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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| **“In military personnel with mild traumatic brain injury and post-traumatic stress disorder, does yoga improve sleep quality and increase heart-rate variability?”** |

**AUTHOR**

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**CLINICAL SCENARIO**

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| Twenty-percent of military personnel who sustain mild traumatic brain injuries (mTBI) develop post-traumatic stress disorder (PTSD), and/or emotional trauma (Stoller, Greuel, Cimini, Fowler, & Koomar, 2011). PTSD includes symptoms such as: difficulty sleeping, reduced quality of sleep, increase in stress, Circadian rhythm changes, increased variability in heart rate, caregiver burden, potential disruptions in social and interpersonal lives, and sometimes dependency or addiction (Kim et al., 2013, Libby et al., 2012, Mitchell et al., 2014, Stoller et al., 2012). If not treated, PTSD may lead to substance abuse, domestic violence, divorce, job loss, financial difficulties, homelessness, suicide, and most often disruption in family, social, and occupational life (Stoller et al., 2011). Unfortunately talk therapies have had limited success in treating these symptoms (van der Kolk et al., 2014; Stoller et al., 2011). Mind-body interventions have been shown to be helpful in PTSD symptom reduction in military personnel with PTSD without TBI, women who have experienced trauma, as well as children and adolescents who have been in natural disasters, potentially due to treatment of autonomic hyperarousal (Stoller et al., 2012, Libby et al., 2012, Seppala et al., 2014, Staples et al., 2013).  This CAT seeks to investigate whether mind-body interventions such as meditation, yoga, tai chi, qigong, or mindfulness based stress reduction (MBSR) can help reduce the aforementioned symptoms associated with PTSD and improve quality of life in military personnel who have sustained a mTBI. |

**SUMMARY OF SEARCH**

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| A total of 104 studies that met the inclusion and exclusion criteria were identified. This group was narrowed down to 9 studies based on relevance to the clinical question and study quality. This group included 2 systematic reviews (SR), 5 randomized controlled trials (RCTs), and 2 case series. Due to the small amount of research on this topic not all of the studies are SR’s and RCTs, and not all studies look at military or veteran populations. A total of three studies were reviewed and discussed due to their superior quality, intervention that was closest to yoga, and use of a military population.  Of the RCTs (average Downs & Black score = 20.8/28), generally the sample sizes are small, attrition is moderate, investigators are generally not blinded to the experiment, and the discussion always includes the need for more research on yoga over a longer period of time with a larger sample size.  These studies consider a variety of types of yoga for a variety of populations who experience PTSD. The SRs used reviewed a small number of articles and looked at studies regarding different mind-body practices for PTSD, and yoga as therapy for major psychiatric disorders— there isn’t currently an SR specifically about yoga and PTSD, probably since it is such a small topic.  The three papers selected as best evidence indicate mind-body interventions significantly reduce state and trait anxiety, improve sleep quality, generally decrease in PTSD symptoms, decrease in stress levels, improve mood, and increase relaxation. |

**CLINICAL BOTTOM LINE**

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| Preliminary evidence suggests that mind-body interventions including meditation, yoga, tai chi, qigong, or MBSR significantly reduce symptoms associated with PTSD in military personnel. |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** | | | |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Stress disorder\*, post traumatic  PTSD  Post-traumatic stress disorder  Injury, Brain, Traumatic, Mild  Mild Traumatic Brain Injury  Mild TBI | Yoga | (not applicable) | Sleep quality  Sleep\*  Heart-rate  Heart rate  Heart rate variability  Heart-rate variability |

**Final search strategy: PubMed**

1. stress disorders, post-traumatic OR PTSD OR post-traumatic stress disorders
2. injury, brain, traumatic, mild OR mild traumatic brain injury OR mild TBI
3. yoga
4. sleep quality OR sleep
5. heart-rate OR heart rate OR heart rate variability OR heart-rate variability
6. #1 AND #2 AND #3 AND #4 AND #5
7. #1 AND #2 AND #3
8. #1 AND #3

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **PubMed**  **CINAHL**  **EMBASE** | **30**  **8**  **66** | **N/A**  **N/A**  **N/A** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| -published up until September 2014  -studied humans  -published in English |
| **Exclusion Criteria** |
| -case studies or case series  -abstracts, conference proceedings, letters to the editor, dissertations, narrative article reviews  -studies that involved patients with severe TBI  -studies that involved patients with orthopaedic or cardiovascular issues |

**RESULTS OF SEARCH**

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| A total of | 9 | relevant studies were located and categorized as shown in the following table (based on Levels of Evidence, Jewell, 2011)  Based on study quality:   1. (Downs & Black, 1998) for study designs other than systematic reviews, with a modified item #27, scaled 0 for no statistical significance, and maximum score of 1 for statistical significance, and a total scale score change to xx/28 2. The AMSTAR (Shea et al., 2007) quality assessment rating scale was used to assess the quality of systematic reviews |

**Summary of articles retrieved that met inclusion and exclusion criteria:**

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| **Author (Year)** | **Study quality score** | **Level of Evidence** | **Study design** |
| **1)** (Cabral, Meyer, & Ames, 2011) | **8/11** | **1a** | **SR** |
| **2)** (Dick, Niles, Street, Dimartino, & Mitchell, 2014) | **20/28** | **1b** | **RCT** |
| **3)** (Kim, Schneider, Kravitz, Mermier, & Burge, 2013) | **8/11** | **1a** | **SR** |
| **4)** (Libby, Reddy, Pilver, & Desai, 2012) | **16/28** | **4** | **Case series** |
| **5)** (Mitchell et al., 2014) | **21/28** | **1b** | **RCT** |
| **6)** (Staples, Hamilton, & Uddo, 2013) | **16/28** | **4** | **Case series** |
| **7)** (Stoller, C. C. et al., 2012) | **21/28** | **1b** | **RCT** |
| **8)** (Telles, Singh, Joshi, & Balkrishna, 2010) | **20/28** | **1b** | **RCT** |
| **9)** (van der Kolk et al., 2014) | **22/28** | **1b** | **RCT** |

**BEST EVIDENCE**

The following 3 studies were identified as the ‘best’ evidence and selected for critical appraisal. Reasons for selecting these studies were:

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| * **(Kim et al., 2013)** This is an a priori designed comprehensive literature search of four databases that included status of publication, appropriate characteristics about each study mentioned, quality methods, and conclusions based on scientific quality. * **(Stoller et al., 2012)** This study had the largest sample size, which was of military personnel. It also used intention-to-treat in the outcomes, which was rare in the studies reviewed. * **(van der Kolk et al., 2014)** This study was the stronger of two studies to blind investigators to the outcomes. It also uses intention-to-treat in the outcomes, which was rare in these studies. |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of:**

Stoller, C. C., Greuel, J. H., Cimini, L. S., Fowler, M. S., & Koomar, J. A. (2012). Effects of sensory-enhanced yoga on symptoms of combat stress in deployed military personnel. *American Journal of Occupational Therapy*, 66, 59-68. Doi: 10.5014/ajot.2012.001230.

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| **Aim/Objective of the Study:** |
| This study sought to explore the effects of sensory-enhanced hatha yoga on combat stress in military personnel deployed to Iraq. |
| **Study Design** |
| Study Design: RCT, unblended  Type of sample: simple random sample  How recruited: e-mail solicitation and flyers placed around the Forward Operating Base Warrior, Kirkuk, Iraq.  Timing of Outcome Measures: STAI, AASP, and Quality of Life survey were utilized before and after the intervention was complete, 3 weeks later  The Programs: The programs were identified as a control group (n=35) who did basic military physical activity only, and an experimental yoga group (n= 35) who did basic military physical activity and sensory enhanced hatha yoga. |
| **Setting** |
| Intervention location: a gym near the Brooke Army Medical Center, San Antonio, Texas with rubber flooring, aluminium beams, and plastic fabric walls |
| **Participants** |
| N=70  Eligibility criteria: any military personnel who had been deployed to Forward Operating Base Warrior, Kirkuk, Iraq  Type of sample: randomized by computer during initial data collection  Key Demographics:   1. Gender: 22 women (31.4%), 48 men (68.6%) 2. mean age: 32 years old, SD: 9.09 3. Branch of the military: U.S. Army: 20 participants (28.6%), U.S. Air Force: 50 participants (71.4%)   Dropouts: n= 10, all in the treatment group  Number available for follow-up: treatment group: n = 25, control group: n = 35 |
| **Intervention Investigated** |
| ***Control*** |
| The control group received no training beyond their regular military physical exercise regimen. |
| ***Experimental*** |
| Seventy-five minute sensory-enhanced hatha yoga classes led by the PI, Jon H. Greuel at a gym near San Antonio, Texas were offered seven times per week for three weeks. Participants in this intervention group were required to attend at least two classes per week and nine classes in total by the end of the three week period. The classes were based on a specialized sensory-enhanced hatha yoga program developed specifically for veterans with PTSD by co-investigator, Lucy Cimini in 2005. Elements included are: centering at the beginning, pranayama, asana, meditation, and savasana. These elements are meant to address the following: enhanced proprioceptive input, deep touch pressure, slow rhythmical movement, calming pranayama techniques, balancing of the nervous system. During class there was zen meditation music as well as selected quotations from yogis that were read while paired with specific poses.  Participants were still engaging in the regular military physical exercise regimen. |
| **Outcome Measures** |
| 1. **Adolescent/Adult Sensory Profile (AASP),**   A standardized sensory processing scoring questionnaire to help determine threshold to sensory input, and categorize patients into particular sensory profiles.  Max score: 60 items x 5-point Likert scale = 300  Administered by: self  Where: gym facility near San Antonio, Texas   1. **Spielberger Trait Anxiety Inventory (STAI)**   A standardized state and trait anxiety questionnaire  Max score: 40 items x 5-point Likert scale = 200  Administered by: self  Where: gym facility near San Antonio, Texas   1. **Quality of Life Survey**   A tool developed by the authors of this study to assess occupational performance, level of arousal, mood, interpersonal relations, and cognitive functioning. No reliability or validity assessments have been performed on this measure.  Max score: 18 items x 5-point Likert scale = 90  Administered by: self  Where: gym facility near San Antonio, Texas |
| **Main Findings** |
| 1) Effects of Treatment on State Anxiety  Description of Finding: The STAI revealed that sensory-enhanced hatha yoga significantly diminished state anxiety in military personnel with PTSD.  Treatment Group: mean decrease of 8.23 (SD = 8.55)  Control group: mean increase of 1.38 (SD = 8.52)  Difference between groups: 9.61 (standard error = 2.055), t(67) = 4.677, p <.001  95% confidence interval: 9.61 ± 2.00 x 1.71 or 13.01 to 19.85  2) Effects of Treatment on Trait Anxiety:  Description of Finding: The STAI revealed that sensory-enhanced hatha yoga significantly diminished trait anxiety in military personnel with PTSD.  Treatment Group: mean decrease of 6.86 (SD = 6.99)  Control Group: mean increase of 1.21 (SD = 7.19)  Difference between groups: 8.06 (standard error = 1.71), t(67) = 4.727, p > .001  95% confidence interval: 8.06 ± 2.00 x 1.71 or 10.36 to 17.20    3) Effects of Treatment on Sensory Processing:  Description of Finding: The AASP revealed that there is no evidence to show that a sensory-enhanced hatha yoga program significantly normalizes sensory processing. This is possible due to the fact that the six participants who scored in the high sensory sensitivity range were randomized to the control group.  *A] Sensory sensitivity identified questions* in control group: mean increase of 0.15 (SD = 4.92)  *Sensory sensitivity identified questions* in treatment group: mean decrease 1.67 (SD = 3.41)  Difference between groups: 1.82, t(66) = 1.73, p = .96  *B] Sensory avoidance identified questions* in control group: mean increase of 0.47 (SD = 3.20)  *Sensory avoidance identified questions* in experimental group: mean decrease of 0.92 (SD – 3.96)  Difference between groups: 1.32, t(64) = 1.54, p = .94  *C] Low registration identified questions* in control group: mean increase of 0.48 (SD = 5.68)  *Low registration identified questions* in experimental group: mean decrease of 0.68 (SD = 3.93)  Difference between groups: 1.16, t(64) = 0.92, p = .82  *D] Sensory seeking identified questions* in experimental group: mean decrease of 0.30 (SD = 4.21)  *Sensory seeking identified questions* in control group: mean increase of 0.08, (SD = 3.65)  Difference between groups: -0.38, t(66) = -0.39, p = .35  3) Effects of Treatment on Quality of Life:  A) Participants in the treatment group had significantly greater improvement on 16 out of 18 items of the Quality of Life Survey at the p=.05 level of significance.  Further, “having difficulty concentrating,” “feeling irritable,” “having difficulty performing daily tasks,” “ avoiding socializing,” “not feeling real interested in things,” and “experiencing feeling of boredom” were established at the p=.001 level of significance.  54% of participants noted their sleep was improved after yoga sessions |
| **Original Authors’ Conclusions** |
| The reduction in state and trait anxiety produced by the sensory-enhanced hatha yoga program in this study could be due to an “inhibitory effect on the autonomic nervous system” (p. 65). This is potentially due to the combination of positive affirmations with the neurophysiological effects of the asanas, which could have assisted participants into learning how to address negative thoughts, no matter their situation. The authors suggested that separating elements of the program could help further elucidate which elements are the most beneficial.  In regards to sensory processing, the participants in the experimental group all tested normal on the AASP, so there wasn’t a change, this was not surprising. The authors suggest a larger sample size may assuage this effect.  The sensory-enhanced hatha yoga program positively influences quality of life, specifically in terms of sleep.  Overall, sensory-enhanced hatha yoga works to “reduce hyperarousal and improve self-regulation in adult populations” (p. 66). It also can help treat symptoms of combat stress to minimize their progression to PTSD, which has been known to cause “occupational dysfunction” (p. 66). |
| **Critical Appraisal** |
| **Validity** |
| **Sources of Potential Bias:**  PI supervised the outcome assessments, and taught the yoga classes.  **Quality score on methodology quality rating scale:**  21/28 on (Downs & Black, 1998) with a modified item #27, scaled 0 for no statistical significance, and maximum score of 1 for statistical significance, and a total scale score change to xx/28. Items scored “0” include: no report of adverse events, characteristics of patients lost to follow-up, subjects weren’t representative of the entire population from which they were recruited, and no blinding of participants or investigators.  **Effect size:**  Sensory sensitivity: r = .210, low  Sensory avoidance: r = .190, low  Low registration: r = .118, very low  Sensory seeking: r = -.048, very low  Trait anxiety: r = .495, medium  State anxiety: r = .491, medium  **Missing Information:**  This study used best practice intention to treat approach and calculated data based on n = 35 (original) as well as n = 25 (with drop outs). |
| **Interpretation of Results** |
| This study supports the use of sensory-enhanced hatha yoga on symptoms of combat stress in deployed military personnel as it produces statistically significantly reductions in both state and trait anxiety based on the STAI, when compared to patients who received no intervention. Participants in the intervention group also experienced better sleep quality, though this was on a subjective quality of life scale. |

1. **Description and appraisal of:**

Kim, S. H., Schneider, S. M., Kravitz, L., Mermier, C., & Burge, M. R. (2013). Mind-body practices for posttraumatic stress disorder. *Journal of Investigative Medicine : The Official Publication of the American Federation for Clinical Research*, *61*(5), 827–34. doi:10.231/JIM.0b013e3182906862

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| **Aim/Objective of the Systematic Review:** |
| The aim of this SR was to access and appraise the literature that looks at how mind-body practices work as complementary and/or alternative treatment for patients with PTSD. |
| **Study Design** |
| Study Design: Systematic Review  Search strategy:  Databases:  1) PubMed/MEDLINE  2) EBSCO/PsycINFO  3) Published International Literature on Traumatic Stress Database    Date Searched: June 27, 2012  Search terms:  “mindfulness” OR “mind-body” AND “exercise” OR “yoga” OR “tai chi” OR “qigong” OR  “meditation” AND “posttraumatic stress disorder” OR “PTSD”  Selection Criteria:  1) English  2) human participants with PTSD  3) RCTs, comparative studies, and observational studies  4) studies which looked at whether mind-body interventions change PTSD symptoms  Further methods were not specified. |
| **Setting** |
| The setting of the search was not specified in the text.  The authors all work in the Department of Health, Exercise, and Sport Science, the Clinical and Translational Science Center, or the Department of Internal Medicine at the University of New Mexico, Albuquerque, NM. |
| **Studies Included:** |
| Flow of the systematic review process:  92 articles identified initially🡪 75 articles removed after abstract review based on selection criteria🡪17 full length studies assessed🡪 1 article excluded because of confounding factors = 16 studies included  Summary of 16 articles selected:  6 RCTs  1 randomized non-controlled study  8 nonrandomized studies  1 observational non-controlled study  Total number of participants:  N = 1065  13/16 studies on adults (n= 813), 1/16 studies on children (n = 31), 2/16 studies on adolescents (n = 221)  6/16 studies included females only (n = 512) 10/16 studies included males only (n = 553)  average age: 33.92 years |
| **Interventions Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| 9/16 studies did not have a control group.  Other details on control groups were not specified. |
| *Experimental* |
| Interventions:  2 yoga  5 meditation or meditation and relaxation  1 tai chi and qigong  3 efficacy of mindfulness-based stress reduction (MBSR)  1 mantram  1 relaxation or relaxation and deep breathing, or relaxation and deep breathing and thermal biofeedback  3 multiple mindfulness-based approaches  The 5 RCTs all included mindfulness-based components of relaxation, meditation, and deep breathing and their effects on PTSD symptoms. One of the RCTs compared relaxation, relaxation combined with deep breathing, and relaxation combined with deep breathing and thermal biofeedback. Another RCT compared short-term meditation-relaxation to narrative exposure therapy in children. Another RCT compared transcendental medication with traditional psychotherapy. Interventions were applied over as short of a period as one week to as long of a period as one year. On average, interventions were applied over 9.56 weeks. There was limited information based on how frequently interventions were applied, but generally it was once weekly for anywhere from twenty to ninety minutes. The who, when, and where were not specified for any of the studies. Ten studies included follow-up, which ranged from three to fifteen months after the intervention was completed. |
| **Outcome Measures** |
| PTSD Symptom severity measures:  PTSD Check List (PCL)  Post-Vietnam Stress Disorder (PVSD)  Harvard Trauma Questionnaire (HTQ)  Impact of Event Scale  UCLA PTSD Index for *DSM-IV* (UPID)  PTSD Reaction Index  Child PTSD Symptom Scale  These self-rated measures are all assessments of variation in PTSD symptom severity. Where these tests were performed was not specified. |
| **Main Findings** |
| There was conflicting data amongst the RCTs, which all used different interventions, as to whether or not mind-body interventions were able to reduce PTSD symptom severity. Three out of the six RCTs did find statistically significant changes in PTSD symptom reduction based on mantram (p = 0.02), meditation-relaxation (p = 0.0001), and mind-body skills (p = <0.001). Another of these RCTs did find a significant decrease in sadness (mean [SD], 7.12 [3.21] vs 5.98 [3.58] p <0.05, with the non-yoga group having increased anxiety (mean [SD], 4.76 [2.69] vs 4.88 [3.15], p < 0.05. One RCT found a significant effect of relaxation (p >0.05), but not breathing and/or biofeedback. Two RCTs found no significant changes in heart-rate variability (HRV), or overall PTSD symptoms. All of the studies that were not RCTs found significant decreases in symptoms of PTSD. However, there were inconsistencies as far as whether or not improvements persist in the long-term, one study found maintenance of symptom reduction at a six month follow-up, while another study did not. |
| **Original Authors’ Conclusions** |
| Authors acknowledge the quality, intervention, study duration, design, use of control group, age of participants, and gender in the studies utilized were all highly variable. This made completing a meta-analysis impossible. The authors recommend future studies address these issues by including larger samples, and outcome measures involving biomarkers. They provided a qualitative synthesis of the studies using tables.  The authors found many different aspects of mind-body practices have been shown to reduce PTSD symptoms in both the short and long-term according to the studies reviewed in this SR. In one study however, results were not maintained over the long-term if meditation practice, for example, was not continued, unless this happened to be due to a confounding factor.  Older children generally showed more improvement in PTSD symptoms than younger children. Due to the short duration not appropriate for severity of PTSD, and inclusion of fast breathing in intervention, HRV decreased in some studies. In other studies, HRV and parasympathetic functioning increased with deep breathing.  In general, mind-body interventions can help “reduce stress levels, improve mood, reduce intensity of PTSD arousal symptoms, and observe what they experience from a more relaxed state with less fear and more equanimity” (p. 833). |
| **Critical Appraisal** |
| **Validity** |
| Quality assessment tool: AMSTAR: 8/11  Strengths:  a priori, duplicate study selection, comprehensive literature search, aggregated characteristics, appropriate methods utilized to combine findings  Weaknesses:  Likelihood of publication bias was not assessed, conflict of interest was not included for each study, only the SR, list of excluded studies was not provided, abstracts were not read by more than one person creating potential inclusion bias, only 9/16 studies had control groups, so whether there is any value in the effect size is questionable, the diverse nature of the studies produced questionable results |
| **Interpretation of Results** |
| This SR supports the use of mind-body interventions to reduce PTSD symptoms generally. The strategies and methods used in this SR were reasonable—the issue is the quality of existing research. There were many different interventions and combinations of interventions used in most often short-term and uncontrolled scenarios, in a wide range of populations making it difficult to generalize the results, and indicating the necessity of further research on this topic. |

1. **Description and appraisal of:**

van der Kolk, B. A., Stone, J., West, J., Rhodes, A., Emerson, D., Suvak, M., & Spinazzola, J. (2014). Yoga as an adjunctive treatment for posttraumatic stress disorder: A randomized controlled trial. *Journal of Clinical Psychiatry*, *75*(6), e559–e565. doi:10.4088/JCP.13m08561

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| **Aim/Objective of the Study:** |
| This study sought to determine whether or not yoga helped increase affect tolerance and decrease PTSD symptoms in women with histories of interpersonal violence who were shown to be unresponsive to treatment. |
| **Study Design** |
| Study Design: RCT, investigator blinded  Type of sample: simple random sample  How recruited: newspaper, radio ads, website, solicitation from mental health professionals  Timing of Outcome Measures: Clinician-Administered PTSD Scale (CAPS) was measured before, during, and after the intervention was complete, 10 weeks later  The Programs: The programs were identified as a control group (n=32) who participated in supportive women’s health education, and a treatment group (n=32) who participated in trauma-informed yoga. Both groups participated for one hour a week for ten weeks. |
| **Setting** |
| U.S.; not-specified, since it was an efficacy study, assume it was a controlled environment |
| **Participants** |
| N= 64  Eligibility criteria: women ages 18-58 with chronic, treatment nonresponsive PTSD  Key demographics:   1. age: mean: 42.9 years, SD: (12.0), p = .35 2. white race: 78.1%, p = .91 non-Hispanic ethnicity: 85.9%, p = .67 3. college graduate: 73.4%, p = .53 4. single marital status: 45.3%, p = .65 5. employed: 59.4%, p = .05 6. income: $12,000-$15,000: 18.8%, p = .08   Dropouts: n = 4, 1 in treatment group, 3 in control group  Number available for follow-up: treatment group: n = 31, control group: n = 29 |
| **Intervention Investigated** |
| *Control* |
| The control group received a one-hour session of women’s health education class once per week for ten weeks. Topics discussed included: how to seek medical services, how to discuss health issues with healthcare professionals, talking comfortably about bodily functions, medical terminology, and preventative self-care activities. Participants engaged in the course through workbooks, resource books, videos, games, charts, and diagrams. Participants were allowed to bring food for the course, and have contact with each other outside of the course. Location was not specified nor was the instructor. |
| *Experimental* |
| The experimental group received a one-hour session of trauma-informed yoga once per week for ten weeks. Tenets addressed were: breathing, postures, and meditation. Ideas emphasized were: curiosity about bodily sensation, bodily control, and non-interpretive language without metaphor. This program was developed by certified yoga teachers who had master and doctoral-level degrees in psychology, as well as the PIs. Participants were not allowed to bring food for the course or have contact with each other outside of the course. The location was not specified nor was the instructor. |
| **Outcome Measures** |
| 1. **Clinician Administered PTSD Scale (CAPS)**   45-60 minute interview which assesses the 20 DSM-V PTSD symptoms, onset and duration of symptoms, distress, impact of symptoms on social and occupational functioning, severity, dissociative subtype information  Max score: 80, Likert scale on severity from 0-4 on 20 items  Administered by: postdoctoral and master’s level clinicians who received training and continuous supervision  Where: not specified   1. **Inventory of Altered Self-Capacities (IASC)**   Generally used to measure psychological difficulties related to identity, dysregulation, and interpersonal conflict. It was used in this study to identify issues with affect regulation and emotional control  Max score: 252, Likert scale on severity from 1-4 on 63 items on 9 scales  Administered by: self  Where: not specified   1. **Davidson Trauma Scale (DTS)**   Quick assessment of PTSD symptoms corresponding to the DSM-IV symptoms of PTSD and severity  Max score: 136, Likert scale from 0-5 on 17 items for both frequency and severity  Administered by: self  Where: not specified   1. **Beck Depression Inventory-II (BDI-II)**   This measure quantifies the severity of depression.  Max score: 63, Likert scale from 0-3  Administered by: self  Where: not specified |
| **Main Findings** |
| 1. **Total CAPS severity:** loss of PTSD diagnostic status (based on a score <45, determined to rule out false negatives)   Description of finding: The yoga group experienced larger decreases on the CAPS than the control group with a medium effect size.  A) Treatment group:  Pre-treatment Mean = 73.94 (SD = 20.83) Post-treatment: Mean = 49.48 (SD = 25.16)  *b* (unstandardized regression coefficient) = -24.45, significant at the p<.001 level  Cohen *d* = -1.07*,* meaning a high effect size  B) Control group:  Pre-treatment mean = 76.66 (SD = 20.83), Post-treatment: Mean = 63.49 (SD = 25.48)  *b* (unstandardized regression coefficient) = -13.17, significant at the p<.01 level  Cohen *d* = -0.66, indicating a medium effect size  C) Group x time:  *b* (unstandardized regression coefficient) = -14.74, significant at the p<.05 level  Cohen *d* = -0.41, indicating a medium effect size   1. **DTS**   Description of Finding: The treatment group showed a medium effect size linear trend, while the control group only showed a significant medium effect size quadratic trend. This means the treatment group maintained the improvements they made, while the control group did not.  A) Treatment group:  Pre-treatment Mean = 65.17 (SD = 23.50) Mid-treatment: mean = 56.01 (SD=26.59) Post-treatment: Mean = 51.49 (SD = 24.09)  Linear change:  *b* (unstandardized regression coefficient) = -6.84, significant at the p<.01 level  Cohen *d* = -0.52*,* indicating a small-medium effect size  Quadratic change:  *b* (unstandardized regression coefficient) = 0.79  Cohen *d* = 0.11, very small effect size  B) Control group:  Pre-treatment mean = 73.06 (SD = 25.86), Mid-treatment: mean = 50.96 (SD = 24.91), Post-treatment: Mean = 63.75 (SD = 28.81)  Linear change:  *b* (unstandardized regression coefficient) = -4.66  Cohen *d* = -0.29, indicating a small effect size  Quadratic change:  *b* (unstandardized regression coefficient) = 5.82, significant at the p<.05 level  Cohen *d* = 0.46, indicating a small-medium effect size  C) Group x time:  Linear change:  *b* (unstandardized regression coefficient) = -5.07  Cohen *d* = -0.10, indicating a very small effect size  Quadratic change:  *b* (unstandardized regression coefficient) = -5.03, significant at the p<.05 level  Cohen *d* = -0.34, indicating a low-medium effect size   1. **BDI-II**   Description of finding: Both the treatment and control groups showed a reduction in depressive symptom, but the group x time interaction was not significant. The treatment group had a medium effect size while the control had a small-medium effect size.  A) Treatment group:  Pre-treatment Mean = 20.89 (SD = 11.13) Mid-treatment: mean = 19.23 (SD=13.59) Post-treatment: Mean = 13.92 (SD = 9.91)  Linear change:  *b* (unstandardized regression coefficient) = -3.49, significant at the p<.001 level  Cohen *d* = -0.60*,* indicating a medium effect size  Quadratic change:  *b* (unstandardized regression coefficient) = -0.57  Cohen *d* = -0.19, indicating a small effect size  B) Control group:  Pre-treatment mean = 24.06 (SD = 11.47), Mid-treatment: mean = 19.51 (SD = 11.65), Post-treatment: Mean = 19.47 (SD = 11.91)  Linear change:  *b* (unstandardized regression coefficient) = -2.29, significant at the p<.05 level  Cohen *d* = -0.39, indicating a small-medium effect size  Quadratic change:  *b* (unstandardized regression coefficient) = 0.78  Cohen *d* = 0.20, indicating a low effect size  C) Group x time:  Linear change:  *b* (unstandardized regression coefficient) = -3.02  Cohen *d* = -0.14, indicating a very small effect size  Quadratic change:  *b* (unstandardized regression coefficient) = -1.34, significant at the p<.05 level  Cohen *d* = -0.28, indicating a small effect size   1. **IASC-TR**   Description of finding: In the yoga group, a decrease in symptoms and a small-medium effect size was produced while change over time on the subscale was not significant for the control group. The group x time interaction was close to being statistically significant with a small-medium effect size.  A) Treatment group:  Pre-treatment Mean = 73.66 (SD = 14.20) Post-treatment: Mean = 67.17 (SD = 15.32)  *b* (unstandardized regression coefficient) = -6.49, significant at the p<.05 level  Cohen *d* = -0.44*,* meaning a small-medium effect size  B) Control group:  Pre-treatment mean = 67.97 (SD = 13.81), Post-treatment: Mean = 68.51 (SD = 17.17)  *b* (unstandardized regression coefficient) = 0.54  Cohen *d* = 0.03, indicating an extremely small effect size  C) Group x time:  *b* (unstandardized regression coefficient) = -7.03  Cohen *d* = -0.31, indicating a small-medium effect size |
| **Original Authors’ Conclusions** |
| In women with chronic treatment-resistant PTSD, a 10-week yoga program can significantly reduce PTSD symptom. In the control group, which received educational intervention and social support, depression scores decreased even with PTSD symptom relapse. This suggests to the authors that the “physical and interoceptive aspects of yoga, rather than the social dimension of the group, were the critical variables responsible for the change in PTSD symptompatology” (p. 563). |
| **Critical Appraisal** |
| **Validity** |
| **Sources of Potential Bias:** different instructors were used for each group, difference in social support for each group, different evaluators for assessment, sampling bias potentially due to presence of comorbidities (depression, anxiety)  **Quality score on methodology quality rating scale:**  22/28 (Downs & Black, 1998) with a modified item #27, scaled 0 for no statistical significance, and maximum score of 1 for statistical significance, and a total scale score change to xx/28. Items scored “0” include: inclusion of adverse events list, subjects weren’t blinded to the intervention they received, no adequate adjustment for confounding variables, and equal distribution of confounding variables amongst groups  **Missing Information:** Any conflict of interest was not included. Confounding variables were noted mostly in the limitations, but no adjustments were made.  **Intention-to-Treat:**  This study used best practice intention-to-treat approach and calculated data based on n = 64 (original) as well as n = 60 (with drop outs). |
| **Interpretation of Results** |
| This study supports the use of a trauma-informed yoga protocol based on statistically significant reductions in symptoms in women with chronic, treatment-resistant PTSD secondary to interpersonal assaults that started in childhood. This result is difficult to generalize making the clinical significance limited. The effect size was noted for each measure specifically in the main findings section as to avoid confusion. Larger effect sizes were noted for the yoga intervention group. |

**IMPLICATIONS FOR PRACTICE and FUTURE RESEARCH**

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| **Implications for Practice:**  The appraised evidence supports the use of sensory-enhanced yoga for reduction in PTSD symptom severity, state and trait anxiety, and improved sleep quality in deployed military personnel. The appraised evidence also supports the use of various mind-body interventions for overall reduction in PTSD symptom severity, decreased stress, improved mood, and increased relaxation in a variety of populations including adult men and women, adolescents, and children.  This provides support for programs already in existence such as the free Connected Warriors Yoga Program at the Raleigh-Durham VA, in the Department of Physical Medicine and Rehabilitation. This information can also serve as a guide for future programs for military personnel. Emphasis for future programs should be placed on using established sensory enhanced or trauma-informed yoga protocols; working to establish other yoga or mind-body protocols by interdisciplinary collaboration with universities and experts; training yoga teachers in these methodologies; potentially working with more objective data such as heart-rate variability, and sleep data; collaboration amongst community organizations, health care teams, researchers, universities, and military bases for access to these patients; educating physical and occupational therapists, primary care physicians, psychologists, students, and patients about the benefits of this kind of treatment.  This evidence, the outcome measures, with the exception of the Beck Depression Inventory, and the availability of programs are not well known to physical therapy students at the University of North Carolina at Chapel Hill in Chapel Hill, NC.  **Implications for Future Research:**  The authors recommend future longer-term studies that are randomized and controlled which include larger samples on populations with identified confounding variables and outcome measures involving biomarkers. For example, utilizing outcome measures that rely on more objective, quantitative data such as sleep data or heart rate variability would be helpful to further establish yoga as an intervention for the military population and others as well.  Future systematic reviews focused on one particular intervention for defined populations would help determine which interventions are the most significant and valuable in practice for which patients.  Further research into non-pharmacologic psychobiological mechanisms through which mind-body intervention work would be helpful to justify using this in clinical practice, especially in terms of receiving financial reimbursement.  Additionally, further exploration and establishment of self-identification and self-treatment techniques to modulate affect and arousal changes related to PTSD could help reduce cost of service, positively affect dependence of patients with PTSD on mental health services, and help reduce re-victimization of PTSD (van der Kolk et al., 2014). |

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