

# Psychological Trauma: Theory, Research, Practice, and Policy

## Moderators of Treatment Efficacy in a Randomized Controlled Trial of Trauma-Sensitive Yoga as an Adjunctive Treatment for Posttraumatic Stress Disorder

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Online First Publication, August 27, 2020. <http://dx.doi.org/10.1037/tra0000963>

### CITATION

Nguyen-Feng, V. N., Hodgdon, H., Emerson, D., Silverberg, R., & Clark, C. J. (2020, August 27). Moderators of Treatment Efficacy in a Randomized Controlled Trial of Trauma-Sensitive Yoga as an Adjunctive Treatment for Posttraumatic Stress Disorder. *Psychological Trauma: Theory, Research, Practice, and Policy*. Advance online publication. <http://dx.doi.org/10.1037/tra0000963>

# Moderators of Treatment Efficacy in a Randomized Controlled Trial of Trauma-Sensitive Yoga as an Adjunctive Treatment for Posttraumatic Stress Disorder

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**Objective:** This study is a follow-up to van der Kolk et al. (2014), a trial conducted through the Trauma Center at Justice Resource Institute, which demonstrated treatment efficacy and remains the only randomized controlled trial of trauma-sensitive yoga. The present process study extends the outcomes study by examining treatment moderators of the original trial. **Method:** Sixty-four women with childhood interpersonal trauma histories and posttraumatic stress disorder participated in the interventions: Trauma Center Trauma-Sensitive Yoga (TCTSY) versus active control (women's health education). Analyses explored if adult-onset interpersonal trauma and baseline psychological measures (clinician-rated and self-reported PTSD, dissociation, depression, psychological functioning) moderated PTSD changes. **Results:** Three of six measures had small effects in moderating the relationship between adult-onset interpersonal trauma and TCTSY efficacy, in which TCTSY was most efficacious for those with fewer adult-onset interpersonal traumas. Within this subgroup, various levels of all baseline measures except depression indicated that TCTSY was more effective in reducing PTSD than the active control condition. **Conclusions:** By delineating client characteristics most associated with PTSD improvements, practitioners may best target yoga interventions to increase effectiveness.


## Clinical Impact Statement

There is growing evidence for the effectiveness of adjunctive trauma-sensitive yoga, specifically the protocolized Trauma Center Trauma-Sensitive Yoga, to decrease PTSD symptoms. The present study provides evidence on how clinicians may best target this complementary intervention to individuals who would most benefit from it. In particular, exposure to cumulative interpersonal trauma should be considered when determining whether a client may be appropriately referred to trauma-sensitive yoga. Although TCTSY does not appear to be contraindicated, as suggested by the absence of symptom exacerbation in subgroups, clinicians would need to consider other trauma treatment approaches in addition to TCTSY when referring individuals with high levels of cumulative interpersonal trauma histories.

**Keywords:** yoga, trauma-sensitive yoga, yoga intervention, posttraumatic stress disorder, moderation

**Editor's Note.** Sandra Mattar and Kathleen Kendall-Tackett served as the action editors for this article.—KK-T

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Traditional forms of yoga have been in existence for more than 2,500 years, with use of modern yoga as we know it growing since the 1990s (for a historical review, see, e.g., De Michelis, 2008). The practice of yoga has shifted from its roots within Dharmic religions to a form of complementary and alternative medicine in Western societies (Tindle, Davis, Phillips, & Eisenberg, 2005), with both forms comprising *pranayama* (breathwork), *asanas* (postures), and *dharana* (mindfulness). Systematic reviews and meta-analyses demonstrate the effectiveness of ancillary yoga on a multitude of conditions, including depression (Cramer, Lauche, Langhorst, & Dobos, 2013), chronic pain (Cramer, Lauche, Haller, & Dobos, 2013), cancer-related symptoms (Cramer et al., 2017), and cardiovascular disease (Cramer et al., 2014). Yoga has even been demonstrated to be more effective than physical exercise in reducing symptoms in certain conditions, for example, chronic pain (Cramer, Lauche, Haller, et al., 2013).

Trials testing evidence of yoga for these health-related ailments have been more robust than trials on yoga for psychological symptoms following trauma, (e.g., posttraumatic stress disorder [PTSD]); nonetheless, there is still some evidence of the connection between yoga practice and decreased posttraumatic stress symptoms, which may be understated due to the limited rigor and number of existing studies (for reviews, see Cramer, Anheyer, Saha, & Dobos, 2018; Nguyen-Feng, Clark, & Butler, 2019). The theory behind this connection has ample rationale; that is, traumatic memories are purported to be held in the body, and thus, alterations in the body are connected to changes in mental status. Even in consideration of publication bias and the aforementioned low quality of studies, a systematic review and meta-analysis (Afari et al., 2014) demonstrated robust associations among trauma exposure, PTSD, and somatic syndromes. A review (Lanius, Bluhm, & Frewen, 2011) of the neurobiological underpinnings of PTSD among those with chronic trauma suggest that areas of the brain associated with PTSD (e.g., amygdala, insula) interrelate; that is, deficits in emotional- and self-awareness impact self-referential processing. Thus, it follows that one possible mechanism of posttrauma change neuronally links brain activation of resiliency and the ability to perceive bodily sensations (Haase et al., 2016).

The concept of interoception captures this idea of body, brain, emotional awareness, and self-awareness altogether, that is, mind-body connections (for reviews, see Barrett & Simmons, 2015; Craig, 2003). Interoceptive dysfunctions have been linked with childhood traumas and adversity (Schaan et al., 2019), low resiliency (Haase et al., 2016), and PTSD (for a review, see Khalsa et al., 2018). Improvements in the brain-body (mind-body) connection (i.e., interoception) facilitates emotional awareness, reappraisal, and regulation (Brewer, Cook, & Bird, 2016; Füstös, Gramann, Herbert, & Pollato, 2013) that may be helpful for those with PTSD. Yoga has been suggested to promote interoception to decrease a variety of mental health ailments (Farb et al., 2015), including PTSD (Neukirch, Reid, & Shires, 2019; for a review, see Khalsa et al., 2018). Furthermore, yoga practices incorporate mindfulness, which is associated with reduced posttraumatic stress symptoms when taught in mind-body skill groups (e.g., Staples, Gordon, Hamilton, & Uddo, 2020) or mindfulness-based treatments (for a review, see, e.g., Hopwood & Schutte, 2017, cf., Davis et al., 2019; Polusny et al., 2015).

## Rationale for Proposed Moderation

There is some evidence that yoga interventions can affect the theorized connections specifically between trauma and the mind-body, as highlighted in the few randomized controlled trials that do exist (e.g., Culver, Whetten, Boyd, & O'Donnell, 2015; van der Kolk et al., 2014). The support for yoga improving posttraumatic distress is nascent simply due to the low quality and rigor of these studies, although average effect sizes in PTSD improvements may be promising (Cohen's  $d \sim 1.06$ ; for a review, see Nguyen-Feng et al., 2019). Rather than exploring the effectiveness of trauma-informed yoga broadly, it may be useful to conduct an in-depth examination of interventions previously deemed effective. That is, the question shifts from assessing whether trauma-informed yoga (e.g., Justice, Brems, & Ehlers, 2018) broadly works to delineating characteristics of an evidence-based, protocolized approach on which future research and hypotheses may build. Work funded by the National Institute on Aging and the National Institute of Mental Health (Kraemer, Frank, & Kupfer, 2006) reports that efficacy determined even by gold standard procedures such as randomized controlled trials mislead patients and clinical decision makers. Kraemer et al. (2006) stated that conducting moderation-specific analyses are essential to examine efficacy, as controlling for baseline factors and/or conducting subgroup analyses are not enough since they are either counterproductive or subject to multiple testing issues. Moderation analyses also allow for testing of regions of significance (Hayes, 2017) to determine specific levels of a moderator that have the most beneficial treatment effect.

Treatment studies in psychology are also in the burgeoning stages of research on predictors and moderators of interventions and PTSD outcomes (e.g., Rizvi, Vogt, & Resick, 2009; Zandberg et al., 2016). Empirical evidence suggests that demographic variables (e.g., race/ethnicity, gender, age, veteran status) typically do not moderate relations between therapy condition and mental health outcomes (Wolitzky-Taylor, Arch, Rosenfield, & Craske, 2012; for a review, see, e.g., Hopwood & Schutte, 2017). In general, best practices in multicultural methodology decry the use of demographics as categorical moderators due to the socially constructed nature of in-truth, continuous variables (e.g., Helms, Jernigan, & Mascher, 2005). PTSD models employing nondemographic moderators suggest that baseline mental health symptoms (e.g., PTSD, depression severity) and potentially traumatic or stressful life events can moderate changes in PTSD-related symptoms predicted from antecedent conditions, for example, treatment versus no treatment (Zandberg et al., 2016); deployment versus no deployment (Brailey, Vasterling, Proctor, Constans, & Friedman, 2007; Vasterling et al., 2010). Dissociation as a moderator of treatment outcomes has also been an important topic within the complex PTSD literature (e.g., Bryant, 2012; Resick et al., 2012), particularly with its debated inclusion as a subtype of PTSD (e.g., Dalenberg & Carlson, 2012; Friedman, Resick, Bryant, & Brewin, 2011; Lanius, Brand, Vermetten, Frewen, & Spiegel, 2012).

As follows, baseline psychological measures (PTSD, dissociation, depression, psychological functioning) and potentially traumatic events (i.e., adult-onset interpersonal trauma) were examined as moderators of changes in PTSD in the present study. Moderation models require theoretical rationale not only on their proposed moderators and consequent variables, but also on aspects of their antecedent variables. Many studies on the impact of yoga

on psychological symptoms following trauma tend to cluster all Criterion A-defined traumas together (e.g., Culver et al., 2015; Jindani, Turner, & Khalsa, 2015). However, studies have demonstrated differing posttraumatic sequelae dependent on trauma type (e.g., Frazier, Nguyen-Feng, Fulco, Anders, & Shallcross, 2017; Nguyen-Feng, Baker, Merians, & Frazier, 2017; Shakespeare-Finch & Armstrong, 2010). Even within a specific trauma type (e.g., interpersonal traumas), sequelae may be dependent on age of onset, chronicity, or frequency (e.g., Ehling & Quack, 2010; Zlotnick et al., 2008). Thus, the present study assesses nondemographic moderators (i.e., cumulative interpersonal trauma, baseline mental health symptoms) of the relation between yoga and PTSD changes while focusing specifically on adult interpersonal traumas among women with childhood interpersonal trauma histories.

### Trauma Center Trauma-Sensitive Yoga Framework

The present study aims to examine the potential moderators (i.e., cumulative interpersonal trauma, baseline mental health symptoms) on a protocolized trauma-informed yoga intervention: Trauma Center Trauma-Sensitive Yoga (TCTSY; Emerson, 2015; Emerson & Hopper, 2011; Emerson, Sharma, Chaudhry, & Turner, 2009), developed at the Trauma Center at Justice Resource Institute in Brookline, Massachusetts. The few randomized controlled trials on yoga for trauma survivors almost universally teach yoga directed toward a general population rather than a form that has been adapted to the needs of trauma survivors (for a review, see Nguyen-Feng et al., 2019). To date, there has been one randomized controlled trial of trauma-sensitive yoga, following the TCTSY protocol, as an adjunctive treatment for trauma-related symptoms (van der Kolk et al., 2014).

TCTSY (Emerson et al., 2009; Emerson, 2015; Emerson & Hopper, 2011) employs principles of hatha yoga while being distinct from traditional yoga forms because it was specifically developed with trauma survivors' needs in mind. This also differs from other trauma-informed approaches in that this framework is uniquely protocolized, making it suitable for research studies and yoga teacher trainings. Although there are many forms of yoga (see, e.g., Cramer, Lauche, Langhorst, et al., 2013 for a review), typical Western yoga practices tend to use more command-driven language (e.g., "now, turn your head") and focus on physical postures (*asana*) over other more internal aspects of yoga, such as introspection. In efforts to reduce possible triggers for those who have experienced bodily traumas, TCTSY principles adapt Western yoga practices in five core domains: language, assists, teacher qualities, environment, and exercises.

Trauma-sensitive language includes two basic styles of language: language of inquiry (e.g., "be curious") toward body awareness and invitational language (e.g., "if you like") to support choice making. Visual (e.g., modeling of lower intensity postures and adaptations) and verbal assists are emphasized over physical assists to prioritize inner feeling rather than posture form. Importantly, exercises do not focus on posture attainment but rather reclaiming and befriending one's body (e.g., inner feeling rather than outer form), creating personalized bodily rhythms, and practicing distress tolerance. By adapting the holistic yoga environment to the person, TCTSY (Emerson, 2015; Emerson & Hopper, 2011; Emerson et al., 2009) aims to provide a tailored, adaptable approach to teaching for individuals with trauma histories who

may not feel fully comfortable in traditional or Western yoga classes.

As TCTSY was based on practical and clinical experiences working with trauma survivors (Emerson & Hopper, 2011), this framework intends to be a refined and distinct approach for those with PTSD. By exploring moderators specifically for TCTSY (rather than yoga in general that is taught to trauma survivors) on PTSD, we further narrow and define characteristics of those for whom trauma-sensitive yoga would be most effective. As TCTSY appears feasible in quantitative and qualitative studies with growing evidence of effectiveness (e.g., Clark et al., 2014; Nguyen-Feng, Morrisette, et al., 2019; Neukirch et al., 2019), we hope to further understand the nuances of its effect.

### Present Study

In summary, the present process study extends the original Trauma Center at Justice Resource Institute's outcomes study (van der Kolk et al., 2014) by examining moderators of treatment efficacy. The parent study did not describe or delineate interpersonal trauma exposure among its participants. However, as van der Kolk et al.'s study was efficacious and matches the research gold standard of randomized controlled trials (Hariton & Locascio, 2018), it is particularly appropriate for follow-up and further exploration of why it worked (e.g., for whom it worked best). Specifically, the present study aims to do the following:

- 1) Examine how adult-onset interpersonal trauma (compounded with histories of childhood interpersonal trauma) may potentially moderate intervention efficacy on the primary (i.e., PTSD symptom severity) and secondary outcomes.
- 2) Delineate baseline characteristics (i.e., scores on clinical assessment measures, adult interpersonal abuse exposure) that moderate the efficacy of intervention condition (TCTSY vs. active control) on the primary outcome of PTSD symptom severity.

### Method

#### Participants

From 101 women who provided informed consent and were assessed at pretreatment, 83 (82%) met study criteria. Inclusion criteria included having chronic, treatment-unresponsive PTSD resulting from an index trauma that occurred 12 or more years before this study's clinician-administered initial interview, in which all women reported a history of childhood interpersonal trauma. Exclusion criteria included having active suicide risk, unstable medical conditions, or low global functioning (Global Assessment of Functioning score < 40), pregnancy or breastfeeding status, recent substance abuse, and previous yoga experience defined as five or more prior sessions. Treatment unresponsiveness was defined as maintaining a PTSD diagnosis despite having at least three years of treatment focused on the trauma sequelae. From the 83 participants who met inclusion criteria, 12 withdrew from the study before either randomization or treatment, and thus 64 participants (63%) comprise the intention-to-treat sample. Par-



Participants were randomized equally into one of two intervention arms: the TCTSY group ( $n = 32$ ) or women's health education as an active control group ( $n = 32$ ).

On average, participants ( $N = 64$ ) were 42.9 years old ( $SD = 12.0$ ), with 78% identifying as White, 9% as Black/African American, and 5% as other, including American Indian and biracial. Nearly half (45%) of the women reported being single, while 30% reported being married/engaged and 14% reported being divorced/separated from a spouse. Most participants (73%) had completed college and were employed (59%). Sixteen percent of the sample reported household earnings under \$12K annually, 19% earned \$12–15K, 14% earned \$26–39K, 8% earned \$40–59K, 11% earned \$60–79K, and 9% reported their household earning greater than \$80K per year. This is similar to demographics of lifetime and past-year yoga practitioners in the United States (Cramer et al., 2016). Despite baseline differences between intervention conditions in current employment status (yoga = 72% employed; control = 47% employed;  $\chi^2(2) = 5.92, p = .05$ ), the two conditions did not differ on any other sociodemographic or psychological outcome variable. Participants completed most measures, as missingness ranged from 6%–11% across variables used in the present study.

## Materials

**Trauma exposure.** Adulthood trauma exposure was measured with the Stressful Life Events Screening Questionnaire (SLESQ; Goodman, Corcoran, Turner, Yuan, & Green, 1998). Four questions from the Trauma History component of the University of California at Los Angeles PTSD Reaction Index (Steinberg, Brymer, Decker, & Pynoos, 2004) were also administered at preintervention, although they were excluded from these analyses because the items focused on childhood physical, emotional, and caregiver neglect. Adult interpersonal trauma was summed from the adult physical, sexual, and emotional abuse items on the SLESQ, with scores ranging from 0 to 3 each. Goodman et al. (1998) report validity and reliability for the SLESQ.

**PTSD symptoms and severity.** PTSD symptoms, diagnosis, and severity were obtained from the Clinician-Administered Posttraumatic Stress Disorder Scale (CAPS; Weathers, Ruscio, & Keane, 1999). The CAPS assessed for *Diagnostic and Statistical Manual-IV* PTSD criteria and was administered pre- and postintervention by postdoctoral- and master-level clinicians who were blinded to the intervention condition. In a review (Weathers, Keane, & Davidson, 2001) of more than 200 studies covering an array of trauma populations and clinical research settings, CAPS has demonstrated reliability (e.g., interrater, test–retest, diagnostic agreement) and validity (e.g., convergent and discriminant for continuous symptom severity as well as obtaining a yes/no diagnosis). CAPS is considered the gold standard in PTSD assessment (Blake et al., 2000) and was considered the primary outcome measure in the present study.

Self-reported PTSD symptoms and severity were obtained from the 17-item Davidson Trauma Scale (DTS; Davidson, Tharwani, & Connor, 2002) at pre-, mid-, and postintervention. Items (e.g., “Have you had painful images, memories, or thoughts of the event?”) were rated on a 0 (*not at all distressing*) to 4 (*extremely distressing*) Likert scale. Studies with participants who have PTSD or have experienced interpersonal trauma (Seo et al., 2008; Zlot-

nick, Davidson, Shea, & Pearlstein, 1996, respectively) demonstrate reliability and validity of the DTS. Cronbach's alpha in the present sample was .94, .96, and .95 at each measured time point, chronologically.

**Depressive symptoms.** Participants provided self-reports of depressive symptoms using the 21-item Beck Depression Inventory-II (BDI-II; Beck, Steer, & Carbin, 1988) at pre-, mid-, and postintervention. Groups of statements (e.g., Sadness, Past Failure, Loss of Pleasure) were rated on a 0 to 3 Likert scale that increased in severity within each group (e.g., Sadness: 0 = *I do not feel sad*; 3 = *I am so sad or unhappy that I cannot stand it*). Beck, Steer, and Brown (1996) report validity and reliability for the BDI-II in clinical and nonclinical samples, as does a review (Wang & Gorenstein, 2013) of 118 studies using the BDI-II. Cronbach's alpha in the present sample was .92, .96, and .92 at each measured time point, chronologically.

**Dissociative symptoms.** Dissociative symptoms were measured at pre- and postintervention with the 28-item Dissociative Experiences Scale (DES; Bernstein & Putnam, 1986). Items (e.g., “Some people have the experience of finding themselves in a place and having no idea how they got there”) were rated from 0% (*never*) to 100% (*always*) in 10-point increments in regard to what percentage of the time that happens to the participant. A meta-analysis (van Ijzendoorn & Schuengel, 1996) has demonstrated validity and reliability of the DES among participants with PTSD as well as the general population. Cronbach's alpha in the present sample was .93 and .95 at pre- and postintervention, respectively.

**Psychological functioning capacity.** Psychological functioning capacity was assessed at pre- and postintervention with the Inventory of Altered Self-Capacities (IASC; Briere & Runtz, 2002). Two 9-item subscales (Affect Dysregulation; Tension Reduction Activities) of the IASC were each used to examine problems in affect regulation and control as well as emotional control based on one's tendency to adapt external behaviors to reduce internal distress. Items (e.g., “Your mood changed quickly”) were rated on a 1 (*never*) to 5 (*very often*) Likert scale. Briere and Runtz reported validity and reliability of the IASC in both clinical (in which many had interpersonal victimization histories) and nonclinical samples. Cronbach's alpha in the present sample ranged from .96 to .97 across timepoints.

**Interventions.** The TCTSY intervention was offered 1 hr weekly for 10 weeks and followed the TCTSY protocol (Emerson, 2015; Emerson & Hopper, 2011; Emerson et al., 2009). The active control condition involved participation in a women's health education class for 1hr weekly for 10 weeks, in which trauma-specific issues and trauma-related disclosures were not discussed. The class was interactive and aimed to increase women's self-efficacy in various health areas through increased health education knowledge.

## Procedure

After providing written informed consent, participants completed preintervention assessments at baseline, including both clinician-administered and self-report measures. All participants were then randomly assigned to either the trauma-sensitive yoga or the active control group. Self-report PTSD and depressive symptom assessments occurred at midintervention, Week 5. Clinician-administered and self-report measures were again completed at

postintervention, Week 10. All participants were required to be in ongoing psychotherapy and to continue their medications as prescribed, so that any intervention (e.g., TCTSY) was considered as adjunctive, complementary treatment. Please see the parent study (van der Kolk et al., 2014) for other details.

The original randomized controlled trial was conducted in collaboration with the National Center for Complementary and Integrative Health and was registered with the United States National Library of Medicine Clinical Trials database (identifier: NCT00839813). The secondary analyses performed in the present study were deemed as exempt by the institutional review boards at the Justice Resource Institute and the University of Minnesota.

**Data Analysis**

Statistical Analysis Software Version 9.4 was used for descriptive analyses as well as linear mixed models. For the primary research question, linear mixed models were used to estimate the differential effects of treatment on reductions in psychological symptoms by adult interpersonal trauma score, in which restricted maximum likelihood estimation was used to account for missing data. Analyses included fixed effects for time (inclusive of mid-intervention assessments, as applicable), the two intervention conditions, and adult interpersonal trauma as well as random intercepts by participant to reflect differences among participants at preintervention. Two-way (time-by-condition, trauma-by-condition, trauma-by-time) and three-way (time-by-condition-by-trauma) interactions were included in the model, with the comparison of slopes between trauma by condition and the three way interaction being most pertinent to extending the parent study’s (van der Kolk et al., 2014) basic pattern of results of TCTSY reducing psychological symptoms from pre- to postintervention. Effect sizes were computed following Lipsey and Wilson (2001) and interpreted per psychological research conventions (Cohen, 1992).

For the secondary research question, multiple additive moderation analyses were conducted in Statistical Package for Social Sciences Version 25 using Hayes’ (2017) PROCESS macro with preintervention assessments and adult interpersonal trauma as moderators. Intervention condition served as the predictor, and changes in clinician-rated PTSD from pre- to postintervention served as the outcome. Per Hayes, the 16th, 50th, and 84th percentiles were used to select moderator level values, as they denote approximately the mean as well as one standard deviation above and below it. While setting  $\alpha = .05$  as the conventional Type I error rate and  $\beta = .10$  as a conservative Type II error, standard deviations of the outcome of interest were projected from the parent study (van der Kolk et al., 2014); post hoc analyses suggested that these parameters lead to 90% power to detect an effect size of approximately  $E = 20.71$  (Chow, Shao, & Wang, 2008; Hulley, Cummings, Browner, Grady, & Newman, 2013; Kohn, 2020).

**Results**

**Descriptive Analyses**

All participants had a history of childhood interpersonal trauma. Regarding interpersonal trauma in adulthood, participants reported the full range of exposure, from 0 to 3 forms of either physical, sexual, or emotional abuse ( $M = 1.94, SD = 0.73$ ). See Table 1 for bivariate correlations between adult interpersonal trauma and pre- to postintervention change scores in the primary and secondary outcomes by intervention condition. Negative change scores reflect a decrease in symptoms, while positive change scores reflect an increase in symptoms over time. In the active control condition, adult interpersonal trauma was not significantly correlated with outcome changes, with the exception of dissociative symptoms, in which greater adult interpersonal trauma was associated with more

**Table 1**  
*Correlations Between Adult Interpersonal Trauma and Changes in Outcomes Over Time*

Variable	1	2	3	4	5	6	7
Trauma-sensitive yoga intervention condition							
1. Adult interpersonal trauma	—	—	—	—	—	—	—
2. Clinician-rated PTSD (CAPS)	.41*	—	—	—	—	—	—
3. Self-reported PTSD (DTS)	.45*	.57*	—	—	—	—	—
4. Depression (BDI-II)	-.03	.37†	.50*	—	—	—	—
5. Dissociative symptoms (DES)	.35†	.36†	.37†	.42*	—	—	—
6. Emotional control problems (IASC-TR)	.32†	.29	.18	.06	.13	—	—
7. Affect dysregulation (IASC-AD)	.19	.38*	.35†	.22	.13	.30	—
Active control condition (Women’s health education)							
1. Adult interpersonal trauma	—	—	—	—	—	—	—
2. Clinician-rated PTSD (CAPS)	-.18	—	—	—	—	—	—
3. Self-reported PTSD (DTS)	.16	.14	—	—	—	—	—
4. Depression (BDI-II)	.18	.38*	.32	—	—	—	—
5. Dissociative symptoms (DES)	-.38*	.49*	-.10	.14	—	—	—
6. Emotional control problems (IASC-TR)	-.26	.20	-.11	.38†	.59*	—	—
7. Affect dysregulation (IASC-AD)	-.08	.18	-.01	.34†	.48*	.79*	—

*Note.* PTSD = posttraumatic stress disorder; CAPS = Clinician-Administered Posttraumatic Stress Disorder Scale; DTS = Davidson Trauma Scale; BDI-II = Beck Depression Inventory-II; DES = Dissociative Experiences Scale; IASC-TR = Inventory of Altered Self-Capacities, Tension Reduction Activities; IASC-AD = Inventory of Altered Self-Capacities, Affect Dysregulation. *N*s = 25–31 due to missing data.

†  $p < .10$ . \*  $p < .05$ .

dissociative symptom decreases,  $r = -.38, p = .049$ . In the TCTSY intervention, there were significant positive correlations between adult interpersonal trauma and changes in clinician-rated PTSD symptom severity,  $r = .41, p = .02$ , and self-reported PTSD symptom severity,  $r = .45, p = .02$ . The relation between adult interpersonal trauma and both dissociative symptoms,  $r = .35, p = .07$ , and emotional control problems,  $r = .32, p = .08$ , were nonsignificant at the  $\alpha = .05$  level, although the  $r$ s trended toward positive correlations. That is, the greater number of adult interpersonal traumas was associated with a less substantial decrease in symptoms over time.

### Question 1: Examine How Adult-Onset Interpersonal Trauma (Compounded With Histories of Childhood Interpersonal Trauma) May Potentially Moderate Intervention Efficacy on the Primary (i.e., PTSD) and Secondary Outcomes

See Table 2 for linear mixed models type III tests of fixed effects, trauma by condition and trauma by condition by time. Regarding the trauma-by-condition two-way interactions, the clinician-rated,  $F(2, 57) = 2.46, p = .09, d = 0.392$ , and self-reported,  $F(2, 57) = 2.42, p = .09, d = 0.389$ , PTSD effects were nonsignificant at the  $\alpha = .05$  level. Descriptive comparison of slopes among those in the TCTSY condition suggested that those with greater adult interpersonal trauma (vs. those with fewer adult interpersonal traumas) may have had less change in their self-reported PTSD symptoms, 1 versus 3:  $b = -28.13, t(57) = -2.07, p = .04, d = -0.52$ . Clinician-rated PTSD symptom changes were nonsignificant at the  $\alpha = .05$  level, that is, 0 versus 3:  $b = -26.88, t(57) = -2.07, p = .08, d = -0.52$ ; 1 versus 3:  $b = -20.11, t(57) = -1.99, p = .05, d = -0.50$ .

In terms of trauma by condition by time, PTSD (clinician-rated and self-reported), depression, and affect dysregulation did not have significant three-way interactions, indicating that these variables were not moderated by adult interpersonal trauma. Emotional

control problems,  $F(2, 51) = 3.18, p = .049, d = 0.45$ , and dissociative symptoms,  $F(2, 50) = 3.79, p = .029, d = 0.49$ , had significant three-way interactions. These interactions were further probed by comparing slopes and parsing differences between the least squares means, after which some patterns emerged that were similar to the slopes comparison of the two-way interactions for PTSD. When comparing estimated coefficients in the TCTSY condition at postintervention, emotional control problems and adult interpersonal traumas trended toward a negative relation although were nonsignificantly related at the  $\alpha = .05$  level, that is, 1 versus 2:  $b = -10.97, t(51) = -1.76, p = .09, d = -0.52$ . On the other hand, those in the active control condition with fewer adult interpersonal traumas reported more dissociation at postintervention that those with greater adult interpersonal traumas, that is, 1 versus 2:  $b = -20.28, t(50) = -2.12, p = .04, d = -0.53$ ; 1 versus 3:  $b = -25.29, t(50) = -2.50, p = .02, d = -0.63$ . No other variables shared a pattern of findings in this direction. Models with depression and affect dysregulation had no significant results in the interactions of interest for either intervention condition.

### Question 2: Delineate Baseline Characteristics (i.e., Assessment Scores, Adult Interpersonal Abuse Exposure) That Moderate Intervention Condition (TCTSY vs. Active Control) on the Primary Outcome of PTSD.

See Table 3 for preintervention moderator values for significant conditional effects of intervention condition on clinician-rated PTSD change scores. Although each preintervention moderator variable had three levels (16th, 50th, 84th percentiles), only levels with significant effects are included due to space constraints. Three notable patterns emerged. First, with the exception of depression, all preintervention measures had at least one significant conditional effect of intervention condition on PTSD change score. Furthermore, TCTSY consistently outperformed the active control

Table 2  
Linear Mixed Models Type III Tests of Fixed Effects

Dependent variable	Numerator DF	Denominator DF	F value
Adult interpersonal trauma Intervention condition			
Clinician-rated PTSD (CAPS)	2	57	2.4 <sup>†</sup>
Self-reported PTSD (DTS)	2	57	2.42 <sup>†</sup>
Depression (BDI-II)	2	57	0.36
Dissociative symptoms (DES)	2	57	0.94
Emotional control problems (IASC-TR)	2	57	0.22
Affect dysregulation (IASC-AD)	2	57	0.55
Adult interpersonal trauma Intervention condition $\times$ Time			
Clinician-rated PTSD (CAPS)	2	53	2.07
Self-reported PTSD (DTS)	4	85	0.97
Depression (BDI-II)	4	88	0.80
Dissociative symptoms (DES)	2	50	3.79*
Emotional control problems (IASC-TR)	2	51	3.18*
Affect dysregulation (IASC-AD)	2	52	0.81

Note. PTSD = posttraumatic stress disorder; CAPS = Clinician-Administered Posttraumatic Stress Disorder Scale; DTS = Davidson Trauma Scale; BDI-II = Beck Depression Inventory-II; DES = Dissociative Experiences Scale; IASC-TR = Inventory of Altered Self-Capacities, Tension Reduction Activities; IASC-AD = Inventory of Altered Self-Capacities, Affect Dysregulation.  $N = 64$ .

<sup>†</sup>  $p < .10$ . \*  $p < .05$ .

Table 3  
*Moderator Values for Significant Conditional Effects of Intervention Condition on Clinician-Rated PTSD Change Scores Among Participants Exposed to One Form of Adult Interpersonal Trauma*

Moderator variable, Pre-Intervention	Moderator value	Effect	SE	95% CI
Clinician-rated PTSD (CAPS)	75.50 <sup>^</sup>	-27.49	10.75	[-49.03, -5.94]
	92.48	-36.49	12.42	[-61.38, -11.59]
Self-reported PTSD (DTS)	72.00 <sup>^</sup>	-24.92	10.94	[-46.89, -2.95]
	95.16	-25.33	12.08	[-49.59, -1.08]
Dissociative symptoms (DES)	6.29	-34.71	11.91	[-58.60, -10.82]
	13.93 <sup>^</sup>	-29.22	10.77	[-50.82, -7.61]
Emotional control problems (IASC-TR)	56.00	-27.93	12.01	[-52.01, -3.86]
	68.00 <sup>^</sup>	-28.21	10.79	[-49.83, -6.59]
	86.00	-28.62	12.50	[-53.69, -3.56]
Affect dysregulation (IASC-AD)	60.00	-35.63	12.80	[-61.30, -9.97]
	75.00 <sup>^</sup>	-28.60	10.70	[-50.06, -7.14]

*Note.* PTSD = posttraumatic stress disorder; CAPS = Clinician-Administered Posttraumatic Stress Disorder Scale; DTS = Davidson Trauma Scale; BDI-II = Beck Depression Inventory-II; DES = Dissociative Experiences Scale; IASC-TR = Inventory of Altered Self-Capacities, Tension Reduction Activities; IASC-AD = Inventory of Altered Self-Capacities, Affect Dysregulation. Negative unstandardized coefficients indicate greater improvements in the trauma-sensitive yoga intervention condition over the active control condition. Non-significant and marginally significant effects (e.g., depression) are not reported. All effects significant at the  $\alpha = .05$  level. *Ns* = 57–60 due to missing data.

<sup>^</sup>Moderator value at the 50th percentile; values less than or greater are at the 16th and 84th percentile, respectively.

condition in decreased PTSD scores when probing significant conditional effects of intervention condition on PTSD change scores. Lastly, with the exception of one effect (dissociative symptoms), significant conditional effects were detectable only among those who reported exposure to one form of adult interpersonal trauma. That is, participants with greater levels of adult interpersonal trauma exposure did not differ in PTSD change scores at any of the three tested levels of the preintervention measures.

### Exploratory Post-Hoc Analyses

To determine if outcome differences were driven by differential preintervention PTSD symptom severity among adult-onset interpersonal trauma survivors, we conducted analyses of variance. There was no significant difference in preintervention PTSD symptom severity among all levels of adult-onset interpersonal traumas,  $F(3, 60) = 0.37, p = .77$ .

### Discussion

This study delves into the only randomized clinical trial (van der Kolk et al., 2014) of a protocolized trauma-sensitive yoga intervention (TCTSY) by examining moderators of intervention efficacy. By determining for whom an intervention works best, then clinicians may target interventions to those most likely to benefit from them. The present sample consisted of women with histories of childhood interpersonal trauma, which allowed us to explore how additional interpersonal trauma in adulthood may impact responsiveness to the TCTSY intervention. We expanded upon this analysis by exploring how preintervention assessment scores may relate to changes in PTSD symptoms at postintervention.

The results from the primary research question provide preliminary evidence that the TCTSY intervention may have been most

efficacious for those with less adult interpersonal trauma compared to those with more adult interpersonal trauma experiences. This was the only consistent pattern among clinician-rated PTSD, self-reported PTSD, and emotional control problems, although effects were relatively small to moderate,  $ds = 0.39$ – $0.45$ . Depression, dissociative symptoms, and affect regulation were not moderated by experiences of adult interpersonal trauma in the TCTSY intervention.

In regard to the secondary research question, all preintervention measures moderated intervention condition effects for participants exposed to fewer (i.e., one) forms of adult interpersonal trauma, aside from preintervention depression scores. That is, the efficacy of the intervention conditions was less predictable among those with a history of greater adult-onset interpersonal trauma. For those with fewer adult-onset interpersonal traumas, the trauma-sensitive yoga intervention was consistently more efficacious than the active control condition at particular levels of the proposed moderator variables measured at preintervention.

These findings suggest that the efficacy of TCTSY may be particularly driven by those with fewer adult interpersonal traumas, and thus clinicians may feel most comfortable recommending TCTSY to these clients. That is not to discount the potential effectiveness of TCTSY on those with greater adult interpersonal traumas, as there simply may be differences in dose-responsiveness, and the findings did not suggest contraindications such as exacerbated symptoms for this population; rather, the efficacy of the TCTSY intervention compared to the active control was not as clear as for those with fewer adult interpersonal traumas, as those with more adult-onset interpersonal trauma decreased their PTSD symptom severity in both conditions. Because we did not control for mental health counseling that participants received, those with additional traumas may have received similar, more intensive counseling in re-



sponse to their traumas, thus leading to similar changes between intervention conditions. The TCTSY group was also compared to a relatively stringent active control condition (weekly women's health education group) rather than simply treatment as usual. Furthermore, it is important to highlight that this sample consisted of women who all had histories of childhood interpersonal traumas, who had been holding their index traumatic event for at least 12 years, and who had chronic, treatment-unresponsive PTSD from said event, all of whom were also undergoing counseling. Given the severity of cases as well as the between-groups comparisons, the previous outcome (van der Kolk et al., 2014) and present process findings are of note.

These results parallel the World Health Organization World Mental Health Survey Initiative findings on cumulative traumas and adult PTSD risk ( $N = 51, 295$ ; Karam et al., 2014). The World Mental Health surveys suggest that four traumatic events serve as a threshold for greater functional impairment and morbidity than those with three or fewer traumatic events. Specifically, those with four or more traumatic events had an earlier age of PTSD outset, longer symptom duration, higher comorbidity with other mental health disorders, and more hyperarousal symptoms. These individuals were also more likely to experience adulthood interpersonal traumas such as intimate partner violence and other forms of assault. Inclusive of the index trauma and childhood interpersonal trauma(s) in the present sample, four traumatic events were also the threshold for a less clear association between trauma exposure and TCTSY efficacy. As Karam et al. state that individuals with four or more traumatic experiences appear to be more complex clinical cases that require targeted intervention approaches, the present study suggests the same. By exploring moderators of intervention efficacy, we take the first step in determining how best to target the burgeoning mind-body medicine approach of TCTSY in this unique group.

This study has limitations that are important to consider when drawing conclusions. To note, this study uses data from a randomized controlled trial where TCTSY was administered adjunctive to participants' trauma treatment as usual; thus, effects cannot be attributed to TCTSY alone. Responses to TCTSY may simply parallel how individuals with less cumulative trauma exposure respond to interventions in general. As secondary analyses, the administered assessments were not chosen based on potential moderators; for instance, somatic measures would have been useful to determine whether changes in distress act through interoception given the theory of trauma living in the body. Post hoc analyses indicated that levels of adult-onset interpersonal trauma were not related to preintervention PTSD symptom severity, suggesting that another construct may be driving these outcomes. Furthermore, other moderators and mediators of intervention efficacy (notably, e.g., social support, perceived safety; Cai, Ding, Tang, Wu, & Yang, 2014; other life stressors; McLaughlin, Conron, Koenen, & Gilman, 2010) were not able to be included in the present study as they were not measured in the original trial. Participant perceived safety was also not measured, which would be an important component when fully measuring contraindications. In addition, interpersonal trauma was operationalized ordinally with a small range that did not account for differences in severity or chronicity of abuse. Even with this limitation in

trauma assessment, it is interesting to note that the findings on adult interpersonal trauma moderation were consistent across mental health symptom types. Nonetheless, sample characteristic measures could have been improved. Although the sample demographics mirrored US adults who practice yoga (Cramer et al., 2016), a larger and more diverse sample would increase generalizability. The smaller sample had limited power that might have influenced the results and also limited data analytic approaches that could have been appropriately applied.

Overall, TCTSY appears promising in reducing PTSD symptoms among female survivors of longstanding interpersonal traumas, with it being more effective for certain subgroups of survivors than others. However, to increase access to holistic and better mental health care, it would be important for research and practice to bring TCTSY to individuals outside of the average yoga practitioner. TCTSY is a protocolized trauma-informed yoga approach that makes it amendable for research; yet the core principles of TCTSY (e.g., using invitational language over command-based language, emphasizing noticing sensations over physical posture attainment) can be readily applied to all hatha yoga practices to make them more trauma-informed. In line with increasing the impact of holistic and better mental health care, future TCTSY intervention research should attempt to replicate the parent study through larger randomized controlled trials in more diverse community samples (e.g., National Library of Medicine, 2015). Future research should also include specific measures for possible mediators and moderators, especially because of its theoretical grounding in improving mind-body connections.

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Received November 1, 2019

Revision received July 7, 2020

Accepted July 9, 2020 ■