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Nutrition and Physical Activity Knowledge Assessment: Development of Questionnaires and Evaluation of Reliability in African American and Latino Children

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Please note that this study was published before the implementation of Healthy, Hunger-Free Kids Act of 2010, which went into effect during the 2012-13 school year, and its provision for Smart Snacks Nutrition Standards for Competitive Food in Schools, implemented during the 2014-15 school year. As such, certain research may not be relevant today.

ABSTRACT

Background
African-American and Latino children living in neighborhoods with a low-socioeconomic index are more at risk of obesity-associated metabolic disease than their higher socioeconomic index and/or white peers. Currently, consistent and reliable questionnaires to evaluate nutrition and physical activity knowledge in these children are needed.
Objective
The purpose of this study was to develop nutrition and physical-activity knowledge questionnaires that would be reliable and internally consistent when used with African-American and Latino children living in inner-city communities.
Methods
A total of 112 children, 8–11 years of age, identified by a parent as being either African-American or Latino, were recruited and administered questionnaires. Internal consistency, one measure of reliability, was assessed by calculating the Cronbach's alpha of test scores. Test-retest design was used to assess the reproducibility by calculating the intraclass correlation coefficients and Pearson correlation coefficients.
Results
The nutrition knowledge and physical-activity knowledge indices had alphas of 0.80 and 0.77, respectively. Both questionnaires had excellent test-retest reliability, with intraclass correlation coefficients of 0.82 and 0.83, respectively. The questionnaires had reliable alphas for both African-American and Latino 8-11yr old children, for both boys and girls. Multiple linear regression analysis, with ethnicity, gender, and grade entered simultaneously into the models, showed that nutrition knowledge and physical activity knowledge scores were not significantly related to these three variables.
Application to Child Nutrition Professionals
The questionnaires used in this study are internally consistent and may be used to evaluate nutrition and physical-activity knowledge in African-American and Latino children in grades 3, 4, and 5. Additional evaluations would be needed to determine if these tools are also reliable for children from other ethnicities, ages, and grades.

INTRODUCTION

Unhealthy lifestyles and habits during childhood and adolescence may affect day-to-day well-being, performance, growth, development, and dental health, as well as increase risks of chronic diseases related to poor diets, inadequate physical activity, and obesity. Research in the last decade has shown that the diets of schoolchildren provide more than the recommended amount of energy from fat (37.4–38.7%), and fall short in meeting the dietary recommendations for the major food groups (Holman & White, 2011).

People living in low-socioeconomic communities are less likely to consume a nutrient-dense diet high in complex carbohydrates, fruits, and vegetables than middle- and upper-income persons (Saksvig et al., 2005; Stevens et al., 1999), and to engage in adequate physical activity (Lowry, Kann, Collins, & Kolbe, 1996; Powell, Slater, Chaloupka, & Harper, 2006). Less than optimal levels of physical activity have been associated with increased risk of all-cause mortality, as well as higher risks of cardiovascular disease, colon cancer, and diabetes (Berlin & Colditz, 1990; Blair et al., 1989; Kampert, Blair, Barlow, & Kohl, 1996). Children in low-socioeconomic communities may also find it harder than their middle- and upper- socioeconomic peers to achieve adequate physical activity and a balanced diet when economic conditions are exacerbated by cultural, psychological, and social factors, advertising promotions, and inadequate physical activity and nutrition knowledge (Anderson, Bell, Adamson, & Moynihan, 2002; Bucholz, Desai, & Rosenthal, 2011). Thus, changing existing eating and physical activity patterns in children is a major challenge for nutrition educators (Luepker et al., 1996; Thakur & D'Amico, 1999).

Knowledge of what constitutes optimal nutrition and physical activity is one of several critical predictors of a healthy diet and active lifestyle, even though nutrition knowledge alone may not be sufficient to support changes in consumers' food behaviors (Bandura, 1982; Worsley, 2002). To complement efforts of their caregivers, it is important for children to have a level of nutrition and physical-activity knowledge appropriate for their age so they may develop good habits in early life and maintain them. In order to measure and monitor changes in knowledge, researchers need reliable instruments, yet the availability of tools to use for performing these evaluations in children is extremely limited.

In the peer-reviewed literature, child nutrition and physical-activity knowledge have been reported in many studies. We identified only one nutrition knowledge tool, however, that reported an acceptable internal consistency (Cronbach’s alpha = 0.75) for nutrition knowledge (based on photographs of *healthy* and *unhealthy*food) when used with 81 children, ages 4–8 years (Calfas, Sallis, & Nader, 1991). This study also reported Cronbach’s alpha = 0.14 for physical activity behavior (Calfas et al., 1991). Although the International Physical Activity Questionnaire (IPAQ) was reported to be reliable and valid when used to assess physical activity knowledge in adults ages 18–65 (Craig et al., 2003), we were not able to identify any questionnaires that were reported to be reliable and valid for assessing physical-activity knowledge of children in the 8–11 age group.

It is well recognized that evaluation tools must be appropriate for use in the population of interest. Although the prevalence of obesity in some groups of U.S. children appears to be leveling off (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010), the high risk for metabolic syndrome among overweight and obese children remains of great concern. Our interest relates to the development of interventions that reduce risk of metabolic diseases associated with obesity in children. Thus, we focused on African-American and Latino children, since they are at higher risk for obesity than their non-Latino white peers (Ogden et al., 2010).

In order to determine whether nutrition and physical activity interventions have the potential to improve relevant behaviors in targeted children, reliable and consistent tools must be used to assess the improvements in nutrition and physical-activity knowledge needed to support behavior change. Consistent and reliable questionnaires are needed to evaluate nutrition and physical activity knowledge in children, including those of African American and Latino ethnicities. To address this gap, the objective of this study was to develop nutrition and physical activity knowledge questionnaires that would be reliable and internally consistent when used with African-American and Latino children living in inner-city, low-socioeconomic communities.

METHODOLOGY

Questionnaire Development

A nutrition knowledge questionnaire was developed and modeled, in part, after the CATCH Kids Club Questionnaire (http://www.sph.uth.tmc.edu/catch/KidsClub.htm). Questions were selected that would specifically assess knowledge regarding nutritional qualities of vegetables, fruit, whole grain foods, water,

sugary foods, and beverages. The questionnaire consisted of 30 questions, including 10 multiple choice questions with answers depicted pictorially and in words, 10 multiple choice questions with answers provided only in words, and 10 questions with “yes/no/I don’t know” responses.

A physical activity knowledge questionnaire was developed, with question styles based on those included in the nutrition knowledge questionnaire. The physical activity knowledge questionnaire consisted of 27 questions, including 18 multiple choice questions with answers provided pictorially and in words, 2 multiple choice questions with answers provided only in words, and 7 questions with “yes/no/I don’t know” responses. The selection of questions followed our goals of assessing knowledge regarding the relationships of physical activity to health and general well-being, and the development of broad-based physical activity skills.

To ensure content and face validity, questions were developed and reviewed by experts in the field, who were informed of the learning objectives and goals. As needed, questions were eliminated or modified until experts approved a total of 30 questions for the nutrition knowledge questionnaire and a total of 27 questions for the physical-activity knowledge questionnaire.

Participants

Participating children were recruited at six after-school sites that qualified to provide all attending children free school lunch and snacks, located in inner-city regions of Oakland or Richmond, California, with a minimum of 20 African-American and 20 Latino children in the qualifying age range. Potential participants in the study were screened based on the following inclusion criteria: a) 8–11 years of age and/or grades 3-5; b) identified by a parent, as being either African-American or Latino (defined as having at least one parent of either ethnicity); c) able to speak conversational English; and d) regularly attend specific after-school programs located in inner-city regions of Oakland or Richmond, California. Inner city areas are the usually older, poorer, and more densely populated central section of a city (*www.merriam-webster.com/dictionary*). By maintaining a confidential record that linked the name of each participating child to his/her non-identifying code, care was taken to ensure that no subject participated more than once.

The target sample size was 100, as this is recognized to give good precision for measuring repeatability and agreement of instruments (Peat, Mellis, Williams, & Xuan, 2002). A total of 112 child participants were recruited and administered questionnaires. Demographic data for 2 participants were excluded since either age or ethnicity did not meet our inclusion criteria; 1 participant was excluded because of an incomplete data set; and 1 participant was excluded due to a clearly repeating answering pattern. Thus, analyses were performed using a final sample size of 108 including 51 boys and 57 girls.

Data Collection and Handling

Questionnaires were approved by the Committee for the Protection of Human Subjects at the University of California, Berkeley prior to being administered to child participants. The questionnaires were completed in group settings by trained personnel. Participants completed the questionnaires at their own pace. Staff members were available to answer individual questions, assist with reading if needed, and to check questionnaires for completeness.

Internal consistency, one measure of reliability, was assessed by calculating the Cronbach's alpha of test scores. This statistic was used to determine how well the scores of the individual items fit together, and whether they assessed the same construct (Cronbach, 1951; Nunnally & Bernstein, 1994). An alpha of 0.7 or more was used as the standard for internal consistency since this standard is defined as having good internal consistency and as adequate for among-group comparisons (Nunnally & Bernstein, 1994). Reliability of the scores was also examined by determining the impact of removing each individual item, in turn, on the alpha value. However, as cautioned by others, care was taken not to sacrifice utility and purpose of the final questionnaire by using changes in alpha as the sole criterion for question selection (Peat et al., 2002).

Test-retest evaluations were administered 1-3 weeks following the first administration. This time interval was selected as a sufficient duration to make it unlikely that the children would remember their initial responses to questions, yet not of such long duration as to allow for developmental changes that could inadvertently influence responses. To determine test-retest reliability at the individual level, the intraclass correlation coefficient (ICC) was used to assess agreement among scores from the two tests (Peat et al., 2002). Values for Pearson’s correlation coefficient for these two tests were also calculated. Retest questionnaires could not be administered at all of the community sites due to unanticipated logistical problems including recruitment delays causing re-test time to correspond to school holidays at some sites, child attendance inconsistency, and site staffing changes impacting after-school site priorities.

Scores of 1 or 0 were assigned to correct and incorrect answers, respectively, for all questions. Scores for each questionnaire then were calculated as the sum of all questions and divided by the number of questions; for example, if 70% of questions were answered correctly, the total score would equal 0.70. In this paper, these scores are labeled as Nutrition and Physical Activity Indices scores. If more than one choice was marked for a question, a score of 0 was assigned. A score of 0 was also assigned if no choice was marked for a question or if the child selected the "I don't know" response (Fanslow, Brun, & Hausafus, 1981). Finally, questions answered correctly by 90% or more or 10% or less of the children did not meet the criteria for *question difficulty* as suggested by others (Fanslow et al., 1981) and were excluded from the final analyses.

Data Analyses

Analyses were performed using SPSS version 18.0 for Windows. Statistical significance was reported at $p < 0.05$. Data were double entered for accuracy. Reliability of indices was evaluated by calculating Cronbach's alpha, ICCs, and Pearson's correlations. The influence of three independent variables (ethnicity, gender, and grade) on each of two dependent variables (nutrition and physical activity knowledge scores) was evaluated using multiple linear regression analysis methods. Children in grades 2 and 6 were excluded from this final analysis due to the small numbers of children at these two grade levels. Thus, regressions were performed only on children in grades 3-5.

RESULTS

This analysis was performed on data from 47 African American and 61 Latino children with a mean age of 9.3 years (Table 1). Gender and grade distributions were not significantly different for the African American and Latino children in this sample. More than 90% of the children were of the same ethnicity as his/her mother.

Table 1. *Demographics of Study Participants*

	African American	Latino
Number	47	61
Age[a] (mean ± SD)	9.38 ± 1.03	9.31 ± 1.10
Grade[a] (mean ± SD)	4.04 ± 0.91	4.05 ± 1.07
Gender*b*, male	38%	54%
Ethnicity of mother same as child[c]	92%	98%

[a] Differences not statistically significant, using two-tailed t-test following Levene's test for equality of variances. b Differences not statistically significant using Chi Square test. c Ethnicities of child and mother were reported to be the same.

Cronbach's alpha, calculated for the nutrition knowledge index when all 30 items were included, was 0.82. Scores for 4 items did not meet the question difficulty criteria and were deleted from all subsequent analyses. Using the remaining 26 items, the alpha was 0.80 and, thus, met the standard for acceptability, set at > 0.70 (Table 2). When the single item least related to the other items in the index was deleted, the alpha was unchanged (a = 0.80).

Table 2. *Reliability: Cronbach's Alpha and Test-Retest Correlations*

	Cronbach's Alpha (n =108)		Test-Retest (n = 36)		
	a, All items	a, 1 item deleted[a]	Number of items	ICC[b]	r-value[b]
Index Name					
Nutrition Knowledge	0.80 (26 items)	0.80 (25 items)	26	0.82	0.82

	Cronbach's Alpha (n =108)		Test-Retest (n = 36)		
Physical Activity Knowledge	0.77 (26 items)	0.77 (25 items)	26	0.83	0.83

Note. ICC = intraclass correlation coefficient; r-value = Pearson correlation coefficient.
[a] Alpha determined after deleting the single item least related to the other items in the index.

Alphas for both African American (a = 0.73) and Latino (a = 0.85) children met the reliability threshold (Table 3). Also, alphas for boys (a = 0.80) and girls (a = 0.81), and for children in grades 3 (a = 0.81), 4 (a = 0.77) and 5 (a = 0.77), exceeded the threshold of 0.70. Both the test-retest ICC of 0.82 (Table 2) and Pearson's correlation coefficient of 0.82 were strong. Although the sample size for these test-retest calculations was small (n=36), increasing sample size would be expected to have little effect on values of these coefficients.

Table 3. *Influence of Ethnicity, Gender, and Grade on Cronbach's Alpha*

		Nutrition Knowledge Index		Physical Activity Knowledge Index	
	n	a 26 items	a 1 item deleted[a]	a 26 items	a 1 item deleted[a]
By Ethnicity					
African American	47	0.73	0.74	0.79	0.80
Latino	61	0.85	0.85	0.75	0.76
By Gender					
Male	51	0.80	0.81	0.79	0.79
Female	57	0.81	0.81	0.75	0.76
By Gradeb					
3rd	32	0.81	0.83	0.80	0.81
4th	34	0.77	0.79	0.76	0.79
5th	31	0.77	0.78	0.76	0.78

[a] Alpha determined after deleting the single item least related to the other items in the index.
[b] Means not reported for 2nd or 6th grades since number of participants in these grades (n = 4 and 7, respectively) were not sufficiently large for alpha values to be reliable.

The overall mean of the 26 item nutrition knowledge index was 0.58 (Table 4). Mean scores for this index were 0.57 and 0.58 for African American and Latino children, respectively; 0.60 and 0.56 for boys and girls, respectively; and 0.53, 0.57, and 0.60 for children in grades 3, 4, and 5, respectively. Neither ethnicity, gender, nor grade was related to the nutrition knowledge score in bivariate analyses.

Table 4. *Means (+ SD) of Nutrition and Physical Activity Knowledge Indices*

	n	Nutrition Knowledge Index	Physical Activity Knowledge Index
All participants	108	0.58 ± 0.19	0.71 ± 0.16

	n	Nutrition Knowledge Index	Physical Activity Knowledge Index
By Ethnicity			
African American	47	0.57 ± 0.17	0.72 ± 0.17
Latino	61	0.58 ± 0.20	0.71 ± 0.16
By Gender			
Male	51	0.60 ± 0.19	0.73 ± 0.17
Female	57	0.56 ± 0.19	0.69 ± 0.16
By Grade[a]			
3rd	32	0.53 ± 0.19	0.69 ± 0.18
4th	34	0.57 ± 0.18	0.71 ± 0.16
5th	31	0.60 ± 0.17	0.72 ± 0.16

[a] Means not reported for 2nd or 6th grades due to small numbers of participants (n = 4 and 7, respectively).

When ethnicity, gender, and grade were entered simultaneously into the regression model, nutrition knowledge scores still were not significantly related to the child's ethnicity, gender, or grade (Table 5).

Table 5: *Regression Analysis: Association of ethnicity, gender, and grade of participant with total scores for knowledge indices (n=97)*[a]

	Dependent Variables			
	Nutrition Knowledge		Physical Activity Knowledge	
Independent variables	Unadjusted	Adjusted2	Unadjusted	Adjusted2
	Standardized regression coefficients			
Ethnicity[c]	-0.011	-0.017	-0.065	-0.075
Gender[d]	-0.059	-0.063	-0.084	-0.094
Grade	0.160	0.160	0.073	0.074

[a] Data for participants in 2nd or 6th grades were excluded from regression analyses since the numbers of participants in these grades (n = 4 and 7, respectively) were not sufficiently large. b Ethnicity, gender, and grade were entered simultaneously for multiple linear regression analysis, so the relationship of each variable is shown after adjusting for any influence of the other two variables. c Ethnicities coded as follows: African American, 1; Latino, 2. d Genders coded as follows: Male, 1; Female, 2.

The physical activity knowledge index included 27 items. With all of these items included, the alpha was 0.77. Scores for 1 item did not meet the question difficulty criteria and was deleted from all subsequent analyses. Using the remaining 26 items, the alpha was 0.77 and met the standard for acceptability set at > 0.70 (Table 2). When this index was optimized by deleting the single item least related to the other items in the index, alpha

was unchanged (a=0.77). Alphas were acceptable for both African American (a = 0.79) and Latino (a = 0.75) children (Table 3), for both boys (a = 0.79) and girls (a =0.75), and for children in grades 3 (a = 0.80), 4 (a =0.76), and 5 (a = 0.76). Both the test-retest ICC of 0.83 (Table 2) and Pearson's correlation coefficient of 0.83 were strong.

The overall mean of the 26 item physical-activity knowledge index was 0.71 (Table 4). Mean scores for this index were 0.72 and 0.71 for African American and Latino children, respectively, 0.73 and 0.69 for boys and girls, respectively, and 0.69, 0.71, and 0.72 for children in grades 3, 4, & 5, respectively. Ethnicity, gender, and grade level were not related to the physical activity knowledge score in bivariate analyses. When ethnicity, gender, and grade level were entered simultaneously into the regression model, physical activity knowledge scores still were not significantly related to the child's ethnicity, gender or grade level (Table 5).

DISCUSSION

To our knowledge, this is the first study to report internally-consistent nutrition and physical- activity knowledge questionnaires (alpha > 0.70) specifically evaluated in children ages 8–11 in inner-city, African American and Latino children. Additionally, both questionnaires showed high test-retest reliability when evaluated in a subsample of this population. Using test-retest methodologies, good reproducibility has been reported for school-based physical-activity knowledge questionnaires, but not for nutrition knowledge and attitudes (Penkilo, George, & Hoelscher, 2008). As the children included in our study are more at risk of obesity-associated metabolic disease than their white peers, these questionnaires should provide a tool for assessing efficacy of diet and physical activity intervention efforts in high-risk populations, such as these.

In our study, the nutrition and physical activity knowledge indices had reliable alphas of 0.80 and 0.77, respectively. Others have developed and used tools to assess nutrition (Anderson et al., 2002; Cronbach, 1951; Levy, Iverson, & Walberg, 1980; Nunnally & Bernstein, 1994; Peat et al., 2002; Stevens et al., 1999) and physical activity knowledge (Calfas et al., 1991; Gortmaker et al., 1999; Manios, Moschandreas, Hatzis, & Kafatos, 1999; Walter & Wynder, 1989; Williams, Arnold, & Wynder, 1977; Williams, Carter, & Eng, 1980) of children and adolescents. To our knowledge, however, only one tool was shown to have an acceptable alpha > 0.70 for assessing nutrition knowledge (Calfas et al., 1991), but this was in 4-to 8-year-old children, younger than our targeted population of 8- to 11-year-olds.

Internal consistencies for both the nutrition and physical-activity knowledge questionnaire were acceptable in both the African American and Latino children. Using regression analyses, mean scores were not significantly related to ethnicity. Since there was a small sample size, verification with a large follow-up study is needed. A previous study (Beech, Rice, Myers, Johnson, & Nicklas, 1999) reported an influence of ethnicity on knowledge scores, and reported that Latino and White high school students had higher nutrition knowledge scores than African American students (Beech et al., 1999). Ethnic group differences due to cultural influences on knowledge, habits, and preferences have been recognized previously, and some have suggested that interventions for children be tailored for different ethnicities (Cullen et al., 2002). Results from our study suggest that these questionnaires can reliably be used in both African American and Latino children and, when recruited from the same or similar communities, our questionnaire suggested that nutrition knowledge levels were similar for the two groups.

Internal consistency for nutrition knowledge questionnaires was previously reported to be influenced by the grade level of the children being evaluated, with alphas higher for 12th grade than 8th grade adolescents (Whati et al., 2005). In our study, however, alphas did not consistently increase across grades 3–5 for either the nutrition or physical-activity knowledge indices. Thus, our results suggest that these indices are similarly reliable when used to assess children's knowledge in grades 3, 4, or 5. A future study with larger sample sizes in grades 2 and 6 would be needed to determine whether these indices may be used across a wider range of grades. In our study, nutrition and physical activity knowledge scores were not significantly related to grade of the child respondent when third- through fifth-grade children were included in the regression model. If children receive education related to these domains, one might expect scores to increase with grade level. Similarities across these three grades may be explained by a lack of information related to these constructs provided in schools, or minimal retention of such knowledge, but cannot be determined from this study.

We observed that internal consistency of the nutrition knowledge and physical-activity indices was similar for boys and girls in our cohort. Additionally, scores were not significantly influenced by gender. Other researchers reported significantly higher nutrition knowledge scores for high school girls than boys (Beech et al., 1999).

Limitations of this study include restriction to 8–11-year-old African American and Latino children living in low-income, inner-city regions of Oakland and Richmond CA. This precludes extrapolation to children of other races and ages. Another limitation was the unanticipated logistical problems resulting in only 30% participation in the retest questionnaires. Also, these indices are specific for the subject matter we were particularly interested in, which limits their use for evaluating knowledge in other areas.

CONCLUSIONS AND APPLICATION

Our results suggest that these questionnaires are suitable for both boys and girls who are African American or Latino and in grades 3–5. Thus, these questionnaires may be reliably used to assess the influence of targeted interventions on changes in nutrition and physical-activity knowledge in this population. Although these questionnaires may also be appropriate for performing evaluations in children of other ethnicities and grades, researchers would first need to evaluate reliability in those populations.

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