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Consumption of recommended food groups among children from medically underserved communities

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Abstract

This cross-sectional study of 2 to 12 year olds living in medically underserved areas examined the proportion of children meeting the food group intake recommendations for fruits, vegetables, total grains, dairy, and meat/meat alternatives by age group and body weight status. Based on 24-hour recalls collected between July 2004 and March of 2005, mean food group intake and deviation from the recommended intake amount were determined (actual intake minus recommended intake). Measured weight and height were used to calculate body mass index z-scores using the Centers for Disease Control and Prevention (CDC) growth charts. Analyses were conducted for two age groups (2 to 5 and 6 to 12 year olds) (n=214), by weight status categories (underweight or healthy weight (<85th percentile), overweight (85 to 94th percentile), or obese (≥ 95th percentile)), and repeated for the subset of children with biologically plausible reports. The majority of children lived in low-income households. More 2 to 5 year olds met intake recommendations compared to 6 to 12 year olds. Overall, the proportion of children meeting the food group intake recommendations was low with the exception of the meat group, which was met by 52% to 93% of children. There was a positive association between the proportion of younger children meeting the fruits or total grains recommendation and increasing body weight. The data support the importance of community-level nutrition intervention programs to improve children's diet quality in low income, medically underserved areas and suggest that such interventions may help reduce the risk of obesity.

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Keywords

child nutrition; nutrition monitoring; childhood obesity

Introduction

The prevalence of overweight in children is high in the United States (U.S.). Current estimates indicate that 17 % of children and adolescents are obese (≥95th percentile of the Center for Disease Control and Prevention's (CDC) age-and gender-specific body mass index (BMI)-for-age growth charts) (1–3), representing a three-fold increase (3) compared to two decades ago. The quality of children's diets may be an important contributor to the risk for obesity (4). Dietary intakes changed concurrently with the increase in BMI: consumption of total energy, fat, and added sugar intake increased (5–7) while intakes of fruits, vegetables, and whole grains were suboptimal (8–10).

Pediatric obesity prevention is a critical public health priority (11). There is an urgent need to clarify how dietary patterns might contribute to the development or perpetuation of obesity. This is particularly important in children from low-income (12,13) and ethnic minority communities (3,14–16) who may have higher obesity rates and are more likely to live in areas lacking medical services (17). Children living in such medically underserved areas often employ the free services of Health Resources & Service Administration (HRSA)-supported Community Health Centers (CHCs). These CHCs, therefore, are appropriate settings to examine the dietary characteristics of children living in an environment known to be highly predictive of obesogenic dietary behaviors.

To assess the need for community nutrition programs to improve the food intake of children served by CHCs or who have similar socioeconomic or ethnic backgrounds, intakes of the MyPyramid food groups were examined in a sample of CHC pediatric clients. Objectives were to identify the proportion of children meeting the recommendations in the total sample, in two age groups (younger 2 to 5 year olds and older 6 to 12 year olds), and by weight status categories. The hypotheses are that high proportions of children in this predominantly low-income population have low quality diets not meeting the MyPyramid intake recommendations for food groups and that intake patterns vary by body weight status.

Methods

This cross-sectional study was part of a larger study based on a convenience sample of children ages 2 to 12 years old who attended one of eight HRSA-supported CHCs in medically underserved areas of two HRSA regions. A more detailed description of the larger study can be found elsewhere (17). Parental informed consent and children's assent, when appropriate, were obtained. Approvals for this study were given by the Institutional Review Boards of The Children's Hospital of Philadelphia, the University of Pennsylvania, the Pennsylvania State University, and the Research Ethical Review Board of the National Center for Health Statistics.

Data collection was conducted between July 2004 and March of 2005 and included anthropometric measurements, a questionnaire administered to the child's caretakers, and repeated 24-hour dietary recalls with children. Children's height and weight were measured using standard techniques (17) and body mass index (BMI) z-scores were calculated to express deviation from the mean of the CDC BMI-for-age growth charts (2,18). Children were classified as underweight/healthy weight (<85th %ile), overweight (BMI 85th to 94th %ile), or obese (≥95th %ile) (1).

The questionnaire was administered by a trained interviewer from the staff of the CHC to the child's caretaker. Socio-demographic information was collected, including the child's age, sex, race, ethnicity, and household income. The questionnaires were professionally translated and administered in English, Spanish, or Chinese if the interviewers were fluent in the language. Interpreters were used as needed. To ensure standardized data collection, on-site training sessions were conducted as recommended (19). Personnel was trained at the sites to take anthropometric measurements based on standardized clinical measurement procedures. Each observer measured height and weight of children twice and observer measurements were compared to ensure accuracy.

Children's race and ethnicity were coded as Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, Hispanic, and Other. Household income was reported by children's caretakers in $5,000 increments. The method suggested by the U.S. Census Bureau for the calculation of the poverty income ratio (PIR) was employed to estimate relative income (20). Household income was subsequently dichotomized to reflect the proportion of children living in low income families (income-eligible for the Special Supplemental Program for Women, Infants, and Children, PIR<1.85) or non-low income families (PIR≥1.85).

Dietary information was collected by telephone-administered 24-hour dietary recalls on three randomly selected days including at least one weekend and one week day. Dietary data for children under six years old was reported by their caretaker while children ages seven and older reported their own diet with the help of an adult. Trained dietitians at The Diet Assessment Center at the Pennsylvania State University and the General Clinical Research Center (GCRC) at the Children's Hospital of Philadelphia collected the recalls. Dietitians in both centers completed the data collection training provided by Nutrient Data System for Research (NDS-R) and followed the same standardized dietary intake data collection protocol. Caretakers of children were given portion size estimate posters by the CHC staff at the research visit when the anthropometrics were measured and the questionnaire was administered. The dietitians prompted the caretaker and/or child to use the portion size estimate posters during the dietary recall phone call to improve the accuracy of the amount of foods consumed. If requested, household measurement units were used in lieu of the portion size posters to help estimate portion sizes consumed. Intake records were analyzed at the Diet Assessment Center using NDS-R (Version 4.06–34 ed., Nutrition Coordinating Center, University of Minnesota, Minnesota, 2003).

The method of Huang et al.(21) was employed to identify dietary intake data with plausible energy intakes. This method is based on the assumption that the reported energy intake should equal 100% of the predicted energy requirements in weight-stable conditions (since energy balance is a function of energy intake being equal to energy expenditure). Sex and age group-specific deviation cutoffs for reported dietary energy intake in proportion to the predicted (biologically plausible) energy requirement were calculated. Children were coded as having plausible records if reported average energy intakes were within two standard deviations of the predicted energy intake. Based on evidence that truncating data to a subset of individuals with intake reports above/below a set cutpoint does not improve understanding of diet-outcome relationship (22), analyses in this study were conducted in the total sample and the subsample of children with plausible energy intakes.

Average intakes of total energy (kcal/day) and MyPyramid food groups (fruit, vegetable, grain, milk/dairy, meat/meat alternatives) were calculated in cups or ounces per day. Continuous variables to express the deviation of food group consumption from the age- and sex specific recommended amount (actual intake minus recommended amount) were created. These "deviation from the intake recommendation" variables equaled zero when individuals met the intake recommendations and were negative values if actual intakes fell short of the

recommendation. Dichotomous variables were created for children meeting or not meeting the recommended intake of each food group. Percentages of children meeting each recommendation were determined. Due to the potential association between child age and BMI z-scores, data were stratified into two age groups commonly used to capture the developmental differences between preschoolers (2–5 year olds) and school-age children (6–12 year olds) (23). Results were tabulated for all children and the plausible reporters only by age group and by body weight status. All analyses were conducted in STATA 9.2 (STATA corporation; version 9.2, College Station, TX, 2004).

Results and Discussion

Sample characteristics

Total sample—Of the 319 children in the study, only children with two (n=24) or three (n=190) days of dietary intake data were included in this study. Children whose caretakers could not be reached for the 24-hour recalls or who had withdrawn from the study were not included in this analysis. Descriptive analysis of the sample indicated that approximately half of the children were 2–5 years old (Table 1). The majority of children (70%) lived in low-income households (PIR<1.85). The sample included more children classified as underweight/healthy weight (n=138) compared to overweight (n=30) or obese (n=46). Approximately 45% of the 2 to 5 and 36% of the 6 to 12 year olds were overweight or obese.

Mean total energy intake in the 2 to 12 year olds was 1,585 kcal/day, which is lower than the 1,800 kcal/day energy intake estimates of same aged children from the National Health and Nutrition Examination Survey 1999–2004. Similar to other studies, the 2 to 5 year olds had lower daily energy intakes compared to the 6 to 12 year olds (1,424 kcal compared to 1,738 kcal).

Dietary intake levels of food groups varied by age group (Table 2). Compared to the 6 to 12 year olds, 2 to 5 year olds' average intake deviated less from the food group intake recommendations. For instance, mean intake of fruits was approximately one half cup below the recommended level in the younger children but 0.8 cups too low in the older children. The largest observed deviation from the intake recommendation was found in the total sample and the plausible reporters of 6 to 12 year old who consumed on average 1.7 cups or almost 2 cups of vegetables less than recommended.

Only 3% of obese 2 to 5 year olds but between 9% and 13% of the 6 to 12 year olds met none of the food group recommendations. Overall, the proportion of children meeting the food group intake recommendations was higher in the 2 to 5 year olds compared to the 6 to 12 year olds. The lowest proportion of children met recommendations for the vegetable group. Only 36% of the 2 to 5 year olds and 23% of the 6 to 12 year olds met the recommendation for vegetables.

It has been noted that higher vegetable consumption contributes to lower body weight in children (24) and adults, perhaps because of the relatively high water content and satiating value of vegetables (25,26). However, this association between vegetable consumption and body weight status was not confirmed in this study, maybe due to lack of variation of vegetable intake in this sample. Data from this study concur with nationally representative data indicating an alarmingly low vegetable intake in the American population, particularly in low-income children (27).

Approximately 50% of children met the recommendations for total grains or dairy in all age and weight categories. Meat and meat alternatives were consumed in adequate amounts by more than half of the children in each age and body weight group.

No consistent increasing or decreasing proportion of children meeting recommendations with increasing body weight was observed. For instance, the percent of 2 to 5 year olds meeting the fruit and vegetable consumption levels decreased with increasing body weight status but the same change was only observed for the total grain and dairy group in the 6 to 12 year olds. However, for some food groups, the proportions of children meeting the intake recommendations were higher among the obese compared to the healthy weight children. In the 2 to 5 year olds, this observation held true for total grains, dairy, and meat and in the 6 to 12 year olds more obese children met the recommendations for fruit and meat.

Plausible reporters—There were no significant differences in age, sex, ethnic group, or body weight status between the total sample and the subsample of plausible reporters. As expected, the younger children 2 to 5 year old had lower daily energy intakes than older 6 to 12 year old children (1,207 kcal compared to 1,493 kcal).

The proportion of children with plausible intake reports who met the dietary intake recommendation differed from the total sample. For instance, none of the 2 to 5 year olds but more than 10% of the 6 to 12 year olds met none of the food group intake recommendations. It is also noteworthy that 20% of the obese 2 to 5 year old children met all five food groups, while none of the other 2 to 5 year olds or any of the 6 to 12 year olds met all food groups.

More than one third of the 6 to 12 year old population and more than 40% of the 2 to 5 year olds met the recommendations for fruits, grain, dairy, and meat. However, only 33% of the 2 to 5 year olds and 11% of the 6 to 12 year olds met the recommendation for vegetables. Interestingly, meat was consumed in adequate amounts by at least half of the children with the exception of the healthy weight 6 to 12 year olds (36%).

Similar to the total sample, there was no consistent change in the proportion of children meeting the food groups by body weight status in the plausible reporters. However, there was a direct association in the proportion of children meeting the food group intake recommendations with increasing body weight for fruits and total grains in the 2 to 5 year olds and the fruits in the 6 to 12 year olds. In contrast, a decreasing number of 6 to 12 year olds met the recommendations for total grain and dairy with increasing body weight status. Interestingly, there were more obese compared to healthy weight 2 to 5 year old children who met the food group recommendations for all five food groups while more obese compared to healthy weight 6 to 12 year olds met the recommendations for only the fruit and the meat groups.

Whole study

An important difference between the total sample and the plausible reporters was that lower average energy intakes and lower proportions of children meeting the intake recommendations were observed in the plausible reporters. However, there was a direct association between the proportion of children meeting the food group recommendations with increasing body weight only for some food groups in the younger plausible reporters. Overall, in this group of predominantly low income children high proportions of children did not meet any food group intake recommendations. It may be assumed that this population is at risk for both low diet quality and childhood obesity (3,27,28). Since children from lower income families are less likely to have access to nutritious foods (28,29), children living in low-income families have a higher risk for not meeting the MyPyramid recommendations. Possible explanations for this are the limited access to high-quality foods based on the high cost of healthy foods, such as fruits, vegetables, and whole grain products as well as limited numbers of supermarkets in low-income neighborhoods (30–33).

Grouping subpopulations from a large, nationally representative sample using a definition of plausible dietary intake reports based on total energy intake cut points failed to produce

significantly different results for the association between dietary energy intake, energy density, and body weight in another study (22). However, the authors suggested that reporting results for both the total sample as well as the subgroup of plausible reporters allows better understanding of the data since the upper and lower extremes of energy intake reports are removed from the analysis in the plausible reporters.

As this study indicates, children classified as having plausible dietary intakes are on average reporting lower energy intakes compared to the total sample. This is due, in part, to the classification of plausible reporters. Plausible reporters include only individuals who report dietary energy intakes within two standard deviations from the biologically plausible mean energy intake. Implausible reporters, on the other hand, are those children who reported dietary energy intake amounts below or above two standard deviations away from the biologically plausible mean. Thus, over- or under-reporters are excluded. Of interest is that the proportion of children in the plausible and implausible intake reports was independent of children's socio-demographic characteristics or body weight status. Thus, lack of plausible dietary intake reports did not appear to indicate biased reporting by children in a particular category. Based on this finding, one could conclude that all examination of dietary intake patterns in young, predominantly low-income children should include an examination of the intake patterns in plausible reporters alone in an effort to prevent erroneous conclusions based on under- or over-reporting of dietary consumption.

Study limitations include the cross-sectional design, which limits causal inferences. The use of 24-hour recalls reported by adults about the diets of children may lead to incomplete or biased reports. However, the practice of requesting caretakers to report young children's diets and to assist school-age children has been widely accepted (34–35). Children more than seven years old reported their own diets with the help of adults. This diet assessment method is limited by children's limited cognitive ability to recall food consumed (35–36). Furthermore, the use of food groups to assess dietary intake does not allow inferences about nutrient adequacy of diets. Since nutrient profiles within the food groups vary greatly. The study sample was based on a relatively small convenience sample, and is not representative of the U.S. child population. It is also not possible to determine whether the child's weight status is a factor in determining who seeks CHC services or who participated in this study. Thus, the prevalence of overweight or obese children might be over- or under-represented.

Conclusion

This study included an ethnically diverse sample of children from predominantly low-income households. Results support the need for nutrition interventions in this high-risk group to improve overall diet quality by increasing food group consumption levels, particularly in the vegetables group. Such interventions may also help to reduce the risk of childhood obesity. Understanding the relationships between meeting food group recommendations and obesity risk is complicated by dietary reporting issues. However, the CHC setting may be an appropriate venue for community-level intervention studies aimed at improving the dietary intake habits of children at high risk for childhood obesity.

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Table 1

Socio-demographic characteristics and body weight status of the study sample (in percentages)

Socio-demographic variables		Full sample (n=214)	
		2–5 year olds (n=104)	6–12 year olds (n=110)
Low-income household[a]		70	64
Gender	Girls	57	41
	Boys	43	59
Ethnicity	Non-Hispanic White	45	48
	Non-Hispanic Black	8	7
	Non-Hispanic Asian	20	20
	Other	12	10
	Hispanic	15	15
Child's body weight status[b]	Underweight	3	4
	Healthy weight	52	61
	Overweight	14	15
	Obese	31	20

[a] Low-income household is <1.85 of the Poverty Income Ratio (PIR)

[b] Based on the 2000 Centers for Disease Control and Prevention (CDC) growth charts: underweight < 5^{th} %ile, healthy weight 5^{th} to 84^{th} %iles, overweight 85^{th} to 94^{th} %iles, obese ≥95^{th} %ile

Table 2

Proportion of children (total sample and plausible reporters only) meeting the MyPyramid food group recommendations and the deviation from the recommended food group intake amount (as mean and SD in cups or ounces)[a] by age- and body weight status group[b] (in percentages)

Age and Body weight groups	% of Children Meeting None, Specific, of All Food Group Recommendations						
	None	Fruits	Vegetables	Total Grains	Dairy	Meat[c]	All
2–5 yr olds, total sample (n=104)	1	64	36	52	55	72	10
<85th %ile (n=58)	0	66	40	48	55	69	12
85th to 94th %ile (n=15)	0	67	33	47	47	93	7
≥95th %ile (n=31)	3	61	29	61	58	68	6
Suboptimal Intake (mean±SD)[d]		−0.45±0.06	−0.82±0.07	−0.43±0.07	−0.61±0.07	−0.62±0.06	
2–5 yr olds, plausible reporters (n=48)	0	58	33	40	47	73	4
<85th %ile (n=28)	0	54	32	29	46	64	0
85th to 94th %ile (n=10)	0	60	20	50	30	90	0
≥95th %ile (n=10)	0	70	50	60	50	80	20
Suboptimal Intake (mean±SD)[d]		−0.52±0.09	−0.89±0.10	−0.45±0.08	−0.76±0.10	−0.34±1.0	
6–12 yr olds, total sample (n=110)	10	45	23	52	49	55	9
<85th %ile (n=72)	10	44	23	56	56	52	8
85–94th %ile (n=16)	13	38	25	50	44	69	13
≥95th %ile (n=22)	9	55	22	41	32	55	9
Suboptimal Intake (mean±SD)[d]		−0.81±0.07	−1.72±0.11	−0.61±0.08	−0.91±0.09	−0.62±0.09	
6–12 yr olds, plausible reporters (n=53)	11	38	11	34	38	45	0
<85th tile (n=36)	11	33	25	42	44	36	0
85–94th tile (n=9)	11	33	0	22	33	67	0
≥95th tile (n=8)	13	63	11	13	13	63	0
Suboptimal Intake (mean±SD)[d]		0.90±0.10	−1.99±0.15	−0.81±0.13	−1.15±0.14	−0.82±0.14	

[a] Recommended intake amounts are: fruits (girls 2–8 years old: 1.5 cup, 9–12 year old: 2 cups; boys 2–3 year olds: 1.5 cups, 4–12 year old: 2 cups), vegetables (girls 2–3 year old: 1 cup, 4–8 year old: 2 cups, 9–12 year old: 3 cups; boys2–3 year old: 1 cup, 4–8 year old: 2 cups, 9–12 year old: 4 cups), total grain (girls 2–3 year old: 3 ounces, 4–8 year old: 4 ounces, 9–12 year old: 6 ounces; boys 2–3 year old: 3 ounces, 4–8 year old: 5 ounces, 9–12 year old: 7 ounces), dairy (girls and boys 2–8 year old: 2 cups, 9–12 year old 3 cups, meat/meat alternatives (girls 2–3 year old: 3 ounces, 4–8 year old: 5 ounces, 9–12 year old: 5.5 ounces; girls 2–3 year old: 3 ounces, 4–8 year old: 5 ounces, 9–12 year old: 6 ounces)

[b] Based on the 2000 Centers for Disease Control and Prevention (CDC) growth charts: underweight/healthy weight 0 to <85th %iles, overweight 85th to 94th %iles, obese 95th %ile

[c] Meat and Meat Alternatives in ounces and ounce equivalents

[d] Mean food group intake below the intake recommendation. Calculated as actual intake (in cups or ounces) minus recommended intake (in cups or ounces). Values equal to zero indicate that individual met the age- and sex-specific intake recommendation, negative values indicate the number of cups or ounces below the recommended intake level.