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Is exercise therapy effective in improving symptoms of post-traumatic stress disorder in adults?

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ABSTRACT

OBJECTIVE: The objective of this systematic review is to determine whether or not exercise therapy is effective in improving symptoms of post-traumatic stress disorder (PTSD) in adults.

STUDY DESIGN: Review of two randomized controlled trials (RCTs) published in 2015 and 2018 and one case-series study published in 2015; all articles were published in English language and compared the efficacy of exercise therapy for improvement of PTSD symptoms in adults.

DATA SOURCES: Two RCTs and one case-series study were found using PubMed. All of the articles were published in peer reviewed journals. All articles were selected based on their relevance to the clinical question and whether the outcomes of the research were patient oriented evidence that matters (POEMs).

OUTCOMES MEASURED: Reduction in PTSD symptom severity after completing an exercise program was measured through CAPS interview and PCL-C scores.

RESULTS: The RCT conducted by Rosenbaum et al. had a statistically significant mean change from baseline in PCL-C scores of 9.8 between the group receiving exercise therapy compared to the control group's mean change from baseline of 4.2; $p=0.04$ ($p <0.05$). In the RCT by Goldstein et al., the mean change from baseline in CAPS scores for the integrative exercise (IE) group was 30.64 after the 12-week program, compared to a mean change from baseline in CAPS scores of 14.27 for the waitlist control group. The study reported a Cohen's d of -0.90, indicating a large treatment effect for the IE group. The case-series study by Fetzner et al. reported a Cohen's d score of 0.98, indicating the effect of exercise in reducing PTSD symptoms was large based on reported PCL-C scores for the 11 participants enrolled.

CONCLUSION: This systematic review concludes that exercise therapy is an effective, inexpensive and well-accepted treatment for reducing symptoms of PTSD in adults. Two RCTs and one case-series study have provided statistically and clinically significant evidence supporting that exercise reduces symptoms such as avoidance, re-experiencing, numbness, and hyperarousal that many adults suffering with PTSD experience.

KEY WORDS: Stress Disorders, Post traumatic, Exercise Therapy

INTRODUCTION

Post-traumatic stress disorder (PTSD), a condition that develops after exposure to a traumatic life event, causes significant emotional and occupational impairment in patients' lives. PTSD causes symptoms of hyperarousal, re-experiencing, negative cognitions, and avoidance. Patients may experience intrusive thoughts, nightmares, and flashbacks related to the past traumatic event, may avoid reminders of the trauma, and experience severe sleep disturbances. Patients with PTSD commonly have comorbid anxiety, depression, and substance abuse and are at increased risk of negative health outcomes including cardiovascular disease, obesity, and early mortality.

The lifetime prevalence of PTSD within the general population is estimated between 5-10%.[1] It can occur at any age and affect anyone exposed to trauma, but the prevalence rate is significantly higher among combat veterans and police officers. There is not an exact estimate of healthcare visits specifically for PTSD; however, annually there is an estimated 56.8 million physician office visits and 4.8 million emergency department visits with mental, behavioral, and neurodevelopmental disorders as the primary diagnosis.[2] An exact number of the total healthcare cost for PTSD has not been identified, but in 2019 an estimated $225.1 billion dollars was spent on treatment for mental health conditions, including PTSD, as a whole.[3] Numerous traumatic events in recent years such as wars in Afghanistan and Iraq, the terrorist attacks on the World Trade Center on September 11, as well as sexual assault, physical abuse, and shootings across the world put patients at risk of developing PTSD.

It is unclear why only select individuals develop PTSD after a traumatic life event. However, multiple factors have been linked to its development outside of exposure to the severe psychological trauma. Risk factors include: a childhood history of abuse, a family history of

PTSD or depression, a history of substance abuse, poor coping skills, lack of social support, and ongoing stress.[4] A study by Dohrenwent et al. found that people exposed to frequent traumatic events have a significantly increased risk of PTSD development.[5]

Currently, the preferred treatment for patients with PTSD is trauma-focused psychotherapy that includes exposure. This approach of cognitive behavioral therapy (CBT) has been supported by multiple clinical trials; it includes education about common reactions to trauma exposure, coping skills, cognitive processing of trauma-related thoughts and beliefs, and gradual exposure to the traumatic event. For patients who prefer a medication over psychotherapy, or when a trauma-focused psychotherapy is not available, selective serotonin reuptake inhibitors (SSRIs) or serotonin and norepinephrine reuptake inhibitors (SNRIs) can be used as treatment options. Suggested treatment for PTSD patients who experience significant sleep disturbances, involving nightmares, includes the use of alpha blockers such as prazosin 30 to 60 minutes before sleep.[6,7] For treatment-resistant patients, second-generation antipsychotics such as risperidone can be used as monotherapy or as an adjunct to CBT.

While all of these treatment options have been proven to effectively treat the symptoms of PTSD, many patients with PTSD are reluctant to seek these traditional treatments. Patients with PTSD often have a stigma towards therapeutic options such as CBT and are unwilling to take medications for their condition due to the associated side effects. Exercise has previously been shown to be an effective treatment for patients with anxiety disorders. Several studies have evaluated the effect exercise has on patients with PTSD, however these studies were not synthesized to fully understand the value this may provide to patients. Therefore, this systematic review analyzes whether exercise therapy can be effective as a monotherapy or an adjunctive treatment for patients who refuse the typical treatment options discussed.

OBJECTIVE

The objective of this systematic review is to determine whether or not exercise therapy is effective in improving symptoms of post-traumatic stress disorder in adults.

METHODS

To find credible articles that fit the specific criteria of adults who were diagnosed with PTSD and had treatment with exercise therapy, key words including “stress disorders”, “post traumatic”, and “exercise therapy” were used. All articles were searched and found using PubMed, were published in peer reviewed journals, and written in the English language. Cochrane Collaboration was also searched to ensure that there were no prior systematic reviews written about the developed clinical question. Articles were selected based on relevance to the clinical question and whether they were patient oriented evidence that matters (POEMs). The inclusion criteria used in the search for credible articles was: RCTs from 01/01/2015 to 12/31/2020. The exclusion criteria was any article that was published before 2015 to ensure the articles analyzed were current. Statistical values of interest included F-score, mean change from baseline, p-value, and Cohen’s d statistic.

The criteria for selection within the studies chosen for review included adults who were diagnosed with PTSD based on the DSM-IV criteria. Studies were comprised of men and women who experienced a variety of trauma throughout their lives; each study had specific inclusion and exclusion criteria, which is included in Table 1. The intervention that was implemented was exercise therapy, in which all studies had an aerobic or resistance exercise program. Two of the studies included were randomized control trials (RCTs) and one was a case-series study. The RCT by Rosenbaum et al. had a comparison group in which participants received usual care only; usual care included psychotherapy, pharmaceutical intervention, and group therapy.[1] The

RCT by Goldstein et al. had a monitor-only control group in which patients did not receive any treatment for their PTSD.[8] The article by Fetzner et al. was analyzed as a case-series study because there was not a non-exercise control group. The group specifically chosen for the case-series completed an aerobic exercise program over a two-week period.[9] The outcome addressed in each study was a reduction in PTSD symptom severity for the adult participants after completing an exercise program.

OUTCOMES MEASURED

The outcome measured for all studies was a reduction in PTSD symptom severity after completing an exercise program. The studies by Rosenbaum et al. and Fetzner et al. both used the PTSD checklist-civilian version (PCL-C) to measure PTSD symptom reduction for participants. The PCL-C is a 17 item self-reported questionnaire that assesses key symptoms of PTSD; it is one of the most commonly used self-reported measures of PTSD. Respondents indicate how much they are bothered by a symptom over the past month using a five-point scale, with five meaning extremely bothered and one meaning not bothered at all. Scores range from 17-85, and higher scores indicate a higher severity of symptoms. A score of 45 meets the primary diagnosis of PTSD. Participants in both studies completed the PCL-C as a baseline before beginning their given exercise programs.[1,9] The article by Rosenbaum et al. had their participants complete another PCL-C, after resolution of their exercise program, between 13.9 and 15.1 weeks.[1] The study by Fetzner et al. had their participants complete the PCL-C at each exercise session, at one-week follow-up, and at one-month follow-up in addition to completion of the baseline PCL-C assessment.[9]

The study by Goldstein et al. assessed PTSD symptom severity using the Clinician-Administered PTSD scale (CAPS). The CAPS interview was administered at baseline before

therapy was conducted and post-treatment at 12 weeks.[8] The CAPS is a semi-structured interview that measures the frequency and intensity of PTSD symptoms; it provides categorical diagnostic standing and symptom severity ratings. The scores range from 0 to 136 and higher scores indicate higher symptom severity.

Table 1. Demographics and Characteristics of Included Studies

Study	Type	# Pts	Age (yrs.)	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Rosenbaum[1] (2015)	RCT	81	23-73	> 18 years old with a DSM IV diagnosis of primary PTSD	Medically unfit to participate in an exercise program, pregnant or planning pregnancy in the proceeding 12 months, or complex PTSD with trauma occurring in childhood only	23	12-week exercise program that involved resistance training and a pedometer-based walking program
Goldstein[8] (2018)	RCT	47	18-69	Veterans 18-69 years old who met DSM IV criteria for current or partial PTSD	Lifetime history of any psychiatric disorder with psychotic features, bipolar disorder, or mania, alcohol or substance dependence in the past year, prominent suicidal or homicidal ideations, pregnancy, clinically significant neurological disorders, asthma, physical disabilities, MI in past 6 months, or moderate to severe TBI	9	Integrative exercise program (aerobic and resistance exercise as well as yoga poses, movements, and breathing within the context of mindful based principles)
Fetzner[9] (2015)	Case-series	11	36.9 ± 11.2	Patients with a primary diagnosis of full or subsyndromal PTSD	Current substance use or psychotic disorder, manic episode, suicidal ideations, began pharmacotherapy in the last six months, or were high risk for physical injury during exercise	2	Aerobic exercise program (six 20-minute sessions of stationary biking over two weeks)

RESULTS

Rosenbaum et al. conducted an accessor blinded RCT that consisted of 81 participants with a DSM IV diagnosis of primary PTSD who were recruited after admission to an in-patient program at a private hospital in Australia.[1] The study's inclusion and exclusion criteria is included in Table 1. Participants completed a 12-week exercise program that involved a weekly supervised exercise session by an exercise physiologist, two unsupervised home-based exercise sessions, and a pedometer-based walking program that included an exercise diary.[1] Participants were randomized to receive either usual care or exercise in addition to usual care; usual care consisted of a combination of psychotherapy, pharmaceutical interventions, and group therapy facilitated by psychologists.[1] An intention-to-treat analysis was performed.[1] There were no adverse events related to exercise participation reported, however two participants experienced injuries during the study unrelated to the intervention.[1]

The study did not report their outcomes in dichotomous data nor could any of the data be converted. PCL-C scores were reported pre-treatment and post-treatment for the intervention and usual care groups between 13.9 and 15.1 weeks. There was no significant difference in PTSD symptom severity between the two groups at baseline.[1] In total, 71% of participants completed the follow-up PCL-C assessment; losses to follow-up were 29%.[1] At follow-up there was a mean change from baseline in PCL-C scores for the intervention group of 9.8 and a mean change from baseline for the usual care group of 4.2 (Table 2).[1] The difference in PCL-C scores between the two groups was 5.4 with a 95% confidence interval (CI) of 10.5 to 0.3; $p=0.04$; $p<0.05$ indicating a statistically significant improvement in PTSD symptoms for the participants who exercised compared to the usual care group. Based on these values, the study reported a moderate

treatment effect. While the CI is fairly widespread, it favors the interventions group; since the p-value is < 0.05 the treatment effect is considered precise.[1]

Table 2. Rosenbaum et al.- Exercise Therapy/Usual Care vs. Usual Care Alone

	Mean change from baseline
Exercise therapy + usual care (intervention)	9.8
Usual care (control)	4.2
Difference in mean change from baselines [95% CI]	5.4 [10.5, 0.3], p=0.04

The RCT conducted by Goldstein et al. researched the effect of an integrative exercise (IE) program on 47 veterans 18-69 years old who met DSM-IV criteria for current or partial PTSD.[8] See Table 1 for inclusion and exclusion criteria. Participants were asked to attend three one-hour group IE sessions each week for 12 weeks at a local YMCA. IE consisted of aerobic and resistance exercise, and yoga poses, movements and breathing within the context of mindfulness-based principles such as a non-judgmental attitude and acceptance.[8] The study compared the IE group to a monitor only waitlist control.[8] Both groups were similar at the start if the trial and completed CAPS scores at pre-treatment and 12 weeks post-treatment.[8] All patients were analyzed in the groups they were randomized, and clinical interviewers were blind to the treatment condition.[8] Losses to follow-up for the IE and the waitlist control were both less than 20%. No adverse events or injuries related to the IE program were reported by any of the participants.

On average, participants in the IE group had a 30.64 point reduction in overall CAPS scores from baseline to post-treatment compared to a mean change from baseline of 14.77 for the waitlist only control group.[8] The mean change from baseline with regards to reduction in PTSD symptom severity for the IE group was significantly greater compared to the waitlist (Table 4). Cohen's d=-0.90, [95% CI: -1.72, -0.08], F-score= 4.40, and p= 0.038 (Table 5) which support

statistical significance; the treatment effect is said to be large based on these values.[8] While the treatment effect is large, the CI is fairly wide. Cohen's d is a true measure of the effect size, while F-score only measures the variance between groups and does not fully measure effect size the way Cohen's d does. For this reason, even though the p-value is <0.05 supporting statistical significance, the treatment effect cannot be considered precise due to the wide CI associated with the Cohen's d statistic.

Table 3. Goldstein et al.- IE Group (Experimental) vs. Waitlist Only (Control) Mean Change from Baseline in Overall CAPS Scores

	Mean change from baseline
Integrative Exercise (IE) group	30.64 ± 17
Waitlist only control	14.77 ± 24.56

Table 4. Goldstein et al.- Significant Statistics Supporting the IE Group

Cohen's d	95% CI	F score	P-value
d= -.90	-1.72 to -0.08	F= 4.64	p=0.038

*p-value considered significant if <0.05

The study by Fetzner et al. was analyzed as a case-series study in which 11 individuals diagnosed with PTSD stemming from multiple traumas participated in an aerobic exercise program.[9] Inclusion and exclusion criteria are included in Table 1. Participants exercised on a stationary bicycle at 60-80% heart rate reserve for six 20-minute sessions over a two-week period.[9] Certified personal trainers supervised the sessions in a private laboratory exercise room and monitored participant exertion level via heartrate monitor displayed on the stationary bike.[9] A total of two patients dropped out of the study; one was injured during the exercise intervention and one chose not to continue; nine participants were allocated to intervention but all 11 were analyzed.[9]

The study measured PTSD symptom severity using PCL-C scores and reported these scores pre-treatment and post-treatment at one week and one month. The data reported was unable to be converted to dichotomous data. The study showed that after two weeks of stationary biking aerobic exercise, the 11 patients from the exercise only (EO) group, the group analyzed in the case-series, reported clinically significant reductions in PTSD symptom severity. Effect size for PTSD symptom change during the treatment was large with a total Cohen's d score of 0.98. The total score consisted of re-experiencing scores, avoidance scores, numbing scores, and hyperarousal scores (Table 1).[9] An estimate of precision was not reported in this study for the EO group.

Table 5. Cohen's d Scores for Case-Series Exercise Only Group in Fetzner et al.

	Total	Negative emotionality	Hyperarousal	Reexperiencing	Avoidance
Cohen's d score	d= 0.98	d= 1.03	d= 1.37	d=1.37	d=0.77

DISCUSSION

PTSD can be a very debilitating mental disorder, and it is suffered by many patients who experience trauma throughout their lives, including veterans and first responders. Exercise has been proven to effectively reduce symptoms of anxiety, depression, and negative mood, while also improving cognitive function.[1] Unlike CBT or medications such as SSRIs that are traditionally used to treat PTSD, there are no side effects or stigma associated with exercising. It is a widely available, inexpensive treatment option with additional physical health benefits and is acceptable to patients resistant to traditional treatments. In the two RCTs and the case-series study analyzed, there were statistically significant evidence supporting exercise therapy as an effective treatment option for adults suffering with PTSD. All three studies had a variety of

adults and differing types of exercise programs, yet all still had evidence supporting exercise to be effective in reducing symptoms associated with PTSD.

While all of the studies supported exercise therapy to reduce PTSD symptoms in adults, there were limitations within each study. All of the studies included in this review were limited with a relatively low generalizability and a small sample size. Goldstein et al. had 47 participants and most were male veterans.[8] While the study was conducted over a relatively long period of 12 weeks, it only took place at one site.[8] Rosenbaum et al. had a total of 81 participants, and they were all from one in-patient unit at a hospital in Australia.[1] Fetzner et al. only had a total of 11 participants, participants were primarily women, and the study was only done over a period of two weeks with six sessions at one site.[9] Contributing to the limitations placed on the Fetzner et al. study was the lack of a control group, which diminished the quality of the study to a case-series.

Another limitation included the use of the PCL-C to assess symptom severity in the Rosenbaum et al. and Fetzner et al. studies. The PCL-C is a self-reported measure of PTSD symptoms and it has been reported that PCL-C underreports changes in symptoms following treatment.[1] Due to this, the results of these studies may reflect a conservative estimate of the true effect of exercise on PTSD symptoms. In the Rosenbaum et al. study, the group that received exercise therapy also received usual care that included pharmacotherapy.[1] The pharmacotherapy was not recorded by participants and could be a confounding factor in their improvement of PTSD symptom severity.[1] In this same study, while it was impossible to keep the patients blind to the intervention of exercising, the clinicians, and study workers involved in the study were not kept blind to the randomized groups. All of these factors could have impacted the study's validity.[1] The study by Goldstein et al. used a self-report questionnaire, the Godin Leisure-Time

Exercise Questionnaire, to assess participation in exercise.[8] This decreases the accuracy of the measurement of exercise participation and also poses concerns about validity. Lastly, the study by Fetzer et al. did not report a measure of precision and the RCT by Goldstein et al. could not be considered precise due to its wide CI.[8,9]

CONCLUSION

The studies included in this evidence-based medicine systematic review provide sufficient evidence to accept that exercise therapy is effective in improving symptoms of PTSD in adults. Two RCTs and one case-series study have provided statistically and clinically significant evidence supporting that exercise reduces symptoms such as avoidance, re-experiencing, numbness, and hyperarousal that many adults suffering with PTSD experience. Given the limitations within each study analyzed, future studies need to be conducted to determine the long-term effects of exercise on PTSD symptom reduction with larger and more generalizable sample sizes. Future research must focus on which type of exercise is most effective at reducing PTSD symptoms. It must also address whether exercise alone reduces symptoms of PTSD enough to be used as a monotherapy or if exercise therapy should be used specifically as an adjunct to treatments currently utilized. This systematic review confirms that exercise therapy is an effective, inexpensive and well-accepted therapy for reducing symptoms of PTSD in adults.

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