying food and 19 per cent choosing slime. When further asked what was needed to see germs on a sandwich 72 per cent of Group A correctly identified the need for a microscope, as did 84 per cent of the pupils in Group B. Just 20 per cent of Group B correctly chose agar when asked to identify the non micro-organism from a list. Only 39 per cent of children knew it is not possible to tell if food is contaminated with germs. Food “looking dirty” was the choice for 23 per cent and “smelling bad” was chosen by 19 per cent with a further 11 per cent expecting it to “taste nasty”.

Learning about food hygiene at home and school. The children were asked about sources of food hygiene knowledge. Eight of those interviewed felt they had learned a lot about food hygiene from adults at home. Another seven children explained how opportunities to learn about food hygiene occurred when they prepared food with family members. Most reported learning more in-depth information about food hygiene at school. Other sources of food hygiene knowledge included reports of food poisoning in the news, programmes such as *Ready Steady Cook*; and *Blue Peter*, the Discovery Channel, and reading books from the library.

Ideas about what might help others to remember food hygiene. All of the children interviewed felt food hygiene is important and most understood the link between micro-organisms and health. The children had lots of ideas about what might help others to remember and follow good food hygiene practice. These included activities designed to help children have fun learning about food hygiene. Watching videos, listening to visiting speakers, and working with food were also perceived as good ways of learning about food hygiene. The children believed interesting posters, perhaps made by the children and displayed in school, could help to remind children of good

practice. Improved hand-washing facilities in school could help to encourage good hand-washing practice.

Key Stage 3 (11-14 years)

Pupils generally had very good knowledge of food hygiene topics, with an overall score of 69 per cent (Table III). Areas of weakness, however, related to cooking and micro-organisms and food poisoning. The specific areas of weakness are discussed below.

Hand-washing and cleaning. Results showed that 11-14 year olds had an excellent knowledge of cleanliness with most correctly identifying occasions when they should wash hands (Figure 1), and 92 per cent correctly identifying an occasion (before shopping for food) when it is not necessary. The majority (88 per cent) reported “always” washing hands after visiting the toilet. Twenty-two of those interviewed reported to “always” wash hands, most indicating that they did so out of habit. These pupils understood that there might be harmful bacteria on hands. Interviews pointed to routines, visual reminders, and knowledge of micro-organisms encouraging good practice. There were differences between hand-washing behaviour prior to preparing food at home and school, with less frequent hand-washing at home due to the lack of routine and reminders. Eighty-four percent of pupils reported “always” washing hands at school, whereas at home 69 per cent reported “always” washing hands. Those interviewed indicated that at school food technology lessons were structured such that they could not start to prepare food unless they had washed hands, with frequent reminders to do so by teachers. By comparison, however, 31 per cent of pupils reported “always” washing hands prior to lunch at home, but only 13 per cent reported “always” doing so at school. Those interviewed indicated that lack of time and poor facilities at school resulted in not washing hands “always”, with some stating that they actively avoided washing hands at school as the facilities were so unpleasant.

Most young people (75 per cent) identified the best method for surface cleaning and 95 per cent knew a work surface must be cleaned after contact with an animal. However, only 55 per cent reported that they would “always” clean a work surface before preparing food. Those interviewed indicated that barriers to the adoption of the desired food hygiene behaviour included misunderstandings regarding the nature of micro-organisms, assumptions about cleanliness at home or assuming that someone else had already cleaned the surface. For instance, some would only think to clean a surface that was visually dirty. Most (90 per cent) never sneezed or coughed on food, and 54 per cent never licked fingers when working with food. Interviews indicated that

Table III.
Hygiene knowledge
scores of 11-14 year old
school children in
England, Scotland,
Northern Ireland and
Wales (*n* = 700)

Topic	Maximum score attainable	Average score $\pm$ sem* (%)
Cleaning	5	4.2 $\pm$ 0.04 (84)
Cooking	3	1.7 $\pm$ 0.04 (57)
Chilling	3	2.2 $\pm$ 0.03 (73)
Cross-contamination	2	1.5 $\pm$ 0.02 (75)
Micro-organisms and food poisoning	4	2.1 $\pm$ 0.04 (53)
Food hygiene quiz	17	11.8 $\pm$ 0.11 (69)

Note: *sem – standard error of mean

Figure 1. Percentage of 11-14 year old school children in England, Scotland, Northern Ireland and Wales correctly responding to the question "When do you NOT need to wash your hands?" ($n = 700$)

young people who understood the implications of poor practice avoided these behaviours.

Temperature control. Fewer young people had a good knowledge of temperature control (especially key temperatures). Cooking food properly to kill bacteria was correctly identified by 63 per cent of pupils; a similar number (69 per cent) knew how to decide when a chicken is thoroughly cooked. Only 33 per cent correctly identified 63-75°C as the correct temperature for hot holding cooked food, 30 per cent did not know. Just 54 per cent knew the correct temperature for a fridge (0-5°C) although chilling as a means of slowing down bacterial growth was identified by 77 per cent.

Cross-contamination, micro-organisms and food poisoning. Knowledge of keeping raw and cooked foods separate to prevent cross-contamination was demonstrated by 93 per cent of pupils. However just 59 per cent knew raw meat should be stored below cooked meat. Knowledge of micro-organisms was more limited. Only 42 per cent of pupils knew that you cannot tell if food is contaminated with food poisoning bacteria (Figure 2).

In common with Key Stage 2 pupils, popular responses reflected a belief that food poisoning bacteria changed the sensory characteristics of foods. Thus 32 per cent believed the food would "smell bad" or "nasty" and 18 per cent that the food would "look mouldy".

Figure 2.
Percentage of 11-14 year
old school children in
England, Scotland,
Northern Ireland and
Wales correctly
responding to the question
“How can you tell when
food is contaminated with
food poisoning bacteria?”
(*n* = 700)

Attitudes and learning about food hygiene. All of the young people thought that food hygiene is important with most citing the prevention of illness as the reason for its importance. Most young people recalled learning about food hygiene at school and some had adults at home who taught them. Others reported acquiring knowledge from television programmes, such as *Ready, Steady Cook*.

Ideas about what might help others to remember food hygiene. Pupils interviewed had lots of ideas about how others could be helped to remember food hygiene. Above all was the need to make the subject exciting and fun. Pupils mentioned more practical activities, including activities illustrating cross-contamination, as they preferred to see and do, rather than read text books. Posters in key places would remind them to wash hands, and also leaflets and visiting speakers (e.g. chefs) were popular. Explaining the link between illness and food hygiene would help and better facilities would encourage more frequent hand-washing.

Discussion

Children generally had good food hygiene knowledge, particularly of appropriate hand-washing occasions. Knowledge of the detail of how to clean and of temperature control was less good. There were also misunderstandings over the nature of micro-organisms. In general, the extent of knowledge increased through the Key Stages, which is to be expected given the requirements of the national curriculum (notably testing

of pupils was based on learning outcomes at the different Key Stages). Extent of understanding of food safety appeared to relate to reports of implemented behaviour, with better understanding of why certain behaviours were desirable linking to those more frequently engaging in desirable behaviours.

Although knowledgeable about personal hygiene, pupils did not always report implementation of desirable behaviours at all times, which concurs with previous research (e.g. Medeiros *et al.*, 2001; Haaple and Probart, 2004). Differences also emerged between reported behaviour at home and at school. At Key Stage 3, reported hygiene-related behaviours were better at school than at home, but the reverse was true for pupils at Key Stage 2. At Key Stage 3 all children engaged in Design and Technology or Food Technology, within which food preparation is an integral part. Thus pupils received more verbal reminders and had the opportunity to observe and engage in good practice. At Key Stage 2 involvement in practical food-related activities is very limited, thus there is little opportunity to model desirable behaviours at school. In addition, the facilities in which these activities take place are often far from ideal. Key Stage 2 pupils thus reported gaining more knowledge from home, and more frequently engaging in desirable behaviours at home. Key Stage 2 currently represents a break in the reinforcement of desirable food hygiene behaviours, owing to limited food preparation opportunities. A limitation relating to behavioural self-reports is honesty of reporting, with a number of authors pointing to reported behaviours being greater than actual behaviours (Griffith and Redmond, 2001; Haaple and Probart, 2004). The researchers, prior to children completing the tasks, emphasised the importance of honesty in responses, and the team are encouraged that not all children reported “always” to behaviours they might recognise as important, but not “always” engage in.

Children recognised the importance of food hygiene, and many could articulate why it was important in relation to human disease, although this did not always translate into desirable behaviours, a result also found by Jamison (2001). Those who better understood such connections were more likely to always engage in good practice, highlighting the importance of understanding as a motivator. Barriers to performing desirable behaviours included lack of reminders, misunderstandings relating to the nature of micro-organisms, not having time, believing someone else had cleaned surfaces and poor facilities. Jamison (2001) found that both primary and secondary school children were generally well-informed, but that they had similar key areas of weakness to children in the current study, notably of key temperatures (Key Stage 3) and believing that food-poisoning bacteria changed the sensory qualities of foods (Key Stages 2 and 3). Pinfold (1999) also found that hand-washing was most commonly practised when hands were thought to be dirty, rather than before or after certain activities. He also found that hand-washing behaviour, although understood and practised sometimes, was not a routine practice.

MacGregor *et al.* (1998) found that children asked about health at schools frequently linked hygiene to perceptions of the school toilets. Vernon *et al.* (2003) also found that 9-11 year old children in Northern England and Sweden sometimes avoided using school toilets as they perceived them to be unpleasant. They found that, in some cases, sinks only had cold water, or had inadequate hand-washing materials such that children were not encouraged to wash hands. Results for the current study also indicated that poor hand-washing facilities were a barrier to frequent hand-washing, with some children actively avoiding the facilities as they perceived them to be unpleasant.

Remembering at Key Stage 3 was assisted by teachers reinforcing hygiene messages when these children engaged in food preparation activities, there seem to be less reminders at home with this age group. Jamison (2001) also found that good practices were reinforced in secondary schools through reminders during practical tasks. At Key Stage 2 occasional food preparation takes place, thus there are few opportunities for pupils to see and engage in good practice. There also appear to be fewer reminders from teachers on other occasions. Children in this age group were expected to take responsibility for hand-washing. This age group may benefit from more food preparation opportunities in school, allowing them to engage in good practice, and reinforcing messages learned at Key Stage 1. Food hygiene does appear in the curriculum for this age group, but within science. Teachers have indicated that the best way to teach this subject is through hands-on activities and results suggest that the lack of such activities in this age group, along with infrequent hand-washing reminders, is mitigating against children performing desirable behaviours on all occasions. More reminders come from home for this age group. At Key Stage 1 established hand-washing routines, facilitated by teachers and support staff, ensure reinforcement of desirable behaviours.

Teachers were an important source of hygiene knowledge, but as Griffith and Redmond (2001) indicated, teachers' knowledge of food hygiene may be no better than that of the general public. Those teaching Key Stage 3 should be better equipped to convey accurate messages as Food Technology teachers are subject specialists, compared with primary school teachers who teach across the curriculum. There are, however, issues with the currency of knowledge. Many pupils reported learning about hygiene at home from parents and sometimes older siblings, a result also found by the Food and Drink Federation (1996) and Caraher *et al.* (2004). Caraher *et al.* (2004) noted that the mother remained the most prominent person passing on cooking skills. Hart *et al.* (2003) noted the importance of parents as health education intermediaries through the behaviours they model and the information that they impart. It has been suggested, however, that parents may not be reliable sources of information (Griffith and Redmond, 2001). In particular, if parents do not recognise personal food-related practices to be risky, behaviour may not model good practice (Patnoad and Pivarnik, 2000). Children also reported gaining knowledge from TV programmes. TV is an important agent of socialization, and could be a valuable medium to convey and demonstrate good hygiene skills, but the hygiene messages projected by TV chefs have been found to be variable (Griffith *et al.*, 1994).

The children pointed to fun, interesting activities to help them learn about food hygiene, and also to more eye-catching visual reminders. Jamison (2001) also found that pupils pointed to permanent reminders in teaching rooms, e.g. posters, and that they felt that they were more likely to remember messages given in practical lessons. Pupils in the current study also suggested more practical activities, as they preferred to learn by doing. OFSTED (2004) also found that effective practice in teaching of food and nutrition in schools was associated with, amongst other things, children being active participants in learning, with opportunities to put what they had learned into practice. Improved hand-washing facilities were also important. In essence, making good hygiene practises easy to achieve. It has previously been found that health-related interventions involving the classroom, and also changes in the environment and family involvement, are likely to be more effective than classroom-based initiatives alone

(Lister-Sharp *et al.*, 1999). Thus, there is scope for widening food hygiene education into the home, for instance, through take-home activities to engage both children and carers.

Conclusions

Children generally had good knowledge of food hygiene. Misconceptions about the nature of micro-organisms and how they affect food, lack of reminders and practical food activities, especially at Key Stage 2, and poor hand-washing facilities, however, mean that children do not always report implementation of desirable behaviours. If children are to be engaged by food hygiene education it needs to be fun and relate to real life, and provide opportunities to practice what is learned. Ensuring that food hygiene knowledge in the population is correct, and that people do not underestimate personal vulnerability to food-borne illness, will require adequate training of teachers and extension of classroom activities into the home. Overcoming misconceptions should be addressed in training of teachers. Food hygiene instruction should start at the outset of compulsory education and be extended and reinforced throughout schooling, such that good habits are established and maintained into adulthood.

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