Mood, Anxiety, Rpe, and %Mhr after a Single 15, 30 and 60 Minute Session of Vinyasa Yoga

Marissa Gabriella McGuirk
Georgia Southern University

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MOOD, ANXIETY, RPE, AND %MHR AFTER A SINGLE 15, 30
AND 60 MINUTE SESSION OF VINYASA YOGA

by

MARISSA MCGUIRK

(Under the Direction of Barry Joyner)

ABSTRACT

The literature supports that yoga practice decreases stress, anxiety, and improves overall mood, with reports of these changes after only one session of yoga. Purpose: The purpose of this study was to investigate the change in anxiety and mood and compare RPE and %MHR after a single 15, 30 and 60 minute session of Vinyasa yoga in a healthy college population. It was hypothesized that (1) the total POMS score, scores for the six POMS subscales, state anxiety, and (2) values of RPE and %MHR would be significantly different from 30 and 60 minutes, but 30 and 60 minutes would not be significantly different.

Methods: Female participants (N=12) aged between 18 and 21 years (M = 20.17, SD = .193 years) were recruited from yoga physical activity classes at Georgia Southern University. To answer the first hypothesis two-Way ANOVA’s (3x2) with repeated measures on both factors were used to examine the durations (three levels) by time (pre-post) interaction. To answer the second hypothesis, a one-way ANOVA (3x1) with repeated measures was used. Significance was set at α = 0.01.

Results: For total POMS score, vigor, tension, depression, confusion, and state anxiety there was no significant interaction (p>0.001) between the durations and pre- and post- scores and there was no significant difference among the durations (p>0.001), but there was a significant difference between the average of pre- and post- scores (p<0.001). The post-score were significantly lower than pre-scores. For RPE there was a significant difference across the three durations (p=0.001). Contrasts showed that RPE for 60 minutes was significantly higher than RPE for 15 and 30 minutes (p<.001), but there was no significant difference between 15 and 30 minutes (p=0.055). For %MHR there was no significant difference across the three durations (p=0.445).

Conclusions: The current study supports Vinyasa yoga as a moderately-intense physical activity (50-70%MHR) which could be used as an alternative form of physical activity that may positively influence cardiovascular health. Additionally, similar psychological benefits experienced with practicing Hatha or general yoga were observed in this study, with no statistical difference between improvements in psychological measures between 15, 30 and 60 minutes. Therefore, people with a limited amount of time for physical activity can practice 15 minutes of Vinyasa yoga, twice a day, and still gain the desired psychological benefits while also meeting the ACSM/CDC physical activity requirements for cardiovascular health.

INDEX WORDS: Yoga; Vinyasa yoga; Acute bouts of physical activity; Single yoga session
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MARISSA MCGUIRK

B.S., Rochester Institute of Technology

A Thesis Submitted to the Graduate Faculty of Georgia Southern University in Partial
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of the Requirements for the Degree

MASTER OF SCIENCE
STATESBORO, GEORGIA
2012
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MARISSA MCGUIRK

Major Professor: Barry Joyner
Committee: Jim McMillan
Brandomn Harris

Electronic Version Approved:
MAY 2012
DEDICATION

This thesis is dedicated to my parents; because of the pride they drew from excellence in their own work, and their motto “just don’t do it, do it right,” I decided to seek higher education and strived to accomplish what I have today.

Thank you both for the continual encouragement and support in all my endeavors, but most importantly, thank you for standing by me through my early, dire years of writing, armed with nothing but a red pen.
ACKNOWLEDGMENTS

First and foremost, I wish to express my appreciation to my thesis chair, Dr. Barry Joyner for encouraging and convincing me to pursue a master’s thesis and in doing so, helped me to develop the confidence within myself to not only accomplish this challenge, but to welcome challenges in the future.

I would like to extend my gratitude to the rest of my thesis committee: to Dr. Jim McMillan for his enduring patience with my constantly changing plan of action, and for his endless list of thought-provoking questions that ultimately brought this research to a higher level; to Dr. Brandonn Harris for his willingness and enthusiasm to take on this project and for his indispensable guidance from the initial proposal to the completion of this research work.

I wish to give a special thank you to Dr. Tom Buckley and Dr. Barry Munkasy for their insightful comments and recommendations, and to Dr. Tony Pritchard for entrusting me with an overflowing box of heart rate monitors.

I must also gratefully acknowledge Jody Rushing and Beth Sammons for the constant and invaluable secretarial assistance, and the Department of Health and Kinesiology for providing the support to be able to complete this study.

Lastly, I say thank you to my study participants and your blissful love of Vinyasa yoga, for without you this study would not be possible.
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CHAPTER I
INTRODUCTION

Past research indicates that there is a positive relationship between physical activity and health. Participation in regular physical activity has been shown to decrease the risk for health issues, such as cardiovascular disease, diabetes, hypertension, and obesity. The concept that exercise is related to desirable changes in mood is supported by the International Society of Sports Psychology and is in concurrence with the United States Department of Health and Human Sciences who elaborates and associates physical activity with improvements in anxiety and depression.

For desirable changes in mood resulting from participation in exercise, Berger and Owen suggested that the physical activity should be enjoyable, aerobic, noncompetitive, temporally and spatially certain, and repetitive and rhythmical. However, in addition to the variables identified by Berger and Owen, perceived exertion should also be considered. Borg’s Rating of Perceived Exertion (RPE) is a scale that asks a person to associate a number with the degree of exertion felt during exercise, and, from the physiological standpoint, RPE has a linear relationship to heart rate. Rocheleau investigated the mastery hypothesis, which is the idea that the sense of accomplishment derived from completing a difficult activity, such as exercise, is responsible for improving mood, by analyzing RPE scores with changes in mood. This study found increased RPE due to a session of resistance training led to a greater decrease in negative mood than cardiovascular activity.

Previous research suggests acute bouts of physical activity can provide an immediate psychological benefit however there are inconsistencies as to which intensity promotes the greatest positive influence. Greater improvements in mood and positive well-being were reported
after high-intensity aerobic activity when compared to lower intensity\textsuperscript{6-8}, but at the same time, greater positive affect and decreases in anxiety have also been documented for lower intensity aerobic activity when compared to higher intensity.\textsuperscript{9-11} Furthermore, there has been ample research supporting that acute bouts of physical activity decrease anxiety and stress and improve positive well-being and overall feeling, however, the duration of these studies is inconsistent and ranges from 10 minutes to two hours.\textsuperscript{3,6,7,9,12-16} Regarding the discrepancies of the preceding research, the issue of the “optimal” dosage of exercise remains important and needs continued examination.\textsuperscript{9,17}

Continual practice of yoga not only strengthens the physical body, but also improves the connection between the mind, body and soul\textsuperscript{18}, and as a result, in recent years yoga has quickly become a popular form of physical activity in the United States.\textsuperscript{19,20} According to the 2007 National Health Interview Survey (NHIS), which included a comprehensive survey of Complementary and Alternative Medicine (CAM) used by Americans, yoga is one of the top ten CAM modalities used. In light of CAM surveys and in combination with past research, the National Center for Complementary and Alternative Medicine (NCCAM), a division of the National Institute of Health (NIH), suggests there is growing evidence that yoga works to enhance stress-coping mechanisms and mind-body awareness.\textsuperscript{21} Supported by past research, yoga practice alone is successful in decreasing stress\textsuperscript{16,22,23}, anxiety\textsuperscript{14,22,24,25}, and contributing to a greater body satisfaction and sense of well being, that improves overall mood\textsuperscript{26-28} and self-esteem\textsuperscript{29}. Additionally, positive influences on psychological measures, such as anxiety, stress, and mood have been reported after a single session of yoga practice however, the duration of that single session is not consistent across all studies and ranges from 20, to 50 to 180 minutes.
Of the many styles of yoga, Hatha and Vinyasa yoga are largely fundamental, and therefore the most frequently practiced in the Western World. Hatha yoga is gentle and slow paced, combining asanas (single postures), pranayamas (breathing techniques), and chandra (meditation) or savasana (relaxation)\textsuperscript{18,19,30}, and corresponds to low intensity aerobic activity.\textsuperscript{20} Whereas the faster pace style of Vinyasa yoga, also known as flow-yoga, is considered to be a more challenging style because of the continuous synchronization of movement with breath.\textsuperscript{31} Past research regarding yoga is largely dominated by Hatha yoga or relaxation and to date only two studies\textsuperscript{31,32} were found that investigated explicitly Vinyasa yoga, and although both studies determined Vinyasa yoga to be a moderately intense activity\textsuperscript{31,32}, neither of which considered psychological variables. Therefore, future research should evaluate the intensity of yoga practice with psychological variables such as mood and anxiety, similar to the research that has been done with cardiovascular exercise, in order to determine whether there is a maximally effective or minimally required “dose” of practice for stress reduction.\textsuperscript{23}

Many adults in the 18 to 25 age range are college students who are exposed to a variety of new stressors, such as the lack of ability to manage academic demands, job obligations and family commitments, in addition to financial responsibilities, changes in living arrangements, social pressures, and preparation for life after graduation.\textsuperscript{33} College students are not well versed in necessary stress management skills and coping strategies\textsuperscript{27}, but if the evidence that supports that physical activity decreases anxiety and stress\textsuperscript{3,34,35} was considered, perhaps physical activity is one coping strategy that is underutilized by many college students.\textsuperscript{27} Furthermore, physical activity is a cost-effective alternative to medicine that is associated with minimal adverse side-effects and can be indefinitely be sustained by the individual, unlike pharmacological and psychotherapeutic treatments.\textsuperscript{36} It is possible that a student who is reluctant to seek traditional
counseling may see yoga, or another form of physical activity, as an acceptable alternative.\textsuperscript{37} Therefore the potential for physical activity, and the various modalities, to reduce stress and anxiety in college students warrants further investigation.\textsuperscript{38}

The current research regarding Vinyasa yoga is limited to various studies investigating the metabolic response elicited by this practice. The influence on psychological measures experienced after a single session is abundant in Hatha and general yoga research, but yet to be expanded to include the Vinyasa style. Additionally, the dose-response relationship between the duration of a single yoga session and the immediate psychological response has yet to be explored. Therefore, the purpose of the current study is to investigate the change in anxiety and mood and compare RPE and %MHR after a single 15, 30 and 60 minute session of Vinyasa yoga in a healthy college population.
CHAPTER II
METHODOLOGY

Participants

According to the initial power analysis using G*Power\(^3\), 12 healthy college aged students were needed to participate in this study. Each participant experienced all three durations and participants were randomly assigned into one of six groups, with order of the durations counterbalanced among the groups. Participants were recruited from the physical activity yoga classes offered at Georgia Southern University, age 18 to 25 years, and had three months prior experience with yoga poses and Vinyasa yoga sequences. Participation in this study was voluntary, and at any given point during the study participants were be able to withdraw without fear of academic penalty.

<table>
<thead>
<tr>
<th>Day</th>
<th>Assessment</th>
<th>Pre-</th>
<th>Post-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>POMS, STAI-Y1</td>
<td>POMS, STAI-Y1, RPE, %MHR</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>POMS, STAI-Y1</td>
<td>POMS, STAI-Y1, RPE, %MHR</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>POMS, STAI-Y1</td>
<td>POMS, STAI-Y1, RPE, %MHR</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Data Collection Time Points

Instrumentation

There were several different assessments used for data collection in this study. Initially, participants were given an overview of the study and asked to complete an IRB approved consent form, demographic and the ACSM/AHA medical questionnaire, and a Physical Activity
Readiness Questionnaire (PAR-Q). The PAR-Q was adopted by the American College of Sports Medicine as a physical activity screening tool for determining the possible risk of exercising for an individual. The exclusion criteria were the selection of “yes” on any single PAR-Q item or four or more indicators on the ACSM/AHA medical questionnaire. See Appendix E for copies of the consent form, the ASCM/AHA medical questionnaire, and the PAR-Q questionnaire.

The Profile of Mood States (POMS)

The POMS was developed by McNair et al. as an inventory that measures psychological distress. Total mood disturbance (TMD) and six domains of total mood, fatigue-inertia, vigor-activity, tension-anxiety, depression-dejection, anger-hostility, and confusion-bewilderment, are measured. The original POMS was a self-report questionnaire with 65 items that could be administered to both the physically ill and healthy populations. Since then a shortened version, POMS-SF has been generated, consisting of 37 items while maintaining the ability to score total mood and the six subscales individually. Scores are reported on a 5 point Likert scale, ranging from 0-not at all to 4-extremely. TMD is found by reversing scoring specific items, then adding all the subscales and subtracting vigor.

The correlations between total mood disturbance and subscale scores on the POMS-SF and those from the original POMS all exceeded .95. Internal consistency estimates of the POMS-SF scales, using Cronbach’s alpha, ranged from .80 to .91, and internal consistency estimates using the original POMS scales ranged from .74 to .91. Internal consistency estimates for the POMS-SF subscale scores are quite high across all six samples and ranged from .76 (confusion subscale) to .95 (depression subscale). These results suggest that the POMS-SF may be an excellent alternative to the more time-consuming POMS because it preserves subscale
information available in the original POMS without any significant decrease in internal consistency.\textsuperscript{41} See Appendix F for a copy of the POMS-SF questionnaire.

**The State-Trait Anxiety Inventory- Form Y1 (STAI-Y1)**

The STAI is a 20 item self-report assessment used to measure anxiety in adults. Form Y1 measures state anxiety (change in emotional state due to an outside factor) and form Y2 measures trait anxiety (predisposition to anxiety based on personality and nature). Statements are scored on a four point Likert scale, ranging from 1-not at all to 4-very much so. Several items are reversed scored (items 1, 2, 5, 8, 11, 15, 16, 19, 20) before scoring the total. Total scores range from 20-80, with a higher score indicating a higher level of anxiety.\textsuperscript{42}

Construct validity was established through the correlation between Panic Disorder and right-hemisphere brain over activation\textsuperscript{43} and convergent validity was reinforced by the positive correlation with the Conjugate Lateral Eye Movement Test.\textsuperscript{44} Furthermore, according to the test-retest correlations provided by Spielberger et al., the STAI has 0.54 (state) and 0.86 (trait) correlation\textsuperscript{42}, and in addition Rule and Tarver found similar reliability coefficients of 0.40 (state) and 0.86 (trait).\textsuperscript{45} See Appendix G for a copy of the STAI-Y1 questionnaire.

**Rate of Perceived Exertion (RPE)**

The Borg RPE scale is an ordinal scale with values from 6 to 20 that requires participants to rate perception of exertion during exercise, with a higher score indicating a higher level of exertion.\textsuperscript{4} Concurrent validity of the RPE scale has been determined by the correlation of RPE scores with heart rate and other measure of physical exertion. Borg reported correlations of 0.80 to 0.90 between RPE and heart rate\textsuperscript{46}, and also test-retest and intra-class reliability coefficients of 0.78 to 0.83 have been reported.\textsuperscript{47} The Borg CR10 is an adapted category ratio scale with values from 1 to 10 with a reliability coefficient of 0.99 and a 0.98 correlation with the original RPE.
scale. The Borg CR10 has a wider range of application than the original RPE scale and therefore will be used in this study. See Appendix I for a copy of the Borg CR10 scale.

**Polar Heart Rate Monitor (PHRM)**

PHRMs and a valid regression equation to predict maximum heart rate in healthy adults \[HR_{\text{max}} = 208 - (0.7 \times \text{age}) \pm 7-11 \text{ beats/min}\] were used to determine the predicted percent maximum heart rate (%MHR) during the yoga session. In 1988, Leger and Thivierge tested 13 different heart rate monitors during rest, exercise and recovery and compared the results with an electrocardiograph. The results indicated that only heart rate monitors based on the principle of chest electrodes were valid. Supporting the previous study, Macfarlane et al. found heart rate monitors using chest electrodes produced a mean bias and variability of less than 1.0 beat/min throughout their functional range and Seaward et al. obtained a correlation coefficient of 0.99 when comparing data from a portable heart rate monitor with an electrocardiogram. Additionally, Goodie et al. utilized wireless heart rate monitors during mental stress and found a correlation coefficient of 0.98 when compared to an electrocardiogram. In agreement with the literature review by Achten and Jeukendrup in 2003, heart rate monitors using chest electrodes were considered to be both valid and reliable during physically and mentally stressful conditions.

PHRM with chest electrodes and a wireless wrist receiver have been successfully used during a session of gentle, Hatha, and Ashtanga yoga to estimate percent maximum heart rate. Furthermore, the combination of a valid regression equation to predict maximum heart rate in healthy adults \[HR_{\text{max}} = 208 - (0.7 \times \text{age}) \pm 7-11 \text{ beats/min}\] and portable heart rate monitors have been previously used to measure intensity during a Hatha yoga session.
Procedures

Interested participants, recruited from the yoga physical activity classes at Georgia Southern University, attended an informational meeting to learn about the requirements of the study and to complete the consent forms, ACSM/AHA medical health questionnaire, and PAR-Q, in addition to being given a detailed description of the psychological benefits of Vinyasa yoga. A completely within design was implemented, where each participant performs each of the three test conditions.

Upon arriving at the Human Performance Laboratory Annex, participants were fitted with Polar chest straps with two electrodes, moistened with water, and given the corresponding watch receiver. Immediately before each Vinyasa yoga session, the participant were asked complete the POMS-SF and STAI-Y1 in a randomized order. Vinyasa yoga sessions were on three nonconsecutive days (Tuesday, Thursday, Tuesday). Each Vinyasa yoga session was administered at the same time of day, on all three days. Video was used to present all Vinyasa yoga sessions. The three durations each participant experienced once were 15 minutes of Vinyasa yoga; 30 minutes of Vinyasa yoga; 60 minutes of Vinyasa yoga. After each session, participants were again given the POMS and STAI-Y1 in a randomized order and in addition provide an RPE score. The Polar heart rate watches were collected by the researcher, to later extract the data, and the participants removed the chest straps.
**Table 2: Participant Group and Vinyasa Yoga Session Duration (minute) Schedule**

<table>
<thead>
<tr>
<th>Group</th>
<th>Day 1</th>
<th>Day 3</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (G1)</td>
<td>15</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Group 2 (G2)</td>
<td>15</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>Group 3 (G3)</td>
<td>30</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Group 4 (G4)</td>
<td>30</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>Group 5 (G5)</td>
<td>60</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Group 6 (G6)</td>
<td>60</td>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>

**Table 3: Lab Schedule**

<table>
<thead>
<tr>
<th>Duration</th>
<th>Day 1</th>
<th>Day 3</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 min</td>
<td>G1 + G2</td>
<td>G3 + G5</td>
<td>G4+ G6</td>
</tr>
<tr>
<td>30 min</td>
<td>G3 + G4</td>
<td>G1 + G6</td>
<td>G2+ G5</td>
</tr>
<tr>
<td>60 min</td>
<td>G5 + G6</td>
<td>G2 + G4</td>
<td>G1 + G3</td>
</tr>
</tbody>
</table>

**Statistical Analysis**

The independent variable was the length of the Vinyasa yoga session: 15 minutes, 30 minutes and 60 minutes. The dependent variables were TMD, the six subscales of the POMS, state anxiety, RPE, and %MHR. Pre- and post- scores of TMD, the six subscales of the POMS, and state and trait anxiety were analyzed with a two-way ANOVA (3x2) with repeated measures. RPE and %MHR were analyzed with a one-way ANOVA (3x1) with repeated measures. Any findings were followed with contrasts. To account for the extensive number of dependent variables and control for Type I error, the alpha levels were set at 0.01.
CHAPTER III
RESULTS AND DISCUSSION

Results

Data were initially collected on paper, scored in the computer program Microsoft Excel, and transferred to IBM SPSS Version 19 (SPSS Inc., Chicago, IL) for analysis and interpreted. Information collected from the demographic questionnaire was used to describe the participants. Male (N=2) and female (N=12) college students were recruited for this study, however based on the minimum sample size determined by the initial power analysis and to eliminate gender as a possible confounding variable, the data analyses included data only from female participants (N=12) aged between 18 and 21 years (M = 20.17, SD = .193 years), height (M =161.96, SD = 7.316 centimeters), weight (M = 69.42, SD = 17.770 kilograms), and BMI (M = 26.21, SD = 5.060).

To answer the first hypothesis, two-way ANOVA’s (3x2) with repeated measures on both factors were used to examine the durations (three levels) by time (pre-post) interaction for TMD, fatigue-inertia, vigor-activity, tension-activity, depression-dejection, anger-hostility, confusion-bewilderment and state anxiety, with the significance set at α = 0.01. To answer the second hypothesis, a one-way ANOVA (3x1) with repeated measures was used to examine RPE and %MHR scores, with the significance also set at α = 0.01. Mauchly’s test for sphericity was used to determine if the sphericity assumption was met, but if violated, the Greenhouse-Geisser correction was used and, if necessary, with-in subject contrasts in order to see where significant changes occurred.

For TMD, the sphericity assumption was assumed (p=0.037). There was no significant interaction (p=0.198) between the durations and pre- and post- scores and there was no
significant difference among the durations (p=0.600), but there was a significant difference between the average of pre- and post- scores (p<0.001). The post-scores were significantly lower than pre-scores. (See Table 1, Figure 1)

For fatigue-inertia, the sphericity assumption was assumed (p=0.748). There was no significant interaction (p=0.683) between the durations and pre- and post- scores and there was no significant difference among the durations (p=0.033), but there was a significant difference between the average of pre- and post- scores (p=0.004). The post-scores were significantly higher than pre-scores. (See Table 1, Figure 2)

For vigor-activity, the sphericity assumption was assumed (p=0.094). There was no significant interaction (p=0.654) between the durations and pre- and post- scores and there was no significant difference among the durations (p=0.560), but there was a significant difference between the average of pre- and post- scores (p=0.010). The post-scores were significantly lower than pre-scores. (See Table 1, Figure 2)

For tension-activity, the sphericity assumption was assumed (p=0.012). There was no significant interaction (p=0.638) between the durations and pre- and post- scores and there was no significant difference among the durations (p=0.241), but there was a significant difference between the average of pre- and post- scores (p=0.003). The post-scores were significantly lower than pre-scores. (See Table 1, Figure 2)

For depression-dejection, the sphericity assumption was assumed (p=0.074). There was no significant interaction (p=0.282) between the durations and pre- and post- scores and there was no significant difference among the durations (p=0.522), but there was a significant difference between the average of pre- and post- scores (p<.001). The post-scores were significantly lower than pre-scores. (See Table 1, Figure 2)
For anger-hostility, the sphericity assumption was assumed (p=0.001). There was no significant interaction (p<.001) between the durations and pre- and post- scores, no significant difference among the durations (p=0.068), and no significant difference between the average of pre- and post- scores (p=0.140). (See Table 1, Figure 2)

For confusion-bewilderment, the sphericity assumption was assumed (p=0.464). There was no significant interaction (p=0.640) between the durations and pre- and post- scores and there was no significant difference among the durations (p=0.341), but there was a significant difference between the average of pre- and post- scores (p=0.007). The post-scores were significantly lower than pre-scores. (See Table 1, Figure 2)

For state anxiety, the sphericity assumption was assumed (p=0.105). There was no significant interaction (p=0.805) between the durations and pre- and post- scores and there was no significant difference among the durations (p=0.090), but there was a significant difference between the average of pre- and post- scores (p<.001). The post-scores were significantly lower than pre-scores. (See Table 1, Figure 3)
### Table 4: Means and Standard Deviations of Average Pre- and Post- Scores

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre/Post</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Mood</td>
<td>pre</td>
<td>2.92</td>
<td>2.61</td>
<td>3.43</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>-6.03*</td>
<td>1.58</td>
<td></td>
</tr>
<tr>
<td>Fatigue-Inertia</td>
<td>pre</td>
<td>4.58</td>
<td>0.85</td>
<td>-0.035</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>4.61*</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>Vigor-Activity</td>
<td>pre</td>
<td>9.61</td>
<td>1.05</td>
<td>-1.35</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>11.03*</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>Tension-Activity</td>
<td>pre</td>
<td>1.59</td>
<td>0.50</td>
<td>1.30</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>0.94*</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Depression-Dejection</td>
<td>pre</td>
<td>1.06</td>
<td>0.39</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>0.86*</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>Anger-Hostility</td>
<td>pre</td>
<td>1.64</td>
<td>0.57</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>0.50</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Confusion-Bewilderment</td>
<td>pre</td>
<td>1.06</td>
<td>0.35</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>0.61*</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>State Anxiety</td>
<td>pre</td>
<td>33.75</td>
<td>1.81</td>
<td>2.47</td>
</tr>
<tr>
<td></td>
<td>post</td>
<td>29.28*</td>
<td>1.68</td>
<td></td>
</tr>
</tbody>
</table>

*Significantly different from the pre-score (p<0.01)

**Figure 1: Average POMS-SF Total Mood Disturbance Pre- and Post- Scores**
**Figure 2: Average POMS-SF Subscale Scores**

![Graph showing average POMS-SF subscale scores pre and post intervention.](image)

*Significantly different from the pre-score (p<0.01)*

**Figure 3: Average State Anxiety Scores**

![Graph showing average state anxiety scores pre and post intervention.](image)

*Significantly different from the pre-score (p<0.01)*
For RPE, the sphericity assumption was assumed (p=0.242) and there was a significant difference across the three durations (p=0.001). Contrasts showed that RPE for 60 minutes was significantly higher than RPE for 15 and 30 minutes (p<0.001), but there was no significant difference between 15 and 30 minutes (p=0.055). (See Table 2, Figure 4)

For %MHR, the sphericity assumption was not assumed (p=0.019), but the correction revealed no significant difference across the three durations (p=0.445). (See Table 2)

Table 5: Means and Standard Deviations of RPE and %MHR

<table>
<thead>
<tr>
<th></th>
<th>RPE</th>
<th>%MHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 min</td>
<td>3.04 ± 1.74</td>
<td>0.76 ± 0.12</td>
</tr>
<tr>
<td>30 min</td>
<td>4.25 ± 2.52</td>
<td>0.72 ± 0.07</td>
</tr>
<tr>
<td>60 min</td>
<td>5.17* ± 1.85</td>
<td>0.69 ± 0.23</td>
</tr>
</tbody>
</table>

*Significantly different from 15 and 30 minutes (p<0.01)

Table 6: %MHR (Intensity) Based on Average Heart Rate

<table>
<thead>
<tr>
<th>Subject</th>
<th>Duration (min)</th>
<th>Avg. HR (bpm)</th>
<th>% MHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>109</td>
<td>56.48</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>116</td>
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<td>2</td>
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<td>56.48</td>
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<td>60</td>
<td>103</td>
<td>53.37</td>
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<td>15</td>
<td>111</td>
<td>57.51</td>
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<tr>
<td></td>
<td>30</td>
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<td>52.85</td>
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<td>51.28</td>
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<td>15</td>
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<td></td>
<td>30</td>
<td>127</td>
<td>64.13</td>
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<td>112</td>
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</tr>
<tr>
<td>11</td>
<td>102</td>
<td>110</td>
<td>97</td>
</tr>
</tbody>
</table>

**Figure 4: Average RPE values**

*Significantly different from 15 and 30 minutes (p<0.01)

**Discussion**

The most important finding of the current study is that the dose-response relationship between mood and anxiety and Vinyasa yoga was not present. Regardless of duration, 15, 30 or 60 minutes, there were positive, statistically significant changes in TMD, vigor-activity, tension-
activity, depression-dejection, confusion-bewilderment, and state anxiety, and a negative, statistically significant change in fatigue-inertia, but no significant change in anger-hostility. Although research regarding the dose-response relationship of any type of yoga was not found and the literature on Vinyasa yoga is extremely limited, these significant findings are consistent with previous studies that observed the dose-response changes in mood and anxiety after participation in aerobic activity.\textsuperscript{13,15,56}

In 2001, Hansen observed changes in POMS and subscale scores in healthy college students after 10, 20, and 30 minutes of cycling at 60\% estimated VO\textsubscript{2max}. Participants reported improved levels of vigor, fatigue, and total mood after 10 minutes of exercise, with progressive improvements in confusion over 20 minutes, but no additional improvements over longer periods. The authors concluded that for the college population psychological benefits can be gained from 10 minute bouts of physical activity, with little improvements seen in durations longer than 10 minutes.\textsuperscript{13}

Additional studies examining the immediate psychological benefits of acute exercise also observed improvement in mood and anxiety. Rendi et al. initially sought to resolve the issue between psychological benefits and exercise intensity and modality by comparing the Exercise Induced Feeling Inventory scores five minutes before and after 20 minutes after stationary biking and treadmill walking at self-selected workloads. Although, the authors reported positive significant psychological improvements after 20 minutes of physical activity, there was no significant difference between modality.\textsuperscript{15}

Further research performed by Roth supports that a single 20 minute bout of moderately-intense physical activity is sufficient to statistically significantly reduce tension and anxiety in both active and inactive college students.\textsuperscript{56} The current study agrees supports existing literature
regarding the dose-response relationship between general physical activity and psychological improvements, emphasizing that durations as short as 15 minutes are sufficient to provide significant improvements in mood and anxiety.

Regarding yoga specifically, there are multiple studies that reported psychological improvements after single sessions of yoga practice\textsuperscript{16,24,27,57,58}, however very few studies have examined improvements after the shorter duration of 60 minutes or less. Khmea observed a significant reduction in state anxiety after 20 minutes of guided yoga-based deep relaxation.\textsuperscript{59} Although participants did not engage in actual movement, the results of the study highlight that a short duration of engaging the mental state induced by yoga practice has positive implications on state anxiety.

Subramanya additionally utilized the STAI to analyze changes in anxiety after 22.5 minutes of cyclic meditation, or more specifically cycles of standing, side-bending, forward-bending, and back-bending poses coupled with guided relaxation.\textsuperscript{14} The decreases in state anxiety found complimented the research by Khemka and also supported that a short duration of flow-style yoga induces positive changes in anxiety.\textsuperscript{59}

Bing contrasted three modes of physical activity, walking, water aerobics, and yoga practice, as a means to reduce stress in college students. Not only was 50 minutes of yoga practice reported to statistically reduce arousal levels and produce a state of calmness and relaxation, it was also the most effective regarding the previously mentioned variables when compared to the other modes.\textsuperscript{27}

Wheeler also focused on college students to investigate changes in perceived stress after yoga asana practice. On four separate occasions positive and significant pre-post session changes on perceived stress were observed.\textsuperscript{23} The current study expands on short duration yoga session
research by observing no statistical difference in pre-post changes of total mood and state anxiety after the durations of 15, 30 and 60 minutes.

In the current study, the pre-to-post significant improvements (p<0.01) observed in the POMS-SF subscales tension, depression, vigor and confusion are similar to changes in the previous research using the POMS with a health college population. After a single session of yoga practice, Berger and Owen also reported improvements in tension, depression, anger and fatigue. In the literature on acute bouts of aerobic activity, McGowan observed significant decreases in tension, depression, anger, and confusion, Barabasz also found tension to decrease, while Hansen observed improved levels of vigor and fatigue. In the current study, fatigue significantly increased pre-to-post, which is contrary to the results of Berger and Owen. One possible explanation is that Vinyasa is more challenging than Hatha yoga and required a greater physical demand.

The Iceberg Profile is the expected POMS subscale profile based on the study conducted by Morgan in 1980. In the study, average scores of the POMS were compared to US wrestlers who did and did not make the 1976 Olympic team. The findings showed that the wrestlers who displayed a profile close to the general population (Iceberg-GP) did not make the team, while the profile of the wrestlers who made the team (Iceberg-W) was well below the average on all subscales, with the exception being well above the average on vigor. Comparing the Iceberg Profile to the current study revealed that the participants initially displayed a profile similar to that to the Iceberg-W, and actually scored lower on tension, depression, and anger. The single session of yoga practice further reduced the subscale scores of tension, depression, confusion, and anger, and also improved the scores on vigor. (See Figure 5)
Figure 5: POMS-SF Subscale Scores and Iceberg Profile

*Significantly different from 15 and 30 minutes (p<0.01)

Furthermore, the current study is among the few to explore the psychological benefits of Vinyasa yoga. Although previous research has investigated the metabolic cost of Vinyasa yoga\textsuperscript{32} and compared the heart rate responses of Ashtanga, Hatha and Gentle yoga\textsuperscript{31}, the psychological measures had not been explored to the same degree as Hatha or general yoga. The majority of the literature is centered on the improvements of mood\textsuperscript{3,22,28,57}, decreases in stress\textsuperscript{16,22,23,37}, and decreases in anxiety\textsuperscript{14,22,24,27,59,61} after general yoga practice or Hatha yoga, the present study is the first to provide verification that there are psychological benefits induced by the faster flow-style of Vinyasa yoga.
The physiological or psychological explanation of mood and anxiety improvements observed as a result of physical activity is not yet fully understood. Berger and Owen suggested that physical activity for mood improvement should be enjoyable, aerobic, noncompetitive, temporally and spatially certain, and repetitive and rhythmical, however there is research to support the physiological mechanism of releasing beta-endorphins in response to exercise is the driving force that leads to a feeling of well-being and ultimately improves mood. In a paper by Thoren et al., it was proposed that prolonged exercise that was rhythmic activated the central opioid (a chemical that binds to opioid receptors primarily found in the central nervous system and decreases the perception of pain) systems via the nerve fibers in contracting skeletal muscles, which also coincides with one of the physical activity traits for mood improvement described by Berger and Owen.

With this theory in mind, and the rhythmic nature of Vinyasa yoga, it is not only logical to suggest that increasing the duration of exercise will linearly increase the improvement in mood, but it is also supported by the literature until relatively high levels of exertion (80-85% maximum). However, the results of the current study and previously mentioned research on mood improvements after acute bouts of exercise may reflect on the idea of a possible endorphin threshold, and once that threshold is met, greater improvements in mood will not be observed. Another possible explanation is that beta-endorphin behavior is dependent on the intensity of the activity, as supported by the research by Schwartz and Kindermann, which reported in predominantly anaerobic exercise, beta-endorphin response it is dependent on the degree of metabolic demand.

However, with regards to yoga, the involvement of the parasympathetic nervous system should be considered as a contributor to the improvement in mood. In yoga, the breath is
manipulated in many different ways, such as breathing deeply into the abdomen, breathing against airway resistance, physical postures, holding the breath at different parts of the breath cycle, or breathing alternately through both nostrils, or only one nostril. By voluntary controlling the breath, the parasympathetic nervous system is activated and vagal tone is increased. Ujjayi breathing, resistance breathing through the nose practiced during Hatha and Vinyasa yoga, magnifies this increase in vagal activity, and may subsequently provide therapeutic responses, such as improved mood, reduced stress and anxiety, and overall emotional regulation.

The second major finding of this study is that average heart rate values corresponding to moderate-intensity, 50-70\%\text{MHR}, were observed in all three durations, \%\text{MHR} was not significantly different across all three durations and only the RPE value of 60 minutes was significantly different from 15 and 30 minutes.

There is supporting literature that moderately-intense physical activity can significantly decrease stress and anxiety and improve overall mood. In 1995, Tate reported aerobic exercise, specifically cycling at moderate intensity (55\%\text{VO}_{2\text{max}}), decreased anxiety, and in 2003, based on positive well-being and fatigue scores, Daley suggested that 20 minutes of moderate intense exercise provided psychological benefit whereas low intensity exercise did not, and further hypothesized that higher intensity could negatively affect psychological well being by increasing feeling of fatigue during and after exercise.

Similar to the findings by Tate and Daley, and more recently, in 2006 Bixby observed greater positive affect after 30 minutes of steady state low intensity exercise when compared to high intensity exercise of the same duration. All three studies suggest that physical activity
performed at low intensity warrants higher levels of psychological benefit than when performed at moderate or high intensity.

However, despite the previously mentioned literature, there is contradicting research that suggests higher intensity exercise may provide greater psychological benefit than low intensity. Earlier research by Barabasz supports aerobic exercise at a vigorous intensity induces significant improvements in TMD and the tension-anxiety scale of the POMS. Daley explored well-being scores during and after high intensity aerobic exercise, and also contrasted the results with scores after moderately intense aerobic activity. Participants reported higher Psychological Well-being (PWB) scores in the low intensity condition during exercise but higher scores were reported in the high intensity condition after exercise. Additionally, Cox observed exercising at a high intensity (80% VO$_{2}$max) to be more effective than at a moderate intensity (60% VO$_{2}$max) in elevating positive via the Subjective Exercise Experiences Scale (SEES), a scale that assesses positive well-being, psychological distress, and fatigue in response to exercise, with a population of active females.

Based on previous studies, Hatha yoga is associated with low-intensity aerobic activity and the current study, along with research by Cowen, supports Vinyasa yoga as a moderately-intense aerobic activity, but both styles of yoga have been observed to provide psychological benefits.

According to ACSM cardiovascular guidelines for decreasing disease and health risks, people should participate in 30 minutes of moderate-intense (50-70% of heart rate maximum) physical activity on most days of the week. The US Department of Health and Human Services Office of the Surgeon General further states that the physical activity duration can be split into several short periods, for example 10 minutes, 3 times a day instead of one single 30 minute
duration. In the current study, eleven of the total twelve participants exerted an average heart rate during a single session that met the moderately-intense heart rate guidelines for one or more durations (see Table 3), and therefore supports Vinyasa yoga as a moderately-intense physical activity. It could be suggested that when participating in 30 minutes of moderately-intense physical activity is not plausible, performing multiple shorter bouts of Vinyasa yoga equivalent to 30 minutes (two, fifteen minute sessions) will not only provide equivalent immediate psychological benefits as a single 30 minute session, but will also meet the ACSM recommendations and offer cardiovascular health benefits.

The average heart rate values may also be correlated to and presented as an explanation for the improvements in mood and anxiety. In addition to the variables identified by Berger and Owen, intensity should also be included when considering psychological benefit from physical activity. The mastery hypothesis, which is the idea that the sense of accomplishment derived from completing a difficult activity, such as exercise, is responsible for improving mood, was initially investigated by Treasure and Newbery. They examined the relationship between self-efficacy, exercise intensity, and feeling states during and after an acute bout of exercise. Participants of the study performed moderate-intensity (45-50%HRR) exercise, high-intensity exercise (70-75%HRR), or a no-exercise as a control group. Changes in feeling states across the course of the exercise bout were experienced by both the high and moderate-intensity exercise groups, however moderate-intensity exercise produced fewer negative feeling states but less immediate positive self-efficacy, whereas high-intensity exercise produced positive self-efficacy but negative feeling states, thereby suggesting a reciprocal relationship between self-efficacy and feeling states is strongest in the high intensity exercise condition.
Rocheleau attempted to provide insight on the mastery hypothesis by analyzing RPE scores and changes in mood, as measured by the POMS, after a session of resistance training and cardiovascular activity. However, the results partially supported the hypothesis, as the increased exertion expressed led to greater decreases in mood after a session of resistance training, in regards to cardiovascular activity increased RPE was related to less change in negative mood.\(^5\) However, the findings by Daley fully supported the mastery hypothesis and the authors noted that the higher positive well being scores observed after the high intensity exercise (80-85\%MHR) compared to the low intensity (50-55\%MHR) exercise could be derived from the sense of achievement in the successful completion of a task.\(^8\)

In the current study, the average heart rate values across all three durations, 15, 30, and 60 minutes, corresponded to moderate-intensity, 50-70\%MHR\(^{68}\), physical activity. Although this range is slightly lower than the values of the high intensity exercise in previous research shown to exhibit the mastery hypothesis, it may be interpreted that because of the challenging, fast-pace nature of Vinyasa yoga, the derived feeling of accomplishment is sufficiently significant regardless of the moderately intense heart rate values observed.

One limitation of the current study is the non-randomized selection of the sample, which reduced the generalizability of the results. A second is the large standard deviations across the chosen measures. Repeating the methods with a larger sample may have resulted in smaller standard deviations and allowed for significant differences in the statistical analysis between the various durations and possibly support a dose-response relationship. Additionally, in the current study subjects participated in all durations and despite counterbalancing the order prescribed, potential cross-over might have been a contributing factor because of the short period of time between durations. Repeating the study with a longer period of time between durations may
allow for greater improvements in the psychological measures across one or all durations. Or, to completely avoid the potential for cross-over effects, another option would be to divide the sample so as each group only participated in one of the session durations.

Lastly, because of the completely with-in design, the current study did not have a true control group. This exclusion may limit how generalizable the results are because it cannot be confirmed the improvements are a direct results of the Vinyasa yoga, only inferred.

Future research should quantify and compare the psychological benefits experienced after separate sessions of Hatha and Vinyasa yoga practice of equal duration, comparable to past research on the psychological benefits of aerobic activity at varied intensities. A self-efficacy inventory should also be included in the research regarding improvements in psychological mood and well-being. Additionally, the dose-response relationship should be further developed by comparing a longer session of yoga (i.e. 60 minutes) with multiple bouts of shorter sessions of equal durations (i.e. two, 30 minute sessions or three, 20 minute sessions) on psychological and additionally potential physiological improvements. Furthermore, the relationship between the mastery hypothesis and yoga should be explored by quantifying psychological improvements and including a measure of self-efficacy after the lower intensity Hatha yoga and the higher intensity Vinyasa yoga.

In regards to the dose-response relationship of any yoga style, the issue should be examined with a larger sample size, the division of the sample into groups, the inclusion of a control group, or if using the participants as their own control, increase the duration between Vinyasa yoga sessions.
Conclusion

The current study supports Vinyasa yoga as a moderately-intense physical activity (50-70% MHR) which could be used as an alternative form of physical activity that may positively influence cardiovascular health. Additionally, similar psychological benefits experienced with practicing Hatha or general yoga were observed in this study, with no statistical difference between improvements in psychological measures between 15, 30 and 60 minutes.

Therefore, people with a limited amount of time for physical activity can practice 15 minutes of Vinyasa yoga, twice a day, and still gain the desired psychological benefits while also meeting the ACSM/CDC physical activity requirements for cardiovascular health.
APPENDIX A
REVIEW OF LITERATURE

Introduction
The purpose of the literature review is to provide an understanding of the psychological benefits of general physical activity and yoga practice. The first section will explain the psychological responses and benefits of general physical activity and the effects of acute bouts of physical activity on mental well-being. The second section will provide a background of yoga as a form of physical activity and differentiate between the style and intensity of Hatha and Vinyasa yoga. Third, will be an explanation of the psychophysiological changes that occur during yoga practice as a result of breathing techniques and the health benefits reported in previous yoga research, specifically, focusing on the reduction of anxiety, and the improvement in mood and overall feeling. Lastly, this literature review will discuss the validity and the appropriateness of the psychological measures selected for this study, and close with the justification for further research on the optimal intensity and duration of acute yoga practice to provide maximum psychological benefits.

Physical Activity and Mental Well-Being
Mental health disorders are common in the United States, and in a given year approximately one quarter (26.2%) of adults are diagnosed with one or more disorders with an average age of onset of 14 years old. (NIMH, 2010) The World Health Organization (WHO) and the United States Department of Health and Human Services acknowledge physical activity as a means to improve mental health and well-being. As a result, various researchers have attempted to gain an insight on the influence of physical activity on psychological well-being but few have studied the effect on a healthy population.
Nguyen-Michel conducted a study in 2006 aimed to associate physical activity levels and perceived stress/hassles in college students. Participants in this study included 814 college students from three southern California colleges. Based on total weekly leisure activity scores and the Graduate Student Inventory (GSI), there was a significant linear relationship between physical activity and hassles thus implying that health promotion programs for college students may benefit from incorporation of physical activity strategies to reduce stress.\textsuperscript{38}

More recently, in 2010, Tyson et al. focused on physical activity as a means to improve mental health in a student population. One-hundred undergraduate university students were surveyed by means of the Hospital Anxiety and Depression Scale (HADS) and separated into low, medium, and high levels of physical activity via Physical Activity Questionnaire (PAQ) scores. Based on the results, students who engaged in high (554.94 points) levels of physical activity showed significantly lower levels of anxiety and depression than the medium (68.45 points) and low (3.26 points) physical activity groups, suggesting the greater the amount of cumulative physical activity, the lesser the symptoms of anxiety and depression, and furthermore indicating that engagement in physical activity can be an important contributory factor in the mental health of undergraduate students.\textsuperscript{17}

**Acute Effects of Physical Activity**

The dose-response relationship describes the quantity of exposure to a stressor, or doses, and the effect on the body. In regards to physical activity, the dose-response relationship is between the duration and/or the intensity, and the maximum health benefits obtained, without producing additional health risks.
Intensity

In the literature there is evidence to support greater psychological benefits are experienced at high-intensity aerobic activity. Barabasz et al. utilized the POMS to quantify improvements in mood experienced after one single bout of 45 minutes of vigorous aerobic exercise. This study supports higher intensity aerobic activity induces greater increases in psychological parameters, specifically improvements in total mood disturbance.\(^6\)

Cox et al. compared treadmill jogging at 60% \(\text{VO}_2\text{max}\) and 80% \(\text{VO}_2\text{max}\) for 33 minutes and found exercise at both intensities had little effect on fatigue or distress but had a beneficial effect on positive well-being. However, in agreement with Barabasz et al, a high intensity bout of exercise appeared to be as or more effective than a moderate bout in terms of elevation positive well-being.\(^7\)

Further corroborating the evidence for high-intensity physical activity, Daley reported RPE and Positive Well-Being scores before and after one single, 20 minute session of treadmill jogging at 50-55% \(\text{VO}_2\text{max}\) and 80-85% \(\text{VO}_2\text{max}\). The results indicated positive well-being scores were greater after the higher intensity exercise than the lower intensity exercise.\(^8\)

However, previous research also supports low-intensity physical activity for providing greater psychological benefits. A study by Steptoe and Cox analyzed the components of the POMS, tension/anxiety, fatigue, and mood after two, eight minute trials of high-intensity exercise and two, eight minute trials of low-intensity exercise, with five-to-sixteen minutes rest between trials. The authors found high-intensity exercise resulted in increases of self reported tension/anxiety and fatigue, while low-intensity exercise induced positive mood changes, specifically vigor and exhilaration.\(^11\)
Tate et al. compared pre- and post- state anxiety, energetic arousal (positive) and tense arousal (negative) scores following 30 minutes of cycling at 55% VO$_{2\text{max}}$ and at 70% VO$_{2\text{max}}$. State anxiety increased during exercise for both intensities however a significant post-reduction was only experienced at 70% VO$_{2\text{max}}$. Overall findings suggested that aerobic exercise at 55-70% VO$_{2\text{max}}$ decreased anxiety and increased positive affect, but the magnitude of changes may have been dependent on exercise intensity. Furthermore Bixby observed a greater positive affect reported during low-intensity conditions when compared to high-intensity conditions.

Duration

In reference to aerobic activity, few studies have investigated the relationship between the duration of the activity and the degree of psychological benefits. Hobson and Rejeski found no differential mood effects at 10, 25, or 40 minutes of exercise, however Thayer observed brisk walking of only 5-10 minutes was sufficient to increase energy and reduce tension. The most recent study, performed by Hansen, explored the changes in POMS scores after 10, 20 and 30 minute bouts at 60% VO$_{2\text{max}}$ on a cycle ergometer. The results indicated improved feelings of vigor, fatigue, and total mood occurred after 10 minutes of exercise, with progressive improvements in confusion over 20 minutes, however, no additional improvements were reported over longer periods.

Perceived Exertion

For mood enhancement from physical activity, Berger and Owen suggested that the activity should be enjoyable, aerobic, noncompetitive, temporally and spatially certain, and repetitive and rhythmical, however an addition variable that should be considered is perceived exertion. Borg’s Rating of Perceived Exertion (RPE) 6-20 scale describes a person’s perception of exertion during exertion and has a linear relationship to heart rate. The Borg CR10 is an
adapted category ratio scale with values from 1 to 10 with a reliability coefficient of 0.99 and a 0.98 correlation with the original RPE scale.\textsuperscript{48} Rocheleau hypothesized that mastery hypothesis, the sense of accomplishment derived from completing a difficult activity such as exercise, is responsible for improving mood, and found increased RPE on the Borg CR10 scale due to a session of weight lifting led to a greater decrease in negative mood but increased RPE due to cardiovascular activity was related to less change in negative mood.\textsuperscript{5} Based on this research, future studies should consider the relationship of RPE and mood with a measure of actual exertion such as heart rate.

**Percent Maximal Heart Rate (\%MHR)**

In the literature, \%MHR is a well-established method to determine exercise intensity. Kennedy and Newton examined how aerobic exercise and exercise intensity affected transient mood states, assessed by the POMS, on healthy a population. Subjects either participated in low-intensity (less than 60\%MHR) or high-intensity (75\%MHR) bench-stepping for 50 minutes. Tension, depression, fatigue and anger decreased while vigor increased in both conditions. Also, the high-intensity group reported feeling less fatigue and anger than those who participated in the low-intensity group.\textsuperscript{74} The results from this study suggest that mental benefits resulting from physical activity might be correlated with the intensity of the activity. However, Berger and Owen did not find a significant interaction between exercise intensity and pre-post mood benefits in college students jogging at 55%, 75% and 79\%MHR. Regardless of the low-or moderate-intensity, participants reported that they “felt better” after exercising.\textsuperscript{75}

**Fit vs. Unfit**

Lastly, in regards to various fitness levels, Daley et al. reported that exercise positively influenced psychological states irrespective of the participants’ current activity status\textsuperscript{8} and Bixby
commented that regardless of exercise intensity participants of high and low fitness level report similar positive affective experiences during recovery from exercise\textsuperscript{10}

**Yoga History**

In recent years yoga has become a popular form of physical activity in the United States.\textsuperscript{19,20} *Yoga*, derived from the Sanskrit root *yug*, meaning *union*, fosters a connection between the mind, body and breath.\textsuperscript{18} The word yoga was first mentioned around 1500 B.C., in the Rig Veda, the oldest of the sacred texts of Brahmanism. However, little is known until about 500 B.C. when yoga was practiced in India as a discipline to alleviate suffering.\textsuperscript{76} Since then, many different variations of yoga have appeared all over the world. Hatha yoga, which was developed based on Hindu teachings, has become today one of the most popular style in Western culture.\textsuperscript{20} Through gentle and slow paced progressions, Hatha yoga represents the union of opposites by combining *asanas* (single postures), *pranayamas* (breathing techniques), and *chandra* (meditation) or *savasana* (relaxation).\textsuperscript{18,19,30} By combining the negative and positive, Hatha yoga generates a balance in the human body and creates a state of perfection and happiness.\textsuperscript{20} The faster pace style of Vinyasa yoga, also known as flow-yoga, coordinates breath patterns with a series of asanas and is considered to be a more challenging form of yoga. During Vinyasa yoga, the practitioner moves from position to position while either inhaling or exhaling at a much faster pace than experienced in Hatha yoga.\textsuperscript{31}

**The Intensity of Yoga**

Vinyasa and Hatha yoga each provide therapeutic benefits, however, the continuous synchronization of breath with movement involved in Vinyasa yoga may potentially require a higher workload\textsuperscript{31}, and therefore the intensity of each style of yoga should be distinguished.
There are several measurements that define the intensity of physical activity as defined by the American College of Sports Medicine and the Centers for Disease Control and Prevention (see table 7). The mode and purpose of the physical activity or exercise will determine which measure is the most appropriate.

**Table 7: Intensity of Physical Activity**

<table>
<thead>
<tr>
<th></th>
<th>METs</th>
<th>% MHR</th>
<th>Borg CR10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0-3</td>
<td>40-54%</td>
<td>0-3</td>
</tr>
<tr>
<td>Moderate</td>
<td>3-6</td>
<td>55-69%</td>
<td>4-6</td>
</tr>
<tr>
<td>High</td>
<td>6-10</td>
<td>70-100%</td>
<td>7-10</td>
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</table>

In previous research, Hagins examined the intensity of Hatha and determined the metabolic cost was $2.5 \pm 0.8$ METs and corresponded to $49.5 \pm 12.2$ %MHR, which is associated with low-intensity aerobic activity. However, this study did note that the sequence of sun salutation postures (typical flow-yoga found in Vinyasa style) elicited a slightly higher intensity of $2.9 \pm 0.77$ METs and $54.8 \pm 11.8$ %MHR and when practiced for greater than ten minutes may have corresponded to a level of intensity sufficient to improve cardiorespiratory fitness in unfit or sedentary individuals.

Completed two years prior, Clay et al. determined through metabolic and heart rate responses that non-salutation Hatha yoga practice elicited approximately $2.07 \pm 0.4$ METs and $55.98 \pm 9.19$ %MHR and the sun-salutation portion corresponded to $3.74 \pm 0.70$ METs and $66.99 \pm 9.99$ %MHR. Only one study was found that looked exclusively at the metabolic requirement of Vinyasa yoga. By utilizing open circuit spirometry, Carroll et al. determined the metabolic cost of Ashtanga Vinyasa yoga to be $6.7$ METs and thereby corresponding to moderate-intensity. Moreover, the study by Cowen et al. was the only study found to compare heart rate
changes across multiple styles of yoga, specifically reporting Ashtanga yoga (a set sequence of yoga asanas performed in Vinyasa style), Hatha yoga and a gentle session of yoga to generate %MHR values of 54%, 45%, and 42%, respectively.\(^3\)

This compilation of studies illustrates the difference in intensity of Hatha and Vinyasa yoga, specifically suggesting that Hatha yoga is consistent with low-intensity aerobic activity and Vinyasa yoga with moderate-intensity aerobic activity. However, there is a need for additional studies that compare multiple measures of intensity and further the physiological responses experienced across the various yoga styles.

**Parasympathetic Response to Yoga**

Founded on the therapeutic experiences expressed by yoga practitioners, the National Center for Complementary and Alternative Medicine (NCCAM), a division of the National Institute of Health (NIH), acknowledges yoga as a valid mind-body intervention. However, there is physiological evidence to support this theory.

The autonomic nervous system (ANS) is a branch of the peripheral nervous system that regulates involuntary movement. The ANS further divides into the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS), which function in constant opposition. Stimulating the SNS induces the stress response and increases heart rate, blood pressure, blood glucose level, and respiration, whereas the PNS induces the relaxation response and conversely, when stimulated, decreases heart rate, blood pressure, blood glucose level, and respiration. The vagus nerve, whose cell bodies originates in the medulla, is responsible for stimulating the parasympathetic neurons to release acetylcholine, a neurotransmitter that retards the rate of sinus discharge and consequently slows heart rate.\(^7\) Reducing sympathetic and inducing
parasympathetic nervous system tone are integral for inducing therapeutic responses, such as improved mood, reduced stress and anxiety, and overall emotional regulation.  

Yoga aims to influence the manner in which we breathe so as to control the energy flow and eliminate toxins and negative karmic airs that allow for an increase in oxygenation, and ultimately strengthen the physical body. In yoga, breath is manipulated in many different ways, such as breathing deeply into the abdomen, breathing against airway resistance, physical postures, holding the breath at different parts of the breath cycle, or breathing alternately through both nostrils, or only one nostril. This voluntary control of breath activates the parasympathetic nervous system and in so doing increases vagal tone and subsequently reduces stress and blood pressure, provides emotional regulation, and potentially induces an altered state of consciousness.

In addition, Ujjayi breathing, resistance breathing through the nose, is a component of pranayama that magnifies the increase in vagal activity and further improves heart rate variability, which may be considered to reduce the risk for cardiovascular disease. Lastly, the slow breathing techniques associated with yoga posture have been shown to substantially reduce chemoreflex (modulates of sympathetic activity) sensitivity to hypoxia (reduced oxygen delivery to the tissues) especially after long-term practice, and thereby increasing the parasympathetic response.

Derived from the evidence that involvement in general physical activity promotes improved mental well-being, together with the therapeutic response elicited by yoga breathing, there is an argument for yoga as the optimal form of physical activity for improving mental well-being.
Previous Yoga Research

In the literature there is supporting evidence that yoga practice induces therapeutic responses such as reductions in stress and anxiety and improvements in mood and overall well-being. A 10 week study by Wheeler and Wilkin found that perceived stress levels in college students decreased after each one hour yoga asana session. Also an overall decrease in perceived stress was observed from week four to week eight.\textsuperscript{23} Michalsen conducted a three-month intensive yoga program and observed pronounced and significant improvements in perceived stress, State and Trait anxiety, well-being, vigor, fatigue, and depression, in addition to pain relief.\textsuperscript{22} Smith recorded STPI scores after one hour of weekly yoga practice and relaxation for 10 weeks and found anxiety and quality of life improvements over time.\textsuperscript{61}

A few studies have focused on the immediate psychological benefits after a single yoga session. Subramanya et al. compared anxiety scores, as defined by the STAI, after 22.5 minutes of cyclic meditation and savasana relaxation of equal time. He observed a significant decrease in anxiety after one single session in both of the yoga styles, although a greater magnitude of decrease after cyclic meditation.\textsuperscript{14} Telles et al. examined the effect of a single yoga practice session or yoga theory session on anxiety and found a 14.7\% reduction after 2 hours of yoga practice and a 3.4\% reduction after an equal time of yoga theory in STAI scores.\textsuperscript{24} Khemka et al. also focused on the reductions in STAI scores immediate after yoga-based deep relaxation and supine rest. Significant reductions were seen after 20 minutes of yoga-based deep relaxation but not after supine rest.\textsuperscript{59}

Additional research investigated changes in psychological measures across multiple exercise modes. Streeter compared the effect of yoga versus walking on mood and anxiety. Participants engaged in their respective activity for 60 minutes a day, three days a week, for a
total of 12 weeks. Based on EIFI and STAI scores, the yoga practitioners experienced greater improvements in mood and anxiety than walking. Netz evaluated mood alterations in response to yoga, Feldenkaris (awareness through movement), aerobic dance, and swimming after one 90 minute session across an entire academic year thought the STAI, DACL, and SWBS. The results indicated that mindful, low-exertion activities have the ability to enhance mood after one single session of exercise.

West utilized the 14-item Perceived Stress Scale and saliva cortisol levels to quantify perceived stress levels before and after 90 minutes of Hatha yoga practice and African dance in healthy undergraduate students. A decrease in perceived stress levels was reported after both Hatha yoga and African dance, however, only Hatha yoga decreased saliva cortisol levels. Bing et al. compared SAI scores after a single, 50 minute session of walking, water aerobic, and yoga in healthy college students. This study reported that yoga was the most effective in reducing arousal levels and producing a state of calmness or relaxation. Berger et al. measured stress reduction and mood enhancement across swimming, body condition, Hatha yoga, and fencing by the change in POMS and SAI scores after on single bout. While all modes improved both measures, yoga produced the greatest magnitude of positive changes in anxiety, depression, anger, and fatigue.

The previous studies indicated that psychological benefits are not only a product of habitual yoga practice, but can also be experienced after one single session. Additionally, when compared to alternative modes of physical activity, previous research has suggested that the beneficial response yoga elicits is equivalent to or greater than that experienced after many aerobic activities. However, the literature does not sufficiently contrast the psychological benefits associated with short versus long duration yoga practice or investigate the duration of a
yoga session, if any, which is attributed with maximum reductions in anxiety and stress and improvements mood and overall well-being.

**Psychological Measures**

The Surgeon General’s report on physical activity and health supports the beneficial effect of physical activity on relieving symptoms of depression and anxiety and on improving mood. In addition, the report suggests that there is evidence that physical activity may protect against the development of depression and improve psychological well-being.²

In 1999 Fox published a literature review investigating the relationship between physical activity and psychological well-being. Based on the current research at that time, there was sufficient evidence to support the effectiveness of physical activity in the treatment of clinical depression in addition to reducing the debilitating effect of state and trait anxiety, improving physical self-perceptions and global self-esteem. Looking at the conclusions cumulatively, moderate regular exercise should be considered as a viable means of treating depression and anxiety and improving mental well-being.³ Since then, researches have employed a variety of questionnaires in an attempt to quantify changes in the facets of mental well-being.

The Profile of Mood States (POMS) analyzes mood in six domains, fatigue-inertia, vigor-activity, tension-anxiety, depression-dejection, anger-hostility, and confusion-bewilderment, in order to determine an overall measure of psychological distress.⁴ Multiple studies have used the POMS to analyze the alteration in mood after a single bout of physical activity.

In 1991, McGown, reported reduced total mood disturbance, tension, depression, anger, and confusion after a single session of 75 minutes of running, karate, or weight lifting.¹² Also in 1991, Barabasz determined improvement in total mood disturbance and the tension-anxiety
subscale after a 45 minutes of aerobic exercise. Further, in 2001, Hansen observed improved levels of vigor, fatigue, and total mood after 10 minutes of bicycling with the POMS.\textsuperscript{13}

In regards to yoga, a study by Berger used the POMS and found that after a single bout of yoga, participants reported to be less anxious, tense, depressed, angry and fatigued.\textsuperscript{3} Most recently, in 2011, Yoshihara compared the long term (over two years) effect of yoga practice with non-yoga practitioners on mood using the POMS. The results indicated a decrease in the average self-rated mental disturbance, tension-anxiety, anger-hostility, and fatigue scores.\textsuperscript{79}

The International Society of Sports Psychology concluded that exercise has been related to desirable changes in mood\textsuperscript{1} and the United States Department of Health and Human Sciences also indicated that physical activity was associated with improvements in mood states such as anxiety and depression.\textsuperscript{2} The State-Trait Anxiety Inventory (STAI) has been widely used to measure anxiety in adults.\textsuperscript{42} In past research the STAI has been utilized after general physical activity and with exclusively yoga practice.

Both Subramanya and Telles used the STAI to report a decrease in anxiety following a single yoga session.\textsuperscript{14,24} Netz determined that mindful low-exertion activities result in lower state anxiety scores.\textsuperscript{57} Additionally, Khemka and Streeter observed significant reductions in state anxiety after participating in yoga-based deep relaxation and yoga practice, respectively.\textsuperscript{28,59}

**Conclusion**

The psychological benefits of yoga practice have been previously explored and are widely accepted however, there is no research on yoga that is similar to the current research on cardiovascular activity that compares the immediate benefits after different durations of a single bout of yoga practice within the same sample. Furthermore, there was no research found that investigated the psychological benefits of solely Vinyasa yoga.
REFERENCES


47. Noble BJ, & Robertson, R.J. *Perceived exertion*. Champaign, IL: Huamn Kinetics; 1996.


70. Haskell WL, Lee IM, Pate RR, et al. Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the


APPENDIX B

Hypothesis

1. Scores for total mood disturbance (pre-post), fatigue-inertia (pre-post), vigor-activity (post-pre), tension-activity (pre-post), depression-dejection (pre-post), anger-hostility (pre-post), confusion-bewilderment (pre-post) and state anxiety (pre-post) for 15 minutes will be significantly different from 30 and 60 minutes, but 30 and 60 minutes will not be significantly different.

2. Values of RPE and %MHR for 15 minutes will be significantly different from 30 and 60 minutes, but 30 and 60 minutes will not be significantly different.
APPENDIX C

Operational Definitions:

1. Anxiety: as measured by the STAI-state.
2. Mood: as measured by the POMS-SF.
3. Perceived Exertion: as measured by RPE.
APPENDIX D

Limitations

1. Sample selection will be non-randomized (volunteer).

Delimitations

1. Participants will be healthy college students, ages 18-25, recruited from yoga physical activity classes offered at Georgia Southern University.
2. Collegiate athletes will be excluded.
3. Yoga practice will solely include Vinyasa yoga.

Assumptions

1. Each participant will answer each inventory honestly and to the best of their abilities.
2. All training sessions and data collections will be administered in the same way, with the same instructions given to each participant.
INFORMED CONSENT

Mood, Anxiety, RPE, and %MHR after a Single 15, 30 and 60 Minute Session of Vinyasa Yoga

1. **Principal Investigator:**
   Marissa G. McGuirk, B.S., Graduate Student, mm05357@georgiasouthern.edu
   
   Dr. Barry Joyner, Ph.D., Department Chair, 478-0200, joyner@georgiasouthern.edu
   Dr. Jim McMillan, Ed.D., Associate Professor, 478-1926, jmcmillan@georgiasouthern.edu
   Dr. Brandon Harris, Ph.D., Associate Professor, 478-7900, bharris@georgiasouthern.edu
   Department of Health and Kinesiology, P.O. Box 8076, Statesboro GA 30458

2. **Purpose of the Study:** The purpose of the current study is to investigate the change in state and trait anxiety and mood, and compare rate of perceived exertion scores (a number between 1-10 based on how hard you feel your body is working) and percent maximum heart rate (the percent of your maximal heart rate determined by the equation: 220-age) after a single 15, 30 and 60 minute session of Vinyasa yoga using a healthy college population.

3. **Procedures:** Each participant will experience three durations: a 15 minute, 30 minutes and 60 minute session of Vinyasa yoga practice. Participants will be randomly assigned into one of six groups so as to counterbalance the treatment order among participants. Participants will be recruited from the yoga physical activity classes offered at Georgia Southern University, age 18 to 25 years. Participation in this study is voluntary, and at any given point during the study participants will be able to withdraw without fear of academic penalty.

4. **Discomforts and Risks:** All physical assessments involved in data collections will follow the accepted procedure. Present at all data collections will be the principal investigator, Marissa McGuirk, who is Red Cross CPR and First Aid certified and capable of following the necessary protocols for proper care in the instance of illness or injury. With all physical activity there is a risk of physical injury, however a medical questionnaire and the PAR-Q will be required of every participant, and in addition each Vinyasa yoga posture and flow and all muscular stretches will be explained and demonstrated to ensure proper form to minimize this risk.
As a participant, I understand that medical care is available in the event of injury resulting from research but that neither financial compensation nor free medical treatment is provided. I also understand that I am not waiving any rights that I may have against Georgia Southern University for injury resulting from negligence of Georgia Southern University or investigators.

Georgia Southern University Health Services
404 Forest Drive
Statesboro, GA 30458
(912) 478-5641

5. Benefits:
   a. The benefits to participants include an increase in knowledge and experience with Vinyasa yoga practice.
   b. This study also hopes to further the literature on the dose-response relationship between duration and the psychological benefits of Vinyasa yoga practice.

6. Duration/Time: As a participant, you will be required to attend three data collection sessions (approximately 30-75 minutes) on three separate days over the course of five days.

7. Statement of Confidentiality: All information/data including medical history collected on participants for presentation purposes will be kept confidential and stored in a locked file drawer in the Human Performance Laboratory. This information will available only to the principal investigators. Your identity will not be revealed in publications or presentations that result from this study so as to protect your privacy and confidentiality. All data will be reported as means and standard errors. Three years following the completion of this study, all participant information documents will be shredded.

8. Right to Ask Questions: Participants have the right to ask questions and have those questions answered. If you have questions about this study, please contact the principal investigators, whose contact information is located at the beginning and end of the informed consent. For questions concerning your rights as a research participant, contact Georgia Southern University Office of Research Services and Sponsored Programs at 912-478-0843.

9. Compensation: By participating in this study, you are automatically entered in a $50 Wal-Mart gift card drawing. After all data collection sessions are complete, a drawing will be held and three Wal-Mart gift cards, each in the amount of $50, will be given out.

10. Voluntary Participation: Participation is entirely voluntary and you may end participation at any time by telling the person in charge, Marissa McGuirk, without fear of academic penalty. Also, you do not have to answer any questions you do not want to answer.

11. Penalty: There is no penalty for deciding not to participate in the study, and at any time during the study you no longer wish to participate, you may withdraw without penalty or
retribution. However, if you choose to withdraw from this study before the completion of all data collections, you will not longer be eligible for a Wal-Mart gift card.

12. You must be 18 years of age or older to consent to participate in this research study. If you consent to participate in this research study and to the terms above, please sign your name and indicate the date below.

You will be given a copy of this consent form to keep for your records. This project has been reviewed and approved by the GSU Institutional Review Board under tracking number H12101.

Title of Project: Mood, Anxiety, RPE, and %MHR after a Single 15, 30 and 60 Minute Session of Vinyasa Yoga

Principal Investigator:
Marissa G. McGuirk, B.S., Graduate Student, mm05357@georgiasouthern.edu

Dr. Barry Joyner, Ph.D., Department Chair, 478-0200, joyner@georgiasouthern.edu
Dr. Jim McMillan, Ed.D., Associate Professor, 478-1926, jmcmillan@georgiasouthern.edu
Dr. Brandon Harris, Ph.D., Associate Professor, 478-7900, bharris@georgiasouthern.edu

______________________________________  ______________________
Participant Signature                      Date

I, the undersigned, verify that the above informed consent procedure has been followed.

______________________________________  ______________________
Investigator Signature                    Date
AHA/ACSM Health/Fitness Facility Pre-participation Screening Questionnaire  
(Medical History Form)

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<th>Name</th>
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Eagle ID | DOB | Sex (M/F) |
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Asses your health needs by marking all **true** statements:

<table>
<thead>
<tr>
<th>History</th>
<th>Other Health Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>You have had:</td>
<td></td>
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<tr>
<td>a heart attack</td>
<td>you have musculoskeletal problems</td>
</tr>
<tr>
<td>heart surgery</td>
<td>you have concerns about the safety of exercise</td>
</tr>
<tr>
<td>cardiac catheterization</td>
<td>you are pregnant</td>
</tr>
<tr>
<td>coronary angioplasty (PTCA)</td>
<td>you are taking any medications (if yes, please list)</td>
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<tr>
<td>heart valve disease</td>
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<td>heart failure</td>
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<td>heart transplantation</td>
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<td>congenital heart disease</td>
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<td>pacemaker/implantable cardiac defibrillator/rhythm disturbance</td>
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Symptoms

- you experience chest discomfort with exertion
- you experience unreasonable breathlessness
- you experience dizziness, fainting, blackouts
- you take heart medications

If you marked any of the statements in this section, consult your healthcare provider before engaging in exercise. You may need to use a facility with a medically qualified staff.

Cardiovascular Risk Factors:

- you are a man older than 45 years
- you are a woman older than 55 years or you have had a hysterectomy or you are post menopausal
- you smoke
- your blood pressure is > 140/90
- you don’t know your blood pressure
- you take blood pressure medication
- your blood cholesterol level is > 240 mg/dl
- you don’t know your cholesterol level
- you have a close blood relative who had a heart attack before age 55 (father or brother) or age 65 (mother or sister)
- you are physically inactive (ie, you get < 30 minutes of physical activity on at least 3 days per week)
- you are > 20 pounds overweight

If you marked 2 or more of the statements in this section, consult your healthcare provider before engaging in exercise. You might benefit by using a facility with a professionally qualifies exercise staff to guide your exercise program.

- none of the above is true

You should be able to exercise safely without consulting your healthcare provider in almost any facility that meets your exercise program needs.

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: circle YES or NO.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
2. Do you feel pain in your chest when you do physical activity?
3. In the past month, have you had chest pain when you were not doing physical activity?
4. Do you lose your balance because of dizziness or do you ever lose consciousness?
5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
7. Do you know of any other reason why you should not do physical activity?

If you answered YES to one or more questions:

- Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.
- You may be able to do any activity you want --- as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those that are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- Start becoming much more physically active --- begin slowly and build up gradually. This is the safest and easiest way to go.
- Take part in a fitness appraisal --- this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- If you are not feeling well because of a temporary illness such as a cold or fever --- wait until you feel better.
- If you are or may be pregnant --- talk to your doctor before you start becoming more active.

Please note: If in doubt after completing this questionnaire, consult your doctor prior to physical activity. If your health changes so that you then answer YES to any of the former questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.
APPENDIX F
The Profile of Mood States - Short Form

Below is a list of words that describes feelings people have.

Please read each one carefully.

Circle ONE answer to the right that best describes how you are feeling RIGHT NOW.

The numbers refer to these phrases:
0 = Not at all   1 = A little   2 = Moderately   3 = Quite a bit   4 = Extremely

1) Tense
2) Angry
3) Worn out
4) Unhappy
5) Lively
6) Confused
7) Peeved
8) Sad
9) Active
10) On edge
11) Grouchy
12) Blue
13) Energetic
14) Hopeless
15) Uneasy
16) Restless
17) Unable to concentrate
18) Fatigued
19) Annoyed

20) Discouraged
21) Resentful
22) Nervous
23) Miserable
24) Cheerful
25) Bitter
26) Exhausted
27) Anxious
28) Helpless
29) Weary
30) Bewildered
31) Furious
32) Full of pep
33) Worthless
34) Forgetful
35) Vigorous
36) Uncertain about things
37) Bushed

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APPENDIX G

The State-Trait Anxiety Inventory-Form Y1

For use by Marissa McGuirk only. Received from Mind Garden, Inc. on November 2, 2011

SELF-EVALUATION QUESTIONNAIRE STA1 Form Y-1
Please provide the following information:

<table>
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<th>Name</th>
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<tbody>
<tr>
<td>Age</td>
<td>Gender (Circle)</td>
<td>M</td>
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</tbody>
</table>

DIRECTIONS:
A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1. I feel calm ................................................................. 1 2 3 4
2. I feel secure ............................................................... 1 2 3 4
3. I am tense ................................................................. 1 2 3 4
4. I feel strained ........................................................... 1 2 3 4
5. I feel at ease ............................................................. 1 2 3 4
6. I feel upset ............................................................... 1 2 3 4
7. I am presently worrying over possible misfortunes ........ 1 2 3 4
8. I feel satisfied ........................................................... 1 2 3 4
9. I feel frightened ......................................................... 1 2 3 4
10. I feel comfortable ..................................................... 1 2 3 4
11. I feel self-confident ................................................. 1 2 3 4
12. I feel nervous .......................................................... 1 2 3 4
13. I am jittery ............................................................... 1 2 3 4
14. I feel indecisive ......................................................... 1 2 3 4
15. I am relaxed ............................................................. 1 2 3 4
16. I feel content ........................................................... 1 2 3 4
17. I am worried ............................................................ 1 2 3 4
18. I feel confused ......................................................... 1 2 3 4
19. I feel steady ............................................................ 1 2 3 4
20. I feel pleasant .......................................................... 1 2 3 4

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APPENDIX H

Borg CR10

Rate of Perceived Exertion

Look at the rating scale below and circle the number that best describes your level of exertion. The scale ranges from 0 to 10, where 0 means "no exertion at all" and 10 means "maximal exertion."

0 no exertion at all
0.5 extremely light
1 very light
2 light
3 moderate
4 somewhat strong
5 strong
6
7 very strong
8
9 really, really strong
10 maximal exertion