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Effects of a Self-directed Nutrition Intervention among Adults with Arthritis

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Abstract

Chronic diseases are common among adults. A healthy diet may be beneficial for managing the consequences of such conditions. The purpose of this study was to evaluate the effects of a self-directed nutrition program on dietary behaviors among adults with chronic health conditions. As part of a larger trial examining the effects of a self-directed exercise program, participants with arthritis were randomized to a 12-week self-directed exercise or nutrition intervention. Self-reported fruit and vegetable consumption, fat- and fiber-related behaviors were assessed at baseline, 12 weeks, and 9 months. Repeated measures ANCOVAs examined Group x Time changes in dietary behaviors. Effect sizes were computed. Participants (n=321) were, on average, 56.5±10.5 years old, had a mean BMI of 32.9±8.3 kg/m^2, and had 2.0±1.0 chronic health conditions; 88% were female, 65% White, 88% had at least some college education, and 62% married. There were significant Group x Time interactions favoring the nutrition group at 12 weeks for all dietary behaviors ($p<.05$), but not at 9 months. Between group effect sizes were small at 12 weeks and decreased at 9 months. Within group effect sizes were larger for the nutrition group (small to medium) than the exercise group (none to small) at both time points. A self-directed nutrition intervention can result in meaningful improvements in dietary behaviors among adults with chronic health conditions in the short term.

Keywords

nutrition; dietary behaviors; self-directed; intervention; public health; chronic disease

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Conflict of Interest:
None

Introduction

Chronic diseases are a large and growing public health problem. Seven of the top ten leading causes of death in the United States are chronic diseases (Murphy, Kochanek, Xu, & Arias, 2015). About half of all adults in the United States has at least one chronic health condition, and many adults (especially middle to older) have multiple chronic diseases (Ward & Schiller, 2013). Approximately one-third of those 45–64 years of age and over 60% of those 65+ years of age have multiple chronic health conditions (Ward & Schiller, 2013). Obesity was not included as a chronic disease in these estimates; therefore, the prevalence of multiple chronic diseases is likely to be even higher.

Contributors to these high rates of chronic disease include unhealthy diet, physical inactivity, and tobacco use (Dietz, Douglas, & Brownson, 2016). These factors are modifiable and are commonly referred to as the leading causes of *actual* death (Mokdad, Marks, Stroup, & Gerberding, 2004). A number of specific dietary factors can help to prevent the development of comorbid chronic health conditions. There is evidence suggesting that increased fruit and vegetable consumption reduces the risk of diseases such as coronary heart disease, hypertension, stroke, cancer, and overweight, among others (Boeing et al., 2012). The evidence regarding lowering saturated fat intake is mixed, although it has been associated with reduced risk of coronary heart disease (Astrup et al., 2011). Additionally, increased intake of dietary fiber has been shown to reduce the risk of cardiovascular disease, diabetes, obesity, breast cancer, and colon cancer (Timm & Slavin, 2007). There is also evidence suggesting that dietary factors/behaviors can help to manage many chronic health conditions including diabetes (Pastors, Warshaw, Daly, Franz, & Kulkarni, 2002), hypertension (Appel et al., 2006), and obesity (Makris & Foster, 2011).

Unfortunately, a majority of American adults do not meet dietary guidelines (Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010). Lifestyle interventions focusing on healthy eating may be one means for preventing chronic diseases and/or improving the health of those with chronic diseases. A number of dietary interventions focused on preventing or managing chronic diseases have been conducted, however the effectiveness of these programs on dietary adherence outcomes are mixed (Desroches et al., 2013). A majority of these interventions to date are group-based or individualized with a health professional (e.g. nurse, dietician) (Desroches et al., 2013). In an effort to combat this significant public health problem, there is a need for low-cost programs that are easily accessible and can reach a large number of people. One such intervention approach may be computer-tailored interventions, which have shown promise for improving dietary outcomes (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012). Self-directed print dietary programs may also be appealing, as they require very few resources in terms of staff time and equipment, making large scale implementation feasible and potentially impactful. Unfortunately, self-directed programs that can successfully improve dietary behaviors that do not do not require internet or phone contact (Fries et al., 2005; Kristal, Curry, Shattuck, Feng, & Li, 2000) are rare..

As part of a larger trial designed to evaluate the effectiveness of a self-directed exercise program (First Step to Active Health®) (Wilcox et al., 2015), a self-directed nutrition program (i.e., Steps to Healthy Eating) was developed to serve as the attention control condition. Results from the main trial have been published elsewhere (Wilcox et al., 2015), Briefly, participants in the exercise condition showed greater increases in physical activity than those in the nutrition group, and weight significantly decreased in the nutrition group at 9 months (~2 lbs), whereas there was no change in the exercise group. Although evaluating the effects of this program was not a main aim of the trial (Wilcox et al., 2015), the purpose of the secondary analyses conducted in this paper were to evaluate the effectiveness of the self-directed nutrition program on fruit and vegetable consumption and fat- and fiber-related behaviors among adults with chronic health conditions.

Methods

Participant recruitment

Participants with self-reported doctor diagnosed arthritis and who met other eligibility criteria (Table 1) based on a telephone screening interview, were eligible to take part. This validated case definition of arthritis has been used in the National Health Interview Survey and the Behavioral Risk Factor Surveillance System (Hootman, Helmick, & Brady, 2012). A number of strategies to recruit participants were used; the most successful were emails sent to worksite listservs and advertisements in newspapers.

Procedure

Participants deemed eligible were scheduled for a measurement session that was held at the University of South Carolina. At the session, informed consent was obtained, and participants turned in their survey (completed prior to the session) and completed physical and functional measurements. At the end of the session, each participant was randomized to a self-directed exercise program (First Step to Active Health®) or to an attention control self-directed nutrition program (Steps to Healthy Eating). Participants were oriented to their program by study staff. The same measurement procedures were used at each follow-up session (i.e., 12 weeks and 9 months). Participants received a monetary incentive for taking part in each measurement session and for returning logs (described below). This study was approved by the Institutional Review Board at the University of South Carolina,

Interventions

First Step to Active Health®

Participants randomized to the intervention group received the First Step to Active Health® program (i.e., exercise group), which is a 12 week, self-directed multi-component progressive exercise program. The four ‘Steps’ were: (1) cardiovascular activities, (2) flexibility, (3) strength, and (4) balance. Dietary information was not included in this program. More details of the exercise intervention have been reported elsewhere (Wilcox et al., 2015).

Steps to Healthy Eating

A self-directed nutrition program (Steps to Healthy Eating) was developed and used as the attention control group in the overall trial. The program was based on the USDA

MyPyramid approach (which has since been replaced with MyPlate) and modeled to parallel the First Step to Active Health® kit. Participants received a Steps to Healthy Eating kit (will add url for the website where the nutrition kit is posted) and a folder containing weekly self-monitoring logs, postage paid return envelopes (for the logs), and a study expectations calendar. The program includes components of the Social Cognitive Theory (Bandura, 1986), with a particular emphasis on self-regulation and self-efficacy (Michie, Abraham, Whittington, McAteer, & Gupta, 2009). Participants were encouraged to plan, set goals, and self-monitor their dietary intake for each of the 4 steps. Furthermore, in an effort to enhance self-efficacy, an individualized, stepped approach was used (i.e., participants were instructed to move to the next 'Step' when they were consistently meeting recommendations at the current Step), described in more detail below.

The Steps to Healthy Eating kit contained a program manual that included tools to help participants assess their food intake, set goals, customize their program, enhance motivation, and ensure food safety, and four nutrition 'Steps'. Participants were instructed to progress through the four nutrition steps during the 12-week study: (1) fruits, (2) vegetables, (3) grains, and (4) meat and beans. Each step discussed the benefits of the food group, food(s) included in the group, how much they should consume, examples of what foods 'count' towards the recommendation, where to start (based on their personal assessment), goals, and tips for meeting recommendations. Using the Flesch-Kincaid Grade Level readability assessment tool, the readability of the nutrition kit was 6.7 (~7th grade reading level). A MyPyramid pocket card was included that reminded participants of serving sizes for foods in these four groups along with age and gender recommendations for servings per day. Although MyPyramid and MyPlate have five food groups, only four were included to be consistent with the number of steps in the exercise program described below (dairy not included). Once participants were consistently meeting Step 1, they were instructed to add Step 2 into their routine (while continuing on with Step 1), and so on. Although progression through the program was self-paced, participants were encouraged to incorporate all four steps by the end of 12 weeks.

Measures

Measures were completed at baseline, 12 weeks, and 9-months. Measurement staff were blinded to group assignment at all visits.

Demographic/health-related variables.—Participants reported their age, gender, education, race, and marital status. Self-reported presence of hypertension, high cholesterol, cancer, and osteoporosis were also obtained. Height to the nearest quarter inch and weight to the nearest tenth of a pound were obtained via trained measurement staff and BMI (kg/m^2) was calculated.

Fruit and vegetable intake.—The National Cancer Institute Fruit and Vegetable all-day screener measured FV consumption (cups/day) in the past month (National Cancer Institute, 2000). Nine of the original ten items were used (French fry consumption was excluded) (Thompson et al., 1999). A higher score indicated higher fruit and vegetable consumption.

Fat and fiber intake.—The Fat and Fiber-Related Behavior Questionnaire (Shannon, Kristal, Curry, & Beresford, 1997) assessed fat- (27 items) and fiber-related (14 items) dietary behaviors over the past three months. All questions used a 4-point scale, and a lower score indicated more favorable fat- and fiber-related behaviors.

Statistical Analyses

This study included participants with at least one dietary outcome variable at 12 weeks and/or 9 months. Basic descriptive statistics were conducted on demographic and key survey variables. Repeated measures analysis of covariance examined intervention Group X Time differences in fruit and vegetable consumption and fat- and fiber-related behaviors at 12 weeks and 9 months. All models controlled for age, gender, education, and marital status. To determine the magnitude of change (within group) and the magnitude of the difference in change (between groups), effect sizes were computed for each dietary variable. The within group effect size was calculated for each intervention group at 12 weeks and 9 months as d = (post adjusted mean – baseline adjusted mean) / (unadjusted baseline standard deviation). The between group effect size was calculated at 12 weeks and 9 months as d = ([post adjusted mean – baseline adjusted mean for the nutrition group] – [post adjusted mean – baseline adjusted mean for the exercise group]) / (unadjusted pooled baseline standard deviation). Using Cohen's effect sizes (Cohen, 1988), d=0.2 was considered a small effect, d=0.5 a medium effect, and d=0.8 a large effect.

Results

Of the 401 participants randomized, 321 had 12-week and/or 9-month data and were included in this study (80%). More women than men were retained at either time point (p=.04), and those retained also had higher fruit and vegetable consumption at baseline (p=.02). On average, participants were 56.5±10.5 years of age, had a BMI of 32.9±8.3 kg/m^2, and had 2.0±1.0 chronic health conditions. A majority were women (88%), White (65%), married (62%), and had at least some college education (88%). Chronic diseases were prevalent; 85% of participants were overweight or obese, and 100% reported arthritis, 49% high blood pressure, 42% high cholesterol, 13% osteoporosis, and 11% cancer; 94% had at least 2 chronic health conditions and 67% had at least 3. Table 2 shows the health-related characteristics of the sample by intervention group assignment. There were no significant baseline differences between intervention groups on any of these factors.

Participants in the nutrition group returned, on average, 11.0±2.6 (out of 12) logs. Among those returning any logs (n=162), 98.2% made it to Step 1 fruit, 92.6% made it to Step 2 vegetables, 81.5% made it to step 3 grains, and 64.1% made it to step 4 meat and beans. Among those returning a log in week 12 (n=143), 2.8% were on Step 1, 5.6% were on Step 2, 12.6% were on Step 3, and 79.0% were on Step 4.

Table 3 shows the adjusted baseline, 12-week, and 9-month means for dietary behaviors, and the within and between group effect sizes. There was a significant Group X Time interaction for fruit and vegetable consumption. There was a significant increase from baseline to 12 weeks but not baseline to 9 months for the nutrition group. There was no change at either time point for the exercise group. The nutrition group had significantly higher fruit and vegetable consumption than the exercise group at 12 weeks, but there was no difference between groups at 9 months. The effect sizes show that the magnitude of reductions were greater for the nutrition than the exercise group.

There was a significant Group x Time interaction for fat-related behaviors. There was a significant decrease from baseline to 12 weeks and baseline to 9 months for both the nutrition and exercise groups. The nutrition group had significantly lower scores than the exercise group at 12 weeks, but there was no difference between groups at 9 months. The effect sizes show that the magnitude of reductions were greater for the nutrition than the exercise group.

There was a significant Group x Time interaction for fiber-related behaviors. There was a significant decrease from baseline to 12 weeks and baseline to 9 months for both the nutrition and exercise groups. The nutrition group had significantly lower scores the exercise group at 12 weeks, but there was no difference between groups at 9 months. The effect sizes show that the magnitude of reductions were greater for the nutrition than the exercise group.

Discussion

The public health burden of chronic diseases both in terms of prevalence and cost is significant (Gerteis et al., 2014). Although dietary interventions may be one means for reducing the burden of chronic diseases, self-directed dietary programs that can be widely disseminated at a low-cost, and do not do not require internet or phone contact are rare. Findings from this study show promise in that a low-cost, low-resource (i.e., staff and materials), self-directed dietary intervention that incorporates evidence-based behavioral strategies (Artinian et al., 2010) can improve dietary behaviors in adults with chronic diseases in the short-term. Although between group effect sizes were small, small changes across a large number of people have a greater public health impact than large changes across a small number of people (Dzewaltowski, Estabrooks, & Glasgow, 2004; Estabrooks & Gyurcsik, 2003).

While the short-term effects of this intervention are somewhat promising, the long-term effects are less clear. In the nutrition group specifically, fat-related behaviors were maintained at 9 months, and although fiber-related behaviors were not fully maintained, there was still a small effect at 9 months. However, increases in fruit and vegetable consumption were not maintained at 9 months. Furthermore, differences in dietary behaviors between groups no longer existed at 9 months. Although the intervention was low in intensity, participants were asked to complete and return (weekly) daily logs, and compliance was high. Logs were not required during the maintenance period of the study (i.e. after 12 weeks), and interestingly, the corresponding dietary outcomes during this time period were less impressive. The literature shows that self-monitoring is key for behavior change. A meta-regression analysis found that across 122 evaluations of physical activity and dietary change interventions, those that combined self-monitoring with at least one other technique related to self-regulation (e.g., planning, goal setting) were significantly more successful than interventions not including these techniques (Michie et al., 2009). Efforts to continue self-monitoring after the active intervention is complete (i.e. during the follow-up period) should be made, as it may improve maintenance of dietary changes.

Maintenance of behavior change, including dietary behaviors, is challenging and it is unclear how to best achieve it (Greaves et al., 2011). Many of the dietary interventions conducted to date have limited follow-up evaluation (Ammerman, Lindquist, Lohr, & Hersey, 2002; Desroches et al., 2013). Therefore, little is known about the long-term effectiveness of dietary interventions or how to prevent relapse (Ammerman et al., 2002), particularly among those with chronic health conditions. Follow-up measures, and extending the follow-up period even further (i.e., beyond 1 year) may be necessary to better understand the long-term effectiveness of these types of interventions (Ammerman et al., 2002).

This self-directed nutrition program is appealing, as it did not require following a strict diet (e.g., vegetarian/vegan, Mediterranean), fasting, or excluding certain foods. Such diets may be unrealistic from a public health perspective, as it may be difficult for the average person to understand and follow these diets long-term. This intervention was based on the U.S. dietary guidelines, incorporated behavior change strategies consistent with Social Cognitive Theory (Bandura, 1986) (i.e., self-monitoring, goal setting, enhancing self-efficacy), and was designed to be low cost and easily adapted to meet individual needs, making it more desirable and feasible for use at a population level.

Given the importance of physical activity in the prevention and management of chronic diseases (Durstine, Gordon, Wang, & Luo, 2013), public health interventions may want to consider including a dietary *and* a physical activity component. A self-directed exercise intervention delivered in the same manner as this intervention was shown to be effective in increasing physical activity (Wilcox et al., 2015). Interestingly, and unexpectedly, participants in the exercise group also showed improvements in fat- and fiber-related behaviors, albeit very small in magnitude, suggesting that an exercise intervention may also elicit some changes in dietary behaviors. Previous research has suggested that physical activity may be a ‘gateway behavior’ to engaging in other healthy behaviors (e.g. healthy diet) (Blakely, Dunnagan, Haynes, Moore, & Pelican, 2004; Jayawardene, Torabi, & Lohrmann, 2016). Regardless, targeting and changing both behaviors (physical activity and diet) simultaneously may result in more powerful and meaningful effects (King et al., 2013). Although the availability of such programs is the first step, efforts aimed at promoting use of these programs is essential, as evidence-based interventions focused on individuals with chronic health conditions (e.g., arthritis) known to be effective are underutilized (Hootman et al., 2012).

The findings of this study should be interpreted in the context of several limitations. Limitations include the self-reported diagnosis chronic health conditions, the use of self-reported dietary measures, which can lead to social desirability bias, and the measurement of dietary *behaviors* and not consumption (for fat and fiber). Our sample was mostly well-educated women who were likely more motivated to change health behaviors (i.e., they self-selected into the study). Finally, 20% of people did not have follow-up data at either time point, and no imputation methods were used.

Implications for Practice

Comorbidities are common among U.S. adults (Ward & Schiller, 2013). In an effort to combat this significant public health problem, there is a need for low-cost programs that are easily accessible, can reach a large number of people, and are effective at producing behavior change. Self-directed programs are one approach that could be used. These types of programs do not require substantial resources in terms of staff and equipment, making the potential to disseminate widely feasible. Although there was evidence that a self-directed dietary intervention can produce changes in dietary behaviors, the long-term effectiveness of such programs is less clear. Continued work is needed to identify effective ways to promote sustained behavior change, even after the active intervention is over (i.e. prevent relapse). Such programs and approaches are critical for efforts aimed at preventing and/or managing this large, burdensome U.S. public health problem.

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Table 1.

Eligibility and Ineligibility Criteria

Participants were eligible if they:
• Were told by a health care professional that they have some form of arthritis
• Reported at least one symptom of arthritis (joint pain, stiffness, tenderness, decreased range of motion, redness and warmth, deformity, crackling or grating, fatigue)
• Were ≥18 years of age
• Were the only one in their household participating in the study
• Were not planning to move out of the area in the next nine months
• Were able to read and write in English
• Were not participating in another research study (unless it was an observational study without an intervention or medication)
Participants were ineligible if they:
•Endorsed an item on the Physical Activity Readiness Questionnaire (Adams, 1999) :
○ Note: participants were not excluded if they took medication for hypertension and their blood pressure was controlled
•Had a fall in the past year that required medical assistance
•Were pregnant, breastfeeding, or planning to become pregnant in the next year
•Were diabetic and taking insulin
•Could not walk longer than 3 minutes without a rest
•Could not stand without assistance for more than 2 minutes
•Could not sit in chair without arms for more than 5 minutes
•Were already physically active (aerobic activities ≥3 days/week for ≥30 minutes/day or strength training ≥2 days/week for ≥20 minutes/day)

Table 2.

Demographic and Health-related Characteristics of Participants Enrolled in a Self-directed Nutrition or Exercise Program (n=321)

	Nutrition Group		Exercise Group	
	n	Mean (SD) or %	n	Mean (SD) or %
Age, years	164	56.2 (11.0)	157	56.8 (9.9)
BMI, kg/m^2	164	33.3 (8.0)	157	32.5 (8.6)
Chronic diseases, #[a]	164	2.0 (1.1)	157	2.0 (1.0)
Gender				
Male	20	12.2	20	12.7
Female	144	87.8	137	87.3
Race				
White	108	66.3	100	63.7
Non-white	55	33.7	57	36.3
Marital status				
Married/partnered	96	58.5	102	65.0
Not married	68	41.5	55	35.0
Education				
High school graduate or less	19	11.6	18	11.5
At least some college	145	88.4	139	88.5
Arthritis, % reporting	164	100.00	157	100.0
Overweight/obesity (BMI≥25), % yes	145	88.4	127	80.9
High blood pressure, % reporting	78	47.6	79	50.0
High cholesterol. % reporting	67	40.9	68	43.6
Osteoporosis, % reporting	21	12.8	21	13.5
Cancer, % reporting	16	9.8	19	12.3

[a]sum of arthritis, overweight/obesity, high blood pressure, high cholesterol, osteoporosis, cancer

Table 3.

Changes in Nutrition-related Behaviors among Participants in a Self-directed Nutrition or Exercise program, Adjusted Mean (SE) unless otherwise noted

	Nutrition	Exercise	Intervention vs. Control Effect size (d)	Adjusted Group x Time (p-value)
F & V, cups/day				
Baseline	0.9 (0.1)	0.8 (0.1)		
12 weeks	**1.2 (0.1)**[a]	0.8 (0.1)[b]		0.001
12 wk effect size, d	0.26	−0.05	0.33	
9 months	0.8 (0.1)[a]	0.8 (0.1)[a]		
9 mo effect size, d	−0.06	−0.01	−0.06	
Fat-related behaviors				
Baseline	2.7 (.01)	2.7 (0.1)		
12 weeks	**2.5 (0.1)**[a]	**2.6 (0.1)**[b]		0.004
12 wk effect size, d	−0.32	−0.13	−0.22	
9 months	**2.5 (0.1)** [a]	**2.6 (0.1)** [a]		
9 mo effect size, d	−0.29	−0.19	−0.12	
Fiber-related behaviors				
Baseline	3.0 (0.1)	3.0 (0.1)		
12 weeks	**2.8 (0.1)**[a]	**2.9 (0.1)**[b]		<.0001
12 wk effect size, d	−0.45	−0.12	−0.35	
9 months	**2.9 (0.1)** [a]	**2.9 (0.1)** [a]		
9 mo effect size, d	−0.24	−0.12	−0.14	

Note: differing superscripts indicates significant between group differences at 12 weeks or 9 months; bold indicates significant within group change from baseline; for fat and fiber-related behaviors, scores can range from 1–4; lower scores indicate healthier dietary behaviors; models adjusted for age, gender, education, and marital status; d=0.2 small effect, d=.5 medium effect, d=.8 large effect