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Associations between whole grain intake, psychosocial variables, and home availability among elementary school children

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Abstract

Objective—Develop/refine and test psychosocial scales for associations with whole grain intake.

Design—Cross sectional survey

Setting—Minneapolis/St. Paul suburban elementary school

Participants—Children in 4th-6th grades (n=98) and parents (n=76)

Variables of Interest—Child whole grain intake, self-efficacy, outcome expectations, preferences, knowledge regarding whole grain foods, whole grain availability at home.

Analysis—Correlation analysis, one-way ANOVA.

Findings—Internal consistency and test-retest correlation coefficients for child psychosocial scales were modest or acceptable ($\alpha = .55-.70$). Parents reported a mean of 15 ± 7 whole grain products available at home. Child mean daily intake of total grain was about 8 servings and intake of products containing whole grain was slightly over 2 servings. Reported home availability and refined grain intake were significantly related to whole grain intake while psychosocial variables were not.

Conclusions and Implications—Home availability may be a more important variable associated with whole grain intake than psychosocial variables.

Keywords

Children; whole grain; psychosocial variables

Introduction

Scientific evidence indicates that greater consumption of whole grain reduces the risk of chronic diseases such as coronary heart disease, type 2 diabetes, and some cancers¹. Based

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on this evidence, national dietary guidance focuses on increased intake of whole grains². Data from the Continuing Survey of Food Intakes by Individuals (CFSII 1994-1996, 1998) indicated a preference for and over-consumption of refined grains while consumption of whole grains was only at one-third of the recommendation according to the Dietary Guidelines for Americans, 2005³⁻⁶. These data also showed that very few children and adolescents (6–19 yrs) met the whole grain recommendation. Additionally, only 11% of the total grains consumed by individuals over 12 yrs consisted of whole grains⁵.

A better understanding of eating behavior in children will allow interventionists to develop effective education to positively influence eating behavior. According to Social Cognitive Theory (SCT), dietary intake is thought to be influenced by three factors (behavioral, personal, and environmental) which operate in an interactive fashion as reciprocal determinants of each other⁷. A recent review provided evidence for relationships between several psychosocial variables based on SCT and food intake by children⁸. SCT constructs most predictive of fruit and vegetable intake among children and adolescents were outcome expectancies^{9, 10}, preferences^{9, 10}, availability/accessibility^{9, 11}, and parental intake^{9, 11}. However, in general it is thought that theoretical constructs are only able to explain about 30% of the variance in eating behavior¹². While the identity of predictors of fruit and vegetable intake in children and adolescents is fairly well established, little is known about predictors of whole grain intake. Burgess-Champoux et al.¹³ piloted a multi-component intervention to improve whole grain intake by school children. An evaluation tool was developed for children to measure intervention effects regarding several psychosocial variables¹⁴. Baseline results indicated that children were fairly confident in their perceived ability to select whole grain foods in specified situations, eat, and ask parents for whole grain foods; however, associations between these variables and actual whole grain intake were not examined.

The purpose of this study was to further develop and refine scales based on psychosocial variables thought to predict whole grain intake in children. The results may be useful in identifying factors associated with whole grain intake in children that would be effective targets for intervention.

Methods

Participants, Sampling, and Procedures

This study was part of a larger intervention project which focused on gradually increasing whole grain content of rolls and buns served in the school cafeteria over the course of a school year¹⁵. At the end of the school year (spring 2006), children in the fourth to sixth grades were recruited through announcements and fliers distributed in school or sent home to parents and enrolled in this study. Parental consent and child assent was required for participation. The University of Minnesota Institutional Review Board and the school district research committee approved the study. Children and parents were given monetary compensation for their participation.

Data Collection

Individual record-assisted 24-hour dietary recall interviews were conducted one time with children (n=98) by two research assistants trained in the use of Nutrition Data System for Research (NDSR) dietary analysis software (NDSR, University of Minnesota, version 2006). Food record forms were sent home prior to interviews for children to briefly record food and beverage items consumed, time and location. Most children returned the record form for use during the interview. The interviews were conducted over a four-week period on Mondays (n = 23), Wednesdays (n = 21), Thursdays (n = 27), and Fridays (n = 27).

Whole grain servings were calculated using the NDSR food group serving count system which was based on the 2005 Dietary Guidelines for Americans² and the US Department of Agriculture MyPyramid¹⁶. Three subgroup categories were used to classify grain and grain-based products as whole grain, some whole grain and refined grain based on ingredient labels. Whole grain foods had a whole grain ingredient as the first ingredient in the list, some whole grain had a whole grain ingredient on the ingredient list but not listed first, and refined grain products did not have a whole grain ingredient on the list.

A home whole grain inventory tool was developed for parents to assess the availability of whole grain foods in the home. The tool was formatted based on an existing instrument regarding home availability of fruits, fruit juices and vegetables¹⁷. Research staff identified whole grain items in grocery stores in the school catchment area with whole grain listed as one of the first three ingredients. A total of 112 food items were organized under 16 broad categories with specific food items listed by name brand and type of product under each broad category. The inventory tool was tested and revised several times with research and school personnel to simplify and clarify format and instructions. Parents were instructed to check items that were currently in the home at the time of the survey. During the 24 hour dietary recall interviews with children, the inventory tool was used to verify that the grain food reportedly consumed by the child was available at home as reported by parents.

After children completed the 24 hour recall interview, a questionnaire was administered on two occasions approximately 14 to 17 days apart (time 1 and time 2). Questionnaire items were constructed based on SCT constructs that were most predictive of fruit and vegetable intake by children⁸ including preferences, outcome expectations and self-efficacy. Self-efficacy items (n=9) were modified from an existing scale related to whole grain intake previously used in a school-based intervention in the same school district¹⁴. Three response options were: I'm not sure I can = 1, I'm a little bit sure I can = 2, or I know I can = 3. Preferences for 14 whole grain foods were assessed by listing the food item with the following response options: never tried it = missing data, I hate it = 1, I don't like it = 2, It's OK = 3, I like it = 4, or I love it = 5. Food items included breads, cereals, pastas, and snacks. An outcome expectations measure for whole grain foods included 10 items with five response options: strongly disagree = 1, disagree = 2, neither disagree nor agree = 3, agree = 4 or strongly agree = 5. Items included general benefits of whole grains (good for me, healthy heart, grow strong) and negative outcomes (reverse coded) related to gaining weight and upsetting the stomach. One item assessed knowledge of the number of recommended daily whole grain servings needed by children with response options of I don't know, none, one third of all the grain foods I eat, half of all the grain foods I eat, all of the grain foods I eat. If the knowledge item was answered correctly, children were assigned a knowledge score of 1 and if not, they were assigned a score of 0. Prior to completing the questionnaire at time 1, all children were provided an explanation of how to identify whole grain foods. Examples of food labels/packages were shown to children as they completed the survey.

Statistical Analyses

Data were analyzed using Statistical Analysis System (SAS) software (SAS, Version 9.1, copyright 2002-2003, Cary, NC). Whole grain consumption was tested for normality and transformed if necessary using square root transformation prior to analysis (non-transformed values are reported in tables). Scale scores were calculated by summing points on each item across the scales. Internal consistency of each scale was assessed with Cronbach alpha coefficients¹⁸. Spearman correlation analysis was completed to determine test-retest correlation coefficients between each mean scale score at two different times. Each food item selected on the whole grain inventory form was assigned 1 point for a possible total score of 112. Using the median score for whole grain preferences, outcome expectations,

self efficacy, knowledge, and home availability score, children were grouped according to high or low scores. One-way analysis of variance was used to determine if differences in intake existed by high or low scores.

Results

Children in the fourth (n=20), fifth (n=54) and sixth (n=24) grades completed the questionnaire and one 24-hr dietary recall interview. Age ranged from 9 to 12 years (mean 10.7 ± 0.9). About half were female (54%) and 64% were non-Hispanic white. Data from two children were excluded (1 dropped out of the study, another reported unrealistic data (kcal > 5000)). Mean ($\pm$ standard deviation (SD)) consumption of total grain foods per child was 7.7 ± 3.2 servings per day. Of the total, mean ($\pm$ SD) intake of refined grain and whole grain + some whole grain foods was 5.4 ± 3.2 and 2.4 ± 2.3 servings/day, respectively. The child questionnaire was completed by 96 children (98%) at time 1 and 92 (94%) at time 2. Children not completing the questionnaire at time 2 were absent from school or declined to participate the second time.

The overall mean preferences score for whole grain foods was fairly high (mean $\pm$ SD) = 3.8 ± 0.5 . Foods most liked by children included snack foods (popcorn and chips) and familiar foods such as ready-to-eat cereals, bread, and crackers (6% indicated they had not tried these whole grain foods). Less familiar foods such as whole wheat tortillas and whole wheat pasta were not rated as highly (14%-34% of children indicated they had not tried these whole grain foods). Children also had fairly high outcome expectations scores (mean $\pm$ SD) = 3.7 ± 0.4 . Results showed that children believed whole grain foods were generally good for them, helped them be strong, provided energy, kept their heart healthy, and eating whole grain foods pleased their parents. The overall level of self efficacy was moderate with a mean of 2.1 on a scale of 1-3. Children were most confident in their ability to eat whole grain foods at restaurants and when they had many other food choices available.

Internal consistency for the preferences and self-efficacy scales at time 1 was somewhat acceptable ($\alpha = .62$ and $.70$ respectively), whereas internal consistency for the outcome expectations measure was only modest ($\alpha = .55$) (Table 1)¹⁸. Test-retest correlation coefficients for preferences, outcome expectations, and self-efficacy scale scores were acceptable ($r=0.65$, $r=0.63$ and $r=0.55$, respectively). The correlation between the mean response on the knowledge item at the two time points was low ($r=0.33$) (Table 1).

The whole grain home inventory was completed and returned by 76 parents (78%). The age range was 26 to 59 years (mean $\pm$ SD = 42 ± 6). Most were female (81%), had attended or graduated from college (90%), were employed either part or full time (73%), and were non-Hispanic white (84%). Total scores on the home inventory ranged from 1 to 38 for whole grain items with a mean $\pm$ SD of 15 ± 7 (Table 2). About one fourth of parents reported having either 9 items (26%, n = 20) or 20 items in the home (22%, n = 17), while about half (51%, n = 39) reported having 10-19 items. The most commonly available products in the home were dry and cooked cereals, chips and snacks, pastas and grains, and bread. A wide range of whole grain products were available in the home with 12 of the 16 categories having more than one item marked within the category. Fewer parents reported having whole grain flour, other whole grain breads (bagels, pizza, waffles and dough), granola bars, cookies, and entrées (such as frozen prepackaged meals) in the home.

No significant differences in whole or refined grain consumption by children were observed by low or high scores related to psychosocial variables (Table 3). Children with higher scores on the outcome expectations scale consumed more servings of foods in the some whole grain category and fewer servings of foods in the refined grain category compared to

those with low scores, however this difference only approached significance ($p < 0.07$). On the other hand, consumption of foods in the some whole grain + whole grain and whole grain categories was significantly higher by children with higher scores on home availability compared to those with lower scores ($p < 0.05$).

Discussion

Whole grain intake by children was related to availability of whole grain foods in the home but not to preferences, outcome expectations, self-efficacy, and knowledge. These findings are contrary to results regarding predictors of intake of other foods by children⁸⁻¹¹. In particular, preferences were important predictors of fruit and vegetable intake. However, in the current study, intake of whole grain foods was not different by high and low scores on a preference scale. Whole grain items are commonly served as part of mixed dishes (e.g. sandwiches, pizza, pasta dishes) while fruits and vegetables could be more easily recognized by children as individual items. Therefore, children may have had a difficult time separating taste preferences for whole grain products from other components in mixed dishes. Intake of whole grain foods was not different according to scores on an outcome expectations measure which is also contrary to previous research regarding predictors of fruit and vegetable intake by children^{8, 11}. Consumers, especially children, are confused by what constitutes a whole grain product and have difficulty differentiating these products from refined grain products^{3, 14}. This may explain in part, the lack of detection of differences in intake according to preferences and outcome expectations.

Confidence in one's ability to perform a behavior is typically related to the frequency of performing the behavior¹⁹. In the current study, self efficacy was based on ability to consume whole grain foods in difficult situations based on location, peer influences and liking for refined grain foods. Mean self-efficacy was moderate with no relationship to intake of whole grain foods noted. The mean for single items in the scale did not vary widely (ranging from 2.0 to 2.5 with SD from 0.5 to 0.9) indicating that no single item represented a particularly difficult or easy situation. This may have contributed to the lack of differences in intake by self-efficacy score. The previously described issues related to identifying whole grain foods and differentiating them from refined grain foods could also have influenced responses to self-efficacy items. Knowledge of intake recommendations is thought to be important in enabling dietary change as part of the construct known as behavioral capability²⁰. However, relatively few children in this pilot study were able to accurately select the number of daily whole grain servings recommended. Most provided different responses on the two occasions that the questionnaire was administered indicating a general lack of knowledge about recommendations. Recent research related to intake of fruits and vegetables by children indicated that knowledge scores also had poor test-retest reliability with an intraclass correlation coefficient < 0.4 ²¹. It may be that construction of nutrition knowledge items for early adolescent children needs more thought or in the case of whole grain recommendations, more instruction regarding identification of products.

Availability tools have been developed and validated previously to investigate availability and accessibility of fruits and vegetables in the home^{17, 22}. To our knowledge this is the first availability tool that assessed home availability of whole grain foods. A positive attribute of the inventory was that it listed specific items first by category, followed by name brands and lastly type of food. This allowed for fewer problems with identification of products as whole or refined grain by parents. In addition, the list was based on products available in grocery stores in the area to ensure that probable items/brands and types were included. The average household had about 15 whole grain foods from a wide range of categories with the most common items being cereals, snack products, pastas and grains, and breads. These are common dietary sources of whole grain foods for adults and children according to national

dietary intake data^{3, 6} supporting the validity of the instrument. This level of whole grain foods in the home also supports the estimate of whole grain intake for children in this study based on the 24-hour dietary recall interviews. The results also confirm those of others regarding the influence of home availability on intake by children²².

This study has several limitations that need to be considered when interpreting the findings. All data were self-reported by children and parents and therefore potential errors may have occurred based on estimation of intake. However, the opportunity to question children regarding intake via 24 hour recall interviews and to use food packaging as examples may have been more helpful in obtaining accurate estimates of whole grain intake compared to an impersonal measure such as a food frequency questionnaire. The lack of ability to correctly identify whole grain products may also be seen as a limitation despite education regarding labeling and identification issues prior to administration of the instruments. In addition, participants were from one school in one district in a large suburban metropolitan area with most parents having a high level of education, limiting generalizability to a broader group of parents and children.

Implications for Research and Practice

Availability of whole grain foods in the home was related to whole grain intake by children; therefore this may be an important focus for parental nutrition education programs to improve intake of whole grain foods by children. The ability of parents to identify whole grain foods from labels or package information allows them to purchase these foods to have available at home for children. Consumers are generally confused about what constitutes a whole grain product and have limited ability to identify these products based on the label³. Other barriers including limited familiarity and higher cost need to be addressed in education programs to assist parents in making whole grain foods available for children. The recommendation for number of servings of whole grain foods may also be a focus for education for children given that few could identify the correct response.

Additional research is needed to develop and test instruments to examine additional potential predictive variables. If variables with more predictive power are identified, they could become the basis for more effective interventions to improve intake of children.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1
Psychometric properties of scaled variables for children

Child scales	# of items	Range of possible scores	Time 1 N	Mean $\pm$ SD ^a	Cronbach α	Time 2 N ^b	Mean $\pm$ SD ^a	Test-retest reliability ^c
Preferences	14	1-5	96	3.8 $\pm$ 0.5	0.62	92	3.7 $\pm$ 0.6	0.65
Outcome expectations	10	1-5	94	3.7 $\pm$ 0.4	0.55	86	3.8 $\pm$ 0.5	0.63
Self-efficacy	9	1-3	96	2.2 $\pm$ 0.4	0.70	89	2.2 $\pm$ 0.5	0.55
Knowledge item	# of items	Possible score	Time 1 N	Mean $\pm$ SD ^a	Cronbach α	Time 2 N ^b	Mean $\pm$ SD ^a	Test-retest reliability ^c
Knowledge item ^d	1	0 or 1	96	0.3 $\pm$ 0.5	Not applicable	90	0.2 $\pm$ 0.4	0.33

^aSD = standard deviation

^bTime 2 response rate = 92%

^cRefers to the correlation between each scale score based on data collected at different times under the same conditions

^dKnowledge score (includes 1 item) – if answered incorrectly, score = 0, if answered correctly, score = 1

Table 2
Availability of whole grain foods in the home according to parent home inventory report
(n=76 parents)

Category	Number of items ^a listed on inventory form in each category	Mean number of items parents indicated were available in the home $\pm$ SD	Percent of households indicated item was available in the home % (n)
Dry cereal	38	4.1 $\pm$ 2.7	97 (74)
Cooked cereal	6	1.7 $\pm$ 1.3	22 (17)
Snacks	9	1.7 $\pm$ 1.2	86 (65)
Crackers	5	1.6 $\pm$ 1.8	59 (45)
Pastas and grains	11	1.5 $\pm$ 1.5	66 (50)
Rice	6	1.5 $\pm$ 1.2	86 (65)
Bread	11	1.2 $\pm$ 1.1	71 (54)
Taco/tortilla shells	6	0.9 $\pm$ 0.9	66 (50)
Whole grain flour	2	0.5 $\pm$ 0.6	43 (33)
Granola bars	2	0.5 $\pm$ 0.6	55 (42)
Bagels	3	0.2 $\pm$ 0.6	19 (14)
Pizza	4	0.2 $\pm$ 0.4	18 (12)
Dough	2	0.09 $\pm$ 0.3	9 (7)
Cookies	3	0.09 $\pm$ 0.3	9 (7)
Entrée	2	0.06 $\pm$ 0.2	8 (6)
Waffles	2	0.03 $\pm$ 0.2	24 (8)

^aItem refers to the typical container (box, bag, package, etc.) for each category of food.

Table 3
Whole grain intake of children and comparison of high and low groups with psychosocial and availability variables

Variable		n	Whole Grain + Some Whole Grain Mean $\pm$ SD	Whole Grain Mean $\pm$ SD	Some Whole Grain Mean $\pm$ SD	Refined Grain Mean $\pm$ SD
Preferences	Low 3.9	49	2.1 $\pm$ 2.0	1.6 $\pm$ 1.6	0.4 $\pm$ 1.0	5.8 $\pm$ 3.8
	High >3.9	45	2.4 $\pm$ 2.2	1.9 $\pm$ 1.8	0.6 $\pm$ 1.3	5.0 $\pm$ 2.5
Outcome Expectations	Low 3.7	48	2.1 $\pm$ 1.9	1.8 $\pm$ 1.6	0.3 $\pm$ 0.8 *	6.0 $\pm$ 3.7 *
	High >3.7	46	2.5 $\pm$ 2.2	1.7 $\pm$ 1.8	0.7 $\pm$ 1.4 *	4.8 $\pm$ 2.7 *
Self efficacy	Low 2.1	38	2.2 $\pm$ 2.0	1.9 $\pm$ 1.6	0.3 $\pm$ 0.7	5.6 $\pm$ 3.1
	High >2.1	46	2.2 $\pm$ 2.2	1.6 $\pm$ 1.7	0.6 $\pm$ 1.4	5.5 $\pm$ 3.4
Knowledge item	Incorrect	64	3.0 $\pm$ 2.1	1.3 $\pm$ 1.8	0.5 $\pm$ 1.2	4.7 $\pm$ 3.2
	Correct	38	2.2 $\pm$ 1.9	1.1 $\pm$ 1.6	0.4 $\pm$ 1.2	4.1 $\pm$ 3.5
Availability	Low 13	40	1.9 $\pm$ 2.0 **	0.9 $\pm$ 1.7 **	0.5 $\pm$ 1.2	6.0 $\pm$ 3.6
	High >13	36	2.8 $\pm$ 2.2 **	1.6 $\pm$ 1.7 **	0.7 $\pm$ 1.4	4.8 $\pm$ 2.8

**
 $p < 0.05$,

*
 $p < 0.1$ according to ANOVA.