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Assessing Nutrition Knowledge and Dietary Habits of Adolescents using Personal Data Assistants

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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

Objective
To assess nutrition knowledge and dietary behaviors of seventh graders in nine randomly selected middle schools in Louisiana.
Methods
This descriptive study used personal data assistants (PDAs) to administer a pre-validated questionnaire developed from national instruments to 127 seventh grade students from nine randomly-selected schools in Louisiana. Frequencies, Kruskall-Wallis, Wilcoxon-Mann-Whitney, and correlation tests were used to assess differences in factors related to nutrition knowledge scores.
Results
Misconceptions regarding the Food Guide Pyramid, serving sizes, nutrient content of foods, and diet-disease relationships were identified. Although, there were no significant differences in general knowledge scores based on gender, age, or ethnicity, students who reported discussing nutrition with their parents had significantly higher general knowledge scores ($p = 0.02$). For most students, reported intakes of fruits, vegetables, and milk and milk products were below recommendations.
Applications to Child Nutrition Professionals
This study showed that while participants had a good knowledge of the Food Guide Pyramid food groups, they also had significant misconceptions concerning foods belonging to the milk and fat groups. Students also tended to overestimate recommended serving sizes, and were unfamiliar with diet-disease relationships. PDAs proved to be a user-friendly, efficient means of collecting survey data from middle school students.

INTRODUCTION

Adolescence is a period of rapid physiological and psychological changes that correspond with high nutritional needs; it is also a period in which eating habits are erratic, and are influenced by several factors, such as personal preference, targeted media, and peer influence (Delisle, Chandra-Mouli, & deBenoist, 2000). In addition, adolescence is a period characterized by a transition from concrete to abstract thinking, and teenagers are able to recognize relationships between dietary behavior and chronic diseases (Shaffer, 1999). Furthermore, there is a small body of research suggesting that the treatment of overweight is more successful in youth than in adults (Epstein, Valoski, Kalarchian, & McCurley, 1995) and that nutrition education, combined with behavior modification strategies, produces positive outcomes (Steptoe, Perkins-Porras, Rink, Hilton, & Cappuccio, 2004; Williams-Piehota, et al., 2004).

Because behavior patterns become more resistant to change with increasing age, (Winter, Stanton, & Bousley, 1999), intervention at an early age is crucial. It is the position of the American Dietetic Association, the Society for Nutrition Education and the American School Food Service Association that schools are the logical setting

to teach comprehensive behavior-based nutrition education in a sequential way, starting as early as preschool (American Dietetic Association, 2003). Evidence indicates that the school environment can be effective in promoting better diet and health. For example, a previous study found that school-based nutrition education programs had a positive effect on the weight status of 1295 ethnically-diverse Massachusetts schoolchildren (Gortmaker, et al., 1999).

Nutrition education that includes behavior modification has been shown to improve knowledge and dietary habits, and decrease Body Mass Index (BMI) (Story, Lytle, Birnbaum, & Perry, 2002; Wechsler, Brener, & Small, 1999). In addition, increased nutrition knowledge has been positively correlated with healthier dietary practices in adults (Variyam, Blaylock, Lin, Ralston, & Smallwood, 1999), and in children (Powers, Struempler, Guarino, & Parmer, 2005). A successful nutrition education program should integrate nutrition education messages not just in health education classes and the cafeteria, but also through the core curricula and throughout the school (Cho & Nadow, 2004). These messages should be interactive and consistent, and should reinforce each other (Cho & Nadow, 2004). Research shows that a behavior-oriented curriculum promotes healthy food choices and increased physical activity (Koplan, Liverman, & Kraak, 2005). USDA's Team Nutrition is a voluntary, behaviorally-oriented nutrition education initiative that exemplifies these principles. This program was designed to improve children's diets and health through training and technical assistance for school foodservice professionals to help them serve school meals that look good, taste good and meet nutrition standards. The program also aimed to provide multifaceted, integrated nutrition education to children and their parents, and involve school administrators and other school and community partners to build support for healthy eating and physical activity. Schools may enroll as a Team Nutrition School through a database maintained by the USDA's Food and Nutrition Service (FNS).

METHODOLOGY

Participants

Study participants included 127 seventh grade students from nine randomly selected middle schools representative of rural and urban schools in the state of Louisiana. To ensure a random selection that provides statewide representation, and a sufficient number of schools such that the study has a statistically large sample population (n>30), schools were randomly selected from a pool of 48 schools selected from each region with an appropriate mixture of urban and rural districts. Within each of the selected 16 school districts, schools with a 7th grade class were randomly selected by the use of a table of random numbers to a total of nine schools. All the seventh grade students from the selected schools were invited to participate. Parish supervisors and principals of these schools were contacted and invited to participate in the study. Once permission was granted, a contact teacher was assigned as a liaison between the school and the principal researcher. Participation in this study was voluntary for both the schools and individual students. In addition, informed consent forms were sent to parents assuring confidentiality of the students participating in the study. The Human Subjects Committee from Louisiana Tech University reviewed and approved the study procedure and instrument.

Instrument

To assess nutrition knowledge and dietary behaviors of seventh graders, a 76-item questionnaire was developed. The questionnaire was administered via personal data assistants (PDA), which were programmed with animated interactions, a feature intended to be visually appealing to seventh graders, and therefore enhance completion rate.

In the interest of efficiency in obtaining information comparable to national data, items used for the student questionnaire were obtained or adapted from several national questionnaires, surveys, and published research studies, including CDC School Health Index (SHI), Middle Schools and High Schools; Team Nutrition Pilot Study; SHAPE California 2001 (Shaping Health as Partners in Education); and Diet and Health Knowledge Survey 1994-1996 (USDA What We Eat in America). Criteria for item selection were based on how well the item addressed study questions. The questionnaire items developed using the above resources were reviewed for content and face validity by a panel of experts, and revisions were made with the target population in mind with emphasis on cognitive level, clarity, and response burden. A more complete description of the development of the data collection methodology and a complete copy of the questionnaire is available at http://WWW.ers.USDA.gov/publications/ccr20/DBGen.htm (Murimi, Colvin, Liner, Guin, & Guthrie, 2006).

The instrument included four main sections that assessed students' knowledge of the food groups as classified by the Food Guide Pyramid, the recommended number of servings for each group in the Food Guide Pyramid, the recommended serving size for selected foods, and addressed rich sources of the major nutrients in each food group. Knowledge relevant to the Food Guide Pyramid was assessed because this study was designed and conducted before release of the revised and updated MyPyramid by USDA's Center for Nutrition Policy and Promotion. Also, since the Food Guide Pyramid has been a core element of nutrition education since its release in 1992, it is the most-taught nutrition education topic in Louisana middle schools. The questionnaire also assessed knowledge of foods high in dietary fat; saturated fats and cholesterol, and the relationship between diet and chronic diseases. Each item was given a score of 1 if correct, and 0 if incorrect, for a possible score of 76. Demographic data collected included gender, ethnicity, and age.

Analysis

Demographic data were analyzed using SAS, version 8.02, (2004, SAS Inc., Cary, NC) as well as SPSS, version 11.0 (2001, SPSS, Inc, Chicago, IL). Frequency distributions were performed cumulatively and categorically to find coding errors as well as to examine the general trends in the data. Kruskall-Wallis, Wilcoxon-Mann-Whitney, and correlation tests were used to assess differences in factors related to nutrition knowledge scores. Multivariate analysis (MANOVA) was performed to assess group differences across variables of interest.

RESULTS AND DISCUSSION

A total of 127 students from nine randomly-selected schools that provided statewide representation of Louisiana completed the questionnaire. Of the students who completed the questionnaire, slightly more than half were female (52.0%) and Caucasian (55.1%). Table 1 presents other demographic data for this population.

Table 1. Gender, Age, and Ethnicity of Participants

Variable	(n = 127) N	(n = 127) %
Gender		
Males	59	46.4
Females	67	52.8
Missing Data	1	0.08
Ethnicity		
Caucasian	70	55.1
African American	42	33.1
Other	14	11.0
Missing Data	1	0.08
Age		
11 to 12 years	64	50.4
13 to 14 years	55	43.3
15 years or above	7	5.50

Missing Data	1	0.08

Nutrition knowledge of the Food Guide Pyramid food groups

Nutrition knowledge assessed included Food Guide Pyramid food groups, recommended number of servings, portion sizes, and knowledge of foods high in fat, saturated fats, and cholesterol. The mean score for general nutrition knowledge was 33.4 ± 6.5, with the males scoring a mean of 32.9 ± 6.7, while females averaged 33.8 ± 6.4. Caucasians scored slightly higher (34.0 ± 6.0) than African Americans and others (32.6 ± 6.4), with a total possible score of 76 points. As expected, students who reported discussing nutrition with their family had significantly higher knowledge score than students that did not ($p = 0.02$).

Overall, students seemed to know which foods belonged to the Food Guide Pyramid categories. However, there were notable misconceptions related to milk and fats groups. For example, more than half of the students (56%) classified butter in the milk group, 23% of the students classified eggs as from the milk group, 21% of the students classified cold cereal as a milk product, and 20% of the students classified cooked cereal as a fat. Table 2 outlines food group responses.

Table 2. Percentage of Students Who Correctly Placed Foods in Proper Food Guide Pyramid Category

Food Item	Correct %	Incorrect %	Did not know %
Broccoli	96.8	.8	.8
Tomato	66.7	29.6	1.6
Corn	88.9	6.4	4
Potatoes	69.8	19.9	10.3
Strawberries	96.8	.8	.8
Apples	92.1	8	0
English Muffin	85.7	11.9	2.4
Cooked cereal	38.1	32.5	29.4
Cold Cereal	23.8	42.1	34.1
Beans	7.8	70.7	21.4
Chicken	97.6	.16	.8
Fish	90.4	.8	8.7
Eggs	24.6	38.9	36.5
Milk	95.2	.8	4
Yogurt	69.8	26.2	4.0
Cheese	88.1	9.6	2.4
Cake	86.5	11.1	2.4

Candy	96.8	0	1.6
Soft drinks (soda)	89.7	4.0	6.3
Butter	31.8	56.4	11.1

*all categories may not equal 100% due to missing data.

Knowledge of the Food Guide Pyramid recommended number of servings and serving sizes
Although students had a modest understanding of food groups according to the Food Guide Pyramid, students exhibited poor knowledge of the Food Guide Pyramid serving sizes. For example, students tended to overestimate serving sizes for cooked vegetables, with majority of the students (65%) indicating that one cup was the correct serving size for cooked vegetables. More than half (59 %) indicated that one or two cups were the correct serving sizes for cooked cereal, rice, or pasta, and 52% of the students indicated that either ¾ cup or 1 cup was the correct serving size for canned fruits. Table 3 outlines serving size results.

Table 3. Percentage of Correct, Underestimated, and Overestimated Serving Sizes of Selected Foods

Food	Correct %	Underestimate %	Overestimate %	Don't Know %
Wheat Toast	77	13.5	5.6	3.9
Bagel	39.7	0	42.8	15.9
Ready to eat cereal	55.6	15.9	14.3	12.7
Cooked cereal – rice, pasta	20.6	0	58.8	19.6
Raw leafy Vegetables	24.6	29.4	19.8	24.6
Cooked vegetables	19.8	0	65.1	14.3
Vegetable juice	28.6	23.5	28.6	18.3
Medium fruit	52.4	12.7	23	18.3
Canned fruit	34.1	0	51.6	11.9
Fruit juice	31.8	15.9	39.7	10.3
Milk or yogurt	46.8	20.6	19	11.9
Processed cheese	23	48.4	5.6	21.4
Cooked lean meat	45.2	20.6	11.1	21.4
Cooked beans	34.1	0	48.4	15.9
Eggs	38.1	11.9	38.1	11.9
Peanut butter	29.4	33.3	11.1	24.6

Butter	54	0	27	18.2
Salad dressing	30.2	36.5	15.9	16.7
Sour cream	42.9	0	24.6	31
Cream cheese	39.7	0	27	31.7
Sugar, jam, or jelly	42.1	0	42.1	14.3
Soda	27.8	40	21.4	10.3

*All percentages may not total 100 due to missing data.

Students also demonstrated lack of knowledge of the Food Guide Pyramid's recommended number of servings for each food group, with only 11% of students correctly identifying the recommended number of servings for fruits; 16% for vegetables; 17% for milk group; 16% for grains; and for meats and beans 18%.

Knowledge of foods high in fat, saturated fats and cholesterol
Knowledge of foods high in fat among common foods was encouraging, with majority of the students (64%) correctly identifying French fries as higher in fat than baked potatoes; 64% reported that fried chicken strips were higher in fat than a grilled chicken breast; 58% recognized that hot dogs had more fat than turkey slices; over half (51%) reported coleslaw was higher in fat than a green salad; 60% identified that ice cream had more fat than frozen yogurt; approximately 68% identified that a chicken thigh with skin had more fat than a skinless chicken thigh; over half (57%) reported that a muffin had more fat than a slice of wheat toast; and 60% correctly identified that regular chips were higher in fat than pretzels.

However, most of the students did not demonstrate knowledge of foods high in saturated fats with only 39% correctly identifying butter as higher in saturated fat than vegetable oil, and 34% reported that butter was higher in saturated fat than margarine. Only 47% correctly answered that beef steak was higher in saturated fat than a chicken breast, and over half (56%) answered that whole milk had more saturated fat than skim milk. Students were modestly knowledgeable of foods with a high amount of cholesterol, with just over half (52%) correctly answering that meats and animal products were highest in cholesterol.

Knowledge of dietary behaviors and associated disease
Similarly, student knowledge of dietary habits and associated diseases was low. Although slightly over half (51%) of the students correctly identified that type 2 diabetes mellitus was a potential health consequence related to obesity, and 47% correctly identified heart disease as an addition health problem associated with obesity, students knowledge of other chronic diseases was very limited. Only 13% of the students identified eating too much salt or sodium as being associated with high blood pressure, and only 19% of students identified that eating too much cholesterol and saturated fat was related to heart disease and stroke, and that eating too many calories was associated with obesity (19%). Additionally, most students (96%) did not associate a lack of calcium in the diet with osteoporosis. No students associated eating too much sugar with dental problems.

There were no significant differences in general knowledge scores based on gender, age, or ethnicity. Gender was a factor in knowledge of the relationship between calcium intake and osteoporosis, with females being significantly more likely to identify that a diet low in calcium was associated with osteoporosis ($p = 0.02$).

Dietary behaviors and food attitudes
Frequencies of food consumption of various foods within the week prior to the survey were assessed. Students most often reported consuming fruit juice (25%), fresh fruits (30%), vegetables (35%), and salad (47%) one to three times per week in the week before the survey. In addition, more students reported that they ate vegetables (59%) as a snack than fruits (45%), and 58% reported they had eaten fruit and/or vegetables when they went out to eat in the two weeks prior to completing the questionnaire. Comparing

intakes to those recommended by the Food Guide Pyramid, only 17 % of students reported eating 2-4 servings of fruit per day and, 11% of students reported eating 3-5 servings of vegetables per day while approximately one third (32%) of students reported drinking the recommended 2-3 servings of milk per day.

When students were asked their opinions of various fruits and vegetables, they reported that overall, they liked fruits more than vegetables. The five most popular fruits included grapes (83%), watermelon (78%), apples (78%), oranges (74%), and bananas (71%). The five most popular vegetables included corn (56%), greens collard or mustard (50%), potatoes (50%), cucumber (47%), and green beans (42%). The five fruits students reported most frequently that they had never tried were honeydew melon (48.8%), apricots (45%), mangoes (42%), kiwi (17%) and fruit salad (16%). The five vegetables students most frequently reported never trying were radishes (43%), cauliflower (36%), squash (32%), mushrooms (31%), and spinach (26%).

Discussion

A majority of the students (75%) answered more than half of all questions incorrectly. This is reflected in the many misconceptions that were shown regarding the Food Guide Pyramid food groups, correct serving sizes of various foods, nutrient content of foods, and the relationship between diet and disease. The results of this study mirror studies conducted among adolescents and young adults which observed that participants were generally unaware of key elements of nutrition guidelines such as the Food Guide Pyramid and Dietary Guidelines for Americans, and were optimistically biased about health risks associated with overweight (Green, Grant, Hill, Brizzolara, & Belmont, 2003; McArthur, Grady, Rosenberg, & Howard, 2000). The results are also similar to findings of a study (Rolls, 2002) among adults, which showed that adult participants could not correctly identify recommended portions of packaged foods.

Among the majority of students, intakes of fruits, vegetables, and milk and milk products were below those recommended by Dietary Guidelines 2005 and the USDA's Food Guidance System, now known as MyPyramid (USDA, 2005).

These results are of concern since studies show a relationship between nutrition knowledge and dietary behavior, with increased knowledge being positively correlated with healthier dietary practices in adults (Variyam, et al., 1999), and in children (Powers, et al., 2005). Although teachers indicated teaching topics of the Food Guide Pyramid (reported elsewhere), students do not seem to understand it well, or to have applied it to their dietary choices. Future research to investigate how nutrition education can be more effective in promoting behavioral change among students would be useful.

It may be that students lack motivation to change because they are not aware of diet-health relationships. Students in this study scored poorly on items pertaining to dietary behavior and related disease conditions. However, other factors such as social norms or preferences for healthy foods may also play a role, and deserve to be further investigated.

The use of handheld computers proved effective mechanism for collecting point-of-consumption data in this project and had several advantages over using paper format. The method facilitated collection of food consumption data in real time avoiding a lapse in memory that occurs when the data have to be obtained after the students have left the cafeteria. In addition, this method was convenient to project investigators, since the data collected was synced into pre-programmed databases thereby eliminating the need to re-key data later, and minimizing data entry errors. The method was used in areas that computers were not accessible, making handheld computers very useful tools for data collection in situations where more traditional computer-based surveys are not practical due to limited resources, lack of internet connectivity, or slow internet access like rural areas.

CONCLUSIONS AND APPLICATIONS

The findings of this study indicate that although the seventh grade students participating in this study had modest knowledge of food groups based on the Food Guide Pyramid, there were significant misconceptions regarding food groups belonging to fat and milk products. And furthermore, a majority of the students were limited in their knowledge of serving sizes, and diet-health relationships. Most students reported intakes of fruits, vegetables, and milk and milk products that were below recommendations. A majority of the participating students did not know the right serving sizes or recommended number of servings for most of the

food groups. These results have some implications to teachers and parents of junior high school students. Given the fact that adolescence is a period characterized by transitions in thinking styles especially the development of abstract thinking, and that risk factors associated with cardiovascular disease are known to establish themselves during childhood and adolescence, it is imperative for educators and parents to provide the nutrition information to adolescents that is geared towards behavior change. The importance of involving parents in nutrition education is underscored by the fact that the students who indicated that they discussed nutrition with their family had significantly higher nutrition knowledge scores that those who did not. If we expect adolescents to make nutrient-dense food choices, as well as to consume adequate amounts of these foods in order to meet their increased nutritional needs without eating to excess, it is important that they understand both the recommended number of servings and serving size.

The use of PDAs to collect point-of-consumption data offered several advantages over the use of pen and paper format. PDAs were time-efficient, convenient, and appealing to the students. They facilitated collection of food consumption data in Real Time avoiding a lapse in memory that occurs when the data are obtained after the students leave the cafeteria. Programming the menus for both breakfast and lunch into the handheld computers, minimized respondent's burden and increased the accuracy and consistency of the data entered. In addition, this method was convenient and time efficient to project investigators, since the data collected was synced into pre-programmed databases, thereby eliminating the need to re-key data later and minimizing data entry errors. Handheld computers can be used in areas that computers are not accessible, making them useful tools for data collection in situations where more traditional computer-based surveys are not practical due to limited resources, lack of Internet connectivity, or slow Internet access in rural areas.

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