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Dietary Intakes of Children From Food Insecure Households

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Introduction

Food security refers to access by all people at all times to enough food for an active, healthy life.[1,2] According to the classifications obtained with the USDA food security survey, a food secure household can be further classified as high food security or marginal food security. Individuals or households with limited or uncertain access to adequate food are considered to be food insecure. In turn, food insecurity has two categories: low food security (LFS) or very low food security (VLFS) (see Figure 1).[2]

Figure 1: Food Security Categories and Description of Conditions in the Household[2]

Food security	High food security	No reported indication of food-access problems or limitations.
	Marginal food security	One or two reported indications-typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake.
Food insecurity	Low food security	Reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake.
	Very low food security	Reports of multiple indications of disrupted eating patterns and reduced food intake.

In 2010, 14.5 percent of US households were food insecure at least some time during that year, of which 5.4 percent experienced VLFS.[3] As described in Figure 1, VLFS occurs when household members are unable to feed themselves adequately due to economic deficiencies or lack of resources. This results in reduced food intake or disrupted eating patterns. Household members with very low food security may experience hunger because they are unable to afford enough food.

A consistent relationship between food insecurity and poor health status has been demonstrated across a wide range of literature. Numerous studies have shown that individuals living in food insecure households are more likely to report poor physical and mental health than those living in food secure households.[4] Food insecurity has been associated with increased risk of obesity, heart disease, type 2 diabetes mellitus, high blood pressure, and food allergies.[4-6] However, these

relationships have been found more often among adults, especially mothers, compared to children.

While causal relationships between food insecurity and obesity are difficult to establish, there are several associations that may account for this seemingly paradoxical relationship. Studies have found that food insecurity is associated with lower quality diets, inadequate nutrient intake, and reduced consumption of fruits, vegetables, meat, and dairy products with increased consumption of cereals, sweets, and added fats.[7-9]

Despite this vulnerability, very little research attention has been given to the diet of food insecure individuals, especially children. The relationship between food insecurity and dietary outcomes is complex. While some studies have shown that food insecurity is associated with lower dietary intakes, some point in the opposite direction. There is substantial evidence that living in a food insecure household has undesirable consequences for children, including poor quality diets[10,11] and negative health outcomes.[12-15]

Because of the paucity of the literature on this issue, we undertook this study to understand further the dietary behaviors of children living in food insecure homes. As the definitions of LFS and VLFS suggest, there could be a difference in dietary intake in children from LFS households compared to children from VLFS households. Thus, the objective of this descriptive paper is to compare the dietary behaviors of children from LFS households with children from VLFS households over an entire day and during meals specifically consumed at home.

Methods

Study Design

The cross-sectional data were collected as part of a larger longitudinal study with 120 low-income children, 9 to 12 years old. This study was approved by the Institutional Review Board at Baylor College of Medicine, Houston, Texas. Parents provided written consent for themselves and their children, and children provided assent.

Data Collection

Participation for the study was solicited from 150 children, of which 120 agreed to participate. Data were collected in Fall 2010 from the 120 children and their parents. These children were enrolled in a local community-based after-school program. Parents of the recruited children completed a demographic questionnaire along with a food security questionnaire. Children completed 24-hour dietary recalls in-person at the centers.

Demographic Questionnaire
This included questions about the participating child's age, sex, ethnicity, number of adults and children in the household, average annual household income, and parent's marital and educational status.

Food Security Questionnaire
Food security status, the dependent variable, was measured using the short form of the USDA Food Security Scale.[16,17] The responses to the questionnaire were coded based on specifications by the USDA and summed to calculate a food security score. This scale has been used and validated in a number of studies with ethnically diverse populations.[17]

Dietary Assessment
Children's diet was assessed using data collected from 24-hour food recalls. Two recalls were conducted with the children at the centers following usual practice[18] in 2 consecutive weeks. Several validation studies have provided support for the use of 24-hour dietary recalls in children as young as third grade[19-23] and as the most appropriate method for collecting dietary data from diverse cultural groups.[24] All recalls were conducted during weekdays, excluding Monday, by trained personnel. Interviews used the 2-dimensional food model booklet to help children describe portion sizes. These recalls were entered into Nutrition Data System for Research (version 2010; Nutrition Coordinating Center, University of Minnesota) for analysis, which automatically classifies foods into different food groups.[25] Daily consumption of nutrients (total energy, protein, percent of energy from fat and saturated fat, dietary fiber, vitamins A and C, calcium, iron, and sodium) and food groups (servings of fruit, juice, and regular vegetables [non-fried] and ounces of low-fat milk, sweetened beverages, meat, whole grains, desserts and snacks) were obtained. A serving of each food group was based on USDA Center for Nutrition Policy and Promotion guidelines.[26]

Statistical Analysis
Data from the food security module were coded based on USDA coding guidelines and categorized into food secure and food insecure (LFS and VLFS).[2] In addition, data from the 2 24-hour food recalls were averaged for each child before calculating means. Analysis of Variance (ANOVA) was used to compare overall daily dietary intake of nutrients and food groups between the 2 groups (LFS vs. VLFS), controlling for Body Mass Index (BMI) percentile. In addition, separate set of analyses were conducted to assess differences in dietary intake for meals consumed at

home, comparing the 2 groups. Data were analyzed using SPSS (Version 19). Statistical significance was set at 0.05.

Results

Of the 120 participants, complete data were available for 107 children, of which a very small percentage (5%) were from food secure households and were thus excluded from the analyses. All variables for the remaining 102 participants were checked for normality. Descriptive characteristics of the study participants are presented based on their food insecurity status in Table 1. Of the 102 participants, 68 participants were LFS, and 34 were VLFS. Mean child's age was 10.2±1.8 years old with a mean BMI percentile of around 79. About 53% of the participants were females, and approximately 91% of the participants were Hispanic. The majority had at least 2 adults and more than 2 children in the household. About 58% of the households had an average annual income of less than $21,000, with about 91% of the children participating in the free/reduced-price lunch program at school.

Mean values for nutrient intakes are reported in Table 2. Mean energy intake of children from LFS group was 1606.6±661.1 kcals as compared to 1781.5±801.7 kcals in children from VLFS group. No significant differences were found between the two groups for overall daily intakes of nutrients. In addition, mean values for servings of food groups are also reported in Table 2. However, no significant differences were observed between the 2 groups.

Of the 102 children, 40 reported consuming a snack at home (27 LFS vs. 13 VLFS), 98 reported consuming dinner at home (64 LFS vs. 34 VLFS), and 99 reported consuming breakfast at home (65 LFS vs. 34 VLFS). As seen in Tables 3, 4, and 5, there were no significant differences found in the nutrient and food group intakes for any of the meals at home except for vitamin C, which had a higher consumption among LFS group compared to VLFS group during breakfast ($p=0.04$).

Table 1. Descriptive Characteristics of the Participants

Participant Characteristic	Total	LFS	VLFS
	N=102	n=68	n=34
Child's age (Mean±SD)	10.2 ± 1.8	10.1 ± 1.0	9.9 ± 1.0
BMI percentile (Mean±SD)	79.1 ± 25.5	78.5 ± 23.4	79.6 ± 27.5
Child's sex			
Male	49	33	16
Female	53	35	18
Ethnicity			
Hispanic	93	64	29
Non-Hispanic	9	4	5
Average annual household income			
<$21,000	60	31	29
$21,000 - $41,000	34	29	5
$42,000 - $61,000	5	5	0
>$61,000	3	3	0
Number of adults in the household			
2	52	36	16
3	13	9	4
>3	37	25	12
Number of children in the household			
1	10	6	4
2	14	8	6
>2	78	54	24
NSLP participation			
Free/reduced-price lunch	93	61	32
Full price lunch	5	4	1
None	4	3	1
Parent's educational status			
<high school	36	22	14
≥high school	66	46	20

Table 2. Daily Nutrient and Food Group Intake

	Total	**LFS**	**VLFS**
Nutrients	**N = 102**	**N = 68**	**N = 34**
	Mean ± SD	Mean ± SD	Mean ± SD
Energy (kcal)	1663.8 ± 710.9	1606.6 ± 661.1	1781.5 ± 801.7
Protein (g)	67.9 ± 25.3	67.9 ± 26.1	67.9 ± 24.0
% fat	30.8 ± 6.2	30.9 ± 6.6	30.5 ± 5.5
% saturated fat	10.8 ± 2.7	10.8 ± 2.8	10.9 ± 2.4
Dietary fiber (g)*	13.6 ± 5.8	12.9 ± 5.3	15.1 ± 6.4
Calcium (mg)*	991.6 ± 408.7	964.9 ± 422.3	1046.3 ± 379.2
Iron (mg)	12.6 ± 5.5	12.3 ± 5.5	13.4 ± 5.3
Sodium (mg)*	2789.2 ± 1315.0	2657.3 ± 1140.1	3060.8 ± 1602.2
Vitamin A (mg)	747.5 ± 457.7	713.5 ± 453.8	817.5 ± 464.5
Vitamin C (mg)	68.6 ± 46.7	73.4 ± 51.3	58.6 ± 33.8
Food groups (servings)			
Fruit and juice	2.4 ± 2.2	2.5 ± 2.3	2.1 ± 1.8
Vegetables	3.3 ± 3.8	2.9 ± 3.8	4.0 ± 3.7
Whole grains	0.7 ± 0.9	0.7 ± 1.0	0.8 ± 0.9
Whole or reduced-fat milk	0.8 ± 1.7	0.8 ± 1.8	0.9 ± 1.5
Low-fat or fat-free milk	1.4 ± 1.1	1.3 ± 0.9	1.6 ± 1.4
Sugar-sweetened beverages	5.9 ± 10.8	6.6 ± 12.4	4.8 ± 6.7
Snack chips	0.7 ± 1.6	0.6 ± 1.5	0.9 ± 1.8
Desserts	0.6 ± 1.4	0.6 ± 1.5	0.7 ± 1.2

* Based on the mean results: calcium and fiber intakes were lower than the DRI; sodium intake exceeded the DRI.

Table 3. Nutrient and Food Group Intake During Breakfast at Home

	Total	**LFS**	**VLFS**
Nutrients	**N = 102**	**N = 68**	**N = 34**
	Mean ± SD	Mean ± SD	Mean ± SD
Energy (kcal)	319.8 ± 138.7	309.4 ± 131.1	339.9 ± 152.2
Protein (g)	11.8 ± 6.5	11.7 ± 6.9	12.0 ± 5.6
% fat	22.9 ± 9.9	22.8 ± 10.0	23.2 ± 9.8
% saturated fat	8.5 ± 3.5	8.4 ±3.6	8.7 ±3.4
Dietary fiber (g)	2.6 ± 1.5	2.6 ±1.4	2.6 ± 1.5
Calcium (mg)	298.1 ± 181.2	295.4 ± 201.9	303.2 ± 135.4
Iron (mg)	4.3 ± 3.4	4.2 ± 3.4	4.3 ± 3.3
Sodium (mg)	423.4 ± 266.1	419.9 ± 254.3	430.2 ± 291.3
Vitamin A (mg)	207.4 ± 137.9	214.2 ± 156.8	194.4 ± 92.2
Vitamin C (mg) ¶	16.9 ± 18.2	19.6 ± 20.4	11.9 ± 11.8
Food groups (servings)			
Fruit and juice	0.6 ± 0.6	0.6 ± 0.6	0.5 ± 0.5
Vegetables	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.0
Whole grains	0.3 ± 0.5	0.4 ± 0.6	0.3 ± 0.5
Whole or reduced-fat milk	0.8 ± 1.7	0.8 ± 1.7	0.8 ± 1.6
Low-fat or fat-free milk	1.2 ± 0.2	1.0 ± 0.6	1.6 ± 1.4
Sugar-sweetened beverages	0.4 ± 0.2	0.4 ± 1.2	0.3 ± 1.4
Snack chips	0.0 ± 0.1	0.0 ±0.1	0.0 ± 0.0
Desserts	0.1 ± 0.2	0.1 ± 0.2	0.1 ± 0.3

¶ Significant difference $p<0.05$ between LFS and VLFS group

Table 4. Nutrient and Food Group Intake Through Snacking at Home

	Total	**LFS**	**VLFS**
Nutrients	**N = 40**	**N = 27**	**N = 13**
	Mean ± SD	Mean ± SD	Mean ± SD
Energy (kcal)	318.0 ± 234.4	297.2 ± 200.0	358.3 ± 293.9
Protein (g)	7.2 ± 6.4	7.1 ± 6.7	7.4 ± 5.9
% fat	25.9 ± 19.3	27.7 ± 20.3	22.5 ± 17.2
% saturated fat	7.6 ± 6.2	7.3 ± 4.8	8.2 ± 8.5
Dietary fiber (g)	3.3 ± 3.1	3.2 ± 3.2	3.3. ± 3.1
Calcium (mg)	112.8 ± 108.0	91.5 ± 75.8	153.9 ± 137.9
Iron (mg)	1.9 ± 2.0	1.7 ± 1.9	2.4 ± 2.3
Sodium (mg)	387.9 ± 420.1	329.1 ± 283.8	501.4 ± 600.8
Vitamin A (mg)	80.5 ± 108.0	62.2 ± 86.3	115.8 ± 137.8
Vitamin C (mg)	17.4 ± 26.1	15.5 ± 25.4	21.2 ± 27.8
Food groups (servings)			
Fruit and juice	0.6 ± 0.8	0.7 ± 0.9	0.3 ± 0.6
Vegetables	0.1 ± 0.3	0.1 ± 0.2	0.2 ± 0.4
Whole grains	0.4 ± 1.1	0.2 ± 0.7	0.8 ± 1.5
Whole or reduced-fat milk	1.1 ± 2.5	0.9 ± 2.1	1.5 ± 3.4
Low-fat or fat-free milk	0.1 ± 0.6	0.1 ± 0.8	0.0 ± 0.0
Sugar-sweetened beverages	0.9 ± 2.8	0.8 ± 2.9	0.9 ± 2.4
Snack chips	0.5 ± 1.3	0.3 ± 0.9	0.7 ± 1.8
Desserts	0.3 ± 0.6	0.2 ± 0.3	0.5 ± 0.8

Table 5. Nutrient and Food Group Intake during Dinner Time at Home

	Total	**LFS**	**VLFS**
Nutrients	**N = 98**	**N = 64**	**N = 34**
	Mean ± SD	Mean ± SD	Mean ± SD
Energy (kcal)	500.4 ± 326.3	492.5 ± 334.9	515.3 ± 313.8
Protein (g)	21.9 ± 15.3	22.4 ± 16.3	20.9 ± 13.3
% fat	32.3 ± 11.8	32.4 ± 11.2	32.2 ± 12.9
% saturated fat	11.2 ± 5.6	11.3 ± 5.9	10.9 ± 4.9
Dietary fiber (g)	3.5 ± 2.9	3.3 ± 3.1	3.9 ±2.7
Calcium (mg)	193.7 ± 258.4	196.8 ± 292.4	187.8 ± 181.6
Iron (mg)	3.1 ± 2.1	3.1 ± 2.2	3.3 ± 2.1
Sodium (mg)	1029.0 ± 784.5	1000.7 ± 775.5	1074.7 ± 810.9
Vitamin A (mg)	109.9 ± 123.5	109.1 ± 130.5	111.6 ± 110.9
Vitamin C (mg)	21.5 ± 24.2	24.4 ± 27.3	16.0 ±15.9
Food groups (servings)			
Fruit and juice	0.4 ± 0.6	0.5 ± 0.7	0.3 ± 0.5
Vegetables	0.5 ±0.7	0.5 ± 0.8	0.6 ± 0.6
Whole grains	0.3 ± 0.7	0.3 ± 0.8	0.2 ± 0.4
Whole or reduced-fat milk	0.6 ± 1.8	0.6 ± 1.8	0.6 ±1.9
Low-fat or fat-free milk	0.1 ± 0.7	0.2 ± 0.8	0.0 ± 0.0
Sugar-sweetened beverages	3.5 ± 6.1	3.4 ± 6.6	3.8 ± 5.2
Snack chips	0.1 ± 0.3	0.1 ± 0.4	0.1 ± 0.2
Desserts	0.1 ± 0.6	0.1 ± 0.4	0.2 ± 0.9

Discussion

This paper examined whether there were differences in dietary intakes among children living in households with the two categories of food insecurity—LFS and VLFS. Based on the definitions of LFS and VLFS, we speculated that children from VLFS group would have lower dietary intakes compared to children from the LFS group. Among a group of Latino families, greater food insecurity (i.e., VLFS) was negatively related to the variety of foods present in the household,[27] thus affecting the parents' diet. However, in contrast, this study found no significant differences in either nutrient intakes or food group intakes between the 2 groups of children. Since the level of food insecurity was based on household, we also assessed whether there were differences in the intakes during meals at home. Children in this study consumed breakfast, snacks, and dinner at home. Although it was hypothesized that children in the VLFS group would have reduced intakes compared to those in the LFS group during meals at home, no significant differences were found except for vitamin C intake during breakfast. Although not statistically significant, the energy intake for the VLFS group was close to 200 kcals greater than that of the LFS group, a very significant difference clinically and in policy terms. This is in contrast to the study by Matheson et al,[28] which found that children who were more food insecure had lower energy intakes closer to the end of the income month. It would be an important next step to assess the diet of low-income children over a period of a month to assess the variability in diets.

There could be several reasons for such findings. First, regardless of whether the classification is LFS or VLFS, food insecurity may have little relation to children's diets. Several studies[29] have found that, in most food insecure households, children were protected from the effects of the household's food insecurity. Mothers compromised their own diets in order to preserve the healthier diets of their children.[28] Thus, it will be important for future research to also assess parental diet to determine whether the parental protection exists. Although children are thought to be protected from alterations in food intake in all but the most vulnerable of families, it is likely that other aspects of eating and nutrition not observed in this study are indeed different between children in the two levels of food-insecure households. Parental food purchasing and consumption, modeling behaviors, and other characteristics yet to be examined may elucidate differences between LFS and VLFS households that have been observed in other studies. For example, children may experience lower energy intake and intermittent food restrictions and adults may experience decreased fruit and vegetable consumption prior to paydays, potentially

influencing parental modeling, prompts to consume fruits and vegetables, involvement of other adults in feeding, and other behaviors and environmental characteristics that may encourage children's fruit and vegetable consumption.

Another potential reason for not finding a significant difference in dietary behaviors between the 2 groups may be that all the children from both the groups participated in school meal programs (National School Lunch Program [NSLP] and School Breakfast Program [SBP]) and that a majority received free/reduced-priced meals. Meals provided in the NSLP and SBP must follow national guidelines.[29-31] These children also had access to free dinner meals from the community center. Food insecure households that avoid hunger do so by supplementing food shortages with emergency food assistance and with federal food assistance programs, such as the Supplemental Nutrition Program for Women, Infants, and Children (WIC), the Supplemental Nutrition Assistance Program (SNAP), and NSLP and SBP.[32] According to the latest statistics, 55% of food insecure households participated in one or more of the 3 federal food and nutrition assistance programs—SNAP, WIC, and NSLP.[3] Perhaps the USDA's nutrition assistance programs are helping alleviate food insecurity, thus preventing the severe outcomes that might characterize individuals residing in homes with VLFS.

To reduce participant burden, this study used the parent-reported 6-item food insecurity module.[16] The 6-item module provides an acceptable substitute for the original 18-item module. It has been shown to identify food insecure households and households with VLFS with reasonably high specificity and sensitivity and minimal bias compared with the 18-item measure. It does not, however, directly ask about children's food security and does not measure the most severe range of adult food insecurity, in which children's food intake is likely to be reduced. Thus, for future research it will be beneficial to administer the 18-item module to get more accurate assessments.

Finally, the lack of statistical significance in the data may be due to the small sample size and the time of the month when data were collected. Emmons observed significant declines in servings of food groups between the first and fourth weeks of the month among low-income individuals.[33] Because the 24-hour recall data were collected from children over a period of a month, food intakes were not captured at distinct time points when households were expected to be most food insecure.

This study has a number of limitations, including a non-representative convenience sample of students and parents. The

generalizability of these findings to other groups of low-income individuals is unknown. The sample for this study was pre-dominantly Hispanics. Because this research was cross-sectional, causal relations between food insecurity and the diet of children cannot be discerned. Although researchers attempted to use measures and collect data in ways appropriate for low-literacy audiences, it is possible that self-reported behaviors reflect some degree of social desirability. Additionally, the short form of the Food Security Scale does not contain a measure of child hunger; this limited the researchers' ability to disaggregate children experiencing hunger from the rest of the sample. Because of the small sample size, standard deviations on several key variables were large, potentially making group differences too small to be statistically significant.

In summary, this research links the status of household food insecurity to children's food intakes. The economic downturn has signaled an even greater need to study the relationship between food insecurity and dietary intake due to the increase in the number of households not having adequate incomes to purchase the right quantity and quality of foods. Additional research aimed at understanding how low-income Hispanic families manage limited food resources is needed to develop programs that help alleviate short-term, acute food shortages. Moreover, research that compares food-assistance programs with or without community-based interventions designed to provide support and education for food insecure families is needed. These data provide important insights on whether all low-income children are receiving the benefits of the food assistance programs for which they may be eligible. The data also may guide the development of nutrition interventions that augment the food assistance programs already available to low-income families.

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