

U.S. Dietary and Physical Activity Guideline Knowledge and Corresponding Behaviors Among 4th and 5th Grade Students: A Multi-Site Pilot Study

Abstract

Knowledge of U.S. dietary and physical activity recommendations and corresponding behaviors were surveyed among 4th and 5th graders in five Arizona counties to determine the need for related education in SNAP-Ed eligible schools. A <70% target response rate was the criterion. Participants correctly identified recommendations for: fruit, 20%; vegetables, 19%; whole grains, 23%; and physical activity, 37% of the time. Fruit, vegetable, whole grain, and physical activity recommended behaviors were met by 23%, 37%, 30%, and 64%, respectively. Knowledge and behavior were associated only for fruit. These data confirmed the necessity for nutrition and physical activity education in this population.

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Introduction

An alarming 33% of U.S. children, aged 6-11 years, are overweight, and 18% are obese (Ogden, Carroll, Kit, & Flegal, 2012). The prevalence of obesity can double during adolescence and often persists into adulthood (Freedman et al., 1987; Kimm et al., 2002; Kimm & Obarzanek, 2002; Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). These statistics suggest that nutrition and physical activity requirements for obesity prevention are not being met in our youth.

Obesity, poor nutrition, and insufficient physical activity are risk factors for type 2 diabetes, cardiovascular disease, and several cancers (Kim & Lee, 2009; WCRF/AICR Report, 2007). The metabolic and inflammatory disturbances that link obesity to chronic disease have already been demonstrated in young children (Ford, Ajani, & Mokdad, 2005; Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007; Lee, Okumura, Davis, Herman, & Gurney, 2006; Moran et al., 2005; Weiss et al., 2004). Since limited income individuals are at greater risk for chronic conditions associated with modifiable behavioral risk factors (Clark, DesMeules, Luo, Duncan & Wielgosz, 2009), understanding the gaps in knowledge and optimal behaviors in Supplemental Nutrition Assistance Program (SNAP) qualifying areas may be critical. This is particularly important with resources for education programs dwindling. Assessing the continued need for nutrition and physical activity education and interventions by age and community setting will facilitate the targeting of resources to high-risk groups.

The purpose of the study reported here was to determine the need for continued nutrition and physical activity education among 4th and 5th graders in SNAP-Education (SNAP-Ed) eligible schools. The *a priori* criteria to demonstrate a need was <70% of children correctly identifying U.S. recommendations for fruits, vegetables, whole grains, milk, and physical activity (Dietary Guidelines for Americans, 2010; Physical Activity Guidelines Advisory Committee Report, 2008) and <70% meeting these recommendations behaviorally. The hypothesis was that <70% would know and achieve the recommended behaviors and knowledge. The study secondarily explored the association between knowledge and behavior in this age group.

Methods

Study Design

The University of Arizona Nutrition Network (UANN) conducted the study to examine the need for nutrition and physical activity education among 4th and 5th graders in SNAP-Ed eligible schools. A multi-site, observational design and survey were used to query students about nutrition and physical activity related knowledge and behaviors. The present analysis included surveys completed on a single occasion per classroom. The University of Arizona Institutional Review Board reviewed the study and designated it as exempt.

Population and Recruitment

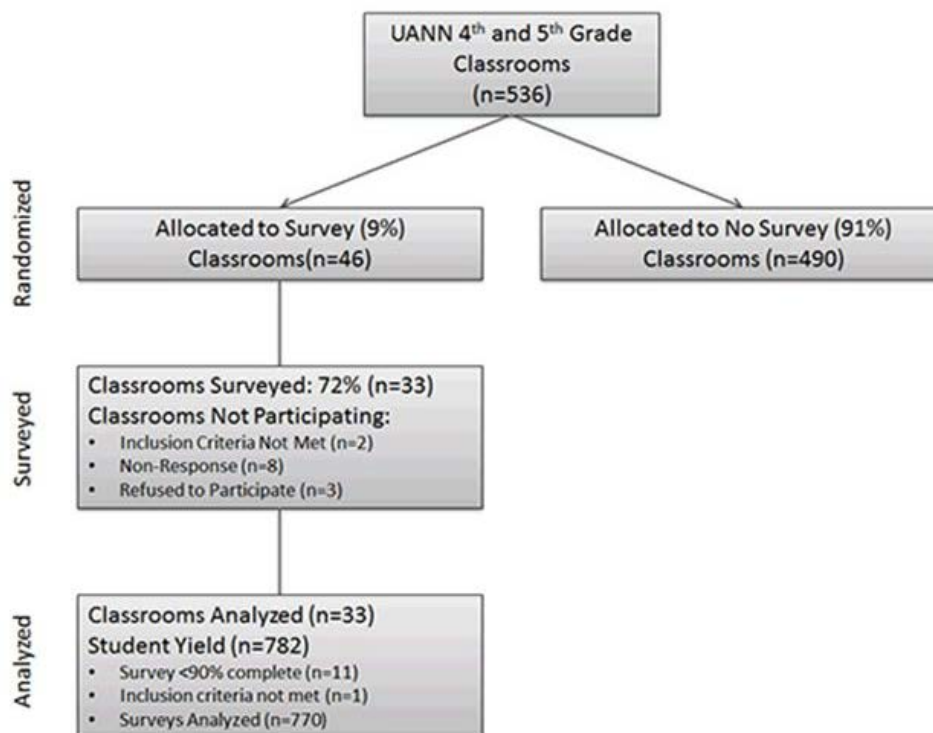
A list of teachers who had participated in UANN programs in the prior year was used to select classrooms to be surveyed. Eight percent of 4th and 5th grade teachers in five Arizona counties was used as the target for the randomization model. A minimum output of two classrooms per county was also forced into the model, for a final yield of 9% (n=46) randomized to survey. Seventy-two percent of those allocated to the survey group agreed to participate (Figure 1).

Survey Instrument and Proctoring

The Youth Nutrition and Physical Activity Survey combined questions from two surveys with good validity and reliability. Nutrition questions were adapted from the School Physical Activity and Nutrition survey and physical activity questions from the Day in the Life Questionnaire (Edmunds & Ziebland, 2002; Edmundson et al., 1996a; Edmundson et al., 1996b; Hoelscher, Day, Kelder, & Ward, 2003; Penkilo, George, & Hoelscher, 2008). The combined survey was reviewed by nutrition experts at the University of Arizona for content face validity, feasibility, and survey layout. It was tested for clarity and interpretation using a convenience sample of three classrooms participating in UANN summer programs; the protocol, instructions, and scripts were also assessed in these classrooms. Based on feedback from teachers, staff, and participants, slight modifications to the protocol and questions were made. Surveys were then administered across Cochise, Maricopa, Pima, Pinal, and Santa Cruz counties between October and December 2011.

The UANN staff or in-classroom teachers administered the surveys using a standard protocol and script. All questions referenced the previous day. Surveys were scheduled Tuesdays through Fridays, and none followed a school holiday. Participants were asked if they consumed fruits, vegetables, whole grains, and milk (0, 1, 2, or ≥ 3 times) "yesterday" and the type of milk they consumed. After school activity and physical education (PE) were measured in minutes. Break times and transportation to and from school were categorized as active versus passive. Knowledge of U.S. vegetable, fruit, whole grain, and physical activity recommendations was also measured. Children were informed that participation was anonymous, voluntary, and would not affect their grades or participation in any activity. Individual surveys were not reviewed for completeness during survey proctoring to maintain anonymity.

Figure 1.
Consort Diagram



Statistical Analysis

The analyses only included surveys that were $\geq 90\%$ complete. Descriptive statistics (mean, SD, frequency) were computed for student demographics, knowledge, and behavior questions. Samples sizes reported vary slightly due to skipped questions and exclusion of multiple answers. Target answers are detailed in Table 1. One-sample binomial tests were used to compare the percent of participants on target to the 70% threshold. Chi Squared tests evaluated the relationship between corresponding knowledge and behavior questions. Differences among counties were evaluated by Pearson's Chi-Squared test for categorical variables and ANOVA for continuous variables. Significance was set at $p < 0.05$. Stata version 10.1 and SAS version 9.3 were used for all statistical analyses.

Table 1.

Target Survey Responses among 4th and 5th Graders in Arizona Applied to Analyses by U.S. Recommendation Category

Category	Mean	SD	Median	p-value ⁵
Milk ¹	1.58	0.93	2	0.60
Whole Grains ²	1.11	0.94	1	0.27
Vegetables	1.21	1.06	1	0.42
Fruit	1.54	1.04	1	0.08
After School Activity (min) ³	45.4	25.90	60	0.027

PE Class Activity (min) ³	15.3	23.20	0	0.007
Total Physical Activity (min) ^{3,4}	60.6	37.88	60	0.001
¹ Drank milk and knew the type (N=613): 32% drank whole; 31% drank 2%; 33% drank 1% or FF; 4% drank soy, almond, rice, or other ² Whole grain question was phrased as "brown" grains ³ Significantly different by Gender (P≤0.018) ⁴ Includes minutes of PE Class plus After School Activity ⁵ ANOVA comparing across the five participating counties				

Results

Participants surveyed (n=770) were primarily 4th graders (70.5%). The mean age was 9.7 (\pm 0.71) years; the gender distribution was 49% male, 51% female. School free and reduced lunch eligibility averaged 84.3% (\pm 9.6%).

Accurate identification of recommendations occurred \leq 23% of the time for diet and 36.7% of the time for physical activity (Table 2). Percentages did not vary across counties, except for accurate knowledge of fruit recommendations (p=0.001). The frequency of accurate responses for all diet and physical activity knowledge questions was significantly less than 70% (p<0.001).

Table 2.

Knowledge of U.S. Recommendations and Practice of Related Behaviors among 4th and 5th Graders in Arizona

		Knowledge		Behavior	
Category	N	% incorrect	% correct	% < Target	% \geq Target
Fruit ^{1,4}	760	80.4	19.6	77.0	23.0
Vegetables ^{1,2,4}	761	81.5	18.5	83.8	16.2
Whole grains ^{1,4}	761	77.0	23.0	70.0	30.0
Total Physical Activity ^{1,3,4}	763	63.3	36.7	36.4	63.6
¹ p<0.001 compared to 70% threshold for knowledge and behavior ² Vegetable answer options on the questionnaire stopped at "3 times or more", such that the "% < Target" is conservative. ³ Includes activity from both PE and after school activity					

⁴No significant difference between genders ($P \geq 0.427$ for all categories, Breslow-Day test)

Actual consumption of whole grains met or exceeded recommendations for 30.0% of children, while adequate fruit and vegetable consumption lagged behind at 23.0% and 16.2%, respectively (Table 2). However, 63.6% of children met or exceeded physical activity recommendations. The percentage of those meeting each target was significantly lower than 70% ($p < 0.001$).

For all dietary categories, consumption frequency was < 2 times on the previous day, with no significant differences among counties (Table 3). Mean percent milk fat consumed was 1.89% (± 1.13).

Table 3.

Mean Daily Consumption Frequency (Times Yesterday) of Key Dietary Components and Minutes of Physical Activity among 4th and 5th Graders in Arizona

Category	Knowledge	Behavior	Notes
Vegetables	2 cups daily for girls 2 ½ cups daily for boys	\geq times yesterday*	N/A
Fruit	1 ½ cups daily	≥ 3 times yesterday*	N/A
Whole Grains (WG)	½ of daily grains	≥ 2 times yesterday*	Behavior target selected based on approximate mean ounce equivalents of grain-based foods likely to be chosen in this age group and target of 3oz WG per day (total grain target of 6oz per day). Example: ½ large bagel (2oz equivalent) and 1 slice of bread <u>or</u> 1 small tortilla (1oz. equivalent of grain) = target of 3 oz. equivalents of grain for consumption of grains "2 times".
Milk	Not measured	≥ 3 times yesterday* 1% or fat free (FF) milk for type of	Non-drinkers were excluded. Percent milk fat was set at: 3.25% for whole milk; 2% for alternative milks; 0.448% for the combined category of 1% & fat free milk.

		milk	
Physical Activity (PA)	≥60 minutes most days of the week	≥60 minutes PE after school PA combined	Transportation or school break times were categorized as active (i.e. walking, biking, running) versus passive (i.e. bus, car, sitting, standing). PA minutes during breaks were not captured. Final PA answer option, "more than an hour" was conservatively set at 75 minutes.
*1 time was assumed to be ½ cup vegetables, ½ cup fruit, 1-2 oz. equivalents of grain, and 1 cup of milk, respectively.			

Time spent being physically active during and after school was significantly different across counties ($p \leq 0.03$), except for morning breaks (Table 3). Sixteen percent reported no morning break, and 64.5% reported no PE the previous school day. Travel to and from school was largely passive ($>70\%$), but most children were active during lunch (72.6%) and morning breaks (74.2%). When limited to only those receiving morning breaks, 88.3% were active (Table 4).

Table 4.

Active Transportation and Break Times Related to a School Day among 4th and 5th Graders in Arizona

Category	N	%	p-value ⁴
Travel to school ¹	167	21.7	<0.001
Travel to home ^{1,5}	200	26.1	<0.001
Morning break ^{2,3}	568	88.3	0.676
Lunch break ³	552	72.6	<0.001
¹ Active was defined as walking or bicycling versus traveling by car or bus ² Includes only those who had a morning break ³ Active was defined as walking or running versus sitting or standing ⁴ Pearson's Chi-Squared test for p-value across the five counties ⁵ Only the "Travel to Home" category was different by gender ($p=0.011$)			

Accurate knowledge of vegetable, whole grain, or physical activity recommendations was not significantly associated with meeting or exceeding the recommendations behaviorally (Table 5, $p > 0.39$). Those consuming adequate fruit were less knowledgeable about recommendations

(p=0.043).

Table 5.

Percent with Correct Responses to Knowledge Questions by Achievement of
Corresponding Behavior Goal among 4th and 5th Graders in Arizona

Category	N	% < Goal	% ≥ Goal	p-value ³
Fruit	149	21.2	14.3	0.043
Vegetables ¹	141	17.4	24.4	0.068
Whole Grains	175	22.1	25.0	0.390
Total Physical Activity ²	280	35.3	37.5	0.531
¹ Vegetable answer options on the questionnaire stopped at "3 times or more", so that the "% < Goal" is conservative. ² Includes activity from both PE class and after school ³ Chi-Squared test for p-value associating knowledge and behavior				

Discussion

The pilot study reported here strongly supports the need for continued nutrition education among elementary school aged children to increase their awareness and adoption of the current recommendations for nutrition and physical activity. Evidence suggests that following U.S. dietary and physical activity guidelines will not only prevent obesity and improve health, but may also aid in academic performance (CDC, 2012). In this cohort, key U.S. dietary recommendations were correctly identified ≤ 23% of the time and physical activity 37% of the time. Recommended dietary consumption levels for fruits, vegetables, milk, and whole grains were met by less than half (Dietary Guidelines for Americans, 2010) and only 64% achieved recommended physical activity levels (Physical Activity Guidelines Advisory Committee Report, 2008). All rates were less than the needs assessment frequency threshold of 70% (p<0.001 in all categories).

Pilot study intake was lower than recent NHANES reports for vegetables, but was similar for fruit (5-11 year olds) and milk (9-13 year olds) (Bradlee, Singer, Qureshi, & Moore, 2010; Kranz, Lin, & Wagstaff, 2007). Fruit and vegetable intake in smaller studies of more comparable age groups were similar to the pilot study (Van Offelen, Schroeder, Lienes, Roth-Yousey, & Reicks, 2011). Nevertheless, fruit, vegetable, whole grain, and milk intake in children has been consistently inadequate across studies compared to current USDA Dietary Guidelines. The preponderance of the evidence suggests that opportunities for nutrition education, healthful consumption, and activity are still needed within this age group. (Bradlee et al., 2010; Dietary Guidelines for Americans, 2010; Gibson, Wardle, & Watts, 1998; Harnack, Walters, & Jacobs, 2003; Krebs-Smith et al., 1996; Van Offelen et al., 2011).

Schools play an important role in providing opportunities for consuming healthy foods and physical activity. For example, the classrooms in the study reported here were located in schools that averaged 84.3% ($\pm 9.6\%$) student eligibility for free and reduced lunch. Unfortunately, opportunities for physical activity during school were more limited. The majority of participants did not have physical education on the prior school day, and 16% were not provided with a morning break. Many schools cite lack of funds and time to address academic standards if greater physical activity time is built into the school day. However, activity breaks have been shown to improve academic performance, and the USDA Dietary Guidelines include increased opportunities for physical education programs, recess, and support for active transportation in the call to action statements (Dietary Guidelines for Americans, 2010; Kibbe et al., 2011). Low levels of active transport to and from school were also seen in this cohort. Since the effect of cumulative activity throughout the day may be at least as effective as a single long bout of activity for improving physical fitness, increasing opportunities for physical activity at school or in transport, even if brief, could provide important contributions to obesity prevention (DeBusk, Stenestrand, Sheehan, & Haskell, 1990).

The study also demonstrated that the association between knowledge and reported behaviors among 4th and 5th graders was limited. The minimal behavior changes observed in nutrition education programs, even when knowledge was changed (Jensen, Kattlemann, Ren, & Wey, 2009), may be attributed, in part, to the disconnect between knowledge and behavior noted in this age group. The current data support the argument that Extension professionals may need to incorporate practice-based approaches, public health approaches, or multi-component models to better support behavior change (Rasmussen et al., 2006). The recent endorsement of public health approaches within SNAP-Ed opens the door for Extension professionals to further engage SNAP-Ed qualifying schools in more comprehensive school wellness policy discussions and interventions (Supplemental Nutrition Assistance Program Education Guidance: Nutrition Education and Obesity Prevention Grant Program, 2013). For example, diverse professionals may collaboratively initiate or support a school gardening program while simultaneously negotiating the use of the garden's produce in the cafeteria. Such an effort would provide multiple opportunities for nutrition education, consumption of healthy foods, and physically activity. Another example would be collaboratively creating or supporting safe routes to school to enhance the currently inadequate physical activity levels described above.

Limitations

Food records or 24-hour dietary recalls were not feasible in the pilot study reported here. This precluded macro and micronutrient analyses and limited direct comparisons with national datasets (Crawford et al., 1995; Harnack et al., 2003; Lytle et al., 1996; McDowell et al., 1994; van Horn et al., 1993). However, the USDA Dietary Guidelines target increased consumption of particular food groups, such that the evaluation of the food groups themselves provides a valuable contribution to the literature. Additionally, minutes of activity during breaks, refined grain consumption, and knowledge of milk recommendations were not captured. The UANN will adjust the survey to improve estimation of knowledge and behaviors accordingly and explore objective measures to calibrate self-report estimates (Haskell, 2012).

Conclusions/Implications

The majority of 4th and 5th graders surveyed did not know or meet U.S. dietary and physical activity recommendations. The SNAP-Ed programs and other Extension professionals are well positioned to address the identified gaps in nutrition and physical activity and reduce the burden of disease in this age group.

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