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Research Article

Ability to Categorize Food Predicts Hypothetical Food Choices in *Head Start* Preschoolers

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ABSTRACT

Objective: To investigate whether preschoolers are able to identify and categorize foods, and whether their ability to classify food as healthy predicts their hypothetical food choice.

Design: Structured interviews and body measurements with preschoolers, and teacher reports of classroom performance.

Setting: Six *Head Start* centers in a large southeastern region.

Participants: A total of 235 preschoolers (mean age [SD], 4.73 [0.63] years; 45.4% girls).

Intervention(s): Teachers implemented a nutrition education intervention across the 2014–2015 school year in which children were taught to identify and categorize food as *sometimes* (ie, unhealthy) and *anytime* (ie, healthy).

Main Outcome Measures: Preschooler responses to a hypothetical snack naming, classifying, and selection scenario.

Analysis: Hierarchical regression analyses to examine predictors of child hypothetical food selection.

Results: While controlling for child characteristics and cognitive functioning, preschoolers who were better at categorizing food as healthy or unhealthy were more likely to say they would choose the healthy food. Low-contrast food pairs in which food had to be classified based on multiple dimensions were outside the cognitive abilities of the preschoolers.

Conclusions and Implications: Nutrition interventions may be more effective in helping children make healthy food choices if developmental limitations in preschoolers' abilities to categorize food is addressed in their curriculum. Classification of food into evaluative categories is challenging for this age group. Categorizing on multiple dimensions is difficult, and dichotomous labeling of food as good or bad is not always accurate in directing children toward making food choices. Future research could evaluate further preschoolers' developmental potential for food categorization and nutrition decision making and consider factors that influence healthy food choices at both snack and mealtime.

Key Words: nutrition knowledge, food categorization, food choices, preschool, *Head Start* (*J Nutr Educ Behav*. 2018;50:238–246.)

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INTRODUCTION

The most recent National Health and Nutrition Examination Survey indicated that approximately 1 in every 4 preschoolers in the US was considered overweight or obese.[1] Previous research and policy examined the role of the environment on preschoolers' eating habits and physical growth. Fewer studies considered the active role preschoolers had as they developed an understanding of healthy living.[2] Studies that assessed nutrition knowledge focused primarily on older children,[3,4] but preschool is a critical period in which children's cognitive capacity emerges to make their own dietary decisions and develop lifelong healthy eating habits. Even at this young age, preschoolers' knowledge of nutrition was found to influence behavior (ie, food choices).[5,6] The current study evaluated *Head Start* preschoolers' food knowledge and examined how their ability to classify food as healthy affected their food choices.

Early childhood is a sensitive period for developing cognitive abilities. During preschool, children's vocabularies are mounting and executive functions such as inhibition and attention develop.[7-10] Nutrition can have a critical role during this period of cognitive development directly, indirectly,

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and with long-lasting consequences. Directly, nutrition deficits may affect structural and biochemical changes in the brain.[7,11,12] Indirectly, dietary insufficiencies may lead to reduced benefits from learning environments as a result of preschoolers demonstrating lethargic behavior, withdrawing from others, and demonstrating poor exploration.[7,13] Poor nutrition in early childhood has enduring consequences and has been related to cognitive functioning in later childhood.[3,14-16]

During this sensitive period for developing healthy dietary practices, it is important to tailor the content of nutrition education to coincide with preschoolers' levels of cognitive development to influence their behavior.[5,6,17] As preschoolers mature cognitively, they are able to use acquired nutrition knowledge to make healthy choices, but with some limitations.[6,18,19] At this age, preschoolers are not able to explain properly why they know something is healthy, how the body digests food, what nutrients are, or connect the food they eat with future health, but they can identify that fruits, vegetables, and milk are good for them.[19,20] In this manner, preschoolers are able to differentiate between foods that are healthy and unhealthy using evaluative categorization, which is the ability to group items together based on some type of value, such as nutrient value.[21] Broader, more inclusive categories are mastered earlier and low perceptual contrasts are more difficult.[22] Consequently, preschoolers are better at categorizing food on 1 dimension or attribute, and the ability to categorize food more accurately on multiple dimensions emerges later.[18] For example, a preschooler might be able to categorize an apple as a fruit, which is healthy, but may have difficulty categorizing ice cream, which is a dairy product that can be healthy although it has too much sugar.

Consequently, typical models of health behavior change would be inappropriate for preschool obesity prevention or healthy eating programs, because they do not take into account the developmental stages of the child.[2,23] Interventions should be informed by developmental theories that outline typical expectations and fallacy of thinking in preschoolers.[24,25] Individual differences in cognitive development across preschool could explain the mechanism behind why a nutrition curriculum is effective for 1 preschooler but not another, and explain the barriers and drivers for successful intervention.[2,26] Successful preschool programs should take information that is overly complex and simplify it into developmentally appropriate concepts, such as basic identification of food and categorization into concrete categories such as healthy vs unhealthy.[6,22,25] Classifying food into these dichotomies is challenging because foods are not simply good or bad.[21] Using descriptive phrases for how often food should be eaten may be more helpful, because these terms provide preschoolers with knowledge about how often different foods should be consumed based on nutrient values preschoolers may not yet be able to understand. For example, in the *All 4 Kids* study, preschoolers learned a dichotomy based on how often food should be consumed (*go* and *whoa*), which predicted the number of healthy foods they chose in a hypothetical situation.[6]

The current study investigated nutrition knowledge and food choices among preschoolers from low-income families who attended *Head Start*. During the school year, preschoolers were taught to differentiate between healthy and unhealthy foods using the terms *anytime* (eg, fruit, vegetables) and *sometimes* (eg, cookie, french fries) foods. It was hypothesized that preschoolers who could correctly identify more snacks as healthy would choose a greater number of healthy foods when asked to select foods to eat in a hypothetical scenario. Children were queried on high- and low-contrast food pairs to examine preschoolers' categorizing limitations.

METHODS

Participants and Procedure

Participants were 235 preschoolers (45.4% girls) aged 3–6 years (mean [SD], 4.73 [0.63] years), enrolled in 6 *Head Start* centers in a large southeastern metropolitan area. At the end of the school year (n = 121), 2.5% of preschoolers were classified as underweight, 63.6% were of healthy weight, 14.0% were overweight, and 19.8% were obese, which was slightly higher than a national sample of preschoolers aged 2–5 five years in terms of the prevalence of obesity and slightly lower in the overweight category.[1] All preschoolers were recruited from a larger study evaluating a nutrition curriculum, *Healthy Habits for Life*. The participating *Head Start* centers were originally randomly assigned to receive a high or low dosage of the intervention; however, there were no significant differences between nutrition knowledge and health based on site or dosage. Therefore, the preschoolers were not differentiated based on dosage in the current cross-sectional study.

Recruitment

Parents and caregivers were recruited at a health-screening day for a yearlong assessment related to nutrition and health. Recruitment continued throughout the school year as new families enrolled. At the end of the school year, 235 preschoolers completed an assessment of their food knowledge and hypothetical choices.[6] Of these preschoolers, 121 were measured for height and weight, and cognitive functioning was obtained from classroom records for 139. Differences in sample sizes resulted from preschooler availability on the day of data collection and parent consent for individual aspects of the study. Each preschooler received a storybook as compensation. An initial power analysis suggested that 180 participants were necessary to detect a medium effect (effect size = 0.15).[27] A *post hoc* power analysis indicated a power level of 0.999 for 5 predictors based on the final sample size (n = 223), probability level of .05, and observed multivariate coefficient (R^2) for the effect size.[28] The institutional review board at the University of North Florida approved all study protocols.

Measures

Preschool snack selection tool. An existing measure of children's nutrition knowledge, the Preschool Snack Selection (PSS),[6] was modified to assess preschoolers' nutrition knowledge. A pilot study was conducted at the

university's preschool, which included the 18 items originally used in the PSS[11] and 8 additional items. Based on children's responses, the research team replaced pictures that were not correctly identified because of the picture representing the food (eg, the chocolate bar picture was mislabeled as a door), and made sure all fruits and vegetables were represented in slices and whole, to avoid misinterpretation. Items that preschoolers identified less often than others were eliminated after the pilot test. Kiwi was retained, however, to represent a novel food item to assess whether students could classify a new food as healthy if they were told it belonged to a healthy food category (ie, fruit). In the final assessment, 26 printed pictures of foods and drinks were used; 14 of the original items were retained whereas 12 new items were added. The 26 snack items were divided into 13 pairs and were differentiated by high-contrast (eg, carrots and donuts) and low-contrast (eg, goldfish and chips) pairs. The majority of food items added for the pilot test belonged to the low-contrast pairs to assess preschoolers' ability to classify food items that were more nuanced in nutrient differences.

Students were taken from their classrooms individually and interviewed in a separate room, a procedure with which they were familiar for regular testing related to *Head Start* requirements. To begin, preschoolers were asked to name their favorite snack and define an anytime food. Regardless of whether preschoolers defined anytime foods correctly, researchers provided the same explanation to ensure each preschooler started the assessment with the same definition. Preschoolers were then shown pairs of food and asked to identify the snacks presented. Researchers recorded each response as 0 (incorrect) or 1 (correct). When a food was identified incorrectly, researchers provided the correct answer (eg, *Close! That is actually broccoli.*) and then asked the preschooler to identify the anytime food among each pair. Finally, children were asked which of the 2 food items they would choose for a snack. Sum scores were created for 3 variables (mean [SD]): *identifying food* was the food items the preschoolers could name (19.26 [3.54]; $\alpha = .80$); *categorizing food* was the food items preschoolers could correctly categorize as anytime (ie, healthy) (5.42 [2.72]; $\alpha = .65$); and *food choice* was healthy food items preschoolers said they would select as a snack (4.54 [2.55]; $\alpha = .62$). In addition, sum scores were created for the number of healthy snacks that could be named and the number of healthy food items that were identified among the high-contrast pairs (easy comparisons) and low-contrast pairs (hard comparisons).

Teaching strategies GOLD. Teaching Strategies GOLD (TSG; Teaching Strategies LLC, Bethesda, MD; 2014) is an online tool employed by *Head Start* with which teachers can track preschoolers' progress throughout the school year. The TSG was widely adopted within the *Head Start* program to measure progress in social-emotional, physical, language, cognitive, literacy, and mathematic subscales and was established as a reliable and valid measure in children from different backgrounds, races, and ethnicities, and for children with special needs.[29] Within each subscale, teachers assessed preschoolers' abilities by age to determine whether they functioned at their age level. The TSG items were coded as failed task (0), on task (1), and above task (2). To provide an overall cognitive functioning score in the current study, items were summed across the cognitive domain subscales (language, cognitive, literacy, and mathematics). Excellent reliability of the TSG subscales was previously established and was replicated in the study's sample.[29] Furthermore, the overall cognitive sum score maintained the same excellence in reliability as the subscales ($\alpha > .90$).

Anthropometric measurements. At the end of the school year, preschoolers' standing height (measured to the nearest 0.1 cm with a Harpenden stadiometer [Wales, UK]) and weight (measured to the nearest 0.1 kg on a Seca digital weighing scale [Cleveland, OH]) were collected by 2 trained research assistants from the nutrition department. Height and weight were measured twice to ensure accuracy, and the average was transformed using the Centers for Disease Control online body mass index (BMI) calculator into a BMI and BMI percentile rank score, which accounted for age and sex.[30]

Data Analysis

Tables 1 and 2 presented intercorrelations among the covariates, independent variables, and dependent variable. The researchers conducted a 3-step hierarchical multiple regression (Table 3) with food choice as the dependent variable. All assumptions for a linear regression were assessed,[31] in which the dependent variable violated the assumption of normality and was transformed using a Box-Cox transformation equivalent to a cube root transformation ($\lambda = .3$).[32] The resulting transformation reduced the positively skewed nature of the variable, but it remained kurtotic and nonnormal. Based on sample size, there was adequate power for the model selected, and the assumption of multicollinearity was not violated. A boxplot inspection identified 6 outliers, which were subsequently excluded from the final model.

The researchers conducted data inspection and descriptive statistics using SPSS (version 24, IBM Corp., Armonk, NY; 2016). The hierarchical regression analyses were conducted using Mplus (version 5.21, Muthén & Muthén, Los Angeles, CA; 2014) due to its ability to address missing data. The PSS, anthropometrics, and TSG were collected at different times by different people; some data were missing. The full information maximum likelihood method in Mplus was used to include as many cases as possible in model estimations.

RESULTS

Descriptive Information

Figures 1 and 2 present the percentage of preschoolers who could identify the healthy food items and the number of preschoolers who could identify healthy foods and demonstrated a preference for a hypothetical healthy snack, respectively. For easy comparisons, preschoolers were better at identifying the unhealthy options (ie, cookie, lollipop, doughnut, chocolate, ice cream), as well as common fruits (ie, orange, apple, banana). Novel food items included kiwi and a granola

Table 1. Descriptive Statistics and Bivariate Correlations Between *Head Start* Preschoolers' Age and Responses on Preschool Snack Selection (Mean ± SD)

Variable	Healthy Snack (13 Items; α = .67) (8.45 ± 2.18)	Easy Comparisons (8 Pairs; α = .78) (3.17 ± 2.14)	Hard Comparisons (5 Pairs; α = .56) (2.25 ± 1.91)	Preschooler Age (4.73 ± 0.64)
Identifying food (n = 231; α = .80) (19.26 ± 3.54)	.927**	.247**	–.020	.382**
Categorizing food (n = 230; α = .65) (5.42 ± 2.72)	.215**	.906**	.656**	.153*
Food choice (n = 230; α = .62) (4.54 ± 2.55)	.298**	.395**	.249**	.289**
Preschooler age	.367**	.148	.071	1

α indicates internal consistency, Cronbach's α.
*$P < .05$; **$P < .01$.
Notes: Identifying food meant that the child could identify the food item. Categorizing food meant that the child could identify which of the pair was healthy. Food choice indicated that the child would choose to eat the healthy option. The healthy snack was the sum of healthy items correctly named. Easy comparisons were the sum of correctly labeled healthy foods in high-contrast food pairs. Hard comparisons indicated the sum of correctly labeled foods as healthy in low-contrast food pairs. Bivariate correlations were carried out to determine associations between preschooler age and the preschool snack selection. Identifying food was significantly associated with all subscales except hard comparisons. Preschooler age was significantly associated with all but 2 dimensions (easy and hard comparisons) of the preschool snack selection.

bar, which were identifiable by <10% of preschoolers. Figure 2 presents the percentage of preschoolers who could name healthy snacks and correctly identify them as healthy, and the number who said they would actually choose the snack if given the option between the unhealthy and healthy options in the pair (ie, chocolate vs broccoli). Table 1 presents descriptive statistics and correlations between age, identifying food (naming food), knowing healthy food items (healthy snack), identifying food as healthy (categorizing food), selecting the healthy option as a snack (food choice), and selecting the healthy choice when it was an easy or hard

Table 2. Bivariate Correlations Between Responses on Preschool Snack Selection, Cognitive Function, and *Head Start* Preschoolers' Age and BMI

	Cognitive Function					
Variable	**Literacy**	**Cognitive**	**Language**	**Math**	**Total**	**BMI % Rank**
Preschooler age	.368**	.351**	.340**	.333**	.383**	.084
Identifying food	.468**	.396**	.430**	.351**	.469**	.030
Categorizing food	.234**	.167	.140	.065	.165	.024
Food choice	.261**	.260**	.244**	.269**	.282**	.031
Number of healthy items identified	.403**	.370**	.415**	.326**	.431**	–.023
Number of easy comparisons correctly identified	.227*	.220*	.161	.101	.199*	.029
Number of hard comparisons correctly identified	.129	-.010	.035	-.031	.025	.004

BMI indicates body mass index.
*$P < .05$; **$P < .01$.
Notes: Bivariate correlations were carried out to determine associations among the preschool snack selection, cognitive function (ie, Teaching Strategies GOLD), and preschooler characteristics. Subscales and total score were all significantly associated with preschooler age, ability to identify foods, and hypothetical food choice. Literacy, cognitive, and total score performance were related to easy comparisons; literacy performance was also significantly associated with categorizing foods. Body mass index percentile was not significantly associated with any variables presented in this matrix. There were no sex differences among variables presented in this correlation matrix.

Table 3. Hierarchical Regression Analysis Predicting *Head Start* Preschoolers' Hypothetical Food Choice (n = 223)

	Hypothetical Food Choice					
	Model 1		Model 2		Model 3	
Variable	**β**	**SE**	**β**	**SE**	**β**	**SE**
Preschooler age	.270***	.077	.239**	.087	.221*	.085
Preschooler sex	.092	.077	.085	.078	.132	.125
Body mass index Percentile Rank	–.058	.085	–.057	.085	–.043	.083
Cognitive function	–	–	.072	.091	.023	.088
Categorizing food	–	–	–	–	.317***	.064
Model information	**Estimate**		**Estimate**		**Estimate**	
R^2	.089*	.045	.093*	.046	.164**	.048
ΔR^2	–	–	.001	–	.068**	–
F	7.132***	–	5.588***	–	8.514***	–
F-change	–	–	.96	–	18.43***	–

R^2 indicates multivariate coefficient.
*$P < .05$; **$P < .01$; ***$P < .001$.
Notes: All regression coefficients are standardized β's. Model 1 includes preschooler demographics and BMI; model 2 includes preschooler cognitive function (sum score of literacy, cognitive, language, and math Teaching Strategies GOLD subscales); model 3 includes preschooler scores for correctly categorizing food items as healthy. All models were significant, with model 3 explaining the greatest amount of variability. In the full model, preschooler age and ability to categorize foods as healthy were significant predictors of a hypothetical food choice. R^2 values ranged from .089 to .164 across all 3 models.

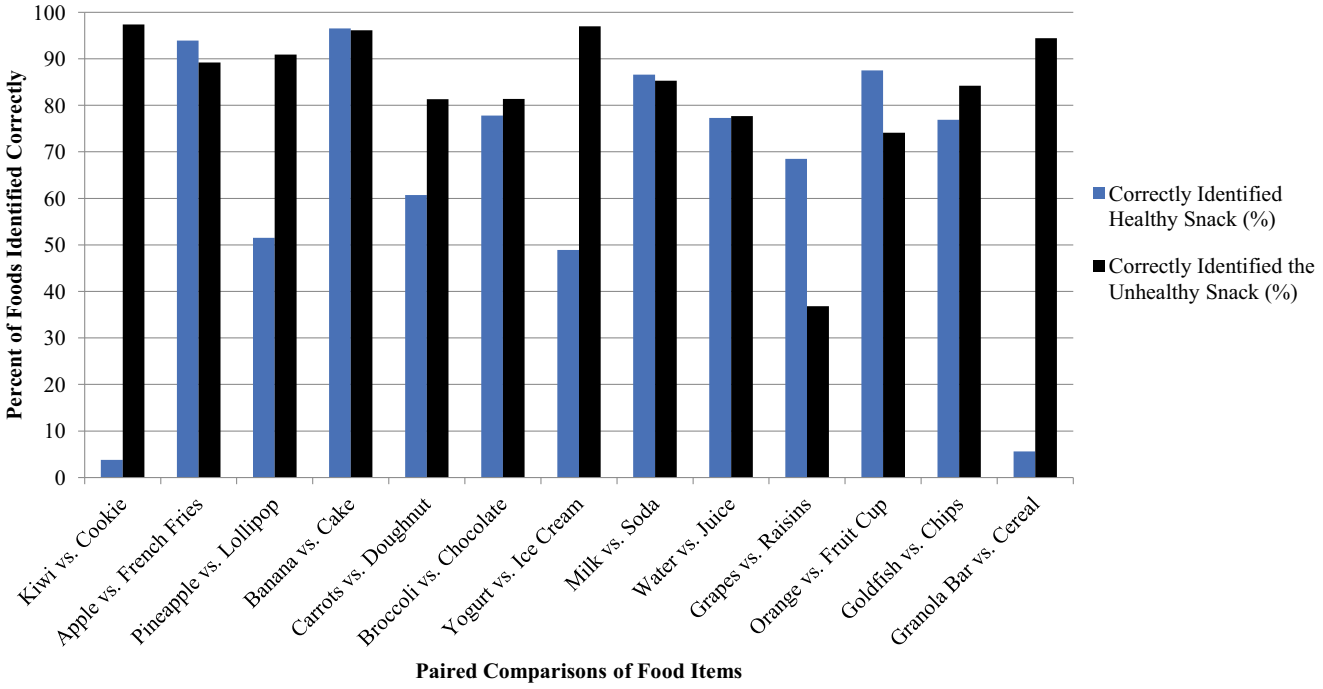

Figure 1. Percentage of *Head Start* preschoolers correctly identifying food items.

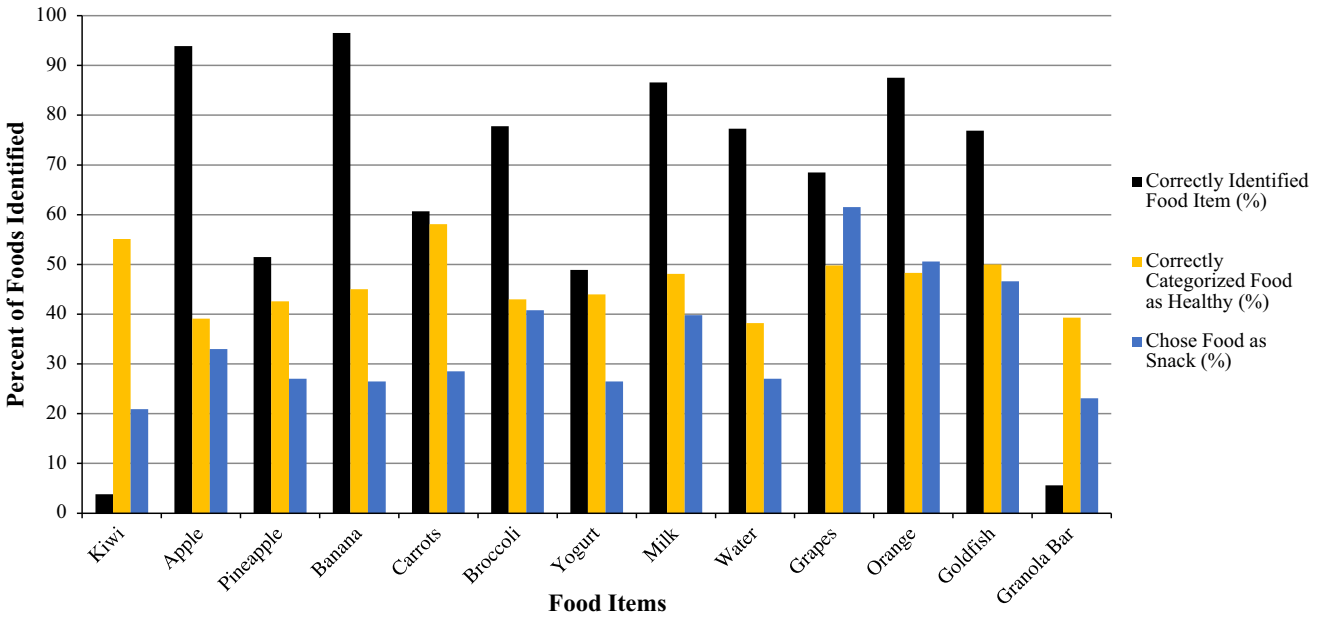

Figure 2. Percent comparisons of healthy foods identified and categorized, and hypothetical snack selections chosen by *Head Start* preschoolers.

comparison. Table 2 examines the relation between the PSS variables, teacher-reported child functioning, and preschooler characteristics.

Hierarchical Regressions

Model 1. Preschoolers' sex and age were retained as covariates in step 1 owing to significant relations with food choice. Specifically, girls reported that they would select more healthy options as a snack (t [158] = 2.06; $P < .05$) and were able to identify more food items (t [158] = 3.29; $P < .01$). Preschooler BMI percentile rank was also included to control for the assumption that preschoolers who were obese may have demonstrated poorer understanding of healthy food and reported poorer food choices than would preschoolers within the normal weight range.[33-35]

Model 2. The TSG cognitive sum score was related to several model variables and was included in step 2 as a covariate. However, this predictor was not significant, which resulted in a small amount of change in variability from step 1 ($\Delta R^2 = .001$; $P > .05$).

Model 3. The number of snacks preschoolers could identify as healthy among the easy (high-contrast) pairs was added in step 3. When controlling for age, sex, BMI percentile rank, and child cognitive functioning, categorizing food as healthy ($\beta = .317$; $P < .001$) was a significant predictor of whether they would select a greater number of healthy snacks (F-change = 18.43; $P < .001$). The covariates (model 2's R^2) alone explained 9.3% of variance, and categorizing food (model 3) explained a significant amount of the variability in preschooler responses, totaling 16.4%.

DISCUSSION

In the current study, preschoolers' ability to categorize food was predictive of hypothetical food choice when controlling for age, sex, BMI percentile rank, and cognitive functioning. The high- and low-contrast food pairs used in the measurement for the study reiterated the necessity of recognizing developmental limits in preschoolers, because the low-contrast pairs seemed to be outside preschoolers' ability to differentiate. Furthermore, the researchers examined a unique combination of child-focused predictors for preschoolers' stated food choices (ie, food classification, anthropometrics, and general cognitive functioning). In a recent review of preschool nutrition interventions, preschoolers' ability to classify foods as healthy or unhealthy and their actual knowledge of food were least often measured, and child anthropometrics and stated preferences or choices were used by only about a third of studies.[2]

Not surprisingly, older preschoolers could identify healthy food and categorize food, and were more likely to report that they would choose healthier food for a snack than would younger preschoolers. This was consistent with the cognitive skills preschoolers improve during the preschool years, such as categorization, vocabulary building, and decision making.[21,22] Child age was related to teachers' assessments of child cognitive functioning (ie, literacy, language, math, cognitive), further providing evidence that older preschoolers display more general knowledge skills. Older preschoolers may have had more exposure to general food and nutrition knowledge, exhibited a greater cognitive capacity for some nutrition education and greater awareness of healthy foods, or had more autonomy in making food choices at home.

However, what is most important is not preschoolers' age in considering implementation of nutrition programs, but what it represents in terms of cognitive abilities. There is a hierarchy to classifying foods,[21,22]

which was conveyed in the current study. Easy food pair comparisons with high contrast (see the first 8 pairs in Figures 1 and 2) showed a consistent pattern of more preschoolers being able to name the food than to classify it as healthy, and to be able to classify it than to say they would choose it as a snack. The hard comparisons did not have the same pattern of categories mediating choices (ie, knowledge > categorization > choice).[22] In fact, there was no consistent relation between how many of combined easy and hard food pairs a preschooler could classify as healthy and preschooler cognitive functioning; categorizing food represented the lowest-magnitude relation to preschooler age compared with their ability to identify or choose healthy food for a snack (Tables 1 and 2). The 5 low-contrast food comparisons (ie, grapes vs raisins, orange vs fruit cup, water vs juice, goldfish vs chips, and granola bar vs cereal) had questionable internal consistency[36] and were consistently unrelated to cognitive functioning. When these 5 pairs were removed so only the high-contrast pairs remained in a sum score (Table 2), preschooler cognitive abilities were related to the ability to classify food more consistently.

These hard comparisons (ie, low-contrast pairs) appear to be outside the capabilities of preschool-aged children, which is consistent with how preschoolers develop object categorization.[18,22] Preschoolers may not be able to detect small differences between the foods to classify them as healthy or unhealthy, or explain their reasoning behind knowing why something is healthy.[18,19] A more developmentally appropriate expectation is for preschoolers to be able to differentiate between high-contrast foods that are easily classified into 1-dimensional categories, such as fruits and vegetables.[21] This was demonstrated with the novel food item kiwi, which preschoolers had difficulty naming but were able to classify once they were given the prompt that it was a fruit. In contrast, cereal was too complex for preschoolers to categorize, perhaps because it could be healthy or unhealthy depending on multiple dimensions and attributes (ie, the amount of whole grains and sugar).[18,22]

The current study focused on preschoolers' ability to understand important messages from a nutrition curriculum in categorizing food appropriately as healthy or unhealthy, but factors influencing food choices are complex and may be biological/genetic, social, psychological, or environmental.[19,26,37] In particular, even if preschoolers are cognitively aware of what is or is not healthy, health behavior might be influenced by attitudes, perceived barriers, or social norms; awareness does not always lead to behavior.[2,23] Moreover, preschoolers who demonstrate knowledge of nutritious foods by identifying and explaining their benefits may choose healthy foods during mealtimes but not during snack times.[19] The researchers could not assess changes in nutrition knowledge because a pretest was not conducted, which would have been helpful in determining treatment effects from the curriculum implementation. Further, some preschoolers in the sample may have lacked understanding of what was being asked during the assessment. For example, although all preschoolers were taught the definition of an anytime food across the school year and it was reiterated at the beginning of the assessment, some preschoolers still may have lacked the understanding that an anytime food was a healthy food option. A small number of preschoolers may have misunderstood researchers' questions owing to language barriers, because some preschoolers spoke Spanish as their first language and children may have been answering to please the adult or researcher.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Current research on preschoolers suggested that helping preschoolers with the complex task of understanding how to categorize food will contribute to better food choices.[6,20,37] It is imperative to understand the complexity of classification and base curriculum on theories of cognitive development to develop and assess preschool nutrition education.[6,24,25] For example, the marketing or availability of food items might influence whether it is perceived as healthy,[38] and even healthy items perceived as sweet, such as yogurt, might challenge preschoolers' ability to classify food correctly. Furthermore, whereas 1-dimensional classification is easier for preschoolers, labels such as healthy and unhealthy can result in preschoolers falsely classifying food as good and bad. Using descriptive phrases, such as how often a food should be consumed, would be more accurate and developmentally appropriate (ie, sometimes/anytime food; go/whoa[6]). Cognitive development should be considered in both research and practice so that programs are developed that match children's abilities (where they are) and developmental capacity (where they could be). Healthy dietary consumption has been shown to mediate the relationship between socioeconomic status and developmental outcomes, so nutrition education and research should focus on those most at risk, such as low-income families served by *Head Start*.[7,39,40] Furthermore, future research could further the field's understanding of the relation between food knowledge, classification, and choices by examining mealtime choices and not just hypothetical snack choices.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.