

## **'Big, strong and healthy': Young children's identification of food and drink that contribute to healthy growth**

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### **Abstract**

Growing awareness of the importance of healthy diet in early childhood makes it important to chart the development of children's understanding of food and drink. This study aimed to document young children's evaluation of food and drink as healthy, and to explore relationships with socioeconomic status, family eating habits, and children's television viewing. Data were gathered from children aged 3 to 5 years ( $n = 172$ ) in diverse socioeconomic settings in Ireland, and from their parents. Results demonstrated that children had very high levels of ability to identify healthy foods as important for growth and health, but considerably less ability to reject unhealthy items, although knowledge of these increased significantly between ages 3 and 5. Awareness of which foods were healthy, and which foods were not, was not related to family socioeconomic status, parent or child home eating habits, or children's television viewing. Results highlighted the importance of examining young children's response patterns, as many of the youngest showed a consistent 'yes bias'; however, after excluding these responses, the significant findings remained. Findings suggest it is important to teach children about less healthy foods in the preschool years.

**Keywords:** Young children; preschool; healthy food; yes bias; parents; television

## Introduction

High rates of childhood obesity (Hedley et al., 2004; IASO, 2012; James, Leach, Kalamara & Shayeghi, 2001), coupled with growing awareness of young children's susceptibility to marketing of unhealthy foods (Borzekowski & Robinson, 2001; Ferguson, Muñoz & Medrano, 2011), have led to increased interest in the development of children's understanding of food and its impact on health. Research findings indicate that there are links between children's food education, food knowledge and their diet (Bannon & Schwartz, 2006; Kandiah & Jones, 2002; Taylor, Evers & McKenna, 2005), indicating the importance of education about food for young children (i.e. those under the age of 6 years), to shape their food attitudes, choices and habits; and this needs to be based in a firm understanding of children's thinking about food (Holub & Musher-Eizenman, 2010; Skouteris, 2012; Slaughter & Ting, 2010). Research therefore needs to investigate children's knowledge of food and health as aspects of their cognitive development; how family, school and community environmental variables influence this developmental process; and how such influences contribute to children's food choices and diet.

Studies have identified important features of children's knowledge of nutrition and health from the primary school years onwards (Slaughter & Ting, 2010), but very little is known regarding children under the age of 6 years, and research into age differences in young children's food knowledge is scant (Holub & Musher-Eizenman, 2010). This gap is a particular concern, as this is a period of rapid development of food knowledge, and food experiences in early childhood are central to later diet and health (Alles-White & Welch, 1985; Aldridge, Dovey & Halford, 2009).

One aspect of young children's food knowledge that is of particular importance to educators and nutritionists is their ability to classify food according to its nutritional content or its consequences for health, as these skills are relevant for educating children about healthy food choices. Very few studies have investigated this topic, however, there is some evidence that abilities develop considerably before children are six years old. For example, Holub and Musher-Eizenman (2010) demonstrated that children as young as 3 years could create 'healthy' and 'unhealthy' meals which were meaningfully different from one another, e.g., the healthy meals, on average, contained significantly less fat and more fruit and vegetables than the unhealthy meals. Nguyen and Murphy (2003) found that children aged 4 years could categorize certain foods as 'junk' at a level that was better than chance. Holub and Musher-Eizenman (2010) found that, compared to younger children, 6 year olds chose

more fruits, vegetables and fewer desserts when creating healthy meals and more desserts and fewer entrees for unhealthy meals.

Research highlights the preschool years as a time of rapid changes in understanding of healthy and unhealthy food and suggests specific gaps in young children's knowledge. For example, Nguyen, Gordon and McCollough (2011) found that 4 year olds had markedly less knowledge that high-fat savoury and sweet foods are not healthy than that vegetables are healthy. Research also points to gaps in young children's understanding of the processes through which food influences health. Slaughter and Ting (2010) found that at 5 years, causal reasoning linking food and health was largely absent; by 8 years, children gave explanations that were linked to naïve biological theories, e.g. energy-giving (vitalistic) or the movement of substances through the body (mechanical). Such findings suggest young children's categorisations and theories of food are flexible and undergo age-related changes consistent with claims that children do not fully understand a food's healthful properties until age 7 or 8, and this has implications for teaching children about food, nutrition and health.

It should be noted that most of this research with young children has been conducted with small, middle-class samples. However, research indicates that poorer eating habits and greater overweight/obesity in children are consistently linked to lower socioeconomic status in Australia, Europe, the USA and elsewhere (Cameron et al, 2012; Craig, McNeill, Macdiarmid, Masson & Holemes, 2010; James et al, 2001; Lamerz et al, 2005; Moschonis et al, 2010; Patrick & Nicklas, 2005). Further research is needed to confirm these findings with children from a wider range of demographic backgrounds in order to allow firmer conclusions to be drawn about features and correlates of young children's food knowledge.

Studies on the sources of young children's food understanding have rarely been conducted, although it is assumed that parents, peers, media and school all introduce children to information about food, eating, nutrition and health (Slaughter & Ting, 2010). Research into how children's eating is shaped is still underdeveloped (Jansen, Daniels & Nicholson, 2012), although researchers argue that parent behaviours have a significant impact, such as modelling of eating behaviours and the food they give their young children (Slusser et al, 2012). Parents' behaviours and eating patterns are likely to be particularly influential in early childhood as children of this age make few independent food choices. Nyberg, Sundblom, Norman and Elinder (2011) have proposed a conceptual model where family socioeconomic status is mediated by parent and classroom factors, to affect

children's food knowledge, attitude and preferences, which in turn influence children's diet.

Another possible environmental influence on young children's food understanding is television advertising (Ferguson et al., 2011). A modest effect of television advertising on children's understanding of healthy and unhealthy foods was identified in a World Health Organisation review (Cairns, Angus & Hastings, 2009), but just two of the experiments reviewed included preschool-aged samples, and these did not find effects. However, these studies were conducted in the USA several decades ago, and researchers have argued that if children view many advertisements for foods that should be consumed infrequently, e.g. those high in sugar and salt, their perception of a normal diet may be distorted (Keller & Schulz, 2010). We believe, therefore, that an investigation into children's understanding of healthy and unhealthy food and drink should include measures of the family food environment (parents' and children's eating) and of children's television viewing.

The present study aims to expand our understanding of young children's knowledge of healthy and unhealthy food and drink, and relationships of this knowledge to environmental factors. Specifically, the study's first aim is to chart the development of understanding of healthy and unhealthy foods in early childhood, because previous studies have produced conflicting findings, and nutrition education needs to build on children's knowledge. Second, the study aims to explore relationships with three environmental factors: (i) the family food environment (operationalised as the child's and parent's scores on a healthy eating scale); (ii) the amount of television watched each week; and (iii) socio-economic status (operationalised as the highest level of maternal education).

When researching with very young children, research methods need to be designed to reflect their abilities (Greene & Hill, 2005). Qualitative research has established that, for young children, comprehension of abstract nutrition concepts such as 'healthy' is challenging (Lytle et al, 1997). We therefore designed an illustrated story to define healthy foods for our very young research participants as foods that 'help to make you big and strong and healthy' a concept frequently used by parents to explain the benefits of healthy food to young children.

## **Method**

### **Participants**

A total of 172 children on the island of Ireland took part (25% from Northern Ireland and 75% from the Republic of Ireland), drawn from 11 preschools and 3 primary schools.

Children were aged 3 to 5 years (36 – 71 months); 31% were 3 years; 47% were 4 years; 22% were 5 years and 48% were boys (see table 1).

Table 1 Age ranges, means, standard deviations and percentages, for each age group

	N		Age (months)	M	SD	males		females	
	%	n				%	n	%	n
Full sample	100	172	36 - 71	52.16	8.55	48	82	52	90
3 years	31	54	36 - 47	42.52	3.00	52	28	48	26
4 years	47	81	48 - 59	53.02	3.63	42	34	58	47
5 years	22	37	60 - 71	64.35	3.35	54	20	46	17

Quota sampling took place in order to achieve a balance of participants from advantaged and disadvantaged communities. Levels of community advantage were identified in Northern Ireland using local government statistics, and in the Republic of Ireland by identifying whether preschools and schools received government supports for disadvantaged communities. Over half of participating children (55%; n = 94) attended preschool/school in disadvantaged communities.

Information about environmental variables (family demographics, family eating habits and children's television viewing) was sourced through a parent questionnaire. After reminders and distribution of second questionnaires, 100 parents returned completed questionnaires, representing 58% of the sample of participating children. This raised the question of whether the children for whom we had data regarding environmental variables differed systematically from those for whom we did not. A series of t-tests and chi-square analyses however identified no significant differences in core study variables, with one exception. Significantly more parents than expected in advantaged communities (68%) returned questionnaires compared to parents in disadvantaged communities (50%);  $\chi^2 5.643$ ,  $df = 1$ ,  $p = .018$ . We therefore examined mothers' reports of their highest level of completed education (a indicator of family socio-economic status) to identify the socio-economic backgrounds of children for whom we had environmental data. Of mothers who returned questionnaires, one-third (32%) had completed secondary (high school) education; nearly a third (29%) had a diploma (post high school qualification, lower than degree level), and just over a third had a university degree (39% bachelor or higher degree). Therefore, in this study, over half of the children participating were drawn from disadvantaged communities, and despite higher parent response rates in advantaged communities, the parent sample is distributed across socio-economic levels.

## Instruments

For this study, a visual, story-based method of assessing children's healthy/unhealthy food and drink understanding was developed. Parents completed measures of family eating habits and child television viewing.

**Healthy Eating Scale** This measure of healthy eating, adapted from Wiecha, Peterson, Ludwig, Kim, Sobol and Gortmaker (2006) and Andreyeva, Kelly and Harris (2011), consisted of seven questions (scored 1-7) about the number of times per week healthy and less healthy foods were eaten. Two questions asked about frequency of eating fruit and vegetables. Five questions asked about frequency of consuming sweets/chocolate; crisps/snacks; sugared cereals; sugared soft drinks; and fast food/takeaways. Parents filled out separate scales for themselves and for their young child. Unhealthy items were reverse-scored and reliability analyses were conducted. Higher scores on the Healthy Eating Scale indicate a healthier eating pattern, i.e. more frequent eating of fruit and vegetables, and less frequent eating of sweet and savoury snacks, sweetened cereals, fast food and sweetened drinks (range = 7-49; Child  $M = 35.80$ ,  $SD = 6.17$ ,  $\alpha = .705$ ; Parent  $M = 37.81$ ,  $SD = 5.94$ ,  $\alpha = .678$ ).

**Television exposure.** This measure, completed by parents, captured the full level of children's active and passive TV exposure on a typical weekday and a typical weekend day, based on a method described by Valkenburg and Buijzen (2005). Parents were asked to indicate (in hours and minutes), the total time their child was "watching alone, with others, and just being in a room when the TV is on". Weekly TV exposure was calculated by multiplying weekday minutes by 5, and weekend minutes by 2, and summing these. Almost all parents (98%) reported their young were exposed to TV. Duration ranged from none to over 6 hours a day (0 – 2700 minutes per week;  $M = 909.07$  minutes,  $SD = 581.38$ ); mean TV exposure was 15 hours and 9 minutes a week, or 2 hours and 9 minutes per day.

**Children's identification of healthy foods** In order to establish a shared definition with young children of the concept of healthy food/drink, a storybook was developed about tiny Mabel Mouse, who longed to grow to be 'big, strong and healthy' so she could run, jump, dance and play with bigger children. The decision to use an animal rather than a human character in the story was based on the widespread use of animal characters in children's stories, literature and media (Burke & Copenhaver, 2004; Cosslet, 2006). Using an anthropomorphised animal as the central character has the benefit of avoiding systematic differences in children's identification with the character based on perceived similarity in age or race. The aim of the story was to define healthy food as promoting positive physical

development, activity and health. The last image of the storybook was an empty plate on a table.

A set of 16 food and drink images was selected (8 healthy, 8 unhealthy); foods were selected from those cited by young UK children as foods they ate (Young, 2000). Foods and drinks were classified as healthy or unhealthy using the UK Department of Health Nutrient Profiling system (Department of Health, 2011). This is used to classify foods as suitable for advertising in UK (including Northern Ireland) and Republic of Ireland children's programming (Broadcasting Authority of Ireland; BAI, 2012a; BAI, 2012b). In order to ensure young children could recognise the food and drink, images were further selected for clarity and visual appeal; checked for suitability with parents of pre-schoolers; and piloted for recognition with children aged 3 and 4 years in both advantaged and disadvantaged communities.

The final eight healthy items were apple, banana, orange, carrots, broccoli, peas, potatoes, and milk; the eight unhealthy items were chicken nuggets, sausages, chips (French fries), crisps (potato chips), cupcakes, ice cream, sweets (candy), and Coca-cola. After consultation with dieticians working on the Irish National Preschool Nutrition Survey for the Irish Universities Nutrition Alliance, it was decided not to ask children whether an item was 'unhealthy', as items are only unhealthy if they are consumed frequently and/or in large quantities. Children were therefore asked if the mouse should have *lots of this* for each food or drink item (see procedure below); if children said *yes* to a healthy item and *no* to an unhealthy item, the answer was correct. Some children said the mouse should eat *just a little bit*; this was scored as correct for unhealthy foods and incorrect for healthy foods. Responses were scored 1 if correct and 0 if incorrect; the total possible score was 16; 8 each for healthy and unhealthy items.

### **Procedure**

After full ethical review, approval for the study was granted by the relevant university ethics committees. An information letter to parents/guardians outlined the nature of the study and the requirement for signed consent forms. Only those children with signed consent were eligible to take part. A pictorial information booklet was designed to inform children about the activities involved in the study; parents and teachers were encouraged to read this with them. Child assent was also sought verbally.

Children were interviewed individually by one of five researchers. All had experience with young children and training was delivered to ensure consistency in data collection.

First, to establish a definition of 'healthy', researchers read children an eight-page illustrated story about Mabel Mouse. This also functioned as an ice-breaker activity. The story was: *Mabel was a teeny tiny little mouse... who loved to watch the children run and play! She loved to see them dance... and jump sooo high!... But Mabel was sad. "I want to run and dance and jump and play with the children", she said, "but how can I? I'm much too tiny. What can I do to grow big and strong and healthy, so I can play with the children?". ...*

When showing the final image, an empty plate on a table, researchers asked the participant, *What food and drink shall we give Mabel to help her grow big and strong and healthy?* They then explained, *You know how there are some foods you should eat lots of, if you want to be big strong and healthy, and some foods you shouldn't eat too much of, if you want to be healthy?* Participants were then shown a picture of each of the 16 food or drink items in random order, and each item was named by the researcher as the picture was presented. The researcher then asked *should the little mouse eat [drink] lots of this, if she wants to be big, strong and healthy – or not?* The task took approximately ten minutes to complete.

## Results

As sampling took place in two jurisdictions, initial analyses (using t-tests and chi-square analyses as appropriate) explored any systematic differences between Northern Ireland and Republic of Ireland participants. There were no significant differences between the jurisdictions in participants' age; gender; advantaged/disadvantaged community; mothers' education levels; home eating habits; television viewing; or responses to healthy/unhealthy items. Data from these groups were therefore combined in subsequent analyses. In addition, because gender differences have been reported in some studies (Holub & Musher-Eizenman, 2010) we used t-tests to look for differences in scores on all reported measures for boys and girls. None were significant so data were pooled for all subsequent analyses.

Furthermore, a key question in this study was whether environmental factors were related to children's responses to healthy and unhealthy food. Therefore, group comparisons were conducted using one-way ANOVA to establish whether there were socioeconomic differences in children's television viewing, and in children's and their parents' levels of healthy eating. Mothers' highest level of completed education was coded into three groups: secondary (high school), post-secondary/high school diploma, and university education. As homogeneity of variance was not observed for some of these tests, the more robust Welch test of equality of means was employed and the Dunnett's T3

post-hoc test was applied to identify which groups differed significantly from one another.

For television viewing, socioeconomic differences were significant:  $F(2, 91) = 5.31$ ,  $p = .007$ ; calculation of the effect size using eta squared indicated this was medium at 0.10 (Cohen, 1988). Mean weekly television exposure among children of mothers who had completed secondary (high school) education, at 18 hours 40 minutes per week ( $M = 1120.17$  mins;  $SD = 651.74$ ) was significantly higher than that of children of mothers who had a university degree, 11 hours 29 minutes per week ( $M = 688.82$  mins;  $SD = 547.64$ ). Children of mothers who had completed a post-secondary (high school) diploma did not differ significantly in their weekly television exposure, at 14 hours and 47 minutes per week ( $M = 886.92$  mins;  $SD = 364.61$ ) from the other two groups.

For parents' healthy eating, socioeconomic differences were also significant:  $F(2, 91) = 9.99$ ,  $p < .001$ ; calculation of the effect size using eta squared indicated this was large at 0.18 (Cohen, 1988). Post hoc analyses indicated that there were significant differences between some groups. Mothers who had a university degree had the highest mean healthy eating scores ( $M = 40.74$ ;  $SD = 4.39$ ) and these were significantly different from the scores for mothers with lower levels of education, though mothers with secondary (high school) and post-secondary diploma did not differ significantly from one another (diploma  $M = 36.88$ ;  $SD = 6.35$ ; secondary  $M = 34.93$ ;  $SD = 5.93$ ).

Finally, for child's healthy eating, socioeconomic differences were also significant:  $F(2, 91) = 14.37$ ,  $p < .001$ . Calculation of the effect size using eta squared indicated this was large at 0.24 (Cohen, 1988). Children of mothers who had completed secondary (high school) education had the lowest healthy eating scores ( $M = 31.81$ ;  $SD = 5.46$ ) and these were significantly lower than those for children of mothers who had completed a post-secondary/high-school diploma ( $M = 36.62$ ;  $SD = 6.78$ ) and those whose mothers had a university degree ( $M = 38.86$ ;  $SD = 4.33$ ); children of mothers with both higher forms of education did not differ significantly in their healthy eating scores.

Overall, therefore, parents of lower socioeconomic status reported that their children watched significantly more television and had significantly less healthy diets, and that they themselves also had significantly less healthy diets.

### **Children's classifications of healthy and unhealthy food and drink items.**

Children's mean correct classifications of total, healthy and unhealthy food and drink items show evidence of age-related improvement from 3 to 5 years of age (see table 2). However, separate examination of the scores for healthy and unhealthy items

demonstrates that children had very high scores on the healthy items at all ages. Due to these ceiling effects, analytic statistics were not carried out on these data. As can be seen in table 2, a strong age-related improvement is evident for unhealthy items. One-way ANOVA demonstrated that these age differences in responses to unhealthy items were significant:  $F(2,169) = 18.8, p < .001$ , and calculation of the effect size using eta squared indicated this was large at .18 (Cohen, 1988). Post-hoc comparisons with the Tukey HSD test indicated that mean accuracy for unhealthy items for 3 year olds was significantly lower than for 4 year olds, and scores at 4 years were significantly lower than at 5 years. Despite this significant age-related increase, 5 year olds' correct identification of unhealthy items, as items one should not consume in large amounts, was substantially lower than their capacity to identify healthy items as foods one should eat a lot of. In addition, chi-square test of goodness of fit indicates that their identification of unhealthy items was not better than chance  $\chi^2(1, N = 37) = 0.13, p > .05$ . In contrast, when responding to the healthy food items the performance of all age groups of children was significantly better than chance (3 years:  $\chi^2(1, N = 54) = 9.56, p < .01$ ; 4 years:  $\chi^2(1, N = 81) = 8.07, p < .01$ ; 5 years:  $\chi^2(1, N = 37) = 7.52, p < .01$ ).

**Table 2 Mean (SD) of correct responses classifying healthy and unhealthy items for each age group**

	3 years		4 years		5 years	
<i>Full sample</i>	<i>n = 54</i>		<i>n = 81</i>		<i>n = 37</i>	
All items (16)	8.98	(2.06)	10.11	(2.34)	11.30	(3.10)
Healthy items (8)	7.48	(1.09)	7.16	(1.17)	7.03	(1.57)
Unhealthy items (8)	1.50	(1.92)	2.95	(2.23)	4.27	(2.24)
<i>After removing 'yes-responders'</i>	<i>n = 29</i>		<i>n = 68</i>		<i>n = 35</i>	
All items (16)	10.03	(2.08)	10.54	(2.31)	11.51	(3.04)
Healthy items (8)	7.24	(0.95)	7.03	(1.25)	7.00	(1.61)
Unhealthy items (8)	2.79	(1.80)	3.51	(1.98)	4.51	(2.05)

### Assent bias

The design of this study required children to answer *yes* or *no* when classifying items. For healthy foods, the correct answer was *yes* and for unhealthy foods the correct answer was *no*; therefore, an assent bias (where children simply answered *yes* to every question), would increase accuracy scores for healthy foods and reduce accuracy scores for unhealthy foods. Research has identified assent biases, particularly in children aged 3 years (Fritzeley & Lee, 2003), so we analysed children's responses to identify any systematic patterns of 'yes-responding', and found that nearly a quarter of children had answered *yes* to every food and drink item they were shown. Younger children were more likely to do so

than older children: nearly half (46%) of 3 year olds said *yes* to every item; substantially fewer 4 year olds did so (16%); and by 5 years this pattern of responding was almost entirely absent (5%). We decided, therefore, to examine age differences in accurate classification of healthy and unhealthy items again, excluding responses from those children where an assent bias was indicated. The means for children who did not display an assent bias can also be viewed in table 2.

Looking to the revised scores, it can be seen that the same patterns of responding were found. Age differences in overall scores were still present, and these were still accounted for by age differences in children's correct responses to the unhealthy food items, so once again only these data were subject to further analysis. One way ANOVA confirmed that a significant age effect for unhealthy food knowledge was still present:  $F(2, 129) = 6.3, p = .002$ . The effect size (eta squared), although somewhat smaller, .09, was still a medium effect (Cohen, 1988). In the post-hoc comparisons with the Tukey HSD test, however, a slightly different finding emerged. At 3 and 4 years of age, children's accurate categorising of unhealthy foods, as foods one should not eat a lot of, was still significantly lower than at 5 years; but 3 and 4 year olds no longer differed significantly from one another. This suggests therefore that a truer representation of age differences in young children's knowledge of unhealthy features of some foods is that a significant improvement takes place between the ages of 4 and 5 years. Again, chi-square test of goodness of fit indicated that the five year olds' identification of unhealthy items was not better than chance  $\chi^2(1, N = 35) = 0.13, p > .05$ . In contrast, when responding to the healthy food items the performance of all age groups of children was significantly better than chance (3 years:  $\chi^2(1, N = 29) = 5.25, p < .05$ ; 4 years:  $\chi^2(1, N = 68) = 4.59, p < .05$ ; 5 years:  $\chi^2(1, N = 35) = 4.5, p < .05$ ).

### **Relationships with environmental variables**

To explore relationships between total correct responses to healthy and unhealthy items and family healthy eating scores and television viewing time, Pearson's product moment correlations were calculated. Child healthy eating was not significantly correlated with correct responses to healthy  $r = 0.28, N = 96, p = .785$  or unhealthy items  $r = .097, N = 96, p = .348$ . Nor was parent healthy eating significantly correlated with correct responses to healthy  $r = .042; N = 96; p = .685$  or unhealthy items,  $r = .073, N = 96, p = .477$ . Furthermore, total weekly television viewing time was not significantly correlated with identification of healthy  $r = -.040, N = 97, p = .700$  or of unhealthy food items  $r = .118, N = 97, p = .248$ . Thus, children's knowledge of how much they should eat of healthy and

unhealthy items was not related to their television viewing, their own healthy eating, or their parents' healthy eating.

Finally, two one-way ANOVAs were conducted to explore whether children from different socioeconomic backgrounds differed in their accuracy of classifying healthy and unhealthy food and drink items. There were no significant differences between socioeconomic groupings for children's correct responses to healthy food/drink items,  $F(2,94) = .507$ ,  $p = .604$  or for unhealthy ones  $F(2,94) = 1.325$ ,  $p = .271$ .

### **Explanations for healthy/unhealthy classifications**

When specifying whether Mabel mouse should eat or drink a lot of a healthy or unhealthy item, many children spontaneously offered explanations for their choices. These explanations were noted verbatim and a coding frame was constructed, using the tactics for generating meaning described by Miles and Huberman (1994). All responses were independently coded by another researcher using the coding frame. Inter-coder reliability was adequate ( $\kappa = .782$ ) and disagreements were resolved by discussion. Children's explanations were grouped into the following codes: health (effects on muscles, brains, teeth, fat or growth); nutrition (containing sugar, salt, energy); food type (fruit, vegetables); preference; and physical properties (appearance, taste or texture). If children simply restated the words contained in the question, this was coded separately. Codes, with sample responses, are shown in Table 3.

Frequency of responding varied by age: 41% of 3 year olds gave an explanation for at least one item, while 68% of 4 year olds and 95% of 5 year olds did so. Because of differences in sample size and rates of responding at each age, the data were calculated as a percentage of valid responses for each code and each age group (see table 4). While these data need to be interpreted with caution, they show that at 3 years, children were more likely to justify food categorisations based on preference – nearly half of 3 year olds' responses were based on this, compared to just over one in ten such responses at 4 and 5 years. There was a correspondingly greater tendency for 4 and 5 year olds to offer justifications based on the nutritional content of food and on the impact of food on health.

**Table 3 Categorisation of children's spontaneous explanations on nutrition knowledge task**

Category	Definition and sample responses
<b>Restatement of question</b>	Answers with no additional information than was included in the question. Examples (healthy): 'It will make her bigger'; 'Makes you big like your daddy'; (unhealthy): 'Cause they'll make her not healthy'
<b>Health outcome</b>	Answers that refer to effects the food has on the body (but excluding references to big, strong and healthy). Examples (healthy): 'Gives you muscles'; 'Cause it's good for your brains'; 'Cause she will get fat and stuff'; (unhealthy): 'Her teeth will fall out'; 'Cause they'll make her super small like a little baby'
<b>Nutrition</b>	Answers that refers to the nutritional content of the food or other ingredients. Examples (healthy): 'Because there's a lot of sugar in them'; 'It's got energy'; (unhealthy): 'It's got no energy'; 'It's got salt'
<b>Reference to type of food (fruit/vegetable)</b>	Answers that correctly classify the food into a superordinate group. Examples (healthy): 'Because its fruit so it's healthy'; 'She has to eat lots and lots of vegetables'; 'Cause they're fruit and they are healthy'; (unhealthy): 'Cause they're not vegetables'
<b>Preference</b>	Answers that refer to liking/disliking the food or someone else liking/disliking the food. Examples (healthy): 'Cause she likes them'; 'Cause I like potatoes very much with chicken'; (unhealthy): 'We don't like peas'; 'Cause there's too much of it I don't like it'
<b>Physical property of food (other than nutrition)</b>	References to the physical appearance, taste or texture of the food. Examples (healthy): 'Cause they're very sweet'; 'It's milkyish'; 'They are big and round'; (unhealthy): 'Cause it's really fizzy'
<b>Other/ Don't know</b>	Responses other than those outlined above: Examples: 'Because it's from cows'; 'Cause I have them in school'; 'We are growing carrots'; 'She should eat it shouldn't she'

**Table 4 Children's justification of their responses on healthy/unhealthy knowledge task as a percentage (frequency) of valid responses for each age group**

Code	Age groups			
	3 years (n = 54)	4 years (n = 81)	5 years (n = 37)	Total
	% (responses)	%(responses)	%(responses)	%(responses)
Restatement	11% (8)	21% (68)	37% (102)	25% (178)
Health	7% (5)	20% (63)	23% (64)	20% (132)
Nutrition	0 (0)	13% (42)	10% (27)	10% (69)
Food type	1% (1)	6% (21)	2% (5)	4% (27)
Preference	46% (34)	11% (34)	15% (43)	17% (111)
Physical properties	8% (6)	14% (45)	4% (11)	9% (62)
Other/don't know	27% (20)	15% (49)	9% (26)	14% (95)
Total no. responses	100% (74)	100% (322)	100% (278)	100% (674)

## Discussion

The present study aimed to describe the development of young children's identification of the food and drink that contribute to health, in an economically diverse sample in Ireland, and to explore relationships of this knowledge with their family healthy eating practices, television viewing and socioeconomic status. Our results demonstrate that a very high proportion of children aged 3 to 5 years identified the healthy nature of fruit, vegetables, potatoes and milk, even after removing responses where children showed a 'yes' bias. However, children's understanding that one should eat little of high-fat or high-sugar unhealthy meal and snack items, such as chips (French fries), sweets (candy) and Coca-cola®, was substantially lower. Understanding of these less healthy items increased with age, with the most robust difference found between the ages of 4 and 5 years. However, it was notable that, at 5 years of age, children were still only able to identify just over half of unhealthy items as foods one should not eat much of, in order to be healthy, at levels not better than chance. For families of lower socioeconomic status, children's television viewing levels were higher and healthy eating was lower; however, children's responses to healthy and unhealthy foods were not related these environmental variables, nor to socioeconomic status itself.

Our findings add support to a small body of research indicating that preschool children can meaningfully identify healthy foods (Holub & Musher-Eizenman, 2010; Nguyen 2007; Nguyen et al 2011) and the present study expands on this research with its finding that this applies across a socioeconomically diverse group. These findings also add to the body of evidence indicating that young children from multiple socioeconomic backgrounds have substantially more difficulty understanding that one should not eat too much of unhealthy foods. Nguyen et al. (2011) similarly reported that 4-year-olds had high levels of knowledge of the healthy nature of vegetables and limited knowledge of a range of high-fat foods and Nguyen (2007) noted that children up to 7 years had difficulties with categorising many unhealthy meal- and snack-based foods. However, others have found the reverse, so this question requires further exploration. Closer investigations of methodological and cultural factors are warranted, as studies have been conducted in several countries, and have differed in the methods and the foods they used.

One of the aims of this study was to explore the possibility that children's ability to distinguish between healthy/unhealthy foods is related to environmental factors suggested by other studies and reviews: children's and parents' healthy eating; children's television viewing and socioeconomic status (e.g. Cairns et al, 2009; Slusser et al, 2012; Taylor et al,

2005). However, despite the fact that clear socioeconomic differences were found in children's and parents' levels of healthy eating and children's television viewing, these environmental variables were not significantly related to young children's ability to identify which food and drinks were healthy. This raises the possibility that the source of young children's food knowledge may not lie in socioeconomic or media exposure factors, nor in their own healthy eating or the home food environment, and we discuss this further below.

There were several methodological strengths associated with the present study. To ensure good recognition of the food images used in the study, we consulted with parents and with pre-schoolers in different community types. Through the use of an age-appropriate story about healthy eating, we established a definition of this challenging, abstract concept with very young participants, and we believe the findings can therefore be interpreted with increased confidence. Further confidence is lent by the fact that even after excluding the responses of children who showed evidence of an 'assent bias' (i.e. they answered *yes* to every *yes/no* question: Fritzley & Lee, 2003), the uniformly high identification of healthy foods remained, and significant age-related increases in understanding that one should not consume a lot of unhealthy foods were still found. This also underlines the importance of attending to response patterns when conducting research with very young children and indicates that it is possible to engage with even very young children about abstract food concepts, if time is taken to ensure that interactions and materials are child centred.

Our analysis of children's spontaneous explanations for foods being healthy or not builds on previous indications that, during pre-school years, children's capacity to explain the impact of food on health changes substantially (Holub & Musher-Eizenman, 2010; Nguyen, 2007). In common with Nguyen (2007) we found that 3 year olds were less well able than 4 year olds to explain their responses to healthy/unhealthy food, and like Holub and Musher-Eizenman (2010) we found that preschool children regularly refer to their personal preferences to justify judgments about how much of a food should be eaten in order to be healthy. Our age-related analysis demonstrates, however, that after the age of 3 years, children are substantially less likely to justify these judgments with personal preferences, and that at 4 and 5 years, they have started to refer to health and nutrition concepts in relation to food. This suggests that understanding of health and nutrition begins to develop by the age of 4 years, earlier than indicated by Slaughter and Ting (2010).

The findings of the study also need to be interpreted in light of some limitations. Just over half of the parents returned questionnaires with socio-demographic details and information about family eating habits and television viewing, meaning that we did not have

this information for many of the children who participated. However, the final parent sample represented several levels of socio-economic status as indicated by mothers' level of education, and therefore reflects a broader range of participants than previous studies of children's food knowledge. The decision to use a mouse as the central character in the story about food enhanced its appeal to the very young participants in this study; however, it is possible that using a non-human character influenced some children's responses. The food images we chose were partially dictated by the availability of photographs of sufficient clarity for young children to readily identify the items. For example, we had originally intended to include plain chicken as a healthy food but we were unable to find a suitable photograph that children could unambiguously identify as chicken meat. For this reason our healthy food group was limited to fruit, vegetables, potatoes and milk; future research should explore other foods and drinks.

In addition, we believe that investigations of family eating and television factors as possible determinants of children's food knowledge should continue, with reframed or refined variables. Other specific ways in which healthy eating is encouraged in the home should be explored, as research indicates that children's nutrition knowledge is significantly related to parenting factors, such as parenting efficacy or control; parent food attitudes; and practices such as allowing children to contribute to eating decisions (e.g. Hays, Power & Olvera, 2001; Nyberg et al, 2011; Slusser et al., 2012). For television, viewing time is widely used as a variable in research studies, and we aimed to capture the full range of children's exposure by asking parents to report on children's passive as well as active viewing. It should be borne in mind that, in the UK (from which 25% of the sample of children was drawn), advertising of unhealthy food is not permitted during children's programmes and in the Republic of Ireland (75% of the sample) advertising for many types of unhealthy food and drink on children's programming has reduced substantially in the last decade (FDII, 2011). Therefore, if the children in this study predominantly viewed children's TV programming, they may have had limited exposure to television advertising for unhealthy foods. However, audience research indicates that children view considerable amounts of television at times, such as during family programming, when advertising for unhealthy food and drink is not restricted, and that such viewing may form the majority of their TV viewing (Ofcom, 2006; BAI, 2012a). In order to identify specific links with television advertising, researchers may therefore need to measure children's actual advertising exposure, for example by identifying the specific channels watched, and at which times of day, and logging unhealthy food and drink advertising for these channels.

Studies should also explore links to children's exposure to food marketing beyond television advertising; in addition, longitudinal studies are needed, as preschoolers may learn marketing information implicitly, and effects may only be seen in later years (Harris et al, 2009). Finally, studies should compare relative effects of home and preschool/school education and modelling factors. Taylor et al (2005) note that inter-relationships between food knowledge and other determinants mean independent knowledge effects are difficult to assess. The findings of this study may further reflect the considerable number and complexity of interacting factors affecting children's eating patterns (Livingstone & Helsper, 2004; Slusser et al, 2012).

In light of growing international concern about obesity, and evidence that food knowledge is one of the factors influencing diet, teaching young children about food and nutrition is likely to become ever more important, and our findings have implications for the design and implementation of educational interventions. For maximum effectiveness, such programmes need to be based on a detailed understanding of what children know at different ages about food. Our research indicates that by 3 years of age, children have significant levels of understanding of the healthy nature of vegetables and fruit but that preschoolers need more information on the importance of not eating too many unhealthy foods.

The findings of this study suggest that young children should receive education about unhealthy foods and the nutritional properties and health consequences of food from 4 years of age, as this is the time at which their understanding of unhealthy food begins to increase and at which they start to apply health-based explanations to healthy and unhealthy foods. These findings point to the importance of early childhood for learning about healthy and unhealthy qualities of food, and add to the evidence indicating that there is a particular gap in young children's understanding about unhealthy foods.

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