EFFECT OF A SINGLE SESSION OF ASHTANGA YOGA OR MODERATE INTENSITY CONTINUOUS TRAINING ON COGNITIVE VULNERABILITIES FOR ANXIETY DISORDERS

A Thesis

Submitted In Partial Fulfillment of the Requirements

for the Degree of

Bachelor of Science (Honours) in Psychology

University of Regina

by

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Regina, Saskatchewan

April, 2018

Abstract

Exercise has many established benefits for psychological wellbeing (Asmundson et al., 2013). Researchers have found that a single session of moderate intensity continuous training (MICT) can decrease anxiety sensitivity (AS), a cognitive vulnerability for anxiety disorders (LeBouthillier & Asmundson, 2015, 2017; Mason & Asmundson, 2018), while repeated sessions of resistance training targets other cognitive vulnerabilities, such as distress tolerance (DT) and intolerance of uncertainty (IU), as well as AS (LeBouthillier & Asmundson, 2017). Group exercise is a cost-effective exercise modality with potential to improve AS, DT, and IU; yet, it has received little attention in the literature. Yoga, including Ashtanga yoga, is a form of group exercise that has promise for improving psychological wellbeing; however, its efficacy for improving cognitive vulnerabilities for anxiety has not been compared to other types of group exercise. This randomized control trial is the first to examine the effects of a single session of MICT and Ashtanga yoga on AS, DT, IU, and mindfulness. Comparisons can be readily made between Ashtanga yoga and MICT because Ashtanga yoga has a standard structure, is a continuous (i.e., without rest) training style, and elevates heart rate to a similar extent as MICT (Schultz, 2000). A total of 42 participants were randomized to a single 60-minute group session of MICT, Ashtanga yoga, or a stretching control. Measures of AS, DT, IU, and state mindfulness were completed before and after all group sessions, and at 3- and 7-day follow-ups. Multilevel modeling was used to evaluate changes in AS, DT, IU, and mindfulness. Results show that as compared to an active stretching control group, a single session of MICT, but not Ashtanga yoga, significantly reduces AS for both the total and cognitive concerns subscale scores. In contrast, a single session of Ashtanga yoga, but not MICT, significantly increases total DT as well as the appraisal subscale scores. No significant changes in IU or mindfulness were observed across

either exercise group. Improvements in AS and DT suggest that a single session of group exercise may be a viable strategy for improving psychological wellbeing.

Keywords: randomized controlled trial, anxiety sensitivity, distress tolerance, mindfulness, intolerance of uncertainty, moderate intensity continuous training, Ashtanga yoga

Acknowledgments

I would like to take this opportunity to express my sincere gratitude to all those involved in making the completion of my thesis possible. First, to my supervisor Dr. Gordon Asmundson, for his guidance and support which have been invaluable throughout this process. I also wish to thank my co-supervisor, Julia Mason, a PhD. student whose mentorship went over and above thorough the editing and advice she provided. Finally, I extend my gratitude to my friends and family whose unconditional love and support allowed me to achieve this goal.

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Effect of a Single Session of Ashtanga Yoga or Moderate Intensity Continuous Training on Cognitive Vulnerabilities for Anxiety Disorders

Anxiety disorders are one of the most prevalent forms of mental disorders (Kessler et al., 2005; Remes, Brayne, Linde, & Lafortune, 2016). Anxiety disorders are highly comorbid with other mental disorders, with approximately 70% of individuals with anxiety disorders also receiving another mental disorder diagnoses (Lewinsohn, Zinbarg, Seeley, Lewinsohn, & Sack, 1997). Anxiety disorders are associated with substantial individual impairment, with anxiety disorders being linked to lower socioeconomic status, increased isolation, and tobacco and alcohol abuse (Mondin et al., 2013). Furthermore, anxiety disorders have both a direct (i.e., costs associated with the use of health-care resources) and indirect (i.e., costs due to lost wages and productivity for the individual with the disorder) economic burden on society (Hoffman, Dukes, & Wittchen, 2008; Koerner et al., 2004). The high societal cost associated with anxiety disorders has prompted researchers to look into cost, time, and human resource-efficient treatment options for anxiety. Alternative treatment options are especially important for individuals with anxiety disorders who do not have access or do not respond to psychotherapy and pharmaceutical treatment for anxiety. Programs capable of improving cognitive vulnerabilities (i.e., risk factors for the development and perpetuation of anxiety disorders) are associated with positive treatment outcomes for anxiety disorders (Boswell, Thompson-Hollands, et al., 2013; Gallagher et al., 2013; Shihata, McEvoy, Mullan, & Carleton,, 2016; Smits, Powers, Cho, & Telch, 2004). Exercise may be a cost-efficient alternative for improvement of cognitive vulnerabilities or risk factors for development and perpetuation of anxiety disorders.

Cognitive Vulnerabilities for Anxiety Disorders

Anxiety sensitivity (AS). AS is the fear of the arousal-related sensations associated with anxiety, based on the belief that these physiological experiences have adverse social, cognitive, or physical consequences (Reiss & McNally, 1985). When individuals with high AS become anxious, the naturally occurring arousal-related physiological sensations (e.g., increased heart rate, sweating) are interpreted as threatening, adding to the initial anxiety response (Taylor et al., 2007). Research has suggested AS is a cognitive vulnerability and maintenance factor for the development of anxiety-related disorders (Asmundson, 1999; Maller & Reiss, 1992; Naragon-Gainey, 2010). Programs capable of reducing AS benefit interventions for anxiety since a reduction of AS is associated with positive treatment outcomes for anxiety disorders (Gallagher et al., 2013; Smits et al., 2004).

Distress tolerance (DT). DT refers to an individual's ability to encounter and endure negative mental states (Simons & Gaher, 2005). Low DT is thought to increase vulnerability for anxiety disorders (Keough, Riccardi, Timpano, Mitchell, & Schmidt, 2010). There is an inverse relationship between DT and AS, meaning as DT increases there tends to be a reduction in AS that is associated with positive treatment outcomes (Keough et al., 2010; Laposa, Collimore, Hawley, & Rector, 2015).

Intolerance of uncertainty (IU). IU is a cognitive vulnerability for anxiety disorders characterized by negative beliefs about the implications of uncertainty and a predisposition to react negatively to uncertain situations (Shihata et al., 2016). Individuals with high IU tend to experience elevated levels of anxiety in situations with uncertain outcomes (Carleton, Sharpe, & Asmundson, 2007; Shihata et al., 2016). It is important to measure AS and IU separately because although they appear related, findings suggest they are distinct constructs (Carleton,

Sharpe, et al., 2007). Elevations in IU have been observed in several anxiety disorders (i.e., social anxiety disorder, panic disorder, generalized anxiety disorder, obsessive-compulsive disorder; Carleton et al., 2012) and reductions in IU are associated with positive treatment outcomes (Boswell, Thompson-Hollands, et al., 2013; Shihata et al., 2016). For better treatment outcomes, programs for the improvement of IU and other cognitive vulnerabilities should be incorporated into existing treatment options.

Moderate Intensity Continuous Training and Cognitive Vulnerabilities for Anxiety

There is strong evidence for the efficacy of many types of exercise interventions for reducing symptoms of anxiety (Asmundson et al., 2013; Stubbs et al., 2017). In line with these findings, exercise also appears to improve cognitive vulnerabilities for anxiety (LeBouthillier & Asmundson, 2015, 2017; Mason & Asmundson, 2018). Researchers have found that both single and repeated sessions of moderate intensity continuous training (MICT; continuous exercise with target heart rate of 70% maximum age adjusted heart rate) and a single session of sprint interval training (i.e., intermittent exercise with target heart rate of 90% maximum age adjusted heart rate) can decrease AS (LeBouthillier & Asmundson, 2015, 2017; Mason & Asmundson, 2018). Only repeated sessions of resistance training seem to improve other cognitive vulnerabilities, including DT and IU (LeBouthillier & Asmundson, 2017). These improvements in cognitive vulnerabilities for anxiety suggest that exercise may be a potential cost-efficient intervention for enhancing treatment outcomes for anxiety-related disorders.

MICT and AS reduction. MICT is an exercise protocol that has received research interest. Reductions in AS have been found following several sessions of MICT (Fetzner & Asmundson, 2015; Sabourin, Stewart, Watt, & Krigolson, 2015) and a single MICT session (Broman-Fulks, Kelso, & Zawilinski, 2015; LeBouthillier & Asmundson, 2015; Mason &

Asmundson, 2018). Researchers have found reductions in AS reduction following MICT protocols administered to both clinical (e.g., participants with PTSD; Fetzner & Asmundson, 2015) and nonclinical populations. Past research has found reductions in total AS score, social concerns, cognitive concerns (Mason & Asmundson, 2018), and physical concerns subscales (LeBouthillier & Asmundson, 2015) following a single session of aerobic exercise.

MICT and DT increase. A single session of MICT or sprint interval training has not been shown to increase DT (Broman-Fulks et al., 2015; LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018). Researchers have also not found significant increases in DT following repeated sessions of MICT (LeBouthillier & Asmundson, 2017); however, participants who underwent an eight-week Bikram yoga protocol experienced significant increases in DT (Medina, Hopkins, Powers, Baird, & Smits, 2015). The mindfulness component of yoga protocols requires participants to be non-judgmental and aware of the present, which may enable participants to shift attention away from negative mental states, potentially resulting increased DT that is not found with a single session of MICT (Baer, 2009).

MICT and IU reduction. To date, only one study has observed an effect of exercise on IU. Improvements in IU have been shown in a full body resistance training exercise protocol composed of three sessions per week and lasting for four weeks (LeBouthillier & Asmundson, 2017). These findings suggest that repeated sessions of resistance training may be required to target IU. Significant changes in IU have not yet been observed following single or repeated sessions of exercise, including MICT or sprint interval training (LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018).

Group Exercise and Cognitive Vulnerabilities for Anxiety

Prescribing exercise in a group environment as compared to exercising individually would likely reduce the time, resources, and associated costs of exercising. Despite the potential benefits of group exercise, it has received little attention in the literature. For instance, researchers have not looked at the effect of a single session of group MICT on cognitive vulnerabilities for anxiety disorders, including AS, DT, and IU. One form of group exercise that has been researched more thoroughly is yoga (Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005).

Yoga and Cognitive Vulnerabilities for Anxiety Disorders

Researchers have found that a regular practice of Ashtanga yoga can reduce state anxiety (i.e., arousal response to a situation) and trait anxiety (i.e., an individual's tendency to experience physiological arousal across many situations; Javnbakht, Kenari, & Ghasemi, 2009). Research on Bikram yoga suggests that an eight-week, twice-weekly protocol can increase DT (Medina et al., 2015), and a single session can reduce state anxiety (Szabo, Nikhazy, Tihanyi, & Boros, 2016); however, the effects of on a single session of yoga on AS, DT, and IU has not yet been investigated.

There are a wide variety of yoga practices available that range in intensity, duration, and structure. Researchers have examined the influence of yoga on anxiety, but there is often inadequate reporting of yoga style, poses, and teaching methods which presents challenges for replication and extension of existing research (Hofmann, Andreoli, Carpenter, & Curtiss, 2016; Kirkwood et al., 2005). Several studies involving yoga and anxiety report using Hatha yoga. This is problematic because Bikram yoga (Medina et al., 2015) and mixed or modified yoga practices (Kirkwood et al., 2005) have also been identified as types of Hatha yoga in the literature.

Inconsistencies in both terminology and selected protocol make it difficult to compare results between studies.

Ashtanga yoga has a standard structure, is continuous, and incorporates mindfulness by asking students to focus on the present moment without judgement (Schultz, 2000). Ashtanga yoga is advantageous for use in research because it requires practitioners to perform the same poses in the same order every session. This consistency allows for direct comparisons to be made between all studies using Ashtanga yoga. The Ashtanga protocol involves continuous energy flow by linking poses (Schultz, 2000) and typically begins with sun salutations, which elevate heart rate to a level comparable to warm-up exercise (Cowen & Adams, 2007). Elevations in heart rate occurring during Ashtanga yoga are similar to the elevations occurring during MICT, which allows for direct comparisons to be made between both protocols. Despite similarities in intensity, Ashtanga yoga differs from MICT in that it encourages participants to remain aware of thoughts and sensations in the present moment. This additional mindfulness component may contribute to increased DT (Medina et al., 2015). Increased physiological arousal (e.g., elevated heart rate) and mindfulness may play a role in improvement of cognitive vulnerabilities.

Potential Mechanisms for Change in Cognitive Vulnerabilities

Interoceptive exposure. Interoceptive exposure is a technique used in the treatment of anxiety disorders, that involves repeatedly exposing individuals to feared physical sensations, leading to a gradual reduction of fear response with each exposure (Sabourin, Watt, Krigolson, & Stewart, 2016; Stewart & Watt, 2008). Research suggests that treatment involving interoceptive exposure results in reductions in AS (Boswell, Farchione, et al., 2013). Since the physiological responses associated with exercise are similar to those associated with anxiety response (e.g., increased heart rate; Asmundson et al., 2013), researchers have proposed that exercise is a

natural form of interoceptive exposure. Interoceptive exposure may also lead to reductions in IU by increasing comfort in the possibility of unknown events occurring in the future (Dugas, Gagnon, Ladouceur, & Freeston, 1998).

Mindfulness. Mindfulness is the process of meaningfully paying attention to and accepting the present moment without judgement (Ludwig, & Kabat-Zinn, 2008). Mindfulness-based interventions have been successfully used in the treatment of anxiety disorders (Kim et al., 2009). Remaining in the present is thought to decrease AS by demonstrating that physiological arousal is temporary and fluctuates without adverse consequences (Roemer, Erisman, & Orsillo, 2008). Furthermore, mindful self-observation enables participants to shift attention away from negative mental states and is associated with the ability to behave adaptively when distressed, thus leading to increases in DT (Baer, 2009).

Purpose

Research suggests that MICT can significantly reduce AS in a single session (Broman-Fulks et al., 2015, LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018); however, research looking at single session group exercise, including MICT, is lacking. The effect of Ashtanga yoga on AS, DT, and IU has not been examined, despite promising research on the effects of Ashtanga yoga on other anxiety-related constructs (i.e., state and trait anxiety; Javnbakht et al., 2009). The purpose of the current trial is to evaluate the effect of a single session of MICT and Ashtanga yoga on AS, DT, and IU total and subscale scores. A secondary focus of the current trial is to examine whether a single session of Ashtanga yoga can elicit increases in mindfulness, based on research showing that yoga increases state mindfulness over 8-week protocol (Cox, Ullrich-French, Cole, & D'Hondt-Taylor, 2016).

Hypotheses

The proposed trial will have three hypotheses. The first hypothesis is that a single session of either MICT or Ashtanga yoga will decrease AS but not IU, when compared to an active stretching control condition. Second, significant increases in DT will occur following a single session of Ashtanga yoga, but not following a session of MICT or active stretching control. The final hypothesis is that a single session of Ashtanga yoga will significantly increase mindfulness, but a single session of MICT or active stretching will not.

Method

Participants

Ethical approval was obtained through the University of Regina Research Ethics Board (See Appendix A). Participants (N = 42) were recruited from the community and University of Regina Department of Psychology Participant Pool. Eligible participants from the Participant Pool received up to three course credits for participation and participants from the community were entered into a draw for a gift card. Inclusion criteria required that participants were between 18 and 65 years of age, not currently physically active (i.e., completed less than 150 minutes of moderate intensity exercise or less than 75-minutes of vigorous intensity exercise per week), and not practicing any style of yoga more than one session per week. Individuals taking benzodiazepines or antipsychotic medication were not eligible to participate. Individuals with health problems for which exercise may pose a safety risk were identified in the screening process and required to consult a medical professional for clearance prior to the study. The current trial did not select for a population with clinical levels of anxiety or AS. Previous research has demonstrated that a significant reduction in cognitive vulnerabilities for anxiety can

be found in samples not selected for clinical levels of anxiety or AS (e.g., LeBouthillier & Asmundson, 2015).

Materials

Physical Activity Readiness Questionnaire for Everyone (PAR-Q+; Warburton, Jamnik, Bredin, & Gledhill, 2014). The eligibility of participants with health problems for which exercise may pose a safety risk was screened using the PAR-Q+ (Warburton et al., 2014). This 7-item self-report questionnaire checks for physiological symptoms that may prevent the participant from safely engaging in exercise.. The PAR-Q+ evaluates heart problems, high blood pressure, dizziness, and joint problems. Participants who endorse any of these symptoms were required to consult a medical professional for clearance prior to completing the exercise session. Data gathered from this measure was only used in the online screen to determine participant eligibility.

Physical Activity Readiness Clearance (Canadian Society for Exercise Physiology, 2013). This form was provided to all participants who met all eligibility criteria except for the PAR-Q+. If still interested in completing the trial, participants were required to have a physician complete this form to verify that they could safely participate in the exercise component of the current trial. The physician was required to list any relevant medical conditions that could impact participation in this trial. If the physician decided that exercise was unsafe for the participant, they were not deemed eligible to participate.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007; See Appendix B). The ASI-3 is a self-report questionnaire that measures the tendency to fear physiological arousal-related sensations. The ASI-3 includes 18 items assessed on a 5-point Likert scale ranging from 0 (*agree very little*) to 4 (*agree very much*). The items correspond to three subscales: Physical Concerns,

Cognitive Concerns, and Social Concerns. The ASI-3 is the most recent iteration of the Anxiety Sensitivity Index (ASI, Peterson & Reiss, 1992), and has higher internal consistency and convergent, discriminant, and known group validities than the ASI. This demonstrates that the ASI-3 is a better measure than the ASI for assessing AS and its dimensions (Taylor et al., 2007). The ASI-3 shows strong replicability in both clinical and non-clinical populations (Kemper, Lutz, Bähr, Rüddel, & Hock, 2011; Taylor et al., 2007; Wheaton, Deacon, McGrath, Berman, & Abramowitz, 2012).

Distress Tolerance Scale (DTS; Simons & Gaher, 2005; See Appendix C). The DTS is a self-report questionnaire that measures tolerance of emotional distress. It includes 15 items measured on a 5-point Likert scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree).* The items correspond to four subscales: Tolerance, Absorption, Appraisal, and Regulation. The DTS demonstrates good convergent, discriminant, and criterion validity (Simons & Gaher, 2005).

Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, & Asmundson, 2007; See Appendix D). The IUS-12 is a self-report questionnaire that measures responses to uncertainty, ambiguous situations, and the future. The IUS-12 is a short form of the original 27-item Intolerance of Uncertainty Scale (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994) and is strongly correlated with the original scale (Carleton, Norton, et al., 2007; Khawaja & Yu, 2010). The IUS-12 includes 12 items rated on a 5-point Likert scale ranging from 1 (*not at all characteristic of me)* to 5 (*entirely characteristic of me*). The items correspond to two subscales: Prospective and Inhibitory IU. The IUS-12 has good internal consistency, convergent validity, and discriminant validity (Carleton, Norton, et al., 2007) in both clinical and non-clinical populations (Khawaja & Yu, 2010).

State Mindfulness Scale (SMS; Tanay & Bernstein, 2013; See Appendix E). The SMS measures an individual's awareness to thoughts and sensations in the present moment and is measured following an activity. The SMS is a self-report questionnaire that measures a temporary, state, mindfulness brought about by an activity. It includes 21 items assessed on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very well*). The items correspond to two subscales: Mind and Body. This measure is shown to have high convergent, discriminant, and incremental convergent validity (Tanay & Bernstein, 2013).

Ratings of Perceived Exertion (RPE; Borg, 1982). The RPE is a self-report questionnaire that measures perceived effort. This scale allows for responses that range from 6 (*no exertion at all*) to 20 (*maximum exertion*). Correlations between perceived exertion and heart rate have been demonstrated; therefore, the RPE can be used to approximate exercise intensity (Borg, 1982). In the current trial, participants rated their perceived exertion on the RPE scale before and immediately after the exercise session. The RPE scale was used to ensure that participants were exercising at an appropriate intensity for their assigned condition.

Equipment. Participants in the MICT group performed exercise on Keiser M3 Series spin cycles. Each cycle was adjusted appropriately for all participants. Three participants in each condition were randomly assigned to wear a Polar H7 heart rate sensor during their session. This sensor was paired to a smartphone through the Polar Beat app and was worn on the chest of these participants to verify they were working at the prescribed intensity. Perceived exertion was also verified by each participant by recording a RPE value following completion of their exercise session.

Procedure

This trial evaluated the effect of a single session of MICT, Ashtanga yoga, and active stretching on AS, DT, IU, and state mindfulness. A randomized control design was used. Four components were involved in trial participation: Screening and randomization, pre-exercise assessment and exercise protocol, post-exercise session assessment, and 3- and 7-day follow-ups. A detailed description of each component is outlined below.

Screening and randomization. Interested participants completed a secure online survey querying demographic, physical activity frequency, and health information to determine eligibility. After completing all screening measures, eligible participants were randomized to one of the two experimental groups (i.e., MICT or Ashtanga yoga) or an active stretching control group. Participants then received a scheduled time to come into the laboratory to complete the group exercise session, but were not informed of their group assignment until after they completed all pre-exercise measures on the day of their group exercise session. In accordance with the Consolidated Standards of Reporting Trials guidelines (Schulz, Altman, & Moher, 2010), group assignment was determined using a randomization feature in the Qualtrics online survey platform (Snow & Mann, 2013).

Pre-exercise assessment and exercise protocol. Participants first completed laboratory pre-exercise assessments and then participated in either a MICT cycling, Ashtanga yoga, or active stretching control group session. Pre-exercise assessments consisted of the ASI-3, DTS, IUS-12, and SMS. After completing all pre-exercise assessments, participants were informed of their group assignment. A certified group fitness instructor then provided a detailed description of the assigned condition to prepare participants for their assigned protocol.

Measures of exercise intensity. Prior to the Ashtanga yoga and MICT sessions, participants were asked to exercise within an RPE range of 12 to 15. This request was made so participants maintained approximately the same exercise intensity between groups. Participants in the stretching condition were not given a target RPE value since the set duration and poses used in this protocol were not expected to increase perceived exertion much higher than rest and not at an intensity level comparable to the exercise groups. Exertion was assessed by having participants report a RPE value following the cool down to verify that they exercised at the appropriate intensity. Due to a limited number of heart rate monitors, three participants from each condition were randomly selected to wear a Polar H7 heart rate sensor on their chest paired to a smartphone through the Polar Beat app. Their heart rate was recorded via the Polar Beat app in 10 minute intervals throughout the exercise session. The heart rate recording was done remotely as to not interrupt the exercise session and was used to check that participants were performing the correct exercise intensity for the Ashtanga yoga and MICT conditions.

MICT protocol. Participants engaged in a 60-minute exercise protocol on a stationary spin cycle. This exercise protocol included a 4-minute warm up, 50 minutes of MICT on a stationary spin cycle, and a 6-minute cool down. Age adjusted maximum heart rate (220 – participant age) was calculated for each participant. Participants maintained a heart rate of approximately 70% of their estimated maximum heart rate throughout the 50-minute MICT, with target heart rate = .70 x (maximum heart rate).

Ashtanga yoga protocol (See Appendix F). Participants engaged in a 60-minute, continuous Ashtanga yoga protocol in which they were led through half of the primary Ashtanga series. All poses up to and including Boat pose (Navasana) were completed, followed by Bridge pose, Upward bow pose (Urdhva Dhanurasana), Seated forward bend (Pascimattanasana),

Forward bend sitting on heels (Yogamudra), Lotus pose (Padmasana), and Scales pose (Utpluthih). The session began with five sets of Sun salutation A (Surya Namaskara A) and two sets of Sun salutation B (Surya Namaskara B), with the final resting pose, Corpse Pose (Savasana), held for 3 minutes. The poses that were not included due to difficulty and injury risk were: Half bound lotus forward bend (Ardha Baddha Padma Pascimattanasana), Forward bend (Trianga Mukhaikapada Paschimottanasana), and Head-to-knee forward bend (Janu Sirsasana C).

Active stretching control protocol. Participants engaged in a stretching routine consisting of 36 stretches held for 90 seconds each, with a total of 6 minutes for transitioning between poses. This was based on an active stretching control protocol previously used in research examining the effects of a single session of MICT on AS, DT, and IU (LeBouthillier & Asmundson, 2015). This protocol was modified to be completed in a group setting and to take double the time of the originally used protocol in order to be consistent with the length of the other two exercise conditions in this trial. Inclusion of the active control group helped account for any non-specific group factors about the group exercise environment (e.g., interaction with other participants) that a waitlist control could not account for.

Post-exercise session assessment. Immediately following each exercise session, participants completed the post-exercise assessment. The post-exercise assessment included the ASI-3, DTS, IUS-12, SMS, and RPE. Participants were then debriefed and reminded to complete the follow-up surveys that would be emailed to them at 3- and 7-days post-exercise.

Completion of 3- and 7-day follow-ups. Participants were emailed a survey at 3- and 7-days following their exercise session. The survey included the ASI-3, DTS, IUS-12, SMS, and a question asking about any changes in exercise habits since the in-laboratory exercise session. Participants were asked to finish the survey within 24 hours of receiving it. A reminder email

was sent to participants who did not complete the survey in this time frame. Survey responses were not included in analysis if collected more than 48 hours after the survey was received.

Analysis. Two-level hierarchical linear modelling (HLM) was performed as the primary analysis. This method is advantageous for use in randomized controlled trials as it offers advantages (i.e., handling missing data) over alternative analyses. These advantages include the ability to handle missing data or data collected at irregular intervals (Tabachnick & Fidell, 2013) and maximization of statistical power (Shin, 2009). Assumptions of independence and homogeneity of regression slopes are not required by HLM as it can model variability in regression slopes and relationships between cases (Field, 2009). It is difficult to predict the statistical power of HLM; however, previous studies have utilized approximately 20 individuals per experimental condition (LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018; Smits et al., 2008).

All analyses used a two-level HLM model that included the dependent variable (e.g., ASI-3 score) at each time point (level 1) nested within participants (level 2). Fifteen separate sets of HLM analyses were performed to test the effects of group assignment (i.e., MICT, Ashtanga yoga, stretching control), time (i.e., pre-exercise, post-exercise, 3-day follow-up, 7-day follow-up), and group by time interaction on each of the ASI-3, DTS, IUS-12, and SMS total and subscale scores. The group assignment was coded as (1) Ashtanga yoga, (2) MICT, and (3) stretching control. Time was coded into four time points, including (1) pre-exercise, (2) post-session, (3) 3-day follow-up, and (4) 7-day follow-up. All models were computed using the maximum likelihood estimation. Pre-exercise score differences between individuals were accounted for by including both a fixed and random intercept in the model. All hypothesis testing was conducted using two-tailed tests at a level of .05.

For the first hypothesis, that both exercise conditions would be more efficacious than the control condition at reducing scores on the ASI-3, but not the IUS-12, the stretching control group was used as the reference group. Time was included as a covariate in these models. A similar analysis was used for the second and third hypotheses, that the Ashtanga yoga condition would be more efficacious than the MICT and stretching control conditions at increasing DTS and SMS scores. To evaluate these hypotheses the Ashtanga yoga group was used as the reference group for all comparisons rather than the stretching control group. Using the Ashtanga yoga group as the reference for comparisons allowed for direct comparisons of changes in DT and mindfulness between the two exercise groups.

At the 7-day follow-up participants were asked whether they had changed their exercise habits since completion of the exercise session. A one-way ANOVA was conducted to evaluate whether there were any differences between groups in exercise habits following the exercise session. This was important to consider whether participants in one group were more likely to increase (or decrease) their exercise frequency following the exercise session as compared to participants in the other groups. Any change in physical activity could confound the results of the models.

Data collected from the heart rate monitors of three participants from each condition were recorded via the Polar Beat app in 10 minute intervals throughout the exercise session. The heart rate recording was checked to verify that the participant fell within the target heart rate range throughout the exercise session. Heart rate in the control condition was expected to be lower than the exercise conditions. Since only a select few participants wore heart rate monitors, RPE compared between groups to assess perceived exertion as a comparison of intensity. Independent

sample t-tests were conducted at post-exercise to evaluate whether there were differences in RPE between the groups.

Results

Descriptive Statistics

Of the 172 participants who accessed the online screener, 56 met eligibility criteria and participated in the exercise session portion of the trial (See Figure 1 for a detailed description of participant flow). Individuals who did not meet all eligibility criteria included people who indicated they were not interested in participating in the exercise session (n = 20), who were already physically active or practiced yoga more than once per week (n = 49), who reported having a medical condition that could make the exercise session unsafe (n = 4), who were currently on antipsychotic or benzodiazepine medication (n = 7), who were not available on the day of the group exercise session (n = 12), who did not consent to participation in the exercise session (n = 1), or who were not between the ages of 18 and 65 (n = 1). Of the 56 participants who met eligibility criteria, 42 (75%) attended the exercise session. Of the 42 participants who participated in the exercise session portion of the trial, 39 (93%) completed the 3-day follow-up and 38 (90%) completed the 7-day follow-up. This level of attrition is lower than other research in this area (LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018; Smits et al., 2008). Follow-up data points were removed if participants filled out the 3-day follow-up more than 5 days after the exercise session or the 7-day follow-up more than 9 days after the exercise session. After removing the follow-up data for participants who completed the follow-up in that time frame, all participants remained for the 3-day follow-up and 36 (86%) participants remained for the 7-day follow-up. Participant demographics are shown by group in Table 1. Individuals from all three groups were similar in terms of age, sex, and ethnicity. In accordance with the

Consolidated Standards of Reporting Trial guidelines, significance testing for demographic differences between groups was not undertaken because random assignment ensures that any observed differences are the result of chance (Schulz et al. 2010). Mean scores and standard deviations for each outcome measure used in the trial are presented in Tables 2, 3, 4 and 5. Additional descriptive statistics for these measures are presented in Table 6.

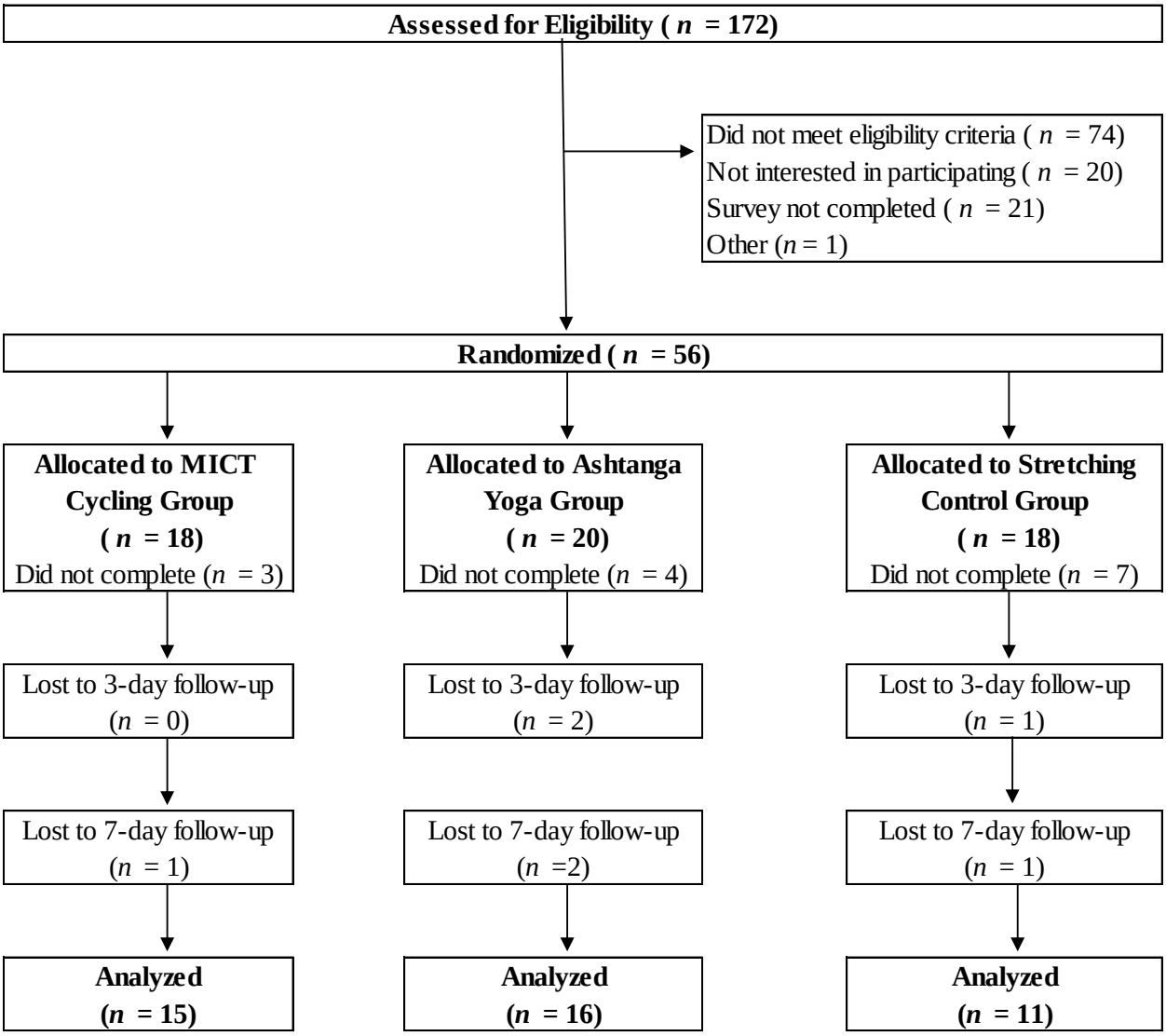

Figure 1. Participant Flow.

Table 1
Participant Demographics

	Ashtanga Yoga		MICT Biking		Stretching Control	
	(*n* = 16)		(n = 15)		(n = 11)	
Variable	*M/n*	*SD/%*	*M/n*	*SD/%*	*M/n*	*SD/%*
Age	24.88	2.11	27.50	3.89	23.67	1.70
Sex						
Male	3	19	2	18	5	33
Female	13	81	9	82	10	67
Ethnicity						
Asian	5	31	1	9	3	20
African-Canadian	1	6	1	9		
First Nations			1	9		
Hispanic					1	7
Caucasian	10	63	8	73	11	73
Relationship						
Single	12	75	6	55	13	87
Married	3	19	4	36	2	13
Other	1	6	1	9		
Education						
Graduated high school	2	12.5			2	13
Partial university education	8	50	8	73	9	60
College diploma	2	12.5				
Undergraduate degree	4	25	2	18	2	13
Master's degree					1	7
Other			1	9	1	7
Employment						
Employed full-time	5	31	2	18	2	13
Employed part-time	6	38	2	18	2	13
Student	4	25	3	28	6	40
Unemployed	1	6	2	18	5	34
Other			2	18		

Note. MICT = moderate intensity continuous training.

Table 2

Anxiety Sensitivity Scores at Pre-Session, Post-Session, and Follow-Up

	Ashtanga Yoga		MICT Biking		Stretching Control	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
ASI-3 Total						
Pre-exercise	22.06	3.81	25.67	4.32	17.33	2.65
Post-exercise	18.44	3.47	21.36	4.88	14.20	2.64
3-day follow-up	19.64	4.15	20.18	5.58	16.80	3.29
7-day follow-up	18.54	4.63	17.70	6.10	15.64	3.63
ASI-3 Cognitive Concerns						
Pre-exercise	6.63	1.55	7.33	2.09	3.80	1.01
Post-exercise	5.31	1.51	5.91	2.35	2.40	1.00
3-day follow-up	4.93	1.57	5.73	2.55	3.87	1.26
7-day follow-up	5.08	1.81	4.80	2.19	3.57	1.33
ASI-3 Social Concerns						
Pre-exercise	8.63	1.35	11.17	1.68	7.33	0.92
Post-exercise	7.00	1.37	9.91	1.58	5.93	1.03
3-day follow-up	8.64	1.59	9.45	1.71	6.80	1.26
7-day follow-up	7.92	1.83	7.50	2.04	6.00	1.37
ASI-3 Physical Concerns						
Pre-exercise	6.06	1.27	4.92	1.44	4.47	1.15
Post-exercise	4.00	1.17	3.82	1.67	3.33	0.92
3-day follow-up	4.93	1.53	3.36	1.84	4.07	1.05
7-day follow-up	4.31	1.61	3.60	1.82	4.57	1.18

Note . ASI-3 = Anxiety Sensitivity Index-3.

Table 3

Distress Tolerance Scores at Pre-Session, Post-Session, and Follow-Up

	Ashtanga Yoga		MICT Biking		Stretching Control	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
DTS Total						
Pre-exercise	42.42	4.39	45.69	2.88	47.87	2.24
Post-exercise	43.55	4.96	5.06	2.74	46.60	2.45
3-day follow-up	45.09	5.22	45.21	3.77	47.27	3.27
7-day follow-up	48.70	6.00	46.92	4.32	48.86	2.82
DTS Tolerance						
Pre-exercise	8.00	0.88	8.38	0.71	9.67	0.70
Post-exercise	9.64	1.17	10.88	0.68	9.33	0.57
3-day follow-up	9.27	1.26	8.86	0.75	9.53	0.82
7-day follow-up	9.60	1.34	9.23	0.96	10.00	0.65
DTS Absorption						
Pre-exercise	8.17	1.04	8.88	0.57	9.20	0.63
Post-exercise	7.64	1.04	10.44	0.63	8.33	0.71
3-day follow-up	7.73	0.96	8.36	0.89	8.53	0.64
7-day follow-up	8.80	0.94	8.69	0.77	8.79	0.78
DTS Appraisal						
Pre-exercise	17.33	1.98	18.81	0.98	19.93	0.79
Post-exercise	16.73	1.85	19.69	1.08	19.47	0.94
3-day follow-up	17.81	1.69	18.14	1.44	19.47	1.09
7-day follow-up	18.00	1.98	18.00	1.59	19.86	1.07
DTS Regulation						
Pre-exercise	7.25	0.77	8.38	0.96	8.00	0.62
Post-exercise	7.36	1.03	7.81	0.59	8.13	0.72
3-day follow-up	7.36	1.03	8.14	0.75	8.13	0.74
7-day follow-up	8.30	1.22	8.85	0.82	9.07	0.74

Note. DTS = Distress Tolerance Scale.

Table 4

Intolerance of Uncertainty Scores at Pre-Session, Post-Session, and Follow-Up

	Ashtanga Yoga		MICT Biking		Stretching Control	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
IUS-12 Total						
Pre-exercise	31.56	2.61	32.08	3.22	31.73	2.47
Post-exercise	28.88	2.67	30.73	3.94	29.53	2.63
3-day follow-up	29.21	2.96	32.45	3.97	31.13	3.19
7-day follow-up	30.31	3.01	29.60	4.17	30.64	2.89
IUS-12 Prospective						
Pre-exercise	19.50	1.53	20.92	1.84	20.20	1.64
Post-exercise	17.81	1.51	19.45	2.15	18.93	1.73
3-day follow-up	18.57	1.80	20.27	2.10	19.80	2.10
7-day follow-up	19.15	1.81	18.40	2.45	19.36	1.90
IUS-12 Inhibitory						
Pre-exercise	11.31	0.99	10.08	1.16	11.20	1.03
Post-exercise	10.56	1.10	9.64	1.34	10.60	1.14
3-day follow-up	10.00	1.05	10.91	1.43	10.26	1.12
7-day follow-up	10.23	1.14	10.30	1.43	11.00	1.06

Note. IUS-12 = Intolerance of Uncertainty Scale, Short Form.

Table 5

State Mindfulness Scores at Pre-Session, Post-Session, and Follow-Up

	Ashtanga Yoga		MICT Biking		Stretching Control	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
SMS Total						
Pre-exercise	78.00	4.64	73.06	1.75	68.20	5.35
Post-exercise	80.73	4.40	83.69	3.51	71.80	5.08
3-day follow-up	77.00	4.26	79.36	2.87	70.40	5.90
7-day follow-up	78.80	5.24	78.38	4.27	68.57	6.72
SMS Mind						
Pre-exercise	55.42	3.36	51.63	1.29	48.40	3.67
Post-exercise	57.09	3.23	59.44	2.95	50.27	3.59
3-day follow-up	54.09	2.95	56.07	2.15	49.47	4.23
7-day follow-up	55.40	3.89	55.08	3.31	49.07	4.81
SMS Body						
Pre-exercise	22.58	1.37	21.44	0.61	19.80	1.74
Post-exercise	23.64	1.29	24.25	0.82	21.53	1.61
3-day follow-up	22.91	1.44	23.29	0.96	20.93	1.76
7-day follow-up	23.40	1.39	23.31	1.09	19.50	1.97

Note. SMS = State Mindfulness Scale.

Table 6

Descriptive Statistics for Outcome Measures

Variable	Obs	M	SD	Range	Skew	Kurtosis
ASI-3						
Total	162	18.827	13.136	65	1.140	0.676
Cognitive Concerns	162	4.883	0.471	24	1.313	0.756
Social Concerns	162	7.907	0.423	20	0.546	-0.647
Physical Concerns	162	4.333	0.383	18	1.027	-0.117
DTS						
Total	162	46.642	1.027	55	-0.189	-0.424
Tolerance	162	9.383	0.244	12	-0.256	-0.770
Absorption	162	8.691	0.225	11	-0.374	-0.649
Appraisal	162	18.722	0.381	22	-0.449	-0.399
Regulation	162	8.092	0.223	11	0.077	-0.696
IUS-12						
Total	162	30.624	0.861	45	0.389	-0.790
Prospective	162	19.340	0.521	28	0.354	-0.791
Inhibitory	162	10.543	0.323	15	0.286	-1.050
SMS						
Total	162	75.389	1.364	84	-0.633	0.658
Mind	162	53.265	0.989	60	-0.525	0.391
Body	162	22.124	0.409	24	-0.724	0.919

Note . Obs. = observations; ASI-3 = Anxiety Sensitivity Index-3; DTS = Distress Tolerance Scale, IUS-12 = Intolerance of Uncertainty Scale, Short Form; SMS = State Mindfulness Scale.

Hypothesis 1: MICT and Ashtanga Yoga will Decrease AS and IU more than the Active Stretching Control Condition

The result of the HLM for the relationship between the experimental condition (MICT, Ashtanga yoga, and stretching) and AS from pre-exercise to 7-day follow-up (See Table 7) showed a significant reduction in total ASI-3 score following MICT, but not Ashtanga yoga, as compared to the stretching control (See Figure 2). Compared to the stretching control group, ASI-3 scores were reduced by 0.29 points on average in the Ashtanga yoga group and 2.01 points in the MICT group. MICT was associated with a Cohen's *d* of -0.20 (95% CI [0.01, 0.38]). Reductions in AS represented a small effect for the MICT group. Additional analyses were also conducted to look at the effect of experimental condition on the specific subscales of AS. There was no significant change in ASI-3 scores for the social concerns (See Table 8) or physical concerns subscales (See Tables 9). Analysis of the relationship between the experimental condition (MICT, Ashtanga yoga, and stretching) and the ASI-3 cognitive concerns subscale from pre-exercise to 7-day follow-up (See Table 10) showed that compared to the stretching control group, there was a statistically significant decrease in ASI-3 cognitive concerns scores for only the MICT group (See Figure 3). The cognitive concerns subscale scores decreased by 0.42 points on average in the Ashtanga yoga group and by 0.74 points in the MICT group. MICT was associated with a Cohen's *d* of -0.21 (95% CI [0.03, 0.39]). The results of the HLM for the relationship between the experimental condition (MICT, Ashtanga yoga, and stretching) and IU over time showed no statistically significant changes in IU scores for the total, prospective, or inhibitory subscales. The HLM models for these analyses are provided in Tables 11, 12, and 13.

Table 7

HLM for ASI-3 Total Score from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	16.97	[9.43, 24.50]	3.76	58.25	4.51	0.01
Time	-0.46	[-1.66, 0.74]	0.60	119.16	-0.76	0.45
Ashtanga Yoga	4.95	[-5.55, 15.45]	5.25	58.57	0.94	0.35
MICT	11.00	[-0.59, 22.59]	5.79	58.32	1.90	0.06
Ashtanga Yoga x Time	-0.29	[-2.00, 1.41]	0.86	119.40	-0.34	0.73
MICT x Time	-2.01	[-3.86, -0.16]	0.93	119.18	-2.15	0.03
Random Effects						
Intercept	172.55	[110.59, 269.24]	39.17			0.01
Residual	26.30	[20.40, 33.91]	3.41			0.01

Note. ASI-3 = Anxiety Sensitivity Index-3; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

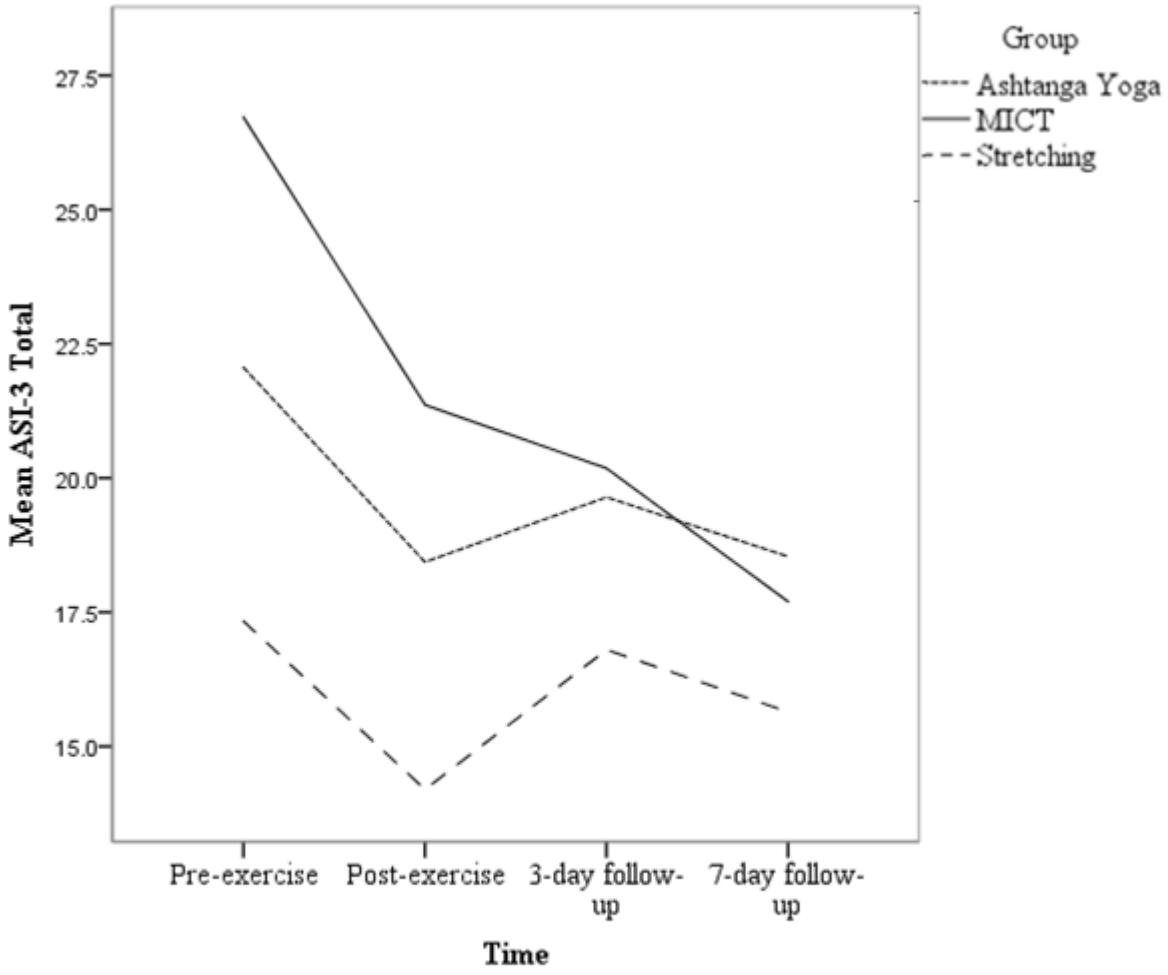

Figure 2. ASI-3 total scores at pre-exercise, post-exercise, and follow-ups.
Note. ASI-3 = Anxiety Sensitivity Index- 3.

Table 8

HLM for Social Concerns Subscale of ASI-3 from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	7.41	[4.64, 10.18]	1.39	62.22	5.34	0.01
Time	-0.38	[-0.86, 0.10]	0.24	119.21	-1.56	0.12
Ashtanga Yoga	0.83	[-3.04, 4.69]	1.93	62.62	0.43	0.67
MICT	4.97	[0.07, 9.23]	2.13	62.31	2.33	0.02
Ashtanga Yoga x Time	0.31	[-0.38, 1.00]	0.35	119.51	0.90	0.37
MICT x Time	-0.66	[-1.40, 0.09]	0.38	119.23	-1.75	0.08
Random Effects						
Intercept	22.36	[14.27, 35.04]	5.12			0.01
Residual	4.25	[3.30, 5.48]	0.55			0.01

Note . ASI-3 = Anxiety Sensitivity Index-3; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 9

HLM for Physical Concerns Subscale of ASI-3 from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	3.96	[1.35, 6.57]	1.31	66.27	3.02	0.01
Time	0.04	[-0.45, 0.53]	0.25	119.13	0.16	0.87
Ashtanga Yoga	1.82	[-1.82, 5.47]	1.82	66.74	1.00	0.32
MICT	1.51	[-2.50, 5.53]	2.01	66.37	0.75	0.45
Ashtanga Yoga x Time	-0.34	[-1.04, 0.36]	0.35	119.48	-0.97	0.33
MICT x Time	-0.67	[-1.42, 0.09]	0.38	119.16	-1.75	0.08
Random Effects						
Intercept	19.00	[12.06, 29.93]	4.40			0.01
Residual	4.38	[3.40, 5.65]	0.57			0.01

Note. ASI-3 = Anxiety Sensitivity Index-3; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 10

HLM for Cognitive Concerns Subscale of ASI-3 from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	3.30	[0.21, 6.38]	1.54	53.35	2.14	0.04
Time	0.03	[-0.39, 0.45]	0.21	119.09	0.14	0.89
Ashtanga Yoga	3.35	[-0.95, 7.65]	2.14	53.57	1.56	0.12
MICT	4.81	[0.07, 9.56]	2.37	53.39	2.04	0.05
Ashtanga Yoga x Time	-0.42	[-1.02, 0.19]	0.30	119.27	-1.37	0.17
MICT x Time	-0.74	[-1.39, -0.09]	0.33	119.11	-2.26	0.03
Random Effects						
Intercept	30.55	[19.68, 47.42]	6.85			0.01
Residual	3.25	[2.52, 4.19]	0.42			0.01

Note. ASI-3 = Anxiety Sensitivity Index-3; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

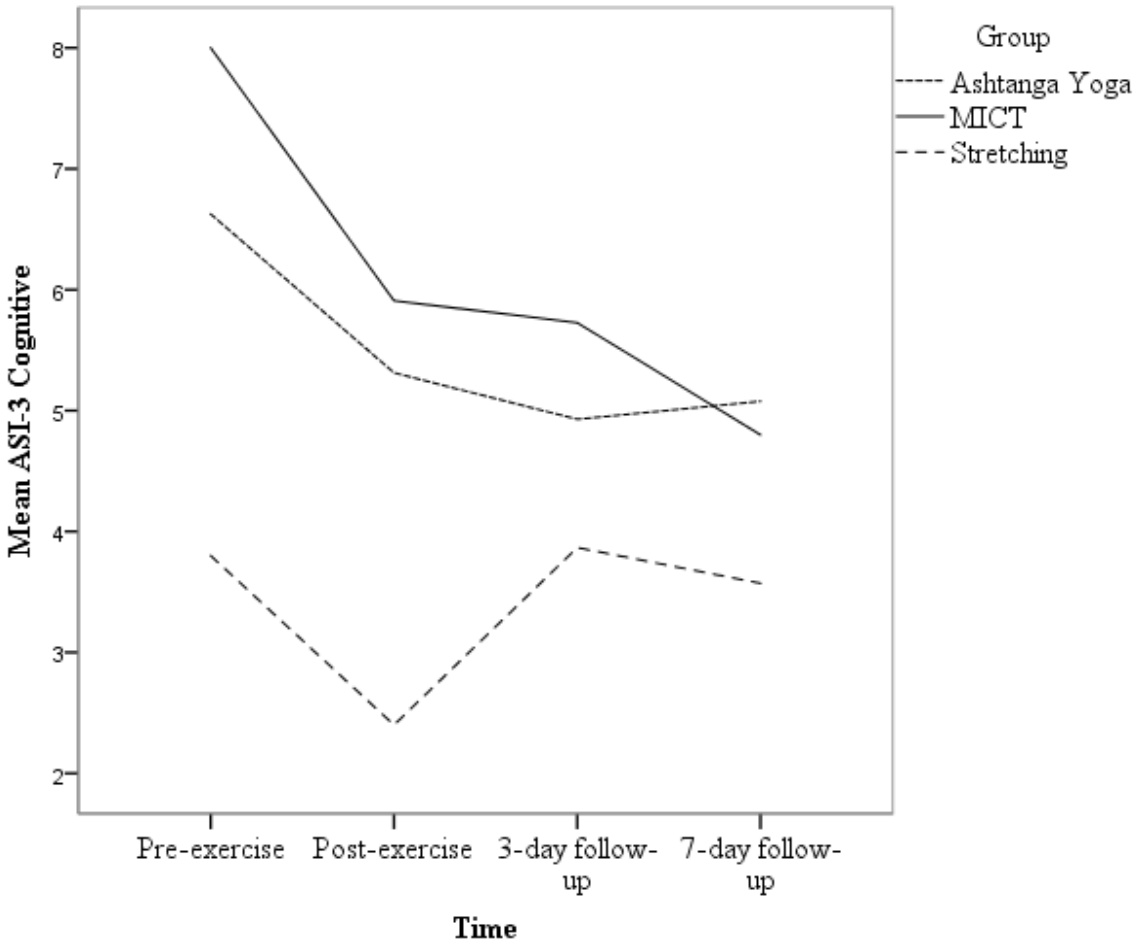

Figure 3. ASI-3 cognitive scores at pre-exercise, post-exercise, and follow-ups.
Note. ASI-3 = Anxiety Sensitivity Index- 3.

Table 11

HLM for IUS-12 Total Score from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	31.55	[25.79, 37.32]	2.88	57.14	10.96	0.01
Time	-0.39	[-1.28, 0.50]	0.45	119.19	-0.88	0.38
Ashtanga Yoga	-0.61	[-8.64, 7.43]	4.01	57.44	-0.15	0.88
MICT	1.80	[-7.07, 10.66]	4.43	57.20	0.41	0.69
Ashtanga Yoga x Time	0.08	[-1.19, 1.35]	0.64	119.42	0.12	0.90
MICT x Time	-0.25	[-1.62, 1.12]	0.69	119.21	-0.35	0.72
Random Effects						
Intercept	102.25	[65.63, 159.31]	23.13			0.01
Residual	14.47	[11.22, 18.65]	1.87			0.01

Note. IUS-12 = Intolerance of Uncertainty Scale, short form; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 12

HLM for Prospective Subscale of IUS-12 from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	20.23	[16.73, 23.72]	1.75	60.59	11.58	0.01
Time	-0.31	[-0.90, 0.27]	0.30	119.26	-1.05	0.29
Ashtanga Yoga	-1.27	[-6.14, 3.60]	2.44	60.95	-0.52	0.60
MICT	1.54	[-3.83, 6.92]	2.69	60.67	0.57	0.57
Ashtanga Yoga x Time	0.23	[-0.61, 1.06]	0.42	119.53	0.54	0.59
MICT x Time	-0.37	[-1.28, 0.53]	0.46	119.28	-0.81	0.42
Random Effects						
Intercept	36.22	[23.17, 56.63]	8.26			0.01
Residual	6.29	[4.88, 8.11]	0.82			0.01

Note. IUS-12 = Intolerance of Uncertainty Scale, short form; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 13

HLM for Inhibitory Subscale of IUS-12 from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	11.12	[8.93, 13.32]	1.10	69.79	10.10	0.01
Time	-0.17	[-0.60, 0.26]	0.22	119.32	-0.77	0.44
Ashtanga Yoga	0.25	[-2.81, 3.32]	1.54	70.31	0.16	0.87
MICT	-0.93	[-4.31, 2.45]	1.69	69.90	-0.55	0.58
Ashtanga Yoga x Time	-0.10	[-0.72, 0.51]	0.31	119.71	-0.33	0.74
MICT x Time	0.23	[-0.43, 0.90]	0.34	119.35	0.70	0.49
Random Effects						
Intercept	13.00	[8.23, 20.53]	3.03			0.01
Residual	3.42	[2.65, 4.41]	0.44			0.01

Note. IUS-12 = Intolerance of Uncertainty Scale, short form; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Hypothesis 2: Significant Increases in DT will Occur Following a Single Session of Ashtanga Yoga, but Not Following a Session of MICT or Active Stretching

The result of the HLM for the relationship between the experimental condition (MICT, Ashtanga yoga, and stretching) and DT over time (See Table 14) showed, as compared to the MICT condition, there was a significant increase in the total DTS score for only the Ashtanga yoga condition (See Figure 4). Compared to the MICT group, DTS scores increased by 2.96 points on average in the Ashtanga yoga. Increase in DT for the Ashtanga yoga was associated with a Cohen's d of 0.22 (95% CI [0.04, 0.40]) which represents a small effect. Analysis of the relationship between the experimental condition (MICT, Ashtanga yoga, and stretching) and DTS appraisal subscale scores over time (See Table 15) showed, as compared to the MICT group, DTS appraisal scores showed a statistically significant increase of 0.93 points on average in the Ashtanga yoga group (See Figure 5). DT did not significantly increase for the stretching group. Ashtanga yoga was associated with a Cohen's d of 0.18 (95% CI [0.05, 0.36]). There was no statistically significant change in absorbance, tolerance, or regulation subscales. The HLM models for these analyses are provided in Tables 16, 17, and 18.

Hypothesis 3: Ashtanga Yoga will Significantly Increase Mindfulness, while MICT or Active Stretching will not

HLM was conducted examining changes in state mindfulness following the exercise sessions, including the stretching control. The result of the HLM for the relationship between the experimental condition (MICT, Ashtanga yoga, and stretching) and mindfulness over time showed no significant increase in mindfulness scores. There was no significant change for the total score, mind subscale, or body subscale for the Ashtanga yoga condition compared to the other conditions. The HLM models for these analyses are provided in Tables 19, 20, and 21.

Table 14

HLM for Total DTS Scores from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	47.73	[40.87, 54.59]	3.45	82.03	13.85	0.01
Time	-0.52	[-2.11, 1.07]	0.80	120.20	-0.64	0.52
Stretching	-1.14	[-10.97, 8.69]	4.94	81.29	-0.23	0.82
Ashtanga Yoga	-9.67	[-20.38, 1.04]	5.39	81.33	-1.80	0.08
Stretching x Time	0.97	[-1.26, 3.20]	1.13	119.68	0.86	0.39
Ashtanga Yoga x Time	2.96	[0.52, 5.39]	1.23	119.65	2.40	0.02
Random Effects						
Intercept	119.30	74.42, 191.24	28.72			0.01
Residual	45.05	[34.94, 58.09]	5.84			0.01

Note . DTS = Distress Tolerance Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

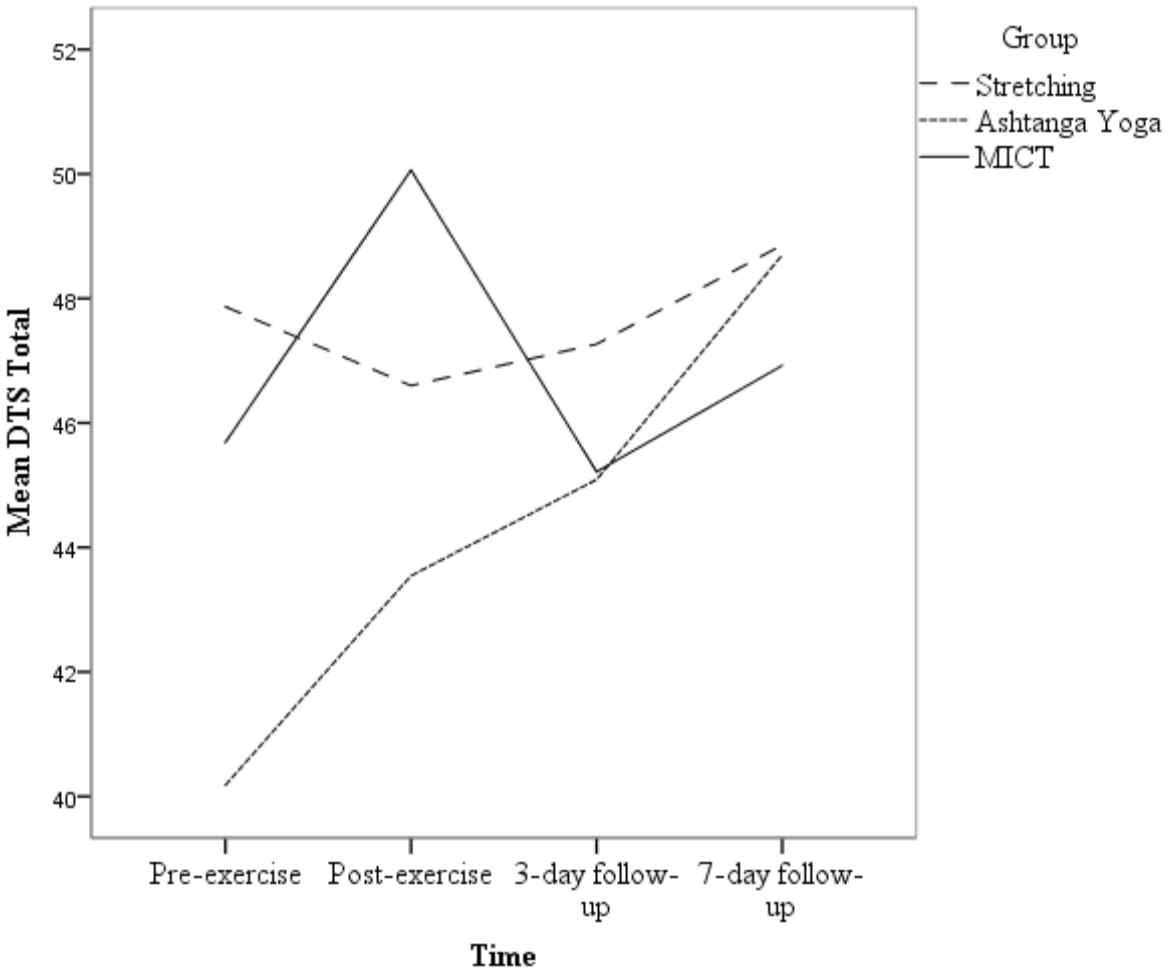

Figure 4. DTS total scores at pre-exercise, post-exercise, and follow-ups.
Note. DTS = Distress Tolerance Scale.

Table 15

HLM for Appraisal Subscale of DTS from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	19.73	[17.20, 22.25]	1.27	82.39	15.52	0.01
Time	-0.50	[-1.09, 0.09]	0.30	120.28	-1.67	0.10
Stretching	-0.11	[-3.74, 3.51]	1.82	81.65	-0.06	0.95
Ashtanga Yoga	-3.54	[-7.49, 0.41]	1.99	81.69	-1.78	0.08
Stretching x Time	0.55	[-0.28, 1.37]	0.42	119.76	1.32	0.19
Ashtanga Yoga x Time	0.93	[0.03, 1.83]	0.45	119.73	2.04	0.04
Random Effects						
Intercept	16.17	[10.09, 25.92]	3.89			0.01
Residual	6.15	[4.77, 7.93]	0.80			0.01

Note . DTS = Distress Tolerance Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

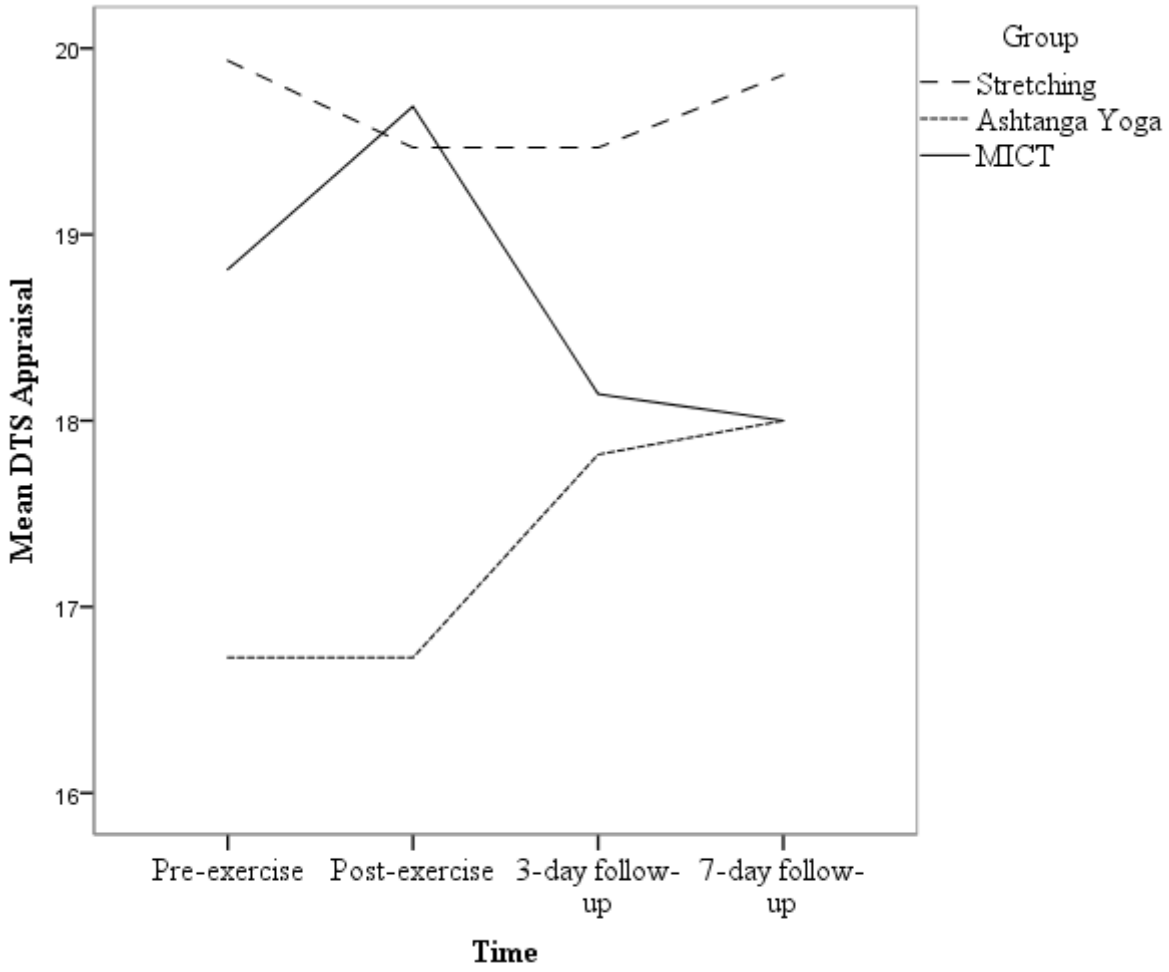

Figure 5. DTS Appraisal scores at pre-exercise, post-exercise, and follow-ups.
Note. DTS = Distress Tolerance Scale.

Table 16

HLM for Absorption Subscale of DTS from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	9.85	[8.30, 11.39]	0.78	103.64	12.65	0.01
Time	-0.33	[-0.75, 0.09]	0.21	120.41	-1.58	0.12
Stretching	-0.90	[-3.11, 1.31]	1.11	102.68	-0.81	0.42
Ashtanga Yoga	-2.49	[-4.90, -0.08]	1.21	102.74	-2.05	0.04
Stretching x Time	0.24	[-0.34, 0.83]	0.30	119.63	0.83	0.41
Ashtanga Yoga x Time	0.54	[-0.10, 1.18]	0.32	119.58	1.67	0.10
Random Effects						
Intercept	4.83	[2.91, 8.01]	1.25			0.01
Residual	3.09	[2.40, 3.99]	0.40			0.01

Note. DTS = Distress Tolerance Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 17

HLM for Tolerance Subscale of DTS from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	9.29	[7.58, 11.00]	0.86	122.58	10.77	0.01
Time	0.00	[-0.50, 0.50]	0.25	121.57	-0.01	0.99
Stretching	0.07	[-2.38, 2.51]	1.23	121.63	0.05	0.96
Ashtanga Yoga	-1.75	[-4.41, 0.91]	1.35	121.70	-1.30	0.20
Stretching x Time	0.11	[-0.60, 0.81]	0.36	120.58	0.31	0.76
Ashtanga Yoga x Time	0.60	[-0.17, 1.37]	0.39	120.52	1.53	0.13
Random Effects						
Intercept	4.81	[2.81, 8.24]	1.32			0.01
Residual	4.52	[3.50, 5.82]	0.59			0.01

Note. DTS = Distress Tolerance Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 18

HLM for Regulation Subscale of DTS from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	7.89	[6.35, 9.43]	0.78	102.33	10.17	0.01
Time	0.13	[-0.28, 0.54]	0.21	120.55	0.62	0.54
Stretching	-0.32	[-2.53, 1.88]	1.11	101.38	-0.29	0.77
Ashtanga Yoga	-1.15	[-3.55, 1.26]	1.21	101.44	-0.95	0.35
Stretching x Time	0.17	[-0.41, 0.75]	0.29	119.79	0.59	0.56
Ashtanga Yoga x Time	0.16	[-0.47, 0.79]	0.32	119.74	0.51	0.61
Random Effects						
Intercept	4.88	[2.95, 8.06]	1.25			0.01
Residual	3.02	[2.34, 3.90]	0.39			0.01

Note . DTS = Distress Tolerance Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 19

HLM for Total SMS Scores from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	75.40	[66.53, 84.26]	4.46	82.40	16.92	0.01
Time	1.24	[-0.81, 3.30]	1.04	120.55	1.20	0.23
Stretching	-5.12	[-17.83, 7.58]	6.39	81.66	-0.80	0.42
Ashtanga Yoga	1.51	[-12.34, 15.36]	6.96	81.70	0.22	0.83
Stretching x Time	-1.55	[-4.43, 1.34]	1.46	120.03	-1.06	0.29
Ashtanga Yoga x Time	-0.82	[-3.97, 2.32]	1.59	120.00	-0.52	0.61
Random Effects						
Intercept	199.49	124.72, 319.06	47.80			0.01
Residual	75.13	[58.29, 96.84]	9.73			0.01

Note. SMS = State Mindfulness Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 20

HLM for Mind Subscale of SMS from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	53.50	[47.02, 59.98]	3.26	85.67	16.41	0.01
Time	0.79	[-0.76, 2.33]	0.78	120.60	1.01	0.32
Stretching	-4.21	[-13.50, 5.09]	4.67	84.89	-0.90	0.37
Ashtanga Yoga	1.35	[-8.78, 11.47]	5.09	84.94	0.26	0.79
Stretching x Time	-0.84	[-3.01, 1.33]	1.10	120.05	-0.77	0.44
Ashtanga Yoga x Time	-0.72	[-3.09, 1.64]	1.19	120.01	-0.61	0.55
Random Effects						
Intercept	103.25	[64.28, 165.87]	24.97			0.01
Residual	42.54	[33.00, 54.83]	5.51			0.01

Note. SMS = State Mindfulness Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Table 21

HLM for Body Subscale of SMS from Pre-exercise to 7-day Follow-up

	Estimate	95% CI	*SE*	*df*	*t*	*p*
Fixed Effects						
Intercept	21.90	[19.22, 24.57]	1.34	89.37	16.28	0.01
Time	0.46	[-0.20, 1.11]	0.33	120.85	1.38	0.17
Stretching	-0.93	[-4.76, 2.90]	1.93	88.55	-0.48	0.63
Ashtanga Yoga	0.16	[-4.02, 4.33]	2.10	88.60	0.08	0.94
Stretching x Time	-0.70	[-1.62, 0.22]	0.46	120.26	-1.51	0.13
Ashtanga Yoga x Time	-0.10	[-1.10, 0.90]	0.51	120.22	-0.20	0.85
Random Effects						
Intercept	16.94	[10.51, 27.32]	4.13			0.01
Residual	7.63	[5.92, 9.84]	0.99			0.01

Note. SMS = State Mindfulness Scale; HLM = hierarchical linear model; MICT = moderate intensity continuous training.

Comparison of Exercise Intensity between Groups

The heart rate monitors showed that participants in the Ashtanga yoga and MICT groups were exercising at the appropriate intensity. Independent sample t-tests were conducted at post-exercise to evaluate whether there were differences in RPE between the groups. The mean for Ashtanga yoga was $M = 13.27$ ($SD = 2.31$) and the mean for the stretching control was $M = 9.82$ ($SD = 2.86$). The differences between the means was statistically significant, $t\ (24) = .34$, $p < .002$ indicating that estimated heart rate was higher for the Ashtanga yoga group than the stretching control. The mean for MICT was $M = 13.93$ ($SD = 2.43$) and the mean for the stretching control was $M = 9.82$ ($SD = 2.86$). The differences between these values was statistically significant, $t\ (24) = .40$, $p < .001$, indicating that the mean estimate heart rate for MICT was higher than the stretching control. The mean for MICT was $M = 13.93$ ($SD = 2.43$) and the mean for the stretching control was $M = 13.27$ ($SD = 2.31$). The differences between the means was not statistically significant, $t\ (28) = .08$, $p > .448$ indicting that the mean estimate heart rates for Ashtanga yoga and MICT did not differ. The Ashtanga yoga and MICT groups were exercising at a higher intensity than the stretching control group. As predicted, participants in the stretching condition did not complete the exercise protocol at an intensity level comparable to the exercise groups.

Comparison of Exercise Habits between Groups

A one-way ANOVA was conducted at the 7-day follow-up to evaluate whether there were any differences between groups for their exercise habits following the exercise session. The results of the ANOVA showed the difference between the means for the conditions were not statistically significant $F\ (2, 36) = .268$, $p > .767$. This indicated that any differences in scores on

follow-up questionnaires were not the result of differences in level of physical activity following the exercise session.

Discussion

The current trial was designed to assess the effect of a single session of Ashtanga yoga or MICT on AS, DT, IU, and mindfulness. This trial is the first to examine the effects of a single session of Ashtanga yoga compared to group MICT on a multitude of cognitive vulnerabilities for anxiety disorders. It is also the first to assess the effect of a single group session of MICT on mindfulness. The first hypothesis predicted that a single session of either MICT or Ashtanga yoga would decrease AS and IU, when compared to the active stretching control condition. This hypothesis was partially supported as a significant decrease in AS was observed following the MICT condition, but not the Ashtanga yoga condition. There also were no significant changes in IU following either exercise condition. These findings are consistent with existing research which has found significant reductions in AS following a single session of MICT (Broman-Fulks, Berman, Rabian, & Webster, 2004; Broman-Fulks & Storey, 2008; LeBouthillier & Asmundson, 2015). Reduction in AS cognitive concerns subscale scores with MICT are somewhat consistent with past research; however, research using the same MICT protocol in an individual setting found reductions in both cognitive and social concerns following a single session (Mason & Asmundson, 2018). These inconsistent findings for the AS social and physical concerns subscales could be due to a problem of power. Consistent with existing research, no significant changes in IU were seen following a single session of MICT (LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018). This was the first study to assess the influence of Ashtanga yoga on IU. Findings suggest that one session of Ashtanga yoga may not target IU. Other mindfulness-based therapy options have been shown to reduce IU over 8 sessions;

therefore, it may take more sessions for an effect on IU to appear (Alimehdi, Ehteshamzadeh, Naderi, Eftekharsaadi, & Pasha, 2016). Additionally, this trial is limited by a small sample size; thus, null findings for IU should be interpreted cautiously. While there is no strict guideline for the number of participants needed for HLM, past studies using similar methods used approximately 20 participants per condition (LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018). The current trial did not meet this level, with only 42 participants between the three conditions. Furthermore, only 11 participants assigned to the stretching control condition attended the laboratory session. Additional investigation is needed to determine if the findings are truly null findings or a problem of power.

The Ashtanga yoga and stretching control conditions differed in intensity level, fluidity (i.e., smooth transition between movements), and speed, but included some poses that looked similar. Thus, it is possible that participants engaging in the active stretching control condition believed they were doing yoga instead, especially since participants were not experienced with yoga. Participants may have expected their mental health to benefit from their participation if they believed they were in the yoga group, since yoga is marketed as good for mental health. This expectancy could have influenced participants' responses to the psychological measures, whereby participants in the control condition reported greater reductions in AS and IU than if a different control (i.e., waitlist) had been used.

The second hypothesis was that significant increases in DT would occur following a single session of Ashtanga yoga, but not following a session of MICT or active stretching. This hypothesis was supported. Significant increases in DT following Ashtanga yoga is consistent with existing research finding increases in DT following an eight-week Bikram yoga protocol (Medina et al., 2015). Results from this trial have extended these findings and suggest that these

improvements in DT can be observed within a single session of yoga. Findings from this trial are also consistent with research demonstrating that significant increases in DT did not occur following MICT (Broman-Fulks et al., 2015; LeBouthillier & Asmundson, 2015; Mason & Asmundson, 2018). Further investigation will be needed in order to further determine the effect that the type of yoga (e.g., Ashtanga, Bikram, Hatha) and duration of the yoga practice have on DT.

The final hypothesis stated that a single session of Ashtanga yoga would significantly increase mindfulness, but a single session of MICT or active stretching would not. State mindfulness increases have been seen following 8-weeks of yoga, but had not been researched in terms of other exercise modalities (Cox et al., 2016). Results of this trial did not support this hypothesis. No significant changes in mindfulness were found in the Ashtanga yoga group compared to the other two conditions. One possible explanation for these findings is that the other experimental conditions also involved mindfulness. For instance, perhaps focusing on maintaining RPE within a specified range in the MICT condition may require the participants to focus more on their actions and bodily sensations. Additionally, null findings should be interpreted cautiously due to the small sample size.

Limitations and Future Directions

Although results from this trial are consistent with existing research suggesting that a single session of MICT can significantly reduce AS, and provide preliminary evidence for a single session of Ashtanga yoga for increasing DT, there are several limitations that should be considered. One limitation of this trial is that participants in the trial were not representative of the general population. Although a community sample was taken, the sample was relatively uniform in terms of age, sex, and ethnicity. Whether individuals available on the day of the

exercise session differ in any way from the individuals who were not available to attend the exercise session is unknown, which may limit generalizability. Future research should replicate the current trial with individuals with anxiety disorders (e.g., social anxiety disorder, panic disorder, generalized anxiety disorder) or clinical levels of AS, DT, and IU, to determine whether a single group exercise session has an influence on these cognitive vulnerabilities for clinical populations.

Some results from this trial were consistent with past research, but other findings were not. It is possible that inconsistent findings are a result of the small sample size. Small samples are a common limitation resulting from using a single session group exercise design because the scheduled time must work for all participants and individual sessions cannot be scheduled to accommodate individual participants. Future investigations should begin the screening process early in order to take place with at least 20 participants in each group.

Another limitation is that increasing the time that each stretch was held and conducting the protocol in a group setting may have resulted in changes in AS, DTS, IU, or mindfulness that would not be seen if completing the protocol alone with an instructor. Although the stretching control had been used in previous research without statistically significant changes to cognitive vulnerabilities for anxiety (LeBouthillier & Asmundson, 2015), in this trial, it was modified by increasing the time each stretch was held so that it would take the same amount of time to complete as the other two conditions. It is possible that stretching time may influence cognitive vulnerabilities for anxiety since research has found a significant reduction in state anxiety following a single stretching session (Logan, Kim, Lee, & Yeo, 2018). The active stretching control condition provided the benefit of control over nonspecific group factors (i.e. being in the presence of others), duration of the session, and engagement in an instructor-led group session

that may have influenced changes in scores for the exercise conditions. A waitlist control may not have this benefit if participants answer the questionnaires individually, spend under 60-minutes with the group, or know they are the control. Future research should compare a group stretching condition to an individual stretching condition to determine whether group effects contribute to improvements of cognitive vulnerabilities for anxiety following a single session of stretching.

The varied times of the group exercise sessions allows for several factors to be controlled (i.e., the room being used, instructor), which would not be possible if all sessions were to occur at the same time. Despite these benefits, differences in the time of day that participants were completing their group session could influence the number of participants who could attend their session. It is also possible that the time of day could influence mood, hunger, fatigue, etc. The benefit of having the same location and instructor for the exercise conditions must be weighed against possible effects of running the exercise sessions at varied times of day.

In this trial participants were asked to face away from the mirrored wall for the duration of the exercise session to avoid any physiological arousal or fear that may be associated with being watched or watching others throughout the group exercise session (Ukezono, Nakashima, Sudo, Yamazaki, & Takano, 2015). Future research may want to look at what, if any, influences facing a mirror would have in a group exercise session. The influence of a mirror, including whether increased arousal from being seen by others or increased mindfulness from watching one’s own movements should be considered in future research.

The finding that a single session of Ashtanga yoga is efficacious at improving DT suggests that acute yoga bouts could be used to improve psychological wellbeing. Specifically, Ashtanga yoga could be used when improvements in DT are desired, or used in a program along

with MICT to target both AS and DT. Ashtanga yoga could also be used as a means to reduce some cognitive vulnerability for anxiety in cases where cycling exercise is not an option due to health, preference, or equipment. Furthermore, since a single session of Ashtanga yoga showed significant improvement of DT, the time required for exercise in research on acute increases in anxiety may be reduced by using one session in place of eight-week protocol. The differences in constructs targeted by Ashtanga yoga as compared to MICT suggests that future research should look to identify potential mechanisms for targeting specific cognitive vulnerabilities. The initial findings from this trial suggest that whether these exercise modalities (i.e., Ashtanga yoga and MICT) are used individually to target specific cognitive vulnerabilities or in a program together to target both AS and DT, group exercise is a feasible strategy for improving cognitive vulnerabilities for anxiety. Findings of decreased AS following MICT, and increased DT following Ashtanga yoga suggests that a single session of group exercise is a feasible, resource-efficient strategy for targeting various cognitive vulnerabilities for anxiety.

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Appendix A: Ethics Certificate

University of Regina

Research Ethics Board
Certificate of Approval

PRINCIPAL INVESTIGATOR	DEPARTMENT	REB#
Sheena A. Hatcher	Psychology	2017-209

SUEPRVISOR: Dr. Gordon Asmundson

TITLE: Effects of a Single Session of Ashtanga Yoga or Mederate Internsity Continuous Training on Cognitive Vulnerabilities for Anxiety Disorders

APPROVED ON:	RENEWAL DATE:
January 15, 2018	January 15, 2019

APPROVAL OF:
Application for Behavioural Research Ethics Review, Recruitment Material, Consent Form, International Physical Activity Questionnaire, State Mindfulness Scale, Ratings of Perceived Exertion, 2017- PAR-Qt, Demographic Questionnaire, Anxiety Sensitivity Index 3, Distress Tolerance Scale, Intolerance of Uncertainty Scale – short form.

Full Board Meeting ☐ Delegated Review ☒

The University of Regina Research Ethics Board has reviewed the above-named research project. The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this research project, and for ensuring that the authorized research is carried out according to the conditions outlined in the original protocol submitted for ethics review. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol, consent process or documents.

Any significant changes to your proposed method, or your consent and recruitment procedures should be reported to the Chair for Research Ethics Board consideration in advance of its implementation.

ONGOING REVIEW REQUIREMENTS
In order to receive annual renewal, a status report must be submitted to the REB Chair for Board consideration within one month of the current expiry date each year the study remains open, and upon study completion. Please refer to the following website for further instructions: http://www.uregina.ca/research/for-faculty-staff/ethics-compliance/human/forms1/ethics-forms.html.

Raven Sinclair, BA, CISW, BISW, MSW, PhD
REB Chair

Please send all correspondence to:

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Appendix B: Anxiety Sensitivity Index-3 (Taylor et al., 2007)

Please circle the number that best corresponds to how much you agree with each item. If any items concern something that you have never experienced (e.g., fainting in public), then answer on the basis of how you think you might feel if you had such an experience. Otherwise, answer all items on the basis of your own experience. Be careful to circle only one number for each item and please answer all items.

	Very little	**A little**	**Some**	**Much**	**Very much**
1. It is important for me not to appear nervous.	0	1	2	3	4
2. When I cannot keep my mind on a task, I worry that I might be going crazy.	0	1	2	3	4
3. It scares me when my heart beats rapidly.	0	1	2	3	4
4. When my stomach is upset, I worry that I might be seriously ill.	0	1	2	3	4
5. It scares me when I am unable to keep my mind on a task.	0	1	2	3	4
6. When I tremble in the presence of others, I fear what people might think of me.	0	1	2	3	4
7. When my chest feels tight, I get scared that I won’t be able to breathe properly.	0	1	2	3	4

8. When I feel pain in my chest, I worry that I'm going to have a heart attack.	0	1	2	3	4
9. I worry that other people will notice my anxiety.	0	1	2	3	4
10. When I feel "spacey" or spaced out I worry that I may be mentally ill.	0	1	2	3	4
11. It scares me when I blush in front of people.	0	1	2	3	4
12. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.	0	1	2	3	4
13. When I begin to sweat in a social situation, I fear people will think negatively of me.	0	1	2	3	4
14. When my thoughts seem to speed up, I worry that I might be going crazy.	0	1	2	3	4
15. When my throat feels tight, I worry that I could choke to death.	0	1	2	3	4
16. When I have trouble thinking clearly, I worry that there is something wrong	0	1	2	3	4

with me.					
17. I think it would be horrible for me to faint in public.	0	1	2	3	4
18. When my mind goes blank, I worry there is something terribly wrong with me.	0	1	2	3	4

Appendix C: Distress Tolerance Scale (Simons & Gaher, 2005)

Directions: Think of times that you feel distressed or upset. Select the item from the menu that best describes your beliefs about feeling distressed or upset Circle only one number per item.

	Strongly agree	**Mildly agree**	**Agree and disagree equally**	**Mildly disagree**	**Strongly disagree**
1. Feeling distressed or upset is unbearable to me.	1	2	3	4	5
2. When I feel distressed or upset, all I can think about is how bad I feel.	1	2	3	4	5
3. I can't handle feeling distressed or upset.	1	2	3	4	5
4. My feelings of distress are so intense that they completely take over.	1	2	3	4	5
5. There's nothing worse than feeling distressed or upset.	1	2	3	4	5
6. I can tolerate being distressed or upset as well as most people.	1	2	3	4	5
7. My feelings of distress or being upset are not acceptable.	1	2	3	4	5
8. I'll do anything to avoid feeling distressed or upset	1	2	3	4	5

9. Other people seem to be able to tolerate feeling distressed or upset better than I can.	1	2	3	4	5
10. Being distressed or upset is always a major ordeal for me.	1	2	3	4	5
11. I am ashamed of myself when I feel distressed or upset.	1	2	3	4	5
12. My feelings of distress or being upset scare me.	1	2	3	4	5
13. I'll do anything to stop feeling distressed or upset.	1	2	3	4	5
14. When I feel distressed or upset, I must do something about it immediately.	1	2	3	4	5
15. When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels.	1	2	3	4	5

Appendix D: Intolerance of Uncertainty Scale, Short Form (Carleton, Norton, & Asmundson,2007)

Directions: Please circle the number that best corresponds to how much you agree with each item. Be careful to circle only one number for each item and please answer all items.

	Not at all characteristic of me	**A little characteristic of me**	**Somewhat characteristic of me**	**Very characteristic of me**	**Entirely characteristic of me**
1. Unforeseen events upset me greatly.	1	2	3	4	5
2. It frustrates me not having all the information I need.	1	2	3	4	5
3. Uncertainty keeps me from living a full life.	1	2	3	4	5
4. One should always look ahead so as to avoid surprises.	1	2	3	4	5
5. A small unforeseen event can spoil everything, even with the best of planning.	1	2	3	4	5
6. When it's time to act, uncertainty paralyses me.	1	2	3	4	5
7. When I am uncertain I can't function very well.	1	2	3	4	5
8. I always want to know what the future has in store for me.	1	2	3	4	5
9. I can't stand being taken by surprise.	1	2	3	4	5
10. The smallest doubt can stop me from acting.	1	2	3	4	5

11. I should be able to organize everything in advance.	1	2	3	4	5
12. I must get away from all uncertain situations.	1	2	3	4	5

Appendix E: State Mindfulness Scale (Tanay & Bernstein, 2013)

Directions: Please circle the number that best corresponds to how aware you were of your thoughts and feelings during the exercise session. Circle only one number for each item and please answer all items.

	Not at all	A little	Somewhat	Well	Very Well
1. I was aware of different emotions that arose in me.	1	2	3	4	5
2. I tried to pay attention to pleasant and unpleasant sensations.	1	2	3	4	5
3. I found some of my experiences interesting.	1	2	3	4	5
4. I noticed many small details of my experience.	1	2	3	4	5
5. I felt aware of what was happening inside of me.	1	2	3	4	5
6. I noticed pleasant and unpleasant emotions.	1	2	3	4	5
7. I actively explored my experience in the moment.	1	2	3	4	5
8. I clearly physically felt what was going on in my body.	1	2	3	4	5
9. I changed my body posture and paid attention to the physical process of moving.	1	2	3	4	5
10. I felt that I was experiencing	1	2	3	4	5
11. I noticed pleasant and unpleasant thoughts.	1	2	3	4	5
12. I noticed emotions come and go.	1	2	3	4	5
13. I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face)	1	2	3	4	5
14. I noticed physical sensations come and go.	1	2	3	4	5
15. I had moments when I felt alert and aware.	1	2	3	4	5
16. I felt closely connected to the present moment.	1	2	3	4	5
17. I noticed thoughts come and go.	1	2	3	4	5
18. I felt in contact with my body.	1	2	3	4	5
19. I was aware of what was going. on in my mind.	1	2	3	4	5
20. It was interesting to see the patterns of my thinking.	1	2	3	4	5
21. I noticed some pleasant and unpleasant physical sensations	1	2	3	4	5

Appendix F: Ashtanga yoga protocol

Modifications to the Primary Series

5 Surya Namaskara A
Modification: Chaturanga on knees, optional baby cobra instead of upward facing dog

2 Surya Namaskara B.
Modification: Chaturanga on knees, optional baby cobra instead of upward facing dog

Standing sequence :
Completed: Padangusthasana Padahastasana to Utthita Hasta Padangusthasana .
Modification: gave option to catch knee instead of big toe
Omitted: Ardaha Badda Pandamottasana, Uttkatasana, Virabadrasana

Seated sequence:
Completed:Dandasana to Marichasana.
Omitted: ardha Baddha Padma Pascimattanasana, Triyanga Mukhaika Pada Pascimattanasana and Janu Sirsanana C
Note: No vinyasa between sides, just after each pose.

Closing sequence
Added: 2 bridge pose
Completed: Urdhva Dhanurasana
Pascimattanasana, Yogamudra, Padmasana, Utpluthih (10 breaths each)
Savasana (3 mins)
Omitted: Savangasana, Halasana, Karnapidasana, Urdva Padmasana, Pindasana, Matsyasana, Uttana Pandasana, Sirsasana, Baddha Pandmasana