

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

## Evidence Profile:

Note: the data extracted (apart from the quality appraisal) has been taken from the included papers and does not represent the opinions of the authors' of this REA.

### Systematic Reviews

Authors, year, country	Study design and number of studies	Quality	Question	Population	Interventions	Primary outcome measures
Caddick et al (2014), UK	Systematic Review (n = 11)	Fair	"What is the impact of sport and physical activity on the well-being of combat veterans?"	<p><b>Brittain and Green (2012)</b> Injured or disabled veterans reported on in the media (ages and gender unspecified)</p> <p><b>Burke and Utley (2013)</b> 4 injured male veterans aged 22-44 years</p> <p><b>Carless et al. (2013)</b> 11 male veterans aged 20-43 with either physical disability, chronic illness or mental health problems</p> <p><b>Cordova et al. (1998)</b> 44 male disabled veterans (aged 19-70)</p> <p><b>Dustin et al. (2011)</b> 10 male and 3 female veterans diagnosed with PTSD (ages unspecified)</p> <p><b>Hawkins et al. (2011)</b> 9 male and 4 female injured combat veterans aged 20-40</p> <p><b>Hyer et al. (1996)</b></p>	<p><b>Brittain and Green (2012)</b> Elite sport - Paralympics</p> <p><b>Burke and Utley (2013)</b> 9 day climbing challenge on Mt. Kilimanjaro</p> <p><b>Carless et al. (2013)</b> 5-day inclusive adapted sports and adventurous training course</p> <p><b>Cordova et al. (1998)</b> National Disabled Veterans Winter Sports Clinic</p> <p><b>Dustin et al. (2011)</b> 4 days 'river running' trip</p> <p><b>Hawkins et al. (2011)</b> 3-day military sports camp</p> <p><b>Hyer et al. (1996)</b> 5 days 'Outward Bound Experience' (outdoor adventure pursuits)</p> <p><b>Lundberg et al. (2011)</b> 5-day adaptive sports and recreation program</p> <p><b>Otter and Currie (2004)</b></p>	The World Health Organisation defines Quality of Life (QoL), Psychological well-being (PWB), Subjective well-being

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

				<p>219 male veterans diagnosed with PTSD (mean age = 41)  <b>Lundberg et al. (2011)</b>                  18 male veterans (mean age 30-34) with acquired disability and/or PTSD diagnosis  <b>Otter and Currie (2004)</b>                  14 male veterans (mean age = 55) diagnosed with PTSD  <b>Mowatt and Bennett (2011)</b>                  67 veterans (age and gender unspecified) diagnosed with PTSD  <b>Spornier et al. (2009)</b>                  132 disabled veterans (87% male, 13% female; mean age = 47.4)</p>	<p>40-week community exercise rehabilitation program  <b>Mowatt and Bennett (2011)</b>                  2-day therapeutic fly-fishing program  <b>Spornier et al. (2009)</b>                  National Veterans Wheelchair Games and Winter Sports Clinic</p>	
<p><b>Findings:</b> Sport and physical activity enhances subjective well-being in veterans through active coping and doing things again, PTSD symptom reduction, positive affective experience, activity in nature/ecotherapy, and quality of life. Impact on psychological well-being includes determination and inner strength, focus on ability and broadening of horizons, identity and self-concept, activity in nature/ecotherapy, sense of achievement/accomplishment, and social well-being. Participating in sport and/or physical activity can also enhance motivation for living.</p>						

Authors, year, country	Study design and number of studies	Quality	Question	Population	Interventions	Primary outcome measures
Whitworth et al. (2016), UK	Systematic Review (n = 12)	Poor	(1) provide the rationale for the use of exercise in the treatment of veterans with PTSD and (2) systematically review studies	<p><b>Hamner and Hitri, 1992</b>                  18 participants: 100.0% M (gender), U.S. Veterans 23.9 (average age)  <b>Buckley et al, 2004</b>                  826: 100.0% M, U.S. Veterans 51.7</p>	<p><b>Hamner and Hitri, 1992</b>  <u>Exercise measure:</u> None  <u>Key finding:</u> During a maximal exercise test, veterans with PTSD produced significantly more beta-endorphins</p>	<p>Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised (DSM-III-R), Structured Clinical Interview for DSM-IV</p>

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

			<p>examining the relationship between exercise and PTSD in military veterans.</p>	<p><b>Otter and Currie, 2004</b> 14: 100.0% M, Australian Veterans 55.0</p> <p><b>Arnsen et al, 2007</b> 55: 100.0% M, Israeli Veterans 49.7</p> <p><b>Kozaric-Kovacic et al, 2009</b> 478: 100.0% M, Croatian Veterans PTSD 41.4%; No PTSD 40.8%</p> <p><b>Chwastiak et al, 2011</b> 501,161: 95.9% M, U.S. Veterans 64.1</p> <p><b>LeardMann et al, 2011</b> 38,883: 77.7% M, U.S. Veterans Not Reported</p> <p><b>Davidson et al, 2013</b> 346: 81.0% M, U.S. Veterans 45.5</p> <p><b>Keller-Ross et al, 2014</b> 39: 100.0% M, U.S. Veterans 33.0</p> <p><b>Talbot et al, 2014</b> 736: 94.3% M, U.S. Veterans PTSD 58.0 (age); No PTSD 58.8 (age)</p> <p><b>Babson et al, 2015</b> 217: 100.0% M, U.S. Veterans 52.2</p> <p><b>Caddick et al. 2015</b> 15: 100.0% M, British Veterans Not Reported</p> <p><b>Smith et al, 2015</b> 735: 94.3% M, U.S. Veterans 58.5</p>	<p>than those without PTSD</p> <p><b>Buckley et al, 2004</b> <u>Exercise measure:</u> Single item measure <u>Key finding:</u> 42.0% of the participants exercised 3 times a week for at least 20 minutes, although 26.0% exercised 1–2 days, and 33.0% reported no weekly exercise</p> <p><b>Otter and Currie, 2004</b> <u>Exercise measure:</u> None <u>Key finding:</u> Participants reported reduced perceptions of stress and increase in activities of daily living, mental alertness, perceived health, social support, and motivation to be active</p> <p><b>Arnsen et al, 2007</b> <u>Exercise measure:</u> Single item measure <u>Key finding:</u> Physical functioning and bodily point tenderness were significantly better in regular exercisers than non-exercisers</p> <p><b>Kozaric-Kovacic et al, 2009</b> <u>Exercise measure:</u> Unspecified measure <u>Key finding:</u> Significantly more veterans without</p>	<p>Axis I Disorders (SCID-I), Clinical administered PTSD scale (CAPS), International Classification of Diseases, 10th revision (ICD-10), International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM), PTSD checklist – military (PCL-M), PTSD checklist (PCL-C)</p>
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What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

					<p>PTSD reported engaging in weekly exercise than those with PTSD (i.e., 48.8% vs. 27.9%)  <b>Chwastiak et al, 2011</b>  <u>Exercise measure:</u> Single item measure  <u>Key finding:</u> 6.2% of the sample had PTSD; PTSD was correlated with no weekly exercise, cigarette smoking, and obesity</p> <p><b>LeardMann et al, 2011</b>  <u>Exercise measure:</u> Modified 2001 NHIS  <u>Key finding:</u> Vigorous exercise reduced the risk of developing new or having persistent symptoms</p> <p><b>Davidson et al, 2013</b>  <u>Exercise measure:</u> Single item measure  <u>Key finding:</u> PTSD symptoms were not correlated with exercise, but were with depression symptoms and sleep quality</p> <p><b>Keller-Ross et al, 2014</b>  <u>Exercise measure:</u> PAQ  <u>Key finding:</u> Veterans with PTSD fatigued faster and were more unstable during a handgrip task than those without PTSD</p> <p><b>Talbot et al, 2014</b></p>	
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What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

					<p><u>Exercise measure:</u> Single item measure  <u>Key finding:</u> Veterans with PTSD reported less exercise and worse sleep quality at baseline; baseline exercise and sleep quality were significant predictors of exercise at 1-year follow-up  <b>Babson et al, 2015</b>  <u>Exercise measure:</u> Total miles cycled  <u>Key finding:</u> Exercise improved hyperarousal symptoms for veterans who had poor baseline sleep quality  <b>Caddick et al, 2015</b>  <u>Exercise measure:</u> None  <u>Key finding:</u> Participants reported improved well-being, positive changes in affective state, and that recreational surfing served as a distraction from PTSD symptoms  <b>Smith et al, 2015</b>  <u>Exercise measure:</u> Single item measure  <u>Key finding:</u> Exercise was significantly associated with reduced odds of obesity in veterans with current and lifetime PTSD</p>	
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What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

**Findings:** Results of these initial studies are promising and suggest that regular exercise is inversely correlated with PTSD and its symptoms in military veterans. However, the longitudinal effect of exercise on PTSD in military veterans remains unclear because the current research lacks a common focus and suffers from several methodological limitations. Recommendations for the development of future trials are included.

## Structured competitive sport

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Burling et al. (1992), USA	Cohort	Fair	Homeless veterans with a substance abuse issue (n = 238)	Residential treatment program, participation in a softball team	Length of stay in treatment, self-report surveys/questionnaires.
<p><b>Findings:</b> Softball cohort members remained in treatment significantly longer than both Cohort A, Mann-Whitney U =1039.50, p &lt; .001, and Cohort B members, Mann-Whitney U = 2056.00, p &lt; .001 (all tests were two tailed). They were more likely to complete the inpatient program than were both Cohort A, z (n = 136) = 2.91, p &lt; .01, and Cohort B members, z (n = 116) = 2.32, p &lt; .05. Softball cohort members also were more likely to “graduate” from the program than were both Cohort A, z (n = 136) = 3.59, p &lt; .001, and Cohort B members, z (n = 116) = 5.02, p &lt; .001. All comparisons between the softball cohort and Cohort A remain significant when alpha is Bonferroni corrected to .02; all comparisons with Cohort B remain significant except for program completion. They were more likely to have been employed than Cohort B members, z (n = 84) = 2.46, p &lt; .05. Softball cohort members also were more likely to have been stably housed than Cohort B members, z (n = 84) = 2.22, p &lt; .05. Only the comparison concerning abstinence rates remains significant when alpha is Bonferroni corrected to .02.</p>					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Laferrier et al. (2015), USA	Cohort	Fair	Active duty service members or Veterans with a disability (all branches of the United States Armed Forces), (n = 220)	Sports recreation and exercise	Quality of life (QOL), Rosenberg Self-esteem scale

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

**Findings:** A positive relationship was found between participant QOL and the number of years spent participating in sports, exercise, and recreation since the onset of their disability. A significant difference was found between pre-event and post event self-esteem scores ( $p < 0.05$ ). A significant difference was also found in self-esteem scores between the levels of years of participation in sports, exercise, and recreation when averaged across activity type. Finally, there were significant differences found on self-esteem scores between the levels of type of activity averaged across years of participation.

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Sporner et al. (2009b), USA	Cohort	Fair	Veterans in wheelchair and rugby tournaments of 2007 and 2008 NVWG (n = 38)	Wheelchair basketball and rugby (collecting activity time, velocity, distance travelled and number of stops and starts)	Miniaturized data logger (MDL)
<p><b>Findings:</b> The results of this study show that the majority (&gt;75%) of the wheelchair athletes in this study (n=14 rugby, n=16 basketball) reached the Center for Disease Control and Prevention (CDC) recommended 20 min of activity during a wheelchair basketball or rugby game. The benefits of participating in organized sporting events and recreation have been well documented and promoting participation in wheelchair basketball and rugby may influence activity levels and help reach the CDC's recommended activity levels.</p>					

## Supervised aerobic exercise

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Cook et al. (2010), USA	RCT	Poor	Gulf War Veterans with chronic musculoskeletal pain (CMP) (n = 32).	Maximal effort test on cycle ergometer, then 7 days later sub-max (70%) effort for 30 minutes.	Ratings of Perceived Exertion (RPE) and Leg Muscle Pain, Experimental Pain Testing, Suprathreshold Pain Testing
<p><b>Findings:</b> 11 GV's with CMP and 16 healthy GV's completed both days of testing. The results of the present investigation suggest that GV's suffering from chronic musculoskeletal pain: 1) experience higher levels of exertion whilst exercising compared to healthy GV's (13.5 vs 12.0) (<math>p &lt; 0.05</math>); 2) experience greater naturally occurring muscle pain during exercise compared to healthy GV's (4.7 vs 4.1) (<math>p &lt; 0.05</math>); and 3) become more sensitive to heat-pain stimuli following acute exercise (<math>p &gt; 0.05</math>). Our</p>					

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

results, and those of others, also suggest that exercise can be developed as a unique model to understand pain-modulation mechanisms in healthy men and women and those with CMP.

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
De Vries et al. (2002), NETHERLANDS	Case control	Poor	Dutch Veterans of Cambodian peacekeeping mission with either reduced activity levels, decreased fitness or symptomatic post strenuous exercise. Matched with healthy Dutch Cambodian veterans (n = 32).	1) 12-consecutive days of self-report in diary activity levels and worn an actometer, 2) maximal effort (~10 minutes) on cycle ergometer, 3) 7-consecutive days post max effort, record activity in diary and wear actometer.	Activity measured objectively via actometer; self-report feelings of fatigue and activity levels (diary).
<b>Findings:</b> No difference in activity levels (actometer) or perceived fatigue following maximal ergometer effort.					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Kerr et al. (2008), AUSTRALIA	Cohort	Poor	Australian male Vietnam War Veterans (n = 164)	12-month exercise program at least twice a week (15-20 minutes of aerobic exercises at 55-75% recommended capacity and 7-9 resistance training exercises)	Systolic BP (mmHg), Diastolic BP (mmHg), HR (bpm)



What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

**Findings:** This study demonstrated that 12 months of combined aerobic and resistance training significantly improved both cardiorespiratory and anthropometric characteristics of Australian male, Vietnam War veterans. For this population, completion of a simple, moderate intensity program of combined modality exercise lowered several cardiovascular risk factors that might lead to a reduction in the incidence of cardiovascular disease development and morbidity/mortality.

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Shivakumar et al. (2017), USA	Cohort	Fair	Premenopausal women with symptomatic PTSD related to trauma (n = 31)	12-week (4 sessions per week) aerobic exercise program (30-40 minutes of brisk walking). Two of the weekly sessions supervised by a researcher.	Rating of Perceived Exertion (RPE), Clinician administered PTSD scale (CAPS), PTSD Checklist (PCL), Inventory of Depressive Symptomatology (IDS), Quality of Life Enjoyment and Satisfaction Questionnaire (Q-LES-Q)
<p><b>Findings:</b> Both post-traumatic and depressive symptoms improved significantly by the end of study (CAPS and PCL). There were no adverse events related to exercise. A small focus group provided subjective experiences supporting positive effects of exercise on emotion, quality of life (QOL), decreased pain severity and physical health. The preliminary results of this study suggests that 12 weeks of moderate intensity aerobic exercise may be a promising intervention for PTSD in women veterans of childbearing potential. Further controlled studies are warranted to determine efficacy of moderate intensity exercise as a treatment modality for this population.</p>					

## Supervised mind body exercise

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

Mehling et al. (2016), USA	RCT	Poor	Veterans with PTSD (n = 47)	12 consecutive weeks of an Integrated Exercise (IE) intervention. Weekly, 50 minute session on body-mind centering, mindful breathing with slow movement and discussion on mindfulness.	Five Facet Mindfulness Questionnaire (FFMQ), Self-report measure (MAIA), Capacity of positive states of mind (PSOM), CAPS, Quality of life (WHOQOL-BREF)
<p><b>Findings:</b> Large effect sizes for the intervention were observed on Five-Facet Mindfulness Questionnaire Non-Reactivity (<math>d=.85</math>), Multidimensional Assessment of Interoceptive Awareness Body Listening (<math>d = .80</math>), and Self-Regulation (<math>d = 1.05</math>). In a randomized controlled trial of a 12-week IE program for war veterans with PTSD, we saw significant improvements in mindfulness, interoceptive bodily awareness, and positive states of mind compared to a waitlist.</p>					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Gaddy et al. (2017), USA	Cohort	Poor	Veterans with either a mood disorder, PTSD, substance use disorder, chronic pain, anxiety, personality disorder or psychotic disorder (n = 42)	Integrative Medicine (IM) program ran over 4 consecutive weeks (hatha yoga, healing foods, guided imagery, Tai chi, creativity in recovery, sensory exploration, holistic pain management)	Short Form 12-item Health Survey (SF-12), Semi-structured interview
<p><b>Findings:</b> Consistent with hypotheses about SF-12 score changes, participants exhibited significant increases in both their physical competency scores (<math>t = 4.9, p = .05, d = 0.76</math>) and mental competency scores (<math>t = 3.76, p = .05, d = 0.58</math>) from pre- to post-IM program completion. Regarding changes in individual item scores, improvements were noted in several areas, including the extent to which pain interferes with daily life (0.67 point average increase on a 5-point scale, <math>t = 4.79, p = .05</math>), amount of time feeling calm (0.86 point average increase on a 6-point scale, <math>t = 4.79, p = .05</math>), amount of time having sufficient energy (0.69 point increase on a 6-point scale, <math>t = 4.69, p = .05</math>), improved mood (0.57 point increase on a 6-point scale, <math>t = 2.37, p = .05</math>), and extent to which physical or mental health issues interfere with social activities (0.74 point increase on a 5-point scale, <math>t = 4.61, p = .05</math>). There were no score changes reflecting worsened health for any composite or individual item score.</p>					

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Hull et al. (2015), USA	Cohort	Poor	Veterans with a pain or mental health issue (n = 226)	Complementary and alternative medicine (CAM) program (iRest yoga, articular acupuncture, individual acupuncture, integrative health classes, gentle yoga, Qigong). Yearlong trial. Veterans encouraged to attend as many sessions as they liked.	Measure Yourself Medical, Outcome Profile-2, Medical Outcomes Study Short Form-36, Insomnia Severity Index Defense and Veteran Pain Rating Scales, Pain Disability Questionnaire, Perceived Stress Scale, Beck Depression Inventory-2, IHW Program Demographics Questionnaire, Additional Electronic Medical Data
<p><b>Findings:</b> The results have suggested that service users did not differ substantially from nonusers, although a higher proportion of females used services, and Marines were less well represented among service users. With respect to demographic factors associated with the number of sessions attended by service users, only age appeared to have an effect, in that older individuals attended more services. Over the course of the yearlong trial, 165 veterans attended more than one session. Symptom severity was not associated with a specific pattern of service use. In general, the current results have provided further support for the inference that CAM Program services are appealing to a broad cross-section of veterans, but no relationship existed between attendance at a CAM session and improved wellbeing.</p>					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Niles et al. (2016), USA	Cohort	Poor	Veterans with PTSD (n = 17)	4 session Tai Chi protocol. Each session lasted 60 minutes and was conducted by 2 experienced Tai Chi instructors.	Checklist for DSM-5 (PCL-5), Brief Pain Inventory—Short Form (BPI), Beck Depression Inventory II (BDI-II)

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

**Findings:** Almost 90% (17/19) of those eligible following the telephone screen enrolled in the program. Three-quarters (76.4%) of the participants attended at least 3 of the 4 Tai Chi sessions. Qualitative data analysis revealed themes indicating favorable impressions of the Tai Chi sessions. In addition, participants reported feeling very engaged during the sessions, and found Tai Chi to be helpful for managing distressing symptoms (ie, intrusive thoughts, concentration difficulties, physiological arousal). Participants also reported high satisfaction: 93.8% endorsed being very or mostly satisfied with the program. All participants (100%) indicated that they would like to participate in future Tai Chi program and would recommend it to a friend.

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
David et al. (2006), USA	Cohort	Poor	Veterans with active diagnosis of PTSD due to military sexual trauma (n = 12)	12-week (36-hour) assertiveness training. Each session: 1 hour of psycho-education about sexual assault and role play to practise assertive communication; 1 hour of physical self-defence; 1 hour of debriefing. Three experienced female psychologists present for each session. Two martial artists (1 male, 1 female) present for first 2 hours.	Portions of Ozer and Bandura's Self Defense Scale, The Interpersonal Self-Efficacy subscale, The Activities Self-Efficacy subscale, The Self-Defense Self-Efficacy subscale, The Aggression Questionnaire, The PCL-C, The Beck Depression Inventory, The General Self-Efficacy Scale. Measures taken at baseline, post-test (12 weeks), 3-months post intervention and 6-months post intervention.

**Findings:** The results of the current study indicate that the research participants showed significant improvement in the following areas: They reported a heightened ability to discern risky situations, a decrease in obsessive fear and worry about assault without believing themselves to be invulnerable; an increased sense of personal safety and increased confidence in their self-defense skills, improved confidence in their ability to be assertive and to set appropriate interpersonal boundaries, decreased depression, decreased PTSD avoidance and hyper-arousal symptoms, and increased willingness to participate in community activities. However, these changes were not statistically significant at any point of measure. PTSD severity had not improved at post-test. PTSD severity had significantly improved at 3-month and 6-month follow up. Participant's perception of their risk of being victim to assault remained unchanged throughout follow up testing.

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

## Supervised combined aerobic and anaerobic exercise

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Morey et al. (2018), USA	Cohort	Fair	Veterans from Veterans Affairs Medical Centers (n = 691), mean age of 75 years.	Gero-fit exercise program (aerobic and strength training, Tai Chi or dancing) that targeted veterans >65 years and at risk of functional decline due to deconditioning, chronic disease or use of an assistive device. Three sessions per week, for 12 months.	30-second chair stands; 8-foot 'up and go' (gait speed); 6 minute walk distance
<p><b>Findings:</b> Pooled characteristics of enrolled participants demonstrate substantial baseline functional impairment (usual gait speed 1.05 +/- 0.3 m/s, 8-foot up and go 8.7 +/- 6.7 seconds, 30-second chair stands 10.7 +/- 5.1, 6-minute walk distance 404.31 +/- 141.9 m), highlighting the need for such programs. Change scores over baseline for 3, 6, and 12 months of follow-up are clinically and statistically significant (P &lt; .05 all measures) and replicate findings from the parent program. Patient satisfaction ratings of high ranged from 88% to 94%. We describe the implementation process and present 1-year outcomes. We suggest that such programs be considered essential elements of healthcare systems.</p>					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Sealey et al. (2010), AUSTRALIA	Cohort	Fair	Vietnam War Veterans (n = 32), 63% had PTSD diagnosis. All participants reported sedentary lifestyle for preceding 24 months.	Single episode of acute exercise. Each veteran completed one of the following: lower-body vibration, upper-body resistance and stretching (20-30 mins) (WBVT);	Subjective exercise experience scale (SEES).

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

				lower-body vibration, upper-body resistance, aerobic exercise and stretching (40-60 minutes); full-body resistance, aerobic exercise and stretching (40-60 minutes)(R+CV).	
<p><b>Findings:</b> The current study indicates that an acute bout of exercise, regardless of the intervention, resulted in increased positive wellbeing for previously sedentary Vietnam Veterans, but these results were not statistically significant (<math>p&gt;0.05</math>). The WBVT and R+CV groups both reporting improvements across all areas of the SEES.</p>					

## Unmonitored unsupervised physical activity

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Bosch et al. (2017), USA	Cohort	Good	Veterans with PTSD (n = 195)	Self-report surveys taken at baseline and 12 month follow up to evaluate levels of exercise (vigorous, moderate or light) and sleep quality.	PTSD checklist – military (PCL-M), The Pittsburg Sleep Quality Index (PSQI), The Michigan Alcohol Screening Test (MAST)
<p><b>Findings:</b> Level of engagement in exercise and subsequent sleep quality and PTSD symptoms one year later among deployed veterans, all of whom reported clinically significant or subthreshold levels of PTSD, showed, via multiple regression analyses that exercise improved sleep quality (<math>p&lt;0.05</math>). Results from the present study did not find a significant association between level of engagement in exercise at baseline and PTSD symptoms and improved sleep quality at one-year follow-up (<math>p=0.57</math>).</p>					

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What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

Bourn et al. (2016), USA	Cohort	Poor	Veterans who were actively seeking treatment for their pain (n = 239)	Self-report surveys to assess relationship between exercise, pain and PTSD.	Brief Pain Inventory (BPI)-Short Form, Clinician-Administered PTSD Scale (CAPS), Godin Leisure-Time Exercise Questionnaire (GLTEQ)
<p><b>Findings:</b> Main and Moderating Effects of Pain Severity and Physical Activity on PTSD Severity Pain severity, but not physical activity frequency, was associated with increased PTSD symptoms. When the moderation term was added to the regression analysis, pain severity and the interaction of pain severity and physical activity were significant. Severe PTSD symptoms were associated with higher pain and higher levels of pain interfering with veterans' daily lives. Exercise did not affect PTSD severity but those who reported a greater frequency of physical activity reported less PTSD symptoms. This finding was irrespective of the level of pain experienced.</p>					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Du et al. (2015), CHINA	Cohort	Fair	Chinese Veterans (n = 967)	Structured self-report questionnaire to examine if physical activity is protective of depressive symptoms. Participation in physical activity was measured as frequency of 30 minutes of exercise, 3 days a week, within the last year.	Center for Epidemiological Studies Depression Scale (CES-D)
<p><b>Findings:</b> The results of this study confirm and extend previous research by demonstrating an inverse relationship between physical activity (PA) and depressive symptoms in a large cohort of older Chinese veterans. Even after controlling for a range of confounders, such as age, sex, variations in lifestyle, negative life events, the most common chronic diseases, and level of cognitive function, the relationship between PA and depressive symptoms remained significant (OR 0.57, 95% confidence interval 0.44–0.72, P,0.0001).</p>					

What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

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Gutierrez et al. (2016), US	Cohort	Good	Veterans (n = 103)	Self-report measures of exercise frequency and heart rate recordings	Suicidal Behaviors Questionnaire-Revised, The SBQ-R Adult Suicide Ideation Questionnaire (ASIQ), Beck Depression Inventory II (BDI-II), International Physical Activity Questionnaire (IPAQ), Pittsburgh Sleep Quality Index (PSQI), 5-minute electrocardiogram (ECG)
<p><b>Findings:</b> The primary hypothesis, that participants' scores on the IPAQ would be significantly negatively associated with ASIQ scores, was not supported (<math>R^2 = .001</math>, <math>p = .74</math>). There was no association between respiratory sinus arrhythmias and suicidal ideation (<math>R^2 = .004</math>, <math>p = .81</math>). Correlations were calculated between all study measures as well. Moderate negative correlations were found between BDI-II scores and both total activity (<math>r = .23</math>, <math>p = .02</math>) and total walking (<math>r = .29</math>, <math>p &lt; .01</math>). Although not statistically significant correlations between ASIQ scores, total activity and total walking were in the expected direction (i.e., negative).</p>					

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Hoerster et al. (2012), USA	Cohort	Fair	US Veterans who had returned from deployment to Iraq/Afghanistan (n = 266)	Recommended weekly minutes of moderate to vigorous physical activity (MVPA) for veterans was >150 min.	PTSD checklist-military version (PCL-M), Patient health Questionnaire (PHQ), self-reported weekly minutes of moderate to vigorous physical activity
<p><b>Findings:</b> Number of participants who engaged in a median of 180 weekly (59%). In multivariate regression models, higher levels of depression (<math>p=.042</math>) and somatic (<math>p=.018</math>) symptom severity were associated with significantly decreased odds of meeting physical activity recommendations.</p>					



What are the physical and mental wellbeing benefits veterans achieve through participating in sporting activities?

## Structured recreational physical activity

Authors, year and country	Study design	Quality	Population including no. of participants	Intervention	Primary outcome measures
Johnson et al. (2018), USA	RCT	Poor	Veterans (n = 29)  Intervention (n = 15) Wait list (n = 14)	Therapeutic Horse Riding (weekly 1 hour class for 6 weeks). Class: welcome to barn (5 to 10 minutes), horse grooming, THR lesson led by instructor and 2 volunteers escorted.	PTSD Checklist-Military Version (PCL-M), The Coping Self Efficacy Scale (CSES), The Difficulties in Emotion Regulation Scale (DERS), The Social and Emotional Loneliness Scale for Adults-short version (SELSA)
<p><b>Findings:</b> Participants had a statistically significant decrease in PTSD scores after 3 weeks of THR (<math>P \leq 0.01</math>) as well as a statistically and clinically significant decrease after 6 weeks of THR (<math>P \leq 0.01</math>). Logistic regression showed that participants had a 66.7% likelihood of having lower PTSD scores at 3 weeks and 87.5% likelihood at 6 weeks. Under the generalised linear model, the ANOVA findings for the coping self-efficacy, emotion regulation, and social and emotional loneliness did not reach statistical significance. The results for coping self-efficacy and emotion regulation trended in the predicted direction. Results for emotional loneliness were opposite the predicted direction. Logistic regression provided validation that outcome effects were caused by riding longer.</p>					

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Bennet et al. (2017), USA	Cohort	Poor	Veterans and unknown number of active, serving military personnel (n = 40) 80% with PTSD	4-day therapeutic fly-fishing program. First 2 days veterans received training, next 2 days spent fishing and socialising.	PTSD checklist – military (PCL-M), Patient health questionnaire (PHQ-9), Perceived street scale (PSS), Walter Reed Functional Impairment Scale (WRFIS), Basic Needs Satisfaction in Life Scale (BNSLS), Leisure Satisfaction Scale (LSS)

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**Findings:** This therapeutic fly-fishing program decreased symptoms of PTSD, depression, perceived stress, and functional impairment during the week of the program ( $p < 0.005$ ) and increased leisure satisfaction 3 months after the program. Although there were improvements from baseline at 3-month follow-up not the differences were not statistically significant ( $p = 0.08$ ). These findings help to add to the current literature on the influence of therapeutic recreation programs, specifically therapeutic fly-fishing programs, for veterans with combat-related disabilities.

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Rogers et al. (2014), USA	Cohort	Poor	Veterans diagnosed with PTSD (n = 11)	Ocean therapy program (five, 4 hour sessions, every week for 5 weeks) Each session: group lesson on surfing, land based warm up, 45 minute one on one lesson with surf instructor. Supervision: 15 instructors and an occupational therapist, 10-15 veterans. Aim: skills built on each week, aim was to stand on board.	The PTSD Checklist—Military Version, The PTSD Checklist—Military Version (PCL-M), Major Depression Inventory, The Major Depression Inventory (MDI)
<p><b>Findings:</b> Participants reported clinically meaningful improvement in PTSD symptom severity (<math>d = 0.77</math>, <math>p = .01</math>) and in depressive symptoms (<math>d = 0.61</math>, <math>p = .04</math>) upon completion of the program. Additionally eight out of eleven participants recorded PTSD symptoms below clinical diagnosis of PTSD. The results of this small, uncontrolled study suggest that a sports-oriented occupational therapy intervention has potential as a feasible adjunct intervention for veterans seeking mental health treatment for symptoms of PTSD.</p>					

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Vella et al. (2013), USA	Cohort	Good	Veterans with PTSD (n = 74)	Fly-fishing (19 separate camps, 3 night, 2 day fly-fishing excursions). Outcome measures taken two weeks prior to intervention, on the final day of the program and at 6 week follow up.	The PTSD check list Military version (PCL-M), Brief Symptom Inventory-18 (BSI), Positive Affect and Negative Affect Schedule (PANAS), The Perceived Stress Scale (PSS), Pittsburgh Sleep Quality Inventory (PSQI)
<p><b>Findings:</b> The results suggest that outdoor recreation is linked to significant improvements in psychosocial well-being. Acute effects indicated significant elevations in attentiveness and positive mood states, accompanied by significant and sustained reductions in symptoms of depression, anxiety, and somatic stress, in addition to negative mood states. Veterans fished for an average of 16 hours in total, over the 4 days. All outcome measures (PCL-M; BSI; PANAS; PSS and PSQI) had significantly improved (<math>p &lt; 0.001</math>) upon recording on the final day of the camp. Moreover, the psychosocial benefits of the outdoor recreation appear to endure up to the 6-week follow-up assessment (<math>p &lt; 0.05</math>). Follow-up analyses revealed increases in sleep quality and significant reductions in perceptual stress and PTSD symptoms. An additional ancillary analysis revealed that reductions in PTSD symptoms served as a driving force that predicted improvements in sleep quality.</p>					

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Asselin et al. (2012), USA	Case study	Poor	Male Veteran with a spinal cord injury	Hippo therapy/ therapeutic horse riding (planned lessons involving riding therapy tasks, such as; hand eye coordination, multi-tasking, spatial orientation, sequencing tasks, etc.)	Self-report perceptions of physical and mental improvements.
<p><b>Findings:</b> Within a few weeks of horse riding, the veteran was able to squeeze the body of the horse with his legs. Two years into the program, the veteran reported reduced muscle spasms and reported a greater sense of whole body strength. Confidence and a greater motivation to continue with his rehabilitation were also offered by the veteran as improvements derived from the THR program. A physical, psychological, and psychosocial benefit of therapeutic horseback riding is shown to have positive results for the spinal cord injured. Therapeutic riding is an emerging field where the horse is used as a tool for physical therapy, emotional growth, and learning. Veterans returning from the Iraq/Afghanistan war with traumatic brain injuries, blast injuries, depression, traumatic amputations, and spinal cord injuries may benefit from this nurse-assisted therapy involving the horse.</p>					

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Lanning et al. (2013), USA	Cohort	Poor	Combat Veterans with mental and physical health issues (n = 13)	24-consecutive week, THR program (1-2 hours once a week) (riding, grooming, interaction with horse accredited by the Professional Association of Therapeutic Horsemanship)	36-Item Short Form Health Survey version 2 (SF-36v2); Beck Depression Inventory-2nd edition (BDI-II); post-intervention open-ended questions.
<p><b>Findings:</b> Second, the participants who completed 12 sessions of THR reported an increase in scores over time in six of the eight health domains, which means that they were experiencing less physical and emotional limitations in those particular health domains over the 12 wk. Likewise, the participants who completed up to 24 THR sessions reported an increase in scores in seven of the eight health domains. Third, the participants indicated fewer depression symptoms over time, dropping almost 6 points.</p>					

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Peacock et al. (2018), UK	Qualitative	Poor	UK military veterans who participated in an adapted sport and adventurous training (ASAAT) program (n = unknown)	ASAAT program: 5 day course; challenged to complete appropriate, physically challenging tasks, received coaching throughout. Researchers attended thirty five, 5 day ASAATs over 18 months. Researchers interviewed participants.	Interviews asked veterans of their experience of the ASAAT program.

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**Findings:** The responses of the interviews were assessed. The researchers decided to summarise the experience of ASAAT from the point of view of one veteran and this veteran's story was shared with twenty members of the public. The veteran's story highlighted how ASAAT helped with his healing process as socializing with other, like-abled veterans showed him that he was not alone. Feedback from the participant and focus groups with members of the public who engaged with the story suggest judgement criteria appropriate for a creative non-fiction representation were achieved. This paper offers important insights into the personal meaning and value of participation in a bespoke 5-day ASAAT program.