Abstract

Posttraumatic Stress Disorder (PTSD) is a disorder associated with poor health outcomes including high rates of cardio-metabolic disease. Exercise and physical activity more broadly offer substantial promise as a feasible and effective component of care. Evidence to date demonstrates that exercise can improve both the physical and mental health of people with PTSD. Exercise should be included in the treatment of PTSD, across the spectrum from inpatients receiving treatment for severe PTSD, to trauma-exposed individuals living in the community with sub-syndromal symptomatology.

Keywords
Exercise • Posttraumatic stress • PTSD • Metabolic syndrome

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1 Introduction

Posttraumatic stress disorder (PTSD) typically occurs following exposure to a potentially traumatic event which may include war, torture, physical or sexual assault or natural disaster (American Psychological Association 2013). PTSD has an estimated lifetime prevalence of 6.8% (Kessler et al. 2005) and is particularly prevalent
among those working in professions who are exposed to high rates of trauma including first responders (police officers, paramedics, firefighters) and combat veterans (Sayer et al. 2010). For example, the estimated point-prevalence of PTSD among combat veterans is as high as 23% (Fulton et al. 2015). Although previously classified by the Diagnostic and Statistical Manual of Mental Disorders (DSM) as an anxiety disorder, PTSD is now classified under a stand-alone chapter of the DSM 5 under trauma and stressor related disorders (American Psychological Association 2013). PTSD is characterized by four symptom clusters including (i) re-experiencing, (ii) avoidance, (iii) negative cognitions and mood, and (iv) arousal. In order for a diagnosis of PTSD to be made, symptoms must cause a clinically significant level of distress or impairment in social interactions, capacity to work or in other areas of psychosocial functioning (American Psychological Association 2013). People with PTSD may present with symptoms of hyper-vigilance, difficulty debriefing following exposure to a traumatic experience, increased anxiety and depression, social withdrawal, aggression, nightmares and substance misuse (Ozer et al. 2008). PTSD is associated with adverse outcomes not limited to severe impairments in psychosocial functioning (Zatzick et al. 2002), significantly increased risk of suicide and suicidal ideation (Jakupcak et al. 2009) and substance abuse and dependence (Schnurr et al. 2005).

2 Current Treatment of PTSD

Current treatments for PTSD include pharmacotherapies such as paroxetine, sertraline, fluoxetine, risperidone, topiramate, and venlafaxine, in addition to psychological therapies such as trauma-informed cognitive behavioral therapy (CBT), exposure therapy and Eye Movement Desensitization and Reprocessing (EMDR) (Watts et al. 2013). Recent guidelines for the treatment of PTSD indicate that up to 12 sessions of between 60 and 120 min duration of trauma informed CBT or EMDR may be required, and that many people experiencing PTSD will require additional treatment sessions (Harvey et al. 2015). Recent evidence has also demonstrated the benefits of non-traditional strategies including mindfulness-based stress reduction (Polusny et al. 2015).

3 Physical Health of People with PTSD

3.1 Cardio-Metabolic Health

People with PTSD experience an excess mortality rate two to three times higher than the general population (Boscarino 2006; Pietrzak et al. 2011) with a growing body of evidence demonstrating the links between PTSD and poor physical health (Bar-toli et al. 2015; Pacella et al. 2013; Rosenbaum et al. 2015b; Wolf et al. 2016a, b). For example, PTSD is associated with the presence and severity of cardiovascular diseases (CVD), which predicts mortality independent of age, gender, and conventional risk factors (Ahmadi et al. 2011). The pooled prevalence of metabolic syndrome (the cluster of risk factors including central obesity, high blood pressure, low high-density lipoprotein (HDL) cholesterol, elevated triglycerides and hyperglycemia (Alberti et al. 2005)) among people with PTSD is 38.7% (95% CI = 32.1–45.6%) with an almost doubled increased risk compared to the general population (RR = 1.82; 95% CI = 1.72–1.92; p < 0.001) (Rosenbaum et al. 2015b). Similarly, the prevalence of type two diabetes (T2DM) among people with PTSD has been determined at 10% (95% CI = 8.1%–12.0%), with PTSD resulting in a significantly increased risk of developing T2DM (RR = 1.49, 95% CI = 1.17–1.89, p < .001) (Vancampfort et al. 2016d). The relationship between PTSD and metabolic syndrome has been further explored in a 2016 study demonstrating that PTSD severity at baseline predicts a subsequent increase in metabolic syndrome severity over time ($\beta = 0.08$, $p = 0.002$). These findings were significant after controlling for initial metabolic syndrome severity, with the authors finding that for every ten PTSD symptoms endorsed (based on a structured clinical interview), the odds of a subsequent metabolic syndrome diagnosis increased by 56% (Wolf et al. 2016a). Furthermore, PTSD has been shown to act as a catalyst for the associa-
tion between metabolic syndrome and broad bilateral reductions of cortical thickness, primarily in the temporal and parietal regions in a sample of relatively young US military veterans (Wolf et al. 2016b). These data provide substantial evidence for calls for new interventions that target not only the psychological symptoms of PTSD, but also the co-occurring cardio-metabolic conditions (Farr et al. 2014; Rosenbaum and Steel 2016).

3.2 Factors Contributing to Poor Physical Health of People with PTSD

The pathophysiology underlying the association between PTSD and cardio-metabolic disease is complex and yet to be fully elucidated. Emerging evidence suggests that both share pathophysiological features, including hypothalamic–pituitary–adrenal (HPA) and sympathoadrenomedullary dysfunction (Dedert et al. 2010), inflammation (Eraly et al. 2014), and common genetic links and epigenetic interactions (Nevell et al. 2014). Comparable to other mental disorders, the contributing role of modifiable lifestyle-related factors is becoming increasingly clear. For example, people with PTSD are more likely than the general population to smoke, with rates of 40–86% for clinical samples (Fu et al. 2007), be alcohol dependent (Blanco et al. 2013), and consume diets that are high in saturated fats and refined sugars (Carmassi et al. 2015), while low in fruit (Godfrey et al. 2013). Furthermore, PTSD symptoms and depression have also been shown to be associated with binge eating (Hoerster et al. 2015), further highlighting the importance of diet as a key modifiable risk factor. Sedentary behavior is also a key risk factor contributing to overall poor physical health (Zen et al. 2012).

3.3 Low Fitness

Low cardiorespiratory fitness defined as the ability of the circulatory and respiratory systems to supply oxygen to working muscles during sustained physical activity (Physical Activity Guidelines Advisory 2008), is a strong and independent predictor of cardiovascular and all-cause mortality and is of comparable importance with diabetes and other established risk factors (Kodama et al. 2009). For example, in the general population, people with low cardiorespiratory fitness have a relative risk for all-cause mortality of 1.70 (95% CI = 1.51–1.92; p < 0.001) and for cardiovascular events of 1.56 (95% CI = 1.39–1.75; P < 0.001) compared with those with a high cardiorespiratory fitness (Kodama et al. 2009). In comparison to those with average cardiorespiratory fitness, those with low cardiorespiratory fitness have a relative risk for all-cause mortality of 1.40 (95% CI = 1.32–1.48; p < 0.001) and for cardiovascular events of 1.47 (95% CI = 1.35–1.61; p < 0.001) (Kodama et al. 2009).

Despite increasing evidence regarding the poor fitness of people with mental disorders including schizophrenia (Vancampfort et al. 2015b) and bipolar disorder (Vancampfort et al. 2015d, 2016e), in addition to evidence demonstrating an increase in fitness can be achieved in mental health populations following specific intervention (Stubbs et al. 2016b; Vancampfort et al. 2015c), and that higher fitness levels are associated with decreased incident depression (Åberg et al. 2012), relatively little is known regarding the relationship between cardiorespiratory fitness and PTSD. In a 2014 study of soldiers completing basic training in the US, the odds of soldiers reporting depressive symptoms were 60% lower at the completion of basic combat training for soldiers in the highest fitness category compared to soldiers in the lowest category (odds ratio, 0.40; 95% CI = 0.19–0.84, p < 0.00xx) (Crowley et al. 2014), with calls to target soldier cardiorespiratory fitness before basic combat training in order to improve psychological health outcomes.

In a subsequent analysis of data from a clinical trial investigating, the benefits of aerobic exercise for PTSD (Fetzner and Asmundson 2015), LeBouthillier et al. (2016) examined the role of cardiorespiratory fitness in predicting reductions in PTSD symptoms and anxiety sensitivity following participation in aerobic exercise, finding that aerobic exercise is particularly effective in individuals with poorer levels of cardiorespiratory fit-
ness. In addition, there is evidence suggesting that veterans with PTSD have a worse performance on submaximal exercise tests such as the 6-min walk test (6MWT), on handgrip strength and the short physical performance battery (SPPB) when compared to veterans without PTSD (Hall et al. 2014). However, the next step towards a more clear and precise comprehension of the fitness capacity of people with PTSD requires assessing and comparing maximal fitness capacity among people with PTSD and without PTSD (Vancampfort et al. 2016).

4 Correlates of Physical Activity in PTSD

Comparable to other psychiatric populations, people with PTSD are more likely than the general population to endorse unhealthy lifestyle behaviors, including high rates of sedentary behavior (Zen et al. 2012). Sedentary behaviour is independently associated with an increased risk of cardiometabolic disease and mortality in the general population (Biswas et al. 2015). Therefore, understanding physical activity correlates is essential to improve health outcomes and reducing sedentary lifestyles. Hall et al. (2015) found that the current literature regarding physical activity in people with PTSD is somewhat inconsistent, with approximately half of the identified studies reporting a significant negative association between PTSD and physical activity participation with the others reporting no significant associations between PTSD and physical activity at all.

Among the general population, correlates consistently associated with increased physical activity participation include male gender, higher self-efficacy, previous physical activity, current health status and the intention to be physically active (Bauman et al. 2012), however, it is unclear whether these factors are similarly associated with physical activity behavior among people with PTSD. Previous qualitative research among people with PTSD found a lack of time (14% before and 39% after PTSD onset) and lack of motivation (24% before and 71% after PTSD onset) negatively affected physical activity participation (de Assis et al. 2008). In order to better understand the barriers and facilitators of participation in physical activity in people with PTSD, Vancampfort et al. (2016b) conducted a systematic review of the correlates of physical activity in people with PTSD. Eight studies were identified that were eligible for inclusion (Arnson et al. 2007; Babson et al. 2015; Davidson et al. 2013; Harte et al. 2013; Rosenbaum et al. 2016; Rutter et al. 2013; Vujanovic et al. 2013), with a total of 1368 (994 males) people with PTSD (age range 18–70 years). The review found no evidence of significant demographic correlates, however, consistent evidence was found that older age was not a barrier to physical activity participation (Vancampfort et al. 2016b). Biological correlates including body mass index, waist circumference and the presence of fibromyalgia were investigated and only the presence of fibromyalgia was associated with less physical activity participation (n = 1), although evidence was limited to a single study (Arnson et al. 2007). Better sleep quality was found to be associated with higher physical activity levels (Vancampfort et al. 2016b). This is of particular clinical interest given that sleep disturbances are common, debilitating symptoms of PTSD and the beneficial effect of exercise on improving sleep quality both in the general population and among those with PTSD (Lamarche and De Koninck 2007).

Strong consistent evidence was found that PTSD symptom severity, and in particular symptoms of hyper-arousal are a negative correlate of physical activity participation among people with PTSD (Vancampfort et al. 2016b). It is possible that the inverse association between physical activity and hyper-arousal is due to a lower likelihood of more anxious individuals to engage in physical activity. For example, those with an increased trait/state anxiety may avoid participating in physical activity to avoid physiological reactions including hyperventilation, tachycardia, dizziness, or sweating, which are also common signs and symptoms of panic (Knapen et al. 2015). However, given that physical activity has demonstrated anxiolytic effects via repeated exposure to anxiety-related somatic sensations (Knapen et al. 2015), it has been argued that increased physical activity among patients with
PTSD may lead to decreased hyper-arousal symptoms (Vancampfort et al. 2016b).

5 Evidence of Exercise as an Intervention

Evidence for the role of exercise in the treatment of PTSD has increased significantly over the past decade. The first Cochrane Collaboration review in this area broadly assessed the effect of sports and games on PTSD and highlighted the lack of available evidence for exercise as a treatment or co-treatment option at the time of publication (Lawrence et al. 2010). At the time (2010), no RCTs were identified as eligible for inclusion, although some studies were found that evaluated exercise and/or sports based interventions for PTSD.

The generalizability of the findings was limited due to considerable methodological weaknesses, including a lack of randomization, small sample sizes, and the inclusion of interventions evaluating play-based therapy, considered a psychological intervention (Chapman et al. 2001; Diaz and Motta 2008; Schreier et al. 2005; Walker 1983). Some of the initial and preliminary evidence of the potential benefit of exercise on PTSD symptoms came from a 2008 study by Diaz and Motta (Diaz and Motta 2008) who conducted a non-randomized study involving twelve female adolescents diagnosed with PTSD. Their results showed that 91% of participants showed a significant reduction in PTSD symptoms on the Childhood PTSD Symptom Scale, following participation in a walking program. The study had a number of limitations including the use of a low intensity exercise protocol, which did not include progressive overload training, and failed to meet basic principles of exercise prescription.

Between 2010 and 2016, there has been growing recognition of physical activity as an important component of treatment for other mental disorders including depression (Schuch et al. 2016a, c; Stanton and Reaburn 2013) and schizophrenia (Firth et al. 2015). Similarly, since the 2010 sports and games for PTSD Cochrane Review, a number of randomized controlled trials have been published regarding the efficacy of exercise as a component of treatment. A 2015 meta-analysis identified four unique RCTs, encompassing a total of n = 200 participants with a mean age of 34–52 years (Rosenbaum et al. 2015c). One key methodological difference between the 2015 review and the 2010 Cochrane Collaboration review was the use of ‘physical activity’ as defined by Caspersen, Powell, and Christenson (Caspersen et al. 1985), as opposed to the more restricted and structured subset of exercise and/or sports. Applying this inclusion criterion allowed for pragmatic interventions such as physical activity counseling and yoga to be potentially eligible, better reflecting clinical practice. The meta-analysis revealed considerable heterogeneity regarding study design, methodological quality, exercise intervention variables and choice of control conditions. Results revealed that physical activity was significantly more effective compared to control conditions at decreasing symptoms of PTSD and depression symptoms among people with a diagnosis of PTSD. The review concluded that physical activity may be a useful adjunct to usual care to improve the health of people with PTSD and despite the relative paucity of data, clinicians should be optimistic regarding the inclusion of physical activity as an intervention for people with PTSD. Details of the identified trials, incorporating structured aerobic and resistance exercise, yoga and treadmill-based aerobic exercise are summarized below (see Table 1).

5.1 Structured Exercise and PTSD

Two trials have determined the efficacy and effectiveness of exercise as an intervention strategy for PTSD (Powers et al. 2015; Rosenbaum et al. 2015a). The trial of Powers et al. recruited participants from the community in Dallas, USA, who were screened positive for PTSD, and were randomized to receive either 12 weeks of prolonged exposure therapy (90 min, one weekly session) or prolonged exposure in addition to exercise. The exercise intervention involved 30 min of moderate intensity (70% of age-predicted maximum heart rate) treadmill exercise supervised by a clinician.
### Table 1  Description of PTSD and physical activity RCTs (n = 4)

<table>
<thead>
<tr>
<th>Trial</th>
<th>Age mean (SD)</th>
<th>Intervention</th>
<th>Diagnostic criteria</th>
<th>Control</th>
<th>Outcome (s)</th>
<th>Setting</th>
<th>Methodological quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitchell, 2014</td>
<td></td>
<td>12 sessions Kripalu (Hatha) yoga (1/wk for 12 weeks or 2/wk for 6-weeks)</td>
<td>Presence of at least one symptom in each DSM criterion cluster or meeting criteria for at least two symptom clusters</td>
<td>No treatment</td>
<td>PSS-I</td>
<td>Advertisement at Veteran Affairs medical Centre</td>
<td>No</td>
</tr>
<tr>
<td>N = 38</td>
<td></td>
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<tr>
<td>Powers, 2015</td>
<td>34 (11.8)</td>
<td>12 sessions of moderate-intensity aerobic exercise (stationary cycling, 70% age predicted max heart rate); in addition to prolonged exposure therapy</td>
<td>DSM</td>
<td>PSS-I</td>
<td>Online advertising</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>N = 17</td>
<td></td>
<td></td>
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<tr>
<td>Rosenbaum, 2015</td>
<td>47.1 (11.3)</td>
<td>12 weeks of supervised, individualised combined aerobic/resistance exercise in addition to usual care</td>
<td>DSM</td>
<td>Usual-care</td>
<td>PCL-C</td>
<td>Inpatients</td>
<td>Yes</td>
</tr>
<tr>
<td>N = 81</td>
<td>52.0 (12.7)</td>
<td></td>
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<tr>
<td>van der Kolk, 2014</td>
<td>41.5 (12.2)</td>
<td>10 weeks 1x weekly 60 min trauma-informed yoga</td>
<td>DSM</td>
<td>Supportive health education</td>
<td>CAPS</td>
<td>Community advertisement</td>
<td>Yes</td>
</tr>
<tr>
<td>N = 64</td>
<td>44.3 (11.9)</td>
<td></td>
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</tr>
</tbody>
</table>

*DSM* diagnostic and statistical manual mental disorders, *CAPS* clinician administered PTSD scale, *PSS-I* PTSD symptom scale-interview (Rosenbaum et al. 2015c)
The exercise intervention employed a 5-min warm-up and used increasing speed until the pre-determined target heart rate was achieved. Following the exercise session, speed was gradually reduced for 5 min followed by a period of stretching as a form of cool-down (Powers et al. 2015). In addition to a reduction in PTSD symptoms, the investigators found a significant and large impact of the exercise intervention on levels of brain derived neurotropic factor (BDNF) (Cohen’s $d = 1.08$, SE = 0.72), which has previously been implicated as a factor in the relationship between exercise and improved mental health (Schuch et al. 2016a). The authors concluded that exercise as an augmentation strategy to exposure therapy may have the potential to enhance psychological outcomes and holds promise for those who have a sub-optimal response to routine treatment, via the promotion of synaptic plasticity. While these data are encouraging regarding the efficacy and potential moderating role of BDNF in response to an exercise intervention for people with PTSD, certain limitations should be considered including the sample size ($n = 9$), which was too small to allow for between-group significance testing. In addition, these data provide useful evidence regarding the mechanism of action and augmentative benefits of specifically aerobic exercise, however, as acknowledged by the study authors, the augmentation effects of exercise are likely not limited to bouts of acute aerobic exercise, and considering other exercise modalities in combination with patient preferences and barriers, is likely to facilitate the design and delivery of best-practice, evidence-based exercise programs. In another study of $n = 33$ participants with PTSD and sub-syndromal PTSD, Fetzner and Asmundson (2015) also demonstrated the beneficial effect of aerobic exercise, with clinically significant improvements in symptoms following a brief (2-week/6-session) intervention, in which participants were randomized into one of three groups: (i) exercise plus cognitive distraction ($n = 11$), (ii) exercise plus interoceptive prompts ($n = 11$), or (iii) exercise only ($n = 11$). The overwhelming majority of the sample (89%) experienced clinically significant reductions in PTSD symptom severity following the 2-week intervention. While the lack of a control group presents a methodological limitation, the authors argue that given the ease of implementation, aerobic exercise should be considered in the treatment of PTSD-affected individuals (Fetzner and Asmundson 2015). Interestingly, baseline aerobic capacity may moderate the effects of exercise on anxiety sensitivity based on recent data demonstrating that participants with lower baseline levels of cardiorespiratory fitness, experienced greater reductions in PTSD symptoms including avoidance and hyper-arousal, as well as total, physical, and social symptoms of anxiety sensitivity following an exercise intervention (LeBouthillier et al. 2016). Investigating moderators of response in exercise trials in people with mental health disorders should be a priority for future research because such evidence may help in identifying subgroups that are more likely to benefit from exercise interventions (Schuch et al. 2016b).

The largest trial to date of structured exercise for people with PTSD was conducted in Sydney, Australia, among $n = 81$ in patients receiving treatment for PTSD (Rosenbaum et al. 2015a). Similar to the trial of Powers et al. (2015), the study aimed to investigate the impact of adding a structured exercise intervention to usual care, comprising of a combination of pharmacotherapy, group therapy and psychotherapy (e.g. trauma informed cognitive behavioral therapy). Participants received either usual care ($n = 42$), or usual care in addition to the exercise program ($n = 39$) for a period of 12 weeks. Participants were inpatients for a total period of 3 weeks and were recruited during their second week of treatment. Those randomized to the exercise intervention ($n = 39$) were provided with a 12-week exercise program, involving one supervised exercise session per week (supervised by an exercise physiologist with mental health experience), and were asked to complete a minimum of two home-based, unsupervised sessions. The intervention was a pragmatic design, reflecting clinical practice. Supervised sessions focused on increasing patient autonomous motivation towards exercise (Vancampfort et al. 2015a, 2016a), education and goal setting. Participants were provided with
a pedometer and encouraged to record their daily step count in an exercise diary. Participants were also provided with elastic exercise bands in order to perform recommended resistance training exercises. Resistance exercises focused on multi-joint (compound) exercises targeting the major muscle groups including squats, chest press and seated/standing rows. Participants were asked to record all exercises including sets and repetitions in the exercise diaries provided. These were reviewed at the weekly supervised sessions and goals adjusted accordingly. Results revealed a clinically significant impact of adding the exercise intervention to usual care, with a between group difference of $-5.4 (-10.5$ to $-0.3)$, $p = 0.04$ on the Posttraumatic Stress Disorder Checklist – Civilian scale (range = 17–85). Similarly, in line with evidence demonstrating an anti-depressive effect of exercise on symptoms of depression among people with various mental illness (Rosenbaum et al. 2014a), a significant between group difference on the Depression Anxiety and Stress Scale (DASS) was found $-17.4$ ($-28.9$ to $-6.0$), $p = 0.004$ (Rosenbaum et al. 2015a). Physical health was also assessed via the 6-min walk test and through basic anthropometric assessments including waist circumference and body weight. Overall, a reduction in cardio-metabolic risk was observed as determined by a reduction in waist circumference, body fat percentage and trend for a reduction in body weight. Of interest, the control group experienced a mean increase in body weight of 1.1 kg from baseline to follow-up, highlighting a potential preventative effect of the intervention regarding cardio-metabolic health. Several potential explanations for this increase in control group body weight can be hypothesized, namely an increase in sedentary behavior coupled with a change in dietary habits including increase in caloric consumption. The results of the trial, while promising, should be interpreted in light of methodological limitations. Firstly, the potential impact of extra time and attention that the intervention group received should be considered as a potential mediating factor explaining the relationship between the exercise intervention and improved symptoms. Although a possibility, the effects of the intervention on objectively assessed cardio-metabolic risk and self-reported walking and moderate-vigorous physical activity levels (as assessed by the International Physical Activity Questionnaire (Rosenbaum et al. 2014b)) suggest a direct impact of the exercise intervention. Secondly, no changes were reported in measures of exercise capacity (cardiorespiratory fitness and grip strength). A potential explanation for this lack of change is due to the selection of assessments used. For example the 6-min walk test, although validated for use in other psychiatric populations such as schizophrenia (Bernard et al. 2015), has not been validated specifically among people with PTSD, and use of a sub-maximal cycle ergometer protocol such as the Åstrand-Rhyming test would have provided increased specificity and reliability (American College of Sports Medicine 2013). This is particularly relevant given the relatively young mean age of participants (between 47 and 52 years).

While evidence for the effect of structured exercise on PTSD is in its infancy, current evidence base suggests that augmenting usual care with structured exercise may provide significant clinical benefits for those affected. Future research should consider building on the previous studies through programs targeting those receiving treatment in the community as well as imbedding clinical exercise programs within routine treatment.

5.2 Yoga

Yoga and the impact on psychiatric disorders including PTSD is the focus of increasing academic investigation. Two 2014 RCTs investigated the impact of yoga on people with PTSD (Kolk et al. 2014; Mitchell et al. 2014), finding evidence of a beneficial effect on psychiatric symptomatology, in line with previous reviews investigating the effect of yoga on other psychiatric conditions. Given that yoga cannot be classified as either strictly a cardiorespiratory or resistance-based activity, the promising results demonstrate that both types of activity are likely beneficial for people with PTSD. The trial of Mitchell et al.
utilized 12 sessions Kripalu (Hatha) yoga, with one session per week for a total of 12 weeks, or two sessions per week for a total period of 6 weeks. The trial of Kolk et al. used one 60-min session of trauma informed yoga for a total of 10 weeks. The authors described trauma-informed yoga as incorporating the central elements of hatha yoga (breathing, postures, and meditation) while simultaneously emphasizing curiosity about bodily sensations (Kolk et al. 2014).

In another RCT of yoga for n = 38 women with PTSD symptoms recruited from Veteran Affairs hospital, those randomized to the yoga intervention received 75-min yoga classes weekly for 12 weeks, or twice weekly for 6 weeks, depending on the participant’s preference (Martin et al. 2015). In contrast to the hypothesis that participants randomized to receive the yoga intervention (in comparison to a wait-list control group), no increase in self-reported leisure-time physical activity was observed despite a positive trend. Changes in self-efficacy and motivational regulation for exercise were found, with those in the yoga group showing evidence of a significant decrease in external regulation. Given the established importance of increasing autonomous motivation towards physical activity in order to achieve long term and sustainable lifestyle change (Vancampfort et al. 2015e, 2016a), these findings offer promise regarding the optimal method of delivering interventions for people with PTSD and maximizing adherence.

6 Methodological Considerations and Implications for Future Research

Interpreting the evidence base regarding the impact of exercise on PTSD should be undertaken in light of significant progress that has been made regarding exercise and the treatment of other mental health conditions. For example, recent reviews have found that the analysis of the exercise and depression literature has repeatedly and systematically underestimated the impact of exercise on both depressive symptoms and major depression due in part to publication bias and a large control group response in clinical trials (Schuch et al. 2016c; Stubbs et al. 2016a). The exercise and PTSD literature is at risk of similar interpretations, and future trials should, as a priority, be designed with these caveats in mind.

Similarly, drawing on the depression and schizophrenia literature, trials utilizing trained professionals with clinical training in exercise prescription (such as physiotherapists and exercise physiologists) have repeatedly been shown to reduce drop-out and maximize adherence to exercise-based interventions (Stubbs et al. 2016c; Vancampfort et al. 2016c). Furthermore and somewhat unsurprisingly, among people with major depressive disorder, greater baseline symptom severity predicts greater drop-out from exercise interventions highlighting the importance of addressing motivation as a key component of exercise interventions (Stubbs et al. 2016c). Given recent data indicating that people with PTSD highly value, are preparing for and feel ready to engage in healthier lifestyles (Klingaman et al. 2015), ensuring that interventions maximize external validity by including a motivational component is of key importance.

In order to justify the inclusion of exercise programs as a routine component of treatment for PTSD, cost-benefit analysis are required in order to determine and quantify the financial implications of diverting resources or investing funds into such initiatives. Such economic rationales must aim to include cost-savings associated with prevention in the context of the treatment of physical health comorbidities and ideally potential benefits regarding preventing future episodes of poor mental health.

While evidence of the efficacy of exercise and physical activity interventions in the treatment of PTSD is increasing, effectiveness research capable of driving practice change, along with policy level research is urgently required. Such an argument has been made for physical activity research more broadly (Rutten et al. 2016), yet is particularly pertinent in a condition such as PTSD where the prevalence, cost of treatment and overall burden is increasing.
7 Conclusion

PTSD is a pervasive condition associated with poor health outcomes including high rates of cardio-metabolic disease. Exercise and physical activity more broadly (including yoga-based interventions) offer promise as accessible, feasible, and effective components of care. The evidence to date overwhelmingly support inclusion of structured exercise as a component of standard care. Given the established impacts of exercise on improving cardio-metabolic health, fitness and symptoms of other mental health conditions including depression, failing to provide access to supported exercise programs, should be considered as a failure to provide best-practice, evidence-based care for people with PTSD.

References


