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Dietary Quality is Associated with Better Self-Efficacy and Depression in Patients with Fibromyalgia from a Comparative Effectiveness Trial: A Small Pilot Study

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ORIGINAL RESEARCH

Dietary Quality is Associated with Better Self-Efficacy and Depression in Patients with Fibromyalgia: A Pilot Study

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Introduction: Diet and exercise may be beneficial for managing symptoms of fibromyalgia. However, data on the relationship between diet quality and fibromyalgia symptoms are limited. We investigated the relationship between diet quality, fibromyalgia, and psychological health in patients who participated in a randomized controlled trial (RCT) evaluating the use of Tai Chi versus aerobic exercise for managing symptoms of fibromyalgia.

Methods: A cross-sectional study enrolled participants from a RCT. Diet quality and fibromyalgia symptoms were assessed using the Healthy Eating Index 2010 (HEI-2010) and Revised Fibromyalgia Impact Questionnaire (FIQR), respectively. Retrospective analyses were performed using Spearman's rank correlation coefficient (r) to examine the association of diet quality with pre-intervention FIQR, psychological variables, and quality of life.

Results: Twenty-six female adults (mean age = 56 years; mean pre-intervention body mass index = 29.6) of 223 trial participants (11.7%) were included in the analyses. Higher diet quality was associated with higher pre-intervention chronic pain self-efficacy scores (r = 0.62, *P* = .01) and lower scores on the Hospital Depression scale (r = -0.47, *P* = .02). There were no significant associations between diet quality and pre-intervention severity of anxiety or physical health, quality of life, sleep quality, or FIQR scores.

Conclusion: Preliminary results suggest a positive association between diet quality and self-efficacy and psychological health in women with fibromyalgia. Future prospective studies are needed.

Keywords diet, nutrition, fibromyalgia, self-efficacy, psychological health

Fibromyalgia is a multidimensional disorder characterized by chronic widespread musculoskeletal pain, often together with fatigue, sleep disturbance, and psychological disturbance.[1] It is the second most common rheumatologic condition in the United States, affecting up to 2% of the general population between 18 and 65 years of age. Fibromyalgia can have devastating effects on quality of life and lead to decreased productivity and increased healthcare costs.[2]

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Although some pharmacological interventions provide statistically significant benefits for patients with fibromyalgia, they are of questionable clinical relevance, have not been consistently demonstrated, have significant risk of serious adverse events, and are not tolerated by many participants.[3,4] Thus, finding new and effective non-pharmacological treatments for fibromyalgia patients is urgently needed.

Vegetarian diets, dietary weight-loss interventions, gluten-free diets, glutamate-free diets, and some micronutrients may be beneficial non-pharmacological tools for symptom management of fibromyalgia.[5,6] Dietary interventional studies have

shown some success in symptom management, albeit most studies have poor statistical quality and high risk of bias.[7] Similarly, dietary and nutritional approaches to reducing musculoskeletal pain have been studied, including anti-inflammatory, low-calorie, and plant-based dietary patterns.[8–12] However, data on the relationship between diet quality and fibromyalgia symptoms are limited.

Studies have shown that mind-body exercise (e.g., yoga and Tai Chi) can help improve fibromyalgia symptoms.[13–17] However, data on the effect of diet and exercise on fibromyalgia symptoms are limited. To gather preliminary data for designing a multimodal intervention incorporating healthy dietary patterns and exercise, we analyzed data from a previously published trial[13] combined with new data collected in this study. First, we investigated the relationship between dietary quality and fibromyalgia symptoms in patients with fibromyalgia who participated in a randomized controlled trial (RCT) of exercise (cross-sectional analyses). Second, we studied the relationship between dietary quality and a variety of pre-intervention psychological health, self-efficacy, and quality of life measures in the same patients (retrospective analyses). Secondary outcomes included a qualitative comparison of diet quality among females with fibromyalgia and the general U.S. adult population, as well as changes in FIQR scores from baseline of the original trial to post-intervention follow-up of the current study.

MATERIALS AND METHODS

The study was conducted in an urban medical center and medical school in Boston, Massachusetts from September 2016 to September 2017. Participants were recruited from the 52-week comparative-effectiveness RCT, Tai Chi and Aerobic Exercise for Fibromyalgia (FMEx; ClinicalTrials.gov identifier: NCT01420640). All participants fulfilled the American College of Rheumatology 1990 and 2010 preliminary diagnostic criteria for fibromyalgia.[18,19] Details of the recruitment process for FMEx were described previously.[13] Figure 1 depicts the design of FMEx and this pilot study.

Patients who completed the 52-week follow-up evaluation in FMEx and consented to be contacted again for future studies were contacted for recruitment by phone, email, or mailed letter. Because consent was needed to determine eligibility in the study, patient eligibility was assessed after enrollment in the study. Patients were excluded if they 1) had participated in a clinical trial since the original trial, 2) were pregnant, 3) were diagnosed with cardiovascular disease or hypertension since the end of the original trial, or 4) had participated in a dietary intervention since the end of the original trial.

Information on diet history was assessed using the National Cancer Institute Diet History Questionnaire (DHQ-II past-year recall without portion sizes).[20] Diet quality was calculated using the Healthy Eating Index 2010 (HEI-2010), which assesses compliance with the 2010 U.S. Dietary Guidelines for Americans.[21] This index has nine dietary adequacy components, including total fruit, whole fruit, total vegetables, greens and beans, whole grains, total protein, seafood and plant proteins, and fatty acid ratio. In addition, there are three moderation components, including refined grains, sodium, and empty calories. Higher scores indicate higher compliance with the dietary guidelines. Fibromyalgia symptoms were assessed using the total score from the Revised Fibromyalgia Impact Questionnaire (FIQR), a validated instrument that measures participant-rated severity of fibromyalgia.[22] Higher scores indicate more negative impact. In this paper, we refer to FIQR scores collected alongside the DHQ-II as "post-intervention follow-up." Body weight was measured using a digital scale. Participants also completed a short survey assessing their current involvement in physical activities, including the intensity and type of activity.

Data from the FMEx trial included FIQR scores obtained at baseline and after 24 weeks of intervention. This contrasts with the post-intervention follow-up FIQR and DHQ-II obtained for this study 13.3 months (SD = 1.3) after completion of FMEx. Psychosocial and quality of life measures, self-efficacy scores, and sleep-quality scores were also obtained from the FMEx trial. Self-efficacy was assessed using the arthritis self-efficacy scale, which has been validated to assess patients perceived ability to cope with the consequences of chronic pain. Scores range from 0 to 10, with higher scores indicating higher self-efficacy.[23] Depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II), a 21-item questionnaire that assesses the intensity of depression in clinical and normal patients according to diagnostic criteria listed in the Diagnostic and Statistical Manual for Mental

Disorders.[24] Scores range from 0 to 63, with higher scores indicating greater depressive symptoms. Levels of anxiety and depression were assessed using the Hospital Anxiety and Depression Scale, a 21-item questionnaire that detects and assesses the severity of depression and anxiety in clinical settings.[25] Scores range from 0 to 21, with higher scores indicating more severe symptoms. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a questionnaire that assesses sleep quality and disturbances over 1 month. Scores range from 0 to 21, with higher scores indicating worse sleep quality.[26] Finally, health-related quality of life (HRQOL) was assessed using the Medical Outcomes Study Short Form 36 Health Survey (SF-36). Scores range from 0 to 100, with higher scores indicating better health status.[13,27] The questionnaire assesses multiple concepts, including physical functioning, social role limitations, pain, mental health, and vitality.

Associations of diet quality with FIQR scores at baseline, 24 weeks, and post-intervention follow-up 13.3 months (SD = 1.3) after completion of FMEx were analyzed using the Spearman's rank correlation coefficient (r), a nonparametric test, because variables were not normally distributed. Associations of diet quality with pre-intervention psychosocial and quality of life measures, self-efficacy scores, and sleep-quality scores were assessed using the Spearman's rank correlation coefficient (r). Retrospective analyses of changes in FIQR scores was explored using the paired t-test. All analyses were performed in R (version 3.4.3) and RStudio (version 1.1.383),[28,29] and a *P* value less than 0.05 was considered statistically significant.

This study was approved by the Tufts Medical Center and Tufts University Health Sciences Institutional Review Board. All participants provided written informed consent.

RESULTS

We enrolled 34 of the 223 participants who took part in the FMEx trial. Of these, three did not meet the eligibility criteria, and five did not complete the DHQ-II. Twenty-six female participants [mean age = 56 years; mean pre-intervention body mass index (BMI) = 29.6] were included in the analysis. About two-thirds (n = 19) of these participants completed the study at Tufts University School of Medicine, and the remaining one-third (n = 7) completed the surveys at home and self-reported their body weight. Mean time between completion of the 52-week FMEx trial and enrollment in this study was 13.3 months (SD = 1.3).

Compared to the participants from the FMEx trial who did not enroll in this study (n = 189), the participants in this study were all female (100% vs. 92%), were older (mean age = 56 vs 52), and had similar BMI (mean = 30 kg/m^2). Six participants in this study reported that their diet changed since the end of the FMEx trial. Total HEI-2010 scores for participants who participated in Tai Chi did not differ significantly from those who participated in aerobic exercise (mean = 69.5 vs 74.0, P = .23).

The diet quality of these 26 participants (mean total HEI-2010 score = 71.4 ± 1.8 SE) was better than the general U.S. adult population aged 18-64 years (mean = 59.0 ± 0.95 SE) (Table 1). The study participants consumed higher amounts of fruit, vegetables, greens and beans, seafood and plant proteins, and fatty acids. They also consumed lower amounts of whole grains and dairy. Study participants also consumed comparatively lower amounts of refined grains, sodium, and empty calories (Table 1). The only food categories that study participants scored lower in than the general U.S. adult population were whole grains, dairy, and total protein foods.

Analysis revealed that higher diet quality was associated with higher pre-intervention self-efficacy (r = 0.62, P = .01) and lower scores on the Hospital Depression Scale (r = -0.47, *P* = .02) (Table 2). There were no significant associations between diet quality and pre-intervention severity of depressive symptoms (from the Beck Depression Inventory), Hospital Anxiety Scale, mental or physical health, quality of life, or sleep quality. Higher diet quality was not significantly associated with post-intervention follow-up fibromyalgia impact scores (r = -0.28, *P* = .16). After completing the trial, seven (47%) of the 15 participants who participated in Tai Chi continued Tai Chi exercise. One (9%) of the 11 participants who participated in aerobic exercise started Tai Chi exercise.

The analysis also revealed that all participants had significantly reduced FIQR scores from the baseline of the FMEx trial (mean = 59.9, SD = 24.0) to the post-intervention follow-up assessed during this study 13.3 months (SD = 1.3) after completion

of FMEx (mean = 46.2, SD = 21.0, $P < .001$). This reduction was consistent and statistically significant among the Tai Chi participants (mean = -16.3, SD = 11.6, n = 15, $P \leq .001$), but nonsignificant among the aerobic exercise participants (mean = -10.1, SD = 18.7, n = 11, $P = .10$). Diet quality for all participants was not significantly associated with FIQR scores at baseline (r = -0.17), 24 weeks (r = 0.02), or post-intervention follow-up (r = -0.25).

DISCUSSION

This study is the first to examine dietary quality among patients with clinically diagnosed fibromyalgia. Higher pre-intervention self-efficacy and lower levels of depression were associated with higher diet quality in patients with fibromyalgia who participated in the FMEx trial. Analysis of FIQR scores from the baseline of the FMEx trial to the post-intervention follow-up after completion of FMEx also revealed that Tai Chi mind-body therapy may have long-lasting therapeutic effects on fibromyalgia symptoms.

The results from this study are consistent with a large cross-sectional study of women with fibromyalgia.[30] Ruiz-Cabello and colleagues found that daily or near-daily consumption of fruits and vegetables was associated with more favorable psychosocial measures, including higher scores in mental health assessed by the SF-36 and lower levels of depression assessed by the BDI-II, in women with fibromyalgia. They also found that daily or near-daily consumption of cured meats and sweetened beverages was associated with worse scores for depression and optimism assessed by the Life Orientation Test-Revised.[30] Greater consumption of fruits and vegetables contributes to a higher HEI-2010 score (or better diet quality), while higher consumption of empty calories results in a lower HEI-2010 score (or worse diet quality), as recommended by the 2010 Dietary Guidelines for Americans.

A recent systematic review found that dietary interventions in people with fibromyalgia may provide therapeutic benefits.[7] Specifically, interventions such as vegetarian diets; a low Fermentable Oligo-, Di- and Monosaccharides, Alcohols and Polyols (FODMAPs) diet; and hypocaloric diets reduce symptoms of fibromyalgia, including pain and fatigue, and significantly improve depression, anxiety, and quality of life. However, these results were ultimately inconclusive and should be interpreted with caution based on scarce and low-quality studies. Several concerning limitations were noted in prior intervention trials of diet in fibromyalgia patients, including lack of controls and randomization, as well as small sample size. In a double-blind, placebo-controlled crossover study by Holton and colleagues, a dietary glutamate challenge resulted in significant worsening of fibromyalgia, as determined by the FIQR.[6]

Our study is limited by a small sample size, which likely contributed to a limited ability to detect associations between dietary quality and other outcomes. Potential participants frequently cancelled appointments or did not show up to scheduled study appointments. Reasons for cancellations included weather and flare-ups of fibromyalgia symptoms. Many of these participants seemed excited to be invited to participate in the study just days before their scheduled appointments. Considering the challenges of recruiting patients with fibromyalgia for clinical research, team members found maintaining a personal relationship with study participants to be most helpful in ensuring a positive experience for participants and recruitment for the follow-up study. Future trials measuring diet quality and other outcomes in patients with fibromyalgia may consider administering surveys and other study tools remotely, as well as limiting in-person requirements for study participation. However, these approaches also have their limitations.

In addition to a small sample size, our study had other limitations. For example, DHQ II (past-year recall without portion sizes) was used to measure participants' usual diet, which has known measurement errors and may suffer from recall bias. To calculate dietary quality, HEI-2010 was used. Although this index measures adherence to the U.S. Dietary Guidelines for Americans, other healthy dietary patterns may better predict the risk of chronic disease.[31] Cross-sectional analyses were also conducted using data from different timepoints. Although this is a concerning limitation, the DHQ II is used to assess intake over the past year, possibly mitigating the effects of analyzing data from two different timepoints. Additionally, the study is vulnerable to selection bias, as participants may have enrolled in the study due to interests in healthy eating. Lastly, because this was a pilot study, the sample size was small.

CONCLUSION

In conclusion, this pilot study demonstrated an association between diet quality, self-efficacy, and psychological health in women with fibromyalgia who took part in the FMEx trial of Tai Chi vs aerobic exercise for fibromayalgia.[13] These findings inform future research in discovering new and effective lifestyle interventions for fibromyalgia. Future prospective studies evaluating the combined effects of healthy diet and mind-body exercise on symptom management in individuals with fibromyalgia are needed. Due to challenges in measuring dietary intake and known measurement errors in self-reported dietary assessments, future studies should consider using nutritional biomarkers for measuring healthy dietary patterns or dietary changes.[32,33]

Table 1. Healthy Eating Index 2010 (HEI-2010) Total and Component scores in the Women with Fibromyalgia (n = 26) and in U.S adults and older adults.

HEI-2010 Dietary Component (maximum score)	Study Participants 24-75 years (n=26)	U.S. Adults 18-64 years (n=4,044)[1]	U.S. Older Adults ≥ 65 years (n=1,032)[1]
Adequacy *(higher score indicates higher consumption)*	Mean Score (standard error)		
Total Fruit[2] (5)	4.20 (0.25)	2.61 (0.11)	3.84 (0.22)
Whole Fruit[3] (5)	4.36 (0.23)	3.52 (0.15)	4.99 (0.05)
Total Vegetables[4] (5)	4.24 (0.22)	3.54 (0.09)	4.16 (0.19)
Greens and Beans[4] (5)	4.09 (0.31)	3.63 (0.16)	3.58 (0.47)
Whole Grains (10)	2.48 (0.31)	2.75 (0.16)	4.23 (0.34)
Dairy[5] (10)	4.59 (0.57)	5.78 (0.13)	5.99 (0.16)
Total Protein Foods[6] (5)	4.46 (0.18)	5.00 (0.00)	5.00 (0.00)
Seafood and Plant Proteins[6,7] (5)	4.52 (0.19)	3.98 (0.22)	4.91 (0.18)
Fatty Acids[8] (10)	7.13 (0.46)	4.92 (0.19)	5.60 (0.36)
Moderation *(higher score indicates lower consumption)*			
Refined Grains (10)	9.04 (0.30)	6.36 (0.17)	7.34 (0.31)
Sodium (10)	6.62 (0.51)	4.04 (0.08)	3.66 (0.26)
Empty Calories[9] (20)	15.69 (0.85)	12.53 (0.28)	14.99 (0.44)
Total Score *(higher score indicates higher dietary quality as specified by the 2010 Dietary Guidelines for Americans)*			
Total HEI-2010 score (100)	71.42 (1.83)	58.27 (0.98)	68.29 (1.76)

[1]Calculated using the population ratio method. Data source: National Health and Nutrition Examination Survey, 2011-2012 (available from https://www.cnpp.usda.gov/healthyeatingindex)

[2]Includes 100% fruit juice.

[3]Includes all forms except juice.

[4]Includes any beans and peas not counted as Total Protein Foods.

[5]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.

[6]Beans and peas are included here (and not with vegetables) when the Total Protein Foods standard is otherwise not met.

[7]Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.

[8]Ratio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs)

[9]Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is > 13 grams/1,000 kcal.

Table 2. Spearman Correlations of Diet Quality (HEI-2010 scores) with Pre-Intervention Fibromyalgia Impact Scores, Various Psychosocial and Quality of Life Measures, Self-Efficacy, and Sleep Quality in 26 Women with Fibromyalgia.

	Healthy Eating Index 2010 (HEI-2010) [0-100 points[1]]
Physical health Quality of Life (SF-36 PCS) [0-100 points[1]]	0.32 (p=0.12)
Mental health Quality of Life (SF-36 MCS) [0-100 points[1]]	0.20 (p=0.33)
Chronic Pain Self-Efficacy Scale [0-10 points[1]]	0.62 (p=0.01)
Revised Fibromyalgia Impact Questionnaire (FIQR) [0-10 points[2]]	-0.27 (p=0.18)
Beck II Depression Inventory (BDI) [0-63 points[2]]	-0.17 (p=0.40)
Pittsburgh Sleep Quality Index (PSQI) [0-21 points[2]]	-0.16 (p=0.44)
Hospital Anxiety Score (HADS) [0-14 points[2]]	-0.34 (p=0.08)
Hospital Depression Score (HADS) [0-21 points[2]]	-0.47 (p=0.02)

[1]Higher score is better.

[2]Higher score is worse.

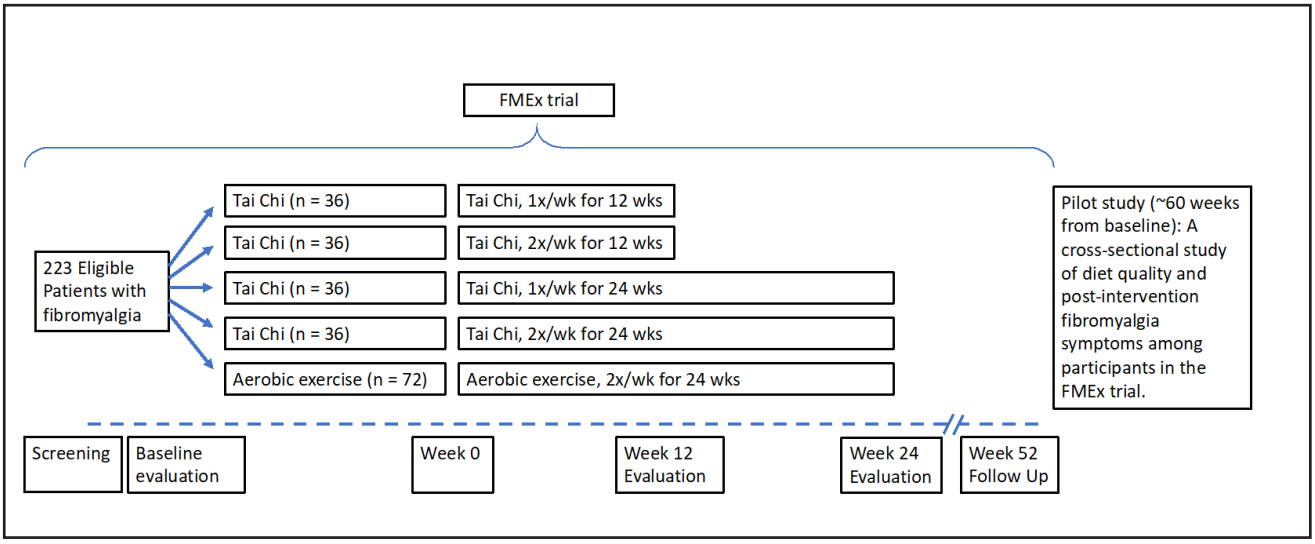

Figure 1. Design of the FMEx trial and this pilot study.

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Conflicts of Interest: None

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