

A Pilot Study to Examine the Effects of a Nutrition Intervention on Nutrition Knowledge, Behaviors, and Efficacy Expectations in Middle School Children

MARIANE M. FAHLMAN, PhD^a
JOSEPH A. DAKE, PhD, MPH^b
NATE McCAUGHTRY, PhD^c
JEFFREY MARTIN, PhD^d

ABSTRACT

BACKGROUND: This was a pilot study to determine the impact of the Michigan Model (MM) Nutrition Curriculum on nutrition knowledge, efficacy expectations, and eating behaviors in middle school students.

METHODS: The study was conducted in a large metropolitan setting and approved by the Institutional Review Board. The participants for this study were divided into an intervention group (n = 407) and a control group (n = 169). An MM instructor trained health teachers in the use of the curriculum, and the teacher subsequently taught the curriculum to students in the intervention group. A valid and reliable questionnaire was used to determine pre-post differences. It consisted of 3 subscales assessing eating habits, nutrition knowledge, and efficacy expectations toward healthy eating. Subscale scores were analyzed using a 2 groups (intervention vs control) × 2 times (pre vs post) analysis of variance.

RESULTS: The intervention group increased their nutrition knowledge at post. There was also a significant main effect for groups in the subscales “Eating Behaviors” and “Efficacy Expectations Regarding Healthy Eating.” Subsequent post hoc analysis revealed that the intervention group was significantly more likely to eat fruits and vegetables and less likely to eat junk food than the control group. Students in the intervention group also felt more confident that they could eat healthy.

CONCLUSIONS: The results of this pilot study suggest that the MM Nutrition Curriculum delivered by trained professionals resulted in significant positive changes in both nutrition knowledge and behaviors in middle school children. Further research needs to be conducted to determine the long-term impact.

Keywords: nutrition education; Michigan Model; middle school nutrition.

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^aAssociate Professor, (m.fahlman@wayne.edu), Kinesiology, Health and Sport Studies, Wayne State University, 5101 John C Lodge Service Dr, Matthaei 262, Detroit, MI 48208.

^bAssistant Professor, (jdake@utnet.utoledo.edu), College of Health Science and Human Service, University of Toledo, Mailstop 119, Toledo, OH 43606.

^cAssociate Professor, (natemccaughtry@wayne.edu), Kinesiology, Health and Sport Studies, Wayne State University, 5101 John C Lodge Service Dr, Matthaei 125, Detroit, MI 48208.

^dProfessor, (aa3975@wayne.edu), Wayne State University, 63 Old Main, Detroit, MI 48208.

Address correspondence to: Mariane M. Fahlman, Associate Professor, (m.fahlman@wayne.edu), Kinesiology, Health and Sport Studies, Wayne State University, 5101 John C Lodge Service Dr, Matthaei 262, Detroit, MI 48208.

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INTRODUCTION

Behavioral patterns established in childhood often carry over into adulthood, and some of these are later associated with adult morbidity and mortality.¹ A prime example of this is eating patterns. Several authors have demonstrated that the quality of the diet of children and adolescents has deteriorated over the past 20 years.¹ For example, a recent study demonstrated that only 20.1% of teenagers had eaten the recommended servings of fruits and vegetables and 16.2% had drunk 3 or more glasses of milk in the 7 days preceding the survey.² The situation is even bleaker for elementary and middle school children where only 5% had eaten the recommended servings of fruits and vegetables and 9% had met the recommendations for dairy products.³

The decline in diet quality is closely correlated with an increase in child and adolescent obesity. The prevalence of overweight and obesity in the United States has doubled in the past 20 years such that 15% of children aged 6-19 years are either at or above the 95th percentile for body mass index.⁴ This increase in overweight puts these children at risk for the subsequent appearance of morbidities that had been previously isolated to adult populations. For example, 1 disease-related consequence of obesity, type 2 diabetes, has shown dramatic increases in the adolescent population in recent years.⁴ Additionally, 60% of overweight youth have 1 risk factor for cardiovascular disease and 25% have 2 or more risk factors.⁵

Overweight adolescents have an 80% chance of becoming overweight adults,⁶ and many of them carry obesity-related morbidities with them into adulthood with grave consequences.⁷ Therefore, it is imperative that interventions be implemented in the child-adolescent population to stem the growth of this trend.⁸ With over 53 million students in attendance at schools on a daily basis,⁵ the school system is one vehicle for interventions aimed at children and adolescents.⁹

Numerous programs have been developed to address rising obesity levels in children through efforts in the school setting using short-term interventions, after-school programs, social marketing, and modifications to or implementation of specific curricula at the classroom level.⁹⁻¹¹ In the state of Michigan, one common method for addressing the issue of poor nutrition in children and adolescents is through a specific nutrition curriculum taught during the health class. Currently, 95% of schools report teaching health in grades 6-9, and 90% of those schools report using the Michigan Model (MM) for some aspect of health.¹² The nutrition module for middle school "*What's Food Got to Do With It?*" is designed to address "dietary patterns," 1 of the 6 health risk behaviors identified by the Centers for Disease Control and Prevention.² The 8 lesson plans contain components related to nutrition knowledge such as the food groups, food pyramid, food labels,

advertising, and body image. They also contain components specifically designed to target nutritional risk behaviors such as increasing fruit, vegetable, and dairy consumption and healthy eating at fast-food restaurants. The purpose of this research was to determine the effects of the above curriculum on nutritional knowledge, eating behaviors, and efficacy expectations on middle school students.

METHODS

Subjects

This was a pre/postassessment quasi-experimental design using a total of 783 middle school students from a large metropolitan area. The study was approved by the university's Institutional Review Board. Participation was voluntary, and schools were selected based on the health teacher's willingness to participate in the study, undergo in-service training in the curriculum, and implement the curriculum during the study time frame. Control schools were selected from a convenience sample of volunteers. Briefly, recruitment took place at a state conference attended by health teachers. Volunteers were sought to administer the pre- and posttests during the same time frame as the intervention group but prior to teaching nutrition in their health class. A total of 7 control schools were selected from the 10 volunteers primarily due to their geographical location within a 25-mile radius of the intervention schools. At pretest, the intervention group consisted of 613 students from 11 different schools. After posttest, the number of matched surveys was 407 middle school students who participated in preassessment, 8 nutrition lessons, and postassessment. The control group started with 245 students at pretest, which dropped to a matched 169 students at posttest. These students participated in only pre- and postassessments. The pre- and postassessments were conducted by graduate students and retired teachers trained in data collection methods, and the nutrition lesson plans were taught to the classes by 17 teachers certified by the state of Michigan to teach health education. The pretest was administered prior to beginning the curriculum and the posttest 2 weeks after the curriculum was administered.

Instrument

The instrument was developed in several phases. The first phase consisted of the following: 33 questions asking about the foods that students had eaten "yesterday" were taken from the School Physical Activity and Nutrition Project.¹³ The instrument has been validated for use at the secondary level.¹⁴ These questions included pictures of the foods being asked about. A total of 20 questions were developed based

on MM Curriculum content intended to determine students' knowledge about nutrition. Finally, 8 questions were developed to assess healthy eating efficacy expectations. In phase 2, the instrument was reviewed by a panel of experts for clarity of wording and instructions and then reviewed again by a panel of middle school teachers. Based on their recommendations, several changes were made and several additional questions were included. In phase 3, the instrument was pilot tested on 75 middle school students. Construct validity was established using a principal components factor analysis with varimax rotation. The eigenvalue was set at 1, and factors that loaded at .45 or better were retained. This resulted in a survey instrument that consisted of 4 factors. When the factors were examined, the knowledge questions from the MM as well as the knowledge questions added from the reviewers double loaded on 2 factors. It was decided that these 2 factors would be combined into 1 "Nutrition Knowledge" subscale of 18 items. The other 2 factors were used to create the content of the subscales "Eating Behavior" (33 items) and "Efficacy Expectations Regarding Healthy Eating" (4 items). For the eating behavior questions, the questionnaire presented students with a single serving size picture of different foods based on the food groups. Answers ranged from none to 3 or more times, and students were asked to indicate how often they ate the pictured food "yesterday." Answers were totaled by food group. The total number of servings per food group was analyzed pre to post. The nutrition knowledge questions were coded for correct or incorrect answers, and the total number correct was analyzed pre- and postintervention. A 7-point (1 = not at all confident to 7 = very confident) Likert-type format was used for the 4 efficacy expectation questions. The answers were totaled, and the total score was analyzed pre to post.

Each of the subscales was tested for internal reliability using Cronbach's alpha. The subscales Eating Behavior (.71), Nutrition Knowledge (.80), and Efficacy Expectations (.72) were found to be reliable. To examine test-retest reliability, the test was administered to 30 middle school students on 2 occasions, 2 weeks apart. The Pearson correlation coefficient was .78 for behavior, .71 for nutrition knowledge, and .76 for self-efficacy, indicating high test-retest reliability for this age-group.

Procedures

The intervention took place in March 2005. Teachers who were going to be conducting the intervention in their classrooms participated in 8 hours of in-service training on the middle school nutrition book: "What's Food Got to Do With It?" (MM). Research assistants conducted the preassessment, and then, teachers taught the lessons over the course of 1 month. The lessons contained material on the contents and benefits

of the food groups, eating based on the food groups, reading food labels, body image, and surviving fast-food restaurants and the school cafeteria (Figure 1). A period of 2 weeks after the unit, research assistants administered the postassessment.

Data Analysis

Descriptive statistics were used to summarize demographic data. To determine the effects of the curriculum, a 2 (pre vs post) \times 2 (intervention vs control) repeated measures analysis of variance was run on each set of subscales. For the behavior questions, analyses were run on the specific food groups: grains, fruits, vegetables, dairy products, meats, and other. The "other" category was used to describe foods that would go at the top of the food pyramid such as doughnuts, candy, or other foods that should be eaten on a limited basis and are often referred to as "junk food." When significant time, group, or interaction between time and group effects were found, Tukey's post hoc analyses were run to determine the source of the individual differences. The statistical package used to run all analyses was SPSS (version 14.0, Chicago, IL). Statistical significance was set at $p \leq .05$.

RESULTS

Preliminary data analysis determined that there was no significant gender difference for any variables; therefore, final analyses were not performed separately by gender. Demographic information is given in Table 1. Almost one third of the sample was lost in the follow-up. Reasons for the loss include, but are not limited to, incomplete instruments, student absences on data collection days, students leaving the school, and inability to match the pre- and post-instruments. Pretest data on the students lost to follow-up are included in each table. The results of the eating behavior questions are shown in Table 2. Students in the intervention group demonstrated significant improvements pre to post and were significantly higher than the controls at post in their consumption of fruits ($F = 3.97, p = .047$), vegetables ($F = 5.61, p = .018$), and other ($F = 5.9, p = .025$).

The results and questions for the subscale "Nutrition Knowledge" are given in Table 3. Students in the intervention group ($F = 72.82, p < .001$) demonstrated a significant improvement pre to post and were also significantly higher than the control group at post ($F = 67.07, p < .001$). For the "Efficacy Expectation Regarding Healthy Eating" subscale, there was a significant group \times time interaction ($F = 9.4, p = .002$) (Table 4). Subsequent post hoc analysis revealed that students in the intervention group demonstrated a significant improvement in some efficacy expectation items pre to post. There were no pre- to post differences in the control group ($F = 1.49, p = .223$).

Figure 1. Objectives for the Michigan Model Book, "What's Food Got to Do With It?"

Lesson 1: The Five Food Groups Revisited

Objectives: Upon completion of this lesson, the student will:

- Review and share information on the Five Food Groups
- Evaluate a typical day's food intake for the presence of the Five Food Groups
- Gather nutritional information from restaurants in their community

Lesson 2: Nutrition Think Tanks

Objectives: Upon completion of this lesson, the student will:

- Investigate information on the Five Food Groups
- Design presentations for their peers to promote the health benefits of each of the food groups

Lesson 3: Good Nutrition Sells

Objectives: Upon completion of this lesson, the student will:

- Illustrate the benefits of eating foods from each of the Five Food Groups by conducting advertising campaigns
- Decide which of the selling points are most likely to influence them to eat foods from each of the Five Food Groups
- Select new foods from each of the food groups to add to their diets

Lesson 4: Unlocking the Secrets of Food Labels

Objectives: Upon completion of this lesson, the student will:

- Interpret nutrition information available on Nutrition Facts food labels
- Differentiate between foods that are nutrient dense and foods that are low in nutrients

Lesson 5: Advertising Claims

Objectives: Upon completion of this lesson, the student will:

- Recommend foods for specific dietary goals by using the nutrition information available on food labels
- Recognize common health claims on food packages and in advertisements
- Predict the meanings of health claims on food packages
- Distinguish which are accurate health claims on food packages and advertisements in order to identify foods that have the most nutritional value

Lesson 6: Have a Healthy Body Image

Objectives: Upon completion of this lesson, the student will:

- Recognize the range of body types
- Summarize factors that determine body weight
- Choose to have a realistic view of a healthy body image
- Formulate guidelines for eating to share with their peers

Lesson 7: Fast Food Survival

Objectives: Upon completion of this lesson, the student will:

- Share guidelines for health, fast-food eating with their peers
- Identify healthier food choices they can make when eating at fast-food restaurants

Lesson 8: Nutrition at School

Objectives: Upon completion of this lesson, the student will:

- Investigate the availability of nutritious foods in the school cafeteria
 - Advocate for availability of appealing, nutritionally balanced lunches in the school cafeteria
 - Make a plan to improve their eating habits
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DISCUSSION

There is little doubt that the eating behaviors of children and adolescents have deteriorated in the past 20 years.¹ Given the fact that these behaviors are linked to adult eating patterns and subsequent risk of dis-

ease,¹⁵ intervention at an early age is an essential aspect of preventions geared toward eliminating or reversing this trend. The most important finding of this pilot study is that middle school students who were taught

Table 1. Demographic Characteristics of Respondents

	Intervention Completers (n = 407)	Control Completers (n = 169)	Intervention Noncompleters (n = 206)	Control Noncompleters (n = 76)
Number of schools	11	7	11	7
Mean age (SD)	12.5 (0.5)	11.9 (0.8)	12.4 (0.7)	12.2 (0.6)
Percent of students receiving free/reduced lunch	67	25	67	25
Sex, n (%)				
Female	207 (51)	87 (51)	105 (51)	39 (51)
Male	200 (49)	82 (49)	101 (49)	37 (49)
Race, n (%)				
African American	354 (87)	43 (25)	177 (86)	18 (24)
Asian	4 (<1)	6 (4)	0 (0)	2 (3)
White	21 (5)	118 (70)	28 (14)	54 (71)
Other	28 (7)	2 (1)	1 (<1)	2 (3)
Ethnicity, n (%)				
Hispanic	37 (9)	47 (28)	21 (10)	19 (25)
Non-Hispanic	370 (91)	122 (72)	185 (90)	57 (75)

the MM Nutrition Curriculum not only increased their nutrition knowledge but also were more likely to report making changes to their eating habits that reflect a healthier lifestyle.

The MM Curriculum is based on the belief that middle school children can impact their future health by instituting and then maintaining healthy nutritional habits. The lesson plans in the curriculum focus on using the food pyramid to choose healthy snacks, increase consumption of fruits and vegetables, and make healthy selections when dining at fast-food restaurants. The short-term evaluation of the curriculum demonstrates that middle school students are indeed capable of instituting these practices. Upon completion of the 8 lesson plans, students in the intervention group increased their reported consumption of fruits and vegetables while decreasing their consumption from the “other” group that consists mostly of junk food. Subjects in the intervention group were also more likely to report increased confidence that they could both increase their consumption of fruits and

vegetables and eat in a healthy manner at a fast-food restaurant. This increase was a change between their behaviors prior to the intervention and also was significantly higher than the consumption of the control group who did not receive the intervention.

Additionally, upon completion of the study, students in the intervention group had increased their consumption of fruits, vegetables, and dairy products to the recommended daily allowance, while the controls demonstrated no change in eating patterns. Given that more than 80% of high school students² and 95% of middle school students⁴ are not eating the recommended daily amounts from those food groups, this is a tremendous success rate. If the short-term gains later translate into longer term gains and permanent behavior change, these students will be well on the way to healthy eating and the subsequent health benefits associated with it.

The School Health Education Evaluation Study¹⁶ reported that program-specific effects occur after 10 hours of classroom learning but that it generally takes

Table 2. Mean Servings per Food Group*

Food Group	Intervention Completers (n = 407)		Control Completers (n = 169)		Intervention Noncompleters (n = 206) [†]	Control Noncompleters (n = 76) [†]
	Preintervention	Postintervention	Preintervention	Postintervention		
Grains	2.82 (2.0)	2.75 (2.0)	3.10 (1.7)	2.90 (1.9)	2.90 (1.7)	2.97 (1.4)
Fruit	2.48 (1.8) [‡]	3.25 (0.7) ^{‡,§}	2.52 (1.5)	2.41 (1.0) [§]	2.49 (1.2)	2.47 (1.8)
Vegetables	1.11 (1.1) [‡]	2.03 (1.2) ^{‡,§}	1.38 (1.4)	1.22 (2.0) [§]	1.21 (1.6)	1.58 (1.9)
Dairy	2.49 (1.6)	2.95 (1.7)	3.01 (1.6)	2.92 (1.7)	2.77 (1.5)	2.89 (1.2)
Meats	2.08 (1.7)	2.12 (1.7)	2.11 (1.9)	21.6 (1.9)	2.10 (1.4)	2.10 (1.6)
Other	5.9 (2.8) [‡]	4.3 (2.7) ^{‡,§}	5.2 (3.3)	5.0 (3.0) [§]	5.7 (2.0)	5.5 (2.4)

*Numbers reported are means and SD.

[†]Preintervention means (SD) for subjects not completing the posttest.

[‡]Significant within-group differences between pre- and posttests (the intervention group increased fruit and vegetable consumption while decreasing “other” consumption when comparing pre- to post-means).

[§]Significant between-group differences at the posttest (there was a significant difference in pre- to post-mean change between the intervention group and the controls for fruit, vegetable, and “other” consumption).

Table 3. Percent of Students Answering "Nutrition Knowledge" Questions Correctly

	Intervention Completers (n = 407)		Control Completers (n = 169)		Intervention Noncompleters (n = 206)*	Control Noncompleters (n = 76)*
	Preintervention	Postintervention	Preintervention	Postintervention		
Total knowledge score (% correct)	32 [†]	49 ^{†,‡}	39	39 [‡]	32	37
Individual knowledge items						
From which food group should you eat the most servings every day?	14 [†]	44 ^{†,‡}	30	32 [‡]	17	27
From which food group should you eat the fewest servings every day?	57 [†]	72 [†]	69	71	55	69
How many servings of fruits and vegetables should you eat each day?	11 [†]	25 ^{†,‡}	10	7 [‡]	10	10
How many servings of meats should you eat each day?	21	24	26	24	22	23
How many servings of grains should you eat each day?	7 [†]	32 ^{†,‡}	20	18 [‡]	5	19
Which food group is a good source of vitamin C?	32 [†]	54 ^{†,‡}	33	36 [‡]	32	32
Which food group is a good source of energy?	5 [†]	42 ^{†,‡}	12	13 [‡]	5	9
Which food group is a good source of calcium?	37 [†]	63 ^{†,‡}	49	50 [‡]	40	42
Which food group provides protein for muscles?	20 [†]	49 ^{†,‡}	35	36 [‡]	22	35
Which nutrient contains the most calories?	62	60	66	58	60	62
What is the recommended amount of calories from fat that you should get from foods you eat?	4 [†]	38 ^{†,‡}	6	5 [‡]	6	6
What you eat can make a difference in your chances of getting heart disease.	82	82	86	86	83	84
What you eat can make a difference in your chances of getting cancer.	60	59	62	60	60	62
People who are overweight are more likely to have health problems than those who are normal weight.	86	84	86	85	86	86
French fries are a "nutrient-dense" food.	34 [†]	70 ^{†,‡}	28	34 [‡]	32	33
The word "lite" on a food package means low fat.	31 [†]	50 ^{†,‡}	36	39 [‡]	32	33
The word "lean" on a food package means the food is fat free.	55 [†]	70 ^{†,‡}	54	53 [‡]	48	52
I know how to design a plan for better nutrition.	35 [†]	70 ^{†,‡}	65	65 [‡]	34	37

*Preintervention percents for subjects not completing the posttest.

[†]Significant within-group differences between pre- and posttests (the intervention group increased fruit and vegetable consumption while decreasing "other" consumption when comparing pre- to post-means).

[‡]Significant between-group differences at the posttest (there was a significant difference in pre- to post-mean change between the intervention group and the controls for fruit, vegetable, and "other" consumption).

an average of 50 hours of instruction to change behaviors. Students in this study received 8-10 hours of instruction and demonstrated significant changes in nutrition knowledge both pre to post and compared to the control group as well as changes in behavior. If this health module is followed up in high school with the additional modules on nutrition, an even greater impact on eating behaviors may be achieved.

The results of this study support the notion that well-designed and -executed school-based nutrition programs can result in positive changes in dietary eating behaviors, as well as increased self-efficacy expectancy regarding nutritional choices in middle school children. It remains to be seen whether these changes can be sustained in the longer term in a manner that will have an impact on the future health of this population. While it is probable that a combination of successful interventions is necessary to combat the steady decline in the diets of children that has taken place in the past 20 years, the MM Nutrition Curricu-

lum for middle school students can certainly be considered valuable to any multifaceted approach to this problem.

This was a short-term pilot study. Teachers' willingness to participate in the study may have biased findings toward success. While the students who participated in this study are characteristic of other metropolitan students, the results cannot be generalized to all middle school students. The survey used self-reported measures of eating behaviors. The possibility that students may have answered in a socially desirable manner or reported eating amounts they recently learned represents a threat to the internal validity of the findings. There were nearly one third of students who took the pretests but were not in attendance at posttest. To the degree that these students differed significantly from those completing the posttest represents a possible threat to the external validity of the results. Additionally, this study used students from 18 schools in a large metropolitan area (clustered

Table 4. Efficacy Expectations Regarding Healthy Eating for Intervention and Control Groups at Pre- and Posttests*

	Intervention Completers (n = 407)		Control Completers (n = 169)		Intervention Noncompleters (n = 206) [†]	Control Noncompleters (n = 76) [†]
	Preintervention	Postintervention	Preintervention	Postintervention		
How confident are you that you can (1 = not at all confident to 7 = very confident)						
Eat more fruits and vegetables	4.2 (1.9) [‡]	6.3 (1.9) ^{‡,§}	4.3 (1.9)	4.2 (1.9) [§]	4.2 (1.1)	4.3 (1.8)
Eat less fat	4.7 (1.9)	4.6 (1.9)	4.8 (1.9)	4.9 (1.9)	4.8 (2.0)	4.8 (2.3)
Drink less pop	4.6 (2.0)	4.5 (2.2)	4.5 (2.2)	4.6 (1.8)	4.5 (1.9)	4.5 (1.9)
Eat healthy at a fast-food restaurant	4.0 (2.0) [‡]	5.9 (2.0) ^{‡,§}	4.4 (2.1)	3.3 (2.0) [§]	3.9 (2.0)	4.2 (1.8)

*Numbers reported are means and SD.

[†]Preintervention percents for subjects not completing the posttest.

[‡]Significant within-group differences between pre- and posttests (the intervention group increased fruit and vegetable consumption while decreasing "other" consumption when comparing pre- to post-means).

[§]Significant between-group differences at the posttest (there was a significant difference in pre- to post-mean change between the intervention group and the controls for fruit, vegetable, and "other" consumption).

design). The data were analyzed at the student level and not at the school level, and this could have resulted in statistical errors in the confidence intervals should the students within schools have similarities within the school but different from other schools. Finally, longer term studies need to be conducted to determine whether students are able to maintain their improved eating habits. Despite these limitations, this research is the first to evaluate the effects of a curriculum used widely throughout an entire state and demonstrate positive effects of that curriculum on behavior.

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