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Environmental and individual determinants of core and non-core food and drink intake in preschool aged children in the United Kingdom

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Abstract

Background/Objectives—Strategies to achieve healthier diets for children are likely to benefit from an understanding of the determinants. We examined environmental and individual predictors of children's intake of 'core' foods (fruit, vegetables) and 'non-core' foods (snacks, sweetened beverages). Predictors included parental intake, home availability, parental feeding styles (Encouragement and Monitoring), and children's food preferences. Based on research with older children, we expected intake of both food types to be associated with maternal intake, core foods to be more associated with children's preferences, and non-core food intake more with the home environment.

Subjects/Methods—Primary caregivers (n=434) of children (2-5 years) from preschools and Children's Centres in London, UK, completed a self-report survey in 2008.

Results—Multiple regression analyses indicated children's fruit intake was associated with maternal fruit intake (B=.29; p=0.000), children's liking for fruit (B=.81; p=0.000) and a Monitoring style of parental feeding (B=.13; p=0.021). Children's vegetable intake was similarly associated with maternal intake (B=.39; p=0.000), children's liking for vegetables (B=.77; p=0.000), Encouragement (B=.19; p=0.021) and Monitoring (B=.11; p=0.029). Non-core snack intake was associated with maternal intake (B=.25; p=0.029), Monitoring (B=-.16; p=0.010), home availability (B=.10; p=0.022) and television viewing (B=.28; p=0.012). Non-core drink intake was associated with maternal intake (B=.32; p=0.000) and television viewing (B=.20; p=0.019).

Conclusions—Results indicate commonalities and differences in the predictors of core and non-core food intake; with only maternal intake important across all types. Effective interventions to improve young children's diets may need to call on different strategies for different foods.

Keywords

Core food; non-core food; children; diet

Introduction

Children's diets are less than optimally nutritious (Bates et al.2009; Butte et al. 2010), which has implications for health both in childhood and adult life (Dietz, 2004; Singh et al. 2008). In England, only 25% of boys and girls aged 5 years eat the recommended minimum of five

portions of fruit and vegetables a day (National Health Service, 2010). Children aged 4-10 years across the UK consume ~60 grams a day of cakes, biscuits, savoury snacks and sweets (Bates et al. 2009). Development of strategies to improve young children's diets is likely to be more successful if underpinned by an understanding of the determinants of both healthy and unhealthy food intake.

For preschool children (2-5 years), the major environmental influences on diet are likely to come from the family and home. Among the most important family factors is parental, and particularly maternal, diet. Regardless of food type, children's intake tends to resemble their mothers', with positive mother-child correlations found for fruit and vegetable intake (Fisher et al. 2002; Gibson et al. 1998; Cooke et al. 2004) and snacks and soft drinks (Brown and Ogden, 2004; Grimm et al. 2004). Parental feeding practices such as monitoring their child's intake of unhealthy foods have been associated with lower intake of these types of foods in children (Faith et al. 2004), and parental encouragement to try new foods and eat a varied diet, with higher intake of vegetables (Veerecken et al. 2004). The home environment is also important, with home availability and accessibility being associated with children's intake of both healthy (Hanson et al. 2005) and unhealthy foods (Martens et al. 2005). Television viewing has been specifically associated with higher intake of non-nutritious snacks and lower intake of fruit and vegetables in many studies (Boutelle et al. 2003; Campbell et al. 2006; Kourlaba et al. 2009), and family meals have been shown to be associated with children's vegetable intake (Sweetman et al. 2010). Children's own characteristics also play a role, with a recent review finding that children's liking for fruits and vegetables were associated with consumption in 11 out of 13 studies (McClain et al. 2009).

Many studies have tended to examine the predictors of *either* healthy *or* unhealthy food intake, but rarely to contrast the determinants of these two categories in the same sample. However, a recent analysis of food intake in a sample of 11-year-old twins (Johnson et al. 2010) used the Australian categorization of foods into 'core' foods (e.g. starch, vegetables, fruit, dairy, and protein) and 'non-core' foods (e.g. cookies, cakes, sweets, soft drinks, and high-fat snacks) (Bell et al. 2005). 'Core' foods are typically important components of a balanced diet; whereas 'non-core' foods are usually 'extras'; eaten for pleasure rather than health. The results showed interesting differences between core and non-core foods: maternal intake was associated with both, but children's preferences were only associated with intake of core foods, while home availability of foods and television exposure were associated only with non-core foods (Johnson et al. 2010). Understanding differences in determinants of intake between core and non-core foods has important implications for nutrition education and dietary interventions. If the determinants are different; the messages for change may also need to be different.

Determinants of intake in preschool children may differ from those in older samples (Johnson et al. 2010). In the early years, parents play a more central role in shaping the family food environment and eating experiences, both in terms of their control over the foods that are made available and through their feeding policies and practice (Birch and Fisher, 1998). Older children by contrast, have greater autonomy over their food intake, and are also more influenced by their peers (Patrick and Nicklas, 2005).

The present study investigated the determinants of young children's diets in relation to actual foods rather than nutrients. This approach provides a more meaningful basis for communicating with the public and may have useful applications in nutrition education efforts. We examined predictors of two 'core' food types (fruits and vegetables) and two commonly consumed 'non-core' food types (snacks and sweetened beverages). Following a previous study, we hypothesized that: i) parental intake would be associated with intake of all foods, ii) home availability would be more associated with intake of non-core than core

items, iii) television viewing would be related more to non-core than core food intake, iv) preferences would be more associated with core than non-core food intake, and v) parental monitoring would be associated with non-core food intake and parental encouragement with core food intake.

Subjects and Methods

Study Design

Data for this study were from a parent-report community survey, the Poppets Study (Sweetman et al. 2010). Parents or primary caregivers* with a child aged 2-5 years attending 60 London preschools and Children's Centres were eligible to participate. Survey items were from published and validated questionnaires where possible. Envelopes containing an information sheet, questionnaire, and freepost return envelope were distributed by staff to potential participants, with a small cash incentive offered to enhance participation. Ethical approval was granted by the University College London Research Ethics Committee.

Measures

Demographic characteristics—Respondents reported their ethnic group in detail, but for statistical analysis ethnicity was categorized as 'white' or 'non-white' because of the small number of individuals in any ethnic minority sub-group. Parental education level was reported using a six-point scale from 'no qualifications' to 'post-graduate', but for all analyses was categorized as 'university level education' vs 'not'. Respondent's age and relationship to the child, and the child's age and sex, were also reported.

Children's Food Consumption—Two types of core foods (fruits and vegetables) were assessed using two questions 'How many servings of fruit [vegetables] does your child typically eat, including those eaten at mealtimes and as snacks'. Responses were on a seven-point scale (from 'less than one per week', to 'three or more per day'). Examples of portion sizes were provided, and parents were asked to exclude potatoes, sweet potatoes and plantains. For analysis, responses were assigned a score reflecting the average number of servings per day indicated by each response option (0.07, 0.14, 0.36, 0.71, 1, 2 or 3.5). This method of scoring has been used in other similar studies (Sweetman et al. 2010; Campbell et al. 2007).

Non-core snack food and drinks were defined using the Australian system as in previous research (Johnson et al. 2010; Bell et al. 2005). Non-core snack foods included sweets and sweet and savoury snacks, and non-core drinks included sweetened carbonated drinks (including diet varieties) and other sweetened drinks (e.g. squash, fruit drinks) but not 100% fruit juice. Intake was assessed by asking 'How often does your child have the following as a snack or drink between meals: sweets; sweet snacks; savoury snacks; sweetened carbonated drinks; diet sweetened carbonated drinks; other sweetened drinks'. Responses were on a seven-point scale (from 'never/rarely', to 'three or more times per day'). Examples were provided (e.g. sweets, chocolate, cakes, ice cream, crisps). For drinks, several common UK brands were named as examples. Responses were assigned a score reflecting the average number of occasions of consumption per day indicated by each response option (0, 0.14, 0.36, 0.71, 1, 2 or 3.5) and summed within each broad category, i.e. snacks or drinks (Sweetman et al. 2010; Campbell et al. 2007).

*Parents or primary caregivers were asked to complete the survey if they had children between the ages of 2 and 5 years. Although over 90% of respondents were biological mothers, the term parents will be used when discussing respondents in general terms to avoid the implication that all responsibility falls on the mother.

Potential Determinants

Parental Intake[†]: Parents' intake of fruit, vegetables, non-core snacks and non-core drinks were assessed using the same questions as for the child, with the same method of scoring, reflecting the average number of servings a day (fruit and vegetables), or occasions per day (non-core snacks and drinks) (Sweetman et al. 2010; Campbell et al. 2007).

Parental Feeding Style: From the Parental Feeding Style Questionnaire [PFSQ] (Wardle et al. 2002), we used the Encouragement sub-scale, which has 8 items referring to general praise and encouragement used for food and mealtimes (e.g. 'I encourage my child to eat a wide variety of foods'). Response options for PFSQ items were on a five-point scale (never, rarely, sometimes, often, always). The Monitoring sub-scale was selected from the Child Feeding Questionnaire [CFQ] (Birch et al. 2001) with 3 items pertaining specifically to non-core foods; e.g. 'How much do you keep track of the high-fat foods [sweet foods or snack foods] that your child eats', with five response options expressing frequency (never, rarely, sometimes, often, always).

Home availability: Availability was assessed for core and non-core foods using a series of single items: 'Are any of the following foods and drinks in your house right now' [fruit, vegetables, snacks (including: sweets, sweet snacks, savoury snacks) and drinks (including: regular sweetened and diet beverages and other sweetened drinks)]. For all items, response categories were yes/no/don't know.

Television viewing: The child's television viewing (TV) was assessed using parent-report of hours watched on a typical week day and weekend day. This was used to calculate average weekly hours of television viewing. For analysis, this was recoded into 'up to the recommended 2 hours a day' vs. 'over the recommended 2 hours a day'; representing guidelines for the US and UK (Committee on Public Education, 2001; Scottish Intercollegiate Guidelines Network, 2010).

Child food preference: Child liking for the core and non-core food and drinks included in these analyses was assessed by asking 'How much does your child like the following [all relevant food/drink types]', with responses of 'Likes a lot', 'Likes', 'Dislikes', 'Dislikes a lot' or 'Has never tried it'. Mean liking scores were generated for the food/drink types which had been tried.

Statistical Analysis

Analyses were performed using SPSS (version 15.0, 2006, SPSS Inc, Chicago, Illinois.). Univariate associations between the predictor variables and the child's intake of core and non-core foods were assessed using Spearman's rho correlations. Complex samples general linear model was used to conduct multiple regression analyses adjusting for the effect of non-modifiable socio-demographic variables (child age and sex, ethnicity, parental education level), taking into account clustering of children drawn from preschools and Children's Centres. Separate models were run for each child intake variable (core and non-core foods), where the dependent variable was regressed onto a number of environmental and individual predictor variables.

[†]The term parental intake has been used up until this point. However, given that the survey was completed by biological mothers of the children in over 90% of cases, the term maternal intake specifically will be used from this point forward.

Results

Participant characteristics

Four hundred and sixty five parents and caregivers returned completed questionnaires, of which 434, (mean age 36 years; SD 5.8) were eligible. The 60 primary schools and Children's Centre's recruited reported approximately 2,419 children within the study age range (2-5 years) on their registers at the time. Settings were given this number of questionnaires (in total) and asked that they be distributed to all parents of suitably aged children. However, calculating a response rate from these data is impossible given that no researchers were present when questionnaires were handed out and there is no way of knowing how many were actually given to parents. Full details of participant characteristics can be found elsewhere (Sweetman et al. 2010). The majority of respondents reported their ethnicity as white ($n=313$; 76%) and almost two thirds (64%) had a university education. Children's ages ranged from 24 to 60 months (mean 42 months; SD 9), and 54% ($n = 232$) were girls. Additional characteristics of the sample are presented in Table 1.

Predictors of children's core food intake

Univariate associations were examined between predictor variables and the two core foods and are shown in Table 2. Multiple regressions are shown in Table 3. The child's age and sex were not associated with children's core food intake in the regression models (not presented in Table 3).

In the regression model (Table 3), children's fruit consumption was predicted by their liking for fruit, maternal fruit intake, ethnicity (being white), and greater use of parental Monitoring (CFQ). Neither home availability nor TV viewing predicted fruit intake, with parental Encouragement (PFSQ) almost reaching significance. The final model accounted for 32% of the variance (R^2) in children's fruit intake (Wald $F(10,49)=22.566$, $p=0.000$).

Children's vegetable consumption was predicted by child liking for vegetables, maternal vegetable intake, ethnicity (being white), and greater parental use of Monitoring (CFQ) and Encouragement (PFSQ). Home availability and TV viewing did not predict intake. The final model accounted for 44% of the variance (R^2) in children's vegetable intake (Wald $F(10,50)=66.631$, $p=0.000$).

Predictors of children's non-core food and drink intake

Univariate associations between predictor variables and non-core food and drinks and are shown in Table 2. Multiple regressions are shown in Table 3. Child age, sex and ethnicity were not associated with children's intake of these items in the regression models.

Maternal intake of non-core snacks predicted children's non-core snack consumption along with TV viewing above the recommended daily amount, lower use of parental CFQ Monitoring (in relation to sweets, snacks and high-fat foods), and greater availability of non-core foods in the home. The final model accounted for 21% of the variance (R^2) in children's non-core food consumption (Wald $F(10,50)=3.335$, $p=0.002$).

Children's consumption of non-core drinks was predicted by maternal consumption of these drinks, lower parental education level and TV viewing above the recommended daily amount. The final model accounted for 33% of the variance (R^2) in children's non-core drinks consumption (Wald $F(10,48)=7.840$, $p=0.000$).

Discussion

This study found similarities and differences in environmental and individual predictors of 'core' and 'non-core' food intake in a large sample of London preschoolers (2-5 years).

Maternal intake was associated with both core and non-core food intake; confirming many previous studies (Fisher et al. 2002; Gibson et al. 1998; Brown and Ogden, 2004; Grimm et al. 2004; Faith et al. 2004; Johnson et al. 2010; Cooke et al. 2003; Fisk et al 2010). This provides further evidence of the strong influence of maternal intake on children's consumption across a wide range of items and suggests a direct modelling effect.

Differences in the impact of parental feeding practices on core and non-core food intake were striking. Encouragement (PFSQ) was associated with core food intake only, consistent with our hypothesis and with previous research relating verbal praise to increased vegetable consumption (Vereecken et al. 2004). This is likely due to children requiring more praise and encouragement to consume vegetables. The CFQ Monitoring sub-scale refers specifically to non-core foods (e.g. sweets, high fat snack foods) and as predicted, higher monitoring was associated with lower intake of non-core snacks. Unexpectedly, it was also associated with higher intake of fruits and vegetables. Perhaps parents of young children who keep track of their non-core food intake substitute healthier alternatives (e.g. fruit or raw vegetables) for unhealthy snacks. Monitoring may therefore be beneficial across the board.

Home availability was not associated with intake of core foods, but was associated with intake of non-core snacks, confirming previous findings with a sample of older children (Johnson et al. 2010). A previous study with 5-6 year olds also found that availability was not a determinant of vegetable intake, but nor did it find any association with non-core items (Campbell et al. 2006). This discrepant finding may be due to different ways of defining food availability. In the present study food availability was defined simply as having that food item in the home at the time of questionnaire completion, whereas the previous study included items on how easy/difficult it was to buy fresh produce in the local area; which may not reflect the domestic situation (Campbell et al. 2006). It should also be noted that there was limited variation in parental responses to this question, particularly in relation to core food availability which may have reduced the explanatory power of this variable.

Children's TV viewing showed associations with both core and non-core food intake in univariate analyses, but in the regression models only the association with non-core snacks and drinks remained significant. A previous study in a similar age group also found that TV viewing was associated with non-core snack and drink consumption, but was also predictive of lower vegetable intake. This may have been because no direct measure of parental intake was included, which could have been a confounder (Campbell et al. 2006).

As predicted, children's preferences were strongly associated with core food intake, but not with non-core snacks and drinks. This replicates previous findings in older children (Johnson et al. 2010). The lack of association with non-core items may be because children almost universally like highly palatable snacks and drinks (Wardle et al. 2001; Russell and Worsley, 2007; Wardle and Cooke, 2008).

Strengths and Limitations

A strength of this study is that it investigated predictors of core and non-core food and drinks in the same sample. It also included examples of portion sizes for core foods, maximizing accurate reporting, although this was not possible for non-core items because of the wider range of items included. However, all data were parent-reported and therefore

subject to recall and social desirability bias, but as participants completed questionnaires anonymously and returned them directly to the research team this should have minimised these effects. The number of questionnaires distributed to eligible parents by nursery staff was unknown, and as a consequence it was not possible to calculate a response rate. Nonetheless, the final sample was large and more ethnically diverse than the general UK population (Sweetman et al. 2010) with home ownership patterns closely matching population levels but with higher levels of university education. In addition, the generic measure of home availability used in the present study (i.e. categorising 'fruit' as one broad category) meant that little variation was detected in participant responses, particularly for core foods, with most parents answering 'yes'. Perhaps future research might tease this apart more clearly by asking about the different types of fruit and vegetables available in the home at a given time and categorising people based on availability scores. Finally, because the study was cross-sectional, causal relationships cannot be determined, but the consistency between the present findings and previous research (Johnson et al. 2010) gives confidence in the conclusions.

The finding that different factors are associated with intake of different food groups emphasizes that a 'one-size-fits-all' approach to healthy and unhealthy eating may have limitations. Parental feeding styles such as encouragement were of greater importance for core food intake, specifically vegetables, as were children's own food preferences. By contrast, availability within the home and other environmental factors such as TV viewing were more important correlates of non-core food intake. These findings provide an interesting parallel with the field of physical activity; where active and sedentary behaviours are no longer seen as two sides of the same coin but having different determinants (Biddle et al. 2004; van Sluijs et al. 2010).

The implication of these findings is that, in addition to helping parents understand how their own consumption patterns influence their children, different interventions may be needed to increase core and decrease non-core food intake. Focusing on increasing children's acceptance of healthy, but less palatable core foods could involve use of exposure-based tastings (Wardle et al. 2003). Increasing parental use of monitoring and enabling parents to provide encouragement and praise to children could also improve dietary quality. Helping parents reduce availability of non-core food items in the home and reducing time spent watching TV, or at least discouraging eating while watching TV, could help reduce children's intake of sweet and high-fat, snack sweet foods.

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Table 1
Child, parental and environmental characteristics of the Poppets Study sample (UK children aged 2–5 years)

Figures are means (SD) unless otherwise stated

Sample Characteristics	
Child intake:	
Core: Fruit servings per day (n=421)	2.2 (1.1)
Core: Vegetables servings per day (n=421)	1.7 (1.1)
Non-core ^a : Snack occasions per day (between meals) (n=390)	0.9 (0.8)
Non-core ^b : Drink occasions per day (n=405)	0.4 (0.8)
Maternal intake:	
Core: Fruit servings per day (n=425)	2.0 (1.1)
Core: Vegetables servings per day (n=423)	2.3 (1.1)
Non-core ^a : Snack occasions per day (between meals) (n=409)	0.9 (1.1)
Non-core ^b : Drink occasions per day (n=413)	0.5 (0.8)
PFSQ Encouragement score (n=424)	4.3 (0.5)
CFQ Monitoring score (n=425)	4.0 (1.0)
Home availability: % saying 'yes' (n)	
Core: Fruit (n=428)	98.8 (423)
Core: Vegetables (n=431)	98.4 (424)
Non-core ^a : Snacks (n=418)	92.1 (385)
Non-core ^b : Drinks (n=423)	60.0 (254)
TV per day: % (n)	
2 hours per day or less	75.6 (306)
Over 2 hours per day	24.4 (99)
Child liking^c:	
Core: Fruit	3.3 (0.4)
Core: Vegetables	2.9 (0.5)
Non-core ^a : Snacks	3.7 (0.5)
Non-core ^b : Drinks	3.0 (0.8)

PFSQ Parental Feeding Style Questionnaire; CFQ Child Feeding Questionnaire, both range 1-5

^aNon-core snacks: sweets; sweet snacks; savoury snacks

^bNon-core drinks: sweetened carbonated drinks; diet sweetened carbonated drinks; other sweetened drinks

^cLiking Range 1-4, 1=Dislikes a lot, 4=Likes a lot

Table 2
Univariate correlations between demographic, environmental and individual child factors and core and non-core food and drink intake in UK children aged 2-5 years

	Core food: Fruit	Core food: Vegetables	Non-core: Snacks ^a	Non-core: Drinks ^b
Demographics				
Child age	-.11 *	-.11 *	.08	.16 **
Child sex	-.06	.03	-.02	.05
Parental Higher Education (yes/no)	.19 ***	.21 ***	-.03	-.35 ***
White (versus non-white)	-.22 ***	-.33 ***	.09	.25 ***
Parental Factors				
Maternal intake of item [†]	.38 ***	.54 ***	.45 ***	.52 ***
PFSQ Encouragement	.23 ***	.24 ***	-.07	-.08
CFQ Monitoring	.23 ***	.29 ***	-.21 **	-.18 ***
Environmental Factors				
Home availability of item [†]	.15 **	.18 ***	.31 ***	.51 ***
TV viewing over daily guidelines	-.11 *	-.25 ***	.21 ***	.24 ***
Child Factors				
Child liking of item [†]	.35 ***	.43 ***	.09	.18 **

Values are Spearman's rho correlation coefficients. All significance values were classified as PFSQ Parental Feeding Style Questionnaire; CFQ Child Feeding Questionnaire

p<0.001

**
p<0.01

*
p<0.05.

^aNon-core snacks: sweets; sweet snacks; savoury snacks

^bNon-core drinks: sweetened carbonated drinks; diet sweetened carbonated drinks; other sweetened drinks

[†]of the outcome variable

Table 3
Linear regression analyses of predictors of core and non-core food intake in UK children aged 2–5 years¹

Predictor	Core food: Fruit ^a (n=349)		Core food: Vegetables ^a (n=348)		Non-core: Snacks ^a (n=315)		Non-core: Drinks ^a (n=272)	
	Unstandardized B	p	Unstandardized B	p	Unstandardized B	p	Unstandardized B	p
Parental Factors								
Maternal intake of item [‡]	.29	.000	.39	.000	.25	.029	.32	.000
PFSQ Encouragement	.21	.055	.19	.021	.08	.402	-.01	.914
CFQ Monitoring	.13	.021	.11	.029	-.16	.010	-.01	.847
Environmental Factors								
Home availability of item [‡]	.42	.131	.21	.074	.10	.022	.15	.084
TV viewing over guidelines	.15	.293	-.05	.590	.28	.012	.20	.019
Child Factors								
Child liking of item [‡]	.81	.000	.77	.000	.15	.077	.10	.109
Total variance explained								
Model R ²	.32	.000	.44	.000	.21	.000	.33	.000

p value = significance level

PFSQ Parental Feeding Style Questionnaire; CFQ Child Feeding Questionnaire, both range 1-5

Model R² -Fully adjusted model including all demographics (child sex, age, parental education, white (versus non-white)) plus potential correlates

¹Complex samples General Linear Model analyses taking into account clustering of children drawn from 60 preschools and Children's Centres across an area of London, UK

^aAdjusted for covariates (child sex and age, parental education level and ethnicity)

[‡]of the outcome variable; core food=servings per day; non-core food=occasions per day