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Yoga Resilience Training to Prevent the Development of Posttraumatic Stress Disorder in Active-Duty First Responders: A Cluster Randomized Controlled Trial

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Objective: Evidence on effective prevention of posttraumatic stress disorder (PTSD) is sparse, particularly among first responders. This study evaluated the effectiveness of a Tactical Mind–Body Resilience Training program on PTSD symptoms in first responders. ***Method:*** Active-duty first responders ($n = 80$; $M_{age} =$ 41.8 years, 82.5% men) were randomized to the intervention group or the waitlist control condition. PTSD symptoms as measured by the PTSD-8 were the primary outcome assessed at postintervention and at 3-month follow-up. Secondary outcomes were cognitive and emotional coping strategies, resilience, somatic symptoms, work performance, and sickness absence. ***Results:*** At postintervention, the intervention group had significantly reduced PTSD symptoms compared to the control group ($d = -0.26$, difference $= -2.52$, 95% confidence interval [CI] [−4.93, −0.11], $p = .040$); however, this difference was attenuated at 3-month follow-up ($d = -0.07$, difference $= -1.41$, 95% CI [−3.83, 1.01], $p = .248$). The intervention group had significant improvements in cognitive reappraisal and resilience at postintervention compared to the control group, which were sustained at 3 months. The remaining secondary outcomes had statistically nonsignificant improvements. ***Conclusions:*** This workplace-delivered intervention shows potential in preventing the development of PTSD in first responders. Further research is needed on maintaining long-term benefits of this training.

Clinical Impact Statement

Effective preventative interventions are needed to reduce the burden of PTSD among first responders. This is the first study to provide evidence for a tactical mind–body resilience training program in reducing symptoms of PTSD in the short term, as well as for improving adaptive strategies in active-duty first responders. Sustained improvements in PTSD symptoms for individuals with subthreshold PTSD show further potential for this training as a preventative intervention in reducing the future risk of PTSD among first responders.

Keywords: first responders, posttraumatic stress disorder, prevention, yoga, mind–body

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Leona Tan served as lead for formal analysis, project administration, and writing–original draft and contributed equally to investigation. Mark Deady, Rebecca M. Foright, Eric M. Brenneman, and Richard A. Bryant served in a supporting role for writing–review and editing. Olivia Mead served in a supporting role for resources and writing–review and editing. Samuel B. Harvey served as lead for supervision and served in a supporting role for writing–review and editing. Leona Tan, Mark Deady, and Samuel B. Harvey contributed equally to conceptualization.

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Many first responders experience cumulative exposure to potentially traumatic events, which can have an adverse impact on their mental health (Harvey et al., 2016). Global reports of posttraumatic stress disorder (PTSD) are approximately 10% in first responders (Berger et al., 2012; Petrie et al., 2018), compared to 4% in the general population (Liu et al., 2017). While there is a strong evidence base for first-line treatments such as trauma-focused cognitive-behavioral therapy, meta-analyses have suggested that only half achieve remission when defined as no longer meeting the criteria of a PTSD diagnosis (Springer et al., 2018). First responders have a distinct clinical profile compared to civilians, which may explain poor treatment response in this population (Bryant, 2022). Furthermore, first responders are reluctant to seek help because of stigma, fears of negative impact on employment, as well as other barriers to care (Haugen et al., 2017; Jayasinghe et al., 2005). As a result, there have been increased calls for more preventative and novel approaches to broaden the range of strategies needed for first responders, including workplace interventions that can be delivered across the organization (World Health Organization, 2022).

Although the need for prevention strategies is increasingly recognized, evidence on effective prevention of PTSD is limited. A meta-analysis of pharmacological and psychosocial interventions to prevent the onset of PTSD in trauma-exposed adults found overall low-quality evidence for interventions delivered pre- or postincident within 3 months of trauma exposure, with insufficient evidence to strongly recommend any intervention as routine delivery for the prevention of PTSD (Bisson et al., 2021). Furthermore, as there was a clear absence of studies in the meta-analysis involving first responders, it remains unclear how best to prevent the development of PTSD in these professions with repeated and ongoing exposure (Wild et al., 2020). In a rare prospective study of pretrauma risk factors conducted among a large cohort of paramedics (Wild et al., 2016), the study found that targeting modifiable cognitive strategies may be promising in preventing the development of PTSD and depression. These modifiable risk factors include both adaptive and maladaptive strategies such as perceived resilience, suppression, avoidance coping styles, and social support. There is also increasing evidence showing that physical (pain and somatic) symptoms following trauma exposure precede and may even predict later PTSD psychopathology (Graham et al., 2022; McFarlane, 2010; Stensland et al., 2020). Yet the underlying physiological and biological mechanisms associated with trauma exposure and PTSD are rarely targeted by existing treatment and prevention efforts, and somatic experiences of individuals remain largely neglected (Daskalakis et al., 2016; Graham et al., 2022). While research on the precise pathways and mechanisms linking trauma exposure, physical symptoms, as well as PTSD is ongoing, there are increasing calls for better integration of psychological and physical health strategies in prevention and early intervention efforts (McFarlane, 2017; Milligan-Saville et al., 2017). This is of particular importance for first responders who are at significant risk of psychological as well as physical injury due to their ongoing exposure to physical and psychological hazards (Gray & Collie, 2017; Milligan-Saville et al., 2017, 2018).

One such intervention that has the advantage of targeting both physical and psychological health, and that is growing in acceptability, is mind–body exercise (MBE; Clarke et al., 2018; Li et al., 2020). While there currently is no consensus on how MBE interventions are defined, these generally comprise practices that combine mindfulness and breathing techniques, as well as controlled physical movement (Gendron et al., 2018; Li et al., 2020). MBE interventions include stand-alone interventions such as yoga or tai chi, or could be included as part of a broader intervention such as mindfulness-based stress reduction (MBSR), a standardized program comprising yoga, mindfulness meditation, and facilitated group discussions (Kabat-Zinn, 1990). Previous reviews on yoga have demonstrated small to moderate effectiveness in the treatment of PTSD (Bisson et al., 2020; Cramer et al., 2018; Gallegos et al., 2017), and evidence has been found for yoga in improving regulation of autonomic nervous system functioning and hypothalamic–pituitary–adrenal system (Pascoe et al., 2017), as well as severity of somatization disorders (Lakhan & Schofield, 2013). MBSR has also been shown to increase activation in brain regions involved in the fear response, as well as cognitive and emotional processes and that have been implicated in the pathophysiology of PTSD (Bremner et al., 2017). Moderate effects have been found for yoga and meditation in improving PTSD symptoms among Veterans (Gallegos et al., 2017), another high-risk cohort with similar occupational characteristics to first responders. Furthermore, a meta-analysis found potential evidence for MBE interventions in preventing the development of PTSD in the short term (Tan et al., 2023). Despite these promising findings, evidence on MBE interventions is limited by the small number of high-quality studies (Cramer et al., 2018; Gallegos et al., 2017; Tan et al., 2023). Nonetheless, current guidelines consider these interventions a potential priority candidate for further research on the prevention and treatment of PTSD (Bisson et al., 2019). Moreover, MBE interventions have similar advantages to low-intensity interventions where it does not require mental health specialists to facilitate its delivery (Dawson et al., 2015), does not bear the stigma associated with mental health care, and can be easily adapted for professional groups within the workplace. Taken together, further research is warranted to determine the potential of MBE interventions in preventing the development of PTSD among first responders.

The primary aim of this study was to determine if a workplace-delivered mind–body tactical resilience training program would be more effective than a waitlist control condition in reducing PTSD symptoms among active-duty first responders. Secondary outcomes include modifiable risk factors such as cognitive and emotional strategies, resilience, somatic symptoms as well as self-reported work performance and sickness absence.

Method

Participants

Five first responder organizations consisting of one police department and four fire departments based in metropolitan and regional areas of Colorado in the United States were invited to participate in the research study. Recruitment was conducted in February 2022. A point of contact within each organization notified relevant employees of the study and interested individuals within their respective shifts were invited to participate in the research study. Upon input from operational shifts, the participating organizations informed the research team of the number of shifts interested in participating to enable the randomization process. Eligible participants were required to be over 18 years of age, currently residing in the United States and active-duty and operational frontline first responders (either law enforcement, firefighters, paramedic or emergency medical technicians, and dispatchers). The exclusion criteria were previous participation in the YogaShield Yoga For First Responders (YFFR) training and performing nonoperational duties. Participation in the study

was voluntary. Ethics approval was obtained prior to commencement of the study through the Human Research Ethics Committee at the University of New South Wales (UNSW) in December 2021 (HC210832), and prospectively registered with the Australian New Zealand Clinical Trials Registry (ACTRN 12621001670864).

Design

The study utilized a cluster randomized controlled trial (cRCT) study design. Interested participants were invited to enroll prior to randomization using an online sign-up Google form to provide their contact details as well as shifts. Randomization occurred with 13 clusters grouped according to participants' operational shifts, with each cluster ranging between two and 11 individuals. An independent researcher who was not part of the study research team performed the randomization using an online random sequence generator, and randomly allocated the two groups to either the intervention or waitlist control condition. Neither the research team nor the participants were blinded to their randomization status. All organizations had a random combination of intervention and control study conditions apart from one organization which only had one shift express interest in participating and was randomly allocated to the control condition.

Upon randomization, a member of the research team informed each organization's point of contact which shifts were allocated to each study condition. The point of contact then emailed all interested shifts to inform them of which study condition they had been allocated to and directed to the study landing page. Upon consent, participants were automatically directed to the baseline questionnaire. Measures were administered at three timepoints: at baseline (T0) prior to the intervention group receiving their training, postintervention (T1) immediately after the intervention group had completed their training, and at 3-month follow-up (T2). Data collection at all timepoints was administered via an online survey using the RedCap platform (Harris et al., 2019) hosted at UNSW. The intervention group began their training within 2–3 weeks of completing the baseline survey.

Reporting of the intervention followed the CLARIFY guidelines (see the online supplemental materials; Steffany et al., 2021). The Tactical Mind–Body Resilience Training program was previously developed by YFFR (2022). A full description of the intervention training program is provided in the online supplemental materials. To monitor adverse events, facilitators were asked to report any adverse events to the research team and participants were advised prior to commencement of the research study to report any events including complaints and concerns to the University's Human Research Ethics Coordinator. Contact details of the coordinator were provided in the participant information statement and consent form as part of the recruitment procedure. The waitlist control group were offered the same training program at the conclusion of the study.

Measures

Sociodemographic information collected included age, gender, occupation type, employment status, length of service, and previous yoga or resilience training. Exposure to critical incidents involving serious injuries and fatalities was based on a previous study on first responders (Milligan-Saville et al., 2018). Two additional items asked participants to indicate any direct or indirect experience of physical or sexual assault and if any of these events occurred to a close family member or friend. These questions were derived from Criterion A of the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*) PTSD Diagnostic Criteria (American Psychiatric Association, 2013). Participants were also asked to indicate the frequency in which they had practiced mind–body techniques (breathwork, yoga, and meditation) in the past month. Frequency of practice was assessed using one of six categories (daily, almost daily, 3–4 times a week, once or twice a week, less than 5 times in the past month, or did not practice at all).

The primary outcome of PTSD symptoms was measured using the PTSD-8 (Hansen et al., 2010), an abbreviated version of the Harvard Trauma Questionnaire (Mollica et al., 1992). It measures three symptom clusters of the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.) criteria for PTSD criteria: four items on intrusion, and two items on the avoidance and hypervigilance clusters each. Responses were rated on a 4-point Likert scale ($1 =$ *not at all*, $4 =$ *most of the time*). The cutoff criterion for likely PTSD is calculated by a combination of at least one symptom with an item score of 3 or higher from each of the three PTSD symptom clusters. It has been shown to have good sensitivity and specificity, as well as high overall accuracy when validated against a diagnostic clinical interview for PTSD (Andersen et al., 2018). Total summed scores are an indication of symptom severity. Good internal consistencies have been demonstrated in previous trauma-exposed samples ($\alpha = .83, .84, .85$, respectively; Hansen et al., 2010).

Secondary outcome measures included the Kessler Psychological Distress Scale (Kessler et al., 2002), the Emotion Regulation Questionnaire (Gross & John, 2003), the Stress Mindset Measure (Crum et al., 2013), the Short Form Perceived Stress Scale (Cohen & Williamson, 1988), the Brief Resilience Scale (Smith et al., 2008), an abbreviated version of the Patient Health Questionnaire for somatic symptoms (Kroenke et al., 2002), self-reported work performance (Kessler et al., 2003) and sickness absence (detailed information on each measure is provided in the online supplemental materials due to space constraints).

Sample Size and Data Analysis

Power was calculated using the G*Power tool (Faul et al., 2009) based on a previous review on yoga training which found small to moderate effects on PTSD symptoms (Gallegos et al., 2017). To detect an estimated effect size Cohen's d of 0.3, between-group difference with 80% power, $\alpha = .05$, and account for the clustered RCT design with an assumed four people per cluster and an intraclass correlation (ICC) of .05, a total of 83 participants were required for the study. To account for an expected 25% loss to follow-up, the total sample size we aimed to recruit was 110, with 55 participants in each study condition.

Primary and secondary outcome analyses were undertaken using the intention-to-treat principle, where participants were analyzed according to their original assigned group regardless of adherence, deviation from the assigned intervention or withdrawal (Fisher et al., 2017; Newell, 1992). Data analysis was performed using SPSS Version 27 (IBM Corp., 2020). The MIXED procedure in SPSS was used to conduct linear mixed models (mixed-model repeated measures) to assess significance of change in primary and secondary outcomes. Restricted maximum likelihood estimated was used to account for missing data. Clustering of each shift of participants

was accounted for by a random cluster membership factor, and an unstructured variance–covariance matrix was used to accommodate the relationships between observations at the three different measurement timepoints, from baseline (T1) to the final 3-month follow-up (T3). Analyses included fixed effects for group, time, Group × Time interaction, as well as any statistically significant group differences at baseline. Secondary analyses of differential intervention effects for those with subthreshold and full PTSD were also conducted, as well as per-protocol analyses for those who successfully completed the baseline and follow-up assessments.

Results

A total of 80 first responders ($M_{age} = 41.8$ years, $SD = 9.8$) consented to participate in the study and completed the baseline survey. Figure 1 details the study flow diagram according to the Consolidated Standards of Reporting Trials (CONSORT) guidelines (Schulz et al., 2010). At postintervention, there was a 38% loss to follow-up, and at 3-month follow-up, there was a 51% loss to follow-up. There were no baseline differences between groups for those who completed follow-up and those who did not. Little's MCAR test for all outcome variables was not significant ($p = .563$), suggesting data could be considered missing at random.

Table 1 shows the demographic characteristics for each group at baseline. At baseline, no significant differences were found between the groups for any of the demographic variables or previous yoga or resilience training. The control group reported significantly higher levels of exposure to critical incidents involving serious injury ($p < .001$) as well as incidents involving fatalities or the threat of death ($p = .004$), although more than half of the intervention group reported the same level of exposure. No significant differences were found for other types of critical incidents. At baseline, 29% ($n = 23$) of participants met criteria for PTSD, however, there were no significant differences between groups for those meeting criteria for PTSD ($p = .749$) or psychological distress ($p = .414$).

Although the cRCT design was undertaken to minimize cross-contamination between groups, there were some deviations between the groups. Nine participants from one shift within the control group misunderstood their assigned study condition and attended the training despite being informed by the point of contact of their assigned group, and three participants from one shift within the intervention group were inadvertently misinformed of their assigned study condition. Ten participants in the intervention group did not attend the training for unknown reasons. Within the intervention group, no baseline differences were found for those who attended the training and those who did not for any of the demographic variables, symptoms of PTSD, or psychological distress ($p > .05$). The full study sample ($N = 80$) based on the original group assignment was retained despite nonadherence or withdrawal, in accordance with intention-to-treat analysis principles and the study protocol. No adverse events were reported throughout the study.

The ICC for primary outcome of total PTSD symptoms was .156. All main analyses on primary and secondary outcomes controlled for baseline differences in critical incidents involving serious injury and fatalities. At T1 there was a significant difference between groups for total PTSD symptoms, with Cohen's $d = -0.26$ (difference = −2.52, 95% confidence interval [CI] [−4.93, −0.11], $p = .040$). However, this difference was attenuated at T2, Cohen's $d = -0.07$ (difference = −1.41, 95% CI [−3.83, 1.01], $p = .248$). There was no significant interaction for condition by time across the whole study, $F(2, 42.36) = 2.22$, $p = .121$. Figure 2 displays the change in PTSD score for both groups across all timepoints.

The mean change and group differences for secondary outcomes are shown in Table S1 in the online supplemental materials (due to space constraints). No significant between-group differences were found for psychological distress or perceived stress symptoms at any timepoint ($p > .05$). The intervention group had significantly improved cognitive reappraisal scores at T1 (difference = 3.68, 95% CI [0.22, 7.14], $p = .038$) and at T2 (difference = 3.61, 95% CI [0.35, 6.86], $p = .030$) compared to the control group. Resilience had also significantly increased at T1 (difference = 2.65, 95% CI [0.94, 4.35], $p = .003$) and at T2 (difference = 2.23, 95% CI [0.26, 4.21], $p = .027$) in the intervention group compared to the control group. The intervention group showed a significant improvement in expressive suppression (difference = −1.99, 95% CI [−3.93, −0.06], $p = .043$) and stress mindset (difference = 3.29, 95% CI [0.24, 6.34], $p = .035$) at T1 compared to the control group but not at T2 (difference = −0.92, 95% CI [−3.24, 1.41], $p = .433$ and difference = 1.65, 95% CI [−1.99, 5.30], $p = .367$, respectively). A marginal significant improvement for somatic symptoms in the training group compared to the control group was detected at T1 (difference = −1.54, 95% CI [−3.08, −0.01], $p = .049$), but not at T2 (difference = −0.88, 95% CI [−2.29, 0.53], $p = .213$). No significant differences were found for self-reported work performance or sickness absence at T1 or at T2.

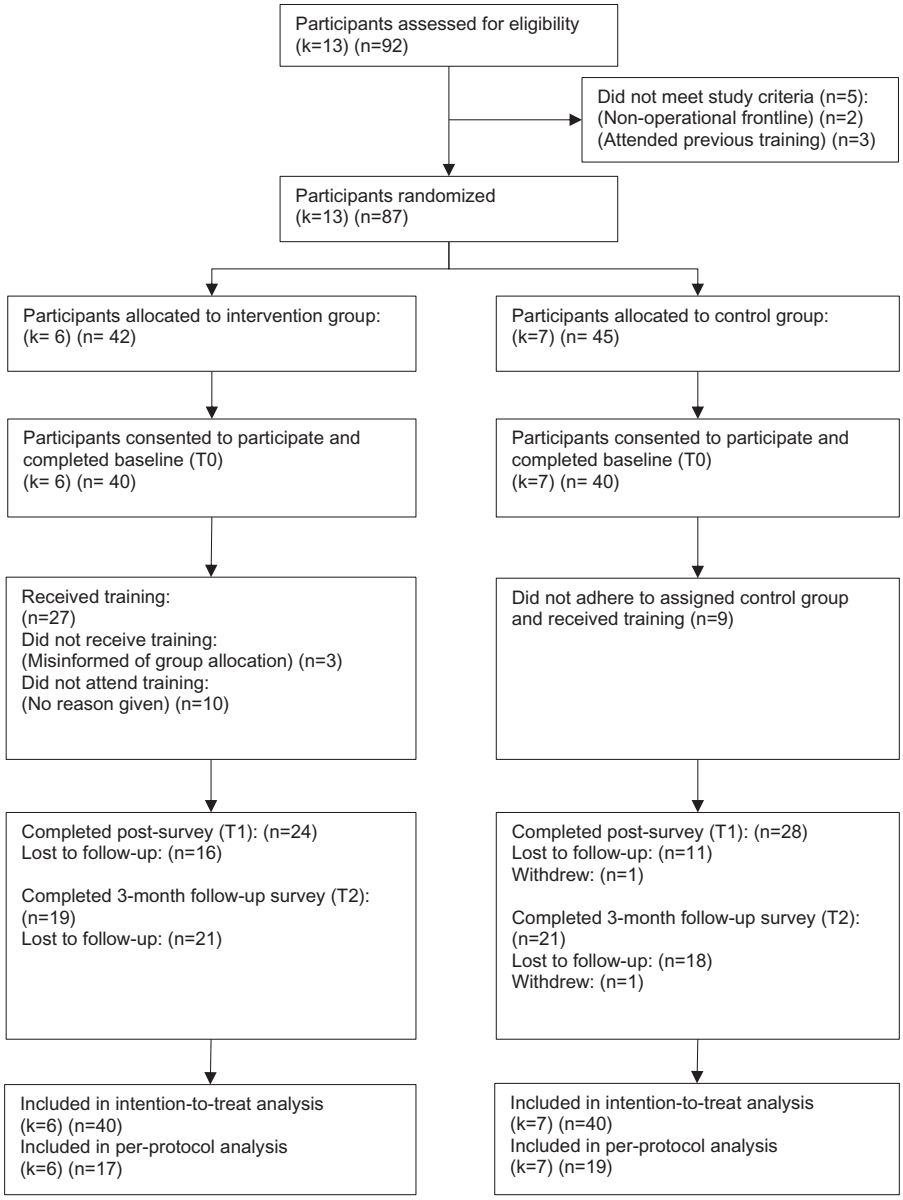
Further prespecified secondary analyses were conducted to determine differential intervention effects on those with subthreshold symptoms (21.3%, $n = 17$) as well as full PTSD (28.8%, $n = 23$). Given that the PTSD-8 scale does not have a clinical cutoff for subthreshold PTSD, we used a median baseline score of 16. A significant group by time effect was found for subthreshold PTSD, $F(2, 26.48) = 7.57$, $p = .003$, with the intervention group reporting statistically significantly reduced scores at both T1 (difference = −5.25, 95% CI [−10.07, −0.43], $p = .034$) and T2 (difference = −5.76, 95% CI [−9.55, −1.97], $p = .003$). No significant differences were found for the full PTSD sample at T1 ($p = .715$) or T2 ($p = .164$).

Per-protocol analysis was performed at the 3-month follow-up based on adherence to the study protocol, where participants in the intervention group received the training and completed the final follow-up assessment ($n = 19$), and participants in the control group adhered to their assigned group and completed the final follow-up assessment ($n = 17$). Figure S1 in the online supplemental materials shows the mean change scores at 3-month follow-up for PTSD symptoms for the control group, the training group who continued to practice the training techniques less than once a week, and the training group who practiced at least once a week. Although both training groups appeared to have reduced symptoms compared to the control group, these differences did not reach statistical significance ($p > .05$).

Discussion

This study is the first RCT to examine the effectiveness of a workplace mind–body resilience training for active-duty first responders in reducing symptoms of PTSD. At postintervention, a significant small effect was found in the intervention group for reduced PTSD symptoms compared to the waitlist control group, however, this difference was attenuated at 3-month follow-up. Secondary

Figure 1
Study Flow Diagram



Note. T0 = baseline; T1 = postintervention; T2 = three-month follow-up.

analyses examining differential effects showed significant improvements in those with subthreshold PTSD across the study, but no significant effect among those with full PTSD, highlighting the potential of this training program for selective prevention of PTSD. Analyses of secondary outcomes also showed significant improvements in the training group for cognitive reappraisal and resilience at postintervention and 3-month follow-up. Overall, our results show promise for workplace mind–body resilience training as a potential means of preventing the development of PTSD among active-duty first responders in the short term, as well as for improving adaptive strategies.

Our findings support previous trials on MBE interventions for trauma-exposed populations on posttraumatic stress symptoms (Kelly & Garland, 2016; Saban et al., 2022) and the small effect size at postintervention is consistent with a previous review on MBE for preventing the development of PTSD (Tan et al., 2023). While we did not find any differential effects on individuals with full PTSD, our significant findings for individuals with subthreshold PTSD have important implications around early interventions and possible selective prevention of PTSD (Fink et al., 2018). These findings are noteworthy as individuals with subthreshold PTSD often experience substantial impairment in functioning, high comorbidity with mental and physical disorders (Pietrzak et al., 2011). Furthermore, a national cohort study of U.S. Veterans found that individuals with subthreshold PTSD were more than 6 times likely to develop full PTSD over a 7-year follow-up period, highlighting

Table 1
Study Sample Baseline Characteristics

Baseline characteristics	Intervention group ($N = 40$) *n* (%)	Control group ($N = 40$) *n* (%)	Test of difference between groups *p*
Age in years, *M* (*SD*)	39.9 (10.1)	43.8 (9.1)	.071
Gender			
Man/male	31 (77.5)	35 (87.5)	.380
Woman/female	8 (20)	5 (12.5)	
Nonbinary	1 (2.5)	Nil	
Occupation group			
Law enforcement	11 (27.5)	3 (7.5)	.057
Firefighters	20 (50)	32 (80)	
Firefighter and paramedic/EMT	7 (17.5)	4 (10)	
Dispatcher	1 (2.5)	Nil	
Years of experience			
<1	1 (2.5)	Nil	.076
1–5	8 (20)	2 (5)	
Between 5 and 10	9 (22.5)	9 (22.5)	
Between 10 and 15	5 (12.5)	4 (10)	
Between 15 and 20	4 (10)	11 (27.5)	
More than 20	13 (32.5)	14 (35)	
Employment status			
Full-time	39 (98.8)	40 (100)	.314
Part-time	1 (2.5)	Nil	
Previous yoga or resilience training			
No	27 (67.5)	28 (70)	.809
Yes	13 (32.5)	12 (30)	
Number of incidents attended where one or more individuals were seriously injured			
0	1 (2.5)	Nil	.004*
1–5	5 (12.5)	1 (2.5)	
6–10	5 (12.5)	2 (5)	
11–20	6 (15)	2 (5)	
21 or more	23 (57.5)	35 (87.5)	
Number of incidents attended involving one or more fatalities or the threat of death			
0	2 (5)	Nil	<.001**
1–5	6 (15)	Nil	
6–10	4 (10)	Nil	
11–20	5 (12.5)	1 (2.5)	
21 or more	23 (57.5)	39 (97.5)	
Number of incidents attended with direct or indirect experience of physical or sexual assault			
0	8 (20)	10 (25)	.833
1–5	13 (32.5)	16 (40)	
6–10	3 (7.5)	3 (7.5)	
11–20	6 (15)	4 (10)	
21 or more	10 (25)	7 (17.5)	
Number of incidents listed above that involved a close family member or friend			
0	17 (42.5)	16 (40)	.769
1–5	19 (47.5)	20 (50)	
6–10	3 (7.5)	3 (7.5)	
11–20	1 (2.5)	Nil	
21 or more	Nil	1 (2.5)	

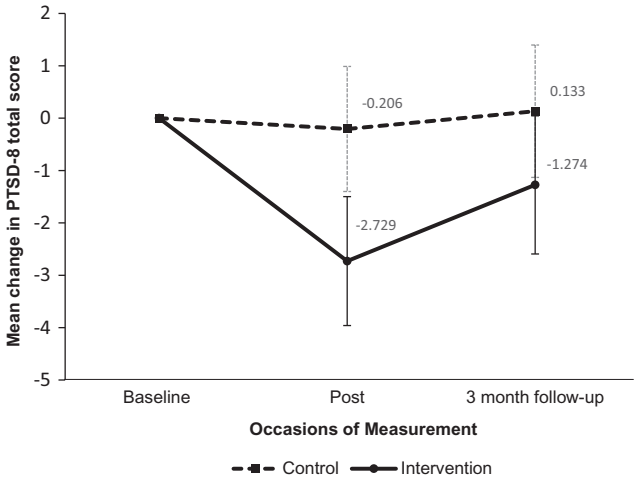
Note. Test of difference between groups carried out using *t* test for age, chi-square with linear-by-linear association for years of experience, and the number of critical incidents attended. EMT = emergency medical technician.
* $p < .05$. ** $p < .001$.

the importance of preventative interventions for this high-risk group (Pietrzak et al., 2021).

Although our study did not examine possible mediators, analyses of secondary outcomes suggest that this intervention may be able to influence key modifiable mechanisms associated with PTSD, including emotion regulation, as suggested by a previous RCT of yoga on women with subthreshold or full PTSD (Dick et al., 2014). Emotion regulation, which includes cognitive reappraisal and expressive suppression strategies, is a promising predictor of the development and maintenance of PTSD psychopathology (Ehring & Quack, 2010; Villalta et al., 2018). The significant finding of cognitive reappraisal at both postintervention and at 3-month follow-up may be indicative of the strength of the program in applying reframing techniques through physical and mental challenges specific to first responder

Figure 2

Mean Change Scores and Standard Error for PTSD Total Symptoms



Note. Change in estimated marginal means for PTSD-8 total scores are shown for intervention and control groups. Error bars represent standard errors. PTSD-8 = eight-item Posttraumatic Stress Disorder Scale; PTSD = posttraumatic stress disorder.

work. Our significant finding on resilience also lends support for mindfulness-based training in improving perceived resilience in first responders (Joyce et al., 2019), suggesting that this type of training is helpful for improving participants' perceptions of their ability to recover from adverse experiences. Although some secondary outcomes had improved postintervention, these were not sustained at 3-month follow-up. It is likely that improvements in these areas may require consistent practice and ongoing training. While the study's scope limited the training to a short-term period, the training program is designed to be delivered continuously, subject to budgetary constraints of the first responder organization. Similar to other psychosocial interventions administered by nonclinical personnel (Dawson et al., 2015), ongoing training is likely needed for skill retention, particularly for first responders with ongoing exposure.

Our study addresses a research gap among first responders and adds to the limited studies on evidence-based PTSD prevention strategies. Despite these strengths, our study is not without important limitations. First, our study experienced low retention rates in the follow-up assessments, which may have introduced some bias. Although it is not known why this loss occurred and how these may have influenced the results, similar response rates across both study conditions were found. Furthermore, the use of linear mixed models has been shown to be a robust way of addressing missing data and provides unbiased estimates of intervention effects (Ashbeck & Bell, 2016). Our study also experienced issues with program adherence, where some participants did not adhere to their assigned intervention group. Regardless, deviations were not imbalanced across groups and the intention-to-treat analysis is a conservative approach that preserves the value of randomization and underestimates treatment effects (Fisher et al., 2017). Second, sampling bias may have occurred as this type of intervention may have attracted symptomatic individuals or those already interested in mind–body interventions, which may limit its generalizability. It is also not known if participants had received or adjusted treatment for mental health conditions during the study duration, however, participants were all active-duty first responders, and none were on long-term sick leave. Third, although the use of a cRCT design is a robust method of evaluation to eliminate selection biases, the control group had a significantly higher proportion of participants attending critical incidents involving serious injuries and fatalities. However, more than half of the intervention group had been exposed to these incidents, and differences were controlled for in the main analyses. Our study was also limited by a waitlist control condition, which may have introduced a level of expectancy bias. Future trials should incorporate the use of an active control condition to limit possible biases.

Despite these limitations, the training has several additional benefits. The standardized training protocol and curriculum allows for consistency in its delivery, making it suitable for wider implementation. Instructors trained and certified in delivering the YFFR training protocol are often first responders themselves, including peer support officers, allowing for practical and wide dissemination of the training, as well as ease of access (YFFR, 2022). In addition, the kinesthetic and experiential techniques that emphasize job-specific application provide participants with practical skills that can be applied throughout their daily lives, on and off the job. The training also has the advantage of integrating physical and psychological health strategies, and its emphasis on job-specifics and practical skills does not bear the stigma of mental illness. However, as the focus of the study was mostly on psychological measures, efficacy of the training in addressing physical health symptoms was limited to only one measure on somatic symptoms. This abbreviated measure may have not accurately captured these or other physical conditions.

Overall, our study demonstrates the potential of a workplace delivered mind–body resilience training for first responders in preventing the development of PTSD. Given the elevated rates of mental health problems among first responders, our findings show the potential value of this type of intervention that can be delivered as part of preventative occupational training for first responders. Further research is needed to determine how to sustain the benefits of this training in the long term.

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