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Demographic, familial and trait predictors of fruit and vegetable consumption by pre-school children

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Abstract

Objective: To examine the contribution to fruit and vegetable eating in children of potential predictive variables within the domains of demographics, parental feeding practices and personality traits.
Design: Cross-sectional survey.
Setting: Questionnaires were distributed to parents through 22 London nursery schools.
Subjects: Questionnaires were completed and returned by 564 parents or principal caregivers of 2–6-year-old children.
Results: Significant predictors of children's fruit and vegetable intake emerged from all three domains examined. Demographic variables associated with child's vegetable consumption were mother's education and child's age and gender. Only ethnicity was significantly associated with fruit consumption. Parental consumption, breast-feeding and early introduction to fruit and vegetables were related to intake of both. Family mealtimes were associated with higher intake of vegetables, but not of fruit. Two characteristics of children themselves (food neophobia and enjoyment of food) were strongly related to the consumption of fruit and vegetables. Subsequent multivariate analyses revealed that parental intake and child food neophobia independently predicted intake of both foods. In the presence of these, fruit consumption was affected by breast-feeding and early introduction to fruit, whereas vegetable consumption was related only to child's gender and enjoyment of food.
Conclusions: These findings may be used to inform future interventions aimed at increasing children's consumption of fruit and vegetables. Parents should be made aware of the possible impact of their own behaviour on the eating habits of their children.

Keywords
Children
Fruit
Vegetables
Predictors
Parents

Diets high in fruit and vegetables have been associated with multiple health benefits including a reduced risk of obesity[1], cardiovascular disease[2], stroke[3], diabetes[4] and some cancers[5,6]. The World Health Organization[7] recommends people to eat at least five servings of fruit and vegetables (approximately 400 g) per day, and many countries include similar recommendations in their nutrition guidelines[8]. However, in most countries, intake falls well short of these guidelines[9,10], with consumption among children being particularly low[11,12].

There are a number of reasons why improving the diet of children is particularly important. Many eating behaviours are initiated in childhood, track over the childhood years[13] and persist into adulthood[14,15], in which case starting from a better position could provide life-long benefits. In addition, there is growing evidence that poor diet in childhood can sow the seeds of serious health problems normally associated with older adults, notably diabetes[16], obesity[17] and cardiovascular disease[18]. As a result, early intervention should reap the maximum health benefit.

To develop effective interventions, it is important to be able to identify both the target groups who are most at risk and the factors influencing intake. Higher socio-economic status, indexed by either occupational status or educational level, is consistently related to fruit and vegetable intake both in adults[19,20] and adolescents[21,22]. Findings in younger children are more equivocal, although no studies have reported a negative association[23–26].

Gender also appears to be related to fruit and vegetable intake in adults. Men consume fewer fruits and vegetables than do women across many different settings[27–29]. The gender patterning in adolescents' consumption is less clear, although where differences have been documented they always show higher intake in girls[30–33]. In younger age groups, findings are also mixed[23,34]. Overall the data

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appear to show higher intake in females, albeit with some developmental fluctuations.

Demographic predictors of intake indicate the sectors of the population who are most likely to be at risk of poor nutrition, but only indirectly point to possible processes influencing food choices. The most influential aspect of a young child's environment is likely to be the family, and the food-related behaviours of parents – mothers in particular – would appear to be a promising area for investigation. Parent–child similarities in intake of fruit and vegetables have been found in several studies[24,35]. The powerful influence of maternal eating behaviour may even begin during pregnancy, according to recent research which suggests that flavours in the mother's diet are transmitted to the baby through the amniotic fluid and later through breast milk[36]. Breast-fed babies' early experience with a range of flavours that are absent from infant formula milk may facilitate the acceptance of a wider variety of foods at the weaning stage.

Parents can further influence their young children's eating habits by controlling where meals are eaten and with whom. Companionship at mealtimes has been shown to increase children's intake of the basic food groups[37] and regular 'family dinners' are associated with healthier dietary patterns including more fruit and vegetables in 9–14-year-olds[38]. This effect remained unchanged after adjustment for household income. The authors speculate that this is either because foods served at a family dinner are less likely to be ready-prepared foods, or that eating together engenders family conversations about healthy eating. However, it also seems likely that the opportunity to observe parents and siblings eating and enjoying foods encourages children's consumption of those foods, since modelling effects are widely documented[39–41]. The relationship between parental feeding practices and fruit and vegetable consumption warrants further investigation.

While aspects of the family environment might be important, characteristics of the individual child itself may also influence their behaviour. Humans seem to have a predisposition to reject new foods in favour of familiar ones (termed 'food neophobia' by Rozin[42]). Neophobia appears to reach a peak in early childhood (age 2–3 years) and tail off thereafter[43]. A recent study of North American 9–10-year-olds found that higher levels of food neophobia were associated with less dietary variety, but not with lower consumption of fruit and vegetables[44]. Other eating styles may also be related to more or less healthy diets. Some children appear to be more responsive to food than others, manifested as greater interest in and enjoyment of food[45]. On this basis one might expect higher levels of consumption of fruits and vegetables among children who have a more positive reaction to foods overall.

The literature reviewed here suggests that the determinants of fruit and vegetable intake in children may encompass demographic and familial factors and traits of children themselves. However, most studies limit their attention to only one or two of the three domains. Investigations of the influence of factors in any one domain are likely to be strengthened by also taking account of the others, because they may not prove to be independent. The present study investigated the contribution of potential predictive variables within the domains of demographic characteristics, family feeding practices and child traits to fruit and vegetable intake in a large community sample of families with young children.

Method

Procedure

Twenty-two North London nursery schools with a total of 896 pupils in the age range 2–6 years were invited to take part in a study of children's food preferences. The survey was publicised with posters displayed in the nurseries, and questionnaires were left for staff to distribute to parents, together with a freepost return envelope. Numbering questionnaires and linking these numbers to parents' names in a separately stored file ensured anonymity for participants.

Measures

Demographic characteristics

Respondents were asked their age at leaving full-time education. Responses to items covering current employment situation ('not working', 'working part-time' or 'working full-time'), possession of a car and housing tenure ('rented from the local authority', 'rented privately' or 'owned') were summed to provide a composite deprivation/affluence score. Further questions requested details of the respondent's age and ethnicity (subsequently classified as 'white Cancasian' or 'other'), and their child's age and sex.

Child's and parent's intake of fruit and vegetables

Frequency of fruit and vegetable consumption by both parent and child was assessed by asking 'How often do [you][your child] eat the following items?' This was followed by a list of six food types, including 'fruit (fresh or tinned)' and 'vegetables (including salad but not potatoes)'. Possible answers were 'never', 'less than once a week', 'once a week', 'twice a week', 'three times a week', 'four times a week', 'five times a week', 'six times a week', 'every day' or 'more than once a day'.

Parental feeding practices

Family feeding practices were measured using three items derived from preliminary interviews with mothers of young children: 'Do the children in your family most often eat their evening meal at the same time as the grown-ups?', 'Do the children in your family most often eat the same food as the grown-ups?' and 'Do the children in your family most often eat in the same place as the grown-ups?'

Answers were 'yes' or 'no'. Possible scores ranged from 0 to 3. Cronbach's alpha for this scale = 0.60.

Early feeding was investigated by asking 'How did you feed your child before they began eating solid foods?' Possible responses were 'breast-fed only', 'bottle-fed only' or 'breast- and bottle-fed'. Parents were asked when they had introduced each of a variety of different fruits and vegetables into their children's diet. In view of the likely difficulty for parents of remembering exactly when specific fruits or vegetables had been introduced, age of introduction to fruit was taken to be the earliest age at which any fruit was introduced. Likewise, age of introduction to vegetables was derived from the earliest reported introduction to any vegetable.

Child's food-related characteristics

The Child Food Neophobia Scale (CFNS[46]) is a six-item scale (reduced from 10 original items) designed to assess the extent to which children reject unfamiliar foods, e.g. 'My child is afraid to eat things she has never had before'. Items are scored on a 4-point scale from 'strongly disagree' to 'strongly agree' (Cronbach's alpha = 0.84). The Child Enjoyment of Food Scale from The Children's Eating Behaviour Questionnaire (CEBQ[47]) (Cronbach's alpha = 0.88) was scored in the same way and includes such items as 'My child loves food'.

Statistical analysis

Data from the questionnaires were analysed using SPSS version 10 (SPSS, Inc., Chicago, IL, USA). To normalise distributions of fruit and vegetable intake variables for both parents and children, the data were appropriately transformed ($\text{sqrt}[(x_{\max}+1)-x]$ and $\log_{10}[(x_{\max}+1)-x]$, respectively) as recommended by Tabachnik and Fidell[48]. Relationships of all variables to children's fruit and vegetable intake were assessed by bivariate Pearson's product–moment correlation coefficients, *t*-tests or analyses of variance, as appropriate. Gender differences between variable means were examined using independent samples *t*-tests.

Variables having significant univariate relationships with fruit and vegetable intake were entered into simultaneous multiple regression analyses to determine their relative contribution in the presence of other predictor variables. This was done separately for fruit and vegetables in the light of evidence that the influences on these two food types might be different. To ensure that data from 'father' and 'other' respondents made no material difference to the pattern of results, analyses were re-run with data from mothers only.

Results

Response rates and sample characteristics

Nine hundred questionnaires were given out to the nursery schools, of which 572 were returned (64%). Eight questionnaires were excluded from further analyses as the children concerned failed to meet the age criteria for the study, resulting in a sample size of 564. Parental respondents were aged between 21 and 59 years, with a mean of 36 (standard deviation (SD) 5) years. Three hundred and eighty-six respondents (68%) gave their ethnicity as 'white Caucasian', 105 (19%) as 'other' and 73 (13%) declined to answer. Five hundred and fifteen respondents (90%) were the mother of the child (90%), 45 the father (8%), and 12 not reported. Mean age of leaving full-time education was 21.3 (SD 3.4) years. Over 68% of respondents were aged 21 or over at leaving full-time education and, as a result, a new dichotomous education variable was created: 'leaving full-time education before the age of 21' or 'leaving full-time education after the age of 21'. Ninety per cent of respondents owned at least one car. Seventy-six per cent of the sample lived in privately owned accommodation, 13% in privately rented and 9% in local authority-rented property. Roughly equal proportions of respondents were employed full-time (33%), employed part-time (33%) and not working (34%).

Children ranged in age from 24 to 72 months, with a mean age of 45.2 (SD 10.1) months. Forty-seven per cent ($n = 267$) of the children were male, 50% ($n = 284$) were female and 3% ($n = 13$) did not have a gender specified. Prior to weaning, 35.5% ($n = 200$) of children had been exclusively breast-fed, 52% ($n = 293$) were breast- and bottle-fed, and 11.5% ($n = 65$) were bottle-fed. The mean age at which children had been introduced to their first fruit was 4.77 (SD 1.87) months and to their first vegetable, 6.21 (SD 2.97) months.

Children's intake of fruit and vegetables

In line with the findings of previous research, both parents' and children's reported intakes of fruit and vegetables were generally low (see Table 1). More than 30% of children ate fruit less than once a day and more than 40% ate vegetables less than once a day. There was no gender difference in frequency of fruit intake ($t(547) = 0.81$; $P = 0.42$), but boys ate vegetables less frequently than girls ($t(545) = 2.78$; $P = 0.006$).

Table 1 Frequency of fruit and vegetable consumption of respondents and their children

	Respondents	Children
Frequency of fruit consumption, % (*n*)		
Less than once a day	38.7 (218)	31.4 (177)
Every day	32.8 (185)	37.4 (211)
More than once a day	27 (152)	29.6 (167)
Missing	1.6 (9)	1.6 (9)
Frequency of vegetable consumption, % (*n*)		
Less than once a day	25.7 (145)	40.8 (230)
Every day	46.5 (262)	40.6 (229)
More than once a day	26.4 (149)	16.7 (94)
Missing	1.4 (8)	2.0 (11)

Factors associated with children's intake of fruit and vegetables

The factors investigated in the present study are considered in three categories: demographic characteristics, feeding environment including behaviour of parents, and characteristics of the child. All univariate predictive variables are then included in a multivariate analysis.

Demographic characteristics

Parents with more education had children who ate more vegetables ($t(550) = 2.72$; $P = 0.007$), but no such effect was seen for fruit intake ($t(552) = 0.76$; $P = 0.45$). No relationship was found between deprivation/affluence score and either fruit or vegetable consumption. Children from 'other' ethnic groups ate less fruit than did 'white Caucasian' children ($t(481) = 2.06$; $P = 0.04$) but there was no ethnic difference in vegetable consumption ($t(479) = 1.19$; $P = 0.24$).

Parental feeding practices

The amount of fruit or vegetables that parents themselves reported eating was a strong predictor of their children's intake, with positive correlations between adult's and child's intakes of vegetables ($r = 0.49$; $P < 0.001$) and fruit ($r = 0.39$; $P < 0.001$).

Family feeding practices (scale mean = 1.92, SD 0.97) were modestly correlated with vegetable consumption ($r = 0.10$; $P = 0.02$), with a trend in the same direction for fruit ($r = 0.08$; $P = 0.06$) indicating that traditional family mealtimes were associated with higher intakes.

The earlier the age that children had been introduced to vegetables, the greater the child's current intake ($r = -0.10$; $P = 0.02$). A similar effect was observed for fruit ($r = -0.13$; $P = 0.004$). Roughly 10% of respondents failed to complete this section of the questionnaire on the grounds that they were unable to recall when they had introduced fruit or vegetables. The analyses were therefore re-run after assigning the sample mean to all missing values, with no material difference in the outcome.

Early infant feeding practices also appeared to be influential. Children who had been exclusively breast-fed ate vegetables more often than those who had been both breast- and bottle-fed, who in turn ate them more often than those who were entirely bottle-fed (linear $F(1,544) = 11.2$; $P = 0.001$). The same effect was observed for fruit consumption (linear $F(1,546) = 16.2$; $P < 0.001$).

Child characteristics

Older children ate vegetables significantly more often than younger ones ($r = 0.09$; $P = 0.03$), but there was no association between age and fruit consumption.

The two eating behaviour characteristics that were measured were both significantly associated with consumption. Children who were more neophobic ate fruit less often ($r = -0.16$; $P < 0.001$) and vegetables less often ($r = -0.27$; $P < 0.001$) than their peers. Children who enjoyed food more ate fruit ($r = 0.14$; $P = 0.001$) and vegetables more often ($r = 0.28$; $P < 0.001$).

Multivariate analyses of fruit and vegetable intake

In total, 10 variables were found to be significantly related to fruit consumption, vegetable consumption or both (see Table 2). Influences were apparent from demographic, familial and trait factors and differed somewhat in their impact on fruit and vegetable intake. In order to assess their individual contribution in relation to other predictor variables, the six variables significantly related to fruit intake and the nine related to vegetable intake were entered into separate multiple regression analyses.

Multivariate predictors of fruit consumption

Children's fruit intake was most strongly predicted by parental intake. There was a persistent influence of early feeding, with children who had been breast-fed eating more fruit. Child food neophobia remained a significant predictor, as did early introduction to fruit. These four factors accounted for 20% of the variance in consumption. In their presence, ethnicity and enjoyment of food failed to contribute significantly to the variation in intake (see Table 3).

Multivariate predictors of vegetable consumption

The pattern for predicting vegetable consumption had some similarities. Again the strongest predictor of child's intake was adult's intake, followed by neophobia. Enjoyment of food and gender also had significant effects, together explaining 34% of the variation in intake (see Table 4). In contrast to fruit consumption, early feeding method (breast or bottle) did not have an independent effect in the presence of these four variables. Similarly, the impact of child's age, family feeding practices, age of introduction to vegetables and parental education were no longer predictive, suggesting that their effects were either part of, or mediated by, the effects of one of the other variables in the analysis.

When analyses were repeated on 'mothers' only no differences were observed except that white ethnicity remained a significant independent predictor of fruit intake in the multivariate analyses, where it had dropped out when all respondents' data were included.

Discussion

The results of this survey provide further evidence of the low levels of fruit and vegetable consumption in children, with more than one-third of children failing even to eat fruit and vegetables on a daily basis, despite a number of public awareness campaigns. The findings are broadly in line with previous research in this area[11,23] and amply demonstrate the scale of the problem of poor diet in children in the UK. Since respondents typically

Table 2 Univariate associations (Pearson's product–moment correlation coefficients) for potential predictor variables and frequency of children's fruit and vegetable intake*

Variable	Frequency of fruit consumption	Frequency of vegetable consumption
Demographic characteristics		
Sex of child 1 = boy 2 = girl	0.04	**0.12**[b]
Child's age	0.001	**0.10**[a]
Ethnicity 1 = white Caucasian 2 = other	**− 0.09**[a]	− 0.05
Parents' education level 1 = leaving full-time education before the age of 21 2 = leaving full-time education after the age of 21	0.03	**0.12**[b]
Food environment		
Adult intake	**0.39**[d]	**0.49**[d]
Early feeding 1 = no breast-feeding 2 = some breast-feeding 3 = full breast-feeding	**0.17**[d]	**0.14**[c]
Age of introduction to fruit/vegetables	**− 0.13**[c]	**− 0.10**[a]
Family feeding practices	0.08	**0.10**[a]
Child characteristics		
Child food neophobia (score 6–24)	**− 0.16**[d]	**− 0.27**[d]
Child enjoyment of food (score 4–16)	**0.14**[c]	**0.28**[d]

* Significant correlations are highlighted in bold.
Significantly correlated: [a], $P < 0.05$; [b], $P < 0.01$; [c], $P < 0.005$; [d], $P < 0.001$ (two-tailed).

overestimate intake of fruit and vegetables[49], the true picture could be even more worrying than our figures suggest.

Significant predictors of children's fruit and vegetable intake emerged from all three categories examined. Demographic factors associated with greater vegetable consumption were mother's education and child's age and gender. A positive relationship between maternal education and child's fruit intake has been reported previously[24,25] but not with vegetable intake, although the very high average level of education among respondents in the present study limits the conclusions we are able to draw. The finding of greater vegetable intake in older children may be related to a reduction in neophobia that occurs with age[43]. That boys ate vegetables less often than girls is consistent with previous research with adults[29] and children[11]. However, our finding applies to younger children than previous research and it seems unlikely that gender differences in health beliefs would mediate this result at this age.

Table 3 Result of the simultaneous multiple regression analysis of univariate predictors of frequency of children's fruit consumption

Variable	*B*	Standard error of *B*	*β*	*t*	*P*(*t*)
Adult fruit intake	0.178	0.021	0.35	8.34	0.000
Early feeding	0.052	0.019	0.12	2.81	0.005
Child food neophobia	− 0.009	0.004	− 0.12	− 2.48	0.014
Age of introduction to fruit	− 0.013	0.006	− 0.09	− 2.07	0.039
Ethnicity	− 0.056	0.030	− 0.080	− 1.90	0.058
Child enjoyment of food	0.007	0.005	0.062	1.28	0.200

$r = 0.45$, $r^2 = 0.20$, adjusted $r^2 = 0.19$, $F(6, 458) = 19.3$, $P < 0.001$.

Demographic predictors of fruit intake differed from those for vegetables, with the only significant association being between ethnicity and fruit intake. Interpretation of the finding that 'white Caucasian' children eat more fruit than 'other' ethnic groups is problematic, however, given the under-representation of ethnic minorities in the sample.

Parental consumption was a highly significant predictor of both fruit and vegetable intake, which is consistent with previous research findings[24,35]. This could be attributed to a combination of factors including modelling effects[41], availability in the home[50] and other aspects of the shared environment, as well as genes. However, given the finding that children's food preferences may themselves influence the family diet[51], a definite causal interpretation is not possible. Early experiences with food were also influential, with associations between breast-feeding and early introduction to fruit and vegetables and child's intake. In addition, family feeding practices were associated with a higher intake of vegetables though not of fruit. Lastly, characteristics of children themselves were strong predictors of fruit and vegetable consumption. As predicted, lower food neophobia and greater enjoyment of food were related to higher intakes of both fruit and vegetables.

The results of the subsequent multivariate analyses permit examination of the relative importance of the factors that influence children's fruit and vegetable intake

Table 4 Result of the simultaneous multiple regression analysis of univariate predictors of frequency of children's vegetable consumption

Variable	*B*	Standard error of *B*	β	*t*	*P*(*t*)
Adult vegetable intake	0.278	0.023	0.45	11.93	0.000
Child food neophobia	−0.014	0.003	−0.19	−4.49	0.000
Child enjoyment of food	0.013	0.004	0.13	2.95	0.003
Sex of child	0.061	0.02	0.11	2.97	0.003
Family feeding practices	0.013	0.011	0.045	1.21	0.229
Age of introduction to vegetables	−0.004	0.003	−0.043	−1.17	0.244
Early feeding	0.017	0.016	0.039	1.05	0.294
Parental education	0.018	0.022	0.029	0.78	0.434
Age of child	0.001	0.001	0.029	0.772	0.440

$r = 0.58$, $r^2 = 0.34$, adjusted $r^2 = 0.33$, $F(9, 499) = 28.49$, $P < 0.001$.

in the univariate analysis and their relationships with other variables. The strongest independent predictor of children's fruit and vegetable consumption was parental intake. In addition, the impact of child food neophobia remained significant for both (though less so for fruit than for vegetable consumption). In the presence of these factors, however, significant independent predictors differed between fruits and vegetables. For frequency of fruit intake there was a persistent effect of early feeding experiences (breast-feeding and early exposure) whereas the frequency of vegetable consumption was affected by child's gender and enjoyment of food. The influence of all other variables was rendered non-significant. Whilst the analyses performed here do not permit the establishment of causal relations, they do indicate that some variables share variance, or are on a pathway, with one another. The relationship between these predictor variables warrants further investigation. Overall, in contrast with previous research in older children[24] which documented quite separate predictors of fruit and vegetable consumption, the present study found that fruit and vegetable intake were predicted by two factors in common – food neophobia and parental consumption.

Before discussion of the implications and applications of the findings of this study, a number of limitations require acknowledgement. Respondents were predominantly white, middle-class and highly educated. Findings cannot therefore be generalised to less privileged populations. The sample characteristics may have led us to underestimate the extent of the prevalence of low fruit and vegetable intake and the strength of the relationship with socio-economic status. This assertion requires further investigation. A further shortcoming concerns the measure used to assess intake of fruit and vegetables. The scale used to assess children's consumption (from 'never' to 'more than once a day') was designed to build on previous research findings by illustrating just how far below recommended guidelines their intake falls. Perhaps because of the high socio-economic status of the majority of participants, responses were skewed towards the top end of the scale and we were unable to distinguish any very high consumers from average consumers, although previous research suggests that very few children eat more than two daily servings of fruit and vegetables combined. Finally, the reliability of responses to items concerning the timing of introduction of fruit and vegetables during the weaning process was questionable and the interpretation problematic. Almost 10% of participants failed to complete this section on the grounds that they could not remember exactly when they had introduced certain foods. It is also reasonable to question the likely accuracy of those who did estimate the timing, to the nearest month, of an event that had taken place as much as 5 years previously.

Despite these limitations, a number of areas for intervention are suggested by the results. First, whilst awareness of the importance of high consumption of fruit and vegetables has been the focus of education campaigns in recent years, the relevance of this message to children's eating may not have filtered through to parents and requires re-stating. A further area for research concerns early feeding practices. The promotion of breast-feeding could include information on the possible future benefits of a greater acceptance of fruit and vegetables. The strength of the association between children's intake and food neophobia suggests that this trait is an important barrier to food acceptance. The evidence that early and repeated taste exposure can reduce neophobia and increase acceptance of foods should inform the guidance given to parents during weaning and into childhood. Above all, parents should be made aware of the potential importance of their own fruit and vegetable intake in encouraging their children to eat a healthy diet.

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