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Original Article

Fruit and vegetable exposure in children is linked to the selection of a wider variety of healthy foods at school

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Abstract

Schools often offer healthy fruits and vegetables (FV) and healthy entrées. However, children may resist these efforts due to a lack of familiarity with the offerings. While numerous exposures with a food increase its liking, it may be that an exposure to a variety of FV at home leads to greater willingness to select other foods – even those that are unrelated to those eaten at home. As an initial test of this possibility, this study was designed to examine how self-reports of exposure and consumption of various FV were associated with the selection of FV and lunch entrées at school. Participants ($n = 59$) were a convenience sample of elementary children. A median split was used to place students into high- and low-exposure groups for self-reports of both exposure and consumption at home. The primary dependent variables were self-reports of selecting FV at school; the children's absolute and relative ratings of eight 'healthier' lunch entrées; and self-reports of selecting these entrées. These entrées were recently added to the school menu and, therefore, tended to be less familiar to children. Food ratings were collected through taste exposures conducted at school. Results indicate that children who reported more frequent exposure to FV at home consumed a wider variety of FV at school and were more likely to report selecting 'healthier' entrées at school lunch. These data suggest that exposure to, and the consumption of, a variety of FV may make children more willing to select a wider range of FV and other healthy entrées.

Keywords: children, fruits and vegetables, exposure, school lunch.

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This study was approved by The University of Texas Institutional Review Board, and both parental consent and student assent were obtained prior to data collection.

Introduction

Childhood obesity is a nationwide epidemic. Results from the 1976–1980 and 2007–2008 National Health And Nutrition Examination Survey (NHANES) indicate that obesity increased from 6.5% to 19.6% in children aged 6–11 years, and from 5.0% to 18.1% in adolescents aged 12–19 years (Ogden *et al*. 2012). Obese and overweight children are at an increased risk for numerous adverse health conditions, including high blood pressure, hyperlipidemia, elevated insulin levels, elevated low-density lipoprotein cholesterol levels, type 2 diabetes, orthopaedic complications, and psychological and behavioural problems (depression, low self-esteem, anxiety) (Deckelbaum & Williams 2001; Weiss *et al*. 2004; Freedman *et al*. 2007). Children with a body mass index in the 85th–95th percentile are classified as overweight and are at risk for being overweight or obese later in life, with this risk increasing with increasing age

(Deckelbaum & Williams 2001; Guo *et al.* 2002; Morrison *et al.* 2008). Thus, it is important to intervene early in order to establish lasting, long-term health behaviour patterns.

Although the causes of childhood obesity are complex, primary contributors appear to be an overall pattern of consumption emphasising high-fat foods and sugary beverages, and a decreased intake of fruits and vegetables (FV) (Nicklas *et al.* 2001; Berkey *et al.* 2012). In fact, pizza, snacks and desserts may account for one-third of the daily intake of a child's diet (Van Horn *et al.* 2005), with 30% of adolescents consuming fast food up to three or more times per week (Bauer *et al.* 2009). In contrast, FV consumption is known to aid in weight management due to its low-energy density and high water and fibre content (Rolls *et al.* 2004; Ledikwe *et al.* 2006; Vioque *et al.* 2008). Several researchers have demonstrated a link between an increased FV intake and a lower body weight (Kahn *et al.* 1997; Trudeau *et al.* 1998; Lin & Morrison 2002; He *et al.* 2004), as well as a reduced risk for chronic disease, including cardiovascular disease, diabetes, certain types of cancers and metabolic syndrome (Riboli & Norat 2003; Esmaillzadeh *et al.* 2006; Yeh *et al.* 2008). Additionally, dietary patterns and eating behaviours developed during childhood have been shown to track into adolescence and adulthood (Kelder *et al.* 1994; Ritchie *et al.* 2007; Cutler *et al.* 2009).

Despite the increased awareness of the importance of FV intake and initiatives, such as Healthy People 2020, FV consumption among children in the United States falls well below recommendations. It is estimated that only 10–14% of girls and boys aged 4–8 years and 18–20% of children 9–13 years consume the USDA Nutrition Plate recommendations of five or more servings of FV per day (Guenther *et al.* 2006). A recent analysis of the 2003–2004 NHANES data by Kimmons *et al.* (2009) indicates that this may be an overestimation. When data were analysed in the form of two, non-consecutive 24-h recalls – instead of a single day – results indicated that a shocking 0.9% of adolescents aged 12–18 years met the recommendations.

This lack of FV consumption may derive from an absence of early and consistent exposure to a variety of FV. An early study by Birch *et al.* (1987) demonstrated that 'taste' exposures are more effective than merely 'look' exposures in increasing a child's preference for seven novel fruits. Likewise, Wardle *et al.* (2003b) found that daily exposure to sweet red pepper strips for 2 weeks, or eight tasting sessions, significantly increased both the liking and the consumption in children aged 5–7 years, compared to a no-treatment control. This effect is generalisable to parent intervention. Wardle *et al.* (2003a) demonstrated that a 14-day parent-led exposure to an initially disliked vegetable increased liking, ranking and consumption of the target vegetable in children 2–6 years of age.

The evidence supporting the link between exposure, preference and intake of FV has led to the implementation of numerous school-based nutrition intervention programmes to prevent weight gain. With 50% of youth eating at least one meal at school and 10% consuming two (Hendy *et al.* 2005; Howerton *et al.* 2007), the school setting is an ideal environment for targeting food behaviour change in youth. In February of 2010, First Lady Michelle Obama introduced a nationwide initiative, Let's Move, and incorporated the HealthierUS School Challenge (HUSSC) into her campaign. HUSSC was

Key messages

- Both being offered and eating a range of fruits and vegetables (FV) at home predicted children's reports of consumption of FV offered at school lunch.
- Children offered a greater variety of FV at home were more likely to select the chef salad, Greek salad and veggie hummus plate than those not frequently offered FV at home.
- Future interventions should focus on ways to increase exposure to, and accessibility of, FV in both the home and the school environment, as well as decrease the number of competing foods offered in conjunction with these lower-fat, novel entrées.

established in 2004 and awards schools that participate in the National School Lunch Program, with a monetary incentive for meeting a distinguished standard of food quality, nutrition education and physical activity opportunities. Four levels of performance are awarded based on criteria set forth by the USDA: Bronze, Silver, Gold and Gold of Distinction. For example, an elementary school awarded the Gold Standard must offer a different vegetable every day of the week, with dark green or orange vegetables offered three or more days per week and cooked dry beans or peas at least once per week.

The relative newness of the HUSSC awards provides a novel area of research for scientists in the health domain. Attempts to implement this programme will necessitate change in menu construction – often for foods that are unfamiliar to most children. For example, wrap and pita sandwiches, main-dish salads and novel vegetables (e.g. sweet potatoes) are being offered at a greater frequency to children who are not likely to have experience with these foods. Given the relationship between the number of taste exposures and food preference (Birch *et al*. 1987; Lakkakula *et al*. 2011), one would expect these, less familiar foods to be bypassed by children. If so, this would prevent sufficient exposure to develop a positive opinion of their taste and, potentially, undermines the effort to modify eating behaviour through the school lunch menu. However, this raises the question of if exposure must be tied to the specific foods or, if exposure to a variety of FV might generalise to other food items.

The existing research has centred on the match between exposure and later food selection of the target item – e.g. exposure to celery increases liking and consumption of celery (Wardle *et al*. 2003a,b). However, might exposure to celery also increase children's willingness to select and enjoy a Thai salad and other novel entrées? There are reasons to expect this to be the case. Children who are exposed to a variety of FV may be more willing to experiment with other less familiar foods. Falciglia *et al*. (2000) found that neophobic children (unwilling to try new foods) had less overall diet quality, as assessed by the USDA Healthy Eating Index, than both 'average' and 'neophilic' children. In addition, exposure to more bitter FV might also create less reactance to other less sweet foods. Prior to testing these potential mediators, it would be reasonable to ascertain if exposure to a variety of FV is associated with taste ratings of less popular lunch entrées. Taste-test data have previously been used to describe the absolute and relative preference of low-fat entrées in elementary school children (Jowers *et al*. 2009). Results found numerous instances in which a high absolute rating for the entrée was paired with a low intention to select, when presented as an alternative to popular, higher-fat entrées (e.g. cheeseburger). The distinction between the absolute and relative ratings of the entrées demonstrates that low-fat foods can be palatable to children but not selected for lunch at school.

Thus, this study is designed to (1) examine the relationship between exposure to a variety of FV in children and the consumption of FV at school lunch; (2) to quantify the preference for several novel lunch entrées, recently introduced to the Gold Standard lunch menu; and (3) to examine the relationship between FV exposure at home and selection of these recently introduced lunch entrées at school.

Materials and methods

Participants

The participants were 59 ethnically diverse children enrolled in the third, fourth and fifth grades (total number of students enrolled = 264) in a Central Texas elementary school, awarded the USDA Gold Standard. Specific demographic information is reported in the Results section. Gender and race/ethnicity were based on self-report at the distribution of the first survey. This study was approved by The University of Texas Institutional Review Board, and both parental consent and student assent were obtained prior to data collection.

Instrumentation

The FV questionnaire was developed to test home and school exposure for five fruits (orange, pineapple, mandarin orange, melon and apple) and six vegetables (cucumber, carrots, bell pepper, broccoli, zucchini

and tomato) offered as a part of this particular elementary school's lunch. These foods were chosen because they are offered as side dishes each week as a part of the Gold Standard menu. Previous studies have provided evidence that children will reliably report FV exposure. Domel *et al.* (1993) measured FV exposure and preference to fruits, vegetables and snacks in fourth and fifth graders, and found internal consistencies to range from 0.65 to 0.95 and test–retest reliabilities from 0.65 to 0.84. A more recent study by Economos *et al.* (2008) assessed FV exposure in 6–9-year-old children, and found that over 90% of the children reported valid intake recall (as was confirmed through direct observation), with test–retest reliabilities for recall ranging from 93% to 94% (fruits) and from 76% to 90% (vegetables). For the present study, we applied this methodology with two photos of a single fruit or a single vegetable. One was a photo of how it was offered at school and the second was a generic photo of the same item. To assess exposure, each page contained two identical columns, one in English and one in Spanish, with four multiple-choice questions that referred to the specific fruit or vegetable pictured at the top of the page (e.g. 'My parents have never offered this to me, sometimes offer this to me, always offer this to me'). The four questions are shown in Table 1 and are similar in language and format as those found in previous research (Economos *et al.* 2008). Cronbach's alphas ranged from 0.72 to 0.78 for the fruit items and from 0.59 to 0.74 for the vegetable items. In general, children tend to prefer fruits over vegetables due to their sweet taste and pleasant texture (Kroiner *et al.* 2011) and are, therefore, more likely to be offered and to eat a wider variety of fruits than vegetables. As a result, while the alphas for the vegetable items are acceptable, the lower value is expected as children are likely to have less exposure to a wider range of vegetables than fruits. Items were coded as 0 (never offered) and 1 (sometimes or always offered) and summed across all food items for each child. A median split was used to categorise students into high and low groups for parent offering of the FV at home and into high and low groups for the actual consumption of the FV at home.

Table 1. High and low group participant characteristics

	Parents offer		Eat at home	
	Low	High	Low	High
Mean FV offered/Eaten (#)	6.29	9.84	5.63	9.16
Male (%)	52.0	52.0	52.0	45.2
Female (%)	48.0	48.0	48.0	54.8
Third graders (%)	17.9	29.0	18.5	28.1
Fourth graders (%)	14.3	3.2	14.8	3.1
Fifth graders (%)	67.9	67.7	66.7	68.8
Non-Hispanic white (%)	11.5	9.7	12.0	9.4
Hispanic white (%)	65.4	58.1	64.0	59.4
Non-Hispanic black (%)	7.7	9.7	8.0	9.4
Hispanic black (%)	11.5	0.0	12.0	0.0
Non-Hispanic Asian (%)	3.8	6.5	4.0	6.3
Hispanic American Indian (%)	0.0	16.1	0.0	15.6

FV, fruits and vegetables.

The taste-test evaluation form used in this study was developed by Jowers *et al.* (2009) for absolute and relative taste ratings for the school lunch in elementary children (test–retest reliability coefficient = 0.87). Children were asked to provide an absolute rating of the entrée on a 5-point Likert-type scale (0 = disliked a lot, 4 = liked a lot). Relative rating was assessed for each food by asking children if they would (1) select the food for lunch with no comparison and (2) select the food instead of several comparison foods that were offered as a part of their lunch menu: fruit and cheese platter, whole grain chicken nuggets and whole grain pizza. These items were selected because they reflect the range of entrée popularity. For each question, children circled a 'yes' or a 'no', coded as 1 and 0, respectively. Selection against pizza, chicken nuggets, and the fruit and cheese platter were analysed using binomial tests to indicate the child's preference for the specific entrée.

Procedure

Administration of the FV questionnaire took place in the school gym during a physical education (PE) class. Children entered the gym during their assigned class time and those that had provided parental consent and written assent to participate in the study were pulled aside. The number of students taking the questionnaire at any one time ranged from 5 to 17. The questionnaires, clipboards and pencils were

distributed to the students and they were given verbal directions for completion of the first page (identification and demographics). These directions included clarifying information for each item, as well as responses to any questions from the students. Upon completion of the first page by the full group, verbal instructions pertaining to each question of the survey were given to ensure understanding and clarity. Students proceeded, question by question, following the instructions, and were encouraged to ask questions at any time during the assessment. The questionnaire took approximately 10–15 min to complete, after which students joined the rest of the class for the remainder of PE.

The district offered three lunch entrées each day, and we limited to 4 days of data collection. Children tasted all three entrées offered for that day's lunch, resulting in a total of 12 taste tests: whole grain cheese pizza, Thai chicken salad, chicken ranch pita, chef salad, whole grain chicken nuggets, ham and cheese sub, Greek salad, sunbutter and apple sandwich, veggie hummus plate, turkey cheese pocket, chicken patty and cheeseburger. The pizza, chicken nuggets, chicken patty and hamburger were not included in the analyses because of their high popularity among the students. All samples were prepared by the food service staff the morning of the testing and were one-fourth the size of a normal lunch entrée. Prior to student arrival, cups with water, eating utensils and the taste-test forms for the first entrée were placed at every other seat on the cafeteria tables by the researchers. Children entered the cafeteria as a class and were instructed to sit down and fill out the identification and demographic information. In an effort to limit peer pressure for a particular response, children were spaced apart by at least one seat for all testing. Food samples were then distributed and the children were told to taste the food and then fill out the evaluation. Members of the research team monitored the completion of the forms to ensure that students followed the protocol and understood all items on the evaluation. Students were instructed to raise their hand when they had finished, and a staff member collected the form. After collection of the forms for the first entrée by all students in a particular class, the same procedure was repeated for the subsequent entrées for that day. Students tasted no more than three entrées in each tasting session. If any students were unwilling to taste the sample, the research staff was told to collect the food and the form was not included in the data analyses. However, no instances of complete refusal to try a sample were reported by the research staff. Three of the four tasting sessions were conducted in the morning, at approximately 9:30 am, while one session was conducted at 1:30 pm, due to a special request by the school personnel.

Results

Participants

Of the 59 participants, 59.3% were Hispanic white, 8.5% were non-Hispanic white, 11.9% were non-Hispanic black, 5.1% were Hispanic black, 8.5% were American Indian, 5.1% were Asian and 1.7% were Native Hawaiian. The gender of the sample was evenly divided (30 girls and 29 boys), with 23.7% enrolled in the third grade, 8.5% in the fourth grade and 67.8% in the fifth grade. None of the students failed to taste a food and, as a result, all children were included in the analysis. A median split was used to categorise students into high and low groups for parent offering of the FV at home and into high and low groups for the actual consumption of the FV at home. The demographic characteristics of these groups are summarised in Table 1. For parent offering of FV at home, the low group was offered a mean of 6.29 FV and the high group was offered a mean of 9.84 FV. There was an even distribution of gender in each group, with both the low and the high group having exactly 48.0% females and 52.0% males. The low group was 11.5% non-Hispanic white, 65.4% Hispanic white, 7.7% non-Hispanic black, 11.5% Hispanic black and 3.8% non-Hispanic Asian. The high group was 9.7% non-Hispanic white, 58.1% Hispanic white, 9.7% non-Hispanic black, 6.5% non-Hispanic Asian and 16.1% Hispanic American Indian. The low group was composed of 17.9% third graders, 14.3% fourth graders and 67.9% fifth graders. The high group was composed of 29.0% third graders, 3.2% fourth graders and 67.7% fifth graders. For the actual consumption of FV at home, the low group ate a mean

of 5.63 FV and the high group ate a mean of 9.16 FV. The low group was 48.0% female and 52.0% male, while the high group was 54.8% female and 45.2% male. The low group was 12.0% non-Hispanic white, 64.0% Hispanic white, 8.0% non-Hispanic black, 12.0% Hispanic black and 4.0% non-Hispanic Asian. The high group was 9.4% non-Hispanic white, 59.4% Hispanic white, 9.4% non-Hispanic black, 6.3% non-Hispanic Asian and 15.6% Hispanic American Indian. The low group was composed of 18.5% third graders, 14.8% fourth graders and 66.7% fifth graders. The high group was composed of 28.1% third graders, 3.1% fourth graders and 68.8% fifth graders.

Fruit and vegetable items: descriptives

All data were analysed using SPSS Version 19 (SPSS Inc., Chicago, IL, USA). Mean scores ± standard deviations for each FV for the four variables of interest ('parents offer', 'eat at home', 'school offers' and 'eat at school') are reported in Table 2. There was a range of 0–2 for each variable (0 = never offered, 1 = sometimes offered, 2 = always offered), with $n = 59$ students.

Prediction of fruit and vegetable consumption at school

To determine if exposure to and eating a variety of FV at home were associated with the consumption of FV at school, Mann–Whitney *U* independent non-parametric tests were conducted between the categorised high and low groups and the consumption of FV at school. This required two sets of analyses. One set of analyses was conducted for students who reported high or low home offerings ('parents offer'). A second set of analyses was conducted as a function of high and low consumption ('at home I eat'). Both sets of tests used self-reported consumption of individual FV as the dependent variable.

Results indicated that consumption at school significantly differed between the high- and low-exposure groups for 6 of the 11 FV items: oranges ($z = 2.16$, $P < 0.05$), cucumber ($z = 2.44$, $P < 0.05$), pineapple ($z = 3.41$, $P < 0.01$), mandarin oranges ($z = 2.93$, $P < 0.01$), tomato ($z = 3.14$, $P < 0.01$) and broccoli ($z = 3.26$, $P < 0.01$). In contrast, the level of consumption at school significantly differed between the high and low home consumption groups for 10 out of the 11 FV items: oranges ($z = 2.24$, $P < 0.05$), cucumber ($z = 2.64$, $P < 0.01$), pineapple ($z = 4.19$, $P < 0.01$), mandarin oranges ($z = 3.06$, $P < 0.01$), tomatoes ($z = 3.47$, $P < 0.01$), bell pepper ($z = 2.25$, $P < 0.05$), broccoli ($z = 4.00$, $P < 0.01$), melon ($z = 3.06$, $P < 0.01$), apples ($z = 2.79$, $P < 0.01$) and zucchini ($z = 2.27$, $P < 0.05$). Thus, consumption at home had a broader impact on consumption at school than did mere exposure to FV at home.

Table 2. Descriptive statistics on fruits and vegetable items

	Parents offer		Eat at home		School offers		Eat at school	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Orange	1.19*	0.57	1.19	0.57	1.15	0.41	1.12	0.49
Cucumber	0.98	0.63	0.95	0.75	0.97	0.49	0.76	0.68
Carrots	1.14	0.60	1.25	0.66	1.02	0.47	0.98	0.67
Pineapple	1.10	0.61	1.32	0.71	1.11	0.59	1.25	0.78
Mandarin oranges	1.14	0.78	1.25	0.85	1.11	0.45	1.32	0.75
Tomato	0.78	0.77	0.51	0.65	0.86	0.48	0.48	0.68
Bell Pepper	0.42	0.59	0.34	0.58	0.43	0.62	0.25	0.54
Broccoli	1.19	0.71	0.98	0.78	1.02	0.47	0.88	0.77
Melon	1.19	0.68	1.25	0.71	0.03	0.55	1.07	0.77
Apple	1.47	0.68	1.51	0.69	1.17	0.53	1.47	0.68
Zucchini	0.46	0.60	0.36	0.61	0.53	0.57	0.40	0.65

*0 = never offered, 1 = sometimes offered, 2 = always offered.

Taste tests: descriptives

Absolute ratings

Mean scores ± standard deviations for the absolute ratings of each entrée are reported in Table 3. Paired *t*-tests were conducted between the means for the absolute ratings, and a significance level of 0.05 was used for all comparisons. Results are summarised in Table 3. An examination of the mean differences indicates that the entrées varied greatly in their absolute preference ratings. Post hoc analysis indicated that all entrées fell within one of three bands of student absolute preference rating (indicated by superscripts a, b and c). Entrées within each group are not different from one another, but are significantly ($P < 0.05$) different from the entrées in the other two groups. The highest rated group of entrées, marked with an 'a', was rated by participants between 2.50 and 3.00 on the 4-point Likert-type scale. These included the ham and cheese sub and sunbutter and apple sandwich. The second band of entrées, marked with a 'b', was rated by participants between 1.50 and 2.00 on the same scale. These included the chef salad, chicken ranch pita, turkey cheese pocket and the Thai salad. The least preferred grouping, marked with a 'c', was rated between 0.80 and 1.05 on the same scale. These included the Greek salad and veggie hummus plate.

Additionally, the mean scores ± standard deviations and effect sizes for the absolute preference ratings by group (high and low for parental offering of FV and high and low for the consumption of FV at home) were calculated and are reported in Table 2. Differences between means were analysed using a one-way analysis of variance. Results indicated that these groups only differed in two of the eight entrées tested. A significant difference between the absolute ratings of the chef salad ($F = 7.65$, $P < 0.01$) and the Greek salad ($F = 11.04$, $P < 0.01$) were found between high and low groups of parental offering of FV. No significant differences were found between the high and low groups for the consumption of FV at home.

Relative ratings

The relative ratings of the eight entrées of interest were analysed using binomial tests of significance and

Table 3. Descriptive statistics on absolute ratings of entrées

Entrée	*n*	Overall		Parents offer low		Parents offer high		Effect size	Eat at home low		Eat at home high		Effect size
		Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Ham and cheese sub	53	3.00[†]	0.90	2.87	1.01	3.10	0.80	0.25	2.75	1.03	3.21	0.73	0.52
Sunbutter and apple sandwich	52	2.63[†]	1.36	2.73	1.25	2.52	1.47	0.16	2.68	1.28	2.57	1.45	0.08
Chef salad	55	1.98[‡]	1.51	1.40*	1.47	2.47*	1.38	0.75	1.67	1.58	2.23	1.43	0.37
Chicken ranch pita	50	1.94[‡]	1.25	1.82	1.40	2.04	1.14	0.17	2.00	1.41	1.90	1.15	0.08
Turkey and cheese pocket	25	1.70[‡]	1.10	1.61	1.15	1.82	1.08	0.19	1.71	1.22	1.69	1.03	0.01
Thai salad	48	1.52[‡]	1.30	1.17	1.03	1.84	1.46	0.54	1.18	1.14	1.81	1.39	0.50
Greek salad	52	1.05[§]	1.16	0.56*	0.85	1.54*	1.24	0.94	0.82	1.11	1.26	1.20	0.38
Veggie and hummus plate	52	0.86[§]	1.01	0.60	0.90	1.12	1.07	0.53	0.58	0.91	1.11	1.05	0.54

*Significant difference between groups ($P < 0.01$). [†]Sunbutter and apple sandwich and ham and cheese sub (highest rated group of entrées). [‡]Chef salad, chicken ranch pita, turkey cheese pocket and Thai salad (medium rated group of entrées). [§]Greek salad and veggie hummus plate (least preferred entrées).

Table 4. Comparison of relative ratings of entrées

Entrée	Pizza (%)	Chicken nuggets (%)	Fruit and cheese platter (%)
Ham and cheese sub	21*	38	57
Sunbutter and apple sandwich	27	29	58
Chef salad	24	22	25
Chicken ranch pita	21	17	38
Thai salad	25	18	45
Turkey and cheese pocket	12	20	28
Greek salad	15	17	14
Veggie and hummus plate	6	4	10

*The percent of students that would pick the entrée of interest over the comparison item (either pizza, chicken nuggets or the fruit and cheese platter).

tested relative to the 50% distribution (Ho: $P = 0.50$). Results are reported as the percent of students that would pick the entrée of interest over the comparison item and are shown in Table 4. The results of the binomial tests were similar to the data for the absolute preference ratings, with three levels of preference for these entrées. The highest rated entrées were found for the ham and cheese sub and the sunbutter and apple sandwich. These were followed by a lower, but similarly grouped set of ratings for the chef salad, chicken ranch pita, Thai salad and the turkey cheese pocket. The lowest relative ratings were found in the Greek salad and the veggie hummus plate. Additionally, it can be seen that intention to select was highest when the entrées were compared to the fruit and cheese platter.

Prediction of entrée selection

To determine if exposure to and eating a variety of FV at home were associated with the selection of FV at school, Mann–Whitney *U* independent non-parametric tests were conducted between the categorised high and low groups and the consumption of FV at school. This required two sets of analyses. One set of analyses was conducted for students who reported high or low home offerings ('parents offer'). A second set of analyses was conducted as a function of high and low consumption ('at home I eat'). Both sets of tests used self-reported selection of individual FV as the dependent variable.

Results indicated that the distribution of selection differed between high and low groups for parental offering of FV at home for three of the eight entrées. These included the chef salad ($z = 2.55$, $P < 0.05$), the Greek salad ($z = 2.09$, $P < 0.05$) and the veggie humus plate ($z = 2.10$, $P < 0.05$). In the second analysis, the distribution of selection across high and low groups for the consumption of FV at home was only significant for one of the eight entrees – the veggie and hummus plate ($z = 2.02$, $P < 0.05$) – although there was a trend for the chef salad and the Thai salad.

Discussion

The first aim of this study was to examine the relationship between exposure to a variety of FV in children and the consumption of FV at school lunch. Results indicated that the self-report of both being offered a range of FV at home and of actually eating a range of FV at home predicted children's reports of consumption of FV that are offered at school lunch. This finding supports existing literature that home availability and accessibility of FV is associated with child intakes of those foods (Van Der Horst *et al.* 2007; Pearson *et al.* 2009; Spence *et al.* 2011), as well as supporting the theory that exposure drives preference and consumption of foods in children (Wardle *et al.* 2003a,b; Cooke 2007). In this study, children who were highly exposed to FV at home were willing to eat more of the FV offered at school lunch, including typically 'disliked' items, such as cucumbers and tomatoes (Lakkakula *et al.* 2008).

The second aim of this study was to quantify the preference for several lunch entrées that had recently been introduced to the Gold Standard lunch menu. The absolute and relative taste-test ratings indicated that children liked the ham and cheese sub on whole grain bread and the sunbutter and apple sandwich most out of the eight entrées taste-tested. This may be due to a resemblance of these foods to familiar items – e.g. the typical deli sandwich and a peanut-butter and jelly sandwich. Indeed, Pliner & Stallberg-White (2000) demonstrated that children were more willing to try novel foods when it was paired with a familiar flavour than when it was served alone. The chef salad, chicken ranch pita, turkey and cheese pocket, and

Thai salad were moderately liked by children and may be a viable option for schools to offer with greater frequency in the future. The relative ratings of these entrées showed a reasonably high intention to select (near 20%) even when paired against popular items, such as pizza and chicken nuggets. This value increased when the comparison item was the fruit and cheese platter. This supports previous literature that states that reducing the number of high-fat competing entrées offered in conjunction with low-fat items will increase the likelihood of the selection of these items. Bartholomew & Jowers (2006) showed that low-fat entrees were selected more than twice as often when they were paired with one rather than two alternative, higher-fat entrees at elementary school lunch.

Finally, the third aim of this study was to examine the relationship between FV exposure at home and the selection of several unfamiliar lunch entrées at school. To our knowledge, this is the first study to assess the generalisability of FV exposure to other types of food. Our results indicated that children who were offered a greater variety of FV at home were more likely to select the chef salad, the Greek salad and the veggie hummus plate than those who were not frequently offered FV at home. This was also supported by the significant difference between high and low groups of parental offering of FV between the absolute ratings of the chef salad and the Greek salad. Although this trend was not true for every entrée, this novel finding suggests that offering children a variety of FV may lead to a willingness to try new foods; especially those items that are typically avoided. For example, the Greek salad and the veggie hummus plate were rated the lowest in both absolute and relative terms, but were both more likely to be selected by those with higher exposure to FV at home. While this conclusion is speculative, it does hold promise for potential intervention design and a direction for future research.

These findings highlight the importance of continuing to increase the amount and variety of FV offered to children in the school environment, as it is apparent that not all children are regularly exposed to these foods at home. Second, results found numerous instances in which a high absolute rating for the entrées was paired with a low intention to select when presented as an alternative to popular, high-fat entrées (e.g. cheeseburger). Thus, by decreasing the number of higher-fat or 'popular' items, children may select the unfamiliar and more healthful lunch entrées at a greater frequency. This would result in an increased number of exposures to these foods and thus the potential to enhance preference. Taste-test data have been used to describe the absolute rating and relative preference of low-fat entrees in elementary school children (Jowers *et al*. 2009). The distinction between the absolute and relative ratings of the entrées demonstrates that low-fat foods can be palatable to children but not selected for lunch at school.

Limitations

There are several limitations in this study. First, the conclusions of this study are based on a relatively small sample of children of varied developmental levels and thus may not generalise to all elementary students. Second, this study measured the absolute and relative preference for the entrées, not the actual selection and consumption of the items during school lunch. Although it would have been ideal to support the intention scores with actual purchases, several studies have utilised similar measurements to predict health behaviour (Saba & Di Natale 1998; Nader *et al*. 1999). Third, this study utilised self-report of children's exposure to and consumption of FV without parent verification. However, as previously stated, researchers have demonstrated children's ability to accurately report FV exposure and intake (Domel *et al*. 1993; Economos *et al*. 2008), and obtainment of full psychometric properties was beyond the scope of this study. Fourth, the participants in this study were of a narrow range of ethnicity (predominately Hispanic); thus, we do not know if the high and low groupings used in the analyses would generalise across other schools of a more varied population. Fifth, in a desire to construct a workable set of items, the assessment tool was limited to the 11 FV offered in this school lunch. While this included both popular (apples, oranges, carrots) and less popular (broccoli, zucchini, melon) items, it failed to include other popular (e.g. grapes) and less popular (papaya) items. This raises the possibility that some other sets of items

might result in a different pattern of results. However, there was a significant relationship between exposure to these items and food preference. Thus, it appears as if the items were sufficient to tap into some aspect of general exposure. Despite this, further test of this methodology, with different items, is warranted. Finally, we did not assess the history of children's exposure to the 'less familiar' entrées and, thus, we do not know if children were being offered items such as hummus or salads at home, nor do we know how often they had selected these entrées at school. However, this was the first year that these entrées appeared on the school lunch menu and, thus, all children had the same school exposure to each entrée at school. A check of the menu in the months in which data collection took place indicated that children were exposed, on average, to each of the eight entrées two and a half times per month; the maximum number of times any one entrée was offered in a single month was four.

Conclusions

The present study found that children who are more frequently exposed to 11 FV at home consume more FV at school and are more likely to select healthy, less familiar entrées at school lunch. Future interventions should focus on ways to increase the exposure to and accessibility of FV in both the home and the school environment, as well as decrease the number of competing foods, particularly those that engender low relative preferences, offered in conjunction with these lower-fat, novel entrées.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

EVK and JBB analysed and interpreted the data. EVK wrote the initial draft of the manuscript and JBB provided statistical guidance in data analyses, as well as guidance in the interpretation of results and subsequent manuscript revisions. All co-authors participated in data collection and manuscript preparation and critically reviewed the text for important intellectual content.

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