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Nutrition education intervention increases total ω-3 fatty acid intakes in heart patients living in the Midwest

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Abstract
The objective of this research was to assess the impact of a nutrition education intervention on intake of total ω-3 fatty acids (n-3 FA) in heart patients. The intervention design was a randomized trial comparing 2 interventions: decisional balance (DB) and no decisional balance (NDB). The outcome measures were total dietary n-3 FA intake and food sources. Intakes were measured using an n-3 FA food frequency questionnaire at baseline, at 1 month (midpoint), and at 2 months (end). Participants were a convenience sample of 36 adults (15 males, 21 females) recruited from a local heart clinic. Data were processed using the SPSS computer software (version 10.0, SPSS, Chicago, Ill). Two-way repeated measures analysis of variance with post hoc tests (least significant difference) were used to assess differences in total dietary n-3 FA intake over time and changes in intake from food groups. Total ω-3 FA intakes for both interventions increased from baseline to midpoint ($P < .001$) and from baseline to end ($P < .014$). Although there was no significant difference between groups, the DB intervention increased consumption of fruits, vegetables, nuts/seeds, fish/seafood, dairy, eggs, and legumes at 1 month and maintained the increases in vegetables, eggs, and legumes at 2 months ($P < .05$). The NDB intervention increased consumption of fruits, nuts/seeds, dairy, vegetables, fish/seafood, and eggs at 1 month ($P < .05$), and maintained the increases in dairy, fish/seafood, and eggs at 2 months. The intervention could be used by health care providers and nutrition educators who work with populations that will benefit from consuming more total dietary n-3 FA.

Keywords: ω-3 fatty acid, Heart disease, Food frequency questionnaire, Intervention, Nutrition education

1. Introduction

Diet composition has played an important role in the prevention of cardiovascular disease (CVD). Owing to the low intake of fish in the Midwest, the researchers of this study wanted to design a nutrition education intervention to increase total n-3 FA in heart patients and to assess the impact of decisional balance (DB) on dietary change in total ω-3 fatty acid (n-3 FA) intakes.

Scientists have observed that Greenland Eskimos exhibited significantly lower rates of mortality from coronary heart disease (CHD) when compared with Danes [1]. Researchers suggested that this could be due to their high intake of fish, which are rich sources of eicosapentaenoic acid and docosahexaenoic acid (DHA) [2]. Many studies have reported the relationship between reductions in sudden cardiac death with increased intake of fish [3]. Epidemiological and clinical studies have indicated that consumption of fish or fish oil is associated with lower rates of heart disease [4]. Coronary heart dis-

ease via atherosclerosis is the leading cause of death from CVD [5]. Eicosapentaenoic acid and DHA, which are found in fish and fish oil, reduce the risk of total mortality, CHD, and sudden death [6]. In a study involving 11 324 patients who survived recent myocardial infarctions, the results indicated that fish oil consumption in patients with existing CVD leads to decreased cardiovascular risk through multiple mechanisms including improving lipoprotein profile, lowered arterial pressure, and diminished thrombogenicity [7]. *a* Linolenic acid (ALA) reduces CVD risk, possibly by favorably changing vascular inflammation and endothelial dysfunction [8]. Researchers are beginning to identify and appreciate the heart healthy contributions that ALA provides [9, 10].

Previously reported total n-3 FA dietary intakes in the Midwest have been low (0.62 g/d) [11]. Recommended n-3 FA intakes for the normal healthy population are 1.1 g/d for females and 1.6 g/d for males based on average ALA intake [12]. Multiple studies have suggested that n-3 FA can have heart healthy benefits, specifically for heart patients [13–15].

Decisional balance, part of the transtheoretical model, has been used to identify barriers to making positive behavioral changes. Decisional balance uses pros and cons to help individuals focus on key areas that they view as a potential positive or negative in changing a behavior. Ling and Horwath [16] concluded that DB could be used to help guide interventions in influencing fruit and vegetable selection and consumption.

Outcomes included total n-3 FA intakes and food sources of n-3 FA. Information on how free-living heart patients adopt n-3 FA dietary patterns can be used by clinical interventionists to effectively deliver n-3 FA nutrition education programs and researchers to design effective interventions.

2. Methods and materials

2.1. Participants and recruitment

Mailing lists of patients from a local heart clinic were obtained and postcards were mailed to potential volunteers inviting them to call the project office if they were interested in participating. Prospective participants who called were given a detailed description of the study by the investigator. Inclusion criteria included living within 100 miles of the study site. Patients receiving medical care that limited their food choices were excluded. All procedures were approved by the institutional review board for the protection of human subjects in research.

2.1.1. Design

The purpose of this study was to assess the effects of nutrition education using 2 interventions: one using DB and one without DB. Intervention components and their time sequence are presented in Table 1. All participants were required to attend a 2-hour n-3 nutrition education program during week 1. Health benefits of n-3 FA and ways to incorporate foods containing n-3 FA into the participants' current diets were discussed in-depth during the nutrition education presentation. Participants were provided an n-3 cookbook and an n-3 nutrition education notebook [17, 18].

A 1-hour nutritional counseling session using DB was provided for participants in DB (n = 17) intervention during week 2, whereas no DB (NDB) (n = 19) intervention participants received follow-up phone calls. Participants in DB intervention were asked to meet one-on-one with a registered dietitian for an hour during the second week of the program. They completed a DB worksheet and listed their pros and cons for making changes in

Table 1. Time sequence of an ω-3 nutrition intervention program for heart patients

Program component	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
2-h nutrition program	DB							
	NDB							
ω-3 FA cookbook	DB							
	NDB							
Food frequency questionnaire	DB			DB				DB
	NDB			NDB				NDB
Knowledge quiz	DB							DB
	NDB							NDB
Medical history form	DB							
	NDB							
Demographic form	DB							
	NDB							
DB worksheet		DB						
One-on-one counseling session		DB						
Phone call follow-up		NDB	DB				DB	
			NDB				NDB	
Study evaluation forms								DB
								NDB

DB Intervention group (n = 17). NDB Intervention group (n = 19).

their typical diet to include more total n-3 FA containing foods. These were then discussed in-depth with the dietitian. Participants in the NDB intervention received a 5- to 10-minute follow-up telephone call during the second week to answer any questions. All participants in both DB and NDB interventions received 5- to 10-minute follow-up telephone calls during weeks 3 and 7.

2.1.2. Food frequency questionnaire and DB worksheet

A food frequency questionnaire (FFQ), including 149 food items, was developed and tested for validity and reliability. Foods were grouped into the following categories: fish, meat, eggs, dairy, fruits, vegetables, legumes, grains and grain products, fats and oils, nuts and seeds, spices. Validity was tested using peer professionals and minor changes were made to help clarify the FFQ and to make it more user friendly. Reliability was established in a group of heart patients using test-retest (a = .83) [19]. The 2 testings were 1 week to 10 days apart.

Participants completed the FFQ at baseline, 4 weeks, and 8 weeks of the study. A DB worksheet was developed to help participants in DB intervention evaluate the pros and cons of making dietary changes to include more foods that contain n-3 FA. The DB worksheet was tested for content validity using peer professionals. Some minor changes were made to clarify the directions for the worksheet. Each participant was asked to list their "pros" (benefits of changing) and "cons" (costs of changing) for eating foods containing n-3 FA. Then, they were asked to rate each pro and con from 1 to 5, with 5 being very important and 1 being not so important. Pros and cons were grouped into categories. The main purpose of the DB worksheet was to serve as a resource for nutrition counseling that helped participants identify their personal pros and cons for making the behavioral changes needed to increase their total n-3 FA intakes. Each pro that was listed was reinforced during the counseling session, whereas each con was discussed to decrease the negative impact it had on making positive dietary change. For example, if a participant thought that a con for increasing their total n-3 FA intakes was an increase in the cost of their grocery bill, the dietitian would demonstrate to the participant easy, inexpensive ways to increase their total dietary n-3 FA.

2.2. *Statistical analysis*

Data were processed using SPSS version 10.0 (SPSS, Chicago, Ill). Two-way repeated measures analysis of variance and post hoc test (least significant difference) were used to assess differences in total dietary n-3 FA intake over time. t Tests were used to compare mean total n-3 FA intakes for DB and NDB interventions. χ^2 Test was used to look for differences between intervention groups in demographic characteristics.

3. Results

3.1. Demographics

The sample for this study included 36 participants. Sociodemographic characteristics were similar in the 2 groups. Slightly more women (58%) participated than men (42%) and more than one half of them were aged 60 years or older. All of them were white, two thirds had education beyond high school, and more than one half had annual incomes of $35 000 or higher. Slightly more than half consumed n-3 eicosapentaenoic acid and DHA supplements, and more than two thirds were consuming vitamin/mineral supplements. None of the participants reported having a food allergy to eggs or egg products. Eighty-two percent (n = 14) of the DB intervention and 58% (n = 11) of the NDB intervention reported consuming eggs as part of their usual diet.

One third of participants had previously experienced a heart attack. Most participants (94%) were taking prescription medications. Slightly more than half (58%) reported high blood pressure. One fourth of participants reported a history of obesity and depression. Participants reported receiving nutrition information from a variety of sources. Approximately one half (52 %) of all participants relied on their physician for nutrition information, whereas approximately one third (36%) relied on nonscientific magazines as a source of nutrition information.

3.2. Dietary assessment

The n-3 FA FFQ provided information over time on consumption and selection of foods providing total n-3 FA by food groups. Figure 1 shows the changes in total n-3 consumption over time. Participants increased total n-3 FA intakes from baseline to 1 month (P < .001) and from baseline to 2 months (P < .014). Main effect for group

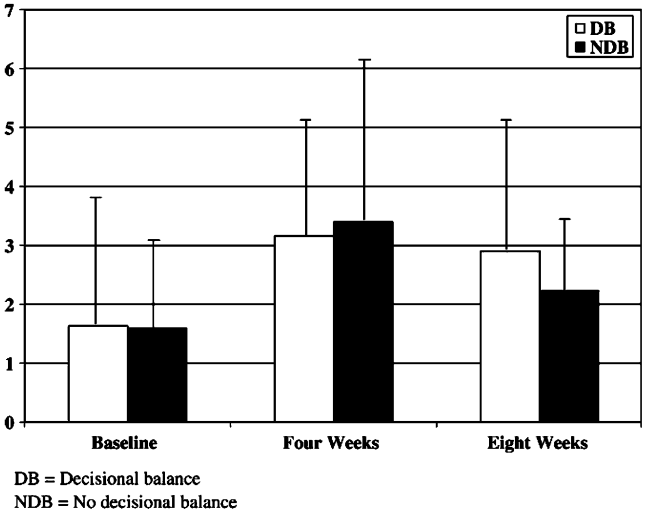

Figure 1. ω-3 Intakes (mean ± SD) at baseline and at 4 and 8 weeks.

Table 2. Decisional balance qualitative data: DB intervention group (n = 17)

Pros	
	Helps with triglycerides
	Helps with cholesterol
	Prevents stroke, prevents heart attacks
	Helps control diabetes
	Decreases cancer risk
	Heart healthy
	Weight loss (helps with)
	Live a long life
	Love all foods on the list
Cons	
	Not wanting to cook
	Eating out
	Don't like fish
	Increase in saturated fats
	Changing of dietary habits
	Lack of knowledge regarding n-3 fatty acids
	Effort to buy certain foods
	Cost
	Busy schedule/no time to plan

and the time by group interaction were not significant ($P > .05$). Although participants in both interventions increased their total n-3 FA intakes from baseline, the DB intervention was somewhat more able than NDB to maintain a higher total n-3 FA intake at 2 months; however, this difference was not significant.

The major increases in food sources of total n-3 FA by food group for DB intervention participants were (in this order) vegetables, nuts/seeds, fish/seafood, dairy, eggs, and legumes and products. For NDB intervention, the main increases in food groups providing total n-3 FA were (in this order) fruits, nuts/seeds, dairy, vegetables, fish/seafood, and eggs. For both groups, egg and nut/seed intakes doubled from baseline to 2 months.

3.3. Decisional balance

The DB worksheet produced qualitative and quantitative data. The qualitative data are presented in Table 2. Participants' "pros" and "cons" were evaluated for common threads and are listed in order by which they were most frequently reported by participants.

4. Discussion

We developed and evaluated a nutrition education intervention to increase total n-3 FA intakes in heart patients. The n-3 FA nutrition education program was developed to improve knowledge and skills in selecting foods from all food groups that contain all 3 types of n-3 FA in established heart patients. Nutrition education designed for heart patients has the potential to accomplish a major goal of helping participants change eating habits to increase total n-3 FA intakes, which can lead to the prevention of further cardiac events [20]. We were able to document for both intervention groups an increase in the consumption of identified foods containing all 3 types of n-3 FA from baseline to postintervention. Participants had previously been taught a low-fat, heart healthy diet by a registered dietitian. With permission of their doctors, we educated participants on how to incorporate n-3–enriched eggs into their typical diets. Both groups doubled their egg consumption from baseline to 4 weeks and from baseline to 8 weeks. Participants were taught in the nutrition education program which nuts/seeds were high in total n-3 FA, and this food category also doubled from baseline to 4 weeks and the increase was maintained through the 8-week intervention.

Total n-3 FA intakes were above the dietary reference intakes at the beginning of the program. Is it possible to increase individual's total n-3 FA dietary intakes further when it is already high? This study suggests that it is indeed possible to further increase individual's total n-3 FA dietary intakes. By providing individuals with the knowledge of which foods are sources of all n-3 FA, they are then able to select and incorporate those foods into their typical diet. Foods such as n-3–enriched eggs, walnuts, flaxseeds, canola oil are all high sources of n-3 FA and are relatively easy for most individuals to add to their typical diets. Participants were provided n-3 FA nutritional materials to take home. It is possible that participants reviewed these materials to help them increase their total dietary n-3 FA intakes. For example, all participants received an educational egg fact sheet that provided them with the American Heart Association recommendations for cholesterol and that consuming 1 egg per day falls within their recommendations for dietary cholesterol.

Functional foods containing n-3 FA are now globally available. One such functional food is the n-3–enriched egg. Egg intakes were increased twofold at 1 month post and 2 months post in both groups. These eggs vary in their n-3 FA content (from 100 to >660 mg per egg) by brand and source of n-3 FA. Although all of our participants were heart patients, they were asked to increase their egg consumption using n-3–enriched eggs. Both groups were able to increase their total n-3 consumption by incorporating these eggs into their typical diet.

Decisional balance was beneficial in identifying heart patients' pros and cons that may need to be addressed to help them to make the necessary dietary changes. Participants listed health-related reasons most often for pros to increase their total dietary n-3 FA intakes. Convenience-related reasons (not wanting to cook, eating out, and busy schedule) were listed most often for reasons against making change. Patch et al [21] found similar results with focus groups of overweight individuals and n-3–enriched functional foods. The cost of n-3 FA foods was considered a barrier (or con) for making the desired behavioral change.

Researchers from the Netherlands reported that 30 g of fish daily was associated with a 50% reduction in

deaths related to CHD [15]. In our study, participants were consuming about 34 g of fish per week at baseline, which is equal to about 5 g of fish per day or 0.15 ounces of fish per day. Individuals living in the Midwest have previously reported consuming fish once every 2 weeks [22]. The fish consumption in this study at baseline was similar to previous surveys in the Midwest. These heart patients may have adjusted their diets to include more seafood before the n-3 nutrition education intervention.

4.1. Limitations

Long-term maintenance for individuals making dietary changes is needed. We did not follow these participants for more than 2 months postintervention. We cannot say with certainty that dietary changes were not influenced by seasonal changes in produce availability. NDB had a decrease in total n-3 FA dietary intakes from 4 to 8 weeks. Although this decrease in total n-3 FA intakes was not significant, with a higher N a larger difference might have been detected.

4.2. Applications

Total n-3 FA dietary assessment of persons with heart disease is important. The n-3 FA FFQ that was developed for this study would be inexpensive and easy to administer for nutrition educators. This study used established heart patients and assessed their total dietary n-3 fatty acid intakes and response of intake to a nutrition education intervention.

Further research is needed to determine whether nutrition education programs should include DB. This program needs to be tested with the general population.

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