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The Nutrition Education Initiative Resource Guide: Examining Effectiveness with Middle School Students and Perceptions of Science Teachers

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Abstract

Background and Purpose: With obesity in children and youth continuing to be a major health problem in the U.S., schools are considered an important setting to implement programs to address the issue but few have focused on middle school students. The purposes of this study were to: 1) determine the effectiveness of a school-based nutrition education program, the Nutrition Education Initiative (NEI) Resource Guide, in improving school lunch eating behaviors of middle school students, and 2) identify science teachers' perceptions of the materials. **Implementation**: The project was implemented by 16 middle school science teachers and 309 seventh grade students in a medium-sized north Florida community. The NEI Guide included three conceptual areas (Build a Healthy Base, Choose Sensibly and Aim for Fitness), major concepts, objectives, narrative information, and teaching strategies. **Evaluation**: Using a pre-/post without control group design, the study involved collecting data via food recall surveys with students, and surveys and interviews with teachers. Data were analyzed using descriptive statistics and paired t-tests. **Results**: During lunch time, a higher proportion of students met the recommended dietary servings for dairy, meat, vegetables, fruit, juice and grains from pre-test to post-test. Students also significantly increased dietary intake of meat ($p < .01$), fruit ($p < .01$) and fruit/juice combined ($p < .05$); and significantly decreased intake of fried vegetables ($p < .001$), with decreased fat intake approaching significance ($p < .06$). Differences in dietary patterns were noted between the two schools studied. Science teachers perceived the NEI Guide as effective; yet they also identified challenges including lack of adequate training, lack of time to implement the materials, and lack of collaboration with the project team. **Conclusion**: The project outcomes suggest that middle school science teachers can positively impact school lunch eating behaviors of middle school students in selected schools by incorporating nutrition education in their curricula.

Keywords: School-based nutrition education, health promotion, early adolescent health

Introduction

Obesity in children and youth is an epidemic in the United States. The percentage of children classified as obese tripled between 1980 and 2008 for children (6-11 years of age, from 7% to 20%) and for adolescents (12-19 years of age, from 5% to 18%) (National Center for Health Statistics, 2011). This trend in obesity in children and youth is leading to an increased risk for a range of chronic diseases, poor quality of life and functional limitations (Braunschweig et al., 2005; Cleave, Gortmaker, & Perrin, 2010).

Given these increased health-related concerns in children and youth, school-based interventions are an important way to address health issues in this population (Flynn et al., 2006; Kesten, Griffiths, & Cameron, 2011; Lavelle, Mackay, & Pell, 2012; Luckner, Moss, & Gericke, 2011; Silveira, Taddei, Guerra, & Nobre, 2011). School-based health intervention programs have shown promise in improving dietary behaviors

in children and youth (Cook-Cottone, Casey, Feeley, & Baran, 2009; DeVault et al., 2009; Evans, Ranjit , Rutledge, et al., 2012; Forneris et al., 2010; Kropski, Keckley, & Jensen, 2008; Reinaerts, Crutzen, Candel, De Vries & De Nooijer, 2008; Shaya, Flores, Gbarayor, & Wang, 2008; Silveira et al., 2011; Veuglers & Fitzgerald, 2005), including increasing consumption of fruit and vegetables during school lunch (Blanchette & Brug, 2005; Shemilt et al., 2004; Warren, Henry, Lightowler, Bradshaw, & Perwaiz, 2003). However most of the studies on school-based dietary interventions have focused on children 7-10 years of age, with few addressing middle school students.

Middle school students are learning to make independent decisions (AMLE 2013), including decisions about what to eat (Dammann & Smith, 2010). They also have concerns about their weight and appearance (Kropski et al., 2008) yet studies show that this age group does not eat breakfast and gets at least one third of calories from snacks (Giddings et al., 2005). Thus, diet recommendations for this age group include increased consumption of grains, dairy, fruit and vegetables and decreased consumption of fat and sugar (Gidding et al., 2005). However, few school based dietary interventions are available that promote these dietary behaviors. Recent intervention studies with early adolescents show positive dietary intake outcomes and ultimately obesity reduction, including increases in fruit and vegetable consumption (Cohen at al., 2012; Evans et al., 2012; Siega-Riz, Ghormli, Mobley, et al., 2011), and decreases in foods high in fat (Haerens, De Bourdeaudhuij, Maes, et al., 2007) and in sugar (Bogart, Bogart, Elliott, Uyeda, Hawes-Dawson et al., 2011; Johnson, Bruemmer, Lund, Evens & Mar, 2009), with mixed results noted for vegetable consumption (Cohen et al., 2012; Siega-Riz et al., 2011). None of these studies, however, examined how dietary behaviors might vary by school, based upon percent of students on free or reduced lunch. Studies show that National School Lunch Program (NSLP) meals are higher in saturated fat and sodium and lower in whole grains compared to recommended levels. In addition, students consuming NSLP meals eat more protein than recommended (Cohen, et al., 2012).

Another gap in the school-based literature is teacher perceptions of dietary interventions. For example, none of the studies regarding middle school dietary interventions reviewed for this paper involved teachers' perceptions or changes in the academic curriculum. The extent that teachers and other school stakeholders are supportive of dietary interventions, and are involved collaboratively in the process, can influence implementation (Blom-Hoffman, Kelleher, Power, & Leff, 2004; Flynn et al., 2006; Stang, Story, & Kalina, 1998), and ultimately health outcomes (Cook-Cottone et al, 2009). However, although teachers perceive that having a healthy school environment is important including what foods students consume (Kibik, Lytle, Hannan, Story, & Perry, 2002) and are generally supportive of the programs (Auld, Romaniello, Heimendinger, Hambidge, & Hambidge, 1999; Levine, Olander, Lefebvre, Cusick, & Biesiadecki, 2002; Stang et al., 1998), they are less likely to follow healthy practices in schools themselves (Kibik et al., 2002). Teachers also find sustaining nutrition programs difficult due to structural issues (i.e., lack of time, training and materials) (Auld et al., 1999), and management/organizational issues (i.e., identifying appropriate resource persons, difficulty in collaborating, and preoccupation with negotiating with educational stakeholders during implementation) (Bisset, Daniel, & Potvin, 2009; Levine et al., 2002). Thus, determining teachers' perceptions during implementation of dietary interventions is an important process evaluation step.

The Current Study

The purposes of this pilot study were to 1) determine the effectiveness of a school-based nutrition education program, the Nutrition Education Initiative (NEI) Resource Guide, in relation to improving school lunch eating behaviors of middle school students, and 2) identify science teachers' perceptions of the materials. Students' eating behaviors investigated include consumption of recommended dietary servings, fruit and vegetable servings, and foods high in fat and sugar. These dietary outcomes will be examined for total sample as well as by school to determine possible differences related to the

percentage of students eligible for free or reduced lunch. Based on the literature, it was hypothesized that the NEI Guide would: 1) increase the proportion of students eating recommended dietary servings during lunch, 2) increase the number of fruit and vegetable servings eaten during lunch; and 3) decrease the number of servings of foods high in fat and sugar. It was expected that these eating behavior outcomes may vary by school, with students in the lower income school (with a high percentage of students eligible for free or reduced lunch) having less change in outcomes. This prediction was based upon the finding in the literature that lower income communities have less access to fruits and vegetables and higher access to foods high in fat and sugar (Cohen, et al., 2012).

Theoretical Model

The socio-ecological theoretical perspective guided this project. The socio-ecological (SE) theory includes intrapersonal (e.g., knowledge, attitudes, beliefs, affect and past experiences), interpersonal/social network, organizational and environmental/policy levels (McLeory, Bibeau, Steckler, & Glanz, 1988). Relevant to this study are the intrapersonal, interpersonal and organizational levels within the SE framework. Specifically, this study examines individual dietary changes at school lunch within the context of a teacher-led intervention (interpersonal level) in the broader school setting (organizational level). To illustrate, students' dietary intake at school lunch may change as a result of knowledge gained from being exposed to the NEI Guide, as well as the social influence of the science teachers themselves. Science teachers' perceptions of the effectiveness of the NEI Guide may facilitate and/or impede the implementation of the NEI Guide, which could ultimately influence student behavior change. While health outcomes (e.g., dietary choices at school lunch) occur at the intrapersonal level, the intervention itself occurs in the interpersonal and organizational context.

Methods

Background and Study Design

The project was conducted in a medium-sized community in north Florida. The school system, which had supported implementation of the NEI Guide in selected middle schools between 1999 and 2003, was approached by the project team to consider a more systematic plan for implementing the project. The project team worked collaboratively with the central administration of the school system to develop the project, including identifying goals and implementation procedures. Care was taken in the collaboration to address challenges outlined in the literature, including providing adequate time for training by and consultations with the project team, and developing materials that would require little preparation time (Auld et al., 1999; Levine et al., 2002). The school system selected seventh grade science teachers and their students because of the science requirement for this grade level, thus providing an opportunity to use nutrition as an application of science and to capture all students at this grade level in the project. The project was approved by the Florida State University Institutional Review Board and the school system's review board.

The school system's middle school science teachers and their seventh grade students provided data for the project. A pre/post-test without control group design was used to determine any change in students' dietary behaviors. Although all science teachers in the middle schools in the school system were requested by the school system to participate, the school system did not require full implementation of the NEI Guide in teachers' lessons, nor were they required to provide the pre/post student data. Thus this project provides a naturalistic perspective on implementing a nutrition education curriculum in public schools.

The science teachers participated in a four- hour workshop in February 2004, conducted by the project team that included a teacher education faculty member, registered dietitian and master's level graduate students majoring in nutrition. The project team trained the science teachers on how to use the NEI Guide in their middle school

science classes and how to collect the student food recall data. The NEI Guide was then implemented by the science teachers over a period of nine weeks, from March through May 2004.

Nutrition Education Initiative Resource Guide

The NEI Guide was developed as a part of a broader project to help teachers and other school personnel incorporate nutrition in selected middle schools in north Florida, funded by the U.S. Department of Agriculture's Food Stamp Nutrition Education Program (Greenwood, Ralston, Young-Clark, Cornille, Brown et al., 2009). The materials were developed because none could be found that 1) were designed for the Dietary Guidelines, 2) were focused on diverse middle school populations, and 3) could be integrated into both science and practical arts classes. The NEI Guide was based on the 2000 Dietary Guidelines for Americans. Although developed several years ago, these Dietary Guidelines are consistent with current nutritional best practices. For example, the messages to increase consumption of fruit and vegetable servings and to decrease fat, sodium, and sugar consumption remain central to dietary health and have not changed significantly since 2000 (USDA, 2013). Three conceptual areas are included in the NEI Guide: Build a Healthy Base (Food Guide Pyramid, grains, fruits and vegetables, food safety), Choose Sensibly (reading food labels, lower fat, moderate sugar and salt intake, among others) and Aim for Fitness (healthy weight, nutrition and physical activity, among others) (Greenwood et al., 2009). Each conceptual area included major concepts to be taught, objectives, narrative information from Dietary Guidelines for Americans, and teaching strategies with ready to print student activity sheets. The NEI Guide had two major distinctive features. First, it was designed so that teachers could integrate nutrition content into their standard lessons rather than teach it as a set curriculum, a trend in the literature (Prelip, Kinsler, Thai, Erausquin, & Slusser, 2012; Prelip, Slusser, Thai, Kinsler, & Erausquin, 2011; Silveira et al., 2011). Second, the content was developed to meet mandated state standards since this has been found to increase the likelihood that the program will be embraced and used by teachers (Hoelscher, Evans, Parcel, & Kelder, 2002).

Samples

Student Sample. A total of 309 seventh grade students provided paired pre/post self-report dietary data for the project, representing two of the nine schools that participated in the intervention. This included 259 students in School A and 50 students in School B, out of a total of 453 and 213 seventh graders, respectively, in the two schools (Table 1) resulting in a overall retention rate of 46.3%. The IRB protocol approved for this project did not include collecting individual student characteristics; thus school-level aggregate data were used to provide this information (Table 1). School A was 50.5% female and 6.5% of the students qualified for free/reduced lunch; School B was 51.6% male and 74.7% qualified for free/reduced lunch.

Table 1.

Characteristics of Students in Participating Schools

	School A		School B	
Total enrollment grades 6-8	N= 1,311		N= 609	
Gender	n	%	n	%
Male	224	49.5	110	51.6
Female	229	50.5	103	48.4
Total	453	100.0	213	100.0
Free/reduced lunch	85	6.5	455	74.7
Sample with Pre-test and Post-test scores	259		50	

Based on total enrollment in grades 6-8.

Teacher Sample. Sixteen science teachers representing all seventh grade science teachers in the nine middle schools in the countywide school system agreed to participate in the project. All sixteen teachers agreed to participate and completed the online survey and 15 completed the telephone interviews.

Measures and Data Collection

Student Measures. A food recall survey, "What Did You Eat for Lunch Today," was developed by the investigators and used as a food diary for students to record foods eaten during school lunch. This tool was developed because, with the

limited studies available, we did not find a suitable instrument to use to gather short-term school lunch dietary data for middle school students. The survey requested that students write down everything they ate and drank for lunch and then provide serving sizes. Each food item was recorded by the student in a box corresponding to its food group. The survey was administered twice during the nine-week period by the science teachers—once before they began using the NEI Guide and then immediately following the last time the NEI Guide was used. Students in classes that were held before lunch were asked to record what they had eaten for lunch the previous day. Students in science classes held after lunch were asked to record what they had eaten for lunch that day. Food diaries are considered a reliable and valid assessment to be used with early adolescents (Craig, McNeill, Mason et al., 2010; Lillegaard, Loken, & Anderson, 2007) and have been found in some instances to better assess food intake than food frequency questionnaires (Day, McKeown, Wong et al., 2001; Krall & Dwyer, 1987). Using only a short period to assess dietary intake is consistent with best practices in preventing under-reporting of food consumption, especially in children (Kolodziejczyk, Merchant, & Norman, 2012; Thompson & Byers, 1994).

The information was coded and then rechecked by a registered dietitian. The number of portions entered was determined by evaluating the food items and serving sizes recorded by the students (Table 2). For example, French fries and tater tots were coded as a fried vegetable and also as a serving of fat. Soft drinks and non-chocolate candy were coded as "other and sugar" while chocolate candy and ice cream were coded as "fat, other and sugar." Each two-ounce serving of meat was coded as "meat and fat." Information was entered in a "skipped" field if the student did not eat.

Teacher Measures. Teachers were sent a survey online, adapted by the investigators from the American Dietetic Association's Nutrition and You: Trends 2002 survey (ADA/ADAF Annual Report, 2003). The survey included items regarding background characteristics (age, gender, professional credentials) and nutrition background including preparation in and experience teaching nutrition, perceived importance of nutrition and physical activity (with possible responses of 1=not at all important to 7=very important), participation in health behaviors (carefully select what is eaten to achieve a healthy diet, 1=not at all careful, 7=very careful; make a conscious effort to regularly exercise, 1=little or no effort, 7=very conscious effort), and awareness of obesity (heard about obesity/overweight with responses of a lot, some or little/nothing). Teacher follow-up information was collected via telephone interviews that focused on the extent the NEI Guide was used (number of days material was taught, topics included), their perceptions of the NEI Guide including what was most/least helpful, and recommendations for improvement.

Statistical Tests Used

Analysis of Student Data. Following the coding procedures, the student food diary data collected at pre-test and post-test were entered into SPSS (Version 12.0. Chicago, SPSS, Inc.) and analyzed using descriptive statistics including frequencies, percentages and means along with standard deviations). To analyze data related to the first hypothesis (improving dietary behaviors regarding recommended dietary servings), the McNemar test was used to examine if there were differences in the proportion of servings per food category at pre-test and at post-test. For hypothesis two (increasing fruit and vegetable servings) and hypothesis three (decreasing foods high in fat and sugar), paired t-tests were used to compare pre-test and post-test mean scores for servings at school lunch per food category to determine if there were significant differences. The level of significance was set at .05.

Analysis of Teacher Data. Teacher surveys were analyzed using descriptive statistics. Follow-up interview responses were transcribed and then analyzed by the interviewer using code-based analytic procedures (Potter, 2004) to identify common themes (Ely, Anzul, Friedman, et al., 2003). A second review of the transcriptions was conducted by the project team to triangulate and verify the themes (Pidgeon & Henwood, 2004).

Table 2.

Food Group Coding

Food Consumed	Food Group				
	Meat	Vegetable	Other	Fat	Sugar
Meat (2 oz)	X			X	
Fried meat	X			2X	
Tator Tots (1/2 cup)		X		X	
French Fries (1/2 cup)		X		X	
Candy			X	X	X
Chocolate candy			X	X	X
Chips			X	X	
Ice Cream			X	X	X
Juice drinks (<100% juice)			X		X
Soft drinks			X		X

Results

Students' Results

Recommended Servings. Using the McNemar test, the results for the total sample show that the proportion of students who met recommended servings for dairy, meats, vegetables, juice and grain differed significantly between pre-test to post-test (Table 3). Specifically, meeting recommended servings was higher at post-test for dairy (from 34.6% at pretest to 35.9% at post-test, X^2=5.99, p<.001), meat (75.1% to 80.6%, X^2=8.97, p<.001), vegetables (17.5% to 18.5%, X^2=4.30, p<.001) , fruits (18.8% to 27.2%, X^2=5.21, p<.001), juice (11% to 12.9%, X^2=3.59, p<.001) and grains (75.1% to 76.4%, X^2=8.74, p<.001). The patterns for proportion of recommended servings by school were similar to that of the total sample, except for the proportion of students meeting recommended servings for vegetables which were lower at post-test (X^2= -3.33, p<.001) for School A, and for fruit which was lower at post-test for School B but was not significant (Table 3). The proportion of dietary servings for juice also differed across the two schools, possibly because of the low number of servings for School A at pre-test (X^2=2.85, p=.004).

Dietary Intake. With regard to dietary intake in the total sample, the paired t-test results (Table 4) showed a significant increase from pre-test to post- test for meat servings (M=0.89 $\pm$0.65; M=1.05, $\pm$0.85 respectively, p< .01), fruit (M=0.19 $\pm$0.42; M= 0.29 $\pm$0.51, p< .01), and fruits/juices combined (M=0.31$\pm$0.53; M=0.45$\pm$0.71, p< .05). In addition, consumption of fried vegetables decreased significantly at post-test (M=0.35$\pm$0.57; M=0.13$\pm$0.36, p< .001) with the decrease in fat intake approaching significance (M=1.76$\pm$1.25; M=1.59$\pm$1.26, p< .06).

Table 3.

Proportion of Middle School Students Meeting Recommended Dietary Servings for School Lunch at Pre- and Post-test

Recommended Servings		School A (n=259)		School B (n=50)			Total Participants (n=309)		
		Pre-test	Post-test	Pre-test	Post-test	McNemar's Test	Pre-test	Post-test	McNemar's Test
Dairy	1	34.0	34.4	38.0	44.0	-0.42	34.6	35.9	5.99**
Meat	2	78.5	80.4	70.0	82.0	0.84	75.1	80.6	8.97**
Vegetable	1	14.3	12.7	36.0	52.0	-3.33**	17.5	18.5	4.30**
Fruit	1	15.5	27.4	36.0	26.0	-1.08	18.8	27.2	5.21**
Juice	0	12.8	13.1	2.0	12.0	2.85*	11.0	12.9	3.59**
Grain	2	77.2	74.6	66.0	86.0	0.72	75.1	76.4	8.74**

*p<.01, **p<.001

Table 4.

Pre- and Post-test Mean Scores (SD) for Foods Consumed by Student Participants During School Lunch

Food Category	School A (n=259)			School B (n=50)			Total Sample (n=309)		
	Pre-test	Post-test	t	Pre-test	Post-test	t	Pre-test	Post-test	t
Dairy	0.40(±0.61)	0.39(±0.58)	0.24	0.46(±0.64)	0.46(±0.54)	0.00	0.41(±0.62)	0.40(±0.57)	0.22
Meat	0.91(±0.66)	0.93((±0.62	-0.36	0.82((±0.62	1.62((±1.46	-3.70***	0.89(±0.65)	1.05(±0.85)	-2.49**
Vegetables	0.17(±0.47)	0.14(±0.40)	0.96	0.38(±0.53)	0.79(±0.94)	-2.74**	0.21(±0.48)	0.25(±0.57)	-1.00
Fried Vegetables	0.40(±0.59)	0.14(±0.38)	6.65***	0.08(±0.27)	0.08(±0.27)	0.00	0.35(±0.57)	0.13(±0.36)	6.33***
Grain	1.63(±1.11)	1.67(±1.17)	-0.41	1.32(±1.13)	1.72(±1.22)	-1.77	1.58(±1.12)	1.68(±1.18)	-1.12
Fruit	0.16(±0.38)	0.29(±0.49)	-3.90***	0.38(±0.53)	0.32(±0.58)	0.55	0.19(±0.42)	0.29(±0.51)	-3.00**
Juice	0.13(±0.37)	0.16(±0.46)	-0.77	0.02(±0.14)	0.14(±0.40)	-1.95*	0.11(±0.35)	0.15(±0.45)	-1.36
Fruits/Juice Combined	0.29(±0.52)	0.45(±0.69)	-3.23***	0.40(±0.57)	0.46(±0.81)	-0.44	0.31(±0.53)	0.45(±0.71)	-3.06*
Fat	2.01(±1.18)	1.75(±1.26)	2.56**	0.46(±0.64)	0.78(±0.88)	-2.54**	1.76(±1.25)	1.59(±1.26)	1.88
Sugar	0.97(±0.98)	0.83(±0.85)	1.83	0.30(±0.64)	0.50(±0.67)	-1.80	0.86(±0.97)	0.78(±0.83)	1.25
Fats, Oils, Sweets	4.10(±2.44)	3.68(±2.65)	2.03*	0.84(±1.14)	1.60(±1.34)	-3.36***	3.57(±2.57)	3.34(±2.60)	1.27

*p < .05, **p < .01, ***p < .001

Dietary intake patterns for the two schools were similar to the total sample in some food categories but varied in others. Similarities between the two schools and the total sample were noted for dairy and grains, with no change between pre-test and post-test for both schools. For School A, there was only one difference in the results compared to the total sample: School A did not have a significant increase in servings of meat at post-test. However, for School B, there were several differences in dietary patterns compared to the total sample, including a significant increase at post-test for vegetables (*M*=0.38± 0.53; *M*=0.79± 0.94, p< .01), juice *(M*=.02±0.14; *M*=0.14=±0.40, p< .05), fat (*M*=0.46±0.64; *M*=0.78=±0.88, p< .01) and fats, oils and sweets *M*=0.84±1.14; *M*=1.60±1.34, p<.001) but no change at post-test in fried vegetables, fruit, and fruits/juice combined.

These same patterns were noted in comparing the outcomes for the two schools. Interestingly, School A had a significant decrease in fat (*M*=2.01±1.18; *M*=1.75=±1.26, p< .01) while School B had a significant increase in fat. Similarly, School A showed a significant decrease in combined fats, oils and sweets (*M*=4.10±2.44, *M*=3.68 ±2.65, p< .05)
while School B had a significant increase in this category.

Teachers' Results

Background Characteristics. Of the 16 participating science teachers, ten (63%) were female and six (37%) were male, and most (75%) were aged 25-54 years of age (Table 5). The racial composition of the sample was predominantly Caucasian (75%) with the ethnic identification of the remaining 25% being equally distributed among African American, Hispanic, Asian and other. The science teachers had taught in general for an average of nine years and in middle school for an average of eight years.

Nutrition Background. The science teachers varied in their extent of preparation in nutrition and their experience teaching it to middle school students with half having a course in nutrition and half having taught nutrition concepts previously. All science teachers reported being confident in their abilities to understand, recall, and teach content related to nutrition. Overall, the science teachers appeared to consider diet and nutrition (*M*= 6.1±0.8), exercise and physical activity (*M*= 6.1±1.3) as personally important. However, the mean scores showed that science teachers had problems in following healthy behaviors themselves such as carefully selecting what is eaten to achieve balanced nutrition (M=4.7+1.3) and making a conscious effort to regularly get exercise and physical activity (M=4.4+1.9). A majority of the science teachers (56.3%) had heard or read about obesity

or being severely overweight and were concerned about the issue of obesity or overweight (62.6%).

Use and Perceptions of NEI Resource Guide. The science teachers' use of the NEI Guide in instruction varied from four to 15 days. Teachers most often focused on the topic of the food groups/food pyramid (14), followed by serving sizes (9), food choices and menu design (8), reading food labels (6), exercise (5), cholesterol (5), vitamins and minerals (5), and fats (4). The modules were most often incorporated within the regular science curriculum rather than taught as a separate instructional unit.

The science teachers indicated that the most helpful aspect of using the NEI Guide was having organized information that was of interest to and needed by the students. Teachers' comments included, "Everything laid out and straightforward," "Kids were interested" and "It did affect the kids." A number of responses were obtained pertaining to the areas that were least helpful. Several science teachers reported that time and training were major factors and that they felt pressure to produce. One teacher stated:

> We had to give up a planning day for training in something we already know and had to spend time documenting activities. The course could be helpful, but there was no time. The two weeks we should have spent on growth and development were reduced to three days because of time constraints, and the nervous system, immune system and disease fighting were eliminated.

Other science teachers reported that the material was not new or different and that the information should be specifically tailored for a teenage population. Some science teachers indicated that they would like to have more information on how to teach the curriculum, while others suggested the need for better-quality materials that can be easily reproduced.

Table 5.

Characteristics of Teachers (n=16)

	n	%
Gender		
Female	10	62.5
Male	6	37.5
Age Range		
Under 25	3	18.8
25-34	4	25.0
35-44	4	25.0
45-54	4	25.0
55-64	1	6.3
Racial/Ethnic Background		
Caucasian	12	75.0
Black/African American	1	6.3
Hispanic	1	6.3
Asian	1	6.3
Other	1	6.3
Teacher Preparation		
Certified in Biology	6	37.5
Certified in Middle School Science	5	31.3
Completed Nutrition Course	8	50.0
Taught Nutrition in Middle School	8	50.0
Heard about Obesity/Severe Overweight		
A lot	5	31.3
Some	9	56.3
Little or nothing	2	12.5
Teaching Experience		Mean(SD)
Years as a Teacher		9.4 (8.5)
Years Teaching Middle School		8.0(6.9)
Importance of Nutrition		
Importance of diet and nutrition personally		6.1(±0.8)
Importance of exercise and physical activity		6.1(±1.3)
Health Behaviors		
Carefully select what is eaten to achieve balanced nutrition and a healthy diet		4.7(±1.3)
Make conscious effort to regularly get exercise and physical activity		4.4(±1.9)

Overall, the majority of respondents (n=11) recommended that teachers should collaborate in curriculum development, about half (n=9) suggested the creation of a health class for middle school students where the information could be incorporated. One science teacher commented, "It's an important curriculum that needs to be in health with resources and time." Seven respondents indicated a need for more time to incorporate the curriculum into their class plans. Among the other recommendations were tailoring the information to fit specific benchmarks and standards, spreading the information over several grade levels, creating an interactive CD, and reducing the length of time teaching the curriculum.

Discussion

The purposes of this study were to determine the effectiveness of a school-based nutrition education program, the Nutrition Education Initiative (NEI) Resource Guide, in terms of improving school lunch eating behaviors of middle school students and to identify science teachers' perceptions of the materials. Specifically, in relation to foods consumed at school lunch, it was hypothesized that the NEI Guide would increase the percentage of students meeting recommended dietary servings, increase fruit and vegetable servings, and decrease foods high in fat and sugar.

Student Outcomes

In general, the results of this study support previous literature that demonstrates school-based nutrition education programs can improve middle school students' dietary behaviors (Bogart et al., 2011; Cohen at al., 2012; Evans et al., 2012; Haerens et al., 2007; Johnson et al., 2009; Keckley, & Jensen, 2008; Reinaerts, et al., 2008; Shaya, et al., 2008; Siega-Riz et al., 2011; Silveira et al., 2011; Veuglers & Fitzgerald, 2005). The first hypothesis was supported in that the proportion of students consuming recommended dietary servings, with servings of dairy, meat, vegetables, fruit, juice and grain was higher at post-test although there was variation in consumption of recommended dietary servings between the two schools. There was partial support for the second hypothesis related to increasing fruit and vegetable servings, with servings of fruit and fruits/juice combined significantly increasing at post-test. Finally, the third hypothesis concerning decreasing fat and sugar was also partially supported, with servings of fat and fried vegetables significantly decreasing at post-test. Servings of sugar and combined fats, oils, and sweets decreased slightly, but this change was not significant. These findings suggest that it may be easier to change dietary behaviors related to fat than sugars in middle school students.

Interesting patterns were noted across the two schools and in comparison to the total sample. School A, which was 6.5% free or reduced lunch, appeared to benefit the most from the NEI Guide with significant decreases in servings of fried vegetables and fat at post-test, and significant increases in fruit and fruits/juice combined. In contrast, School B which had 74.7% of their students with free or reduced lunch, had no changes in servings of fried vegetables, fruit, and fruits/juice combined; moreover consumption of fat and fats, oils and sweets significantly increased at post-test. There were, however, significant increases in juice and vegetable consumption for School B. The dietary patterns for School B may reflect the food available in school lunches as noted in the literature (Cohen et al., 2012).

Another pattern of interest in relation to the two schools and the total sample is vegetable consumption. For School A and the total sample, servings of vegetables did not increase. Other studies have shown school-based nutrition education programs are associated with an increase in fruit and vegetable consumption at school lunch (Cohen et al., 2012; Evans et al., 2012). However, consistent with some findings in the literature (Siega-Riz, et al., 2011), our results show that vegetable intake increased in one school but not the total sample, suggesting that greater efforts are needed to change this eating behavior for middle school students. Work with cafeteria staff in making vegetables more attractive is one strategy that appears to result in increased consumption with this age group (Cohen, et al., 2012).

Teacher Outcomes

The project outcomes related to science teachers' perceptions indicate that teachers used the materials, but they also identified barriers. The teachers used the materials in their science lessons, teaching eight different nutritional concepts in varying amounts. However, it is noted that the range of use was quite large. The teachers were generally positive about how the materials were organized for use. However they were not happy about how they were approached to include the information in their lessons. Although viewed by the project team as a "collaboration" with the school system, the teachers clearly perceived that this was not a partnership, but another program for them to

"produce" without their input. Teachers were especially concerned about having to cut other content to teach the nutrition information. These findings are consistent with the literature which shows that teachers are generally supportive of nutrition education (Auld et al., 1999; Levine et al., 2002) but identify structural (Levine et al., 2002) and management/organizational barriers (Bisset et al., 2009; Levine et al., 2002). Even with these drawbacks, the science teachers still believed the content was important for students to have and made suggestions for how the NEI Guide might be incorporated in the future. Thus, these outcomes suggest that student behaviors at school lunch can be influenced with nutrition content integrated into science courses and that working with science teachers in how to incorporate this information may help to improve sustained use of educational materials.

The findings of this project lend some support to the socio-ecological theory. Specifically, as a result of being exposed to the NEI Guide, students may have changed their dietary habits at school lunch by increasing their recommended servings, increasing fruit intake, and decreasing fat intake. Although this study does not specifically examine the intrapersonal and interpersonal factors that may have led to this change, exposure to the NEI Guide may have increased their knowledge as well as provided social reinforcement from teachers to bring about behavior change. Further, although science teachers collectively identified structural barriers in relation to implementing the NEI Guide, even with these concerns, the teachers may have effectively taught the information thus facilitating behavior change. The fact that school-related differences in dietary outcomes were noted suggests that organizational context may play a role in how some students were able to implement health behavior change.

Limitations

There are several limitations to the present study. First, the study included science teachers and students from one community school system; thus whether or not these outcomes would be the same in other communities is unknown. In addition, the community nature of this project may have influenced the outcomes. Although the teachers were monitored by a staff member, there was variability in the amount of time that the NEI Guide was used, ranging from four to 15 days in the nine week period. This is not surprising since teachers were given freedom to use the materials to the extent that they felt appropriate during the last nine weeks of the semester. Thirdly, student information was provided by only two schools. It could be that the science teachers in these schools were more supportive of the project and results might be different if students from the other schools were included. Finally, there were limitations in the methods including instrumentation (self-report survey, accuracy in food recall), design (pre-/post-test design with no control group, short duration of intervention, and no longer term follow-up), relatively small sample size, and analysis (no inclusion of dose-response results). Future projects using the NEI Guide will need to incorporate a more rigorous methodology.

Implications

There are three key implications for school systems and investigators. First, from the national perspective, considerable effort has been made to simplify dietary recommendations since this project was completed. For example, MyPlate is a very straightforward way of teaching dietary choices (e.g., focusing on consuming more fruits and vegetables and reducing foods high in fat, sodium and sugar) (USDA, 2013), and could easily be used as a key part of the NEI Guide. This more simplified information might have assisted the science teachers in using the NEI Guide more frequently and eased some of their concerns regarding the time commitment of integrating nutrition content in the science curriculum.

A second implication is that this study has shown that disciplinary approaches can be used in reaching teachers in promoting health with early adolescents. This study focused on science teachers, but consistent with the broader NEI project, similar strategies might be used for practical arts and social studies teachers. Further, integration of nutrition content need not be lengthy, with a nine week period used in this study.

A challenge pointed out in this study is the need to provide mechanisms to truly collaborate with the teachers in how they incorporate the materials, including more training and more time to use the materials. Clearly they wanted to be willing partners, but were frustrated with the process of how they were engaged. They wanted the school system leadership to understand their challenges. Thus a third implication is that community-based participatory research (CBPR) approaches, similar to those used in reaching community-based populations (Israel, Eng, Schulz, & Parker, 2005), are important for schools to consider in engaging teachers for health promotion programs. CBPR and more broadly community engaged models are increasingly used in schools (Krishnaswami, Martinson, Wakimoto & Anglemeyer, 2012) and youth programs (Jacquez, Vaughn, & Wagner, 2012). In retrospect, our team could have used several engagement strategies to get teacher input prior to beginning the project such as holding initial meetings to determine the teachers' thoughts on the collaboration, identifying natural thought leaders who could help the team navigate the project, and conducting focus groups in addition to the survey to acquire qualitative input on needs. Engaging teachers in this manner also may have allowed us to learn more about organizational differences between schools that affected dietary behavior change in the two schools.

In conclusion, with obesity rates at epidemic levels, it is important to find strategies to work with teachers from a variety of disciplines to provide health messages that will influence student behaviors. The NEI Guide may be one step in that direction along with working to a greater extent to engage teachers in the process of health promotion.

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