Feasibility of a Mobile Meditation Application to Improve Psychological Factors Affecting Performance in Baseball Players

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ABSTRACT

Pitchers are a vital part of the game of baseball and may account for up to two-thirds of the variance in win percentage. As they rise through the ranks of competition, physical skill set becomes less of a factor when compared to mentality. Pitchers are the "first line of defense" for keeping opponents from having an opportunity to score, as well as for holding onto their own team's lead. Baseball pitchers not only face pressure to perform, but also experience stress from factors such as low pay, adjusting to higher levels of competition, and internal team competition for a limited number of spots. Athletes are often resistant to seeking aid from sport psychologists and often turn to unfavorable means to cope (i.e. drugs/alcohol, excessive exercise) with stress instead. Meditation has been shown to have beneficial effects on psychological factors associated with performance including emotional regulation, anxiety, confidence, focus, and mindfulness. Mobile applications have become a popular means of delivering mindfulness. The purpose of this study was to determine the feasibility and preliminary effectiveness of delivering a mindful meditation intervention using a mobile meditation application to improve psychological factors associated with performance (i.e. emotional regulation, anxiety (somatic and cognitive), confidence, focus, mindfulness) to minor league baseball pitchers. Pitchers in instructional league (Phase one) and off season (Phase two) were asked to meditate daily for 10-minutes each day for three weeks (Phase one) and eight weeks (Phase two). Pitchers were asked to complete self-report questionnaires and satisfaction surveys at pre- and post-intervention. Pitchers in phase one reported enjoying meditation, had improvements in self-confidence and sport

confidence, and reported moderate decreases in cognitive anxiety and concentration disruption. Pitchers in phase two also enjoyed meditating (94.7%) and had improvements in self-confidence and moderate decreases in somatic anxiety. Low adherence due to timing (off-season) of intervention may have been a contributing factor to fewer outcomes. Future research should explore the feasibility and effectiveness of implementing meditation during the baseball season.

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INTRODUCTION

Baseball pitchers are an important part of the game of baseball as their performance contributes more to winning than any other aspect of the game.[1] Some research suggests that pitching variables such as opponent runs scored, earned run average, earned runs allowed, home runs allowed, innings pitched, and shut outs may account for up to two-thirds of the variance in win percentage (i.e., the fraction of games won versus total games played).[1] Hits and walks allowed, saves, complete games, and strikeouts account for the largest influence on win percentage. Mastery of these variables leads to wins by allowing opposing teams fewer opportunities to score (fewer hits and walks allowed) and having the ability to maintain leads once obtained (strikeouts, complete games, and saves),[1] making the role of the pitcher vital to the teams' success.

Research has shown that psychological factors (i.e. emotional regulation, anxiety (somatic and cognitive), self-confidence, attentional focus) more strongly predict performance in baseball pitchers than physical skills.[2] Psychological skills alone may account for 34-38% of the variance of a pitcher's performance.[2] As pitchers move from one level of competition to the next (i.e. rookie league to minor league to major league), differences in physical skills become subtler, and even small variances in performance can result in substantial outcomes, which ultimately may have an influence on a pitcher's long-term career.[2]

Psychological factors may influence performance just as physical skills do, particularly in high-stress or peak performance moments.[2-5] Athletes report high stress or anxiety based on the size of the crowd, the time/point of performance (e.g. prior to versus during competition), level of competition (e.g. team's competitive level and the setting of

performance), and self-confidence in skill set.[3,6] In one study, almost 40% of competition-related stress reported by athletes was due to anxiety, lack of self-confidence, and level of competition.[7] Sports psychologists utilize a variety of approaches (i.e. counseling, visualization, progressive muscle relaxation, self-instruction/self-talk) to improve psychological factors and subsequent performance of the athlete; however, despite athletes conveying that they believe they would benefit from sports psychology techniques, athletes underutilize them.[4,8-10] The most common barriers reported are the cost of sessions, the total time of the sessions, the amount of time the sessions take away from other training, and the social stigma associated with receiving counseling.[9,10] Even if an athlete seeks the services of a sports psychologist, 50% will drop out of treatment within four sessions.[11] In addition to their resistance to seek services from a sports psychologist, athletes don't want to divulge their concerns and anxieties to teammates because of the potential that they may be seen as weak or that the information will be used against them.[12] Athletes also report spouses and friends lack the understanding of the situation in order to empathize, and often inadvertently add pressures by projecting expectations onto the athlete, such as assuming a newly drafted pitcher in the minor-league system will eventually play in the major leagues.[12] Instead of seeking support, athletes may try to self-manage the issue. In order to have a sense of control over their emotions and anxiety, athletes may use drugs or excessive exercise to improve performance.[11] There is a need to explore other strategies to manage psychological factors that may potentially aid in performance.[5]

Although meditation to manage psychological factors (i.e. emotional regulation, anxiety (somatic and cognitive), self-confidence, attentional focus) in athletes is still a

somewhat unchartered field, meditation has been linked to improvements in emotional regulation, anxiety, self-confidence and attentional focus in other populations.[13-17] The basic idea behind mindful meditation is that learning to approach the present with a non-judgmental acceptance will mitigate stressors caused by focusing on past and future moments.[13] Mindful meditation also incorporates learning to respond reflectively rather than reflexively, and as a result providing a better emotional regulation strategy than avoidance.[13] The ability to be nonreactive, without judgement, and act with awareness are especially important for athletes' performance. Many of the stressors that affect athletes' emotional regulation, anxiety (somatic and cognitive), self-confidence, and attentional focus are situations that cannot be changed (e.g., size of the crowd, level of competition (i.e., skill set of competition or regular game versus playoff game), setting (home field versus opponents' field)).[6,7] Meditation may help athletes learn to regulate their emotions in response to stressors and subsequently learn to control how their minds and bodies react to stressful situations instead of responding automatically.[13,14]

In a meta-analytic review on anxiety and mood disorders in clinical populations, Hofmann et al. reported significant improvements in anxiety disorders that was maintained at follow-up as a result of participation in mindfulness-based therapies.[13] Due to the variety among the populations assessed, the authors suggest that mindfulness may have generalizable benefits by altering emotional approaches to situations, and reteaching individuals how to accept and better respond to inevitable situations.[13] In another study, low self-esteem or self-confidence was associated with a higher degree of social anxiety, and with the addition of the stressor of attending a social event, anxiety was exacerbated.[15] Mindfulness was shown to positively influence self-esteem, and by doing

so, better control over response to the stressor and ultimately better control over social anxiety was experienced.[15,16] Control over anxiety may be vital to athletes, as multiple studies have explored the relationship between performance and anxiety.[3,16] Self-confidence is often associated with, or at times an influencer of, anxiety in athletes, and therefore regulation also becomes vital to performance.[18,19]

In a study to examine aspects of attention, researchers found that meditation had a positive effect on participants' ability to focus on the task at hand.[17] Meditation seemed to subdue automatic responses that typically cause a shift in attention to outside stimuli/distractions, which allowed the participant to remain focused.[17] Researchers also found that participants in the meditation group had faster responses to the tasks, which they concluded may be a result of an increased ability to focus or enhanced visual-motor abilities,[17] both of which would benefit athletes. Additionally, significant results were found in relation to minutes of meditation per day, but not related to total amount of time (years) spent meditating overall.[17] Meditation may be helpful for athletes as many have limited to no experience meditating, but by adopting a consistent practice, they may still experience the benefits of a prolonged practice.

Recently, research has suggested smart phones and smart phone applications as a method of implementing mindfulness meditation to manage psychological factors (i.e. emotional regulation, anxiety (somatic and cognitive), self-confidence, attentional focus) that impact performance.[9,10] Mobile applications have already been used in psychotherapy studies with evidence of success[20] and may have potential to help mitigate some of the barriers (i.e. cost of sessions, total time of the sessions, amount of time the sessions take away from other training, and social stigma associated with receiving

counseling) athletes report. CALM is a meditation-based mobile application that offers a variety of 10-minute meditation sessions. It is an ideal meditation mobile application for all experience levels. Users of the application can choose to practice one of the multiple extended programs focusing on a common theme (e.g. focus, calming anxiety, managing stress) including a seven-day introduction to the basics of meditation, or they can utilize the "Daily Calm," a guided meditation focusing daily on different topics (e.g. resilience, receiving criticism, judgments). Users may also select a guided or unguided individual meditation, an ideal option for a more advanced practitioner. CALM may be a feasible strategy to deliver mindfulness meditation to athletes, and thus improve performance. To date, there is no known research on the feasibility of CALM, and this study will add to the literature.

Operational Definitions

a. Emotional Regulation: strategies for management of experiential, behavioral, and physiological responses to an emotion[21]
b. Anxiety: a negative emotional state characterized by somatic and/or cognitive responses[22]
    i. Somatic: physical manifestation of anxiety (e.g. increased heart rate)[22]
    ii. Cognitive: mental manifestation of anxiety, often associated with low levels of self-confidence (e.g. I'm going to fail the team)[22]
c. Self-confidence: the belief one has in his or her ability to control the present environment and/or oneself (i.e. skill set)[22]

d. Attentional Focus: the internalization or externalization of focus in response to a situation[23]
    a. Internal: a focus on the actual physical movement and body function[23]
    b. External: a focus on the effect of the movement or on stimuli outside of the body, such as in the environment[23]
e. Mindful meditation: a form of mental training, generally centered around the breath, teaches the individual to be present, aware with non-judgmental acceptance[24]

REVIEW OF LITERATURE

The purpose of this literature review is to examine the literature related to implementing mindful meditation interventions in athletes and the subsequent effects on psychological factors (i.e., emotional regulation, anxiety (somatic and cognitive), self-confidence, attentional focus)) known to impact performance. The studies reviewed are organized by 1) traditional approaches to improve psychological factors in athletes, 2) mindfulness interventions to improve psychological factors in athletes, and 3) mobile applications studied in athletics.

Traditional interventions

Traditionally, psychological factors (i.e., emotional regulation, anxiety (somatic and cognitive), self-confidence, and attentional focus) that effect an athlete's performance have been managed by sports psychologists through a variety of methods (i.e. counseling, visualization, progressive muscle relaxation, self-instruction/self-talk).[25] These methods have experienced varying degrees of success.

Maynard and Cotton (1993)[26] conducted a 12-week stress management intervention (pre-post) to investigate the relationship between treatment type and specific psychological factors and performance in male undergraduate field hockey players (N=20; M=20.6 years, SD=1.32). Participants were stratified into one of three groups (somatic treatment, cognitive treatment, or control) based on scores determined by the Competitive State Anxiety Inventory-2 (CSAI-2) distributed at four timepoints (two days prior, three hours prior, one-hour prior, ten minutes prior) before a competition. Six participants showed an affinity toward somatic anxiety, eight toward cognitive anxiety, and six showed neither and therefore comprised the control group. Participants in the

somatic treatment took part in applied relaxation. This technique consists of six stages starting with progressive muscle relaxation and ending with rapid relaxation in sport specific situations. Techniques of each stage were demonstrated in a group session. Participants were then instructed to practice twice daily on their own and record their reactions to the practice in a log. The log was also used to measure adherence. Stages lasted for two weeks and interviews were conducted at the conclusion of each.

Participants in the cognitive treatment took part in positive thought control. This technique consists of three approaches to thought pattern: 1) using negative thoughts in a positive way, 2) controlling negative thoughts, and 3) training positive thoughts. Participants kept a log recording negative thoughts that they then discussed with the researchers at different time points. They learned to block additional negative thoughts and form positive affirmations to counter negative thoughts. Additionally, they learned to form counterstatements to any new additional thoughts they may develop.

The control group met with experimenters in group and one-on-one sessions every two weeks as well and engaged in activities not believed to be related to anxiety, such as goal-setting and field-hockey specific skill and exercise training.

The CSAI-2 was administered again at the 6-week timepoint and 12-week time point. Performance was assessed by two coaches and the team captain at the same three timepoints. In the group practicing the applied relaxation technique, there was a significant decrease in somatic anxiety ($p<0.05$) equating to a 32.7% reduction in anxiety. Although a significant difference was not reported, there was a 13.89% reduction in cognitive anxiety as well as a 22.09% increase in self-confidence. In the group practicing the positive thought control technique, there was a significant decrease in cognitive

anxiety ($p<0.05$) equating to a 32.89% reduction. Although a significant difference was not reported, there was a 16.74% reduction in somatic anxiety as well as a 22.64% increase in self-confidence. Interrater reliability for performance measures was only found to be moderate ($r=0.67$) and no significant relationships were found between performance and any factors.

Limitations to this study included athletes' reporting that they felt their dedication to the mental-skill training was "not as great as it should have been". This "lack of dedication" could have influenced the lack of statistically significant improvements in anxiety. It would be interesting to understand why athletes were not "dedicated," as this could contribute to better adherence to the intervention. Development of a less burdensome intervention perhaps may improve program adherence and thus improve anxiety outcomes.

In another study, Holm et al. (1996)[27] implemented a seven-week cognitive behavioral intervention in collegiate athletes to improve performance. Participants (n=62) were from the football team and men and women's swim teams and were divided into a treatment (13 football players, 18 swimmers) or control group (13 football players, 18 swimmers) that was matched for gender, sport, and collegiate athletic experience.

Both groups completed the Psychological Skills Inventory for Sport (PSIS) to assess skills related to athletic performance such as anxiety, concentration, confidence, mental preparation, motivation, and team emphasis at baseline and again after the treatment group completed the intervention. Additionally, the Cognitive-Somatic Anxiety Questionnaire (CSAQ) was used to assess trait (e.g. personality) levels of cognitive and somatic anxiety at both timepoints as well. Academic performance was assessed by GPA

from the semester prior to and the semester after the intervention. Athletic performance was assessed for the swimmers by averaging event time from the two meets immediately prior to and after the intervention; football performance was assessed by averaging maximum lifts of the bench press, squat, and power clean from a session immediately prior to and following the intervention.

Participants of the treatment group attended two-hour stress management sessions for seven consecutive weeks. The sessions were led by two clinical psychology graduate students with prior experience teaching group-based stress management. At the first session, progressive relaxation tapes and a manual were distributed to the participants. The manual introduced subjects to various cognitive-behavioral techniques (i.e., progressive relaxation, recognizing and changing cognitive errors, problem solving, coping imagery, time management) and provided examples and worksheets to aid participants in learning to implement the techniques into academic and athletic settings.

Sessions began with discussion of a cognitive-behavioral technique (e.g., imagery) and then structured exercises to demonstrate and reinforce the lesson. Informal discussion followed and focused on ways for participants to integrate the skill into academic and athletic settings. Sessions finished with time allotted for review, reinforcement for practice, and strategies for coping with issues interfering with stress management. Participants were expected to complete homework assignments, but details regarding how many or what additional home practices were assigned were not disclosed. However, authors reported 87.1% of participants completed all homework assignments.

Analysis of psychological skills revealed a significant interaction between group and pre-post-test scores ($p<0.001$). Pre-to-post-test analysis of the subscales revealed a

significant improvement in ability to manage anxiety for the treatment group ($p<0.05$). The control group experienced significant decreases in concentration ($p<0.001$) and confidence ($p<0.01$) as well as motivation ($p<0.001$). However, the treatment group experienced a significant increase in motivation ($p<0.01$). There was also a significant interaction between group and pre-post-test scores on the anxiety measure ($p<0.05$). The treatment group experienced a significant decrease from pre-to-post-test in cognitive anxiety ($p<0.01$). Analysis of mean scores for the control group showed almost no change in cognitive anxiety levels (pre-M = 20.9, post-M=20.5). Although significance was not reached, the treatment group showed a trend toward decreased somatic anxiety ($p<0.1$).

Although this study showed that lack of a training to manage psychological skills can have a negative effect, it also didn't result in any significant improvements within the treatment group outside of anxiety. There is a need for further research into programs to positively affect psychological factors known to affect performance such as concentration and confidence.

In a more recent study, Wagstaff (2014)[28] conducted a single-blind, within-subject, repeated-measures, counterbalanced study to explore the effects of emotional regulation on performance, particularly the effect of emotion suppression on performance. Participants (n=20) were from an undergraduate student population (50% female) with a mean age of 21.13 years (SD=1.61) who all competed in individual endurance sports (i.e., running (n=8), swimming (n=6), rowing (n=6)).

The intervention required four visits from participants to a sport and exercise physiology laboratory. The four visits consisted of four different experimental conditions:

1) familiarization, 2) control, 3) suppression, 4) non-suppression. Participants were given a strict regimen to follow prior to each session and testing was completed in the morning, at the same time each session, and lasted for about one hour.

The first session for each participant was the familiarization condition, which began with demographics and baseline assessments, including blood pressure and blood glucose. Assessments consisted of a subjective fatigue scale, modified Stroop test (used to assess cognitive functioning), and the Brief Mood Inspection Scale (BMIS) (used to assess mood and arousal). Participants were then asked to complete a 10-km timed cycle test while wearing a mask to measure VO2. Heart rate and RPE were measured at 1, 3, 5, 7 and 9 km. Upon completion of the test, another blood glucose sample was collected and participants completed the Stroop test and BMIS again.

After the familiarization condition, participants were randomized to one of four groups (ABC; BCA; CBA; CAB) to determine the order they would receive the remaining conditions. The control condition was identical to the familiarization condition. The suppression condition began with the subjective fatigue questionnaire and BMIS followed by the Stroop test. The participant was then required to view a 3-minute video that had been proven to elicit disgust. The participant was seated at a small desk in front of a 16-inch screen PC computer for the viewing. They were instructed that the video they were about to view had been proven to elicit an emotion, but they should attempt to not show any emotion on their face in reaction to what they view. They were also instructed that they could signal to have the video ended at any time if need be. After the viewing, the participant again completed the subjective fatigue questionnaire, BMIS, Stroop test, and a post-experimental questionnaire (used to assess whether the video did

elicit disgust and how well the participant felt they controlled their emotions). They then completed the 10-km timed cycle test. Heart rate, VO2, and RPE were again measured at 1, 3, 5, 7, and 9 km. Upon completion of this test, participants again answered the BMIS, fatigue questionnaire, and post-experimental questionnaire. The non-suppression condition followed the exact same protocol as the suppression condition except participants received no instruction on suppressing or regulating their reactions.

Analysis of the data revealed no significant difference in performance on the Stroop test (cognitive functioning) between before the timed cycle test and after for the non-suppression group in time to complete ($p=.76$) or number of mistakes ($p=.82$) or the control condition time to complete ($p=.11$) and number of mistakes ($p=.11$). However, in the suppression video there was a significant difference between the test completed prior to the video and after in time to complete ($p=.03$) and number of mistakes ($p<.01$). Bonferroni post hoc analysis revealed significantly slower cycle times for the suppression group compared to the control group ($p<.01$) and compared to the non-suppression group ($p=.02$), but there was no significant difference between the control group and non-suppression group ($p=.12$).

Negative significant differences were observed for every measure analyzed in the suppression condition but not the control or non-suppression condition. Emotional regulation through suppression is an ineffective management technique that may be detrimental to sport performance. There is a need for research to explore better means of strategies to improve emotional regulation in athletes.

These studies highlight some of the effectiveness experienced from common traditional approaches to improving psychological factors in athletes. It has been

hypothesized that imagery, goal-setting, self-talk, and physical relaxation skills are the four most common techniques implemented.[29]

Mindfulness interventions

Traditional interventions have shown some success at improving psychological factors that may improve performance. However, not all these strategies produce effective outcomes for the athlete. For example, emotional suppression has been shown to have negative effects on performance.[23,28,30-32] Psychological factors also tend to build upon each other; anxiety and confidence have been linked,[33] and athletes need to regulate their anxiety and may focus internally to do so. Finding an appropriate method to help athletes manage multiple aspects of psychological factors together is necessary, and mindfulness may be a suitable approach.

Vidic et al., (2017)[34] conducted a mixed methodology study to investigate the impact of a mindfulness-based intervention on emotional regulation in a Division 1 collegiate women's basketball team (age range 18-22 years; M=19.85, SD=1.39). The 16-week intervention consisted of ten mindfulness-based sessions, each one hour in length. The sessions were implemented by a practitioner who had over 30 years of experience with mindfulness training and training with college students. The first 10-20 minutes of each session were allocated to education about mindfulness principles (e.g., how it works, benefits, applications) and as a time for discussion about the previous session. Next, 15-20 minutes of guided meditation was administered. Meditations focused on awareness, presence, and relaxed ease. The final 10-20 minutes were spent answering questions or providing clarification and encouragement.

Assessments were collected at baseline, midpoint (session 5), and post-intervention (session 10) and included stress (Perceived Stress Scale (PSS), emotional regulation (Athletic Coping Skills Inventory (ACSI)), and a journal entry (last session). All test points (pre-, mid-, post-) showed decreases in perceived stress scores, but only pre-to-post-test had significant decreases ($p=0.016$). Overall, as a result of the intervention, athletic coping skills showed significant increases from pre-to-post-test ($p<0.00$) and mid-to-post-test ($p<0.01$) but not from pre-to-mid-test. Five of the seven subscales related to athletic coping skills showed significant increases from pre-to-mid-to-post-test: Coping with Adversity ($p<0.00$), Concentration ($p<0.00$), Confidence/Achievement Motivation ($p<0.04$), Goal Setting ($p<0.03$), and Peaking Under Pressure ($p<0.01$). The Coachability and Freedom from Worry subscales each showed respective improvements, however, they were not statistically significant. Qualitatively, athletes responded with (1) an overall positive effect from the mindfulness intervention; (2) a perceived benefit in various aspects (i.e., athletics, academics, and personal) of their lives from mindfulness training due to outcomes such as increased awareness, sense of control, and improved focus; and (3) the main challenge reported was consistently implementing the practice.

Limitations of this study reported by the authors included inconsistently spaced sessions due to team's schedule, lack of a control group, and no direct measure of mindfulness. Inconsistent spacing of mindfulness sessions could potentially lead to misrepresentative outcomes due to participants receiving varying doses of mindfulness. Sessions implemented in a consistent manner may better reinforce mindfulness practices. More interventions for mindfulness are warranted that take into account flexibility in the

schedule of the meditation sessions. Additionally, without a direct measure of mindfulness and no comparable control group, no direct conclusions can be drawn between any significant findings and mindfulness. Evidence suggests that mindfulness interventions may provide beneficial outcomes for athletes in regard to performance related psychological factors. However, there is a need for more substantial research as support. Future interventions should include a direct mindfulness measure to allow for decisive conclusions between significant findings and mindfulness.

In another mindfulness-based study in athletes, Scott-Hamilton et al. (2016)[35] conducted a pre-post between-group study to explore the effects of mindfulness on sports anxiety in competitive cyclists. Participants (n=47) were competitive Australian cyclists who were naïve to meditation. They were stratified by gender and discipline (road versus mountain cycling) and then randomized to one of two groups; a treatment group (mindfulness intervention; n=27) and a waitlist control group (n=20). Treatment participants were aged 16 to 57 years (M=38.96, SD=12.4) with four females (14.8%) and 92.6% of the group competing once a week (7.4% competed more often). Control participants were aged 22 to 67 years (M=40.65, SD=10.88) with one female (5%) and 100% of the group competing once a week.

All participants received an email one week prior to the intervention with study instructions. The intervention group was asked to participate in 8-weeks of mindfulness training including weekly workshops, home meditation, and group mindful spinning sessions. Program protocol was based on the mindfulness-integrated cognitive behavior therapy program (MiCBT). Workshops focused on information regarding core concepts of mindful-meditation, as well as discussion about the home practice (e.g., difficulties

that arose, strategies for adherence) and incorporation of mindfulness lessons into the group spin session. Participants were given MiCBT CDs offering guided meditations (e.g., breath practice, body scan) to utilize for their home practice. They were instructed to practice 30 minutes per day and record adherence, as well as complete weekly body interoception forms. The group mindful spin sessions were held once weekly on indoor stationary spin bikes and allowed participants an opportunity to integrate the lessons learned into a cycling setting. The workshops and spin sessions were led by the first author who undertook training in MiCBT foundation skills.

The control group completed online baseline questionnaires and then were not contacted again until 8-weeks later for the post-intervention questionnaire. At the completion of the study they were offered the mindfulness intervention components. Both groups were assessed for anxiety and mindfulness at pre-and post-intervention. Sport anxiety was assessed using the Sport Anxiety Scale-2 (SAS-2). Overall mindfulness was assessed using the Five Facet Mindfulness Questionnaire (FFMQ).

On average, 6.33 (SD=1.86) sessions were attended, and 547 (SD=416) minutes were spent meditating. The interoception forms provided an estimated visual evaluation of awareness in body sensations, with an awareness of approximately 22% at week one, 46% at week four, and 70% by the final week. There was no significant observation in anxiety levels between the two groups ($p=0.284$) but there was a significant decrease in anxiety for the treatment group from pre-to-post-test ($p=0.004$). Compared to the control group, the treatment group experienced greater increases in mindfulness ($p=0.049$). A greater increase in mindfulness was correlated with a greater decrease in anxiety concentration.

The authors reported that any benefits obtained from the treatment group could potentially be a result of weekly contact (i.e. workshops, group spin sessions) as opposed to the mindfulness training itself. Having weekly contact may also have attributed to the low (10%) attrition rate of the treatment group compared to the control group (33%). However, having a personal contact also represents a needed resource (i.e., trained facilitator of sessions). There is a need to implement mindfulness-based studies with minimal-to-no contact in order to eliminate the potential bias but also to limit resources needed for meditation programs for athletes.

Mardon et al., (2016)[30] conducted a quasi-experimental study to determine the effects of an 8-week mindfulness intervention on attention and performance in a population of national-level swimmers. Participants (n=6) were mostly female (66.7%). All participants received a one-page description about meditation along with the CD "Guided Meditation Practices" by Jon Kabat-Zinn. Participants were asked to meditate at home using a CD provided to them with meditations lasting 10-30 minutes. Meditations included "Breath"; "Breath and Body"; "Standing Yoga"; and "Body Scan." Participants were instructed to fill out a weekly log, received a phone call prompt at week one, and then weekly email prompts subsequently.

At baseline, participants completed a pencil-and-paper version of the Cognitive and Affective Mindfulness Scale-Revised (CAMS-R) to measures mindfulness, as well as completing attention and mental effort assessments with a researcher present to ensure protocol. A subtest ("elevator counting with reversal") of the Test of Everyday Attention (TEA) measured the auditory-verbal working memory component of attention and was completed in a quiet room with the use of headphones, and self-reported mental effort

was measured immediately afterward through the Rating Scale for Mental Effort (RSME). After a 15-minute break, these two measures were repeated. Attention and mental effort assessments were performed throughout the study at weeks 3, 5, and 7, as well as an administration of the mindfulness measure at week 5. One-week post-intervention, participants again completed the mindfulness, attention, and mental effort assessments, and participated in interviews. Performance was assessed throughout the study via competitions at weeks 4, 5, and 8. Race times and athlete and coach rated key performance indicators (i.e., agreed upon individual specific indicators related to technical and tactical components of performance) collected after each competition.

Due to the small sample size, outcomes were analyzed on a case-by-case basis. Four of the participants showed improved mindfulness scores from pre-to-post intervention, although one participant only showed minor improvement. Four participants showed improved attention efficiency (a combined measure of attention and effort), although one participant's improvement was only minor. Four of the participants experienced improved performance times (ranging from 0.4%-1.5%), and five participants reported improved self-rated performance. From the interviews, five participants reported increased relaxation, four reported improved focus or concentration, and three reported a shift in attention away from performance times and toward technique. Increased confidence and a greater ability to deal with negative situations were also reported.

The small sample size of this study was a major limitation as the data from the participants were presented on a case-by-case basis. Although a majority of the participants showcased improved mindfulness and performance as well as self-reported

relaxation, improved concentration, and shifts in attentional focus, the absence of between-subject comparison results in the inability to draw any group conclusions or generalizations. There is a need to implement mindfulness-based interventions in larger populations to provide substantial data to support more generalizable outcomes.

Though still a growing research base, mindful meditation interventions have shown promising results among athletes in psychological factors that may impact performance, such as decreased anxiety, increased concentration, and positive shifts in attentional focus. However, the available research is limited and what does exist is lacking in areas. Small sample sizes do not allow for generalizable conclusions; exclusion of appropriate measures fail to assess adaptations in mindfulness; workshops necessitate trained facilitators which requires additional resources as well as potential bias in adherence and/or subsequent outcomes; failure to properly regard athletic schedules in program planning may result in inconsistent administration of intervention dosage. There is a need for continued exploration of methods for managing psychological factors that may affect performance while also considering the most effective means of implementation in this specific population. The next section in this literature review will discuss evidence of mobile applications as a potential means for successful intervention implementation.

Mobile applications

Mobile applications may offer an ideal means for mitigating a number of limitations assessed in previously discussed interventions. Mobile applications have become popular with one report stating as much as 87% of daily time spent on mobile

devices in the United States is spent using mobile applications;[36] they allow for the accessibility and flexibility that athletic schedules often require; daily access to an application allows for consistent implementation of an intervention and may mitigate some degree of attrition; and use of an application allows for implementation in larger samples by mitigating the necessity of having a trained individual present to implement the lessons. To the best of the author's knowledge, no study utilizing a mindfulness mobile application in an athletic population has been conducted, therefore a study exploring usage and perception of a non-mindfulness-based application in a sport population is reviewed below

Jospe et al. (2015)[37] conducted a cross-sectional study to determine the usage and perception of diet applications among sports dieticians. Participants (n=180) were 30-39 years of age (34%) and had been in practice for 6-10 years (33.5%). The online survey consisted of 13-26 questions (dependent upon response) and took approximately 5-15 minutes for completion. Questions focused on dieticians' use of smartphone diet apps for assessing and tracking dietary intake of their athletes, dietary assessment and nutrition interventions in sports dietetics, and demographic information.

Diet apps were utilized by 32.4% of respondents with a significant correlation between country and usage (p=0.002, 56% of U.S. sports dieticians utilize apps). Respondents reported dietary apps as being effective means for assisting dietary evaluations, particularly in regards to traditional methods such as diet history (45% found the app more effective, 42% reported it as equivalent). Benefits and limitations of dietary applications were also assessed, with 41% of respondents reporting incomplete

nutritional databases as the biggest limitation and 50% reporting ease of access an app allots as the most beneficial aspect.

This study suggests that general population mobile applications may be appropriate as tools to assist professionals when working with athletes. Amongst professionals who choose to use them, mobile applications earn high ratings in perceived effectiveness. However, mobile applications have barely been explored in an athletic population, despite their potentially advantageous qualities. Beyond this study, the author found only one intervention in which a mobile application was utilized in the delivery of information to reduce ankle injury. Unfortunately, access to the article was unavailable. There is a need for research to examine the effectiveness and potential benefits of mobile applications when used by athletes.

STUDY PURPOSE & HYPOTHESIS

The purpose of this study was to explore the feasibility of a mobile meditation application to improve psychological factors known to influence performance in a population of major league baseball pitchers. The AIMS of this study were:

Aim 1: Examine the feasibility (i.e., acceptability and demand) of a three-week mobile meditation application (i.e., CALM) in professional baseball pitchers during instructional league (takes place during the months of September and October and is an opportunity for young pitchers and players to get more experience and refine their skills) at a time designated during their training. Acceptability was measured with a satisfaction survey. Demand was measured with the number of times spent meditating per week and the number of minutes in meditation per week.

Hypothesis 1: CALM will be acceptable (80% of baseball pitchers will be satisfied with CALM) and demanded (75% of baseball pitchers will participate in meditation 3x/week and/or more than 30 minutes per week).

Aim 2: Examine the feasibility (i.e., acceptability and demand) of an eight-week mobile meditation application (i.e., CALM) in professional baseball pitchers during the off-season (portion of the year when no official competition is taking place) in a setting that requires pitchers to meditate on their own accord. Acceptability was measured with a satisfaction survey. Demand was measured with the number of times spent meditating per week and the number of minutes in meditation per week.

Hypothesis 2: CALM will be acceptable (80% of baseball pitchers will be satisfied with CALM) and demanded (75% of baseball pitchers will participate in meditation 3 x/week and/or more than 30 minutes per week).

Aim 3: Explore the preliminary effectiveness of utilizing the CALM app to improve emotional regulation, anxiety (somatic and cognitive), self-confidence, and attentional focus in professional baseball pitchers.

Hypothesis 3: Utilization of the CALM app will facilitate significant improvement in emotional regulation, decrease of anxiety (somatic and cognitive), improvement of self-confidence, and improvement of attentional focus in baseball pitchers.

METHODS

This study was approved by the Institutional Review Board at Arizona State University. All participants completed an informed consent prior to participation in the study. This study consisted of two phases.

Phase one took place during the instructional league. Pitchers from a specific Major League Baseball organization were asked to utilize the CALM app in a setting where they have specific time set aside for meditation during their instructional league training.

Phase two took place during the off-season in the pitchers only. Pitchers were asked to utilize the CALM application on their own accord.

Data gathered from both phases was used to design a program for the Major League Baseball organization during the 2018 baseball season.

Study Participants

The target population of this study was baseball pitchers employed by a specific Major League Baseball organization. Participant eligibility included: 1) professional pitcher or position player (e.g. infield, outfield, catcher) currently employed by the Major League Baseball organization 2) 18 years or older 3) own a smart-phone or tablet and 4) willingness to download the CALM app. There were no exclusion criteria per the Major League Baseball organization.

Inclusion Criteria

-Pitcher or position player (e.g. infield, outfield, catcher) currently employed by the Major League Baseball organization

-Be 18 years or older

-Own a smartphone or tablet

-Willing to download the CALM app

Exclusion Criteria

- N/A

Recruitment

Phase 1: A total of 44 participants were recruited during the instructional league beginning September 18, 2017. Pitchers participating in the Major League Baseball organization's instructional league were invited to participate in a "test" for a meditation mobile app for future use with the Major League Baseball organization during their mandatory mental skills training workshop.

Phase 2: A total of 100 participants received recruitment emails during the off-season. Initial emails were sent out beginning October 29, 2017. Pitchers in the Major League Baseball organization received an email inviting them to participate in a "test" for a mobile meditation app for future use with the Major League Baseball organization. The email included information about meditation and why it is important, as well as details about the "test" and a link in which to get started.

Phase one

Instructional league pitchers participated in a three-week feasibility study. Pitchers were allocated to the treatment group (n=19). Position players (e.g. infield, outfield, catcher); n=24) were allocated to the control group. During instructional league, all pitchers and position players were exposed to a standard mental skills training program implemented by the mental health coordinator of the Major League Baseball organization. This program consisted of eight 30-minute classroom-based sessions

including education, videos and activities, and practical exercises related to sport specific situations. Pitchers who expressed interest in participating in the "test" were given a packet of assessments. The initial page of the packet was the informed consent; after consent, pitchers completed the demographics and baseline survey. Pitchers were asked to complete the "21 Days of CALM" (which consisted of daily 10-minute meditations to introduce and deepen a meditation practice), which was completed as a group.

After completion of the "21 Days of CALM," pitchers were asked to complete a satisfaction survey. Pitchers were administered two surveys, one at baseline (week 0) and one at the end of the intervention to assess the following psychological factors: (1) emotional regulation using the Emotion Regulation Questionnaire (ERQ) (2) anxiety (somatic and cognitive) using the Revised Competitive State Anxiety Inventory-2 (CSAI-2R), (3) self-confidence using the Trait Sport Confidence Inventory (TSCI), (4) attentional focus using the Sport Anxiety Scale, and (5) mindfulness using the Mindful Attention Awareness Scale (MAAS).

Position players were only exposed to the standard mental skills training program and were not provided the CALM app. They followed the same procedures as the pitchers in which they were guided to an informed consent to participate as the control group. After consent, position players completed the demographics and baseline survey. Position players were also asked to complete the psychological factor surveys identical to the pitchers at baseline and the end of the intervention.

Phase two

This study was a quasi-experimental pre-posttest design. Pitchers partook in an eight-week meditation intervention. Pitchers received an email inviting them to test a

mobile meditation app for future use with their employer, the Major League Baseball organization. A link was provided in the email that took them to an informed consent. After consenting to be in the study, pitchers were provided a link to a demographics and baseline survey, and instructions for downloading the app. Pitchers were asked to complete the "7 Days of CALM" (seven days of 10-minute meditations), an introduction and education for meditation. After completion of this seven-day program, pitchers were then asked to participate in using CALM (10 minutes of meditation daily) using the "Daily Calm" feature (a new 10-12 minutes meditation offered daily). If a pitcher did not participate in their weekly meditation (at least three per week or 30 minutes per week), they received a text message reminder via Google Voice.

Feasibility

Satisfaction (i.e., acceptability)[38]

Pitchers completed a satisfaction survey at post-intervention (week nine). Participation in the meditation (how many minutes, how many days) was provided by CALM. Additionally, pitchers were invited to participate in a post-intervention interview related to satisfaction of CALM.

Demand[38]

The type of meditation, times per week and minutes per week of meditation were reported by CALM weekly during the intervention. Data about which meditations were utilized and how much time was spent meditating was collected by CALM. If a pitcher did not participate in meditation at least 30 minutes per week, they were contacted via text message to remind them to participate in meditation. The number of times a pitcher had to be reminded was also tracked in an excel spreadsheet.

Psychological factors. Pitchers were administered two surveys, one at baseline (week 0) and one at post-intervention (week nine) to assess the following psychological factors: (1) emotional regulation using the Emotion Regulation Questionnaire (ERQ) (2) anxiety (somatic and cognitive) using the Revised Competitive State Anxiety Inventory-2 (CSAI-2R), (3) self-confidence using the Trait Sport Confidence Inventory (TSCI), (4) attentional focus using the Sport Anxiety Scale, and (5) mindfulness using the Mindful Attention Awareness Scale (MAAS).

Measures

Emotional Regulation[18]

Emotional Regulation was measured using the Emotion Regulation Questionnaire (ERQ). The ERQ is a 10-item questionnaire used to assess individuals' employment of several emotional regulation strategies. The questionnaire consists of 2 subscales: suppression and reappraisal. An example question from the suppression subscale is, "I control my emotions by not expressing them." The items are rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The ERQ was tested for reliability in a general undergraduate population. The ERQ had a good internal consistency with alpha coefficients of .73 and.79 for suppression and reappraisal respectively.[18] The ERQ had adequate test-retest scores of .69 for both suppression and reappraisal subscales.[18]

Anxiety[39]

Anxiety was measured using the Revised Competitive State Anxiety Inventory-2 (CSAI-2R). The CSAI-2R is a 17-item questionnaire used to assess athletes' anxiety prior to competition. The questionnaire consists of three subscales: somatic anxiety (e.g. "My

hands are clammy"), cognitive anxiety (e.g. "I am concerned about choking under pressure"), and self-confidence (e.g. "I'm confidence about performing well). The items are rated on a 4-point Likert scale ranging from 1 (not at all) to 4 (very much so). The CSAI-2R had good internal consistency in a collegiate athlete population with scores of .81, .81. and .86 for cognitive anxiety, somatic anxiety, and self-confidence, respectively.[39]

Self-Confidence[40]

Self-Confidence was measured using the Trait Sport Confidence Inventory (TSCI). The TSCI is a 13-item questionnaire used to assess sport-confidence. An example of a question from is, "Compare your confidence in your ability to perform under pressure to the most confidence athlete you know." The items are rated on a 9-point Likert scale ranging from 1 (low) to 9 (high). The TSCI was tested for reliability and validity in a sample of high school and collegiate athletes. The TSCI had good internal consistency with an alpha coefficient of .93.[40] The TSCI had a high acceptability test-retest score of .86.[40]

Attentional Focus[41]

Attentional Focus was measured using the Sport Anxiety Scale-2 (SAS-2). The SAS-2 is a 15-item questionnaire used to assess trait anxiety. The questionnaire consists of three subscales: worry, concentration disruption, and somatic trait anxiety. An example of a question from the concentration subscale is, "I have lapses of concentration during competition because of nervousness." The items are rated on a 4-point Likert scale ranging from 1 (not at all) to 4 (very much so). The SAS-2 was tested for reliability in child and collegiate athletes. The SAS-2 had good internal consistency with an overall

alpha coefficient of .91 and subscale coefficients of .89, .84, and .84 for worry, concentration disruption, and somatic trait anxiety respectively.[41] The overall SAS had an acceptable test-retest score of .87 and the subscales had reliability correlations for worry, concentration disruption, and somatic trait anxiety of .90, .85, and .76, respectively.[41]

General Mindfulness[42]

General Mindfulness was measured using the Mindful Attention Awareness Scale (MAAS). The MAAS is a 15-item questionnaire used to assess core characteristics of mindfulness. An example question is, "I do jobs or tasks automatically, without being aware of what I'm doing." The items are rated on a 6-point scale ranging from 1 (almost always) to 6 (almost never). The MAAS was tested for validity in an undergraduate and general adult population sample with alpha coefficients of .82 and .87 respectively.[42] Acceptable test-retest reliability was found in an undergraduate population with a correlation of .81.[42]

Independent/Dependent variables

The independent variables in phase one of this study were engagement in mindful meditation practice and time and the dependent variables were self-reported emotional regulation, anxiety (somatic and cognitive), self-confidence, attentional focus, and general mindfulness. The independent variable in phase two was time and the dependent variables were self-reported emotional regulation, anxiety (somatic and cognitive), self-confidence, attentional focus, and mindfulness.

Statistical analysis

Statistical analysis was performed by entering collected data from questionnaires into the IBM Statistical Package for Social Sciences (SPSS) version 24.0 (Armonk, NY).

Descriptive statistics (e.g., mean, standard deviation, and frequencies) were calculated for both continuous and categorical variables with 95% confidence intervals. Phase one tested between-group effects for primary outcomes (i.e., mindfulness, emotional regulation, anxiety (cognitive and somatic), self-confidence, attentional focus) by two-way repeated measure ANOVA across time for the treatment and control groups. Pearson/Spearman correlation was used to test for associations between mindfulness and performance related psychological factors. Phase two determined changes in pre-post assessments of mindfulness and performance related psychological factors via dependent t-tests. An ANCOVA was calculated to determine association between primary outcomes and minutes of mindfulness participation. Cohen's *d* was used to determine effect size values. Values of 0.2, 0.5, and 0.8 indicate small, moderate, and large effect sizes, respectively. A p-value of ≤ 0.05 was considered statistically significant.

Qualitative Data[43]

Qualitative data from phase two (off-season) was informally analyzed by summarizing common themes for each question. Interview questions are presented in Table 1.

Table 1. Phase Two End of Intervention Interview Questions

	End of Intervention Interview Questions
1)	Before beginning the meditation program, what was your experience with/exposure to meditation?
	Had you ever heard of meditation?
	What were your thoughts about it/What did you know about it?
	Had you ever meditated before?
	What was your experience like?
2)	Did you enjoy participating in the daily meditations? Why or why not?
3)	If given a choice between meditating as a group or individually, which would you prefer? Why?
4)	Did you notice any changes in your emotions, stress levels, confidence, focus, or your mindfulness? Explain.
	Did you notice any other benefits? Explain.
5)	What is your opinion about the frequency and duration of the meditations?
	Was daily meditation too much? What would be a preferable number of days?
	Did ten to twelve minutes seem appropriate? What would be a preferable length of time?
6)	Now that the meditation program has finished, has your opinion about meditation changed at all?
	How?
7)	Will you continue to use meditation? Why or why not?
8)	Would you recommend meditation for other players? Why or why not?

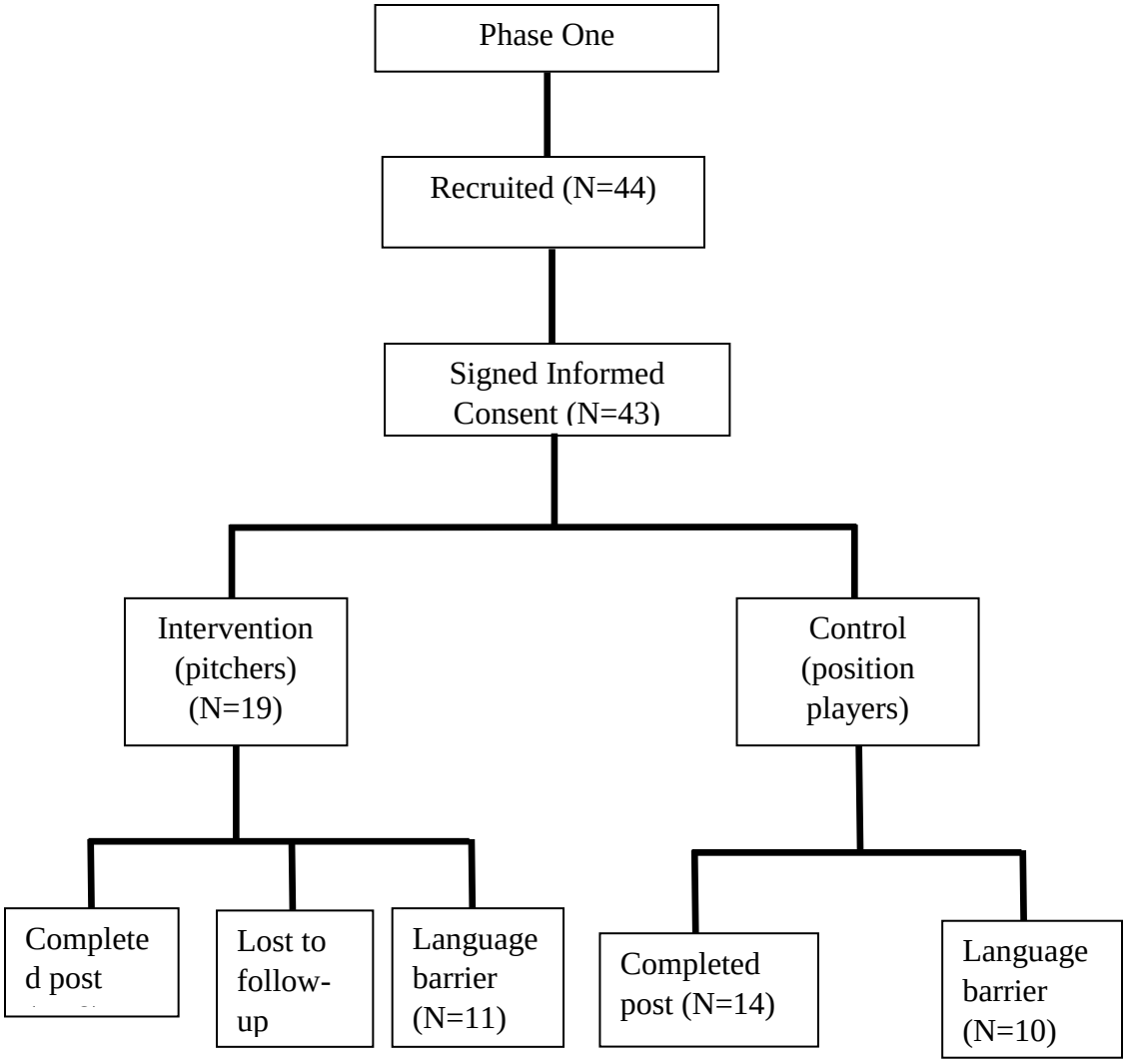
RESULTS

Phase one

Participant Enrollment

In phase one of this study, 44 baseball players were asked to sign an informed consent. Of those, 43 baseball players (i.e. pitchers and position players) signed the informed consent. The 19 pitchers were assigned to the intervention group and the 24 position players (i.e. infield, outfield, catcher) were assigned to the control group. Nine pitchers were excluded due to language barriers and two failed to complete post-assessments, for a total of eight pitchers who completed the phase one intervention group. Ten position players were excluded due to language barriers for a total of 14 who completed the control group. Figure 1 shows enrollment for phase one.

Figure 1. Phase One Enrollment



Participant Demographics

The mean age of the phase one intervention group was 21.14±1.98 years. The mean age of the control group was 20.44±1.71 years. All participants were male. Half of the participants in both the intervention and control group had been with the Major League Baseball organization less than six months (n=10, 52.6%; n=12, 50%) and had been playing professional baseball less than six months (n=10, 52.6%; n=13, 54.2%).

Table 2 located in Appendix A describes the demographics of the intervention and control groups.

Participant Perceptions of Meditation

Over half of the pitchers (n=12, 63.2%) reported never meditating before and (n=8, 42.1%) had never considered trying meditation. Three pitchers (15.8%) reported meditation as something they wanted to try. The most highly perceived potential benefits of meditation were increased calmness/relaxation (n=13, 24.5%), increased focus/concentration (n=12, 22.6%), and increased self-confidence (n=8, 15.1%). Most of the pitchers (n=14, 73.7%) believed that meditation could have an impact on their athletic performance.

Over half of the position players (n=15, 62.5%) had never participated in meditation before and a quarter (n=6, 25%) had never considered trying meditation. Three (12.5%) reported meditation as something they wanted to try. The most highly perceived potential benefits of meditation reported by the position players were increased calmness/relaxation (n=18, 22.5%), increased focus/concentration (n=17, 21.25%), and decreased stress (n=12, 15%). Most of the position players (n=19, 79.2%) believed that meditation could have an impact on their athletic performance. Table 3 located in Appendix B describes the perceptions of meditation of the pitchers (i.e., intervention) and position players (i.e., control) groups.

Satisfaction and End of Intervention Perceptions

At the end of phase one (week three), program satisfaction and "21 Days of Calm" satisfaction was assessed. Eight pitchers (treatment) completed post-measures. Of those, 87.5% (n=7) indicated enjoyment of meditation, and 75% (n=6) indicated

enjoyment of the CALM application. Almost all pitchers (n=7, 87.5%) reported the narrator as enjoyable to listen to, and felt that the length of the sessions (i.e. 10-12 minutes) was enjoyable. Only one individual (12.5%) responded that he enjoyed meditating in a group setting. Table 4 describes phase one program satisfaction. Table 5 describes "21 Days of Calm" satisfaction. End of intervention perceptions of meditation were also assessed in both pitchers (intervention) and position players (control). At the end of phase one intervention, pitchers (n=8) rated the top three potential benefits of meditation as increased attention/awareness (36.8%), increased calmness/relaxation (36.8%), and increased focus/concentration (36.8%). Half of pitchers (n=4, 50%) reported their perception of meditation changed after participating in the program. At the end of phase one those in the control group (position players, n=14) rated the top three potential benefits of meditation as decreased stress (21.4%), increased focus/concentration (19%), and increased calmness/relaxation (16.7%). Interestingly, 78.6% of position players (n=11) reported their perception of meditation changed after participating in the program. Table 6 describes phase one end of intervention perceptions of meditation.

Table 4. Phase One Satisfaction

Program Satisfaction (N=8)		
	Pitchers (N=8)	
	N	(%)
Did you enjoy meditating?		
Yes	7	87.5
NA	1	12.5
Will you continue to meditate beyond the conclusion of this program?		
Yes	3	37.5
Maybe	4	50.0
NA	1	12.5
Will you continue to use the CALM app?		
Yes	4	50.0
No - I'm going to try other apps	1	12.5
NA	3	37.5
Did you enjoy using the CALM app?		
Yes	6	75.0
Somewhat	1	12.5
NA	1	12.5
Do you feel you learned enough about meditation from CALM to meditate without any guidance?		
Yes	3	37.5
Maybe	2	25.0
No	2	25.0
NA	1	12.5
On average, how many days out of the week did you meditate?		
5 to 6	7	87.5
NA	1	12.5
Was the length (10-12 minutes) of the sessions enjoyable?		
Yes - they were the ideal amount of time	7	87.5
NA	1	12.5
Did you find the voice of the narrator to be enjoyable to listen to?		
Yes	7	87.5
NA	1	12.5
Did you enjoy meditating in a group setting?		
Yes	1	12.5
No	3	37.5
No opinion	3	37.5
NA	1	12.5
Would you prefer to meditate on your own time, not in a group setting?		
Prefer to meditate on my own	3	37.5
No preference	4	50.0
NA	1	12.5

Table 5. Phase One "21 Days of Calm" Satisfaction

21 Days of Calm Satisfaction (N=8)		
	N	(%)
I enjoyed the 21 Days of CALM		
3	1	12.5
4	5	62.5
5	1	12.5
NA	1	12.5
I looked forward to each meditation session		
2	1	12.5
3	4	50.0
4	2	25.0
NA	1	12.5
I think the 21 Days of CALM was a good introduction to meditation		
3	1	12.5
4	3	37.5
5	3	37.5
NA	1	12.5
The 21 Days of CALM increased my knowledge about meditation		
4	4	50.0
5	3	37.5
NA	1	12.5

Statistics

Five psychological factors related to performance were assessed during the course of this study; Emotional Regulation, Anxiety, Confidence, Focus, and Mindfulness. They were assessed via pre- and post-intervention self-report questionnaires. Due to the small sample size (n=8), effect size estimates (i.e. Cohen's d) are presented in lieu of probability estimates. Effect sizes are a measure of the magnitude of effect a treatment has on a factor. Per Cohen (1988), small effect is estimated at 0.2, medium at 0.6, and large at 0.8.

Following three weeks of meditation, self-confidence (d=0.97) and sport confidence (d=0.80) improved decidedly. There were moderate decreases in cognitive anxiety (d=-0.54) and concentration disruption (d=-0.67). No effect was found for emotional regulation, somatic anxiety, or mindfulness. Table 7 shows effect size for phase one.

Table 7. Phase One Effect Size

Effect Size	
	Cohen's *d*
Reappraisal	-0.1
Suppression	0.07
Somatic Anxiety	0.2
Cognitive Anxiety	-0.54
Self-Confidence	0.97
Sport Confidence	0.8
Concentration	-0.67
Worry	-0.29
Mindfulness	-0.09

Small effect = 0.2, Medium effect = 0.6, Large effect = 0.8

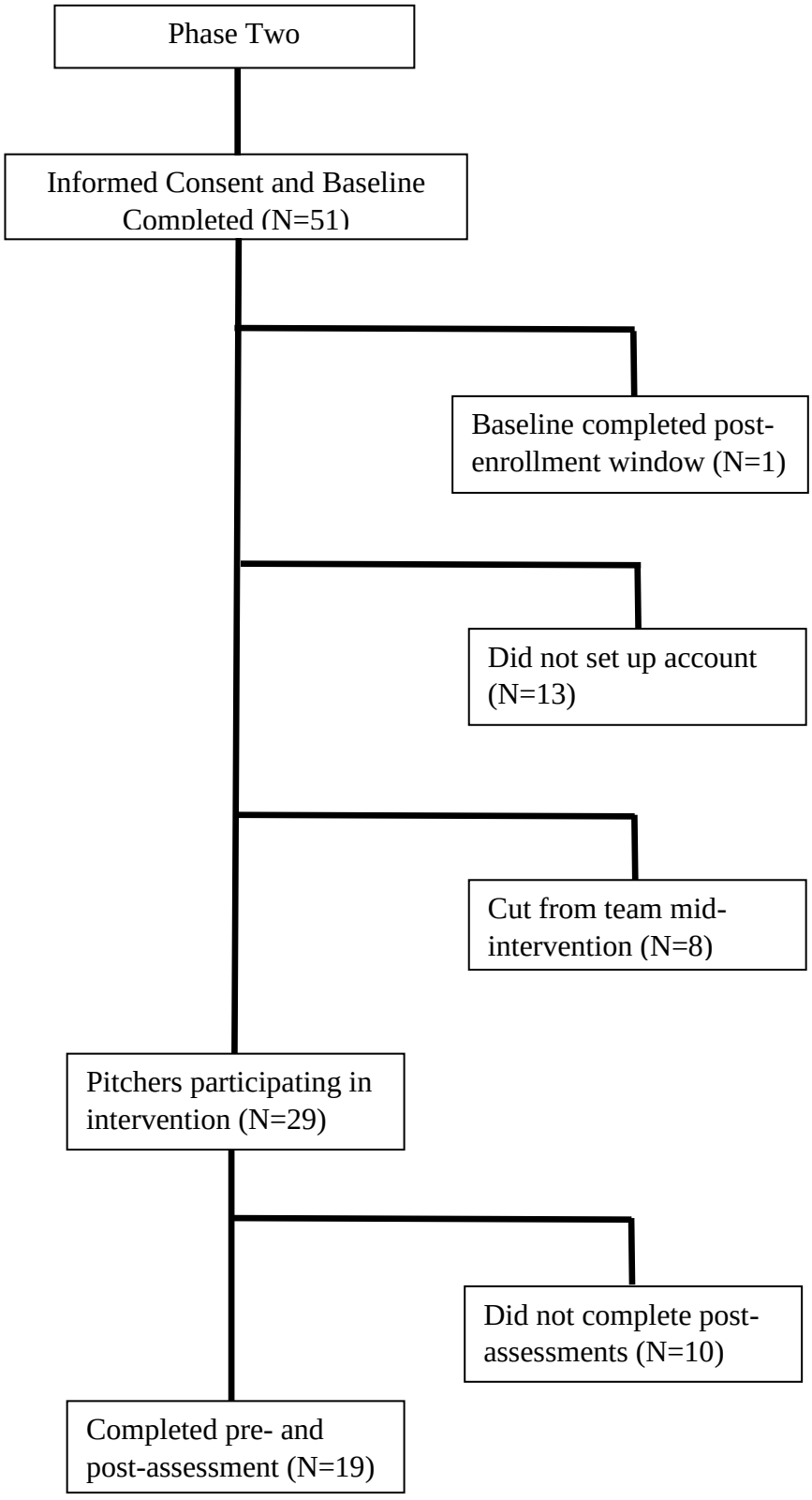
Although moderate to large improvements were noted in four sub-categories of the psychological factors of interest, these results should be interpreted with caution, as such a small sample size (n=8) may result in unstable effects.

Phase Two

Participant Enrollment

In phase two of this study, a recruitment email was sent out by the mental skills coordinator to all pitchers on the Major League Baseball organization's minor league roster (N=100). There were no ineligibility criteria. A total of 51 pitchers signed informed consent and completed baseline assessments. Of those, one completed baseline after recruitment was finished, 13 (25.4%) completed baseline but failed to set up accounts, and eight (15.7%) were cut during the off-season, resulting in 29 pitchers active in the intervention. Six (20.7%) pitchers never meditated once, and several others (n=4, 13.8%) only meditated once or twice. Of the active pitchers, 10 (34.5%) failed to complete post-assessments, for a total of 19 (65.5%) completers. There was no control group. Figure 2 shows enrollment for phase two.

Figure 2. Phase Two Enrollment



Participant Demographics

Of the 51 pitchers who completed baseline, the mean age was 22.08±1.48 years. All pitchers were male. About a quarter of the pitchers had been with the Major League Baseball organization more than three years (n=14, 27.5%) and a third had been playing professional baseball one to three years (n=18, 35.3%). Table 8 located in Appendix C describes demographics for phase two pitchers.

Participant Perceptions of Meditation

Of the 51 participants, most (n=38, 74.5%) had never participated in meditation before and (n=18, 35.3%) had never considered trying meditation; about one quarter (n=12, 23.5%) had considered meditating once or twice, and (n=8, 15.7%) reported it as something they had been wanting to try. The most highly perceived potential benefits were decreased stress (n=14, 27.5%), increased calmness/relaxation (n=15, 29.4%), and increased focus/concentration (n=13, 25.5%). A majority of participants (n=36, 70.6%) believed that meditation could have an impact on their athletic performance. Table 9 located in Appendix D describes the perceptions of meditation of phase two participants.

Satisfaction and End of Intervention Perceptions

At the end of phase two, program satisfaction was assessed. Nineteen pitchers completed post-measures. Of those, 94.7% (n=18) indicated enjoyment of meditation, and 52.6% (n=10) indicated enjoyment of the CALM application. Despite only half the pitchers reporting enjoyment of the CALM app, most pitchers (n=17, 89.5%) felt the length of the sessions (i.e. 10-12 minutes) was an enjoyable length of time to meditate, and most (n=16, 84.2%) found the voice of the narrator enjoyable to listen to. Additionally, most (n=17, 89.5%) responded that they enjoyed using a mobile application

to meditate. About half of pitchers (n=10, 52.6%) felt that a group meditation led by an instructor may be more beneficial than using an application, however, only four (21.1%) responded affirmatively that they would attend a group meditation. Table 10 located in Appendix E describes phase two program satisfaction.

Perception of meditation at the end of phase two was also assessed. Pitchers (n=19) rated the top three potential benefits of meditation as increased calmness/relaxation (21.1%), increased focus/concentration (42.1%), and increased attention/awareness (36.8%). More than half of pitchers (n=12, 63.2%) reported their perception of meditation changed after participating in the program. Table 11 located in Appendix F describes phase two end of intervention perceptions of meditation.

Statistics

Five psychological factors related to performance were assessed pre- and post-intervention via self-report questionnaires during phase two of this study; Emotional Regulation, Anxiety, Confidence, Focus, and Mindfulness. Due to the small sample size (n=19), effect size estimates (i.e. Cohen's d) are presented in addition to probability estimates. Following eight weeks of meditation, self-confidence (d=0.51) increased moderately and somatic anxiety (d=-0.47) decreased moderately. Emotional regulation (reappraisal; d=0.44, suppression; d=0.33) and mindfulness (d=0.11) increased to a small degree, and cognitive anxiety (d=-0.14) and concentration disruption (d=-0.33) decreased to a small degree. No effect was found for sport confidence or worry. Pitchers were asked to meditate a minimum of 30 minutes per week for eight weeks. Five (17.2%) pitchers met the minimum requirement (i.e. 240 minutes), seven (24.1%) met at least 75% (i.e.

180 minutes), 14 (48.3%) met at least 50% (i.e. 120 minutes), and 17 (58.6%) met at least 25% (i.e. 60 minutes). Table 12 shows probability estimates and effect size for phase two.

Table 12. Phase Two Probability Estimates

Probability Estimates and Effect Size		
	p	**Cohen's *d***
Reappraisal	0.069	0.44
Suppression	0.165	0.33
Somatic Anxiety	0.057	-0.47
Cognitive Anxiety	0.556	-0.14
Self-Confidence	***0.04**	0.51
Sport Confidence	0.904	0.03
Concentration	0.163	-0.33
Worry	1	0
Mindfulness	0.653	0.11

*significance was defined at $\alpha \geq 0.05$. Small effect = 0.2, Medium effect = 0.6, Large effect = 0.8

ANCOVA was also calculated to determine correlations between minutes spent in meditation and changes in psychological factors. No significant changes were noted. Table 13 shows values for ANCOVA.

Table 13. Phase Two ANCOVA

ANCOVA	***p***
Reappraisal	0.086
Suppression	0.285
Somatic Anxiety	0.7
Cognitive Anxiety	0.599
Self-Confidence	0.402
Sport Confidence	0.895
Concentration	0.793
Worry	0.196
Mindfulness	0.73

*significance was defined at $\alpha \geq 0.05$

Qualitative Data

Seven (24.1%) of the pitchers from phase two volunteered to participant in post-intervention interviews via telephone. The qualitative findings are reported by the following key themes: (1) experience with meditation, (2) benefits (3) challenges of time/routine, and (4) continued meditation practice. Themes are illustrated with verbatim quotes from the interviews.

Experience with Meditation. Four pitchers in phase one indicated no previous experience with meditation. Two had limited experiences with meditation from attending yoga classes. Those pitchers shared that they associated meditation with the relaxation period (shavasana) at the end of yoga class. One pitcher had participated in a group meditation once a week with his college baseball team.

"Um, honestly, this was the first time that I had tried it. Um, I had a few, uh, former coaches or coaches that had told me that they thought I could, um, benefit from it. Um. Or something along the lines of, of meditation. Um, so this was my first time going into it. And, yeah."

"Um, I was open to it. Um, I always like to try something new, and uh, you know, anything to kind of get an edge. So, I was real open to it and uh, I've wanted to try it."

Benefits of Meditation. An overall sense of calmness and relaxation was the most commonly reported benefit, and two pitchers commented that they felt less stressed after meditating. One pitcher reported changes in his focus.

"*Yeah, I think I had a deeper, like I was more calm. That's the main word."*

"*When I was able to do it early, um, I felt like I had a better day. Like I was just more relaxed about everything and wasn't stressed out about much."*

"Uhhhh...honestly, I-I think it-it helped mostly with just like the relaxing and like...I guess my stress levels were lower, but like, I didn't notice any like difference with like-like emotions and stuff like that."

"Uh, yeah, definitely keeps you, puts you in the moment, and kind of slows things down. Helps you focus more and yeah kinda just lets you detach kind of."

Challenges with Finding Time. Finding time in their off-season routine was an issue for almost all of the pitchers.

"I also found it a little harder, like, I kind of... I never really made it part of my routine, my daily routine, whereas yoga was part of my daily routine. …Um, I just struggled, I struggled to find the 20 minutes a day."

> *Uh, well, honestly for me I was living in Los Angeles and I had a really good routine going and then I moved back to Missouri….And my routine kind of got switched around. And so, the yoga was kind of easy when I was in LA because I had a lot of downtime to do it in the mornings and when I came back to St. Louis, I started working and things like that. So, it's a, honestly, it had nothing to do with, with the meditation, it was more of my schedule just kind of changed.*

Continued Meditation Practice: All but one pitcher was still meditating at least once a week since the intervention had finished. When asked about extending the program into the competitive season, all seven pitchers responded positively.

"Um, yeah, in the season, once our, our time and routine kind of gets, gets kicked in, I think it will be a lot easier to, to do."

"*During the season, I, could definitely see myself like, doing it way more, like almost like every night like after a game because I-I-like after games, I'm always like I'm*

going to fall asleep like after night games so, I feel like if I would, just like, put that in my like, daily schedule to do the meditation I think that it would be very beneficial."

> *Yeah, I mean, I think it, like I said, it all comes down to routine. Like I know even throughout the season we're very routine-oriented as far as like we do the same thing at the same time every day. So, I think if we just got to the point of, okay, at one o'clock every day or whatever we took ten minutes to meditate or whatever it is, I, I don't see a problem with it being every day. Cause, I mean, ten to twenty minutes isn't a big deal. I think it's, it's just a matter of getting it into that routine. Whatever time it's at. Um.*

DISCUSSION

The purpose of this study was to explore the feasibility of a mobile meditation application to improve psychological factors (i.e. emotional regulation, anxiety (somatic and cognitive), confidence, focus, mindfulness) known to influence performance in a population of Major League Baseball pitchers. The study was conducted in two phases, in two different settings. Phase one was three-weeks in which meditation was implemented via a mobile application in a group setting during instructional league (takes place during the months of September and October, and is an opportunity for young pitchers and players to get more experience and refine their skills). Phase two was eight-weeks in which meditation was implemented via individual smart phone during the off-season (portion of the year when no official competition is taking place).

Phase one (instructional league)

It was hypothesized that implementing CALM during instructional league would be acceptable (80% of baseball pitchers will be satisfied with CALM). Approximately 85% of pitchers (n=6, 85.7%) rated their enjoyment of the "21 Days of Calm" as enjoyable or higher. Additionally, the majority of instructional league pitchers (n=7, 87.5%) reported that they enjoyed meditating. Despite the long-standing resistance of athletes to techniques that enhance their mental game,[11,12] it appears that athletes are becoming more open to mental training. In a survey of over 2,000 collegiate student athletes, Wrisberg et al. found (amongst males) 21.3% of those surveyed were willing to seek personal assistance for managing anxiety, 24.7% for managing emotions during competition, 35% for building confidence, and 40.9% for improving focus.[44] Further evidence of an increased utilization of mental skills conditioning (e.g. meditation) was

demonstrated by a brief mindfulness-based training program for student athletes (2017) in which athletes were asked to attend a one-hour mindfulness/education session once a week for five weeks.[45] Sessions consisted of training on specific mindfulness skills (e.g. Responding vs. Reacting to Stimuli, Pleasant and Unpleasant vs. Good and Bad experiences) as well as learning meditation and accessing emotions (e.g. body scan, loving kindness, raising exercise).[45] They were also assigned after-session assignments consisting of a meditation, self-guided readings, and usage of a smart phone application (name of app not provided) to track mood and complete meditations.[45] At one-month follow-up to the fifth session, student athletes reported general trends of enjoyment in the program (85.7% still using mindfulness at one-month follow-up) and usefulness of the skills (80% found the material useful).[45]

Phase one of this study also explored the preliminary effectiveness of a group-based mobile meditation protocol on psychological factors (e.g. emotional regulation, anxiety (somatic and cognitive), confidence, focus, mindfulness) shown to be associated with performance. Both self-confidence and sport confidence improved and cognitive anxiety and concentration disruption decreased moderately. Similar to this finding of moderate decreases in cognitive anxiety, a brief mindfulness training for collegiate football players demonstrated a protective factor of mindfulness toward facilitating a decline in anxiety. In a four-week study, mindfulness-training (based on MBSR and contextualized to fit the football culture including mindful breathing and body scan) was compared to relaxation-training (cognitive behavioral therapy contextualized to fit the football culture including guided imagery, progressive muscle relaxation, and relaxing music) in football players during a high-stress period (e.g. pre-season academic and

football training directly prior to placement camp).[46] The protocol for each group consisted of a 45-minute instructor-led session once a week as well as four 12-minute proctored guided practice sessions per week.[46] Athletes were also provided the same guided practice for at home usage.[46] Due to the intense nature of the pre-season training period when the intervention took place, overall trends for the football players showed reductions in sustained attention, and increases in reaction time variability, anxiety, and depression.[46] Athletes with better adherence (more minutes in mindfulness training) experienced these detrimental effects to a lesser degree (if at all), demonstrating an almost protective-role of mindfulness.[46] This mindfulness study amongst pitchers and the study by Rooks et al suggest that mindfulness meditation may help reduce anxiety in athletes. Because this study only had eight participants, limiting generalizability, future studies are warranted to assess the effects of mindfulness meditation on anxiety levels in baseball pitchers.

Phase two (off-season)

During phase two of this study, pitchers were asked to download the mobile meditation application CALM to their smartphone and to utilize the application for 10 minutes a day, every day over an eight-week period (during off season). It was hypothesized that CALM would be acceptable (80% of baseball pitchers will be satisfied with CALM) and demanded (75% of baseball pitchers will participate in meditation 3 x/week and/or more than 30 minutes per week).

Only about half (n=10. 52.6%) of the pitchers reported that they enjoyed CALM, however, almost all (n=18, 94.7%) of the pitchers reported that they enjoyed meditating. Additionally, most of the pitchers (n=17, 89.5%) enjoyed the length of the sessions (i.e.

10-12 minutes) and most (n=16, 84.2%) enjoyed the narrator's voice. The discrepancies between enjoyment of meditating and enjoyment of the CALM app warrant future exploration.

The benchmark of acceptability of CALM was not met (i.e. only 52.6% of pitchers reported enjoying CALM) and may be explained by the lack of sport-specific content in the CALM app, and therefore a potential lack of interest for the athletes. A six-week mindfulness intervention among female collegiate soccer players noted the importance of connecting mindfulness lessons to the sport.[31] Athletes were asked to partake in the mindfulness meditation for sport (MMTS) program twice a week over six-weeks.[31] Each session was facilitator-led and lasted for 30 minutes (20 minutes of education and discussion, 10 minutes of mindful meditation); athletes were also asked to practice five-to-ten minutes daily on their own.[31] The MMTS program utilized techniques such as breath observation, breath counting, and thought labeling, while approaching these all with nonjudgmental acceptance.[31] The program also incorporated a focused compassion exercise which consisted of compassion imagery and loving kindness meditation.[31] Athletes reported struggling with meditation until the facilitator made the connection between the techniques and utilizing them in applicable situations.[31] Future mindfulness studies in athletes may want to explore more sport-specific mindfulness content in comparison to general mindfulness content.

Additionally, half (n=10, 52.6%) of the pitchers in this study reported that they thought group meditation led by an instructor would be more beneficial than meditating using a mobile application, although most (n=17, 89.5%) reported that they enjoyed meditating with a mobile application. Additionally, less than a fourth (21%) of pitchers

definitively reported that they would attend a group meditation. Future research should explore the differences in feasibility of group meditation as compared to individual mobile meditation and the comparative effectiveness of both modes of delivery.

Benchmarks related to demand (75% of baseball pitchers will participate in meditation 3 x/week and/or more than 30 minutes per week) were also not met. Of those off-season pitchers who completed the post-assessment, more than two-thirds (n=13, 68.4%) self- reported meditating an average of three or more days per week. Contradicting self-report, data provided by CALM (objective) suggests only three pitchers (10.3%) averaged three or more days of meditation per week. CALM objective data also reported that only five pitchers (17.2%) averaged at least the minimum minute requirement (e.g. 30 minutes/week; total 240 minutes) over the eight-weeks of the study. Potential explanations for this failure to achieve demand may be explained by two of the major themes from post-intervention interviews: (1) challenges with finding time and (2) benefits of meditation.

In the interviews, pitchers reported that they forgot to meditate, they didn't have time to meditate, and/or they had a hard time scheduling meditation into their day. Phase two occurred during the off-season, a time of year when pitchers were not required to report to their team, and had other obligations that took precedent, such as staying in shape, working, and moving. The pitchers never figured out how to establish meditation as part of their off-season routine. By comparison, during the regular baseball season, the majority of a pitcher's day is a set routine, every day, including periods of down time and travel time. These were times that players felt were more ideal for meditation. Had the

pitchers found time to meditate and made it a part of their off-season routine they may have been more likely to adhere to the intervention.

Another potential reason that demand benchmarks may not have been met was because of their benefits to meditation. Pitchers reported feelings of calmness/relaxation and some stress reduction on days that they meditated. However, only two pitchers noted any degree of carry-over effects from the meditation session throughout the rest of the day, and only minor benefits beyond relaxation were noted. One study by Carissoli and colleagues (2015) suggested that apps only be used for research for brief periods, as longer periods have worse compliance.[47] Participants may expect to experience immediate benefits, and lose interest in continuation if those benefits are not perceived in what they consider to be a timely manner.[47] The pitchers in this study may have perceived that they would experience significant and sustaining benefits immediately, and therefore may have discontinued participation due to lack of substantial and/or instantaneous benefits. Further research is needed to explore ways to increase program adherence beyond three-weeks.

Preliminary effectiveness of a mobile meditation protocol on psychological factors (e.g. emotional regulation, anxiety (somatic and cognitive), confidence, focus, mindfulness) implemented during the off-season was also assessed. Only self-confidence increased moderately from pre- to post as a result of meditation ($p=0.04$). Somatic anxiety decreased moderately to a slightly lesser degree but did not reach significance. While both somatic and cognitive anxieties have been shown to have inverse relationships with self-confidence, it is typically cognitive anxiety that is more often associated with changes in self-confidence.[15,18,30] Interestingly, in this study there was a

far greater reduction in somatic anxiety than in cognitive anxiety. As somatic anxiety is the physical manifestation of anxiety, the intervention being implemented during the off-season may have influenced this outcome. Many baseball athletes begin their off-season with a month of active rest;[48] therefore, relief from physical stress on the body caused by the demanding baseball season may have contributed to an overall decrease in somatic anxiety.

These results are consistent with the literature. In a meta-analytical review of nine studies implemented in athletes age 15 or older, mindfulness training was found to have moderate to large effects on some psychological factors such as mindfulness, flow (i.e. "in the zone"), and anxiety.[49] Another study by Scott-Hamilton (2016) examined the effects of an eight-week mindfulness intervention on anxiety in cyclists.[35] Participants were randomized to a treatment group or waitlist control.[35] Treatment group participated in weekly mindfulness workshops (focusing on core concepts of mindfulness and meditation), 30-minutes of daily home-meditations, and weekly group mindful spin bike sessions to assimilate lessons into cycle routine.[35] Cyclists significantly increased mindfulness compared to the control group, and significantly decreased anxiety from pre- to post-measures.[35]

A potential reason that more significant outcomes were not observed in psychological factors associated with performance is likely due to low adherence rates. Additionally, there was no control group. Without the inclusion of a control group, it is impossible to determine if the outcomes that improved (i.e. increased self-confidence, decreased somatic anxiety) were due to the meditation intervention. Future research is

needed to determine strategies to improve adherence to meditation as well as appropriate control groups.

Limitations

This study faced several limitations. Both phases had small sample sizes and the second phase had no control group, limiting the generalizability of the findings. In order to more decisively explore significance and/or form generalizable conclusions, a larger sample, inclusion of a control group, and randomized assignment would be necessary.

Phase one was implemented over only a three-week period, which is most likely not long enough to see any significant changes in psychological factors. Although larger effects were noted during phase one than during phase two, phase one took place during the instructional league and was implemented as part of the pitchers' day. This resulted in pitchers meditating 10-minutes per day, six days per week. In phase two, which took place during the off-season, pitchers were again asked to meditate seven days a week, however, participation was completely voluntary and at their discretion. This actually resulted in lower participation rates than in phase one. However, during phase one, two factors (self-confidence and sport-confidence) improved, and two factors (cognitive anxiety and concentration disruption) decreased moderately. If phase one was longer in duration (i.e. eight weeks) it could be expected that more effects would be found. Furthermore, if phase two had meditation in a group-setting as part of the pitchers' structured day, there may have been larger and/or additional improvements in psychological factors.

Although a significant ($p=0.04$) increase in self-confidence and a moderate decrease in somatic anxiety were observed from pre- to post in phase two, it cannot be

determined to any degree what influence meditation truly had on the psychological factors (e.g. emotional regulation, anxiety (somatic and cognitive), confidence, focus, mindfulness) of interest due to the lack of a control group. Inclusion of a control group would have allotted for between-group analysis in order to make more decisive conclusions about the effect of the mobile meditation protocol on psychological factors.

Additionally, this study may have suffered from self-selection bias. Pitchers participating in phase two volunteered to participate, whereas pitchers of phase one had meditation integrated into their training routine. Although some of the pitchers of phase two may have felt obligated to fill out baseline and informed consent, as it was highly encouraged by their coaches, a quarter of them (n=13, 25.4%) still did not set up accounts. Of the 29 pitchers who did set up accounts, six of them (20.7%) never meditated once, and several others (n=4, 13.8%) only meditated once or twice. Therefore, the pitchers who actively participated in phase two of the study (i.e. set up accounts and meditated more than once) may have already been interested in trying meditation and/or may have been more highly motivated to participate, and their results may not be generalizable to the entire population.

Finally, there was some overlap of participation between phase one pitchers and phase two pitchers. Five pitchers who participated in phase one also volunteered to participate in phase two. Their pre-exposure to meditation via the CALM app in phase one (i.e. “21 Days of Calm” series) may have impacted their overall experience and outcomes in phase two.

Future Research

Although mindful meditation interventions are becoming more popular, implementation in the athletic population is limited and warrants future exploration. Future research should focus on determining the best approach to implement these interventions especially related to compliance to the intervention. One possibility would be to implement a mindful meditation intervention during the regular baseball season and require participation as part of the athlete's day. Not only would this allow pitchers to be accountable for the meditation as part of their daily routine, it would also allow for a substantially longer intervention that may result in more positive outcomes.

Pitchers may also benefit from an initial facilitator-based introduction to the program. While mobile application interventions accord convenience, they often lack a level of support and accountability of a traditional facilitator-led intervention. A mindfulness study in a population of cyclists reported a 33% attrition rate in the control group compared to a 10% attrition rate in the treatment group and suggested the treatment group's weekly contact with a facilitator may have attributed to the lower attrition rate.[35] Additionally, the previously discussed Baltzell study of a mindfulness program amongst collegiate soccer players also demonstrated the importance and advantage of incorporating a facilitator.[31] Athletes of that study became more open to meditation after the facilitator helped make the connection between meditation techniques and the applicability to their sport. Future research should explore the potential impact inclusion of a facilitator may have on adherence rates in mindfulness programs.

Given the nature of this population, a true randomized control trial will most likely never be feasible, as a Major League Baseball organization will not likely

volunteer their athletes to potentially miss out on a performance advantage (i.e. randomized to receive treatment (meditation) versus control group). Therefore, future research endeavors should focus on pragmatic study designs, to realize the most effective means of implementing a meditation intervention to benefit the largest range of pitchers as possible. For example, all pitchers of a team may be asked to participate in a meditation protocol, however, those that do not want to participate in the meditation could be asked to still fill out any assessments distributed throughout the study. Although the pitchers would be essentially self-selecting the group they are allocated to, this would still provide for some degree of a comparison group, which is necessary for drawing conclusions to further research in this area.

Conclusions

This study demonstrated that a mobile meditation application may be a feasible means to improve psychological factors (i.e. emotional regulation, anxiety (somatic and cognitive), confidence, focus, mindfulness) affecting performance in Major League Baseball pitchers. A brief intervention during the instructional league warranted improvements in self-confidence and sport confidence, as well as moderate decreases in cognitive anxiety and concentration disruption. Although adherence was low during the second phase (during the off-season), there were moderate improvements in self-esteem and moderate reductions in somatic anxiety. Almost all pitchers reported enjoying meditating and many believed that meditation as part of their routine during the regular season would help them to be successful. Further research is necessary to explore the impact of meditation on psychological factors during regular season and in a broader population of athletes.

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APPENDIX A

PHASE ONE DEMOGRAPHICS

Table 2. Phase One Demographics

Demographics of Study Participants (N=43)					
		Pitchers (n=19)		**Players (n=24)**	
Age, years		M±SD		M±SD	
		21.14	1.98	20.44	1.71
	NA	2		6	
Race		N	(%)	N	(%)
	Caucasian	11	57.9	9	37.5
	African American	0	0	1	4.2
	Hispanic	7	36.8	13	54.2
	NA	1	5.3	1	4.2
Is Spanish your first language?					
	Yes	9	47.4	10	41.7
	No	10	52.6	12	50
	NA	0	0	2	8.3
Marital status					
	Single	15	78.9	17	70.8
	Partnered/In a relationship	4	21.1	5	20.8
	NA	0	0	2	8.3
Education					
	Less than High School	2	10.5	0	0
	High School/GED	5	26.3	10	41.7
	Some College	8	42.1	9	37.5
	Associates/Technical Degree	2	10.5	1	4.2
	Bachelor's Degree	1	5.3	3	12.5
	NA	1	5.3	1	4.2
Spiritual affiliation					
	Christian	14	73.7	15	62.5
	Catholic	4	21.1	6	25
	Spiritual but not religious	1	5.3	2	8.3
	NA	0	0	1	4.2
Do you own either a smartphone or a tablet?					
	Yes	19	100	24	100
How long have you been with the Major League Baseball organization?					
	≤ 6 months	10	52.6	12	50
	6 – 12 months	1	5.3	1	4.2
	1 – 2 years	4	21.1	4	16.7
	2 – 3 years	3	15.8	3	12.5
	≥ 3 years	1	5.3	4	16.7
How long have you been playing professional (i.e., drafted to any team within a major league organization) baseball?					
	≤ 6 months	10	52.6	13	54.2
	6 – 12 months	3	15.8	1	4.2

1 – 3 years	4	21.1	6	25
3 – 5 years	2	10.5	4	16.7

APPENDIX B

PHASE ONE PERCEPTIONS OF MEDITATION

Table 3. Phase One Perceptions of Meditation

Perceptions of Meditation (N=43)				
	Pitchers (n=19)		**Players (n=24)**	
Do you attend religious service regularly?	N	(%)	N	(%)
Yes	5	26.3	8	33.3
No	14	73.7	16	66.7
If yes, how often?				
Once a week	4	21.1	3	12.5
Once a month	3	15.8	3	12.5
Major holidays	3	15.8	5	20.8
Other (please specify)	4	21.1	3	12.5
NA	5	26.3	10	41.7
Have you participated in meditation before?				
Yes	7	36.8	9	37.5
No	12	63.2	15	62.5
If no, have you ever considered trying meditation before?				
Never	8	42.1	6	25
I've thought about it once or twice	2	10.5	7	29.2
It's something I've been wanting to try	3	15.8	3	12.5
NA	6	31.6	8	33.3
Do you currently have a meditation practice?				
Yes	5	26.3	1	4.2
No	14	73.7	23	95.8
If yes, how frequently do you meditate?				
Daily	1	5.3	1	4.2
A few times a week	3	15.8	2	8.3
A few times a month	1	5.3	0	0
Other (please specify)	3	15.8	3	12.5
NA	11	57.9	18	75
If yes, for how long do you mediate?				
$\leq$ 10 minutes	6	31.6	5	20.8
10-20 minutes	1	5.3	1	4.2
NA	12	63.2	18	75
If yes, do you participate in guided or unguided meditation?				
Guided	1	5.3	1	4.2
Unguided	3	15.8	5	20.8
I don't know	5	26.3	0	0
NA	10	52.6	18	75
If guided, who guides your meditation?				
I use an app	3	15.8	1	4.2
I attend a class	0	0	2	8.3
I use videos I've found online	1	5.3	1	4.2
Other (please specify):	3	15.8	1	4.2
NA	11	57.9	19	79.2

If app, which application do you use?				
CALM	5	26.3	1	4.2
10% Happier	1	5.3	0	0
Headspace	1	5.3	0	0
Other (please specify)	2	10.5	1	4.2
NA	10	52.6	22	91.7
On a scale of 1 to 5, how would you rate your knowledge of, or familiarity with, meditation?				
1 – I have no idea what you're even talking about	1	5.6	1	4.2
2 – I've heard the word before	2	11.1	3	12.5
3 – I think you're supposed to empty your mind	4	22.2	6	25
4 – Focus on the breath, be in the moment	11	61.1	14	58.3
On a scale of 1 to 5, how open are you to trying meditation?				
2 – 25% this doesn't seem like my thing but I'm not completely saying no	0	0	2	8.3
3 – 50% I don't think I'm a meditator, but I'm willing to try anything once	5	26.3	7	29.2
4 – 75% I'm still a little skeptical, but count me in	11	57.9	7	29.2
5 – 100% teach me everything!	3	15.8	8	33.3
Of the following, please rank the top three you perceive as potential benefits of meditation?				
Decreased stress	5	9.4	12	15
Decreased anxiety	2	3.8	8	10
Improved emotional regulation	4	7.5	4	5
Increased attention/awareness	6	11.3	7	8.75
Increased calmness/relaxation	13	24.5	18	22.5
Improved quality of sleep	3	5.7	3	3.75
Increased self-confidence	8	15.1	11	13.75
Increased focus/concentration	12	22.6	17	21.25
Do you believe that meditation could have an impact your athletic performance?				
Yes	14	73.7	19	79.2
Maybe	4	21.1	5	20.8
NA	1	5.3	0	0
Do you associate meditation as a religious or spiritual practice?				
Yes	3	15.8	2	8.3
Maybe	3	15.8	8	33.3
No	13	68.4	14	58.3
Do you think meditation is weird?				
Yes	2	10.1	1	4.2
Maybe	2	10.1	5	20.8
No	15	78.9	18	75

APPENDIX C

PHASE ONE END OF INTERVENTION PERCEPTIONS

Table 6. Phase One End of Intervention Perceptions of Meditation

Perceptions of Meditation (N=22)				
	Pitchers (N=8)		**Position (N=14)**	
	N	(%)	N	(%)
On a scale of 1 to 5, how would you rate your knowledge of, or familiarity with, meditation?				
3 – I think you're supposed to empty your mind	0	0.0	2	14.3
4 – Focus on the breath, be in the moment	6	75.0	12	85.7
5 - I'm a meditation guru	1	12.5	0	0.0
NA	1	12.5	0	0.0
On a scale of 1 to 5, how open are you to trying meditation?				
3 – 50% I don't think I'm a meditator, but I'm willing to try anything once	1	12.5	3	21.4
4 – 75% I'm still a little skeptical, but count me in	4	50.0	3	21.4
5 – 100% teach me everything!	2	25.0	8	57.1
NA	1	12.5	0	0.0
Of the following, please rank the top three you perceive as potential benefits of meditation?				
Decreased stress	1	5.3	9	21.4
Decreased anxiety	1	5.3	4	9.5
Improved emotional regulation	2	10.5	3	7.1
Increased attention/awareness	7	36.8	5	11.9
Increased calmness/relaxation	7	36.8	7	16.7
Improved quality of sleep	2	10.5	1	2.4
Increased self-confidence	2	10.5	5	11.9
Increased focus/concentration	7	36.8	8	19.0
Do you believe that meditation may potentially impact your athletic performance?				
Yes	6	75.0	13	92.9
Maybe	2	25.0	1	7.1
Do you associate meditation as a religious or spiritual practice?				
Yes	1	12.5	1	7.1
Maybe	1	12.5	0	0.0
No	6	75.0	13	92.9
Do you think meditation is weird?				
Maybe	0	0.0	1	7.1
No	7	87.5	13	92.9
NA	1	12.5	0	0.0
Has your perception of meditation changed since participating in this program?				
Yes	4	50.0	11	78.6
No	3	37.5	3	21.4
NA	1	12.5	0	0.0
*If asked to meditate, would you prefer to meditate on your own or in a group setting?				
Prefer to meditate as a group			3	21.4
Prefer to meditate on my own			9	64.3

No preference	2	14.3

*only asked of position players (i.e. control group)

APPENDIX D

PHASE TWO DEMOGRAPHICS

Table 8. Phase Two Demographics

Demographics of Study Participants (N=51)			
		Pitchers (n=51)	
Age, years		M±SD	
		22.08	1.48
Race		N	(%)
	Caucasian	22	43.1
	African American	2	3.9
	Hispanic	20	39.2
	American Indian	4	7.8
	Other	2	3.9
	NA	1	2.0
Is Spanish your first language?			
	Yes	38	74.5
	No	13	25.5
Marital status			
	Single	40	78.4
	Partnered/In a relationship	10	19.6
	Married	1	2.0
Education			
	Less than high school	1	2.0
	High School/GED	18	35.3
	Some College	15	29.4
	Associates/Technical Degree	4	7.8
	Bachelor's Degree	12	23.5
	Graduate school or above	1	2.0
Spiritual affiliation			
	Christian	26	51.0
	Catholic	21	41.2
	Agnostic	1	2.0
	Spiritual but not religious	3	5.9
Do you own either a smartphone or a tablet?			
	Yes	50	98.0
	NA	1	2.0
How long have you been with the Major League Baseball organization?			
	≤ 6 months	11	21.6
	6 – 12 months	4	7.8
	1 – 2 years	11	21.6
	2 – 3 years	11	21.6
	≥ 3 years	14	27.5
How long have you been playing professional (i.e., drafted to any team within a major league organization) baseball?			
	≤ 6 months	11	21.6
	6 – 12 months	3	5.9
	1 – 3 years	18	35.3

3 – 5 years	16	31.4
≥ 10 years	3	5.9

APPENDIX E

PHASE TWO PERCEPTIONS OF MEDITATION

Table 9. Phase Two Perceptions of Meditation

Perceptions of Meditation (N=51)		
	N	(%)
Do you attend religious service regularly?		
Yes	24	47.1
No	27	52.9
If yes, how often?		
Once a week	18	35.3
Once a month	2	3.9
Major holidays	1	2.0
Other (please specify)	2	3.9
NA	28	54.9
Have you participated in meditation before?		
Yes	13	25.5
No	38	74.5
If no, have you ever considered trying meditation before?		
Never	18	35.3
I've thought about it once or twice	12	23.5
It's something I've been wanting to try	8	15.7
NA	13	25.5
Do you currently have a meditation practice?		
Yes	5	9.8
No	46	90.2
If yes, how frequently do you meditate?		
Daily	2	3.9
A few times a week	1	2.0
A few times a month	1	2.0
Other (please specify)	1	2.0
NA	46	90.2
If yes, for how long do you mediate?		
≤ 10 minutes	3	5.9
10-20 minutes	1	2.0
30 minutes	1	2.0
NA	46	90.2
If yes, do you participate in guided or unguided meditation?		
Guided	1	2.0
Unguided	3	5.9
I don't know	1	2.0
NA	46	90.2
If guided, who guides your meditation?		
I use an app	2	3.9
NA	49	96.1
If app, which application do you use?		
Headspace	1	2.0
Other (please specify)	1	2.0

NA	49	96.1
On a scale of 1 to 5, how would you rate your knowledge of, or familiarity with, meditation?		
2 – I've heard the word before	10	19.6
3 – I think you're supposed to empty your mind	10	19.6
4 – Focus on the breath, be in the moment	30	58.8
NA	1	2.0
On a scale of 1 to 5, how open are you to trying meditation?		
2 - 25% this doesn't seem like my thing but I'm not completely saying no	1	2.0
3 – 50% I don't think I'm a meditator, but I'm willing to try anything once	6	11.8
4 – 75% I'm still a little skeptical, but count me in	16	31.4
5 – 100% teach me everything!	27	52.9
NA	1	2.0
Of the following, please rank the top three you perceive as potential benefits of meditation?		
Decreased stress	14	27.5
Decreased anxiety	6	11.8
Improved emotional regulation	5	9.8
Increased attention/awareness	4	7.8
Increased calmness/relaxation	5	9.8
Improved quality of sleep	1	2.0
Increased self-confidence	2	3.9
Increased focus/concentration	12	23.5
Other (please specify)	1	2.0
NA	1	2.0
Of the following, please rank the top three you perceive as potential benefits of meditation?		
Decreased stress	3	5.9
Decreased anxiety	7	13.7
Improved emotional regulation	3	5.9
Increased attention/awareness	5	9.8
Increased calmness/relaxation	15	29.4
Improved quality of sleep	1	2.0
Increased self-confidence	7	13.7
Increased focus/concentration	9	17.6
NA	1	2.0
Of the following, please rank the top three you perceive as potential benefits of meditation?		
Decreased stress	6	11.8
Decreased anxiety	5	9.8
Improved emotional regulation	5	9.8
Increased attention/awareness	4	7.8
Increased calmness/relaxation	7	13.7
Improved quality of sleep	1	2.0

Increased self-confidence	9	17.6
Increased focus/concentration	13	25.5
NA	1	2.0
Do you believe that meditation could have an impact your athletic performance?		
Yes	36	70.6
Maybe	14	27.5
NA	1	2.0
Do you associate meditation as a religious or spiritual practice?		
Yes	7	13.7
Maybe	12	23.5
No	31	60.8
NA	1	2.0
Do you think meditation is weird?		
Yes	2	3.9
Maybe	2	3.9
No	46	90.2
NA	1	2.0

APPENDIX F

PHASE TWO PROGRAM SATISFACTION

Table 10. Phase Two Program Satisfaction

Program Satisfaction (N=19)		
	N	(%)
Did you enjoy meditating?		
Yes	18	94.7
No	1	5.3
Will you continue to meditate beyond the conclusion of this program?		
Yes	12	63.2
Maybe	7	36.8
Will you continue to use the CALM app?		
Yes	17	89.5
No - I'm going to meditate on my own	2	10.5
Did you enjoy using the CALM app?		
Yes	10	52.6
Somewhat	8	42.1
No	1	5.3
Do you feel you learned enough about meditation from CALM to meditate without any guidance?		
Yes	8	42.1
Maybe	11	57.9
On average, how many days out of the week did you meditate?		
1 to 2	6	31.6
3 to 4	8	42.1
5 to 6	4	21.1
7	1	5.3
Was the length (10-12 minutes) of the sessions enjoyable?		
Yes - they were the ideal amount of time	17	89.5
No - they were too long	2	10.5
Did you find the voice of the narrator to be enjoyable to listen to?		
Yes	16	84.2
No	2	10.5
No opinion	1	5.3
What barriers to meditation did you experience?		
I didn't have time	1	5.3
I didn't think it would be beneficial to me	1	5.3
Lack of knowledge about meditation	1	5.3
None	5	26.3
Other	10	52.6
NA	1	5.3
Did you enjoy using a mobile application to meditate?		
Yes	17	89.5
No	1	5.3
No opinion	1	5.3
Do you think group meditation led by an instructor would be more beneficial than using a mobile application?		

Yes	10	52.6
No	4	21.1
No opinion	5	26.3
Would you attend a group meditation led by an instructor if it was offered?		
Yes	4	21.1
Maybe	11	57.9
No	4	21.1

APPENDIX G

PHASE TWO END OF INTERVENTION PERCEPTIONS

Table 11. Phase Two End of Intervention Perceptions of Meditation

Perceptions of Meditation (N=19)		
	N	(%)
On a scale of 1 to 5, how would you rate your knowledge of, or familiarity with, meditation?		
2 – I've heard the word before	2	10.5
3 – I think you're supposed to empty your mind	1	5.3
4 – Focus on the breath, be in the moment	14	73.7
5 - I'm a meditation guru	2	10.5
On a scale of 1 to 5, how open are you to trying meditation?		
2 - 25% this doesn't seem like my thing but I'm not completely saying no	2	10.5
3 – 50% I don't think I'm a meditator, but I'm willing to try anything once	2	10.5
4 – 75% I'm still a little skeptical, but count me in	7	36.8
5 – 100% teach me everything!	8	42.1
Of the following, please rank the top three you perceive as potential benefits of meditation?		
Decreased stress	3	15.8
Increased attention/awareness	3	15.8
Increased calmness/relaxation	4	21.1
Improved quality of sleep	2	10.5
Increased self-confidence	2	10.5
Increased focus/concentration	4	21.1
NA	1	5.3
Of the following, please rank the top three you perceive as potential benefits of meditation?		
Decreased stress	2	10.5
Decreased anxiety	2	10.5
Increased calmness/relaxation	2	10.5
Increased self-confidence	4	21.1
Increased focus/concentration	8	42.1
NA	1	5.3
Of the following, please rank the top three you perceive as potential benefits of meditation?		
Improved emotional regulation	2	10.5
Increased attention/awareness	7	36.8
Increased calmness/relaxation	5	26.3
Increased focus/concentration	4	21.1
NA	1	5.3
Do you believe that meditation could have an impact your athletic performance?		
Yes	13	68.4
Maybe	5	26.3
No	1	5.3
Do you associate meditation as a religious or spiritual practice?		

Yes	2	10.5
Maybe	3	15.8
No	14	73.7
Do you think meditation is weird?		
Maybe	1	5.3
No	18	94.7
Has your perception of meditation changed since participating in this program?		
Yes	12	63.2
No	7	36.8

APPENDIX H

IRB APPROVAL LETTER

APPROVAL: EXPEDITED REVIEW

Jennifer Huberty
SNHP: Exercise Science and Health Promotion
-
Jennifer.Huberty@asu

.edu Dear Jennifer

Huberty:

On 9/14/2017 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Feasibility of a mobile meditation application to improve psychological factors affecting performance in baseball players
Investigator:	Jennifer Huberty
IRB ID:	STUDY00006803
Category of review:	(7)(b) Social science methods, (7)(a) Behavioral research
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Demographics, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Phase 2 Satisfaction, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Calm Prescription, Category: Participant materials (specific directions for them); • Recruitment Email, Category: Recruitment Materials; • IRB Protocol, Category: IRB Protocol; • Treatment Informed Consent, Category: Consent Form; • 7 Days of Calm Satisfaction, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

	• Control Informed Consent, Category: Consent Form; • Phase 1 Satisfaction, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Phase 2 Informed Consent, Category: Consent Form; • Email Scripts, Category: Participant

The IRB approved the protocol from 9/14/2017 to 9/13/2018 inclusive. Three weeks before 9/13/2018 you are to submit a completed Continuing Review application and required attachments to request continuing approval or closure.

If continuing review approval is not granted before the expiration date of 9/13/2018 approval of this protocol expires on that date. When consent is appropriate, you must use final, watermarked versions available under the "Documents" tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Tiffany Dowling
Rachel DeFurio
Ryan Eckert
Matthew
Buman
Christine
Glissmann
Tiffany
Dowling
Lynda Ransdell
Jennifer
Huberty
Tristin
Shackelford
Jennifer
Matthews