

# Four weeks of trauma-informed yoga intervention and autonomic tone in female veteran and non-veteran college students

SHANNON STEELE<sup>1</sup>, CASSIE WILLIAMSON-REISDORPH<sup>2</sup>, LAURA DYBDAL<sup>3</sup>, JOHN QUINDRY<sup>2</sup> 

<sup>1</sup>University of Montana, Missoula, United States of America

<sup>2</sup>School of Integrative Physiology and Athletic Training, University of Montana, Missoula, United States of America

<sup>3</sup>Phyllis J. Washington College of Education and Health Sciences, University of Montana, Missoula, United States of America

## ABSTRACT

**Introduction:** Female college students (veteran and non-veteran) are exposed to cumulative stressors and trauma that may lead to an imbalanced autonomic nervous system. Yoga has emerged as an efficacious intervention for psychological and physical trauma; however, the therapeutic dose of intervening yoga is unknown. Additionally, the frequency, duration, and type of yoga needed to achieve a therapeutic dose appear to be population specific when applied to trauma victims. The purpose of the study was to examine whether a short-term trauma-informed yoga intervention altered metrics of autonomic tone as assessed by heart rate variability (HRV) in female veteran and non-veteran college students. **Methods:** Nine female college students (age: 33 years  $\pm$  11, veteran, n = 4, non-veteran, n = 5) engaged in trauma-informed yoga once per week for one-hour over a four-week intervention. Repeated measures ANOVA were performed on the HRV variables lnRMSSD, lnHF, lnLF, and LF:HF. **Results:** Findings indicated no effect of the intervention on HRV as measured by lnRMSSD ( $p = .116$ ), lnHF ( $p = .073$ ), lnLF ( $p = .316$ ), and LF:HF ( $p = .131$ ). Further, no acute alterations in HRV were observed following a single session of trauma-informed yoga ( $p > .05$ ). **Conclusion:** The findings of the study revealed no significant effect of trauma-informed yoga on HRV following a single session or after a four-week yoga intervention.

**Keywords:** Heart rate variability; Stress; Physiology; Parasympathetic activity; Mindfulness.

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 **Corresponding author.** School of Integrative Physiology and Athletic Training, University of Montana, 32 Campus Drive McGill Hall 102, Missoula, MT 59812. United States of America.

E-mail: [john.quindry@mso.umt.edu](mailto:john.quindry@mso.umt.edu)

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## INTRODUCTION

College students experience a unique set of stressors that range from academic demands to social, emotional, and financial stress (Vallejo, Ruiz, Hermsillo, Borja-Aburto, & Cárdenas, 2006). Brougham et al. demonstrated that female college students experience significantly higher levels of stress across four variable categories including: familial relationship, financial, daily hassle, and social stressors (Brougham, Zail, Mendoza, & Miller, 2009). This understanding is problematic in that college aged students that have experienced significant psychological and physical trauma are at significant risk for long-term health consequences when trauma-related stressors go untreated (Association, 2017). Among the many sub-groups on modern college campuses, with significant trauma histories are female military veterans and their non-veteran counterparts. Indeed, female veterans, have additional stressors above and beyond those experienced by non-veterans, such as difficulties reintegrating back into civilian society as well as the effects of potentially traumatic military experiences on the veterans' mental, emotional, and social lives (Osborne, 2014).

The cumulative stress load manifests physiologically, and includes potentially deleterious alterations in the function of the autonomic nervous system (ANS) (Kemeny, 2003; Van der Kolk, 2006). The ANS influences the activity of tissues and organ systems throughout the body and plays an essential function in the maintenance of homeostasis (McCorry, 2007). ANS regulation occurs through the interplay of the two branches: the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS) (McCorry, 2007). During instances of psychological or physiological stress (e.g., exercise), SNS activity predominates, while in rested and low stress states the PNS is most active. However, the interplay between the PNS and the SNS can be reversed in those with poor psychological and physiological health. To this point, it is common for those who have experienced significant psychological and physical trauma to have a predominance of SNS activity at all (or most) times throughout the day, while the PNS activity (called "tone") is low. Being in a state of chronic SNS stimulation with low PNS tone is associated with increased morbidity and all-cause mortality (A Vinay, Venkatesh, & Prakash, 2015).

Based on this rationale, there is a reason to suspect that the stress experienced by veteran and non-veteran female college students may reflect a deleterious interplay of the branches of the ANS, resulting in greater SNS activity and lower PNS activity while in a physically rested state. Fortunately, autonomic balance can be measured non-invasively via a technique called heart rate variability (HRV), which is the quantification of the timing between successive R-R intervals as measured on a single electrocardiogram (ECG) tracing (Kamath, Watanabe, & Upton, 2012). Low HRV is associated with a reduction in parasympathetic activity and increased sympathetic dominance that can lead to unhealthy physical and related emotional outcomes, while higher HRV is associated with longevity and improved health outcomes (A Vinay et al., 2015).

Emotional and physical symptoms of fear arousal may include nightmares, fear, shame, feelings of isolation, and chronic pain (Association, 2017; Outcalt et al., 2015). Because of the problems that untreated chronic stress may cause in female college veterans and non-veterans, therapeutic interventions are necessary. Accordingly, recent research findings by Kozłowska et al. and van der Kolk suggest that interventions should address the mind-body relationship in the individual in such a way that multiple compounding stressors impact the ANS can be mitigated (Kozłowska, Walker, McLean, & Carrive, 2015; Van der Kolk, 2006). Previous research provides preliminary evidence for the effectiveness of such therapies, including yoga, in the reduction of symptoms related to stress and fear arousal (Staples, Hamilton, & Uddo, 2013). For instance, Rizzolo et al. (2009) demonstrated that a short-term yoga intervention (30 minutes of yoga, one day per week for three weeks) acutely reduced both physiological (systolic/diastolic blood pressure (SBP/DSP) and heart

rate (HR)) and psychological stress in college students. In other words, a single yoga intervention significantly reduced SBP, DBP, and HR (Rizzolo, Zipp, Stiskal, & Simpkins, 2009). Further, Vinay et al. demonstrated that a 4-week intervention consisting of a 1-hour yoga session six days per week resulted in increased HRV with greater parasympathetic activity (AV Vinay, Venkatesh, & Ambarish, 2016). HRV markers included time domain parameters, SDDN (increased from 22.60 to 25.6), RMSSD (increased from 22.00 to 25.6), PNN50 (increased from 2.45 to 7.35) and frequency domain parameters, LF (reduced from 39.30 to 30.40) and L/F high frequency ratio (reduced from 2.62 to 2.28) (AV Vinay et al., 2016).

Though previous studies indicate that yoga interventions effectively increase HRV, the effect of trauma-informed yoga has yet to be examined. Trauma-informed yoga uses both the principals as well as knowledge and intentions of Trauma Sensitive Yoga (TSY), which was developed by researchers and yoga practitioners at the Trauma Center at Justice Research Institute. TSY and trauma-informed yoga emphasize the acknowledgment of trauma symptoms (i.e. disconnection from the physical self, hyperarousal, reduced sense of safety, etc.) (Emerson, Sharma, Chaudhry, & Turner, 2009). Trauma-informed yoga specifically has been developed by many yoga instructors and organizations including the Yoga Service Council and Omega Institute to assist trauma sensitive populations such as female college students including veterans (Horton, 2016). Therefore, the purpose of the study was to investigate the effect of a four-week trauma-informed yoga intervention on HRV, with an additional purpose of examining the acute effects of a single session. Based on prior evidence of yoga frequency and duration, we hypothesized that both the four-week intervention and the acute effects of a single session would result an increase in parasympathetic activity as measured with HRV. Results from this study may serve as the basis for the future application of trauma-informed yoga to decrease symptoms of compounding stress and trauma that impact HRV and autonomic balance.

## MATERIALS AND METHODOLOGY

### *Participants*

Prior to initiation of the current investigation, human participants approval was granted by the University of Montana Institutional Review Board. Inclusion criteria required females who were current University of Montana students, aged 18 or older, who had not participated in a habitual yoga practice (i.e. more than ten yoga classes in the last three months). Participants were excluded if they were current smokers, pregnant, had a history of severe asthma, cardiovascular disease, metabolic disease, substance abuse or dependence (within three months of study enrolment), recent changes in psychiatric medication, or those using any medications that alter autonomic function. Participants who did not meet inclusion criteria or were not interested in taking part in the study, were referred to similar yoga programs on campus and within the community.

Table 1. Participant characteristics.

	Female College Students (n = 9)	Veteran (n = 7)	Non-Veteran (n = 5)
Age (yr.)	33.14 ± 11.246	26 ± 5.568	38.5 ± 11.958
White, Non-Hispanic	77.8%		

*Participant characteristics: age represented in mean, ± SD.*

Seventeen female participants (n = 17) were recruited for the study and provided informed consent. Due to time constraints, only 14 participants completed the HRV measures. Eight (approximately 47%) participants were female veterans. Two participants had incomplete HRV data, and additional subject attrition between pre- and post-test resulted in completing analyses for a total of nine participants. All yoga interventions were

conducted in the Mind-Body Laboratory at the University of Montana. Participant characteristics are described in Table 1.

**Study design and Measures**

Participants attended a total of six visits to the Mind-Body Laboratory at the University of Montana. During the first visit, researchers provided participants with an explanation of procedures followed by the completion of the physical activity readiness questionnaire (PAR-Q). Participants that enrolled in the study then completed baseline HRV tests with a standard lead II electrocardiogram recording (PRE-INT), using a negative electrode placed at the right arm and a positive electrode placed at the left leg (using a modified configuration for electrode placement).

Participants reported to the Mind-Body Laboratory following an overnight fast, having avoided alcohol, in addition to caffeine avoidance for 12-hours. Upon their arrival for visits two through five, the PRE yoga session HRV recording was conducted, followed by a trauma-informed yoga session. Immediately following the completion of the yoga session, participants completed the POST yoga HRV recording. During the last visit (visit six), participants completed their POST-INT HRV recording. Study design is presented in Figure 1.

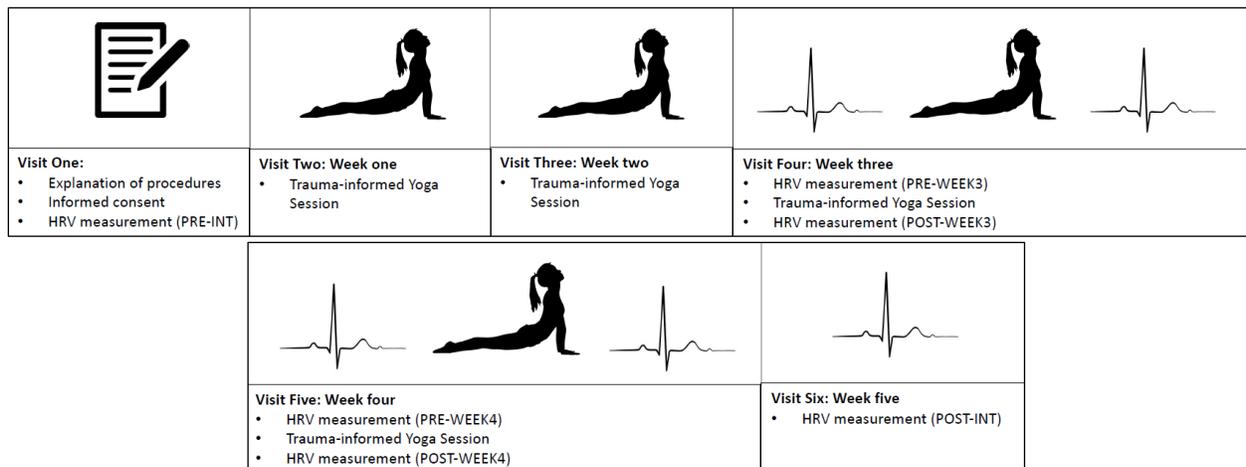


Figure 1. Experimental design.

**Procedures**

*Heart Rate Variability*

The HRV measurements were conducted in a quiet, dimly lit room with the participant lying quietly on a massage table in the supine position. Electrode sites were prepped with alcohol wipes and electrodes were in the modified limb lead positions. Participants were asked to lay quietly for a total of ten minutes while HRV was recorded utilizing an electrocardiogram device (iWorx Teaching Assistant, Dover, NH). The ECG recordings were conducted in Labscribe (Version 2.611700, Dover, H) and then imported into Kubios HRV Premium (Version 3.1.0, Kuopio, Finland) for further analysis.

*Trauma-Informed Yoga Intervention*

During visits 2 through 5, participants engaged in a trauma-informed yoga intervention for one hour, one day per week, for a total of four weeks. The goal of trauma-informed yoga is to help bring an individual’s focus back to one’s body, gain control of emotions and alleviate any symptoms of trauma (Henderer, 2017). The yoga intervention consisted of 10 minutes of intention setting and pranayama, 45 minutes of asana (physical

postures), and 5 minutes of savasana (resting in supine). Specific physical postures that might trigger stress or trauma were avoided including: deep back bends, advanced inversions (including headstand), and happy baby (Ananda Balasana). Additionally, each physical posture sequence was adapted to individual participant capacities to hold a given pose. For example, modifications or props were used to make physical poses more accessible. Furthermore, key mindfulness themes used were emphasized more than specific sequences of postures, and themes differed from one session to the next. Examples of themes included: orienting participant to the present moment, making choices (selecting what variation of the posture to practice), focus on rhythmic movement (body or breath), and emphasis of feeling (i.e. what a specific posture feels like in the body, how does the breath feel, etc.)(Clark et al., 2014). The specific yoga intervention is outlined in Table 2.

Table 2. Yoga intervention.

Week	Theme	Breath	Poses (Asana)
Week 1	Mindfulness (intention, attention, attitude), patience.	Noticing as it is, natural breathing.	<ul style="list-style-type: none"> <li>- Seated (on blocks) – breath → cat/cow</li> <li>- Supine – breath</li> <li>- Knee to chest – core</li> <li>- Windshield wiper</li> <li>- Gentle twist, knees stacked</li> <li>- Table – cat/cow/funky</li> <li>- Downward facing dog</li> <li>- Forward fold</li> <li>- Mountain</li> </ul> <ul style="list-style-type: none"> <li>- Sun salutation variation → to child's pose</li> <li>- High lunge – w/ blocks</li> <li>- Crescent lunge</li> <li>- Warrior II</li> <li>- Mountain</li> <li>- 3-legged downward facing dog</li> <li>- Plank or table</li> <li>- Chaturanga</li> <li>- Goal post arms, side stretch</li> <li>- Savasana</li> </ul>
Week 2	Mindfulness; being gentle with self; "showing up is enough"	Belly breathing; Sighing breath.	<ul style="list-style-type: none"> <li>- Seated or lying down</li> <li>- Roll to supine</li> <li>- Banana</li> <li>- Cactus – stretch side-to-side</li> <li>- Knees to chest</li> <li>- Gentle twist</li> <li>- Feet to ceiling</li> <li>- Roll to side</li> <li>- Seated – cat/cow</li> <li>- Side stretches, forward fold</li> <li>- Boat – side-to-side</li> <li>- Table – cat/cow</li> <li>- Child's pose</li> <li>- Gate pose – windmill to other side</li> </ul> <ul style="list-style-type: none"> <li>- Table</li> <li>- Downward facing dog</li> <li>- Sun salutation B</li> <li>- Crescent warrior</li> <li>- Revolved side angle with block</li> <li>- Warrior II</li> <li>- Reverse warrior</li> <li>- Extended side angle</li> <li>- Mountain pose</li> <li>- Cool down:</li> <li>- Figure four (supine)</li> <li>- Bridge pose (w/ block)</li> <li>- Spinal twist</li> <li>- Savasana</li> </ul>
Week 3	Mindfulness (intention, attention, attitude), patience, gratitude – heart openers.	Introduce three-part breath (Inhale – breathing into/expanding abdomen first, diaphragm second, and chest last; Exhale – softening chest first, diaphragm second, and abdomen last).	<ul style="list-style-type: none"> <li>- Supine – rolled blanket along spine or cross-seated</li> <li>- Easy pose - Torso moves in circular motion – cat/cow</li> <li>- Half butterfly – side stretches</li> <li>- Cradle leg in (pigeon variation)</li> <li>- Table – cat/cow/funky</li> <li>- Core – hover knees</li> <li>- Modified side plank</li> <li>- Chaturanga (from table)</li> <li>- Cobra (arms wide) – repeat</li> <li>- Downward facing dog</li> <li>- Forward fold</li> </ul> <ul style="list-style-type: none"> <li>- Malasana – roll up to mountain pose</li> <li>- Repeat (forward fold, malasana, mountain)</li> <li>- Crescent warrior (cactus arms – heart opener)</li> <li>- Revolved side angle</li> <li>- Warrior II</li> <li>- Reverse Warrior</li> <li>- Extended side angle</li> <li>- Triangle pose</li> <li>- Cool down</li> <li>- Modified fish pose (w/ block)</li> <li>- Hamstring stretch and spinal twists with strap.</li> </ul>

Week 4	Begin linking poses by moving with breath: break down each pose for one sequence (discuss alignment principles), then flow through each pose, linking with breath two more times	In nose, out mouth; three-part breath (wave visualization)	<ul style="list-style-type: none"> <li>- Supine</li> <li>- Knees to chest</li> <li>- Feet to ceiling</li> <li>- Extended leg circles (one at a time)</li> <li>- Cat pulling its tail (w/ strap)</li> <li>- Mermaid (side stretches)</li> <li>- Twists, leaning back</li> <li>- Staff pose</li> <li>- Table – cat/cow</li> <li>- Chaturanga</li> <li>- Cobra</li> <li>- Child’s pose</li> <li>- Table</li> <li>- Downward facing dog</li> <li>- Sun Salutation A</li> <li>- Crescent warrior</li> </ul>	<ul style="list-style-type: none"> <li>-Warrior II</li> <li>- Reverse warrior</li> <li>- Extended side angle</li> <li>- Reverse warrior</li> <li>- Triangle pose</li> <li>- Revolved side angle</li> <li>- Standing split</li> <li>- Forward fold</li> <li>- Modified side plank</li> <li>- Tree pose</li> <li>- Cool down</li> <li>- Staff pose</li> <li>- Forward fold (w/ strap)</li> <li>- Spinal twists</li> <li>- Savasana</li> </ul>
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**Analysis**

A Shapiro-Wilk test was performed to determine if the heart rate variability data set followed a normal distribution. When the data violated normality, a natural logarithmic transformation was performed on RMSSD, HF, and LF. Data are reported as lnRMSSD, lnHF, and lnLF. Repeated measures analysis of variance (ANOVA) were performed to compare the mean differences in HR, lnRMSSD, lnHF, lnLF, and LF:HF. Statistical software (V.25.0, SPSS Inc., Chicago, IL) was used for all analyses and an alpha level of  $p \leq .05$  was used to determine statistical significance. All data are reported as mean  $\pm$  SEM.

**RESULTS**

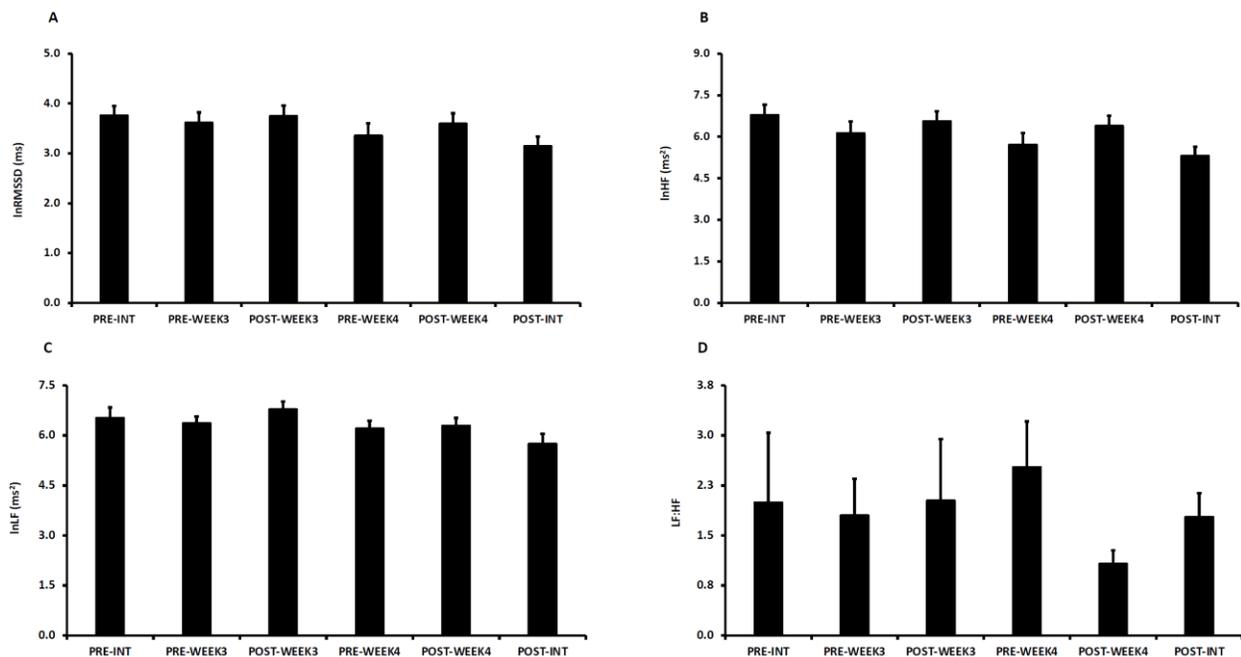


Figure 2. Markers of cardiac autonomic activity are presented as means  $\pm$  SEM. (A) Time domain index lnRMSSD ( $p = .116$ ). (B) Frequency domain index lnHF ( $p = .073$ ). (C) Frequency domain index lnLF ( $p = .316$ ). (D) Frequency domain index LF:HF ( $p = .131$ ).

Mean responses for heart rate variability assessed through the measurement of lnRMSSD, lnHF, lnLF, and LF:HF are presented in Figure 2. Contrary to our hypothesis, repeated measures ANOVA indicate that there was no effect of the yoga intervention on heart rate ( $p = .141$ ), lnRMSSD ( $p = .116$ ), lnHF ( $p = .073$ ), lnLF ( $p = .316$ ), or LF:HF ( $p = .131$ ).

## DISCUSSION

The purpose of this study was to determine whether a four-week, trauma-informed yoga intervention could improve the HRV of female veteran and non-veteran college students. Findings from this study revealed that as prescribed, the current trauma-informed yoga intervention had no measurable effect on HRV markers lnRMSSD, lnHF, lnLF or LF:HF. Additionally, the current study was designed to examine whether a single trauma-informed yoga session would result in acute alterations in autonomic tone as measured through a series of established HRV metrics. Also, in contrast to our hypotheses, the findings of the current study revealed there were no acute changes with a single yoga session. These negative outcomes are quite interesting and suggest several important considerations about both the trauma-informed yoga intervention and population-specific interventions; in female veterans and non-veterans.

The trauma-informed yoga intervention in the current study used many components of yoga (i.e. meditation, pranayama, and asana) similar to previous studies whose interventions showed promising results for HRV (Cheema et al., 2013; AV Vinay et al., 2016). However, the variations between studies was significant. For instance, Vinay et al. identified an increase in HRV measures of healthy males with no prior yoga experience after completing an integrated yoga intervention (AV Vinay et al., 2016). The yoga intervention consisted of 5 minutes of stretching and prayer, 20 minutes of yoga postures including padmanasana (lotus), vajrasana (thunderbolt) and matsyasana (fish), 20 minutes of pranayama and 15 minutes of meditation (AV Vinay et al., 2016). In contrast to the current study, Vinay et al. predominately focused on pranayama, meditation and prayer, emphasizing a more restorative intervention (AV Vinay et al., 2016). Additionally, a study by Melville et al. demonstrated an increase in HRV measures SDNN (+22.5%) in healthy, sedentary (office-based) workers who participated in a single gentle chair yoga intervention (Melville, Chang, Colagiuri, Marshall, & Cheema, 2012). The intervention involved deep breathing techniques and postures such as side bend, forward bend, back bend, and arms above head while seated in a chair. Each pose was held for six breaths and concluded with participants seated in stillness with eyes closed (Melville et al., 2012). Previous research generally indicates that the introduction of yoga to a previously naive population improves HRV and increases PNS vagal activity. However, because of the large variations among the types of yoga, the multitude of class settings, etc., this finding is likely limited to the populations and context in which the outcomes were observed (Tyagi & Cohen, 2016).

Indeed, the modality or type of yoga is a modifiable variable to be considered when examining the autonomic response in a given population or sub-population. In this regard, yoga interventions range from relaxation/meditation exercises with little movement or physical postures, to more advanced physical postures and sequences including inversions (headstand, shoulder stand, etc.). For all these nuances in application, which are certain to have inconsistent impacts on the ANS of population sub-groups, HRV response could vary significantly among different breathing techniques (rapid breathing vs. slow breathing), relaxation/meditation exercises (Yoga Nidra vs. supine rest), or yoga poses (inversion postures vs. chair-based yoga poses) (Tyagi & Cohen, 2016). For example, Monika et al. evaluated the effects of Yoga Nidra, which incorporates relaxation techniques, awareness of breath and visualization while in savasana (supine), on markers of the HRV power spectral density (LF, HF, LF:HF) and demonstrated no changes with a six month intervention (Neuhäuser-Berthold, Beine, Verwied, & Lüthmann, 1997). In contrast, an Iyengar yoga

intervention, which included inversion and backbend postures, significantly improved 24-hour HRV as measured by rMSSD and SDNN (Khattab, Khattab, Ortak, Richardt, & Bonnemeier, 2007). Trauma-informed yoga in the current study fell in between the two studies mentioned in terms of relaxation and rigor.

In addition to the type of yoga utilized in an intervention, the frequency of sessions or the total number of sessions administered within the intervention should be considered when examining changes in autonomic control. For instance, Vinay et al. demonstrated improved HRV after 24 sessions of yoga over a 30 day intervention in male subjects (AV Vinay et al., 2016). Our outcomes are in contrast with these prior findings; however, the current intervention administered a total of four yoga sessions as compared with the 24 sessions. Similarly, Telles et al. administered a yoga intervention for one hour daily for seven days, which also yielded no effect on HRV markers (LF, HF, LF/HF, NN50, pNN50 or TINN) (Telles, Singh, Joshi, & Balkrishna, 2010). Future research should identify a minimum number of sessions necessary to see improvements in autonomic balance.

While hindsight might suggest a longer intervention should have been undertaken for the current study, this investigation was directed at understanding whether a short time course (4 weeks) and an acute intervention would yield measurable changes in ANS function as measured through HRV. While participants universally reported anecdotal perceptions of improved wellbeing after each session, the effect did not extend to the measures of HRV. This interesting finding does not mean that the trauma-informed intervention was unsuccessful, but rather that physiologic improvements may have existed independent of the ANS, or perhaps through ANS measures other than HRV. Accordingly, we recommend for follow-up investigation that additional measures of ANS function, including sensory measures and muscle sympathetic nerve activity be included in future investigations.

Another important design feature of the current study was the frequency of sessions employed and the total length of the intervention in weeks. In this regard, the type of yoga, frequency of sessions, and length of the intervention, the experience of the study sample are independently influential. Moreover, prior studies report that the regular practice of yoga increases indices of PNS activity as measured through metrics of vagal tone (Tyagi & Cohen, 2016). Specifically, yoga practitioners with at least 3 years of regular yoga practice (3 days per week, for a minimum of 30 minutes per day) exhibit an increase in heart rate variability as measured through pNN50 when compared to aerobically fit participants (performing some form of aerobic exercise, 3 or more days per week for at least 30 minutes per day over the previous year) (Friis & Sollers III, 2013). Additionally, when comparing non-yoga practitioners and frequency of yoga sessions practiced, Vinay et al. demonstrated successful HRV results after participants engaged in 24 sessions of yoga over 30 days, whereas Cheema et al. asked participants to engage in a yoga intervention 3 days a week for 10 weeks, and yielded no significant HRV (SDNN, RMSSD, pNN50, log LF power, log HF power and log total results). Based on this understanding and the findings observed in the current study, we recommend that the application of trauma-informed yoga be performed in female veterans and non-veterans with both increased frequency and increased program duration.

Other factors that influence HRV results include nicotine, alcohol and/or caffeine consumption, and hormonally-based birth control medications. Though participants were asked to refrain from ingesting nicotine, alcohol and caffeine 24-hours prior to measuring HRV, it is possible participants did not abstain within the recommended time period. There are many variables that affect changes in heart rate variability, as it takes into account digestive, respiratory and other recovery and stress-related systems (Acharya, Joseph, Kannathal, Lim, & Suri, 2006; Berntson et al., 1997). Moreover, applied research applications like the current study, being pragmatic in nature, are of benefit because of their holistic nature. Stated differently,

a given yoga regimen in a particular population (e.g., trauma-informed yoga in female veterans of college age) should be examined for potential efficacy with potentially confounding factors intact. Accordingly, we recommend for future investigations within this population subset, that many more participants be examined and potential confounding variables (i.e., nicotine use.) be quantified and then examined with multivariate analysis techniques to better understand the interactive nuances.

To the above point, the current preliminary study was limited by a small sample size and short duration of the yoga intervention. Although 17 people were recruited for the study, HRV was analysed for 9 participants. In this regard, some, but not all, studies with a small sample size ( $n = < 40$ ) also report a less consistent change in HRV measures (Bidwell, Yazel, Davin, Fairchild, & Kanaley, 2012; Bowman et al., 1997; Cheema et al., 2013; Telles et al., 2010). Additionally, within our cohort, academic stress combined with the unique stressors female veteran and non-veteran college students experience could have impacted the responsiveness to the intervention. Specifically, HRV measurements taken post-intervention were conducted during the final exam portion the semester. A previous study by Shinba et al. found that tasks inducing anxiety showed a decreased HRV response, particularly high-frequency and low-frequency measures (Shinba et al., 2008).

Future studies investigating the effects of a trauma-informed yoga intervention on female veteran and non-veteran college students should recruit a larger sample size. Eligibility criteria could also include participants with a habitual yoga practice, so researchers may compare yoga practitioners to non-yoga practitioners. Additionally, extending the yoga intervention and including more frequent doses of yoga is recommended.

## CONCLUSION

In the present study, four-weeks of trauma-informed yoga naive college student veteran and non-veterans who self-report as having high stress levels did not affect HRV measures of ANS modulation (Brougham et al., 2009; Koenig, Maguen, Monroy, Mayott, & Seal, 2014; Osborne, 2014; Pariat, Rynjah, Joplin, & Kharjana, 2014). Though the present study did not find significant results, the current approach provides a comprehensive point of reference regarding study design, yoga intervention protocol, and participant recruitment. The current investigation is important in that there continues to be increased interest in the effect of yoga on HRV. Most published findings, however, are in poorly controlled settings and generally limited to healthy male research volunteers (Tyagi & Cohen, 2016). Accordingly, these data are among the first to examine a short-term trauma-informed yoga intervention on autonomic regulators of the heart. Furthermore, no prior study has been conducted examining its effect on female college students or veteran college students. This study serves as an important foundation for future research in this area on female veteran and non-veteran college students who experience many unique and compounding stressors.

## AUTHOR CONTRIBUTIONS

Study concept and design (J.C.Q and L.D.), obtaining funding (L.D.), acquisition of data (S.S., L.D., C.W.R.), analysis of data (C.W.R.), drafting of the manuscript (S.S., C.W.R., J.C.Q., L.D.), critical revision of the manuscript (S.S., C.W.R., J.C.Q., L.D.), and approval of the final manuscript (S.S., C.W.R., J.C.Q., L.D.).

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## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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