Diet qualities: healthy and unhealthy aspects of diet quality in preschool children[1–3]

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ABSTRACT

Background: Diet quality indexes combine the healthy and unhealthy aspects of diet within a single construct, but few studies have evaluated their association. Emerging evidence suggests that predictors differ for the more and less healthy components of children's diets.

Objectives: Our objectives were to determine whether preschool-aged children's frequency of eating healthy foods was inversely related to their intake of unhealthy foods and to determine whether this differed by household income, maternal education, or child race-ethnicity.

Design: We analyzed data from a representative sample of 8900 US children (mean age: 52.5 mo) who were born in 2001 and participated in the Early Childhood Longitudinal Study–Birth Cohort. Primary caregivers reported the frequency with which children consumed fruit, vegetables, milk, juice, sugar-sweetened beverages (SSBs), fast food, sweets, and salty snacks in the past week. Response options ranged from none to ≥4 times/d. We created healthy (fruit, vegetables, milk) and unhealthy (SSBs, fast food, sweets, salty snacks) diet scores. Healthy diet behaviors were defined as ≥2 daily servings of fruit, vegetables, and milk.

Results: The prevalence of consuming fruit, vegetables, and milk ≥2 times/d (i.e., having 3 healthy diet behaviors) was 18.5%, and a similar proportion (17.6%) of children had none of these healthy behaviors. Contrary to our hypotheses, children with more healthy diet behaviors did not have lower unhealthy diet scores. The intake of healthy foods was not inversely associated with unhealthy foods overall or within any subgroup. Overall, the Spearman rank correlation between healthy and unhealthy diet scores was positive (r = 0.09). From the lowest to the highest strata of household income, these correlations were 0.12, 0.14, 0.14, 0.05, and 0.00, respectively.

Conclusions: No evidence was found in US preschool-aged children of an inverse association between eating healthy and unhealthy foods. The implications of combining healthy and unhealthy aspects of diet quality within an overall index should be considered by researchers. *Am J Clin Nutr* 2016;103:1507–13.

Keywords: public health, epidemiology, diet quality, preschool-aged children, national survey, fruit and vegetables, sugar-sweetened beverages, dietary patterns, socioeconomic position

INTRODUCTION

The concept of diet quality arose as one approach to summarizing the complexity of human diets with the goal of understanding how nutrition affects population health (1, 2). Much research, focused on all stages of the life course, has been published (3–7) with the use of multiple diet quality indexes (8–10). Although different in scope and detail, all of the studies were designed to facilitate comparisons of people or populations relative to the healthfulness of what they eat. Most diet quality indexes combine healthy and unhealthy dietary components by assigning point values to different amounts of intake (2, 6, 11, 12). For healthy dietary components, more points are given for high intake; for unhealthy dietary components, more points are given for low intake. Diet quality indexes have been used to evaluate the success of nutrition interventions (13) to compare groups within and between countries (14–16) and to document population trends (17, 18).

The number and variety of diet quality measures underscore a lack of scientific agreement about the definition of "diet quality" (2, 12). Many articles have contrasted diet quality indexes (4–6, 12), but less attention has focused on underlying assumptions made when positive and negative dietary components are combined. For example, there are many ways to achieve a middle score. The few published studies available suggest that predictors differ for the healthy and unhealthy parts of children's diets (19, 20), and they do not support the assumption of a negative association between healthy and unhealthy dietary components (21–23).

In a recent study in 2–5-y-olds (n = 357) living in low-income neighborhoods of Columbus, Ohio (21), we found that for both younger (ages 2–3 y) and older (ages 4–5 y) children, the frequency of eating fruit, vegetables, and milk was unrelated to the

[1] The authors reported no funding received for this study.

[2] All of the data used in this study were collected by the National Center for Education Statistics, within the Institute of Education Sciences of the US Department of Education. A license agreement is in place with The Ohio State University for analysis of restricted-use data from this study. The manuscript was cleared by the National Center for Education Statistics Data Security Office after disclosure review. Neither the sponsor nor the funder was involved in the design or conduct of the analyses, interpretation of results, preparation or approval of the manuscript, or decision to publish.

[3] Supplemental Tables 1 and 2 are available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://ajcn.nutrition.org.

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Received December 2, 2015. Accepted for publication March 16, 2016.

First published online April 20, 2016; doi: 10.3945/ajcn.115.128454.

intake of sugar-sweetened beverages (SSBs),[6] fast foods, salty snacks, and sweets (21). However, the study was small and generalizability was limited by narrow geographic and socioeconomic inclusion criteria. Our objectives in the current study were to analyze a large, nationally representative sample of US preschool-aged children to determine whether the healthy and unhealthy aspects of children's diets are negatively associated, and whether this depends on sociodemographic characteristics. We hypothesized that the frequency of intake of healthy dietary components would be inversely associated with the intake of unhealthy dietary components and this would be particularly true for the most socially advantaged children.

METHODS

Study population

We analyzed data from the preschool wave of the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B). The ECLS-B was a large, nationally representative study in US children conducted by the National Center for Education Statistics (NCES) (24). Births to mothers aged ≥15 y were sampled from state birth certificates by using a complex, clustered, stratified design. The NCES Ethics Review Board approved the study, and parents provided written informed consent. The procedures followed were in accordance with the Helsinki Declaration of 1975 as revised in 1983. More than 10,000 families were enrolled when the sampled child was 9 mo old (25). Trained researchers conducted periodic assessments in the home until children entered kindergarten. The current report focuses on the 2005 assessment when children were ∼4.5 y old. Data from ECLS-B were analyzed under a restricted-use license between NCES and The Ohio State University. In accordance with NCES reporting guidelines, all unweighted sample sizes are rounded to the nearest 50.

Measures

Mothers (or fathers/other guardians in <5% of cases) responded to standardized questions administered by trained, computer-assisted interviewers. Children's sex was recorded from birth certificates and confirmed by mothers. Mothers indicated whether or not their child was of Hispanic ethnicity and selected the child's race or races (26). When children were preschool-aged, mothers reported how many siblings the child had and their own highest level of educational attainment and employment status. Also at the preschool assessment, household income-to-poverty ratio was determined on the basis of reported income and household size (27); an income-to-poverty ratio of 1.0 indicates that household income was at the poverty threshold. These covariates were used in stratified analyses to assess effect modification.

Mothers were asked 8 questions about their child's past-week intake of juice, fruit, vegetables, milk, SSBs, fast food, sweets, and salty snacks by using a modified food-frequency questionnaire (FFQ) (27). Each question followed the form, "During the past 7 days how many times did [child's name] drink milk?" with 7 response options coded as follows: "none" = 0, "1–3 times during past 7 days" = 0.29, "4–6 times during past 7 days" = 0.71, "1 time per day" = 1, "2 times per day" = 2, "3 times per day" = 3, "4 or more times per day" = 4.

Wording of the diet questions is provided in **Supplemental Table 1**. For all questions except for milk, examples and clarifying definitions were provided. We designated greater intakes of vegetables, fruit, and milk as healthy aspects of children's diets and greater intakes of SSBs, fast food, sweets, and salty snacks as unhealthy aspects of children's diets. Juice was not deemed healthy or unhealthy because of the controversy regarding its role in young children's diets (28, 29). We calculated a healthy diet score as the sum of responses to the questions about vegetables, fruit, and milk. Likewise, an unhealthy diet score was calculated by summing SSBs, fast food, sweets, and salty snacks. We also created binary variables to denote healthy and unhealthy diet "behaviors." For fruit, vegetables, and milk, a healthy behavior was defined as a reported intake of ≥2 times/d. Unhealthy diet behaviors were defined as ≥1 time/wk for SSBs and fast food and ≥4 times/wk for sweets and salty snacks. These cutoffs were selected with reference to the USDA dietary guidance for preschoolers (30). We counted the number of healthy diet behaviors (0–3) and unhealthy diet behaviors (0–4) for each child.

Analytic approach

We excluded <50 children with missing information on diet, and thus our analytic sample included 8900 children. Analyses used sampling weights that adjusted for oversampling and nonresponse; results are generalizable to the population of US children born in 2001 (24). Variance estimates account for the complex sample design with the use of the survey procedures in SAS version 9.3 (SAS Institute) (31). We describe the proportion and 95% CI of intake for each food category, as well as the healthy and unhealthy diet scores and counts. We present Spearman rank correlation coefficients between intake of each food category and between healthy and unhealthy diet scores. We used linear regression analyses to estimate the mean unhealthy diet score at each level of healthy diet behavior (modeling healthy diet behavior as a categorical variable); then, treating healthy diet behavior as a continuous variable, we estimated the slope of the line and associated *P* value. We used interaction terms in linear regression models to investigate whether the association between healthy diet behaviors and unhealthy diet score was modified by household income-to-poverty ratio, maternal education, children's race-ethnicity, or maternal employment. When interactions were significant, stratified results are presented.

RESULTS

Children (4500 boys and 4400 girls) had a mean (range) age of 52.5 (44.0–65.3) mo. Characteristics of the sample and population are presented in **Table 1**. Of the 8 food categories queried, milk was the most frequently consumed, with 16.0% (95% CI: 14.8%, 17.1%) of children reported to drink milk ≥4 times/d, 23.6% (22.3%, 24.8%) to drink milk 3 times/d, and 30.1% (28.7%, 31.5%) to drink milk 2 times/d. Overall, 69.6% (69.2%, 71.0%) drank milk ≥2 times/d, and only 2.5% (1.9%, 3.0%) did not drink milk in the past week (Supplemental Table 1). Most

[6] Abbreviations used: ECLS-B, Early Childhood Longitudinal Study–Birth Cohort; FFQ, food-frequency questionnaire; NCES, National Center for Education Statistics; SSB, sugar-sweetened beverage.

TABLE 1
Sociodemographic characteristics of participants in the preschool-aged wave of the Early Childhood Longitudinal Study, Birth Cohort[1]

Characteristic	*n* (%)[2]
Child's sex	
Male	4500 (51.2)
Female	4400 (48.8)
Child's racial-ethnic group[3]	
Non-Hispanic white	3850 (53.9)
Non-Hispanic black	1350 (13.8)
Hispanic	1750 (25.1)
Other, non-Hispanic[4]	1900 (7.2)
Number of siblings	
None	1600 (19.4)
1	3650 (42.9)
2	2250 (24.1)
≥3	1350 (13.6)
Mother's education[5]	
Less than high school	1200 (15.5)
High school/GED[6]/technical school	2650 (31.7)
Some college	2350 (26.8)
College degree or higher	2600 (26.0)
Mother's employment[7]	
≥35 h/wk	3600 (39.7)
<35 h/wk	1700 (19.9)
Looking for work	500 (5.8)
Not in labor force	3000 (34.6)
Household income-to-poverty ratio	
<0.5	900 (9.8)
0.5 to <1.0	1250 (14.9)
1.0 to <1.85	1950 (22.3)
1.85 to <3.0	2300 (25.8)
≥3.0	2500 (27.3)

[1]Mean ages of participants: children = 52.5 mo; mothers = 31.9 y. Because of rounding, percentages may not add to 100%.
[2]*n* values are unweighted and rounded to the nearest 50. Percentages are weighted to be representative of the population of US children born in 2001.
[3]Fewer than 50 children without information on race and ethnicity were excluded.
[4]Includes multiple races.
[5]Fewer than 100 mothers without information on education were excluded.
[6]GED, General Educational Development.
[7]Fewer than 150 mothers without information on employment were excluded.

children were reported to drink juice ≥1 time/d (and almost 1 in 5 children drank juice ≥3 times/d), but 8.3% (95% CI: 7.6%, 9.0%) drank no juice during the past week. Compared with milk and fruit juice, SSBs were less frequently consumed; however, almost 1 in 3 children drank SSBs every day. Children ate fruit more frequently than vegetables, with 42.2% (95% CI: 40.5%, 43.8%) eating fruit and 34.3% (32.8%, 35.8%) eating vegetables ≥2 times/d. The distribution of responses to the healthy diet categories (i.e., milk, fruit, and vegetables) was relatively symmetric. In contrast, the frequency of intake of SSBs, fast food, sweets, and salty snacks was more skewed. Few children (<10%) ate fast food daily, but 76.9% (95% CI: 75.3%, 78.4%) ate a meal or snack from a fast-food restaurant ≥1 time in the past week. A similar proportion of children (72.7%; 95% CI: 70.9%, 74.5%) drank SSBs ≥1 time in the past week. Children ate more sweets than salty snacks: 60.1% (95% CI: 58.6%, 61.6%) ate sweets ≥4 times in the past week compared with 41.2% (39.6%, 42.9%) who ate salty snacks that frequently (Supplemental Table 1).

Correlations between responses for the 8 food categories are presented in **Table 2**. Intakes of fruit and vegetables were strongly positively correlated (r = 0.44). Milk was positively correlated with the intake of fruit (r = 0.17) and vegetables (r = 0.16). The healthy diet score ranged from 0 to 12 with a mean ± SEM and median (IQR) of 4.9 ± 0.04 and 4.8 (3.1, 6.0), respectively. As expected, the healthy diet score was strongly correlated with its components—fruit, vegetables, and milk (Table 2). Among the unhealthy diet components, salty snacks and sweets were most correlated (r = 0.34). SSBs were positively correlated with fast food, sweets, and salty snacks (r = 0.24, 0.20, and 0.25, respectively); and fast food was correlated with sweets and salty snacks (r = 0.11 and 0.18, respectively) (Table 2). The unhealthy diet score ranged from 0 to 15, with a mean ± SEM and median (IQR) of 2.5 ± 0.03 and 1.9 (1.2, 3.2), respectively. We hypothesized that the intake of healthy foods would be negatively correlated with the intake of unhealthy foods, but we found little evidence to support this hypothesis. There were only 5 negative correlations, and all were small and not significant, as follows: milk with SSBs (r = −0.02), milk with fast food (r = −0.02), fruit with fast food (r = −0.02), healthy diet score with fast food (r = −0.02), and vegetables with fast food (r = –0.03). Overall, in contrast to our expectations, the correlation between the healthy and unhealthy diet scores was positive (r = 0.09) rather than negative (Table 2).

The prevalence (95% CI) of eating fruit and vegetables and drinking milk ≥2 times/d (i.e., all 3 healthy diet behaviors) was 18.5% (17.4%, 19.7%); a similar proportion (17.6%; 16.5%, 18.6%) of children had none of these healthy behaviors (**Table 3**). More than 1 in 5 children had all 4 unhealthy diet behaviors, meaning that during the past week they were reported to consume SSBs and fast food ≥1 time, as well as sweets and salty snacks ≥4 times. Fewer than 5% of US preschool-aged children had none of these unhealthy diet behaviors. The mean healthy and unhealthy diet scores at each level of healthy and unhealthy diet behaviors are provided in Table 3. At each level of healthy behaviors, the mean unhealthy diet score was ∼2.5, with no evidence of a negative trend. Likewise, the mean healthy diet score was similar irrespective of the number of unhealthy diet behaviors (Table 3).

We hypothesized that interrelations between healthy and unhealthy components of preschool-aged children's diet may differ relative to sociodemographic characteristics. **Supplemental Table 2** presents correlations between the intake of all food categories stratified by whether the household's income would qualify them for benefits under the Special Supplemental Nutrition Program for Women, Infants, and Children. Correlations between individual food categories were largely similar (absolute difference in correlation coefficient ≤0.1), but when correlations differed they were more positive for children living in lower income households than for those from higher income households (Supplemental Table 2). For example, among children living in households with an income-to-poverty ratio <1.85 (lower portion of Supplemental Table 2), juice and milk were positively correlated (r = 0.18), but juice and milk were uncorrelated (r = 0.00) among children in higher-income households (Supplemental Table 2). Correlations between healthy and unhealthy diet scores were r = 0.14 for children in lower-income households

TABLE 2
Correlations between response frequencies for juice, fruit, vegetables, milk, SSBs, fast food, sweets, and salty snacks and healthy and unhealthy diet scores: US preschool-aged children born in 2001[1]

	Fruit	Vegetables	Milk	Healthy diet score[2]	SSBs	Fast food	Sweets	Salty snacks	Unhealthy diet score[3]
Juice	0.20	0.14	0.09	0.19	0.02	0.05	0.04	0.07	0.07
Fruit		0.44	0.17	0.70	0.01	−0.02	0.11	0.09	0.09
Vegetables			0.16	0.66	0.02	−0.03	0.07	0.07	0.06
Milk				0.65	−0.02	−0.02	0.05	0.02	0.01
Healthy diet score[2]					0.02	−0.02	0.10	0.08	0.09[4]
SSBs						0.24	0.20	0.25	0.65
Fast food							0.11	0.18	0.38
Sweets								0.34	0.68
Salty snacks									0.63

[1]Values are weighted Spearman rank correlation coefficients (*r*); n = 8900. Correlations >0.03 are significant at $P < 0.05$. Data are from the Early Childhood Longitudinal Study, Birth Cohort, when children were 4.5 y old. SSB, sugar-sweetened beverage.

[2]The healthy diet score is the sum of reported past-week intakes of fruit, vegetables, and milk. Seven response options ranged from "none" to "4 or more times per day" and were coded as 0, 0.29, 0.71, 1, 2, 3, and 4.

[3]The unhealthy diet score is the sum of reported past-week intakes of SSBs, fast food, salty snacks, and sweets. Response options were the same as for the healthy foods above. See Supplemental Table 1 for question wording.

[4]We hypothesized that this correlation would be negative.

and r = 0.03 for children in higher-income households. Across each of the 5 strata of household income-to-poverty ratio (i.e., <0.5, 0.5 to <1.0, 1.0 to <1.85, 1.85–3.0, and >3.0), these correlations were 0.12, 0.14, 0.14, 0.05, and 0.00 from the lowest to the highest household income, respectively.

The relation between healthy diet behaviors and unhealthy diet score differed by household income-to-poverty ratio (*P*-interaction = 0.01), child racial-ethnic group (P = 0.005), and maternal education ($P < 0.001$), but not for maternal employment (P = 0.12). **Figure 1** shows the mean unhealthy diet score at each level of healthy diet behavior, stratified by income-to-poverty ratio, child racial-ethnic group, and maternal education. We found no evidence for a negative association between the number of healthy diet behaviors and unhealthy diet score, irrespective of stratification variable. The lines in Figure 1 are generally flat or slightly positive. The degree of positive association was greatest for disadvantaged population subgroups.

TABLE 3
Distribution of healthy (milk, fruit, and vegetables) and unhealthy (SSBs, fast food, sweet snacks, and salty snacks) diet behaviors and average unhealthy and healthy diet scores: US preschool-aged children born in 2001[1]

	Prevalence,[2] % (95% CI)	Healthy diet score[3]	Unhealthy diet score[4]
Number of healthy diet behaviors[5]			
0	17.6 (16.5, 18.6)	2.1 ± 0.02	2.4 ± 0.07
1	37.3 (35.8, 38.7)	4.1 ± 0.02	2.4 ± 0.04
2	26.6 (25.4, 27.7)	6.0 ± 0.03	2.6 ± 0.07
3	18.5 (17.4, 19.7)	7.9 ± 0.05	2.8 ± 0.07
Number of unhealthy diet behaviors[6]			
0	4.1 (3.4, 4.7)	5.1 ± 0.17	0.4 ± 0.01
1	14.2 (13.2, 15.2)	5.0 ± 0.08	1.1 ± 0.03
2	29.7 (28.5, 30.9)	4.8 ± 0.06	1.8 ± 0.03
3	30.9 (29.4, 32.4)	4.8 ± 0.06	2.9 ± 0.04
4	21.2 (19.9, 22.4)	5.2 ± 0.08	4.4 ± 0.06

[1]Values are means ± SEMs unless otherwise indicated; n = 8900. Estimates are weighted to be representative of US preschool-aged children born in 2001. The complex sample design was accounted for in the variance estimates. Data are from the Early Childhood Longitudinal Study, Birth Cohort, when children had a mean age of 4.5 y. SSB, sugar-sweetened beverage.

[2]Because of rounding, percentages may not add up to 100%.

[3]The healthy diet score is the sum of reported past-week intakes of fruit, vegetables, and milk. Seven response options ranged from "none" to "4 or more times per day" and were coded as 0, 0.29, 0.71, 1, 2, 3, and 4. A higher healthy diet score indicates more frequent consumption of milk, fruit, and vegetables.

[4]The unhealthy diet score is the sum of reported past-week intakes of SSBs, fast food, salty snacks, and sweets. Seven response options ranged from "none" to "4 or more times per day" and were coded as 0, 0.29, 0.71, 1, 2, 3, and 4. A higher unhealthy diet score indicates more frequent consumption of SSBs, fast food, sweets, and salty snacks.

[5]Healthy diet behaviors were defined as follows: milk ≥2 times/d, fruit ≥2 times/d, and vegetables ≥2 times/d.

[6]Unhealthy diet behaviors were defined as follows: SSBs ≥1–3 times in past week, fast food ≥1–3 times in past week, sweets ≥4–6 times in past week, and salty snacks ≥4–6 times in past week.

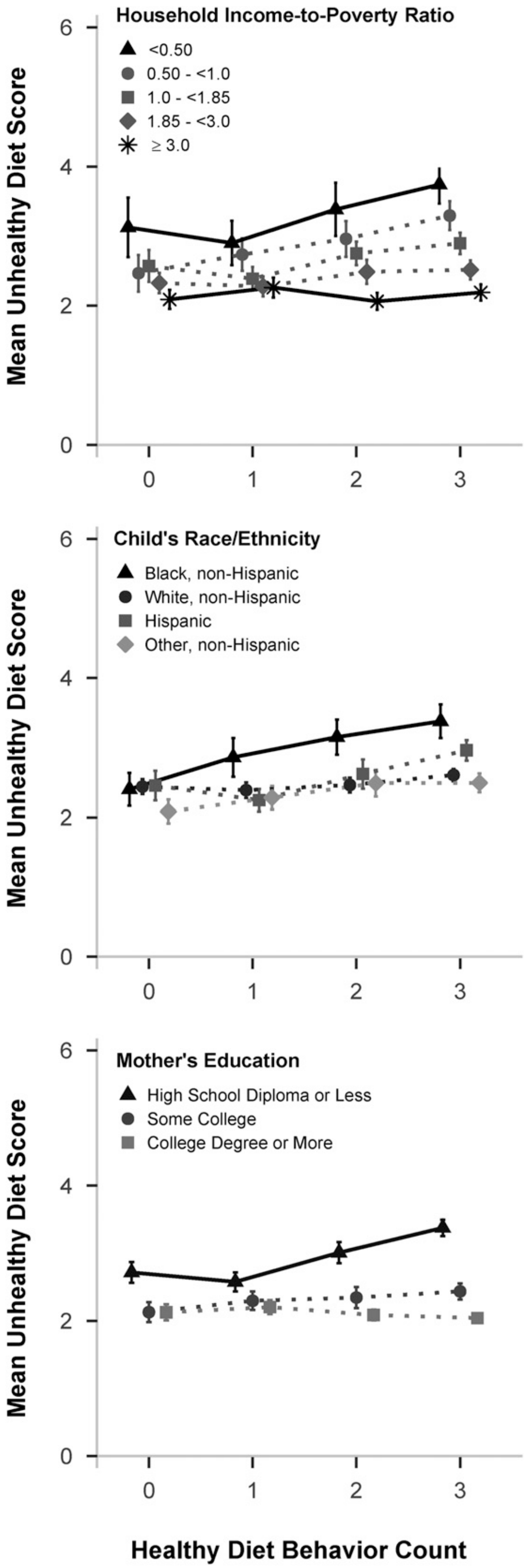

FIGURE 1 Association between healthy diet behaviors and unhealthy diet score in preschool-aged children by sociodemographic characteristics**.** Mean unhealthy diet scores relative to number of healthy diet behaviors (i.e., whether children had ≥2 servings milk, fruit, and/or vegetables/d) stratified by household income-to-poverty ratio (top panel), child racial-ethnic group (middle panel), and maternal education (bottom panel) are shown. Data are representative of US preschool-aged children born in 2001. Analyses use sampling weights and variance estimates to account for the complex sample design of the Early Childhood Longitudinal Study, Birth Cohort. Point estimates and associated standard errors correspond to linear regression models that treat healthy diet behavior as a categorical variable. Error bars indicate ±1 SE. n = 8900. Interactions with household income-to-poverty ratio, child racial-ethnic group, and maternal education were tested in linear regression models (all $P < 0.05$). Slopes were calculated by using linear regression with healthy diet behavior as a continuous variable. All slopes were either positive or flat (i.e., NS): slopes ranged from +0.32 ($P < 0.001$; non-Hispanic black) to −0.04 (P = 0.26; college degree or higher).

DISCUSSION

We analyzed data from a large, nationally representative sample of US preschool-aged children born in 2001. Children's past-week intakes of 8 food categories were assessed by using a modified FFQ. Our objective was to understand how children's intakes of fruit, vegetables, and milk (healthy components of diet) were related to their intakes of unhealthy components of diet (SSBs, fast food, sweets, and salty snacks). We found no evidence to support our hypothesis that the frequency of consuming healthy foods would be negatively correlated with the intake of unhealthy foods. Children's frequency of intake for unhealthy foods was largely unrelated to how often they consumed healthy foods.

These findings confirm and extend our previous research in a small regional sample of low-income 2- to 5-y-old children (21). In that study in 357 children (racial-ethnic distribution: 60% non-Hispanic black, 20% non-Hispanic white, 4% Hispanic, and 16% non-Hispanic other) living in 3 adjoining zip codes in Columbus, Ohio, no association was found between children's intake of healthy foods and their intake of unhealthy foods. Given the lack of socioeconomic variability in that sample (only 6% of parents had college degrees), generalizability was uncertain (21). However, our current results from a large national sample also did not detect an inverse association between children's past-week intakes of healthy and unhealthy foods, neither overall nor within population subgroups.

We used stratified analyses to visualize differences in the relation between children's intake of healthy and unhealthy foods in different population subgroups and to explore the extent to which particular sociodemographic characteristics were explanatory. In Figure 1, we present the mean unhealthy diet score across levels of healthy diet behaviors, but we also examined alternative specifications involving the healthy diet score and the number of unhealthy diet behaviors and our findings were unchanged. We expected to see a negative trend, particularly in subgroups who were socially advantaged because of high maternal education, high household income, or nonminority race-ethnicity. Although we did not detect a significant negative trend in any stratum, the most negative slope (r = −0.04, P = 0.26) was for children of the most educated mothers (college degree or higher). In socially disadvantaged strata (e.g., low household income, minority race-ethnicity), the slope of the relation was positive. Thus, in these groups, the more frequent intake of healthy foods was associated with a greater frequency of intake of unhealthy foods. Whether this positive trend resulted from a compensatory response on the part of parents (e.g., my child ate a healthy meal and can have dessert), an appetitive trait of children (e.g., some children have larger appetites), a response bias (e.g., a resource-constrained parent aiming to demonstrate abundance), or something else cannot be determined by our study.

Few previous studies assessed the relation between healthy and unhealthy aspects of diet quality, but the available evidence agrees with our results. In addition to our small study in 2–5-y-olds (21), the methodology of which this analysis replicates, we identified 4 studies in children that can inform our current results (19, 20, 22, 23). In a study in 650 preschool-aged children and their mothers attending Head Start in Alabama and Texas (22), diet was assessed by using a 24-h recall of 1 weekend day. Partial correlations between fruit, vegetables, sweets, and snacks were reported for children and mothers overall and stratified by racial-ethnic group. Results indicated that children's servings of vegetables were not significantly associated with sweets or snacks, irrespective of race-ethnicity. In contrast, there was a positive correlation between the intake of vegetables and sweets in Hispanic mothers and a weak negative association in non-Hispanic white mothers (22). In a large, population-based study in Australian adolescents (mean age: 11.6 y), Jacka et al. (23) examined healthy and unhealthy aspects of diet quality in relation to depressive symptoms. Using responses to a modified FFQ, they constructed a healthy diet score on the basis of the presence or absence of the following healthy diet behaviors—eating breakfast daily, consuming ≥1 serving low-fat dairy/d, consuming ≥2 servings fruit/d, and consuming ≥4 servings vegetables/d—and an unhealthy diet score, with higher values indicating greater consumption of fast food, salty snacks, sweets, and SSBs (23). Although not directly the focus of their investigation, they commented on the relation between healthy and unhealthy diet scores, noting that "individuals with a low healthy diet score were not the same participants as those with high scores on the unhealthy diet" (23). Two studies in children in the United Kingdom (19, 20) explicitly investigated whether predictors differed for children's intake of core foods (nutrient dense) and noncore foods (energy dense and discretionary). Although differing in study design, children's age, and dietary assessment, both studies found that the variables that predicted children's intake of core foods were distinct from those that predicted the intake of noncore foods (19, 20).

If the positive and negative components of diet quality are not inversely related, then it may be useful to evaluate them separately and not combine them within an overall index of diet quality. There is a precedent for this idea in the physical activity literature. For example, Dietz (32) noted that "inactivity is not the opposite of activity". Furthermore, focusing directly on the importance of understanding sedentary behaviors, Biddle et al. (33) proposed "that 'physical inactivity' is an inadequate label to describe patterns of sedentariness (sedentary behavior), because the definition is assuming 'activity absence' only." In population health research, sedentary behavior and physical activity are no longer thought of as 2 ends of an "activeness" construct. Our results add to a limited research base but suggest that it may be inaccurate to assume that US preschool-aged children with high intakes of fruit, vegetables, and milk have a healthful dietary pattern overall, or that children who frequently consume sweetened drinks, fast food, snacks, and desserts are not also eating recommended amounts of healthy foods.

Diet quality indexes are one approach to aggregating the multiple facets of diet (34). Other approaches use factor or cluster analysis to derive dietary patterns (34, 35). Two patterns found repeatedly with the use of factor analysis are often labeled as "Prudent" or "Healthy" and "Western" or "Unhealthy" (34, 35). Consistent with the lack of correlation we observed between healthy and unhealthy components of US preschool-aged children's diets, the "Western" and "Prudent" factors are independent of one another, such that knowing a person has a high score on one factor does not predict that person's position on the other factor (34, 35). In contrast, dietary patterns defined by using cluster analyses assign each individual to only one cluster (34, 35). Whether dietary patterns are defined by using cluster analysis, factor analysis, or diet quality indexes, each methodology has different underlying assumptions that affect the interpretation of research findings.

Many US preschool-aged children have diets that are poorly aligned with recommendations (30, 36–38). The US dietary guidelines estimate that a moderately active 4-y-old child needs 1400 kcal/d and recommend that daily intake include 1.5 cups vegetables, 1.5 cups fruit, and 2.5 cups dairy (39). In the FITS (Feeding Infants and Toddlers Study) 2008, a 24-h dietary recall was conducted with the primary caregivers of 725 3-y-old children selected from across the United States in a telephone survey (37). The study found that 57% of these 3-y-olds drank fruit juice on the day of dietary recall; 72% had eaten any fruit; 68% had eaten any vegetable (including potatoes); 48% had consumed SSBs; 74% had eaten cookies, cake, candy, or other desserts; and 30% had eaten salty snacks (38). Our results also showed that many preschool-aged children frequently consumed SSBs, sweets, and salty snacks.

Although more research is needed, we believe our results can contribute to the work of researchers and inform policy makers thinking about the nutritional quality of children's diets and public health professionals seeking to understand and influence health behavior. For example, interventions that aim to improve the nutritional quality of children's diets by focusing on fruit and vegetables, assuming that greater consumption of these healthy foods will displace unhealthy foods from the diet, may fall short of their desired goal. In addition, evaluating interventions that simultaneously aim to increase children's intake of healthy foods and reduce their intake of unhealthy foods with a diet quality index that combines these aspects of diet within a single construct could mask the specific area or areas of impact of the intervention. Furthermore, the focus on diet quality as a single construct may encourage policy makers, researchers, and the public to mistakenly assume that children who eat lots of healthy foods tend to eat few unhealthy foods. This misinterpretation could distract attention from obesity prevention efforts to reduce the consumption of excess calories. Multilevel, community-based interventions that simultaneously target multiple aspects of diet show promise for the prevention of obesity (40, 41).

Our research should be interpreted within the context of its limitations. The children studied were born in the United States in 2001 and assessed when ∼4.5 y old. It is not known if these findings would generalize to older children or adults or to preschool-aged children in other countries. Dietary assessment was limited to a modified FFQ and focused on the past week; portion size was not assessed. In addition, we do not know whether the past week was a typical week, nor did we assess the relative healthfulness of choices within food categories. Parental reports could have been biased, but social desirability would tend to support our hypothesized negative association between healthy and unhealthy intakes.

In conclusion, we found no evidence that US preschool-aged children who frequently consumed fruit, vegetables, and milk were any less likely than children who infrequently consumed these aspects of a healthy diet to have a high consumption of SSBs, fast food, sweets, and salty snacks. Few studies have evaluated whether intakes of healthy and unhealthy aspects of a diet are inversely related, but our results are consistent with those published reports that directly assessed this topic. Researchers should consider the implications of combining healthy and unhealthy aspects of a diet within a single "diet quality" construct.

We thank Samantha Chavez for assistance with analysis of data and construction of tables and figures and for helpful comments on drafts of the manuscript.

The authors' responsibilities were as follows—SEA and GK: designed the research; SEA and MR: analyzed the data and performed the statistical analysis; SEA: had primary responsibility for the final content; and all authors: wrote the manuscript. The authors declared that they had no conflicts of interest.

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