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« EARLY EXPOSURE TO FRUIT AND VEGETABLES »

Editorial

The focus of this month's IFAVA Newsletter is fruit and vegetable (FV) exposure in the early years. In the light of evidence that food preferences and consumption patterns are developed in early childhood, and that the typical diet of pre-schoolers is less than optimal, it is vital that interventions begin early.

Mary Kay Fox's contribution sets the scene by describing the food consumption patterns of US two to three year olds. Using 24-hour dietary recall data from FITS (The Feeding Infants and Toddlers Study), the food intake pattern of 1,461 toddlers was analysed and compared with dietary recommendations. Findings were mixed with some encouraging increases in whole milk, and whole-grain cereal consumption , but only 74% of children had eaten any fruit and only 71% had had any vegetables on the day of the survey with potatoes (including french fries) being the most commonly consumed. Clearly, there is considerable room for improvement in this age group.

Dr Coulthard's article uses data from the longitudinal ALSPAC study to examine the impact of early introduction to fruit and vegetables during the weaning period on intake in later childhood. Whilst infants who were exposed to more home-cooked or raw FV at six months of age consumed more FV at seven years, the same effect was not observed in children fed ready-prepared FV. These findings highlight the need to target interventions at parents before they introduce their infants to solid foods.

Finally, Dr Lakkakula and colleagues investigated the impact on older children's liking for vegetables of repeated taste exposure during school lunches. Ten weekly tastings resulted in increased liking in children who had previously indicated their dislike for the vegetables offered. That these techniques were effective in the real world setting of a school cafeteria, is especially encouraging.

Children's diets remain a cause for concern, but high quality research is increasing our understanding of the problem and pointing the way to effective and age-appropriate interventions.

Lucie Cooke
Health Behaviour Research Centre
Department of Epidemiology and Public Health
University College, London

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Infants and Young Children Are Not Eating Enough Vegetables

— Mary Kay Fox[2], Denise Deming[1], Ronette Briefel[1], Kathleen Reidy[2], Elizabeth Condon[2] —

1. Research and Development, Nestle Infant Nutrition, Florham Park, NJ, USA

2. Mathematica Policy Research, Inc., Washington, DC and Cambridge, MA, USA

Vegetables are a key component of a healthy diet. Because food acceptance patterns form early in life, it is important for parents and caregivers to introduce older infants and young children to a wide variety of vegetables, and to encourage consumption of these foods. We used data from the Feeding Infants and Toddler Study, 2008 (FITS 2008), sponsored by the Nestle Nutrition Institute, to assess patterns of vegetable consumption among infants and young children. Data on dietary intake were collected via 24-hour recalls conducted by telephone with parents or primary caregivers of infants (0-11.9 months), toddlers (12-23.9 months) and preschoolers (24-47.9 months). Below, we present three key findings from this research.

1. Substantial numbers of infants and young children consume no discrete serving of vegetables in a day. At 6 to 8.9 months of age, 63% of infants consumed at least one discrete serving of vegetables in a day (Table 1 excluding small amounts of fruits and vegetables in mixed dishes such as pizza and spaghetti). This proportion increased to 72% among older infants but began to decline after that. Among two and three year old children, 70% consumed at least one discrete serving of vegetables in a day. Thus, for most age groups, more than one quarter of children consumed no discrete servings of vegetables in a day. In addition to lack of vegetable consumption, the types of vegetables being consumed is a concern. Consumption of nutrient-dense vegetables was low. For most age groups, fewer than 15% consumed dark-green vegetables. Consumption of deep-yellow vegetables was more common, but declined substantially with age — dropping from 36% at 6 to 8.9 months of age to 14% at two to three years of age.

2. Patterns of vegetable consumption deteriorate as early as the first year of life. Based on per capita intakes (unpublished data), the amount of any vegetable consumed dropped from 84.0±7.5 g/day among older infants (6-11.9 months) to 64.2±3.8 g/day among toddlers and 63.6±3.9 g/day among preschoolers, a downward shift that occurred as baby food vegetables fell out of the diet. A concurrent shift in the types of vegetables in the diet occurred with white potatoes replacing deep-yellow vegetables as the dominant vegetable after infancy. deep-yellow vegetables dropped from 39% of the amount of vegetables consumed among older infants to 19% and 14% among toddlers and preschoolers, respectively, while white potatoes rose from 12% of the amount of vegetables consumed among older infants to 29% among toddlers and preschoolers. By the age of two, about half the amount of white potatoes consumed were French fries (9.4±1.5 g/day), and French fries (22.9±3.1 kcal/day) contributed more than two thirds of the average total caloric intake of white potatoes (32.2±3.2 kcal/day).

3. Preschoolers are not consuming recommended amounts of vegetables. Children two years of age and older should be following dietary patterns recommended in the Dietary Guidelines for Americans. We assessed children's total vegetable intake (including vegetables consumed as part of mixed dishes) using the MyPyramid Equivalents Database[3] and estimated the distribution of usual vegetable intake using the personal computer version of the Software for Intake Distribution Estimation (Iowa State University). Using these methods, we found that, on average, children two to three years of age consumed 0.6 cup of vegetables per day, an amount that is 40% below the recommended amount of one cup[4]. Moreover, 88 percent of children in this age group consumed less than the recommended one cup of vegetables per day.

The FITS 2008 data indicate that some of the dietary patterns of concern for older children and adults begin very early in life. A major conclusion is that pediatric healthcare professionals need to encourage parents and caregivers to think about the quality of the foods they are feeding their children, as well as when to introduce specific kinds of foods. It is important to emphasize that food preferences are established early in life and may predict future eating habits. Older infants and toddlers should consume several different types of colorful, nutrient-rich vegetables each day.

Table 1. Percentage of Infants, Toddlers, and Preschoolers Consuming at Least One Discrete Serving of Vegetables in a Day[1,2]

	6-8.9 mos	9-11.9 mos	12-14.9 mos	15-17.9 mos	18-20.9 mos	21-23.9 mos	24-47.9 mos
	Percentage (S.E.)						
Any Vegetable	62.8 (5.3)	72.3 (4.8)	72.4 (4.7)	70.8 (5.0)	72.1 (4.1)	68.1 (5.7)	69.7 (2.0)
Baby Food Vegetables	51.3 (5.3)	33.8 (4.3)	15.1 (3.5)	7.6 (2.3)a	2.7 (1.6)	1.5 (1.0)a	0a
Cooked Vegetables	15.2 (3.5)	45.4 (5.0)	61.0 (4.8)	60.7 (5.1)	69.2 (4.2)	62.9 (5.7)	59.8 (2.1)
Raw Vegetables	0a	4.8 (1.9)a	6.1 (1.9)a	9.5 (2.3)	8.6 (2.7)a	15.6 (4.5)	21.8 (1.9)
Types of Vegetables							
Dark Green Vegetables	2 (1.6)a	10.9 (3.6)	10.9 (3.2)	6.5 (1.8)a	12.6 (4.5)	8.7 (2.6)	12.7 (1.7)
Deep Yellow Vegetables	36.0 (4.9)	30.3 (4.1)	24.4 (4.5)	15.1 (3.6)	20.7 (5.1)	15.4 (4.7)	14.0 (1.7)
White Potatoes	5.4 (2.5)a	20.1 (3.6)	32.4 (4.6)	29.6 (5.0)	26.1 (4.2)	31.5 (5.6)	30.6 (2.0)
French fries and other fried potatoes	0.8 (0.6)a	6.3 (2.3)a	18.5 (3.8)	11.6 (3.7)	13.8 (3.2)	16.7 (3.7)	18.5 (1.8)
Other Starchy Vegetables	12.4 (3.5)	12.6 (2.7)	11.8 (2.1)	22.8 (4.3)	17.9 (4.5)	22.6 (4.6)	14.6 (1.3)
Other Vegetables	23.9 (4.9)	28.4 (4.4)	26.8 (3.7)	34.3 (4.4)	36.2 (5.3)	35.2 (5.3)	34.1 (2.1)
Sample Size	249	256	243	251	219	212	1,461

a : point estimate is considered imprecise because of small sample size and uncommon or very common event.

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Long-term consequences of early fruit and vegetable feeding practices in the United Kingdom

— Helen Coulthard[1], Gillian Harris[2] & Pauline Emmett[3] —

1. Division of Psychology, Hawthorn Building, De Montfort University, Leicester, UK
2. School of Psychology, University of Birmingham, Edgbaston, Birmingham, UK
3. Department of Community-Cased Medicine, Bristol University, Bristol, UK

Exposure to fruit and vegetable (FV) variety in the early weaning period has been found to influence later acceptance of foods in short-term experimental studies[1,2]. In addition, longitudinal studies have found that early introduction to FV has been associated with increased consumption in later childhood[3,4]. The purpose of this study was to further research the long-term associates of early fruit and vegetable exposure. In particular, whether the age of introduction and frequency of exposure to different forms of FV (home cooked vs. ready prepared vs. raw) in the early weaning period predicted later FV consumption at seven years of age.

A prospective, longitudinal study was carried out on a geographically representative population of 7,866 infants born in Avon, UK, as part of the Avon Longitudinal Study of Parents and Children (ALSPAC). Mother completed self-report questionnaires at six months and seven years about their child's FV intake In particular they were asked to report the age of introduction and frequency of consumption of home cooked, ready prepared and raw fruit and vegetables at six months. At seven years, they filled in a frequency of fruit and vegetable consumption measure. Hierarchical regressions were carried out to see whether consumption of FV at seven years could be predicted from frequency of consumption of ready prepared, raw and home cooked fruits and vegetables at 6 months. Demographic factors, such as breast-feeding, financial difficulties, the age of introduction to solid foods and gender, were controlled for in the first step of the analyses.

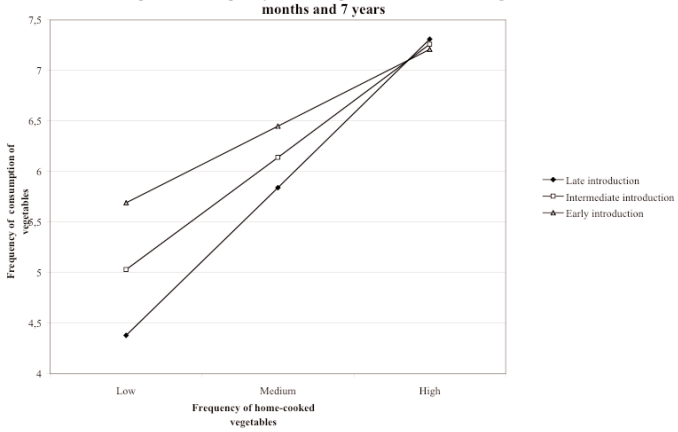
It was found that infants who were given more home-cooked, or raw, fruits and vegetables at six months, were significantly more likely to be eating fruits and vegetables at seven years ($p<0.001$). The provision of ready-prepared fruits and vegetables at six months was not associated with later fruit and vegetable eating ($p>0.01$). It was also found, for home cooked vegetables only, that age of introduction moderated the relationship between provision at six months and seven years. Infants who were given home cooked vegetables at a later age (later than 5.65 months), and given them less frequently, were more likely to eat fewer vegetables at seven years of age. However, infants whose mothers introduced vegetables at a later age, but gave them frequently, had rates of consumption at seven years comparable with those infants introduced to home cooked vegetables earlier ($t(6167)= 2.59$, $p<0.01$, see fig.1).

The results of the present study support those of previous research[3,4] that early exposure to fruits and vegetables is associated with higher levels of FV consumption during childhood. In addition, this study shows that the form of FV provision may also be associated with later consumption. In particular the provision of raw and home cooked, but not ready prepared, FV at six months was more strongly associated with higher levels of FV consumption in childhood. The finding that provision of ready prepared FV did not predict later FV consumption, is an interesting and novel finding, but one that should be treated with caution. It could be argued that exposure to homemade fruits and vegetables are advantageous in a number of ways. Small differences in the preparation of home cooked foods will probably provide the infant a greater variety of taste and texture, which cannot be achieved by feeding ready prepared products. However, it may not be the quality of ready prepared foods that explains this finding. The alternate explanation is that parents, who buy ready prepared baby food, may rely on convenience products more generally, and it is factor that may account for the differences in findings.

The finding that age of introduction moderated the relationship between frequency of consumption of home cooked vegetables at six months and seven years, suggest that the age at which foods are introduced may affect the exposure process. In particular that foods which are more challenging, such as vegetables, may need optimum exposure periods. This research was carried out prior to the WHO recommendation that babies be exclusively breast fed for six months, and it is likely that a similar study carried out today would yield different findings.

This is one of the first studies to examine the form of fruit and vegetable provision during weaning, and how it may be associated with later FV consumption. Further experimental exposure studies may be necessary to explore whether home cooked foods really provide an enriched exposure experience for infants.

Figure 1: Age of introduction to home-cooked vegetables moderates the relationship between frequency of consumption of home-cooked vegetables at 6 months and 7 years



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Repeated taste exposure increases liking for vegetables by low-income elementary school children

— Anantha P Lakkakula and colleagues —

School of Human Ecology, Louisiana State University, Baton Rouge, LA, USA

Children's food preferences are known to be key determinants of their consumption[1]. Frequent experience with foods through sight, smell, and taste is critical to achieving acceptance of these items by children[2]. Repeated taste exposures and modeling of healthy behaviors have been found to be effective in improving food preferences in children[3,4]; however, investigations conducted in public elementary school settings are very limited. It is important to demonstrate the effectiveness of food tasting in settings where children make food choices such as school cafeterias. In the present study we examined if repeated tastings of selected vegetables in school cafeterias increased children's liking of these items.

Cafeteria vegetable tasting

Fourth and fifth grade students attending four elementary schools volunteered to participate. The program began with four consecutive weeks of tasting, followed by a three week break and was halted for three weeks due to school vacations and concluded by six additional weeks of tasting. On the same day and at the same time every week children were offered small samples of freshly prepared vegetables in the cafeteria with their regular lunch. The cold vegetables served included one baby carrot, a small piece of tomato and one-half tablespoon of diced green bell pepper. The hot vegetable included a one-half tablespoon serving of cooked canned green peas without any seasoning. Hot and cold vegetables were served in separate containers. Researchers directed the children to taste the vegetables using a standard script. Children completed a short survey indicating whether they swallowed the vegetable, spat it into the napkin, or did not put it in their mouth, and also recorded their liking for each vegetable after each tasting (5). The responses "swallowed the vegetable" and "spat it into the napkin" were considered as tasting that particular vegetable. If a child refused to taste any of the four vegetables, he/she did not receive a score for that vegetable for that particular day of tasting.

Repeated tasting increased children's liking of vegetables

Three hundred and forty-eight children tasted at least one vegetable during the first or second opportunity to taste and were divided into two groups based upon their first response: Group 1 included those children who indicated that they "did not like" a particular vegetable and group 2 included those children who reported an opinion of either "liked" or "liked a lot" for the particular vegetable. The children's liking scores in the two groups were followed over the 10 tasting sessions for each vegetable.

The liking scores improved for carrots, peas, and tomatoes in group 1 but there was no change for bell peppers. Children reported 5.5 times higher liking scores for carrots, 5.6 times higher liking scores for peas, and 2.8 times higher liking scores for tomatoes at T10 when compared to their liking score at T1. In group 2 children no change was observed in liking scores. The greatest percentage of children reported a change in opinion to liking or liking a lot by the eighth tasting for bell peppers and tomatoes and by the ninth tasting for carrots and peas.

Conclusions

Repeated taste exposures to targeted vegetables increased children's liking for these foods. Eight to nine tastings may be necessary to impact the maximum number of children. The study procedure can be easily adopted by elementary schools and parents as a means to increase children's liking and acceptance of vegetables. However future studies should address the most effective age for intervention and the impact of greater liking on actual vegetable consumption.

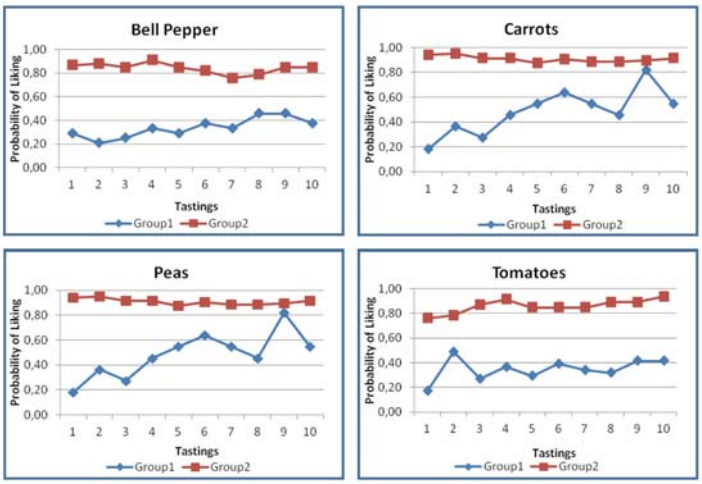

Figure: Change in liking scores among fourth- and fifth-grade children over 10 tastings

Note. Numbers on the horizontal axes correspond to the number of tastings. Group 1: "Dislikers" at the first tasting and Group 2: "Likers" at the first tasting.

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