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SHORT COMMUNICATION

Food Is Medicine: Using a 4-Week Cooking Program of Plant-Based, Olive oil Recipes to Improve Diet and Nutrition Knowledge in Medical Students

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Abstract
Diet can be used to treat chronic diseases, yet nutrition education is not sufficiently included in most medical school curriculum. Providing practical nutrition information that could lead to improvements in clinical measures could improve patient outcomes and physician clinical skills; it might also improve the diet and eating behavior of the medical student. This study used a 4-week cooking program of plant-based recipes that included extra virgin olive oil to provide medical students with practical cooking skills and nutrition education. The results indicate that the program can improve both the diet and eating behavior of the student and their nutrition knowledge.

Keywords Medical students · Food insecurity · Nutrition education

Background

Diet can be used effectively to treat chronic diseases, yet nutrition topics are either insufficiently taught or not included in most medical school curriculums [1]. Including basic nutrition topics in the medical curriculum has value. Providing instruction that could be used with patients of all economic means, however, is more likely to yield clinical results while also potentially improving physician clinical skills.

One of the authors (MMF) developed a cooking program that is plant-based, and uses extra virgin olive oil. The program showed that for food pantry clients, a 6-week version of the program improved food security and increased vegetables and fruits consumed for clients; in addition, it lowered overall food costs and body weight [2]. A comparison of a 7-day meal plan of the diet to the most economical meal plan of the USDA (2012) showed the olive oil diet costs $14.36 less per week or $746.46 less per year per individual [3]. As the recipes are easy, healthful, and economical, it was thought that a cooking program for medical students might provide practical nutrition information and may improve their eating behavior.

The objectives of this study were to test if a 4-week cooking program of plant-based, olive oil recipes would improve (1) diet and eating behavior in medical students and (2) practical nutrition knowledge. Our hypotheses were that participation in the program would improve the diet of the participants by increasing the number of meals that included vegetables, increase the number of meals that were prepared at home, increase the number of plant-based meals that included extra virgin olive oil, and decrease red meat consumption.

Activity

The *Food is Medicine* cooking program took place at the Warren Alpert Medical School located in the Providence, RI, and was offered to all first and second year students by email. The email was sent to 144 first year and 144 second year

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Table 1 Questionnaire assessing eating behavior

1. How many of your lunches each week include at least one vegetable (this can include salads)?

   All 7 days: _____ 6 _____ 5 _____ 4 _____ 3 _____ 2 ___ 1 _____ 0 _____

2. How many days each week do you usually eat dinner at home

   All 7 days: _____ 6 _____ 5 _____ 4 _____ 3 _____ 2 ___ 1 _____ 0 _____

3. How many nights in a typical week do you have take-out for dinner?

   All 7 days: _____ 6 _____ 5 _____ 4 _____ 3 _____ 2 ___ 1 _____ 0 _____

4. How many of your dinner meals each week usually at least one vegetable (including salads)?

   All 7 days: _____ 6 _____ 5 _____ 4 _____ 3 _____ 2 ___ 1 _____ 0 _____

5. How often do you eat red meat (steaks, ground beef as hamburger, meatloaf, meatballs)?

   (include frequency) Weekly _____ less than weekly but monthly ____ less than monthly_____

6. Do you currently use extra virgin olive oil at home*?* Yes _____ no ____ _____

If yes, brand(s) used _____ meals per week with olive oil _____ _____

7. How many meals each week do you eat that do not include meat/ chicken/ seafood? (vegetarian-type)

   All 7 days: _____ 6 _____ 5 _____ 4 _____ 3 _____ 2 ___ 1 _____ 0 _____

The following questions were included in the follow-up questionnaire:

Compared to before you participated in the 4-week cooking program:

8 . Do you **buy:** more less about the same amount **of vegetables**

Do you **eat** more less about the same amount **of vegetables**

9. Do you **buy** more less about the same amount of meat?

Do you **eat** more less about the same amount of meat

11. Do you use the recipes (including your variations on the recipes) from the program? Yes no

If yes, how often in a week do you use them? _____

12. Have you noticed any change in the amount of money you spend for food since you started the program?

I spend: more less about the same

students. Any student expressing interest in this voluntary program was allowed to participate. The cooking programs were either during the student's break from classes for lunch or immediately after the last class of the day. Students were offered various days of the week and time of day in an effort to increase the accessibility of the program. Participants completed two assessments at baseline (the week before the cooking program began), and 2 months after completion of the program (FU): (1) a one-page questionnaire assessing current eating behavior (Table 1) and (2) a nutrition quiz. The eating behavior questionnaire and the nutrition quiz were developed by one of the authors. The questions in the eating behavior questionnaire were designed to test if basic eating behavior changed as a result of study participation.

The nutrition quiz was designed to assess simple nutrition themes which were taught in the program that could be useful in providing patients with dietary advice to decrease chronic diseases by improving risk factors. The weekly topics chosen were ones that medical students could easily convey to patients and were foods/concepts that have been shown to improve health and also included some risk factors that could be measured clinically. The topics were extra virgin olive oil, vegetables, and plant sources of dietary protein, which were foods included in all the recipe. Table 2 provides an outline of the topics discussed for the key food items.

Students were assigned a study identification number as they were enrolled and this was used on their assessments to help insure anonymity.

The cooking classes used an electric skillet and classes lasted approximately 30 min. The classes were 1 day per week for a 4-week period and took place in a student lounge. Each class demonstrated the preparation of a recipe that was plant-based and used extra virgin olive oil, which is a traditional Mediterranean diet. The recipes required 10–15 min to prepare. The ingredients used in the recipes are readily available, shelf-stable, and the completed recipes are low in cost, averaging $1.52/serving with a range in cost of $0.98 to $1.90 per serving (2016 pricing from a major northeast grocery chain). A nutrition topic was presented as the participants tasted the recipe. The participants were also provided with a one-page handout each week that discussed the topic. In addition, they were told that the website www.medfooddiet.com.com had the complete handout, a grocery list, and additional recipes that were plant-based and included extra virgin olive oil. Each week, there was a general discussion on using food to improve health or "food as medicine." "Health" was defined as the absence of chronic diseases and/or healthy values for

Table 2 Weekly topics in the *Food is Medicine* 4-week cooking program

Extra virgin olive oil

- Is the juice of the olive, thus a component of a plant-based diet.
- Daily use has been related to lower body weight [4] and less weight gain over time [5] when compared to subjects not using olive oil daily.
- Daily use of three tablespoons as part of a plant-based diet led to better weight loss compared to a low-fat diet [6].
- Food pantry clients who used the *Food is Medicine* recipes, which included extra virgin olive oil, for 2 to 3 main meals a week lost weight and improved their food security [2].
- Compared to vegetable seed oil, a minimum of two tablespoons of extra virgin olive oil a day will decrease fasting blood glucose and insulin [7, 8], improve insulin sensitivity [8], decrease blood pressure [9], decrease oxidation [10, 11], decrease inflammation [12], and increase high-density lipoprotein cholesterol [13–15].

Vegetables

- A serving is ½ cup of vegetables or 1 cup of greens.
- Frozen and canned vegetables have a comparable nutrient content to "retail fresh" [16], but are higher in some phytonutrients [17] because they are kept on the plant longer; can be brought when they are on sale, thus helping to decrease food costs; are all ready to use, which may increase inclusion in a meal.
- Dark vegetables are high in carotenoids, and sufficient blood levels of carotenoids have been shown to decrease cancer risk [18].
- Carotenoids need dietary fat to be maximally absorbed [19] and cooking vegetables in fat increases absorption [20].
- Vegetable preparation with olive oil compared to water preparation showed that the phenols in the olive oil are absorbed into the vegetables and are lost into the water [2], thus increasing their health properties, in comparison to vegetables eaten raw or cooking with water.

Dietary protein

- Protein needs are lower than what most Americans consume and can be calculated using ideal body weight [21] (0.8 g/kg IBW).
- Vegetables and starch are the food groups that contain plant sources of protein and can meet protein needs.
- Animal products, especially meat, poultry, and seafood, comprise the most expensive part of a food budget [22] so including them is an expensive way to obtain dietary protein.
- Vegan and vegetarian diets contain sufficient dietary protein [23–25] and protein consumed in excess of need is stored as adipose tissue.
- Studies have shown that diets high in dietary protein are related to higher body fat [26–28] and body weight [29–32].
- Eating more protein from plant source would improve body weight, health, and lower food costs.

Table 3 Results ($n = 43$) from questionnaire assessing change in eating behavior

Question	Baseline	Follow-up[1]	P =
1. Lunches including vegetables	4.3±1.9	4.9±1.9	0 01
2. Days/week dinner at home	4.8±1.4	5.1±1.5	0.29
3. Nights/week take-out	1.7±1.6	1.4±1.4	0.08
4. Dinners including vegetables	4.8±1.7	5.6±1.5	0 001
5. Frequency eating red meat/month	1.9±2.1	1.9±2.0	0.062
7. Vegetarian meals /week	3.2±2.4	4.2±2.1	0.005

[1] Follow-up is 2 months post-cooking program

Mean ± SD

6. Use of extra virgin olive oil at home: yes baseline: n= 33 FU: n= 43

Two-month Follow-up questions:

Compared to before you participated in the 4-week cooking program,

Do you buy … amount of vegetables? (43 total participants)

More	Less	about the same
30	0	13

do you eat … amount of vegetables?

More	Less	about the same
34	0	9

Do you buy… amount of meat?

More	Less	about the same
0	18	25

do you eat … amount of meat?

More	Less	about the same
0	19	25

Do you use the recipes from the program?

Yes = 39 no=4

Have you noticed any change in the amount of money you spend for food since you started the program?

I spend: more = 2 less = 14 about the same = 27

risk factors. There was a goal for the study participants to cook at home three dinners/week that were plant-based and included extra virgin olive oil. Participants were provided with a recipe packet and a 500-ml bottle of extra virgin olive oil.

Statistical Analysis

The Wilcoxon signed-rank test was used to compare the responses to the eating behavior survey at baseline to those at

follow-up. The nutrition quiz was based on 100 points and was compared using paired *t* test. All statistics were performed with Stata ver 14 (StataCorp, College Station, TX).

Results

Forty-four students (15% of those invited to participate) enrolled in the program. All 44 students completed the 4-week cooking program but one student did not return their FU questionnaires. The results presented here are for the 43 who completed the protocol. Mean age was 23.9 ± 2.2 years (F = 23; M = 21). Thirty-nine were first year students.

The results from the questionnaire assessing eating behavior for baseline and follow-up (FU) are presented in Table 3. Participation in the program improved reported vegetable consumption at both lunch and dinner. While nights per week eating dinner at home and nights that dinner was take-out did not change, the number of vegetarian meals per week, which were taught in the program, did increase. At baseline, 75% ($n = 33$) were using extra virgin olive oil at home for food preparation which increased at FU to 100%.

Meals per month that contained red meat were low at baseline (1.9 ± 2.1) and remained low at FU (1.9 ± 2.0; $p = 0.62$). However, at FU, 43% ($n = 18$) reported buying less red meat and 45% ($n = 19$) reported eating less red meat. No participant reported buying or eating more meat.

At baseline, plant-based/vegetarian main meals/week were 3.2 ± 2.4 vs. FU 4.2 ± 2.1 ($p = 0.005$). At FU, 91% ($n = 39$) reported using the program recipes 2.2 ± 1.8 meals a week (range 0–9 meals/week). Thirty-three percent ($n = 14$) reported spending less on groceries, 63% ($n = 27$) reported no change in spending, and 5% ($n = 2$) reported spending more on groceries.

Based on the nutrition quiz, nutrition knowledge of the participants improved (baseline 43.4 ± 18.9 vs. FU 83.0 ± 16.1; $p = 0.000$).

Discussion

A 4-week cooking program that is efficient to administer since the weekly classes were completed in 30 min, and can be done at times convenient for medical students, could be used to provide nutrition information that is practical for both improving the diet of students and their patients. The students in this study reported that they increased the number of meals that included vegetables, increased their consumption of meals that were plant-based and used olive oil, and a third reported spending less money overall on grocery purchases. In addition, there was a large increase in their nutrition knowledge. While the program did not improve the number of main meals the students made for themselves per week, the average number made per week at baseline was approximately five which was higher than was anticipated.

Cooking programs are increasingly being used at medical schools as a practical method of teaching nutrition [1]. The cooking program in the current study was designed to provide the students who enrolled with nutrition education for key topics that could be used by the students themselves to improve their diet and for counseling their patients. It was also designed to provide the students with instructions for preparing meals that were nutritious, low-cost, and easily prepared. At the 2-month follow-up, one-third of the participants reported spending less on groceries and an overwhelming majority of the participants reported using the recipes 2 months after the program.

While we believe this study is generalizable to other medical schools, there are some limitations. While all first and second year medical students were offered participation in this study, participation was not mandatory. Thus, the results could reflect a more health conscious group of students or those more motivated to make dietary changes. In addition, we do not know if the students provided accurate information since they knew the purpose of the program and were perhaps attempting to please the faculty who organized the study. However, all participants were assigned a study identification number to help insure anonymity. A larger sample size could indicate if the results are sustained. While such a program likely would not be mandatory for any medical school curriculum, it could be offered to students who are interested in learning how to cook meals that are healthful, inexpensive, and require 10–15 min to prepare.

In conclusion, a 4-week cooking program for medical students of plant-based, olive oil recipes can improve their diet and nutrition knowledge. In addition, it may help them provide dietary advice to all patients, especially those with chronic disease.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This study was approved the The Miriam Hospital IRB and all participants signed informed consent. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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