STUDENT ATHLETES' PERCEPTION OF SMARTPHONE USE AND ITS EFFECTS ON SLEEP QUALITY, ANXIETY, AND DEPRESSION

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STUDENT ATHLETES’ PERCEPTION OF SMARTPHONE USE AND ITS EFFECTS ON SLEEP QUALITY, ANXIETY, AND DEPRESSION

By

Alexis Schaefer

THESIS

Submitted to
Northern Michigan University
In partial fulfillment of the requirements
For the degree of

MASTER OF EXERCISE SCIENCE

Office of Graduate Education and Research

June 2018
ABSTRACT

This study investigated the perception of smartphone use and its perceived effects on sleep quality, depression, and anxiety among NCAA collegiate student athletes (SA). One hundred and ninety one Northern Michigan University SA’s completed an online questionnaire consisting of original content and select components from the Pittsburgh Sleep Quality Index (PSQI), Generalized Anxiety Disorder Assessment (GAD-7), Patient Health Questionnaire (PHQ-9), and the Mobile Phone Problem Use Scale (MPPUS). Pearson product moment correlations examined relationships between demographic information and perception questions. Correlations examined relationships between perception questions and the corresponding health based questionnaire (i.e. “Do you believe your smartphone use has increased or decreased your feelings of anxiety” and the GAD-7). Results indicated that there was a moderate correlation (r=0.513) between the perception of smartphone use increasing depression and the perception of smartphone use increasing anxiety. In conclusion, excessive smartphone use, specifically pre-bedtime smartphone use is a stressor that negatively affects sleep. While this technological device continues to evolve and become increasingly present in all aspects of human life, the chances of negative consequences also continue to increase. Athletes must gain a deeper understanding of healthy sleep and how it can be optimized for maximal performance.
ACKNOWLEDGMENTS

I would like to express my extreme gratitude for all who contributed to the success of my thesis. I am grateful to my director, Dr. Marguerite Moore, who encouraged me push myself in the scientific research process and explore beyond my comfort zone. To my committee members, Dr. Randall Jensen, Dr. Julie Rochester, Dr. Yuba Gautam, thank you for your endless support and encouragement throughout this process. I could not have completed this without the intellect and support of all three of you.

I would like to thank the Northern Michigan University coaches and student athletes that allowed me to take time from their busy schedules and encourage participation. I would like to thank those that actually took the time to complete the survey and contribute to the research process. Involvement in studies such as these helps move the healthcare of student athletes in a positive direction and the involvement does not go unnoticed.

This thesis follows format requirements specified by the School of Health and Human Performance at Northern Michigan University and the Journal of Psychology.
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CHAPTER 1: JOURNAL MANUSCRIPT

INTRODUCTION:

The use of smartphones in America is a trend that continues to climb with each passing year. The number of Americans that own a smartphone has increased 35% in the past six years alone (Street, NW, Washington, & Inquiries, 2017). While the limitless capabilities of smartphones provide innovation and opportunity for humans, the negative consequences of increased smartphone use are becoming apparent in populations. Through physiological and psychological means, smartphones have created issues in driving (Feldman, 2011), the ability to interact and create relationships (Walsh, 2010), self-esteem (Ehrenberg, 2008), personality disorders (Butt & Phillips, 2008), depression (Elhai, Tiamiyu, et al., 2017; Elhai, Levine, Dvorak, & Hall, 2016), anxiety (Elhai et al., 2016), and sleep (Hysing et al., 2015; Lemola, 2014). While objective data on real time smartphone use is still rudimentary, self-reported data is easily collected and has been found to be moderately correlated with actual smartphone use (Andrews, Ellis, Shaw, & Piwek, 2015).

According to a 2017 survey the Pew Research Center, 92% of Americans age 18-29 own a smartphone (Street et al., 2017). This is the most of any age group polled. During this life period, individuals are typically going through post-secondary education, experiencing the trials of being a young adult, navigating the process of making deep relationships, learning how to be independently self-sufficient, meeting their potential partner, getting their first job, and getting married and starting a family (“Growth and Development, Ages 18 and Over-What Parents Need to Know,” n.d., “Late
Adolescence,” n.d.; Shaban, n.d.). The issues that smartphones can create, added to the already tumultuous developmental period this population is going through, can amplify negative consequences.

College students have many aspects of their lives that they are trying to balance, including their academic, social, mental, and physical health. Coupling the expectations in each of these realms with the reality that college aged individuals are still learning how to function as independent adults, sleep is commonly a component of health that is neglected. While young adults require an average of eight to ten hours of sleep each night (“Teens and sleep,” 2015), it has been found that, on average, college students get a total of six to seven hours of quality sleep a night ("Sleep rocks....get more of it", 2016). Gaultney (2010), found that 27% of the college students he assessed presented with enough severe signs and symptoms that they could be diagnosed with at least one sleep condition. While one of the factors cited as leading to this deprived sleep is poor studying habits (Hershner & Chervin, 2014), a second predominant factor is the use of electronic devices before bed (Jones & Madden, 2002). While smartphone overuse is rampant among college students (Lee et al., 2014), few realize that the screens of electronic devices, specifically smartphones, emit light wavelengths that are at a high enough frequency to disrupt the body’s natural circadian rhythm and suppress melatonin, the hormone found in the human body that assists with natural sleep patterns (Lanaj, Johnson, & Barnes, 2014). Studies have reported that individuals who continue to use a smartphone for non-telephone purposes before bed experience poorer sleep quality and greater reports of following day sleepiness when compared to non-smartphone users (Punamäki, 2007; Rathore, 2016)
When the quality of sleep decreases, mood disorders and psychological issues may develop over time. It has been found that when sleep quality drops, prevalence of anxiety and depression increase (Nyer et al., 2013). The relationship between sleep and anxiety and depression is bidirectional. Studies have found that the sleep disturbance commonly presents itself at the same time of anxiety and depression symptoms (Ford & Kamerow, 1989; Gregory, Casp, & Eley, 2005). Poor sleep is considered a risk factor for developing anxiety and depression and problematic sleep can worsen symptom severity in patients (Cox & Olantunji, 2016; Gillin, 1998; Gregory et al., 2005). Because of the bidirectional relationship between sleep quality, depression, and anxiety, worsening symptoms in one of the three components has a high potential of increasing the severity of symptoms of the other two components as well.

Collegiate student athletes encounter all the stresses of being a university student with the added stress and expectation of being a competitive student athlete. Collegiate athletes must push themselves to great physical and mental levels to reach performance goals on the court or field. In addition to the stressors of their sports, these individuals must push themselves through the added physical and mental strain of being a student. Armstrong and colleagues (2009), found that collegiate athletes have a higher prevalence of depression, a lower feeling of social connectedness, and lower reports of self-esteem when compared to their non-athletic collegiate student counterparts. All of these findings predispose student athletes to sleep disturbances, which then in turn, exacerbate present anxiety and depression or predispose them to other psychological issues. Ramifications of poor sleep can also reverberate through a collegiate athlete’s performance. Reported effects of sleep deprivation on exercise performance indicate that lack of sleep leads
athletes to reach levels of exhaustion faster, reduce muscle glycogen concentrations sooner, reduce voluntary force in isometric muscle activation, and increase the perception of effort (Fullagar et al., 2014). With an understanding of the negative ramifications that result from sleep disturbance, athletes must gain a deeper understanding of good sleep and how it can be optimized for maximal performance (Simpson, Gibbs, & Matheson, 2016), and how stress that negatively impacts sleep should be avoided. Smartphones are devices that, if not used appropriately or at appropriate times in the day, have the potential to be a negative stressor.

While there are multiple studies that discuss the impact of smartphone use on reports of sleep in adolescents, university students, and the general population; there are no studies that examine the relationship between perception of smartphone use and sleep among athletes. Sleep helps improve athletic performance quality but lack of sleep is related to mood disorders like anxiety and depression, research is necessary to explore these components. Research is even more critical with the consideration that collegiate athletes are a population that appear to be predisposed to psychological issues such as anxiety and depression.

This study may direct athletes to pursue a healthier sleep routine and healthier smartphone habits that will positively influence their athletic performance and overall quality of life. This investigation could also make coaches, athletic trainers, strength and conditioning coaches, teammates, and parents aware of the dangers of poorly timed smartphone use and the importance of sleep in the life of their athletes. Furthermore, this study may serve as an educational resource to encourage decreased smartphone use before bed. A potential advancement that may be derived from this study, and future
studies to come, is the development of a smartphone application that can help regulate smartphone use as bedtime approaches. Athletes themselves, parents, or coaches could then potentially set parameters on nonessential smartphone applications that are the primary causes of smartphone overuse before bedtime.

The purpose of this study was to investigate student athletes’ perception of their smartphone use and whether this perception correlates with their reports of sleep quality, anxiety, and depression. This study hypothesized that student athletes who report poor sleep quality will have a positive correlation with anxiety and depression. In addition to this, it is hypothesized that individuals who report higher levels of smartphone use will display a correlation with poor sleep quality.

**METHODS**

*Participants*

Four hundred and fifty NCAA collegiate athletes were recruited to participate in this study. Out of the four hundred and fifty surveys sent out two hundred and seventeen were submitted back to the researchers. Out of the two hundred and seventeen submitted surveys, twenty-six were not completed fully and were excluded. One hundred and ninety-one completed the survey and were included in this study (n=191, male: 77, female: 114, age: 20.1±1.4). All participants were recruited from Northern Michigan University collegiate varsity teams. Emails containing the link to the survey were sent out to all athletes inviting them to participate in the study. Meetings were also scheduled with participating teams in order to provide background information regarding the study. Athletes were encouraged to take the survey during or shortly after these meetings. Interested participants reviewed and completed the consent form as approved by the
Institutional Review Board at Northern Michigan University (HS17-890) (Appendix H). After consenting, participants were given access to the rest of the questionnaire (Appendix A). Participants were asked to verify that they were at least 18 years of age and that they owned a smartphone. Participants not meeting these two criteria were automatically excluded from the survey. To encourage participation, all subjects were given the option to provide their email to enter into a drawing to win one of four $25 gift cards to a local store. If a subject chose to participate in the drawing, they clicked a link at the end of the Qualtrics survey and were taken to a separate survey in order to maintain the participant’s anonymity in the original survey.

DATA COLLECTION

Questionnaire

The portion of the survey assessing sleep quality, anxiety, and depression was created borrowing components from the Pittsburgh Sleep Quality Index (PSQI), Generalized Anxiety Disorder Assessment (GAD-7), and the Patient Health Questionnaire (PHQ-9). The portion of the survey assessing perception of smartphone use was taken from the Mobile Phone Problem Use Scale (MPPUS). The portion of the survey assessing perception of smartphone use in relation to sleep quality, anxiety, and depression were original content.

Permission to use the PSQI was gained through an online request to the University of Pittsburgh Department of Psychiatry (Appendix F). The copyright for the PHQ-9 and GAD-7 was formerly held with Pfizer. However, this is no longer the case and permission is no longer required to reproduce, translate, display, or distribute the PHQ-9. Previous studies that utilized the MPPUS did not state gaining permission and
simply cited the original articles by Bianchi and Phillips. Access to the original article was requested and attained through the library system at Northern Michigan University (Appendix G).

Pittsburgh Sleep Quality Index (PSQI): This questionnaire has 24 items that retrospectively measure sleep quality over seven dimensions. Scores from each area are added together for a global score. A score greater than five indicates a positive score for sleep disturbance (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). (Appendix B)

Generalized Anxiety Disorder Assessment (GAD-7): This is a 13 item questionnaire that asks patients how often they are bothered by varying symptoms of anxiety. The GAD-7 is a valid and efficient tool for general anxiety screening and assessing the severity of the disorder (Spitzer, Kroenke, Williams, & Löwe, 2006). (Appendix C)

Patient Health Questionnaire (PHQ-9): This is a 9 item questionnaire that assesses depression symptomology in the general population. It is based on the Diagnostic and Statistical Manual of Mental Disorders, 4th (DSM-IV) criteria for depression and is a useful tool at recognizing not only major depression, but sub threshold depressive disorder as well (Martin, Rief, Klaiberg, & Braehler, 2006). (Appendix D)

Mobile Phone Problem Use Scale (MPPUS): The 27 items on this questionnaire positively correlates with self-reported mobile phone use. The MPPUS has been used in past psychological research and is considered a good tool for measuring general use of mobile phones. Cronbach’s alpha was reported to be $\alpha = 0.91$ (Bianchi & Phillips, 2005). (Appendix E)
STATISTICAL ANALYSIS

Using SPSS v.24 software (SPSS Inc, Chicago, IL), Pearson product moment was used to calculate the correlations between perception, smartphone use, sleep quality, anxiety, depression, and demographic information. Cronbach’s alpha analysis was performed on the survey to analyze the internal validity. Parametric Likert scales with a range of 20 were used for the original content perception questions to promote normal distribution. The data was plotted prior to Pearson product moment correlational analysis in order to assess normal distribution. Pearson product moment ($r$) was used to determine magnitude of correlation using the following classification: $\pm 0.160 < r < \pm 0.290$ weak to low correlation; $\pm 0.300 < r < \pm 0.490$ low to moderate correlation; $\pm 0.500 < r < \pm 0.690$ moderate correlation; $\pm 0.700 < r < \pm 0.890$ strong correlation; $\pm 0.900 < r < \pm 1.00$ very strong correlation (DeLong, DeLong, & Clarke-Pearson, 1988). $P$ value was set apriori at $p \leq 0.05$.

RESULTS

Demographics

The average age of respondents was 20.1 ±1.4. The average academic level of the respondents was sophomore level (Mean: 2.4 ±1.2). The student athlete participants reported an average of 18.3 ±6.8 hours a week spent on sport related workouts, practices and games. The average number of hours spent on the smartphone each day was 5.2 ±2.9. Bedtimes and wake up times were divided into categories on the survey (i.e. 8-9 pm, 9-10 pm etc.) Each category was assigned a numerically value starting with one and ascending from there. The average assigned numerical score that represented average bedtime reported was 6.7 ±1.1. This score correlated with an average bedtime of 11 pm to 12 am the. Likewise, the average assigned numerical score that represented average morning
Wake up time was 8.2 ±1.4. This score correlated with an average morning wake up time of 7-8 am. The student athletes reported it taking an average of 29.5 ±18.4 minutes to fall asleep. However, despite these reported time frames, the student athletes felt that, on average, they were only getting 6.9 ±1.3 hours of sleep each night. A summary of demographic descriptive statistics can be found in Table 1.

When ranking what their smartphones were used for, the student athletes reported social media as first, texting or messaging second, phone calls third, emailing fourth, school or work related tasks as sixth, athletic performance related (i.e. watching film, technique improvement articles) as seventh, games, health related apps, and news all tied for eighth, fantasy sports as tenth, and gambling as eleventh. Because mode was used to assess the ranking of what smartphones were used for, and there were three uses tied for eighth position, there were no uses ranked in fifth or ninth place.

Cronbach’s alpha (α) was performed on all Likert scale questions to measure the internal consistency of the questionnaire. Cronbach’s alpha was 0.875, indicating a high level of internal consistency. When assessing Cronbach’s alpha if an item was deleted, all resulting scores were similar to 0.875 except for the question “Since the start of the 2017-2018 school year, how long (in minutes) does it take you to fall asleep at night?” If this question was removed, Cronbach’s alpha would reach 0.925.
### Table 1: Demographic Data

<table>
<thead>
<tr>
<th></th>
<th>Female (n=114)</th>
<th>Male (n=77)</th>
<th>Total (n=191)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>19.9 ± 1.2</td>
<td>20.5 ± 1.6</td>
<td>20.1 ± 1.4</td>
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<tr>
<td><strong>Grade</strong></td>
<td>Soph. 2.4 ± 1.1</td>
<td>Soph. 2.4 ± 1.2</td>
<td>Soph. 2.4 ± 1.2</td>
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<tr>
<td><strong>Hours Spent in Sport Participation/Week</strong></td>
<td>18.1 ± 6.0</td>
<td>18.7 ± 7.8</td>
<td>18.3 ± 6.8</td>
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<tr>
<td><strong>Hours Spent on Smartphone/Day</strong></td>
<td>5.0 ± 2.4</td>
<td>5.7 ± 3.6</td>
<td>5.3 ± 2.9</td>
</tr>
<tr>
<td><strong>Bedtime</strong></td>
<td>11 pm-12 am 6.6 ± 1.0</td>
<td>11 pm-12 am 7.0 ± 1.2</td>
<td>11 pm-12 am 6.7 ± 1.1</td>
</tr>
<tr>
<td><strong>Wake Up Time</strong></td>
<td>7-8 am 8.2 ± 1.4</td>
<td>7-8 am 8.2 ± 1.4</td>
<td>7-8 am 8.2 ± 1.4</td>
</tr>
<tr>
<td><strong>Time to Fall Asleep (Minutes)</strong></td>
<td>28.4 ± 16.5</td>
<td>31.2 ± 20.9</td>
<td>29.5 ± 18.4</td>
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<tr>
<td><strong>Actual Amount of Sleep (Hours)</strong></td>
<td>7.0 ± 1.1</td>
<td>6.9 ± 1.6</td>
<td>7.0 ± 1.3</td>
</tr>
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</table>

Characteristics of Northern Michigan University student athlete participants displayed in mean ± SD

### Perception Questions and Demographics

Pearson correlations were calculated between questions 1, 2, 3, 4, 6, 8, 9, 10, 11, 14, 16, 17, 18, and 19 (Table 2). A strong correlation (r=0.77) was found between academic level and age. Moderate to low correlations were found between average bedtime and number of hours of actual sleep (r=-0.32) average bedtime and rated overall sleep quality (r=0.38), and average bedtime and number of hours of actual sleep (r=-0.49). Moderate correlations were found between smartphone use increasing or decreasing depression and smartphone use increasing or decreasing anxiety (r=0.51) and how long, in minutes, it takes to fall asleep and how you would rate overall sleep quality (r=0.54). All other correlations were weak to low.
Table 2: Pearson correlations between questions 1, 2, 3, 4, 6, 8, 9, 10, 11, 14, 16, 17, 18, 19

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1: Sex
2: Age
3: Academic Grade or Year in School
4: On average, how many hours a week do you participate in your sport related work-outs, practices, and games?
6: On average, how many hours a day do you use your smartphone?
8: Since the start of the 2017-2018 school year, which of the following best represents your average bedtime?
9: Since the start of the 2017-2018 school year, about how long (in minutes) does it take you to fall asleep each night?
10: Since the start of the 2017-2018 school year, which of the following best represents the time at which you get up in the morning?
11: Since the start of the 2017-2018 school year, how many hours of actual sleep do you believe you get each night?
14: Since the start of the 2017-2018 school year, how would you rate your overall sleep quality?
16: Since the start of the 2017-2018 school year, how many nights a week do you get into bed with the intention to go to sleep, but end up staying up later due to your smartphone use?
17: Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your sleep quality?
18: Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of anxiety?
19: Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of depression?

*significant at the p<.05 level ** significant at the p<.01 level
Pearson correlations were calculated between all components of questions 12, 13, 14, 16, and 17 (Table 3). Moderate to low correlations were found between “Since the start of the 2017-2018 school year, how would you rate your overall sleep quality” and “Since the start of the 2017-2018 school year how many night during the week do you have trouble sleeping because….. of waking up in the middle of the night or early morning” ($r=0.404$); feeling restless” ($r=0.425$); having a racing mind” ($r=0.403$), and having uncontrolled worrisome and anxious thoughts” ($r=0.337$). Moderate to low correlations were found between “Since the start of the 2017-2018 school year, how would you rate your overall sleep quality” and “Since the start of the 2017-2018 school year how many days during the week have you…..had trouble staying awake during school, athletics, or social activities ($r=0.442$) and had a problem keeping up enthusiasm to get things done ($r=0.467$). A moderate correlation was found between “Since the start of the 2017-2018 school year, how would you rate your overall sleep quality” and “Since the start of the 2017-2018 school year how many nights during the week do you have trouble sleeping because you cannot get to sleep within 30 minutes” ($r=0.529$). All other correlations were weak to low.
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Since the start of the 2017-2018 school year, how many nights during the week do you have trouble sleeping because….
12.1: …cannot get to sleep within 30 minutes
12.2: …wake up in the middle of the night or early morning
12.3: …have to get up to use the bathroom
12.4: …cannot breathe comfortably
12.5: …cough or snore loudly
12.6: …feel too cold
12.7: …feel too hot
12.8: …have bad dreams
12.9: …have pain
12.10: …feel restless
12.11: …experience numbness/tingling
12.12: …have a racing mind
12.13: …have uncontrolled worrisome and anxious thoughts

Since the start of the 2017-2018 school year, how many days during the week have you….
13.1: …taken medicine (prescribed or over the counter) to help with sleep
13.2: …had trouble staying awake during school, athletics, or social activities
13.3: …had a problem keeping up enough enthusiasm to get things done
14: Since the start of the 2017-2018 school year, how would you rate your overall sleep quality?
16: Since the start of the 2017-2018 school year, how many nights a week do you get into bed with the intention to go to sleep, but end up staying up later due to your smartphone use?
17: Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your sleep quality?

*significant at the p≤.05 level ** significant at the p≤.01 level
Perception Questions and Anxiety/Depression Questions

Pearson correlations were calculated between questions 15, 18, and 19 (Table 4). Moderate to low correlations were found between “Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of anxiety” and “Since the start of the 2017-2018 school year how many days of the week have you experienced….feeling nervous, anxious, or on edge (r=0.326); trouble relaxing (r=0.339); and feeling bad about yourself or feeling that you are a failure or let yourself or family down (r=0.333). A moderate to low correlation was found between “Since the start of the 2017-2018 school year, do you believe that your smartphone has increased or decreased your feelings of depression” and “Since the start of the 2017-2018 school year, how many days of the week have you experienced feeling bad about yourself or that you are a failure or have let yourself or family down” (r=0.308). All other correlations were weak to low.
Since the start of 2017-2018 school year, how many days of the week do you experience…
15.1: …not being able to stop or control worrying?
15.2: …feeling nervous, anxious, or on edge?
15.3: …worrying too much about different things?
15.4: …trouble relaxing?
15.5: …being so restless that it is hard to sit still?
15.6: …becoming easily annoyed or irritable?
15.7: …feeling afraid, as if something awful might happen?
15.8: …little interest or pleasure in doing things?
15.9: …feeling down, depressed, or hopeless?
15.10: …trouble falling or staying asleep or sleeping too much?
15.11: …feeling tired or having little energy?
15.12: …poor appetite or overeating?
15.13: …feeling bad about yourself or that you are a failure or have let yourself or your family down?
15.14: …trouble concentrating on things such as reading homework or watching television?
15.15: …moving or speaking slowly enough that other people could have noticed?
15.16: …being so fidgety or restless that you have been moving around a lot more than usual?
15.17: …thoughts that you would be better off dead, or of hurting yourself in some way?
18: Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of anxiety?
19: Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of depression?

*significant at the p≤.05 level ** significant at the p≤.01 level

**Table 4: Pearson Correlations between questions 15, 18 and 19**

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Perception Questions and Mobile Phone Use Questions

Pearson correlations were calculated between questions 14, 16, 17, 18, 19, and 20 (Table 5). Moderate to low correlations were found between “Since the start of the 2017-2018 school year, how many nights a week do you get into bed with the intention to go to sleep, but end up staying up later due to your smartphone use?” and “Since the start of the 2017-2018 school year, have you dealt with any of the following issues……I find myself occupied on my mobile phone when I should be doing other things and it causes problems (r=0.357); sometimes when I am on the mobile phone and I am doing other things, I get carried away with the conversation and I don’t pay attention to what I am doing (r=0.352); I have attempted to spend less time on my mobile phone but am unable to (r=0.310); I find it difficult to switch off my mobile phone (r=0.316); my productivity has decreased as a direct result of the time I spend on the mobile phone (r=0.344); I find myself engaged on the mobile phone for longer periods of time than intended (r=0.63) and a moderate correlation with “I lose sleep due to the time I spend on my mobile phone” (r=0.594). Moderate to low correlations were found between “Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your sleep quality” and “Since the start of the 2017-2018 school year, have you dealt with any of the following issues….I find myself occupied on my mobile phone when I should be doing other things and it causes problems (r=-0.318) and I find myself engaged on the mobile phone for longer periods of time than intended (r=-0.347). Moderate to low correlations were found between “Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of anxiety” and “Since the start of the 2017-2018 school year, have you dealt with any of the following issues….my productivity has decreased as a direct result of the time I spend on the mobile phone (r=0.380) and I find myself engaged on the mobile
phone for longer periods of time than intended (r=0.346). All other correlations were weak to low.

Table 5: Pearson Correlations between questions 14, 16, 17, 18 and 19

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*significant at the p≤.05 level, ** significant at the p≤.01 level
DISCUSSION

The purpose of this study was to evaluate the perception of smartphone use and its effect on sleep quality, depression, and anxiety among collegiate student athletes. The relationship between sleep quality, depression, and anxiety is multifaceted and bidirectional. A deficit in one
of these areas has the potential to lead to deficits in the other areas, creating a negative cyclical pattern that is hard to break (Ford & Kamerow, 1989; Gregory et al., 2005; Nyer et al., 2013). Smartphone use is shown to have the potential to negatively impact sleep quality, depression, and anxiety through physiological and psychological means (Ehrenberg et al., 2008; Lanaj et al., 2014; Walsh et al., 2010). Collegiate student athletes are a population with a heightened vulnerability to the negative influence of smartphone use and they are burdened with an increased risk of falling victim to the sleep quality, anxiety, and depression triad. This is due to the expectation and nature of being a collegiate student athlete (Armstrong & Oomen-Early, 2009). This study attempted to tie together these variables to gain greater insight into these relationships.

**Perception of the Impact of Smartphone Use and Population Demographics**

While there are gender differences between how external stress cues are processed, studies find that there is not a significant difference in the rate of depression reports among males and females (Garnefski, Teerds, Kraaij, Legerstee, & van den Kommer, 2004). However, there is a difference between genders regarding reports of anxiety. Women have higher rates of lifetime anxiety diagnoses, however the literature indicates no gender difference regarding age of onset (McLean, Asnaani, Litz, & Hofmann, 2011). While no strong correlations were found between gender and the perception questions in this study, it is important to note the finding of two different statistically significant correlations and the direction of relationship. The questions that asked whether the respondents felt that their smartphone use was increasing or decreasing their feelings of anxiety (r=0.178) and depression (r=0.174) were significant at the p≤0.05 level and had a positive relationship with gender. These findings indicate that females have the potential to be more likely to report that their phone use negatively influences their feelings of anxiety and
depression. A statistically significant correlation at the p≤0.01 level was found between gender and the question asking about average bedtime (r=-0.205), indicating that females tended to report an earlier bedtime.

Age also plays a part in the ability of individuals to positively regulate emotions and respond appropriately to smartphone based stimuli (Demirci, Akgönül, & Akpinar, 2015; van Deursen, Bolle, Hegner, & Kommers, 2015). Due to natural human development, individuals of lower chronological age tend to have lower levels of emotional intelligence and self-regulation. However, in the world of social media, younger aged individuals are also experiencing higher levels of social stress (van Deursen et al., 2015). Because of the combination of these variables, younger people may be more likely to develop unhealthy smartphone use habits. This theory was supported in part by this current study. While not correlated strongly, a statistically significant correlation at the p≤0.01 level was found between age and “How many nights a week do you get into bed with the intention to go to sleep, but end up staying up later due to your smartphone use?” (r=-0.187). This indicates that the younger the student athlete, the more likely they were to stay up later on their smartphone.

Interestingly, the number of reported hours spent in sports related activity did not correlate with negative sleep quality. While no studies were found assessing collegiate student athletes in this relationship, a study done by Lund et al. (2010) assessed one thousand and one hundred twenty-five collegiate aged students and found that over 60% of them fell within the poor-sleep quality category with the predominant reported cause of this problem being emotional and academic stress. Considering that collegiate student athletes have emotional, academic, and sport related stress, the expectation would be that there would be a strong correlation between
increased hours in sport participation and poorer sleep quality. This relationship may have been teased out comparing in season to out of season athletes.

Sleep Quality

A moderate correlation was found between the question “Since the start of the 2017-2018 school year, how would you rate your overall sleep quality” and PSQI based questions. This result supports the fact that the PSQI is a tool that assesses sleep quality. However, there is only one low to moderate correlation when comparing the PSQI question scores to perceptions involving smartphone use and sleep quality. This indicates that, when focusing on sleep quality first, there is a misalignment between the feelings of poor sleep quality and the perception that smartphone use is related to it. This discrepancy between perception and reality is not uncommon in studies of smartphone use or studies of sleep quality.

The negative ramifications of poor sleep quality are seen in memory, vasomotor performance, reasoning ability, and motivation. However, despite objective measurable detriments in these areas and many others, self-perception and self-evaluation of performance does not decrease (Alhola & Polo-Kantola, 2007). In fact, a study by Harrison and Horne (2000) found that participants who were deprived of sleep for 36 hours became more confident in answers to cognitive based questions as the duration of the study progressed and that the participants reported even stronger confidence when the answer was, in fact, wrong. This shows that there is a gap between objective measurements of poor sleep and subjective reports of poor sleep.
Anxiety and Depression

Anxiety and depression are psychological disorders that go hand in hand due to the many overlapping signs and symptoms that define them both (Jansson-Fröjmark & Lindblom, 2008). This study found that anxiety and depression still hold that close relationship when involving perception of smartphone use. A moderate correlation was found between the questions “Since the start of the 2017-2018 school year do you believe your smartphone use has increased or decreased your feelings of depression?” and “Since the start of the 2017-2018 school year do you believe your smartphone use has increased or decreased your feelings of anxiety?” However, despite the correlation between the two perception questions regarding smartphone use and the level of increasing or decreasing anxiety and depression, no strong correlations were found for the components of the GAD-7 or PHQ-9, which are surveys used as a first step to assess clinical anxiety and depression. This indicates that while the subjects may have perceived they were anxious and/or depressed as a result of their smartphone use, smartphone use did not have a relationship with satisfying actual criteria, via the GAD-7 and PHQ-9, necessary to be diagnosed with the disorders.

While many people believe that a defined boundary exists between having psychological disorders and not having psychological disorders, clinicians agree that mental conditions such as anxiety and depression function on a continuum (Maj, 2016). Feelings of anxiety and depression can range from situational, where an individual has a short period of time that they experience the signs and symptoms associated with these psychological disorders, to clinically diagnosed, where the signs and symptoms reach a frequency and severity that satisfy criteria put forth by the DSM-IV (Lovibond & Lovibond, 1995; Maj, 2016; Turner, Beidel, & Larkin, 1986). However, each individual experiences these disorders differently and the ability to truly objectively define
what they are subjectively experiencing remains somewhat ambiguous. Because of the lack of relationship between the perception specific questions and GAD-7 and PHQ-9 based questions, the current study suggests that the feelings of increased anxiety and depression associated with smartphone use may be more of a situational experience as opposed to a clinically diagnosable disorder. However, because anxiety and depression function on a continuum, there is potential for these situational feelings to progress to a clinically diagnosed disorder.

**Mobile Phone Use**

The current study found low to moderate correlations and one moderate correlation between varying questions of the MPPUS and the perception questions “Since the start of the 2017-2018 school year, how many nights a week do you get into bed with the intention to go to sleep, but end up staying up later due to your smartphone use?” and “Since the start of the 2017-2018 school year do you believe that your smartphone use has increased or decreased your sleep quality?” These relationships indicate that when focusing on problematic mobile phone use first, SAs do perceive it negatively influencing sleep quality. Cabre et al. (2017), assessed MPPUS scores and sleep quality in a group of 17-18 year old adolescents. They found that subjects with higher MPPUS scores were more likely to report worse sleep quality.

In the same way, actual smartphone use compared to perceived smartphone use is inconsistent. Andrews et al. (2015) compared subjective reports of total smartphone use and number of smartphone “checks” in a day to objective measurements taken from an app designed to measure the total time the smartphone was activated and how many times the smartphone was activated. While it was found that the subjects’ perceptions of total smartphone use had a moderate relationship with objective measurements, there was a lack of accurate perception in regards to the number of times they checked their smartphones in a day.
All these findings shine light onto the complexity of the relationship between perception and reality. While the well-known relationship between anxiety and depression is supported in the current study, the relationship between sleep and smartphone use remains ambiguous. The subjects appear to have a disconnect between understanding that poor sleep quality and negative mobile phone use are interrelated and that subjective and objective reports are not one-in-the-same.
CHAPTER 2: LITERATURE REVIEW

Smartphones are a useful tool that have become a household item. However, as smartphone use increases, research regarding the negative ramifications of excessive or improper use lags behind. Some known negative consequences are impaired driving (Feldman et al., 2011), lowered self-esteem (Ehrenberg et al., 2008), lowered sleep quality (Hysing et al., 2015; Lemola et al., 2014), and increased anxiety and depression (Elhai, Tiamiyu, et al., 2017; Elhai et al., 2016). Young adults age 16-29 are a population that owns more smartphones than any other age group in America (Street et al., 2017). This age group makes up a majority of college students, a group of individuals who struggle with sleep quality issues do the high demand of social, academic, physical, and mental success in college (American College Health Association, 2012; Gaultney, 2010). Collegiate students do admit that the use of their smartphones are a source of added psychological stress to their already stressful life (Lee et al., 2014; Punamäki et al., 2007; Rathore et al., 2016). Research finds that whenever psychological issues increase, specifically anxiety and depression, sleep quality decreases (Cox & Olantunji, 2016; Ford & Kamerow, 1989; Gillin, 1998; Gregory et al., 2005; Nyer et al., 2013). Collegiate student athletes are a population that are predisposed to anxiety and depression because of the added expectation to perform in their sport in addition to normal stress of being a college student (Armstrong & Oomen-Early, 2009). Sleep is also that much more important to the collegiate student athlete population because of its impacts on physical and athletic performance (Fullagar et al., 2014; Simpson et al., 2016).

This study attempts to tie together these many variables and investigate student athletes’ perception of their smartphone use and whether this perception correlates with their reports of sleep quality, anxiety, and depression. This literature review breaks down these variables by
going over growing smartphone use, smartphone use and college students, the physiological and psychological relationship between sleep quality, anxiety, and depression, and the relationship between collegiate student athletes and sleep quality, anxiety, and depression.

**Growing Smartphone Use**

Approximately 95% of Americans own some kind of cell phone with 77% of Americans owning a smartphone specifically. In 2011, only 35% of Americans owned a smartphone, proving that smartphones are quickly becoming common household objects that almost all individuals will come into contact with at some point in their lives (Street et al., 2017). In a 2017 poll, 100% of participants 18-29 years old owned any kind of cellphone with 92% of them owning a smartphone (Street et al., 2017). This was the highest percentage of smartphone owning individuals among all age groups polled. The high rate of smartphone ownership among this specific age group has the potential to interfere with the typical physical, mental, emotional, social, and psychological development that most 18-29 year olds are experiencing.

Perception studies involving smartphone use are a relatively new and untapped area of research with limitless areas to investigate. There are studies that look at the perception of professionalism surrounding smartphone use (Patel, Lidor, Sanyal, Goepfert, & Hueppchen, 2017), the perception of risk associated with using smartphones (Harback, 2014), and the perception of how smartphone use has improved medical practice (Buchholz, Perry, Weiss, & Cooley, 2016; Hsieh, Yun, Bhatia, Hsu, & Ruiz de Luzuriaga, 2015). However, studies that compare self-reported perceived smartphone use to real-world smartphone use are minimal.

Andrews et al. (2015) measured self-reported estimates of smartphone use and compared the results to data generated by a smartphone application that recorded a timestamp when the
phone became active and inactive. It was found that estimates of self-perceived smartphone use correlated moderately with actual smartphone use. However, while the overall perception of use was close to actual use, subjects under reported the number of times that they checked their phone by almost 50%. A *check* was defined as using the phone for up to 15 seconds. Based on this study, it can be inferred that individuals are acutely aware of how much total time they spend on their phone, but are not as aware of the number of times they pull out and check their phone (Andrews et al., 2015).

**Smart Phone Light**

All artificial light sources, such as smartphones, laptops, televisions, and tablets, emit lights with varying intensities and wavelength frequencies. White light is made up of a spectrum of different colors, with red light having the lowest frequency wavelength and blue/violet light having the highest frequency wavelength (“Electromagnetic Spectrum - Introduction,” n.d.). Exposure to artificial light has been associated with an increased risk of breast cancer, suppression of melatonin secretion, increased sleep onset latency, increased nighttime alertness, and alterations in circadian rhythm. Circadian rhythm disruption caused by artificial light has potential negative effects on natural physiological, cardiovascular, and/or metabolic functionality (Cho et al., 2015).

**The Relationship between College Students, Sleep, and Smartphone Use**

Being a collegiate student requires the ability to balance psychological, academic, social, and physical stress. However, in order to succeed in these four areas, collegiate student frequently sacrifice other areas of life that they deem less important. One area of life that
frequently takes a hit is sleep. While college aged individuals require eight to ten hours of sleep to function at optimal mental levels, most only get six to seven hours a night (*Sleep rocks....get more of it*, 2016, “Teens and sleep,” 2015). The American College Health Association (2012) state that 60% of the college students polled report feelings of sleepiness and being tired for at least three days out of the week. What’s more, Gaultney et al. (2010) found that 27% of the 1800 college students assessed satisfied enough criteria to be diagnosed with a clinical sleep disorder.

While many collegiate students report that the cause of this poor sleep quality is poor studying habits (Hershner & Chervin, 2014), others report that the use of electronic devices, specifically smartphones, are to blame (Jones & Madden, 2002). Lee et al. (2014) conducted an observational study of 95 collegiate students in order to assess smartphone use and habits. In his words “overuse was rampant among college students” and smartphone use interfered with other aspects of the collegiate students’ lives. The students assessed agreed that smartphone use did decrease their functionality in studying, socializing, and even eating (Lee et al., 2014).

**Multifaceted Relationship between Sleep Quality, Anxiety, and Depression**

When sleep disturbance occurs, biological and physiological detriments include altered hormone release (Shechter & Boivin, 2010), chronic pain (Smith & Haythornthwaite, 2004), weight gain (Arble, Bass, Laposky, Viaterna, & Turek, 2009), obesity (Kobayashi, Takahashi, Deshpande, Shimbo, & Fukui, 2012), hypertension (Wang, Xi, Liu, Zhang, & Fu, 2012), and increased risk of diabetes (Chao, Wu, & Yang, 2011). In addition to the physiological systems effected by sleep disturbance, aspects of psychological health are also negatively impacted. Reports of increased depression (Wirz-Justice & Van den Hoofdakker, 1999), increased anxiety
(Nyer et al., 2013), and decreased cognitive function (Nyer et al., 2013) correlate with disruption of sleep.

**Effects on the Limbic System**

Neuroimaging studies have established that a frontolimbic relationship regulates the interaction between sleep and emotions (Etkin & Kalisch, 2011; Hariri, Mattay, & Tessitore, 2003). Gruber and Cassoff (2014) investigated emotion processing and sleep mechanics further, and found that sleep disturbance negatively modifies the frontolimbic neurologic connections. These altered connections result in a limbic system that is hyper-reactive to negative stimuli. In addition to the disruption of the frontolimbic relationship, sleep disturbance also upsets the circulation and release of mood regulating hormones (Steiger, Dresler, Kluge, & Schüssler, 2013).

**Effects on mood**

Connections can be drawn between the neurological and biochemical alterations caused by sleep disturbance and psychiatric illness; specifically anxiety and depression (Klumpp et al., 2017). In longitudinal studies that tracked the onset of sleep disturbance in relation to psychiatric illness, the symptoms of sleep disturbance frequently manifested at the same time of the psychiatric symptom manifestation (Ford & Kamerow, 1989; Gregory et al., 2005). Reports state that sleep disturbance is considered a risk factor in the development and control of mood disorders, such as anxiety and depression and that poor sleep quality may make mood disorder symptoms worse (Cox & Olantunji, 2016; Ford & Kamerow, 1989; Gillin, 1998; Gregory et al., 2005). The relationship between depression, anxiety, and sleep quality are multifaceted and
cyclical (Fig. 1), with symptoms of one disorder commonly exacerbating or creating symptoms in another disorder.

![Diagram showing the relationship between depression, anxiety, and sleep disturbance](image)

Figure 1: The relationship between depression, anxiety, and sleep disturbance is multifaceted and cyclical

**Physiological Relationship between Smartphone Use and Sleep Quality, Anxiety, and Depression**

While overall problematic smartphone use is related to depression severity, anxiety, and stress, the timing of smartphone use also has a specific relationship with anxiety and depression through its effect on sleep quality (Elhai, Dvorak, Levine, & Hall, 2017; Woods & Scott, 2016). That is, nighttime specific smartphone use has a stronger relationship with poor sleep quality than overall smartphone use and that poor sleep quality leads to anxiety and depression. When smartphone use is later in the day, specifically at bedtime, it triggers a negative physiological cascade that results in poor sleep. There are two specific pathways through which this can happen, the first being the relationship between light and sleep and the second being interference with sleep hygiene (Lanaj et al., 2014).
Sleep Hygiene

Sleep specialists coined the term *sleep hygiene* to describe human patterns and actions that encourage healthy sleep quality. Poor sleep hygiene occurs when pre-bedtime routines involve sleep-disturbing products (e.g., caffeine), arousing activities that activate the brain, or when the bed is used for any physical activities other than sleep that delay the process of falling and staying asleep, including work or eating (Gellis & Lichstein, 2009). Smartphone use before bedtime falls in the category of an activity that stimulates the brain and arouses a sense of being awake (Brunborg et al., 2011). This in turn leads to poor sleep hygiene and disruption of the circadian rhythm. Figure 2 demonstrates the chain reaction that starts with smartphone use, specifically pre-bedtime smartphone use, leading to potentially poor sleep quality, anxiety, and depression.

Circadian Rhythm

Human beings have biological regulation of sleep and wake cycles that is governed by the circadian rhythm, a clocklike mechanism that is controlled by the suprachiasmatic nuclei of the hypothalamus (Borb & Achermann, 1999; Czeisler, 1999; Dijk & Czeisler, 1995; Lavie, 2001). Receptors in the eyes take constant measurements of the amount and kind of light that filters through. When the amount of light dips below a certain threshold, and the eyes take note that it is dark, a signal is relayed to the pineal gland to secrete melatonin, the primary hormone responsible for suppressing the body’s wakefulness mechanisms and allowing sleep mechanisms to take over (Lavie, 2001). Therefore light directly inhibits melatonin production and prevents the body’s sleep mechanisms to initiate rest. Brainard et al. (1988) found that light well below that of a typical indoor light triggers the threshold that suppresses melatonin production. Light
receptors in the eyes are not the only source of information that control melatonin and circadian rhythm. Campbell and Murphy (1998) found that a small light pulse shined on the posterior aspect of the knee has the ability to disrupt melatonin and circadian rhythm. Therefore, late night exposure to even the small amount of light emitted from smartphones has the ability to suppress melatonin, delay the circadian rhythm, and disrupt sleep.

**Melatonin**

Melatonin release also responds differently depending on the kind of light the eye receptors receive. It has been found that exposure to blue light, the predominant wavelength emitted from smartphone screens, suppresses melatonin release twice as long as exposure to green light (Tosini, Ferguson, & Tsubota, 2016). Research suggests that altering the levels of blue light emitted from smartphones or even using blue lighting blocking sunglasses can help individuals protect healthy melatonin levels while still utilizing their smartphones at night (Oh, Yoo, Park, & Do, 2015; Sasseville, Paquet, Sévigny, & Hébert, 2006).
Figure 2: The chain of events starting from pre-bedtime smartphone use to sleep disturbance, anxiety, and depression

Psychological Relationship between Smartphone Use and Sleep Quality, Anxiety, and Depression

Not only do smartphones interfere with sleep quality, anxiety, and depression through physiological means, there is a significant psychological relationship between the variables as well. Specifically, social media use on smartphones is found to lead to lower feelings of self-esteem (Ehrenberg et al., 2008), lower abilities to interact and create meaningful relationships (Walsh et al., 2010), increased depression (Elhai, Tiamiyu, et al., 2017; Elhai et al., 2016), increased anxiety (Elhai, Dvorak, et al., 2017; Elhai et al., 2016), and decreased sleep quality (Hysing et al., 2015; Lemola et al., 2014). While these findings answer what happens with problematic smartphone use, research is still discovering why and how problematic smartphone
use leads to these psychological issues. Hadar et al. (2017) conducted a study in which a group of heavy smartphone using subjects were matched and compared with subjects lacking experience with smartphones. The two groups had various behavioral and electrophysiological measurements taken to assess if heavy smartphone use interfered with brain activity. The measurements utilized electroencephalogram (EEG) and transcranial magnetic stimulations (TMS). The study found that heavy usage was associated with decreased attention, decreased numerical processing, and alterations in social cognition. Heavy smartphone use correlated with a reduction in the excitability of the prefrontal cortex; an area of the brain responsible for cognitive control, creating goals, and orchestrating means to achieve the goals (Hadar et al., 2017).

*Emotional Dysregulation*

A recent theoretical model states that problematic phone use is driven by individuals seeking excessive reassurance, having an inability to regulate impulsivity, and exhibiting extraversion (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015). Inability to regulate non-essential impulses stems off decreased emotional dysregulation. Emotional dysregulation is defined by the processes of decreased cognitive reappraisal and increased emotional suppression (Gross, 1998; Gross & John, 2003). Billieux et al. (2015) proposed that problematic phone users abuse their devices because of their inability to regulate their emotions, specifically negative emotions. A study found that undergraduate college students surveyed had associations between emotional suppression and smartphones used for entertainment and social information gathering (Hoffner & Lee, 2015).
**Fear of Missing Out**

Elhai et al. (2016), built off this model and added a phenomena called *fear of missing out* or FoMO. FoMO is a recently labeled personality construct that occurs when individuals that fall within the extraversion pathway experience feelings of distress or reluctance to miss out on important information. The fear of FoMO and the need to maintain a sense of connectedness drives excessive social media use, especially among college students (Alt, 2015; Przybylski, Murayama, DeHaan, & Gladwell, 2013).

![Diagram](image)

Figure 3: Chain of events starting from social media driven smartphone use to depression, anxiety, and sleep disturbance.

**Collegiate Athletes and Sleep Quality, Anxiety, and Depression**

Collegiate athletes are expected to successfully function at a high intellectual level in college level classes. However, in addition to the responsibilities of a typical college student,
student athletes are also expected to physically perform at a highly competitive level within their sport. The combination of physical and psychological stress that student athletes must endure can predisposes this population to injury and illness. One study by Armstrong & Oomen-Early (2009), found that collegiate athletes have a higher prevalence of depression, a lower feeling of social connectedness, and higher reports of low self-esteem when compared to their non-athletic collegiate student counterparts.

**Poor Quality Sleep Ramifications**

Many athletes reported poor sleep quality and attained less sleep compared to non-athletes (Simpson et al., 2016). Many athletes experience poor sleep quality specifically around times of competition, reporting thoughts regarding the competition or feelings of nervousness as the cause of lack of sleep (Juliff, Halson, & Peiffer, 2015). Sleep plays a vital role in the process of learning new tasks (Maquet, 2001), the formation of memories (Stickgold & Walker, 2013), the function of the immune system (Bryant, Trinder, & Curtis, 2004), and the general recuperation of the body after physical exertion (Wesensten, Balkin, & Belenky, 1999). Lastella, Lovell, & Sargent (2014) found that 70% of 103 athletes reported poorer sleep than usual on pre-competition nights. Most of these athletes reported anxiety, noise, early event times, and the need to use the restroom as the top reasons causing their sleep to fall well below the required eight hours. Lastella et al. (2014) went on to conclude that the feelings of fatigue and tension significantly increased as precompetitive sleep quality decreased. Despite all the evidence supporting the fact that athletes experience poor sleep, specifically around times of competition, many athletes and teams still lack a clear strategy to overcome sleep quality issues (Juliff et al., 2015). Student athletes are a population that are predisposed to psychological disorders, before smartphone use is considered (Armstrong & Oomen-Early, 2009). Combining this population’s
predisposition to the psychological disorders associated with excessive smartphone use and poor sleep quality creates a highly vulnerable population. Figure 4 breaks down the multiple variables and characteristics of collegiate student athletes that create this vulnerability.

Figure 4: Summary of interaction between collegiate student athletes, smartphones, sleep quality, anxiety, and depression

CONCLUSIONS

Excessive smartphone use, specifically pre-bedtime smartphone use is a stressor that negatively affects sleep. While this technological device continues to evolve and become increasingly present in all aspects of human life, the chances of negative consequences also continue to increase. Athletes must gain a deeper understanding of healthy sleep and how it can be optimized for maximal performance. They must also understand the negative ramifications of sleep disturbance and how it can hurt them both physically and psychologically (Simpson et al., 2016).
Conclusions

While most of the correlations found in the present study were not strong, it is important to note the statistical significance and direction of the correlations. Although significant correlations do not carry much weight if the r value is not high, they can lend credence to a consistent pattern that is occurring. This will allow future research to more specifically target to certain demographics and learn about these patterns. In addition to this, the direction of the correlations hold meaning as to what association is occurring between the variables and it should not be overlooked.

When tying together the many variables, the current study indicates that the SA population surveyed has a stronger awareness of smartphone use and its effect on anxiety and depression as opposed to its effect on sleep quality. While the perception of smartphone use increasing anxiety correlated strongly with the perception of smartphone use increasing depression, there was a less clear relationship between the perception of smartphone use and sleep quality. However, because the literature supported a cyclical relationship between sleep quality, anxiety, and depression, there is most likely a correlation occurring that did not present in this study due to its limitations.

When assessing anxiety and depression alone, this study suggests that the perception of smartphone use increasing anxiety and depression may fall more on the situational psychological disorder side of the continuum as opposed to the clinically diagnosed side of the continuum. While this is positive in the fact that it would appear although the SA’s in this study do not yet
meet DSM criteria for anxiety and depression, education is necessary to keep it from progressing down the continuum.

**Limitations**

One limitation of this study was questionnaire formatting error. For the sake of creating a questionnaire that could be administered once, the original surveys that questions were taken from were altered. This distorted the scoring system for each survey and led to the inability to create one representative numerical score for each section. Because of this, the correlations done were between each individual question. While this still lead to insightful information, it is not as representative as could be. Therefore, future studies should administer the original questionnaires without modification or create modifications capable of being scored similarly to the originals.

Another limitation was that survey administration time and environment was not controlled, or recorded. The teams took the surveys at varying times of the day, in varying points in their seasons, in varying environments. Individuals who were out of season may report better sleep quality or lower anxiety and depression compared to a point when they were in season. Future studies should either control for timing of survey administration or have a year round survey to gain a full picture of how these variables may fluctuate during a season.

Self-reported data and convenient population sample also limit this study. We can only assume that the subjects completed the survey in an unbiased manner. In addition to that, because of the unique size, setting, and geographical location of Northern Michigan University, results from this study may not be generalized on other populations.

**Recommendations**
Future research regarding the relationship between these variables should focus on specific genders, individual vs. team sports, coaching styles, specific social media use, and socioeconomic status of school setting. All of these variables have the potential to influence smartphone use, sleep quality, anxiety, and depression in student athletes.
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Appendix A
Informed Consent and Questionnaire
Student Athletes’ Perception of Smartphone Use and its Effect on Sleep Quality, Depression, and Anxiety

Alexis Schaefer

Start of Block: Informed Consent

The purpose of this study is to investigate if collegiate student athletes perceive their smartphone use to affect their sleep quality, anxiety, and depression in any way. This is a research project being conducted by Alexis Schaefer, AT ATC at Northern Michigan University. You are invited to participate in this research project because you are a collegiate athlete at Northern Michigan University.

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. If you do choose to participate, there is an opportunity to participate in a drawing for one of four $25 Target gift cards. Information for this drawing will be at the end of the survey.

The procedure involves filling an online survey that will take approximately 10 minutes. Your responses will be confidential and we do not collect identifying information such as your name or sport. The survey questions will be about sleep quality, anxiety, and depression. Due to the nature of some of the questions, there is a risk of a negative psychological impact.

Your part in this study is anonymous. That means you answers to all questions are private. No one else can know if you participated in this study and no one else can find out what your answers were. Any reports will be based on group data and will not identify you or any individual as being in this project. All data is stored in a password protected electronic format. This survey will not contain questions that will personally identify you. The results of this study will be used for scholarly purposes only and may be shared with Northern Michigan University representatives. You will not personally benefit from this study, however, we hope that others may benefit in the future from what we learn as a result of this study.

If you have any questions about the research study, please contact the primary investigator Alexis Schaefer at aschaefe@nmu.edu, the study director Dr. Maggy Moore at mmoore@nmu.edu, or the NMU Institutional Review board Office Asst. Provost of Graduate Education and Research Dr. Rob Winn at rwinn@nmu.edu. This research has been reviewed according to Northern Michigan University IRB procedures for research involving human subjects.
I have read the above "Informed Consent Statement." I understand the risks and demands of this research project. I am at least 18 years old. I understand that I may ask questions and that I am free to remove myself from this research project at any time for any reason without incurring negative consequences. I also understand that this informed consent document along with all other personal data collected will only be accessed by the principle investigators. I consent voluntarily to be a participant in this study.

- Yes, I have read the "Informed Consent Statement" and will be a participant in this study (1)
- No, I will not participate in this study (2)

The purpose of this study is to investigate if collegiate student athletes perceive their smartphone... = No, I will not participate in this study

End of Block: Informed Consent

Start of Block: Demographic Information

Q1 Sex

- Male (1)
- Female (2)
- Prefer not to specify (3)

Q2 Age

<table>
<thead>
<tr>
<th></th>
<th>18</th>
<th>21</th>
<th>23</th>
<th>26</th>
<th>28</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ()</td>
<td>![Bar Graph]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

55
Q3 Academic Grade or Year in School

- Freshman (1)
- Sophomore (2)
- Junior (3)
- Senior (4)
- Fifth Year Senior (5)
- Graduate Student (6)

Q4 On average, how many HOURS a week do you participate in your sport related work-outs, practices, and games?  

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Total Number of HOURS (

Q5 Do you own a smartphone?  

- Yes (1)
- No (2)

Skip To: End of Survey If Do you own a smartphone? = No

Q6 On average, how many HOURS a day do you use your smartphone?  

Not Applicable

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>2</th>
<th>5</th>
<th>7</th>
<th>10</th>
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<th>14</th>
<th>17</th>
<th>19</th>
<th>22</th>
<th>24</th>
</tr>
</thead>
</table>
Q7 What functions or apps do you spend most of your time on when using your smartphone? Please rank (drag and drop) the following functions or apps in order of most used (1) to least used (11).

1. Social media (Instagram, Facebook, Instagram, Snapchat, Youtube, Vine, Tinder)
2. Gambling
3. Games
4. Texting or Messaging
5. Phone calls
6. Emailing
7. School or Work related
8. Health or Workout related (Health tracker apps, Meal preparation apps)
9. Fantasy Sports League related
10. Athletic Performance related (Watching film, technique improvement articles)
11. News related (Current events, Financial, Sports, Lifestyle)

End of Block: Demographic Information

Start of Block: General Sleep Information
Q8 Since the start of the 2017-2018 school year, which of the following best represents your average bedtime?

- 5 - 6 PM (1)
- 6 - 7 PM (2)
- 7 - 8 PM (3)
- 8 - 9 PM (4)
- 9 - 10 PM (5)
- 10 - 11 PM (6)
- 11 - 12 AM (7)
- 12 - 1 AM (8)
- 1 - 2 AM (9)
- 2 - 3 AM (10)
- 3 - 4 AM (11)
- 4 - 5 AM (12)
- 5 - 6 AM (13)

Q9 Since the start of the 2017-2018 school year, about how long (in minutes) does it take you to fall asleep each night?

Number of Minutes ()

0 18 36 54 72 90 108 126 144 162 180
Q10 Since the start of the 2017-2018 school year, which of the following best represents the time at which you get up in the morning?

- 12 - 1 AM (1)
- 1 - 2 AM (2)
- 2 - 3 AM (3)
- 3 - 4 AM (4)
- 4 - 5 AM (5)
- 5 - 6 AM (6)
- 6 - 7 AM (7)
- 7 - 8 AM (8)
- 8 - 9 AM (9)
- 9 - 10 AM (10)
- 10 - 11 AM (11)
- 11 - 12 PM (12)
- 12 - 1 PM (13)
- 1 - 2 PM (14)
- 2 - 3 PM (15)

Q11 Since the start of the 2017-2018 school year, how many hours of actual sleep do you believe you get each night? (This may be different from the number of hours you spend in bed)

<table>
<thead>
<tr>
<th>Number of Hours ()</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
</tbody>
</table>

---

59
Q12 Since the start of the 2017-2018 school year, how many nights during the week do you have trouble sleeping because...

<table>
<thead>
<tr>
<th>Issue</th>
<th>How Many Nights of the Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>...cannot get to sleep within 30 minutes ()</td>
<td>7</td>
</tr>
<tr>
<td>...wake up in the middle of the night or early morning ()</td>
<td>7</td>
</tr>
<tr>
<td>...have to get up to use the bathroom ()</td>
<td>7</td>
</tr>
<tr>
<td>...cannot breathe comfortably ()</td>
<td>7</td>
</tr>
<tr>
<td>...cough or snore loudly ()</td>
<td>7</td>
</tr>
<tr>
<td>...feel too cold ()</td>
<td>7</td>
</tr>
<tr>
<td>...feel too hot ()</td>
<td>7</td>
</tr>
<tr>
<td>...have bad dreams ()</td>
<td>7</td>
</tr>
<tr>
<td>...have pain ()</td>
<td>7</td>
</tr>
<tr>
<td>...feel restless ()</td>
<td>7</td>
</tr>
<tr>
<td>...experience numbness/tingling ()</td>
<td>7</td>
</tr>
<tr>
<td>...have a racing mind ()</td>
<td>7</td>
</tr>
<tr>
<td>...have uncontrolled worrisome and anxious thoughts ()</td>
<td>7</td>
</tr>
</tbody>
</table>
Q13 Since the start of the 2017-2018 school year, how many days during the week have you...  

<table>
<thead>
<tr>
<th>How Many Days of the Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

- ...taken medicine (prescribed or over the counter) to help with sleep? ()
- ...had trouble staying awake during school, athletics, or social activities? ()
- ...had a problem keeping up enough enthusiasm to get things done? ()

Q14 Since the start of the 2017-2018 school year, how would you rate your overall sleep quality?

- Very good (1)
- Fairly good (2)
- Neutral (3)
- Fairly bad (4)
- Very bad (5)

End of Block: Sleep Quality Information

Start of Block: Anxiety and Depression Information

Q15 Since the start of the 2017-2018 school year, how many DAYS of the week have you experienced....  

<table>
<thead>
<tr>
<th>How Many DAYS of the Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>
...not being able to stop or control worrying? ()

...feeling nervous, anxious, or on edge? ()

...worrying too much about different things? ()

...trouble relaxing? ()

...being so restless that it is hard to sit still? ()

...becoming easily annoyed or irritable? ()

...feeling afraid, as if something awful might happen? ()

...little interest or pleasure in doing things? ()

...feeling down, depressed, or hopeless? ()

...trouble falling or staying asleep, or sleeping too much? ()

...feeling tired or having little energy? ()

...poor appetite or overeating? ()

...feeling bad about yourself - or that you are a failure or have let yourself or family down? ()

...trouble concentrating on things such as reading homework or watching television? ()

...moving or speaking slowly enough that other people could have noticed? ()

...being so fidgety or restless that you have been moving around a lot more than usual? ()

...thoughts that you would be better off dead, or of hurting yourself in some way? ()

---

End of Block: Anxiety and Depression Information

Start of Block: Perception of Smartphone Use Information

Q16 Since the start of the 2017-2018 school year, how many nights a week do you get into bed with the intention to go to sleep, but end up staying up later due to your smartphone use?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q17 Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your sleep quality?

<table>
<thead>
<tr>
<th>Greatly Decreased</th>
<th>N/A</th>
<th>Greatly Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q18 Since the start of the 2017-2018 year, do you believe that your smartphone use has increased or decreased your feelings of anxiety?

<table>
<thead>
<tr>
<th>Greatly Decreased</th>
<th>N/A</th>
<th>Greatly Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

...
Q19 Since the start of the 2017-2018 school year, do you believe that your smartphone use has increased or decreased your feelings of depression?

<table>
<thead>
<tr>
<th>Greatly Decreased</th>
<th>N/A</th>
<th>Greatly Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9 -8 -7 -6 -5 -4 -3 -2 -1</td>
<td>0</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>


Q20 Since the start of the 2017-2018 school year, have you dealt with any of the following issues? Please rate each scenario 1-10, with 1 being "not true at all" and 10 being "extremely true"

<table>
<thead>
<tr>
<th>Not true at all</th>
<th>Extremely true</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4 6 9 10</td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td>Rating</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>I can never spend enough time on my mobile phone</td>
<td></td>
</tr>
<tr>
<td>I have used my mobile phone to make myself feel better when I was feeling down</td>
<td></td>
</tr>
<tr>
<td>I find myself occupied on my mobile phone when I should be doing other things, and it causes problems</td>
<td></td>
</tr>
<tr>
<td>All my friends own a mobile phone</td>
<td></td>
</tr>
<tr>
<td>I have tried to hide from others how much time I spend on my mobile phone</td>
<td></td>
</tr>
<tr>
<td>I lose sleep due to the time I spend on my mobile phone</td>
<td></td>
</tr>
<tr>
<td>I have received mobile phone bills I could not afford to pay</td>
<td></td>
</tr>
<tr>
<td>When out of range for some time, I become preoccupied with the thought of missing a call or text</td>
<td></td>
</tr>
<tr>
<td>Sometimes, when I am on the mobile phone and I am doing other things, I get carried away with the conversation and I don't pay attention to what I am doing</td>
<td></td>
</tr>
<tr>
<td>The time I spend on the mobile phone has increased over the last 12 months</td>
<td></td>
</tr>
<tr>
<td>I have used my mobile phone to talk to others when I was feeling isolated</td>
<td></td>
</tr>
<tr>
<td>I have attempted to spend less time on my mobile phone but am unable to</td>
<td></td>
</tr>
<tr>
<td>I find it difficult to switch off my mobile phone</td>
<td></td>
</tr>
<tr>
<td>I feel anxious if I have not checked for messages or switched on my mobile phone for some time</td>
<td></td>
</tr>
<tr>
<td>I have frequent dreams about the mobile phone</td>
<td></td>
</tr>
<tr>
<td>My friends and family complain about my use of the mobile phone</td>
<td></td>
</tr>
<tr>
<td>If I don't have a mobile phone, my friends would find it hard to get in touch with me</td>
<td></td>
</tr>
<tr>
<td>My productivity has decreased as a direct result of the time I spend on the mobile phone</td>
<td></td>
</tr>
<tr>
<td>I have aches and pains that are associated with my mobile phone use</td>
<td></td>
</tr>
<tr>
<td>I find myself engaged on the mobile phone for longer periods of time than intended</td>
<td></td>
</tr>
<tr>
<td>There are times when I would rather use the mobile phone than deal with other more pressing issues</td>
<td></td>
</tr>
<tr>
<td>Statement</td>
<td>Agreement</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>I am often late for appointments because I'm engaged on the mobile phone when I shouldn't be ()</td>
<td></td>
</tr>
<tr>
<td>I become irritable if I have to switch off my mobile phone for meetings, dinner engagements, or at the movies ()</td>
<td></td>
</tr>
<tr>
<td>I have been told that I spend too much time on my mobile phone ()</td>
<td></td>
</tr>
<tr>
<td>More than once I have been in trouble because my mobile phone has gone off during a meeting, lecture, or in a theatre ()</td>
<td></td>
</tr>
<tr>
<td>My friends don't like it when my mobile phone is switched off ()</td>
<td></td>
</tr>
<tr>
<td>I feel lost without my mobile phone ()</td>
<td></td>
</tr>
</tbody>
</table>

Display This Question:

If The purpose of this study is to investigate if collegiate student athletes perceive their smartphones as essential, = Yes, I have read the “Informed Consent Statement” and will be a participant in this study

Q21
To thank you for your participation, we invite you to participate in a drawing for one of four $25 Target gift cards.

Please understand that if you choose to participate in the drawing, your participation will no longer be anonymous. However, the information you provide will remain confidential and will be stored in a password protected electronic format. In addition, following the completion of this study, all personal identifying information will be destroyed. By clicking on the link below, you are agreeing to these terms.

If you would like to participate in a drawing for one of four $25 Target gift cards, please go to the following link:

https://www.surveymonkey.com/r/CYFTQQF

End of Block: Perception of Smartphone Use Information
Appendix B
Pittsburg Sleep Quality Index
Sleep Quality Assessment (PSQI)

What is PSQI, and what is it measuring?
The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates “poor” from “good” sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month.

INSTRUCTIONS:
The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

During the past month,
1. When have you usually gone to bed?
2. How long (in minutes) has it taken you to fall asleep each night?
3. What time have you usually gotten up in the morning?
4. A. How many hours of actual sleep did you get at night?
B. How many hours were you in bed?

5. During the past month, how often have you had trouble sleeping because you
   Not during the past month (1)
   Less than once a week (2)
   Once or twice a week (3)
   Three or more times a week (3)
   A. Cannot get to sleep within 30 minutes
   B. Wake up in the middle of the night or early morning
   C. Need to get up to use the bathroom
   D. Cannot breathe comfortably
   E. Cough or sneeze loudly
   F. Feel too cold
   G. Feel too hot
   H. Have bad dreams
   I. Have pain
   J. Other reason (s), please describe, including how often you have had trouble sleeping because of this reason (s):

6. During the past month, how often have you taken medicine (prescribed or over the counter) to help you sleep?

7. During the past month, how often have you had trouble staying asleep while driving, eating meals, or engaging in social activities?

8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?

9. During the past month, how would you rate your sleep quality overall?
   Very good (1)
   Fairly good (2)
   Fairly bad (3)
   Very bad (3)

Scoring

Component 1 # Score
Component 2 # Score (15 min (2), 16-30 min (1), 31-60 min (2), >60 min (3))
Component 3 # Score (0-1), 2-3, 4-5, 6-7)
Component 4 # Score (0); 1-2, 3-4, 5-6, 7-8, 9-10
Component 5 # Score (0); 1-2, 3-4, 5-6, 7-8, 9-10
Component 6 # Score
Component 7 # Score + # Score (0-1, 2-3, 4-5, 6-7)

Add the seven component scores together

Global PSQI

A total score of “5” or greater is indicative of poor sleep quality.
If you scored “5” or more it is suggested that you discuss your sleep habits with a healthcare provider.
Appendix C
Generalized Anxiety Disorder Assessment
## Generalized Anxiety Disorder 7-item (GAD-7) scale

<table>
<thead>
<tr>
<th>Over the last 2 weeks, how often have you been bothered by the following problems?</th>
<th>Not at all sure</th>
<th>Several days</th>
<th>Over half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Feeling nervous, anxious, or on edge</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Not being able to stop or control worrying</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Worrying too much about different things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Trouble relaxing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Being so restless that it's hard to sit still</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Becoming easily annoyed or irritable</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Feeling afraid as if something awful might happen</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Add the score for each column: +   +   +

Total Score (add your column scores) =

---

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all
Somewhat difficult
Very difficult
Extremely difficult

---

Appendix D
Patient Health Questionnaire
**PATIENT HEALTH QUESTIONNAIRE (PHQ-9)**

**NAME: ____________________________**  
**DATE: ____________________________**

Over the last 2 weeks, how often have you been bothered by any of the following problems?  
*(use "x" to indicate your answer)*

<table>
<thead>
<tr>
<th></th>
<th>No 1 at all</th>
<th>Several days</th>
<th>More than half the days</th>
<th>Nearly every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Little interest or pleasure in doing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Feeling down, depressed, or hopeless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Trouble falling or staying asleep, or sleeping too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Feeling tired or having little energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Poor appetite or overeating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Feeling bad about yourself—or that you are a failure or let yourself or your family down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Trouble concentrating on things, such as reading the newspaper or watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Moving or speaking so slowly that other people could have noticed. Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Thoughts that you would be better off dead, or of hurting yourself</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(add columns:  
**TOTAL:** __________)

*(Healthcare professional: For interpretation of TOTAL, please refer to accompanying scoring card.)*

<table>
<thead>
<tr>
<th></th>
<th>Not difficult at all</th>
<th>Somewhat difficult</th>
<th>Very difficult</th>
<th>Extremely difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
<td>__________</td>
</tr>
</tbody>
</table>

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A25603B 10-104-2005
Appendix E
Mobile Phone Problem Use Scale
<table>
<thead>
<tr>
<th></th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I can never spend enough time on my mobile phone.</td>
</tr>
<tr>
<td>2.</td>
<td>I have used my mobile phone to make myself feel better when I was feeling down.</td>
</tr>
<tr>
<td>3.</td>
<td>I find myself occupied on my mobile phone when I should be doing other things and it causes problems.</td>
</tr>
<tr>
<td>4.</td>
<td>All my friends own a mobile phone.</td>
</tr>
<tr>
<td>5.</td>
<td>I have tried to hide from others how much time I spend on my mobile phone.</td>
</tr>
<tr>
<td>6.</td>
<td>I lose sleep due to the time I spend on my mobile phone.</td>
</tr>
<tr>
<td>7.</td>
<td>I have received mobile phone bills I could not afford to pay.</td>
</tr>
<tr>
<td>8.</td>
<td>When out of range for some time, I become preoccupied with the thought of missing a call.</td>
</tr>
<tr>
<td>9.</td>
<td>Sometimes, when I am on the mobile phone and I am doing other things, I get carried away with the conversation and I don’t pay attention to what I am doing.</td>
</tr>
<tr>
<td>10.</td>
<td>The time I spend on the mobile phone has increased over the last 12 months.</td>
</tr>
<tr>
<td>11.</td>
<td>I have used my mobile phone to talk to others when I was feeling isolated.</td>
</tr>
<tr>
<td>12.</td>
<td>I have attempted to spend less time on my mobile phone but I am unable to.</td>
</tr>
<tr>
<td>13.</td>
<td>I find it difficult to switch off my mobile phone.</td>
</tr>
<tr>
<td>14.</td>
<td>I feel anxious if I have not checked for messages or switched on my mobile phone for some time.</td>
</tr>
<tr>
<td>15.</td>
<td>I have frequent dreams about the mobile phone.</td>
</tr>
<tr>
<td>16.</td>
<td>My friends and family complain about my use of the mobile phone.</td>
</tr>
<tr>
<td>17.</td>
<td>If I don’t have a mobile phone, my friends would find it hard to get in touch with me.</td>
</tr>
<tr>
<td>18.</td>
<td>My productivity has decreased as a direct result of the time I spend on the mobile phone.</td>
</tr>
<tr>
<td>19.</td>
<td>I have aches and pains that are associated with my mobile phone use.</td>
</tr>
<tr>
<td>20.</td>
<td>I find myself engaged on the mobile phone for longer periods of time than intended.</td>
</tr>
<tr>
<td>21.</td>
<td>There are times when I would rather use the mobile phone than deal with other more pressing issues.</td>
</tr>
<tr>
<td>22.</td>
<td>I am often late for appointments because I’m engaged on the mobile phone when I shouldn’t be.</td>
</tr>
<tr>
<td>23.</td>
<td>I become irritable if I have to switch off my mobile phone for meetings, dinner engagements, or at the movies.</td>
</tr>
<tr>
<td>24.</td>
<td>I have been told that I spend too much time on my mobile phone.</td>
</tr>
<tr>
<td>25.</td>
<td>More than once I have been in trouble because my mobile phone has gone off during a meeting, lecture, or in a theatre.</td>
</tr>
<tr>
<td>26.</td>
<td>My friends don’t like it when my mobile phone is switched off.</td>
</tr>
<tr>
<td>27.</td>
<td>I feel lost without my mobile phone.</td>
</tr>
</tbody>
</table>
Appendix F
Pittsburgh Sleep Quality Index Permission to Use
Request to use the Pittsburgh Sleep Quality Index (PSQI)

Gasiorowski, Mary <GasiorowskiMJ@upmc.edu> 11/15/17

to me

Sent on behalf of Dr. Buysse

Dear Alexis,

You have my permission to use the PSQI for your research study. You can find the instrument, scoring instructions, the original article, links to available translations, and other useful information at www.sleep.pitt.edu under the Research/Instruments tab. Please ensure that the PSQI is accurately reproduced in any on-line version (including copyright information). We request that you do cite the 1989 paper in any publications that result.

Note that Question 10 is not used in scoring the PSQI. This question is for informational purposes only, and may be omitted during data collection per requirements of the particular study.

This copyright in this form is owned by the University of Pittsburgh and may be reprinted without charge only for non-commercial research and educational purposes. You may not make changes or modifications of this form without prior written permission from the University of Pittsburgh. If you would like to use this instrument for commercial purposes or for commercially sponsored research, please contact the Office of Technology Management at the University of Pittsburgh at 412-648-2206 for licensing information.

Good luck with your research.

Sincerely,

Daniel J. Buysse, M.D.
Professor of Psychiatry and Clinical and Translational Science
University of Pittsburgh School of Medicine
E-1123 WPIC
3811 O'Hara St.
Pittsburgh, PA 15213
T: (412) 246-6413
F: (412) 246-5300
buyssedj@upmc.edu

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From: uopsc@gmail.com [mailto:uopsc@gmail.com]
Sent: Monday, November 06, 2017 3:59 PM
To: marywpic@gmail.com; Gasiorowski, Mary <GasiorowskiMJ@upmc.edu>
Subject: Request to use the Pittsburgh Sleep Quality Index (PSQI): New respondent (#785)

Request to use the Pittsburgh Sleep Quality Index (PSQI) has received a new response:

Date: 2017-11-06
Name: Alexis Schaefer
Email Address: aschaefe@nmu.edu
Organization / Institution: Northern Michigan University
Name / Brief description of project: Student Athletes' Perception of Smartphone Use and its Effects on Sleep Quality, Depression, and Anxiety
Funding Source Not Funded
Other Funding Source (if applicable):
Modification Requested (if needed)
Additional Comments

Auto notification by Form to Email add-on for Google Forms
Appendix G
Original Access to the MPPUS
NOTICE: This material may be protected by copyright law (Title 17 U.S. Code).
Appendix H
IRB Approval
Memorandum

TO:        Alena Schwab
            School of Health and Human Performance

CC:        Marjorie Moore
            School of Health and Human Performance

FROM:      Dr. Robert Wen
            Interim Dean of Arts and Sciences/IRB Administrator

DATE:      October 23, 2017

SUBJECT:   IRB Proposal #15-17-290
       "Student athletes' perception of smartphone use and its effects on sleep quality, depression, and anxiety"
       IRB Approval Dates: 10/23/2017 - 10/22/2018
       Proposed Project Dates: 10/1/2017 - 5/31/2018

Your proposal "Student athletes' perception of smartphone use and its effects on sleep quality, depression, and anxiety" has been approved under the administrative review process. Please include your proposal number (15-17-290) on all research materials and on any correspondence regarding this project.

Any changes or revisions to your approved research plan must be approved by the Institutional Review Board (IRB) prior to implementation.

If you do not complete your project within 12 months from the date of your approval notification, you must submit a Project Renewal Form for Research Involving Human Subjects. You may apply for a one-year project renewal up to four times.

All forms can be found at the IMU Grants and Research website: [http://www.imu.edu/projectsandresearchforms]