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BRIEF REPORT

Diet quality and exercise in older veterans with PTSD: a pilot study

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Abstract

Older veterans with posttraumatic stress disorder (PTSD) are at increased risk of obesity and cardiometabolic disease. Physical activity and healthy eating are two behaviors that impact health, functional independence, and disease risk in later life, yet few studies have examined the relationship between PTSD and diet quality. This secondary analysis aimed to: (a) characterize the diet quality of older veterans with PTSD in comparison to U.S. dietary guidelines and (b) explore if participation in a supervised exercise intervention spurred simultaneous changes in dietary behavior. Diet quality was assessed with the Dietary Screener Questionnaire (DSQ), which measures daily intake of fiber, calcium, added sugar, whole grain, dairy, and fruits/vegetables/legumes. The sample included 54 military veterans ≥ 60 years old with PTSD who participated in a randomized controlled pilot trial comparing 12 weeks of supervised exercise ($n = 36$) to wait-list usual care ($n = 18$). The DSQ was administered at baseline and 12 weeks. Consumption of added sugar exceeded U.S. dietary guideline recommendations and consumption of whole grains, fruits/vegetables/legumes, fiber, calcium, and dairy fell short. Participation in the supervised exercise intervention was not associated with changes in diet quality. Results revealed that the diet quality of older veterans with PTSD is poor, and while the exercise intervention improved health through exercise, it did not make veterans any more likely to adopt a more healthful diet. Interventions targeting diet, or diet + exercise, are needed to manage the increased risk of obesity and cardiometabolic disease present in older veterans with PTSD.

Keywords

Multiple behavior change, Military veterans, Physical activity, Nutrition, Randomized controlled trial

Implications

Practice: Clinicians should assess diet quality in older adults with posttraumatic stress disorder and facilitate connection to effective interventions.

Policy: Policymakers should consider expanding routine clinical assessment to include screening of diet quality for older adults with posttraumatic stress disorder.

Research: Future research should examine the impact of evidence-based diet and exercise intervention on older adults with posttraumatic stress disorder.

Lay summary

Older veterans with posttraumatic stress disorder (PTSD) are at risk for several physical health conditions that reduce their quality of life. Physical activity and healthy eating are important behaviors for promoting good health and physical function in later life. The purpose of this study was to examine the diet quality of older veterans with PTSD and explore whether a program designed to increase exercise also improved diet. Diet quality was measured with a self-report survey, the Dietary Screener Questionnaire (DSQ), which measures daily intake of fiber, calcium, added sugar, whole grain, dairy, and fruits/vegetables/legumes. Study participants were 54 military veterans age 60 years and older with PTSD who participated in a randomized controlled pilot trial comparing 12 weeks of supervised exercise to wait-list usual care. The DSQ was administered at baseline and 12 weeks post intervention. Results show that older veterans with PTSD have overall poor diet quality that included consuming too much added sugar and not enough whole grains, fruits/vegetables/legumes, fiber, calcium, and dairy. Participation in the supervised exercise did not lead to simultaneous diet quality changes over 12 weeks. This study shows that diet quality is poor in older veterans with PTSD and future programs are needed to target this health behavior.

INTRODUCTION

Posttraumatic stress disorder (PTSD) has been linked to poor psychological health and is associated with an increased risk for cardiovascular and metabolic diseases and disorders [1]. Far less is known about the lifestyle habits that may lead to or contribute to these negative health outcomes, particularly physical activity and diet. Behavioral risk factors often occur together, and act synergistically to effect chronic disease risk. Empirical studies have shown that individuals with PTSD exercise less frequently, develop disordered eating behaviors more often [2], spend more time in sedentary activities, engage in smoking more frequently, and experience more sleep disturbances than individuals without PTSD. Studies on

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diet quality among those with PTSD are few, but found that individuals with PTSD consume more soda and fast food, less fruit, and consume more energy from trans fatty acids compared to individuals without PTSD [3,4]. Adequate nutrition is a critical component of healthy aging, linked to chronic disease, physical function, and quality of life [5]. Yet few of these studies include older adults.

Understanding associations among lifestyle behaviors is important for developing preventive interventions. Previous studies have shown that exercise interventions which were not designed to improve diet nevertheless found healthful changes in diet quality (e.g., increase fruit and vegetable intake, decrease fat intake) [6–8]. Although these studies largely focused on younger adults, the results suggest that the act of increasing exercise may also impact dietary behaviors. The hypotheses to explain this proposed phenomenon are numerous and span psychological and basic science approaches and include, for example: (a) the experience gained from improving exercise habits may help an individual develop an action plan for improved diet (i.e., psychological transference effect), or (b) the beneficial effects of exercise on mood (particularly depression and anxiety) promotes more healthful eating patterns, or (c) that exercise-related biochemical changes influence craving healthier foods [6–8]. Whether exercise is a gateway behavior for diet in individuals with PTSD is unexplored.

The purpose of the current study is to: (a) characterize the diet quality of older veterans with PTSD relative to U.S. dietary guidelines and (b) explore if participation in a supervised exercise intervention is associated with simultaneous changes in diet quality. This study is a secondary analysis of data from a 12-week randomized controlled pilot study of a supervised exercise program compared to wait-list usual care in older veterans with PTSD [9–11].

METHODS

Design

The present report is a secondary analysis of a 12-week, randomized, controlled trial that compared a supervised, multi-component exercise program to wait-list usual care control in older veterans diagnosed with PTSD. All study procedures were approved by the Durham Veterans Affairs Medical Center (VAMC) Institutional Review Board and the trial was registered on clinicaltrials.gov (NCT02295995). All participants provided written informed consent. Full description of all study methods has been published elsewhere [10].

Participants

Participants were recruited from the Durham VAMC primarily through the electronic health record. Inclusion criteria for the randomized trial were: (a) veteran age 60 years or older, (b) current PTSD diagnosis established using the Clinician Administered PTSD Scale for DSM-5 [12], (c) live within 50 miles of the VA medical center, (d) no hospitalizations for cardiovascular events in prior three months, (e) not currently receiving psychotherapy for PTSD, and (f) no cognitive impairment or dementia established using the Short Portable Mental Status Questionnaire [13]. Detailed recruitment methods and exclusion criteria have been published elsewhere [10].

Measures

Measures examined in this secondary data analysis are described below. Additional measures collected as part of the overall trial are reported elsewhere [9,11].

Dietary Screener Questionnaire

The National Cancer Institute's Dietary Screener Questionnaire (DSQ) is a 30-item, self-report measure [14–16]. Participants report how often they consume individual food items over the past month using up to eleven frequency categories, ranging from "never" to "6 or more times per day." Validated scoring algorithms [15] convert individual item responses to sex-age specific portion size estimates of daily intake of fiber (g), calcium (mg), added sugar (teaspoon equivalents), whole grains (ounce equivalents), dairy (cup equivalents), and vegetables, fruits and legumes (cup equivalents). The DSQ was administered at baseline and at the 12-week endpoint. Validity and reliability of the DSQ has been described previously [14–16].

Interventions

The Warrior Wellness exercise intervention comprised a progressive, comprehensive exercise prescription that was individualized to meet the needs of each participant. The intervention targeted insufficiently active (<150 min/week of moderate-intensity activity) older veterans who met diagnostic criteria for PTSD. The program consisted of three times/week supervised exercise sessions lasting 60–90 min held at a fitness facility proximal to the Durham VA Health Care System (VAHCS). Exercise prescriptions were based on the American College of Sports Medicine guidelines for older adults and individualized based on participant's fitness history, current capacity for exercise and health status, and personal preference. The prescription included aerobic, strength, balance and flexibility training and utilized a variety of modalities including recumbent bikes and treadmills for aerobic exercise and body weight, free weight, cables and exercise bands for resistance training. The Warrior Wellness exercise program did not include any diet components (e.g., nutrition or weight loss counseling, education materials), and participants were not urged to change

their dietary habits. Participants randomized to the wait-list usual care group continued to receive their standard level of care and were offered the exercise intervention after they completed the 12-week trial.

Procedure

All consented and enrolled participants were randomized 2:1 to the exercise or control condition, respectively, after the baseline assessment. Trained research team members administered assessments in person at baseline and 12-week follow-up.

Statistical analyses

Statistical analyses were conducted using Statistical Package for Social Sciences version 25 (IBM, Armonk, NY). Means and standard deviations were calculated and compared to U.S. dietary guidelines. To explore prospective changes in diet quality between the two intervention arms (supervised exercise vs. wait-list usual care), Cohen's *d* effect sizes were calculated by dividing the mean difference by the pooled standard deviation. Effect sizes calculations only included participants with data from both timepoints (baseline and 12 weeks). Effect sizes were evaluated as small (d = .20–.49), medium (d = .50–.79), and large (d ≥ .80). Effect sizes were selected instead of inferential statistics given that this pilot study was not fully powered to detect significant group differences.

RESULTS

Participants

Table 1 presents the sociodemographic characteristics of the entire sample (N = 54). Participants were mainly male (91%) veterans with an average age of 67.4 years. Eighty-five percent of study participants self-identified as African American or Black race, and none reported Hispanic or Latinx ethnicity. The average number of physical health comorbidities was 3.8 with at least half of the sample having diabetes (50%), hyperlipidemia (54%), and/or hypertension (80%). Further, over 80% of the sample had a body mass index in the overweight or obese range (Table 1). Sociodemographic and baseline characteristics of exercise (n = 36) and wait-list usual care (n = 18) groups were evaluated previously and shown not to meaningfully differ from each other [9,11].

Table 1 | Baseline demographic and clinical characteristics of total sample

Variable	Older veterans (n = 54)
Age (years), *M* (*SD*)	67.4 (3.6)
Sex	
Male	49 (90.7)
Female	5 (9.3)
Race, *n* (%)	
African American or Black, *n* (%)	46 (85.2)
white	8 (14.8)
Ethnicity, *n* (%)	
Hispanic or Latinx	0 (0)
Not Hispanic or Latinx	54 (100)
Education, *n* (%)	
≤ High School Degree	8 (14.8)
1–3 years of college or 2-year Program Graduate	24 (44.4)
College/University Graduate	12 (22.2)
Post-College Degree (e.g., Masters, PhD or equivalent)	10 (18.5)
Medical Comorbidities	
Hypertension, *n* (%)	43 (80)
Hyperlipidemia, *n* (%)	29 (54)
Diabetes, *n* (%)	27 (50)
Total number of comorbidities, *M* (*SD*)	3.8 (1.7)
Baseline Body mass index (kg/m^2), *M* (*SD*)	30.5 (5.4)
Desired, *n* (%)	9 (16.7)
Overweight, *n* (%)	17 (31.5)
Obese, *n* (%)	28 (51.8)
Baseline PTSD symptoms, *M* (*SD*)	42.6 (14.4)
Baseline Depressive symptoms, *M* (*SD*)	9.9 (5.3)

PTSD Posttraumatic stress disorder. PTSD symptoms were measured with the PTSD checklist (PCL-5) [26] and depressive symptoms were assessed with the patient health questionnaire (PHQ-9) [27]. Percentages may not add up to 100 due to rounding.

Diet quality compared to U.S. dietary guidelines

Table 2 presents the baseline means and standard deviations for all DSQ outcomes as well as the daily U.S. dietary guidelines from the U.S. Department of Agriculture (USDA) [17] and the American Heart Association (AHA) [18]. DSQ values and dietary guidelines are presented separately for males and females to account for gender-based dietary recommendations. Results showed that fiber, calcium, whole grain, dairy, and fruit/vegetables/legumes consumption was below, and added sugars consumption was above the U.S. dietary guidelines. This pattern of results was observed across both male and female veterans enrolled in the sample (Table 2). Further, there was a small amount of missing data due to participants omitting items while completing the DSQ.

Prospective changes in diet quality by intervention arm

Table 3 describes changes in diet quality from baseline to 12 weeks by intervention arm (exercise vs. wait-list usual care). Cohen's d effect sizes for fiber, whole grain, dairy, and fruit/vegetables/legumes illustrating differences in change between wait-list usual care and exercise groups were all small (d ranged from .20 to .30). Effect sizes for added sugar and calcium were negligible (d < .20; Table 3).

DISCUSSION

The present paper is the first study to characterize the diet quality of older veterans with PTSD and

Table 2 | Baseline DSQ variables in total sample and corresponding U.S. dietary guidelines

	Males Baseline (n = 49)			Females Baseline (n = 5)		
DSQ nutrient variable	M	SD	U.S. dietary guidelines for males	M	SD	U.S. dietary guidelines for females
Daily fiber intake (g)	14.87[e]	4.68[e]	28 g[a]	12.26	3.41	22 g[a]
Daily calcium intake (mg)	851.38[e]	515.45[e]	1,000 mg[a]	579.19	125.86	1,200 mg[a]
Daily added sugar intake (tsp)	13.82[e]	9.05[e]	≤ 9 tsp[b]	8.78	5.15	≤ 6 tsp[b]
Daily whole grain intake (ounce equivalent)	0.85[e]	0.83[e]	3 oz eq[c]	0.56	0.42	3 oz eq[c]
Daily dairy intake (cup equivalent)	1.45[e]	0.98[e]	3 cup eq[c]	0.92	0.31	3 cup eq[c]
Daily fruit/veg/legume intake (cup)	2.67[f]	1.20[f]	4.5 cup eq: (2.5 cup eq vegetables + 2 cup eq fruits)[c,d]	2.23	0.57	3.5 cup eq: (2 cup eq vegetables + 1.5 cup eq fruits)[c,d]
Daily fruit/veg/legume minus french fries intake (cup)	2.56[f]	1.16[f]	4.5 cup eq: (2.5 cup eq vegetables + 2 cup eq fruits)[c,d]	2.18	0.59	3.5 cup eq: (2 cup eq vegetables + 1.5 cup eq fruits)[c,d]
Daily intake of added sugar (tsp) from sugar sweetened beverages	5.84	7.72	No guidelines for sweetened beverages only. This is subsumed in the added sugar category.	2.23	2.25	No guidelines for sweetened beverages only. This is subsumed in the added sugar category.

DSQ Dietary Screener Questionnaire; *tsp* teaspoons; *M* mean; *SD* standard deviation.

[a]United States Department of Agriculture (USDA) Guidelines above are specific to males/females age 51+ and assesses 2,000 calorie diet for males and 1,600 calorie diet for females in this age group.

[b]American Heart Association (AHA) Guidelines above are for males and females (age not accounted for).

[c]USDA Guidelines reflect healthy U.S.-style dietary pattern for adults ages 60 and older. Do not account for gender so guidelines listed above are based on 2,000 calorie diet for males and 1,600 calorie diet for females to be consistent with guidelines reported for fiber and calcium.

[d]USDA Guidelines for vegetables and fruits were combined given that the DSQ provides a combined variable.

[e]*n* = 47.

[f]*n* = 48.

Table 3 | Between-group effect size changes in DSQ outcomes

	Baseline		Change		Difference between groups		
Outcome	Mean	SE	Mean	SE	Pooled SD	95% CI	Cohen's d
Daily fiber intake							
Wait-list Usual Care (n = 16)	15.15	1.49	−1.51	1.52	4.61	−4.60 to 2.07	.27
Supervised Exercise (n = 30)	14.17	0.69	−0.24	.42			
Daily calcium intake							
Wait-list Usual Care (n = 16)	836.66	88.14	−126.13	82.94	472.49	−372.90 to 262.44	.12
Supervised Exercise (n = 30)	837.89	110.07	−70.90	105.90			
Daily added sugar intake							
Wait-list Usual Care (n = 16)	11.40	1.87	−0.76	1.35	6.49	−5.159 to 3.32	.14
Supervised Exercise (n = 30)	14.16	1.81	0.16	1.35			
Daily whole grain intake							
Wait-list Usual Care (n = 16)	0.93	0.27	−0.29	.27	0.83	−0.85 to 0.342	.30
Supervised Exercise (n = 30)	0.74	0.12	−0.041	0.08			
Daily dairy intake							
Wait-list Usual Care (n = 16)	1.52	0.25	−0.30	.23	0.94	−0.79 to 0.39	.21
Supervised Exercise (n = 30)	1.39	0.19	−0.10	.18			
Daily fruit, vegetables, legumes intake							
Wait-list Usual Care (n = 16)	2.68	0.33	−0.13	.32	1.12	−0.90 to 0.42	.21
Supervised Exercise (n = 31)	2.53	0.16	0.11	.17			
Daily Fruit, vegetables, legumes, not including French fries							
Wait-list Usual Care (n = 16)	2.62	0.33	−0.13	.32	1.09	−0.85 to 0.42	.20
Supervised Exercise (n = 31)	2.44	0.16	0.09	.16			
Daily intake of added sugar (tsp) from sugar sweetened beverages							
Wait-list Usual Care (n = 17)	3.49	1.38	0.54	.63	5.43	−4.14 to 3.19	.09
Supervised Exercise (n = 31)	6.53	1.53	1.01	1.30			

CI Confidence interval; *DSQ* Dietary Screener Questionnaire; *SE* Standard error; *SD* Standard deviation. Only participants with data from both baseline and 12-week timepoints were included in above. Changes were calculated with the Supervised Exercise group as the reference group (i.e., Change in wait-list usual care minus change in supervised exercise).

evaluate whether an intervention targeting exercise resulted in changes in diet. Results revealed that overall, older veterans with PTSD had low diet quality at enrollment in the study as evidenced by consuming less fiber, calcium, dairy, whole grain, and fruits/vegetables/legumes and more sugar than is recommended by U.S. dietary guidelines. Meaningful changes in diet quality between the supervised exercise and wait-list usual care conditions were not observed, suggesting that increases in exercise levels did not facilitate simultaneous improvements in diet quality among the sample. Taken together, these findings illustrate the need for dietary behavior interventions in older veterans with PTSD and suggest that targeting increased exercise alone is insufficient to facilitate these much-needed dietary changes.

The low diet quality of older veterans with PTSD observed in this study extends prior work that has exclusively focused on young and middle-aged individuals with PTSD [3,4,19]. The physical and psychological burden of PTSD compounds with age and as reflected in our sample, obesity and associated chronic conditions (e.g., diabetes,

cardiovascular diseases) are highly prevalent in this population [20,21]. Diet and nutrition are core strategies of disease management for many of these salient chronic health conditions, and are also linked to PTSD symptoms [19]. Additionally, research has shown that military experience strongly influences post-service eating behavior and body mass index status in American veterans [22], thereby highlighting important and unique characteristics of this population.

The supervised exercise program did not result in improvements in diet quality among older veterans with PTSD. Although this is not entirely surprising given that the primary intervention target was physical function and the program did not specifically focus on diet [10], it is possible that improvements in diet may occur in the context of targeting other health-promoting behaviors like exercise. We reported previously that weight loss was one of the primary veteran-voiced goals for enrolling in the Warrior Wellness study [23], and over 80% of participants indicated interest in combining exercise with dietary counseling in future research trials [23,24]. Further, veterans with PTSD have increased odds of co-occurring poor health behaviors (smoking, physical inactivity, obesity), which impact cardiovascular risk [25]. Therefore, interventions that target both exercise and diet would be valuable to address burdensome health comorbidities and support the goals and motivations of this specific group.

This study was primarily limited in its modest sample size and the low number of female veterans, which may have resulted in suboptimal measures of central tendency and large standard deviations. In turn, these can lower the true estimate of between group effects. Additionally, the DSQ is subject to the drawbacks of self-report instruments and does not yield information regarding quantity of macronutrients and micronutrients (e.g., salt, protein, minerals), which is important for assessing diet quality. Despite these limitations, this paper adds to a small, but growing literature on health promotion for older veterans with PTSD and is the first study reporting diet quality among this unique population. Overall, this work reveals a great need in this population for improving diet quality, as well as developing interventions that target diet in this population. Interventions that target exercise and diet in combination would address shared priorities among the veteran population and the Veterans Health Administration by addressing obesity-related health risks and maintaining functional independence.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: All authors declare that they have no conflicts of interest.

Authors' Contributions: J.B. wrote the initial draft of this manuscript and conducted all analyses. K.S.H. was the principal investigator of the Warrior Wellness trial and oversaw all aspects of the study. M.C.M., J.C.B., and H.B.B. were co-investigators on the study and contributed to manuscript preparation. K.N.P.S. and C.W.B. contributed to the design of this secondary analysis. J.M. assisted with data collection of the Warrior Wellness trial and manuscript preparation. R.S. provided statistical support for the Warrior Wellness trial and this secondary analysis. J.J.G. assisted with interpretation and presentation of the findings.

Human Rights: 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.

Welfare of Animals: This article does not contain any studies with animals performed by any of the authors.

TRANSPARENCY STATEMENTS

1. The study was pre-registered at clinicaltrials.gov (NCT02295995).
2. The analysis plan was not formally pre-registered.
3. De-identified data from this study are not available in a public archive. De-identified data from this study will be made available (as allowable according to institutional IRB standards) by emailing the corresponding author.
4. Analytic code used to conduct the analyses presented in this study are not available in a public archive. They may be available by emailing the corresponding author.
5. Materials used to conduct the study are not publicly available.

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