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BMI and Dietary Intake among Head Start Children and Caregivers

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Abstract

Background—The United States Head Start program serves low-income preschoolers and their caregivers and provides an opportunity for assessment and intervention on obesity. We sought to determine the prevalence of obesity among children and their caregivers and to identify variables that are associated with child BMI z-scores (BMIz) and caregiver BMI.

Design/Setting—Cross-sectional data on diet and BMI from 770 caregiver-child dyads recruited from 57 Head Start centers in Alabama and Texas.

Methods—Height and weight of each caregiver and child were measured using standardized protocols. Dietary intakes of caregiver-child dyads were collected using three 24-hour dietary recalls and Block Food Frequency Questionnaires. Data were collected between September, 2004 and November, 2005. The larger food pyramid categories were divided into 17 food consumption groups and tested for their association with child BMIz. ANOVA was used to test whether food groups were significantly associated with child BMIz.

Results—The prevalence of obesity among children was 18.4%, 24.3% and 37.3% among Black (B), Hispanic (H) and White (W), respectively ($P < 0.0001$), while it was 58.3%, 41.4% and 41.6% among B, H and W caregivers, respectively ($P < 0.0001$). Child BMIz and caregiver BMI were

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correlated ($r=0.16$, $P<0.0001$). In multivariable models, children were 1.90 (95% CI: 1.31-2.74) times more likely to have BMI $\geq 95^{\text{th}}$ percentile if their caregiver was obese. Five variables (fruits, unsweetened beverages, low-fat dairy, race and caregiver's BMI) were significantly associated with child BMIz. Fruits were inversely related, while unsweetened beverages, low-fat dairy, and caregiver's BMI were positively associated with child BMIz ($P<0.03$). Compared to whites, B and H children had lower BMIz ($P<0.05$).

Conclusions—The high prevalence of obesity in this population together with the observed inverse association between fruit consumption and BMI, if replicated in other studies, suggests that interventions that promote fruit consumption could have beneficial effects on child BMI.

Keywords

Children; obesity; dietary intake

Introduction

Obesity is a significant problem in the United States (U.S.) (1-5), and the prevalence of overweight and obesity among children and adolescents is high and rising (6). According to NHANES 2003-2006 data, the prevalence of obesity ($\geq 95^{\text{th}}$ percentile of BMI for sex and age, based on the 2000 CDC reference population) among 2 to 5 year old children was 12.4% (6). Obese preschoolers are particularly at risk because of the strong tracking of overweight and its associated comorbid conditions in adulthood (7-12). Further, the preschool years are a critical time when individual attitudes and behaviors are shaped (13). Obesity and its associated risk behaviors are more prevalent and severe in low-income preschoolers living in socially disadvantaged, obesogenic environments (14-18). Parental obesity and parenting styles influence children's diet quality, activity level, and BMI (19-25). The family risk for obesity reflects genetics, parenting, foods offered, and the shared living environment. The neighborhood environment, for example, affects access to healthy versus unhealthy foods and the potential for active versus sedentary behaviors. Understanding caregiver-child relationships for diet and obesity could help identify specific factors that influence obesity and pave a way for designing interventions for obesity prevention in low-income families where obesity is an increasing public health problem.

Head Start is a national program that promotes readiness for school among newborn to five year-old children largely from families with incomes below the poverty line (26). The program is large, serving 908,412 low-income children and their families throughout the U.S. in fiscal year 2007 (27). Head Start is an excellent community setting to assess obesity and its proximate risk behaviors and to target early interventions for obesity in low-income families. In this study, (1) the prevalence of obesity among children and their caregivers; (2) the relationships of child BMI and caregiver BMI and child and caregiver dietary intake, and (3) child dietary intake and child BMIz scores in a sample of Head Start caregiver-child dyads are examined.

Methods

This study was approved by the Institutional Review Boards of The University of Alabama at Birmingham (protocol number X030702004) and Baylor College of Medicine (protocol number 14064). All subjects provided written informed consent before participating in the study.

Study Sample

Participants in this study were the 770 caregiver-child dyads recruited from 57 Head Start centers in Alabama and Texas. The purpose of the original study was to identify perceived facilitators and barriers to fruit and vegetable intake among caregivers of preschool children from Black (B), Hispanic (H), and White (W) households enrolled in the Head Start program. The details of this study have been described elsewhere (28). Head Start sites in north-central urban Alabama, northern rural Alabama, and southeastern urban Texas were selected because they serve understudied ethnically diverse, low-income populations in rural and urban areas in the South. The target population for this study was 3-5 year old children enrolled in their first year of Head Start and their primary caregiver, defined as the person responsible for greater than 50% of the child's dietary intake outside of Head Start.

Data collection procedures

The program manager and study nutritionist provided quality control over all aspects of data collection including the training and certification of interviewers and the collection, review, and processing of data for analyses. Interviewers were trained and certified in anthropometric and dietary assessments (24-hour dietary recalls and food frequency questionnaires). Dietary recall and food frequency questionnaire training and certification was provided to interviewers by the study nutritionist who was trained at the Nutrition Coordinating Center of The University of Minnesota and who had extensive experience in dietary assessment and intervention. Data on age, race, and ethnicity of children and caregivers were obtained from caregivers who were interviewed by the study personnel. Other aspects of data collection procedures are described elsewhere (29).

Anthropometric Measures

Interviewers conducted two height and two weight measurements with each caregiver and each child using standardized protocols (30). Height was measured to the nearest 0.1 cm with a Shorr Adult Height Measuring Board (Shorr Productions, Olney, MD). Weight was measured to the nearest 0.1 kg using the PS-6600 'Take-a-Weight' electronic scale (Befour, Saukville, WI). BMI and BMI z-scores (BMI_z) were calculated using Epi Info™ software (version 3.01, 2003, Centers for Disease Control, Epidemiology Program Office) adjusting for age and gender based on the U.S. CDC 2000 reference population (31). Caregiver obesity was defined as BMI ≥ 30 while child obesity and underweight were defined as BMI $\geq 95^{\text{th}}$ percentile and BMI $< 5^{\text{th}}$ percentile for same age and gender based on 2000 CDC reference population, respectively (31).

Dietary Measures

Two separate dietary measures were used to assess caregiver and child intake and to provide somewhat independent estimates of intake: twenty-four hour dietary recalls, collected using Nutrition Data System for Research (NDS-R) software (version 5.0_35, 2005, University of Minnesota, Minneapolis) and Block Food Frequency Questionnaires (32-34). The food frequency questionnaires capture dietary intake for the last 12 months for caregivers and for the last 6 months for children. For both dietary assessments, the child's intake was reported by the caregiver.

Three non-consecutive days of 24-hour dietary recalls were obtained for the caregiver and the child according to standardized, multiple pass procedures (35), with at least one weekend day of intake collected for each. Two-dimensional food models were used to estimate portion sizes (36). Child intake was reported by the caregiver on the same day as the caregiver's dietary recall and included only foods and beverages consumed by the child when the caregiver was present. Head Start must comply with the Child and Adult Care

Food Program guidelines. All meals provided by Head Start must meet United States Department of Agriculture/Health and Human Services Commission required meal patterns. Because Head Start meals are regulated in this manner and the study focus is caregiver influences on child intake and BMI, foods and beverages consumed while the child was at the Head Start center were not assessed.

The SWAN/Block 01/02 Food Frequency Questionnaire (FFQ) (32) was administered to caregivers, and the Block Kids 2-7 FFQ (33, 34) was administered to caregivers who reported for their Head Start child. Both questionnaires were interviewer-administered and completed face-to-face. The SWAN FFQ includes 110 questions about the caregiver's usual dietary intake over the previous 12 months. Both frequency and portion size are measured. The Block Kids 2-7 FFQ includes 90 questions about the child's usual dietary intake in the previous 6 months. For the child FFQ, only the frequency of intake was assessed; portion size was not. Both the child and adult FFQs included foods typically consumed by Hispanics such as avocado, guacamole, salsa, tortillas.

Food quality groups

The NDS 24-hour recall intake data and the Block adult and Block child food frequency intake data were reviewed separately for servings of the broader Food Pyramid groups (grains, vegetables, fruits, milk, meat and beans, oils, and discretionary calories). These Food Pyramid groups were examined, and the constituent foods then regrouped based on their energy, fat, and sugar content and customary consumption patterns (e.g., ice cream was grouped with desserts rather than with dairy). This procedure resulted in 17 food consumption groups namely, alcohol, added fats and oils, cakes and desserts, chips, fried vegetables, non-fried vegetables, fruit, fruit juice, high fat dairy, low fat dairy, low-energy beverages, sugar sweetened beverages, fatty meats, lean meats, whole grains, sweet condiments, and refined grains.

To adjust food groups for total energy intake, each food group was checked for normality. If the food group was not normally distributed, a log-, square root- or square-transformation was applied to achieve normality. Each food group (i.e., servings/week for both NDS and FFQ) was then regressed on total energy intake to obtain energy-adjusted food groups as described elsewhere (37). Adjusting for energy removes the correlation between food consumption groups and energy intake making it possible to test food groups for their energy-independent associations with BMI. For each participant, the energy-adjusted food group intake from NDS-R and the respective food group intake from the Block food frequency questionnaire were averaged. This procedure permitted a more stable estimate of individual intake since both dietary instruments covered a different time frame of food intake (i.e., previous 24-hours versus previous 6 or 12 months). Combining measurements from different dietary assessment instruments or biomarkers is known to improve statistical power (38).

Next, pair-wise correlation analyses were performed between food groups and child BMIz. Correlation between energy-adjusted food groups from the average of child NDS and Block FFQ and child BMIz was tested. Additionally, food groups computed from the average of NDS and Block FFQ for caregivers were used to test whether caregivers' intakes are related to child BMIz.

Statistical comparisons

Analyses were performed using Statistical Analysis Software (version 9.1.3, 2003, SAS Institute, Cary, NC). To compare differences in dietary composition among race/ethnic groups, nutrient densities were created for macronutrients. Nutrient densities were obtained

by multiplying intake in grams of that macronutrient by energy content per gram and dividing the product by total energy intake for an individual. Child and caregiver characteristics were then compared across race-ethnic groups. BMIz, the main dependent variable in this study, was modeled as a continuous variable. For continuous variables ANOVA was used to determine whether the distribution of demographics as well as dietary intakes of children and their caregivers were significantly different by race/ethnicity. For categorical variables, similar comparisons were performed using the chi square test.

To identify variables associated with BMIz, stepwise linear regression analyses were performed with child food consumption groups (i.e., average of intakes from Block and NDS), gender and caregiver's age and BMI. The probability to enter and/or stay in the model was set at 0.05.

To understand the independent associations of individual food consumption groups with BMIz, an ANOVA model with variables that were significant in univariate analyses was fitted. Race (black, white or Hispanic) and sex (male or female) were modeled as categorical variables. The solution for fixed effects from this multivariate model was examined. Logistic regression was also used to test whether caregivers' BMI or obesity status was related to obesity in children. The logistic regression models were adjusted for the caregiver's age, sex and race. Differences among groups were considered significant at $P \leq 0.05$.

Results

Child Obesity Prevalence

Overall, 25% of children were obese (i.e., had a BMI $\geq 95^{\text{th}}$ percentile of the 2000 CDC reference population) while 49% of the caregivers were obese (i.e., had a BMI $\geq 30 \text{ kg/m}^2$). Overall, 3.8% of the children were underweight (i.e., had a BMI $< 5^{\text{th}}$ percentile of the 2000 CDC reference population). Selected characteristics of the Head Start study sample are shown in Table 1.

Obesity was significantly ($P < 0.0001$) more prevalent among B caregivers (58%) than H (41%) or W (42%) caregivers. The prevalence of obesity among Head Start children was significantly ($P < 0.0001$) higher among W (37%) compared to H (24%) or B (18%) children. The prevalence of obesity in boys (27%) was similar ($P = 0.29$) to that in girls (24%) regardless of race/ethnicity. The overall mean $\pm$ SD child BMI was $17.4 \pm 3.8 \text{ kg/m}^2$. The median child BMI z-score in the Head Start children was 0.74. BMI z-scores varied significantly ($P < 0.0001$) by race/ethnic group (Table 1).

Child-Caregiver BMI

Significant correlations were observed between caregiver BMI and child BMIz in B ($r = 0.28$) and H ($r = 0.23$) groups, but not in W ($r = 0.09$). In models adjusted for caregivers' age, gender and race, children were 1.90 (95% CI: 1.31-2.74) times more likely to be obese if their caregivers were obese. This association was also observed when caregiver BMI was modeled as a continuous variable (odds ratio = 1.06; 95% CI: 1.04-1.09). Specifically, in models adjusted for caregivers' age, gender and race, a 1 kg/m^2 increase in the caregivers' BMI was associated with a 6% (95% CI: 3.7 to 8.6%) increase in risk for a child having a BMI $\geq 95^{\text{th}}$ percentile of the 2000 CDC reference population.

Child-Caregiver BMI-Relevant Food Groups

The dietary intakes of children and their caregivers varied significantly by race/ethnic group (Table 1). In general, food and nutrient consumption characteristics of child groups by race/

ethnicity tended to mirror those of the group of caregivers of the same race/ethnicity. The dietary intakes of both H children and caregivers was higher in fruits, non-fried vegetables, whole grains, lean meats, high fat dairy, sweet condiments, and cakes and desserts than W or B.

Table 2 shows Spearman correlations between the dietary intakes of children and their caregivers and between child BMIz and the dietary intakes of children and their caregivers. The dietary intakes of the children and their caregivers were correlated for each food consumption group. Child intakes of fruits and refined grains showed significant ($P < 0.05$) inverse correlations with child BMIz. Other food consumption groups were not associated with BMIz when intakes from NDS and Block FFQ were averaged. Caregiver intake of unsweetened beverages showed a significant positive correlation with child BMIz. An inverse association of caregiver intake of fatty meats and child BMIz approached statistical significance. Other caregiver food groups were not significantly associated with child BMIz.

Multivariable associations between food groups and BMIz

Table 3 shows variables that are associated with child BMIz at $P \leq 0.05$ in a multivariate ANOVA model. Fruits were inversely associated with BMIz, while low fat dairy and unsweetened beverages were positively associated with BMIz. Race and caregiver's BMI were also significantly associated with BMIz. In another analysis in which child obesity (coded as yes or no) was used as the outcome variable and food groups as continuous variables (servings/week), the odds ratio (OR) and 95% confidence intervals (CI) for increased likelihood of obesity was 0.79 (0.62-1.01) for fruits, 2.98 (1.46, 6.05) for low fat dairy, 1.49 (1.12, 1.99) for unsweetened beverages, 0.26 (0.16, 0.43) for black vs. whites, 0.49 (0.29, 0.81) for Hispanics vs. whites and 1.06 (1.03, 1.08) for caregiver BMI.

Discussion

The major observations are: (1) prevalence of obesity in Head Start children and their caregivers is high and the BMI of the child relates positively to caregiver BMI, and white children were significantly heavier than Hispanic or black children; (2) dietary intake of the Head Start child and their caregiver are related positively; and (3) three food groups relate independently to child BMIz i.e., fruit inversely and unsweetened beverages and low-fat dairy positively.

There is a high prevalence of child and caregiver obesity in this population. The prevalence was highest among B caregivers and W children. Compared to national samples, the Head Start sample demonstrates a higher prevalence of child obesity (25% vs. 14.6%) (39). Among Head Start caregivers, the prevalence of obesity is similar to NHANES data from the same period except for W females where this study sample has a higher prevalence of obesity (1). The caregivers' BMI is significantly associated with children's BMIz, an observation that is consistent with current literature (40).

Contrary to national statistics, obesity was more prevalent among white children compared to black or Hispanic children. Apart from diet quality which was lower in whites and blacks compared to Hispanics (28), the reason for this finding is not clear but could be related to differences in socioeconomic status, education or physical activity. Unfortunately, we do not have data on socioeconomic status, education or physical activity in order to test this hypothesis.

This study used two separate dietary intake instruments, the 24-hour dietary recall and an FFQ, for assessing caregiver and child dietary intakes. A combination of dietary intake questionnaires has been used in earlier studies for adults and the elderly (41-44). A few

studies have combined the use of dietary instruments in older children. For example, Moore et al compared two versions of the FFQ for assessing dietary calcium intake in 9-16 year old Canadian children (45). In another study, the Kids' Block FFQ was compared with the 24-hour dietary recall to evaluate its appropriateness in measuring nutrient intake in Native American children aged 9-13 years in Minneapolis (46). Both instruments were administered on a single day to participants. A limited number of studies have examined the combined use of two separate dietary instruments in preschool age children (47-50). These studies have focused on nutrient intake comparisons and instrument validation. This is the first study in which intakes from two dietary assessment instruments have been combined at nutrient or food-level to study associations between diet and BMI in preschool children and their caregivers.

Intake of fruits, unsweetened beverages and low-fat dairy were the only food consumption groups that correlated with child BMIz. Contrary to expectations, higher intake of unsweetened beverages and low-fat dairy was significantly and positively associated with higher child BMIz. The reasons for these associations are not clear but may be due to reverse causality in which caregivers switch to foods perceived as healthier either for their own weight loss efforts or as an attempt to reduce their children's weight. Unfortunately, to explore this possibility further is not possible due to the cross-sectional nature of the study.

In this sample, higher consumption of fruits was inversely associated with child BMIz. In the U.S., few studies have examined the relationship between fruit and vegetable intake and BMI in preschoolers (51). Fruit consumption has been linked with lower BMI in older children and adults (52). Field et al found that fruit intake is not associated with any longitudinal changes in BMIz in children aged 9-14 years (53). The relation between fruit and vegetable consumption and body weight in children is inconsistent (54), but given these findings and the high prevalence of obesity in the sample, the association of fruit consumption with child obesity merits further investigation in a longitudinal study.

The relationship between low-income, social disadvantage and child obesity has been widely studied (4, 5, 55-59). Since this study sample is all low-income, the observed higher levels of obesity may relate to their poverty status (39). Recent studies have demonstrated the importance of weight gain in preschool age children as a strong predictor of weight status and metabolic score in later childhood (60, 61). Children who are at or above the 50th percentile of BMI by three years of age have a 40% chance of being overweight and obese ($\geq 85^{\text{th}}$ percentile) at age twelve (61). The prevalence of obesity in low-income preschool children is high and underscores the importance of urgently and effectively addressing this problem (62). The number of children served annually in the federally-funded Head Start program, from which this study sample was derived, supports a population and family-based approach rather than a clinical intervention.

Family interventions on the diet of caregivers and their children are a target for prevention of obesity. The correlation between caregiver and child diets suggests the importance of caregiver roles (e.g., modeling, purchasing and preparing foods) on their child's diet. Several studies have delineated the importance of parental modeling and the role of family environment in preventing childhood obesity (63-65). Parental ability to shape healthful eating habits in their children is crucial in preventing childhood obesity especially in younger children who have relatively less control over what they eat (66). For weight loss and related behavioral changes, interventions that target parents to change their and their children's behaviors are recommended as being more effective in short- and long-term weight loss regulation (63). Current research recommends interventions involving parents to be incorporated within comprehensive interventions to increase their effectiveness in

preventing childhood obesity (66). Incorporating more fruit into family diets may contribute to the prevention of obesity and other chronic diseases.

Strengths and Limitations

The strengths of this study are that all of the children were in Head Start and the 3 ethnicities that compose the largest proportions of Head Start participants were studied; it was conducted in three geographic locations; the weight and height of caregivers and children were measured; and caregiver and child diets were simultaneously assessed and analyzed using the same techniques. Capturing dietary intake outside the Head Start center provides insights to the children's diet where caregivers are the primary influence on their children's dietary intakes. The use of the two dietary instruments was an attempt to decrease the error variance in any one measure. The FFQ captures a longer period of time than the three 24-hour recalls and may relate better to some biomarkers of intake (37). There is also the opportunity for some replication.

A limitation of the study is that child dietary intake was reported by the caregiver, limiting the accuracy of the child's intake. The reporting of both child and caregiver diets covering the same time frame by the same reporter may bias the correlation of child and caregiver dietary intake. Further, potential under-reporting of children's dietary intake by caregivers of obese or overweight children cannot be excluded. Over-reporting by caregivers of underweight children is also a possibility. Both under-reporting and over-reporting could bias the associations between diet and BMI toward the null. Another limitation is that because the child consumes breakfast, lunch, and snacks in Head Start centers, some portion of his/her daily dietary intake is missed in this assessment since the caregiver may not know what a child consumed at the Head Start Center. Furthermore, we do not have data on socioeconomic status, education or physical activity of children or their caregivers. Lack of adjustment for these variables could potentially confound associations between diet and BMIz scores.

While the sample was taken from three geographic areas and captures the largest proportion of Head Start participants (i.e., B, H, and W) in the U.S., it does not capture the full range of Head Start participants. The cross-sectional study design limits inferences of causality between parent and child dietary intake and child diet and BMI. The mechanisms including how caregiver BMI and dietary intake influences child dietary intake and BMI were not explored in this paper.

Conclusions

In summary, the prevalence of obesity in Head Start children and their caregivers is high and the BMI of the child relates positively to caregiver BMI and white children were significantly heavier than Hispanic or black children. The dietary intakes of the Head Start children and their caregivers are related positively and three food groups relate independently to child BMIz i.e., fruit inversely and unsweetened beverages and low-fat dairy positively. The high prevalence of obesity in this population together with the observed inverse association between fruit consumption and BMI, if replicated in other studies, suggests that interventions that promote fruit consumption could have beneficial effects on child BMI.

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Table 1
Demographic, anthropometric and dietary characteristics of a sample of Head Start caregiver-child dyads

	Children				Caregivers			
	Black	Hispanic	White	<i>p</i> ^a	Black	Hispanic	White	<i>p</i> ^a
N	307	218	194	--	308	218	194	--
Females, %	47.1	48.6	50.0	0.81	96.4	95.9	91.2	0.03
Age, years	4.61 ± 0.65	4.08 ± 0.51	4.62 ± 0.50	<0.0001	32.05 ± 8.98	30.00 ± 5.74	31.08 ± 9.15	0.22
Weight, kg	19.92 ± 5.56	18.22 ± 4.41	20.33 ± 5.67	<0.0001	88.72 ± 24.05	72.18 ± 15.64	82.09 ± 25.08	<0.0001
Height, cm	108.16 ± 6.10	102.41 ± 5.33	104.88 ± 6.96	<0.0001	163.67 ± 6.70	156.53 ± 5.65	164.30 ± 7.96	<0.0001
BMI ^b	16.89 ± 3.84	17.21 ± 2.84	18.48 ± 4.55	<0.0001	33.07 ± 8.56	29.45 ± 6.05	30.31 ± 8.59	<0.0001
BMI ^b z-score	0.48 ± 1.61	0.92 ± 1.22	1.27 ± 1.64	<0.0001	--	--	--	--
BMI ^b ≤ 5 th percentile, % ^c	5.8	0.9	3.6	0.01	--	--	--	--
BMI ^b ≥ 95 th percentile, % ^c	18.4	24.3	37.3	<0.0001	--	--	--	--
BMI ^b ≥ 30 kg/m ² , % ^c	--	--	--	--	58.3	41.4	41.6	<0.0001
Energy intake (kcal)	851 ± 358	1333 ± 478	1017 ± 337	<0.0001	1422 ± 582	2213 ± 940	1589 ± 567	<0.0001
Protein, % energy	15.44 ± 3.82	15.33 ± 3.11	13.67 ± 2.89	<0.0001	16.83 ± 4.39	16.38 ± 3.25	14.51 ± 3.89	<0.0001
Carbohydrate, % energy	50.76 ± 8.96	54.85 ± 7.83	52.76 ± 7.50	<0.0001	48.43 ± 9.37	52.40 ± 8.47	51.75 ± 8.42	<0.0001
Total fat, % energy	34.74 ± 6.96	31.47 ± 6.54	35.04 ± 6.25	<0.0001	35.25 ± 7.08	32.65 ± 7.02	34.92 ± 6.59	<0.0001
MUFA ^d , % energy	13.25 ± 3.04	10.98 ± 2.81	13.30 ± 2.79	<0.0001	13.37 ± 3.06	12.07 ± 3.02	13.32 ± 2.90	<0.0001
Saturated fat, % energy	11.64 ± 2.83	11.89 ± 2.97	12.86 ± 2.87	<0.0001	11.59 ± 2.76	10.85 ± 2.84	12.12 ± 3.03	<0.0001
Sweetened beverages ^e	0.63 ± 0.46	0.80 ± 2.27	1.03 ± 0.80	<0.0001	1.49 ± 1.05	1.16 ± 1.09	2.41 ± 1.86	<0.0001
Fruit ^f	0.34 ± 0.46	0.74 ± 0.78	0.40 ± 0.53	<0.0001	0.43 ± 1.04	0.71 ± 0.97	0.44 ± 0.90	<0.0001
Fruit juices ^e	0.44 ± 0.54	0.82 ± 0.95	0.43 ± 0.65	<0.0001	1.30 ± 2.64	0.62 ± 1.21	0.60 ± 1.47	<0.0001
Unsweetened beverages ^e	0.37 ± 0.46	0.62 ± 0.71	0.19 ± 0.32	<0.0001	1.66 ± 2.18	4.26 ± 3.77	1.79 ± 2.28	<0.0001
High fat dairy ^e	0.75 ± 0.48	1.42 ± 0.84	1.09 ± 0.56	<0.0001	0.91 ± 0.66	1.37 ± 1.11	1.14 ± 0.82	<0.0001
Low fat dairy ^e	0.03 ± 0.07	0.08 ± 0.23	0.07 ± 0.21	<0.0001	0.02 ± 0.09	0.05 ± 0.24	0.06 ± 0.21	0.03
Refined grain foods ^e	2.66 ± 1.11	1.80 ± 1.03	2.14 ± 0.96	<0.0001	4.04 ± 1.54	3.07 ± 1.57	3.89 ± 1.37	<0.0001
Whole grain foods ^e	0.27 ± 0.47	0.60 ± 0.76	0.23 ± 0.41	<0.0001	0.47 ± 0.71	2.31 ± 1.80	0.47 ± 0.65	<0.0001
Lean meats ^e	1.25 ± 1.08	1.37 ± 1.24	0.68 ± 0.68	<0.0001	2.93 ± 2.08	3.26 ± 2.03	1.73 ± 1.28	<0.0001

	Children			Caregivers			<i>p</i> ^a
	Black	Hispanic	White	Black	Hispanic	White	
Fatty meats ^e	1.82 ± 1.00	0.98 ± 0.94	1.62 ± 1.08	3.02 ± 1.71	1.99 ± 1.79	2.45 ± 1.41	<0.0001
Chips ^e	0.22 ± 0.29	0.14 ± 0.28	0.24 ± 0.29	0.27 ± 0.42	0.13 ± 0.36	0.33 ± 0.39	<0.0001
Sweet condiments ^e	0.71 ± 0.71	0.93 ± 1.33	0.68 ± 0.55	1.47 ± 1.93	2.48 ± 2.94	1.20 ± 1.64	<0.0001
Cakes and dessert ^e	0.24 ± 0.35	0.34 ± 0.41	0.38 ± 0.46	0.28 ± 0.45	0.49 ± 0.74	0.43 ± 0.51	<0.0001
Non-fried vegetables ^e	0.78 ± 0.54	1.00 ± 0.80	0.81 ± 0.62	1.63 ± 1.04	2.84 ± 1.49	1.90 ± 1.29	<0.0001
Fried vegetables ^e	0.19 ± 0.26	0.10 ± 0.25	0.23 ± 0.32	0.30 ± 0.44	0.14 ± 0.37	0.39 ± 0.51	<0.0001
Added fats and oils ^e	1.63 ± 1.14	1.44 ± 1.62	1.52 ± 1.14	3.03 ± 2.09	2.49 ± 1.88	2.65 ± 1.64	0.004
Alcohol ^e	--	--	--	0.09 ± 0.57	0 ± 0.23	0.03 ± 0.13	<0.0001

^a Global *P* value from the ANOVA test for the overall significance.

^b BMI = Body mass index; calculated as kg/m²

^c Percentiles are based on the 2000 Centers for Disease Control reference population.

^d MUFA = Monounsaturated fatty acids.

^e Serving values are adjusted for total energy intake using regression methods described in Kabagambe et al (37).

Spearman correlations between child body mass index z-scores (BMIz) and dietary intakes in a sample of Head Start caregiver-child dyads

Table 2

Food consumption group	Child diet ^a		Caregiver diet ^a	
	Caregiver diet	Child BMIz	Child BMIz	Caregiver BMIz
Sweetened beverages	0.40 (<i>P</i> <0.0001)	0.07 (<i>P</i> =0.07)	0.06 (<i>P</i> =0.10)	
Fruit	0.51 (<i>P</i> <0.0001)	-0.08 (<i>P</i> =0.03)	0.01 (<i>P</i> =0.76)	
Fruit juices	0.32 (<i>P</i> <0.0001)	-0.03 (<i>P</i> =0.38)	-0.05 (<i>P</i> =0.21)	
Unsweetened beverages	0.26 (<i>P</i> <0.0001)	0.004 (<i>P</i> =0.92)	0.13 (<i>P</i> =0.001)	
High fat dairy	0.31 (<i>P</i> <0.0001)	-0.02 (<i>P</i> =0.62)	0.05 (<i>P</i> =0.17)	
Low fat dairy	0.21 (<i>P</i> <0.0001)	0.05 (<i>P</i> =0.20)	0.03 (<i>P</i> =0.46)	
Refined grain foods	0.27 (<i>P</i> <0.0001)	-0.09 (<i>P</i> =0.02)	-0.03 (<i>P</i> =0.42)	
Whole grain foods	0.38 (<i>P</i> <0.0001)	-0.02 (<i>P</i> =0.62)	0.03 (<i>P</i> =0.47)	
Lean meats	0.49 (<i>P</i> <0.0001)	-0.07 (<i>P</i> =0.08)	-0.04 (<i>P</i> =0.36)	
Fatty meats	0.45 (<i>P</i> <0.0001)	-0.02 (<i>P</i> =0.54)	-0.07 (<i>P</i> =0.06)	
Chips	0.39 (<i>P</i> <0.0001)	-0.01 (<i>P</i> =0.80)	0.04 (<i>P</i> =0.30)	
Sweet condiments	0.23 (<i>P</i> <0.0001)	0.01 (<i>P</i> =0.83)	0.05 (<i>P</i> =0.23)	
Cakes and desserts	0.35 (<i>P</i> <0.0001)	0.02 (<i>P</i> =0.64)	0.01 (<i>P</i> =0.79)	
Non-fried vegetables	0.43 (<i>P</i> <0.0001)	0.01 (<i>P</i> =0.88)	-0.04 (<i>P</i> =0.29)	
Fried vegetables	0.43 (<i>P</i> <0.0001)	-0.03 (<i>P</i> =0.41)	-0.02 (<i>P</i> =0.55)	
Cooking fats and oils	0.36 (<i>P</i> <0.0001)	-0.01 (<i>P</i> =0.86)	-0.02 (<i>P</i> =0.55)	

^a Average of 24-hour recall and Block food frequency questionnaire

Table 3

Variables associated with body mass index z-scores in a sample of Head Start children^a

Effect	B ^b ± SE ^c	DF ^d	P ^e
Intercept	-0.008 ± 0.254	684	0.98
Fruits ^f , servings/day	-0.165 ± 0.069	684	0.02
Low fat dairy ^f , servings/day	0.521 ± 0.234	684	0.03
Unsweetened beverages ^f , servings/day	0.208 ± 0.089	684	0.02
Race: Blacks vs. Whites ^g	-0.966 ± 0.151	684	<.0001
Race: Hispanics vs. Whites ^g	-0.343 ± 0.165	684	0.04
Caregiver's body mass index, kg/m ²	0.042 ± 0.007	684	<.0001

^aValues shown are from the solution for fixed effects in an ANOVA model.

^bβ = Beta coefficient

^cSE = Standard error

^dDF = Degrees of freedom

^eP = Probability value from the t-distribution

^fFood consumption groups are averages of servings from 24-hour recall and Block food frequency questionnaire.

^gRace coded as Black, Hispanic or White, was modeled as a categorical variable, all other covariates were modeled as continuous variables.