Do College Athletes Differ From College Nonathletes in Their Sleep Quality?

A thesis presented to
the faculty of
the College of Health Sciences and Professions of Ohio University

In partial fulfillment
of the requirements for the degree
Master of Science

Martha G. Dettl
May 2013
© 2013 Martha G. Dettl. All Rights Reserved.
This thesis titled
Do College Athletes Differ From College Nonathletes in Their Sleep Quality?

by

MARTHA G. DETTL

has been approved for
the School of Applied Health Sciences and Wellness
and the College of Health Sciences and Professions by

Brian G. Ragan
Assistant Professor of Athletic Training

Randy Leite
Dean, College of Health Sciences and Professions
Abstract

DETTL, MARTHA G., M.S., May 2013, Athletic Training

Do College Athletes Differ From College Nonathletes in Their Sleep Quality?

Director of Thesis: Brian G. Ragan

Current research of sleep quality in the college athlete population is limited. Self-reported sleep questionnaires provide a way to measure sleep quality in large populations, such as a college athlete population. Sleep quality has direct positive and negative effects on the mental functioning and physical functioning of the human body. **Purpose:** To use self-reported questionnaires to measure sleep quality, stress and overall health in the college athlete population and compare to a college nonathlete population. **Methods:** 285 participants (n = 166 athletes, n = 119 nonathletes) completed seven different instruments measuring sleep quality, daytime sleepiness, and daytime functioning. **Results:** Independent $t$ tests indicated there were significant sleep quality, stress, and overall health differences between samples ($P < 0.05$). **Conclusion:** College athletes have better sleep quality, less perceived stress, and overall health differences compared to the college nonathlete sample. Correlations determined the instruments were ideal to use for a sleep profile of college athletes.
Acknowledgments

I would like to thank my family and friends for the support and help throughout my academic career. Without their help, I could not have accomplished the great things because they believed in me.

This thesis could not have been completed without the assistance of Dr. Brian Ragan as well as my committee members Dr. Jeff Russell and Dr. David Horton, who have helped me tremendously. In addition, I would like to thank the athletic trainers, Rob Whitehurst at Bowling Green State University, Robert “Bob” Casmus, Leslie Dent, and Mike Eden at Catawba College, and Kelsey Divers at Ohio University for assistance with data collection.
Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>3</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>4</td>
</tr>
<tr>
<td>List of Tables</td>
<td>11</td>
</tr>
<tr>
<td>List of Figures</td>
<td>12</td>
</tr>
<tr>
<td>Chapter 1: Introduction</td>
<td>12</td>
</tr>
<tr>
<td>Purpose of Sleep</td>
<td>13</td>
</tr>
<tr>
<td>Sleep Characteristics</td>
<td>13</td>
</tr>
<tr>
<td>Positive Effects From Efficient Sleep</td>
<td>14</td>
</tr>
<tr>
<td>Negative Effects From Disrupted Sleep</td>
<td>14</td>
</tr>
<tr>
<td>Measuring of Sleep Patterns</td>
<td>15</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>15</td>
</tr>
<tr>
<td>Purpose</td>
<td>16</td>
</tr>
<tr>
<td>Professional Significance</td>
<td>16</td>
</tr>
<tr>
<td>Research Questions</td>
<td>17</td>
</tr>
<tr>
<td>Null Hypothesis</td>
<td>17</td>
</tr>
<tr>
<td>Delimitations</td>
<td>17</td>
</tr>
<tr>
<td>Limitations</td>
<td>17</td>
</tr>
</tbody>
</table>
Definition of Terms ...................................................................................................... 18

Chapter 2: Review of Literature ....................................................................................... 19

Sleep.................................................................................................................................. 19

Wakefulness and Sleep Criteria ....................................................................................... 19

Wakefulness state criteria .............................................................................................. 19

Sleep stages criteria ......................................................................................................... 20

Positive Effects of Adequate Healthy Sleep ..................................................................... 22

Sleep’s positive effects on mental functioning ............................................................... 22

Summary of positive effects sleep has on mental functioning ........................................ 23

Sleep’s positive effects on physical functioning .............................................................. 24

Summary of positive effects sleep has on physical functioning ....................................... 26

Circadian Rhythm ........................................................................................................... 27

Athletic peak performances and circadian rhythm ............................................................ 28

College Students and Sleep ............................................................................................ 30

Factors affecting sleep and circadian rhythm ................................................................... 30

Negative Consequences Associated with Disrupted Sleep ............................................ 31

Stress-health model ........................................................................................................ 32

Weight issues ................................................................................................................... 32

Mental functioning consequences of disrupted sleep .................................................... 34
Chapter 3: Methods ........................................................................................................... 55

Design of Study/Setting ................................................................................................. 55

Participants ..................................................................................................................... 55

Inclusion/exclusion criteria .......................................................................................... 55

Sample size .................................................................................................................... 55

Instruments .................................................................................................................... 56

Basic demographic form .............................................................................................. 56

Physical activity guidelines ......................................................................................... 56

PROMIS sleep-related impairment instrument ............................................................ 56

PROMIS sleep disturbance instrument ....................................................................... 57

Pittsburgh Sleep Quality Index (PSQI) ........................................................................ 57
Chapter 3: Methods

Recruitment

Athlete population

Nonathlete population

Data Collection

Electronic delivery

Paper delivery

Data Analysis

Chapter 4: Results

Introduction

Basic Demographics

NCAA division level and sport

Descriptive Statistics of Instruments

Descriptive statistics results

Sleep Differences in the Populations

Relationship Between Instruments
Appendix K: Approval Notice for Alternate Data Collection ........................................ 104

Appendix L: Letters of Support and IRB Approval at Alternate Data Collecting Sites. 105

Appendix M: Approval for Data Collection via Facebook............................................. 111

Appendix N: Permissions for Figures............................................................................. 113

Appendix O: Permission to Use PSQI Instrument.......................................................... 132

Appendix P: Consent Form............................................................................................. 134

Appendix Q: Electronic Mail Recruitment to Athletes................................................... 136
List of Tables

Table 1: Sleep’s Positive Effects on Mental Functioning .................................................. 24
Table 2: Positive Effects Sleep has on Physical Functioning .......................................... 25
Table 3: Practice/Game Schedule Based on Circadian Rhythm ........................................ 29
Table 4: Consequences of Disrupted Sleep on Mental Functioning .............................. 35
Table 5: Negative Effects Sleep has on Physical Functioning ......................................... 39
Table 6: Pittsburgh Sleep Quality Index Studies ............................................................... 48
Table 7: Example of a College Softball Athlete’s Weekday ........................................... 53
Table 8: Demographics of Total Population ................................................................. 61
Table 9: NCAA Division Level and Sport ................................................................. 63
Table 10: Descriptive Statistics of Instruments ............................................................. 65
Table 11: Sleep, Stress and Overall Health Differences .................................................. 68
Table 12: Correlation of Instruments in College Athlete Sample .................................... 72
Table 13: Correlation of Instruments in College Nonathlete Sample .............................. 73
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Typical hypnogram for a young adult</td>
<td>22</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Associated relationships between physical activity and sleep</td>
<td>27</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Stress-health model</td>
<td>32</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Reduced sleep duration-overweight cycle</td>
<td>34</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Relationship between sleep disturbance and injuries</td>
<td>38</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Pathophysiologic cycles driven by inadequate sleep</td>
<td>41</td>
</tr>
<tr>
<td>Figure 7</td>
<td>PROMIS SD &amp; SRI and SF12v2 scores</td>
<td>69</td>
</tr>
<tr>
<td>Figure 8</td>
<td>PSQI, ESS, PSS, &amp; CHIPS scores</td>
<td>70</td>
</tr>
</tbody>
</table>
Individuals spend one third of their lives in a sleeping state, averaging 5 to 10 hours a night.\textsuperscript{1-3} Sleep is essential for individuals to maintain healthy and functional lives.\textsuperscript{1} Typically, the quality of sleep is more important than the quantity of sleep.\textsuperscript{4} Current research has shown that disrupted sleep affects cognitive functioning as well as physical performance in different populations. However, sleep profiles of those populations is a necessity before determining the effect disrupted sleep has on performance in the populations. This thesis is a report on the sleep quality of the college athlete population compared to the nonathlete population. This first chapter describes the background of the study, reveals the problem statement, discusses the professional significance of the study, and describes the methodology, concluding with definitions and common terms used throughout the paper.

**Purpose of Sleep**

Sleep is essential for mental functioning and physical functioning of the body.\textsuperscript{4} Sleep provides an opportunity for the body to physically and mentally function during the wakefulness state as well as recover during the sleep state. Adequate healthy sleep leads to peak athletic performances, body recovery, optimized learning, and improved cognitive functioning.\textsuperscript{5-8}

**Sleep Characteristics**

Sleep is a neurobehavioral state,\textsuperscript{9} controlled by the body’s natural clock called the circadian rhythm. The circadian rhythm consists of wakefulness and sleep stages and determines when certain bodily functions (i.e., peak performance) are optimal on a 24-hour basis.\textsuperscript{2} There are two stages of the sleep state: nonrapid eye movement (non-REM)
and rapid eye movement (REM). Non-REM sleep and REM sleep alternate in a rhythmic pattern known as a sleep cycle.\textsuperscript{3, 10}

**Positive Effects From Efficient Sleep**

Efficient sleep positively benefits mental and physical functioning, leading to improvements in memory and learning as well as recovery and restoration of the body. New tasks learned are integrated with existing memories, resulting in better accurate memories.\textsuperscript{4} Better recall of memories results in increased reaction time speed and accuracy,\textsuperscript{3} leading to better physical performance. Sleep impacts the body’s recovery and repair as well as enhances physical activity. In order to recover from strenuous trainings, the growth hormone is released from the pituitary gland during the sleep cycle, which stimulates the protein synthesis necessary for body restoration, muscle repair and growth, bone building and fat burning.\textsuperscript{3, 4, 6} Physical activity and sleep affect each other. For instance, regular physical activity improves sleep quality, and adequate healthy sleep improves physical performance.\textsuperscript{2, 8, 11-13}

**Negative Effects From Disrupted Sleep**

Disruptions during sleep negatively impact both mental functioning and physical functioning. Research suggests that mood states and academic performances are drastically affected by disrupted sleep. First, individuals suffer from negative mood states and decreased motivation, leading to psychological stress. Secondly, academic performances are decreased because of disrupted sleep; lower grade point averages (GPAs) are often seen in students with inadequate and inconsistent sleep.\textsuperscript{14, 15}
Sleep disruptions have a negative impact on physical functioning of the body. Disrupted sleep affects hormones released, which in turn controls appetite and hunger; therefore, increased hunger leads to overeating and obesity.\textsuperscript{16-19} Health is directly affected by disrupted sleep. Specifically, the immune system is compromised, leading to infections, common colds, and upper respiratory tract infections.\textsuperscript{2,3} Finally, disruption of sleep and the circadian rhythm directly affects athletic performance negatively; daytime sleepiness caused by disrupted sleep results in poor decision-making skills in regards to performance outcomes and leads to a higher risk for injuries.\textsuperscript{3,14,15}

**Measuring of Sleep Patterns**

Typically, there are three ways to measure sleeping patterns: polysomnography, actigraphy, and self-reported sleep questionnaires. Polysomnography is an expensive tool that would require an extensive amount of time to perform sleep studies on the college athlete population. Polysomnography is often used in patients with sleeping disorders, providing the research with sleep quantity measurements.\textsuperscript{9} Next, actigraphy is an unreliable measurement because of the variability that comes with the devices (accelerometers) used and the algorithms involved to produce sleep quantity measures. Sleep quality is measured using self-reported sleep questionnaires and the questionnaires are the best approach to developing a sleep profile of the college athlete population.

**Statement of the Problem**

Little research exists regarding the sleep quality of college athletes. Research theorizes that sleep quality differs between the athlete and nonathlete populations\textsuperscript{20}; however, sleep quality differences between these two groups have not been thoroughly studied. Studies of sleep quality in a variety of athletic populations, including dancers,\textsuperscript{21}
elite athletes,\textsuperscript{20} and college basketball players,\textsuperscript{12} have demonstrated the causes of disrupted sleep on mental and physical functioning of the body. However, there are no sleep profiles on sleep quality, daytime sleepiness, and daytime functioning on the college athlete population as a whole (including all sports at a university/college, in and out of season, and NCAA Divisional level).

**Purpose**

The purpose of this thesis is to use self-reported sleep questionnaires to measure sleep quality in the college athlete population. The college athlete population’s sleep quality will be compared with a nonathlete college population with similar characteristics.

**Professional Significance**

The college athlete population is a unique population where there are many external factors directly affecting sleeping patterns. The stress of maintaining a homeostatic life between social influences, athletic commitments, and academic requirements could have a negative impact on sleep in student-athletes. Daytime sleepiness from disrupted sleep could potentially affect athletes’ ability to perform maximally and efficiently during practices and games. Poor decisions and improper skill mechanics due to daytime sleepiness can lead athletes to sustain injuries. Optimal performance during rehabilitation of an injury may be dependent on adequate healthy sleep; disrupted sleep could affect peak performances due to daytime sleepiness.
Research Questions

The research questions guiding this study are:

1. Do college athletes have efficient and better sleep quality as compared to a nonathlete college population?
2. Is there a relationship between stress and sleep quality in the college athlete and college nonathlete populations?

Null Hypothesis

H_{o1}: There is no difference in sleep quality between the college athlete population and the college nonathlete population.

H_{o2}: There is no relationship between stress and sleep quality in the college athlete and college nonathlete populations.

Delimitations

Delimitations of this study include:

1. Participants in this study are college-aged (above the age of 18 years old) and were full-time undergraduate or graduate students.
2. Student athletes included in this study were limited to student athletes competing on a NCAA sanctioned varsity team.

Limitations

Limitations of this study include:

1. The participants were required to complete all self-reported questionnaires. Any incomplete self-reported questionnaires were not scored.
2. Whether the participants truthfully answered the self-reported questionnaires was unpredictable.
3. Athletes were participating in sport at a certain time of the year: in-season, out-of-season, preseason, postseason, etc.

**Definition of Terms**

**Accelerometer:** A small electronic device used to measure movements while patient is asleep.

**Actigraphy:** A validated quantitative technique established to study sleep duration, sleep efficiency, and movement patterns during sleep.

**Circadian rhythm:** A natural biological clock, which produces synchronized rhythms of mental and physical functions during sleep states and waking states, cycling every 24 hours.

**Daytime sleepiness:** An individual feels unusually tired during the day, typically caused by sleep disturbances or disrupted sleep.

**Disrupted sleep:** An individual does not have an efficient sleep due to awakenings in the night (ie, leg cramps, temperature changes in the room, or traffic noise).

**Polysomnography:** An overnight sleep study measuring patients’ sleep cycles; the “gold standard” for measuring sleep cycles.

**Wakefulness:** Consciousness, driven by arousal of the body.
Chapter 2: Review of Literature

Sleep

A healthy adult spends one third of his/her life sleeping.\(^3\) Sleep is a neurobehavioral state\(^9\) controlled by the circadian rhythm\(^3, 18, 22\) and is essential for maintaining homeostatic functioning of the mental and the physical aspects of the body. The mechanism of sleep can be measured objectively. Researchers have been able to study *how humans sleep.*\(^{23}\) The reasoning behind the need for sleep is still unknown; the purpose behind why humans sleep and the variability of sleep quantity and quality in each individual has not been studied.

**Wakefulness and Sleep Criteria**

Sleep is defined as “the natural and regular state of inactivity in which consciousness ceases and the bodily functions slow down or cease.”\(^2\)\(^4\) (p1042) There are two types of sleep based on behavioral and physiological measures that a person cycles through during the night: rapid eye movement (REM) sleep and nonrapid eye movement (non-REM) sleep. Non-REM sleep is often described as “quiet” sleep whereas REM sleep is considered “active” sleep.\(^{22}\)

The two sleep stages are distinct from one another as well as from the wakefulness state. Sleep and wakefulness have distinct physical and behavioral characteristics, which distinguish one state from another state. The criteria of wakefulness and sleep stages are: posture, mobility, response to stimulation, level of alertness, eyelid and eye movements.\(^{18, 25}\)

**Wakefulness state criteria.** Wakefulness is described as consciousness driven by arousal of the body.\(^{26}\) The individual in a wakeful state has open eyelids with waking
eye movements (ie, acknowledging and processing surrounding environments); the individual is also mobile, participating in activities of daily living and alert to surroundings with a normal response to stimulations.\textsuperscript{18}

\textbf{Sleep stages criteria.} The sleep stages, rapid eye movement (REM) and nonrapid eye movement (non-REM), have established behavioral and physiological criteria, separating the sleep stages from wakefulness state.

\textit{Nonrapid eye movement (non-REM).} Nonrapid eye movement (non-REM) is considered the “quiet” state of sleep. An individual in non-REM state is in a recumbent or lying position and has limited mobility with occasional postural shifts. The individual has a mildly to moderately reduced response to stimulation (also known as a low arousal threshold),\textsuperscript{25} unconsciousness state, with closed eyelids and slow rolling eye movements.\textsuperscript{18} Stimulations can be any occasion that may occur such as room temperature changes, bodily functions (ie, bowel movements) or environmental sounds (cars driving by, phone ringing, etc).

\textit{Non-REM stages.} Stage one during non-REM sleep is considered a light sleep, lasting between 1 to 7 minutes. Stage one has a low arousal threshold (a person is easily awoken by external stimuli, such as a person coughing or the sound of a door opening) and is considered a transitional stage throughout the sleep cycle. Stage two lasts between 10 and 20 minutes and has a slightly higher arousal threshold as compared to stage one.\textsuperscript{3, 25} Stage three only last a couple minutes, transitioning quickly into stage four. Stage four lasts between 20 and 40 minutes with normal bodily functions slowing down, such as blood pressure, heart rate, and breathing (ie, “deep” sleep).\textsuperscript{3, 22}
Rapid eye movement (REM). An individual in rapid eye movement (REM) (“active” or “dream”) state will be in a recumbent or lying position and has moderately reduced mobility or immobility with occasional muscle jerks. The individual has moderately reduced to no response to stimulation, unconsciousness state, with closed eyelids and rapid eye movements, characterizing it as the “active” state.³,₁⁸

Rapid eye movement sleep occurs between 30 and 40 minutes after falling asleep and controls one third of a night’s sleep. The brain shifts into an active mode: breathing, heart rate, body temperature, blood pressure, and blood flow all increase as the person’s eyes dart rapidly under closed eyelids as if looking around, and muscles in the body twitch spasmodically (ie, “active: sleep”).³ “Active” sleep restores humans both mentally and emotionally: The brain completes complex mental tasks, such as memory consolidation,²⁷,²⁸ processing information and new learning,²⁹ and facilitating problem-solving and decision-making abilities;²⁹ sleep-deprived individuals report significantly more negative mood states.³

Young adult sleep cycles. In Figure 1, non-REM sleep is separated into the four stages and the amount of time a young adult spends in each stage at each cycle over an 8-hour period. As time progresses during the night, the young adults spend less time in stages three and four of non-REM sleep. Figure 1 also shows the amount of time a young adult spends in REM sleep. As the night progress, a young adult spends a longer amount of time in REM sleep later rather than at the beginning of sleep. Non-REM sleep and REM sleep alternate in the rhythmic pattern known as sleep cycle, and repeat throughout the night every 90 to 100 minutes.³,¹⁰
Figure 1. Typical hypnogram for a young adult. Note: The figure depicts a young adult’s sleep cycle. A person spends a majority of sleeping time in nonrapid eye movement (non-REM) sleep, which is divided further into four different stages. The number of sleep cycles in one night varies based on the total number of hours of sleep. The figure shows the number of sleep cycles that may occur in a period of eight total hours of sleep. Figure 1 is adapted with permission from Bjarke E, Wafford KA, Deacon S. Treating insomnia: current and investigational pharmacological approaches. *Pharmacol Ther*. 2006;112(3):612-629. Copyright 2006 Elsevier.

**Positive Effects of Adequate Healthy Sleep**

Sleep is beneficial to the mental functioning and physical functioning of the human body. Sleep leads to optimal mental functioning in terms of cognitive functioning and emotional well-being. Sleep also leads to peak physical functioning of the body, specifically with efficient body restoration and physical activity.

**Sleep’s positive effects on mental functioning.** Sleep directly influences mental functioning. Efficient sleep quality leads to optimal improvements in memory consolidation and learning. Tasks previously learned are retained while asleep; however, how tasks are retained is not well-understood and researched. Integration of new tasks is promoted within existing memories, resulting in better recall
and accurate, new memories the next day. Improved mental arithmetic skills, promotion of concentration, increased reaction time speed, and problem solving and accuracy are examples of cognitive functioning positively affected by sleep.

**Emotional well-being.** Sleep quality is linked with positive mood states and a healthier mental state. A positive outlook on life leads to positive thinking, happiness and sociability in individuals, which is preventative against stroke and cardiovascular disease, decreased levels of pain, and higher pain tolerance.

**Summary of positive effects sleep has on mental functioning.** Efficient sleep quality directly influences mental functioning. Sleep promotes cognitive functioning and improves emotional well being, as seen in various populations. Table 1 summarizes the positive effects sleep has on mental functioning.
Table 1. Sleep’s Positive Effects on Mental Functioning

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Sample</th>
<th>Mental Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fietze, 2009</td>
<td>Ballet dancers (n = 24)</td>
<td>Memory consolidation, including retention of psychomotor skills</td>
</tr>
<tr>
<td>Gaultney, 2010</td>
<td>College students (n = 1,845)</td>
<td>Optimize learning and cognitive functioning, Promotes integration of newly acquired material with existing memories</td>
</tr>
<tr>
<td>Gerber, 2009</td>
<td>College students (n = 862)</td>
<td>Improved memory, learning capacity, academic performance</td>
</tr>
<tr>
<td>Mah, 2011</td>
<td>Collegiate men’s basketball players (n = 11)</td>
<td>Improvements in mood</td>
</tr>
<tr>
<td>Wolfson, 1998</td>
<td>Adolescents, high school students (n = 3,120)</td>
<td>Higher GPAs associated with more sleep at night and less daytime sleepiness</td>
</tr>
</tbody>
</table>

Abbreviations: GPAs, grade point averages.

**Sleep’s positive effects on physical functioning.** The benefits of sleep on the physical state of the body are recovery and restoration. Sleep has a positive restorative effect on the body because of the growth hormone released. Sleep also positively impacts physical activity, leading to efficient athletic performances. Table 2 summarizes the positive effects sleep on has on the physical functioning of the body in various populations.

**Body restoration and growth hormone.** There is a restorative relationship between sleep and cellular repair and recovery. In order to recover from strenuous trainings, the growth hormone is released from the pituitary gland during the sleep cycle, which stimulates the protein synthesis necessary for body restoration, muscle repair and growth, bone building, and fat burning. The growth hormone is routinely released in
synchrony with the circadian rhythm; consistent and efficient sleeping patterns ensure healing and restoration of the body. The production of growth hormone occurs 90% of the time during nonrapid eye movement (non-REM) sleep, a time in which the body can repair and restore itself.  

### Table 2. Positive Effects Sleep Has on Physical Functioning

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Sample</th>
<th>Physical Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gerber, 2009</td>
<td>College students (n = 862)</td>
<td>Improved daily functioning, Energy conservation, Body restoration, Thermoregulatory function, Exercise improves sleep quality&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lee, 2007</td>
<td>Female college students (n = 291)</td>
<td>Regular physical activity/exercise improve sleep quality&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mah, 2011</td>
<td>Collegiate men’s basketball players (n = 11)</td>
<td>Improvements in physical performance through sleep extension</td>
</tr>
<tr>
<td>Valdez, 2010</td>
<td>Undergraduate female students (n = 9)</td>
<td>Promotes recovery of efficiency</td>
</tr>
</tbody>
</table>

<sup>a</sup>Study showed exercise/physical activity improved sleep quality.

**Physical activity and sleep.** Physical activity and sleep quality have a cyclic effect on each other. Regular physical activity improves sleep quality<sup>3, 8</sup> whereas efficient sleep quality improves physical performance.<sup>8, 11-13</sup> Physical activity is important for maintaining circadian rhythm homeostasis as well as reducing daytime
sleepiness. Individuals with high physical activity levels report less sleep disturbances; however, individuals with lower physical activity levels exhibited longer sleep.\textsuperscript{8,13}

According to the American College of Sports Medicine, physical activity refers to the bodily movements that promote health.\textsuperscript{32} There are two types of physical activity: baseline activity and health-enhancing physical activity. Baseline activity refers to activities of daily living such as standing, walking, lifting lightweight objects; in contrast, health-enhancing physical activity include jogging, lifting weights, performing yoga, etc.\textsuperscript{32} However, peak performance often occurs during athletic activity such as swimming events or power lifting events.\textsuperscript{5} An example of a peak performance during a power lifting event would be surpassing a personal weight record (ie, performing a power clean at 210 pounds when previously performing at 200 pounds).

**Summary of positive effects sleep has on physical functioning.** The relationships associated with adequate healthy sleep are summarized in Figure 2. For example, an individual with adequate healthy sleep leads to a positive effect on tissue repair/restoration (physical functioning) as well as alertness/memory and healthy mood states (mental functioning). The relationships promote mental and physical functioning of the body, ultimately leading back to adequate healthy sleep. Better sleep quality has been shown to have improvements in academic performance (higher GPAs) and mood, as well increased memory and retention skills. Also, better sleep quality leads to improved athletic performance and efficient recovery.
Figure 2. Associated relationships between physical activity and sleep. Abbreviations: GH, growth hormone; OSA, obstructive sleep apnea; RLS, restless legs syndrome; PLMs, periodic limb movements. Note: Research shows the many interrelationships associated with adequate healthy sleep and regular physical activity. Both mental functioning and physical functioning are key components affected. Figure 2 is reprinted with permission from Watenpaugh DE. The role of sleep dysfunction in physical inactivity and its relationship to obesity. *Curr Sports Med Rep.* 2009;8(6):331-338. Copyright 2009 Wolters Kluwer Health.

**Circadian Rhythm**

The states of sleep and wakefulness are regulated by the human body’s natural biological clock, which is located in the suprachiasmatic nuclei (SCN) of the hypothalamus. The SCN functions as a controlling operator of the chronological order of internal processes of the human body. The natural biological clock, called circadian rhythm, produces synchronized rhythms of mental and physical functions during sleep states and wakefulness states, cycling every 24 hours. The circadian rhythm is important for maintaining homeostasis functioning of the body and
allowing the body to recover and restore mental and physical function.\textsuperscript{6,31,35} Any disruption in the circadian rhythm can lead to detrimental effects on the mental and physical functioning of the body.

**Athletic peak performances and circadian rhythm.** There is a relationship between circadian rhythm and athletic peak performances. During the wakefulness state of the circadian rhythm, there is a higher level of effectiveness to execute various skills such as sensory and motor tasks.\textsuperscript{6} Athletic performance peaks in the afternoon (between the hours of 12:00 and 21:00) due to physiological and hormonal changes; increased body temperature and muscle blood flow provide the individual with an enhanced ability to perform complex motor skills.

**Peak performances.** Throughout the circadian rhythm, there are peak performances that occur at varying times in the 24-hour cycle. Starting in the morning (10:00 hour), an individual’s alertness is at the highest level.\textsuperscript{5} Complex skills such as fine motor control and short-term memory peak earlier in the day.\textsuperscript{6} Complex skills are seen in athletic performances that require competitive strategies and decision-making skills. Because alertness is elevated in an individual, the morning is an ideal time to perform coaching instructions/practices with athletes for prime complex skills development and retention.

Optimal physical performances occur during the afternoon hours (12:00 to 21:00 hours) of the circadian rhythm.\textsuperscript{5} Gross motor skills and substantial physical effort peak later in the day based on the circadian rhythm\textsuperscript{1,3,5}, optimal muscle adaptations such as hypertrophy and strength gains occur late in the afternoon.\textsuperscript{5} Complex motor skills involved in aerobic-based sports peak during the afternoon hours of the circadian rhythm.
Competitions and games occurring in the afternoon hours are ideal for peak athletic performances. Table 3 describes the ideal times for practice and games and peak performances that occur throughout the circadian rhythm.

**Increased body temperature/blood flow.** The circadian rhythm coincides with increased body temperature and increased muscle blood flow during the wakefulness stage. Increased body temperature leads to vasodilation, therefore increasing muscle blood flow. With increased muscle blood flow and body temperature, athletic performances are optimal in late afternoon (between the hours of 17:00 and 21:00).

After the 21:00 hour, body temperature deceases because of physiological changes and the circadian rhythm of sleeping/waking, which in turn initiates sleep. Body temperature is at the lowest degree during the early morning, around the 4:30 hour. Typically the lower body temperature occurs during rapid eye movement (REM) stage of sleep.

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Activity</th>
<th>Peak Performances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>Practice</td>
<td>Alertness, Retention of new skills, Fine motor control, Short-term memory</td>
</tr>
<tr>
<td>Afternoon</td>
<td>Game/Competition</td>
<td>Coordination, Muscle strength, Cardiovascular efficiency, Increased muscle blood flow, Increased body temperature</td>
</tr>
</tbody>
</table>

Table 3. Practice/Game Schedule Based On Circadian Rhythm
College Students and Sleep

College students’ sleeping habits are inconsistent. College students tend to wake up early in the morning and go to bed late at night during weekdays, and increase sleep quantity over the weekends. However, sleep may be altered due to extrinsic factors such as noisy residence halls or apartments and social factors associated with college settings. This sleeping pattern displayed by college students alters the circadian rhythm, therefore affecting academic performance. College students with regular sleep schedules and better sleep quality have less daytime sleepiness and better academic performance and athletic performance. College students have higher GPAs when they have experienced better sleep quality as compared to students with inconsistent sleeping habits.

Factors affecting sleep and circadian rhythm. The circadian rhythm is affected by the environmental changes outside the body and physiological changes to the body. Based on the circadian rhythm, daylight promotes wakefulness whereas diminishing light stimulates sleep. However, certain conditions have an effect on sleep, such as hormones, light, noise, and extreme temperature, as well as travel and stress.

Hormones. Hormones play a significant role in promoting wakefulness and sleep throughout the circadian rhythm. Cortisol and testosterone and the neurotransmitter serotonin are released in the early morning hours, which naturally stimulates humans to wake. When nocturnal time arrives, a hormone called melatonin allows for physiological functions to decrease in order to prepare for sleep. If the circadian rhythm is altered, then the release of the hormones are delayed and sleep functioning and daytime functioning are disrupted.
Light, noise and extreme temperatures. A person is sensitive to the environment around them, especially during his sleep setting. Noise (eg, traffic) or artificial light (eg, streetlights) can have a direct negative effect on disrupting sleep. Extreme temperatures, such as hot and cold, affect the body’s temperature while at rest. The body’s temperature rises and drops degrees throughout the circadian rhythm and any extreme heat or cold during the night (ie, air conditioning or thick heavy blankets) can affect body temperature and, in turn, disrupt a person’s sleep.  

Stress and travel. Every day stress due to work/school, training and social life affect the quality of sleep. Traveling across multiple time zones causes tiredness in persons from all sorts of stressors. Because of the travel across time zones, the circadian rhythm is shifted, affecting sleeping patterns and therefore affecting athletic performance.

Negative Consequences Associated with Disrupted Sleep

Disruption of sleep cycles causes negative effects on both mental functioning and physical functioning. Disrupted sleep affects mental functioning in terms of mood states, stress and health, and overall cognitive performance. Disrupted sleep also leads to a decrease in physical functioning of the body; specifically, with weight issues and obesity, overall health issues, athletic performance and injuries.
Figure 3. Stress-health model. Poor sleep and psychological stress combined have a negative effect on the body functioning, leading to illness. Stress and sleep have a reciprocal relationship as well. Figure 3 is reprinted with permission from Benham G. Sleep: an important factor in stress-health models. *Stress and Health.* 2010; 26:204-214. Copyright 2010 John Wiley & Sons, Ltd.

**Stress-health model.** Figure 3 depicts the cause and effect relationship, which is also known as the stress-health model. Poor sleep and psychological stress have an interdependent relationship with each other. Either one leads to an allostatic load (body responding to stressors and trying to maintain homeostatic function) which in turn leads to illness. Illness cycles back to either psychological stress or poor sleep, continuing in a negative cycle.\(^14\)

**Weight issues.** Disrupted sleep causes many weight issues in individuals, leading to obesity. Poor sleep quality leads to hormone changes, increasing the hormone ghrelin, which increases hunger, and decreasing the hormones leptin and insulin, which decreases glucose tolerance. The increase in hunger predisposes individuals to weight gain because of the uptake of food consumption, leading to obesity. Decreased glucose tolerance and obesity are risk factors for developing Type 2 diabetes mellitus. This causes a cyclic pattern, described in Figure 4, in which disturbed sleep is associated with obesity and
hormone changes.\textsuperscript{16-19} Any factor that goes “out of synch” can start the cycle; however, disrupted sleep tends to be the direct cause of hormone changes, which ultimately leads to obesity.

\textit{Reduced sleep duration-overweight cycle.} The reduced sleep duration-overweight cycle shown in Figure 4 shows a cyclic pattern involving poor sleep and obesity. Insufficient sleep leads to hormone changes (leptin, cortisol, and ghrelin), which leads to the individual feeling an increase in tiredness. Both effects lead to an increase in consumption of food and caffeine, ultimately resulting in weight gain and overweight individuals. Finally, the increase in weight results in stress, both socially and psychologically, and the individual returns back to the top of the cycle of insufficient sleep because of the previous factors listed.
Figure 4. Reduced sleep duration-overweight cycle. Inadequate sleep and obesity have a cyclic pattern in which hormone changes and stress are included as well. Figure 4 is reprinted with permission from Noland H, Price JH, Dake J, Tellijohann SK. Adolescents’ sleep behaviors and perceptions of sleep. *J Sch Health*. 2009;79(5):224-230. Copyright 2009 American School Health Association.

**Mental functioning consequences of disrupted sleep.** Disrupted sleep directly affects mental functioning, specifically mood states and cognitive performance. Because mood states and cognitive performance have a direct effect on every aspect of life, quality sleep is key to maintaining a healthy mental balance. Table 4 summarizes the consequences of disrupted sleep on mental functioning in various populations.

**Negative mood states.** Mood is directly affected by sleep disturbances and poor sleep quality is associated with higher self-reported negative moods. Feelings of depression, anxiety, and stress are reported in individuals with inadequate, disrupted sleep. Associated with the negative mood states and disrupted sleep are feelings of fatigue, decreased motivation, and psychological stress.1, 3, 7, 16-18, 21, 36, 39, 40
**Cognitive performance deficits.** Disruption in sleeping patterns leads to a decrease in cognitive performance. In adolescents and college students, academic performance is dramatically decreased with associated inadequate sleep.\(^1, 3, 7, 13-16, 36, 41\) Both populations minimize the quantity and quality of sleep during the weekdays and play “catch-up” on the weekends, leading to a disrupted sleeping pattern. Mental tasks such as attention, problem solving, memory, and overall cognitive ability-IQ\(^15\) are impaired when the sleeping pattern is disrupted. Deficits in attention, working memory, and executive mental functions are also noted in college students with poor sleep.\(^6\)

**Table 4.** Consequences of Disrupted Sleep on Mental Functioning

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Sample</th>
<th>Mental Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam, 2004</td>
<td>Elite professional ballet dancers (n = 54)</td>
<td>Psychological distress, such as depression, anxiety Decreased concentration Negative mood states</td>
</tr>
<tr>
<td>Benham, 2009</td>
<td>Undergraduate students (n = 218)</td>
<td>Impact memory</td>
</tr>
<tr>
<td>Fietze, 2009</td>
<td>Ballet dancers (n = 24)</td>
<td>Decreased cognitive performance Poor concentration</td>
</tr>
<tr>
<td>Gaultney, 2010</td>
<td>College students (n = 1,845)</td>
<td>Deficits in attention and academic performance Depression Risk-taking behavior Reduced motivation</td>
</tr>
<tr>
<td>Lee, 2007</td>
<td>Female college students (n = 291)</td>
<td>Poor academic performance</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Findings</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Noland, 2009</td>
<td>9th-12th grade students (n = 384)</td>
<td>Changes in mood and decreased motivation, leading to emotional and behavioral difficulties. Decreased alertness and concentration. Lower grades. Increase in anger, impulsivity, and sadness.</td>
</tr>
<tr>
<td>Orzech, 2011</td>
<td>College students 18 years or older (n = 4,513)</td>
<td>Decreased cognitive, psychomotor, and emotional functioning such as feelings of tense, irritable, anxious, depressed, angry, and confused. Decreased academic performance.</td>
</tr>
<tr>
<td>Owens, 2005</td>
<td>Children aged 3-7 years old (n = 71)</td>
<td>Neurobehavioral deficits such as motor skills, attention and response inhibition, problem solving, memory, overall cognitive ability-IQ, and academic achievement, mood dysfunction.</td>
</tr>
<tr>
<td>Taheri, 2012</td>
<td>Male college students athletes (n = 18)</td>
<td>Decreased cognitive function, such as reaction time.</td>
</tr>
<tr>
<td>Valdez, 2010</td>
<td>Undergraduate female students (n = 9)</td>
<td>Deficits in attention, working memory, and executive functions.</td>
</tr>
<tr>
<td>Wolfson, 1998</td>
<td>Adolescents, students (n = 3,120)</td>
<td>Increased levels of depressed mood, daytime sleepiness, and problematic sleep behaviors.</td>
</tr>
</tbody>
</table>

**Physical functioning consequences of disrupted sleep.** Sleep disruptions have a negative impact on physical functioning of the body and athletic performance. Sleep quality has a direct negative effect on physical functioning on the body whereas physical functioning has a direct positive effect on sleep quality. Disruption of sleep leads to overall health issues and a decrease in athletic performance and an increase in injuries.
Table 5 summarizes the consequences of disrupted sleep on physical functioning in various populations.

**Overall health issues.** Impaired quality of life is associated with disruption of sleeping patterns. With adequate sleep, the body is capable of recovering, specifically the immune system. Melatonin released during sleep enhances the immune system and disruption in the sleeping pattern disrupts the release of melatonin, therefore affecting the body’s immune system.\(^3,14\) Chronic sleep disruptions directly compromise the immune system and increase vulnerability to infections, common colds, and upper respiratory tract infections.\(^2,3\) An individual cannot fully recover from illness without adequate sleep.

**Athletic performance.** Athletic performance is driven by the circadian rhythm.\(^4\) Disrupting the sleep cycle affects athletic performance. In tasks that require accuracy and consistent performance, such as weight lifting, cardiorespiratory functioning, and psychomotor skills, there is a negative impact\(^12\) due to tiredness and low energy\(^20\) in the athletic population. There is also a decrease in performance tasks such as reaction time, alertness, and memory due to daytime sleepiness.\(^6\) Daytime sleepiness is the result of poor sleep where an individual feels unusually tired during the day. Daytime sleepiness results in poor decision-making skills in regards to performance outcomes and leads to a higher risk for injuries.\(^3,14,15\)

**Injuries.** Individuals with sleep disturbances have a higher risk for injuries. Although there is no specific injury or mechanism (ie, acute or chronic), sleep disturbances have been correlated with injuries in children as well as elite professional ballet dancers.\(^15,21\) Sleep disturbances increases daytime sleepiness, negatively affecting
imperative cognitive functioning such as memory, problem solving, and overall cognitive ability. Due to impaired cognitive functioning, the individual no longer makes decisions that could likely prevent injuries from occurring during athletic activities. Overall, the effect sleep disturbances have on the risk of injury has not been thoroughly studied in athletic populations.

Figure 5. Relationship between sleep disturbance and injuries. Sleep disturbance causes inadequate/disrupted sleep, leading to daytime sleepiness, causing a decrease in mental functioning and physical functioning. The decreasing in functioning increases injury risk behavior, which results in increased injury rates. Figure 5 reprinted with permission from Owens JA, Fernando S, McGuinn M. Sleep disturbance and injury risk in young children. *Behav Sleep Med.* 2005;3(1):18-31. Copyright 2005 John Wiley & Sons, Ltd.

Relationship between sleep disturbance and injuries. The relationship between sleep disturbances and injuries is described in Figure 5. Any disruption in the sleeping patterns lead to inadequate or disrupted sleep, causing daytime sleepiness. Daytime
sleepiness causes a decrease in mental functioning (inattention, distractibility, impulsivity, and mood lability, which is intense mood changes) and physical functioning (externalizing behaviors such as hyperactivity and aggression), which, in turn, increase injury risk behaviors and injury rates. For example, a person who frequently wakes up in the middle of the night suffers from disrupted sleep. Therefore, disrupted sleep leads to excessive daytime sleepiness (tired throughout the day) and the person will be affected mentally/emotionally. The person could have feelings of aggressive behavior and inability to pay attention, leading to risky injury behavior. Due to the injury risk behaviors, the person is now at a higher risk for suffering from multiple injuries due to improper cognitive functioning.

Table 5. Negative Effects Sleep Has on Physical Functioning

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Sample</th>
<th>Physical Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam, 2004</td>
<td>Elite professional ballet dancers (n = 54)</td>
<td>Injuries Unhealthy eating Substance abuse</td>
</tr>
<tr>
<td>Benham, 2009</td>
<td>Undergraduate students (n = 218)</td>
<td>Poorer health Cumulative wear and tear on body through a process of allostatic load due to poor sleep Impact on immune system</td>
</tr>
<tr>
<td>Dickinson, 2009</td>
<td>Elite athlete scholarship holders (n = 59)</td>
<td>Tiredness and low energy Difficulty concentrating</td>
</tr>
<tr>
<td>Gaultney, 2010</td>
<td>College students (n = 1,845)</td>
<td>Drowsy driving Poorer health</td>
</tr>
<tr>
<td>Author, Year</td>
<td>Description</td>
<td>Findings</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>Mah, 2011</td>
<td>Collegiate men’s basketball players (n = 11)</td>
<td>Negative impact on weight-lifting, cardiorespiratory functioning, and psychomotor tasks that require accuracy and consistent performance</td>
</tr>
<tr>
<td>Noland, 2009</td>
<td>9th-12th grade students (n = 384)</td>
<td>Obesity: physical growth changes and endocrine changes. Increases hunger, appetite and cravings for sweets, starches and salty snacks which result in poorer glucose intolerance which results in poorer insulin responses to hyperglycemia</td>
</tr>
<tr>
<td>Owens, 2005</td>
<td>Children ages 3-7 years old (n = 71)</td>
<td>Behavioral and mood dysfunction may increase risk of accidental injuries</td>
</tr>
<tr>
<td>Perna, 2003</td>
<td>Competitive college rowers (n = 34)</td>
<td>Impair muscle growth and repair processes by prolonging the presence of post-exercise catabolic hormones</td>
</tr>
<tr>
<td>Ryu, 2011</td>
<td>Korean adults aged 19 and older (n = 4,411)</td>
<td>Underweight, Obesity, Cardiovascular disease including hypertension, Diabetes mellitus, Stroke</td>
</tr>
<tr>
<td>Valdez, 2010</td>
<td>Undergraduate female students (n = 9)</td>
<td>Increases sleep pressure, producing sleepiness and deteriorating performance of many tasks, such as motor coordination, reaction time, alertness, vigilance, memory, verbal comprehension, and arithmetic operations</td>
</tr>
<tr>
<td>Vgontzas, 2008</td>
<td>Random individuals above 20 years old (n = 16,583)</td>
<td>Increased levels of obesity; predispose individuals to weight gain by increasing appetite, thus caloric intake as a result of altered levels of appetite-regulating peptides, such as leptin and ghrelin</td>
</tr>
</tbody>
</table>
Summary of negative effects of disrupted sleep. Altering sleeping patterns has a negative impact on physical functioning. Figure 6 describes the interrelationships between disrupted sleep and physical functioning. For example with insufficient sleep/poor sleep quality can lead to tiredness, resulting in depression/anxiety. An individual who suffers from depression/anxiety has an unhealthy diet, which causes obesity. An individual can take any pathway from insufficient sleep/poor quality that eventually leads to obesity. Inadequate sleep affects overall health, weight, and finally athletic performance.

Figure 6. Pathophysiologic cycles driven by inadequate sleep. Inadequate sleep causes overall health issues, weight issues and physical performance deficits. Direction of arrows indicates cause-effect; bi-directional arrows indicate reciprocal interactions. Figure 6 is reprinted with permission from Watenpaugh DE. The role of sleep dysfunction in physical inactivity and its relationship to obesity. Curr Sports Med Rep. 2009;8(6):331-338. Copyright 2009 Wolters Kluwer Health.
Measuring Sleep Cycles

There are several ways to measure sleep cycle. Polysomnography, actigraphy, and self-reported questionnaires have been used most often in research studies.\textsuperscript{9} Polysomnography is the “gold standard” for measuring sleep-wake patterns whereas actigraphy and self-reported questionnaires are more reasonable for measuring sleep-wake patterns in larger populations, measuring sleep quantity and sleep quality, respectively.

**Polysomnography.** Polysomnography or sleep study is considered the current “gold standard” for measuring sleep-wake patterns and disturbances in clinical and epidemiologic samples. During polysomnography, measurements of patients’ sleep cycles include recording breathing patterns, blood oxygen levels, brain waves (electroencephalography), electrical activity of muscles (electromyography), eye movement (electrooculography), brain temperature, and heart rate.\textsuperscript{34,42} Unfortunately, this method is very costly and requires special equipment and facilities for subjects to stay overnight in order to get accurate measurements,\textsuperscript{9} leading to differing results from night one compared to consecutive nights after.\textsuperscript{43}

**Actigraphy.** In order to provide accurate and convenient estimates of sleep and wake times, actigraphy relies on a strong correlation between sleep-wake state and movement patterns.\textsuperscript{9} Actigraphy is used for subjects with or without sleep disorders, measuring sleep-wake patterns\textsuperscript{44} (specifically, sleep duration, sleep efficiency, and movement patterns during sleep)\textsuperscript{27} and allows for measurements to be taken over a longer period of time, which is more difficult and expensive to accomplish using polysomnography measure. Actigraphy is listed as a diagnostic tool in the International
Classification of Sleep Disorders-2 and can show inconsistencies between objective and subjective measures of sleep timing. Actigraphy is a reliable and valid tool for detecting sleep patterns in normal, healthy adults as well as patients with various sleep disorders.44, 45

Actigraphy involves an accelerometer, usually the size of a wristwatch, and software to record and measure sleeping patterns. With measuring sleep patterns, ActiLife, a software program, is able to download data using 1-minute epoch intervals, as long as the “time to bed” and the “time out of bed” for each night measured is readily available. There are programmed algorithms within the ActiLife software: the Cole-Kripke algorithm, which is used in adults aged 35-65 years old, and the Sadeh algorithm is used in subjects ranging from 10 years old to 25 years old. Sleep “scores” are produced using both algorithms: latency, time awake, total sleep time, awakenings, average awakenings, and sleep efficiency.46,47

Actigraphy algorithms have approximately an 88% accuracy rate of separating wakefulness from sleep state in a mixed sample population.46 When compared to polysomnography, actigraphy overestimates total sleep time, shortens sleep latency, but does not differ from sleep efficiency. However, actigraphic estimates of sleep efficiency and total sleep time are correlated highly with polysomnographic scores, providing reliable information. Even sleep latency is closely related to polysomnographic scores and provides useful information but is less reliable than sleep efficiency and total sleep time variables.46

Actigraphy is more ideal for studying multiple nights of sleep. Actigraphy is less expensive and more convenient than performing polysomnographic recordings.
Actigraphy can be performed for multiple nights whereas polysomnographic recordings tend to only occur 1 to 3 nights.\textsuperscript{46}

**Self-reported sleep questionnaires.** Self-reported sleep questionnaires are an economical and efficient way to measure sleep quality in athletes with and without sleep disorders.\textsuperscript{9} Subjective means of assessing athletes’ sleep quality are more useful than trying objective means such as polysomnography and actigraphy in large populations.

**Patient Reported Outcomes Measurement Information System (PROMIS).** The Patient Reported Outcomes Measurement Information System (PROMIS) offers item banks that measure commonly studied patient-reported outcomes, and has been tested in the U.S. general population and clinical groups. The development and validation of the PROMIS sleep disturbance (SD) and sleep-related impairment (SRI) instruments occurred at the University of Pittsburgh, using 1,993 adults recruited from a polling sample and 259 adults with sleep disorders recruited from medical, psychiatric, and sleep clinics. Self-report item banks were developed via literature reviews, collecting and sorting items, qualitative patient research, expert content review, and pilot testing.\textsuperscript{9,49} Psychometric testing was conducted using 128 PROMIS sleep-wake items, the Pittsburgh Sleep Quality Index (PSQI), and the Epworth Sleepiness Scale (ESS), and patient-reported measurements of global health (physical function, emotional distress, and satisfaction with social roles and discretionary activities, fatigue and pain), as well as perceived health.\textsuperscript{9}

The sleep disturbance item bank includes a 27-item bank reflecting difficulties with sleep over the past 7 days. The SD instrument measures self-reported perceptions of sleep quality, sleep depth, and restoration associated with sleep. The sleep-related
impairment has a 16-item bank consisting of negative daytime consequences of poor sleep. The SRI instrument measures self-reported perceptions of alertness, sleepiness, and tiredness during usual waking hours, and the perceived functional impairments during wakefulness associated with sleep problems or impaired alertness over a duration of seven days.⁹

Existing scales, such as the PSQI, have moderate to high correlations with the PROMIS instruments, creating validity of the PROMIS instruments in participants with and without sleep disorders. The final score is represented by a T-score, a standardized mean score of 50 and a standard deviation of 10. There are two administration options of administering the SD and SRI instruments: Short forms and computerized adaptive testing (CAT). Subjects answer all questions available on the short form while each patient’s responses guide the computer’s choice of succeeding items from the full item bank.⁹,⁴⁹ The PROMIS sleep-related impairment instrument item bank is correlated at 0.84 and also as a correlation of 0.70 with PSQI and 0.45 with the ESS. The PROMIS sleep disturbance instrument item bank is correlated at 0.75 and also as a correlation of 0.85 with PSQI and 0.25 with the ESS.⁴⁹

**Pittsburgh Sleep Quality Index (PSQI).** The PSQI measures sleep quality as well as discriminates between “good” and “bad” sleepers. The PSQI provides a clinical assessment of possible sleep disturbances that may affect sleep quality. Based on a monthly time frame, the PSQI assesses sleep duration, sleep latency, sleep efficiency, sleep disturbances, use of sleeping medications, daytime dysfunction, and sleep quality using 19 self-rated questions. The 19 self-rated questions are broken down into seven component scores, ranging on a 0-3 scale, which then produces a global PSQI score,
ranging from 0-21, with the higher score indicating poorer sleep quality. A score greater than 5 indicates a poor sleeper, and has been established as a standardized cutoff score for the PSQI. Items from the PSQI were developed from three sources: clinical experience and knowledge with sleep disorder patients; a literature review of sleep quality questionnaires; and 18 months of field-testing with the instrument.

Subjects were divided into three groups during the 18-month study: “good” sleepers and “poor” sleepers, with “poor” sleepers having two subsets. The “good” sleepers consisted for 52 healthy control subjects without sleep complaints; the “poor” sleepers consisted of patients with major depressive disorder in one group and patients who were physician-referred from Sleep Evaluation Center (SEC) of the Western Psychiatric Institute and Clinic. All subjects involved in the study completed the PSQI as well as evaluated with routine sleep laboratory studies, including electroencephalographic, electro-oculographic, and electromyographic leads. The field-testing has demonstrated the internal consistency of the 19 individual questions, the stability of the responses over time, and the validity of the PSQI to differentiate patients from controls by concurrent polysomnographic findings.

The PSQI is an ideal questionnaire because it provides a combination of qualitative and quantitative information as well as assigning ordinal scores to the information, allowing for single component scores and a single global score. The simplicity of the questionnaire allows for subjects to complete the questionnaire in 5-10 minutes with the researcher scoring 10-15 minutes; it also allows for a single overall assessment of sleep quality and direct comparison of individual subjects or groups.
The PSQI has been used in varying and relevant populations, including German students,8 American undergraduate students,14,37 ballet dancers,27 and young female adults.13 The PSQI and PROMIS sleep instruments are directly correlated48 with each other. The PSQI has also been validated in the college population in multiple studies8,13,14,36,37 and summarized in Table 6.
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Sample</th>
<th>Instruments</th>
<th>Results</th>
</tr>
</thead>
</table>
| Benham, 2010 | Undergraduate students (n = 218) | *Pittsburgh Sleep Quality Index*  
Perceived Stress Scale  
Inventory of College Student's Recent Life Experiences  
Epworth Sleepiness Scale  
Cohen-Hoberman Inventory of Physical Symptoms  
Pennebaker Inventory of Limbic Languidness | Poorer sleep quality  
Greater daytime sleepiness associated with poorer health |
| Carney, 2006 | Undergraduate students (n = 243) | *Pittsburgh Sleep Quality Index*  
Social Rhythm Metric  
Beck Depression Inventory-2nd Edition | No difference between good and poor sleepers in regard to their mean age  
Young adults with limited social activities have poor sleep quality |
| Buysse, 1989 | Individuals (n=1,993); Individuals with sleep disorders (n = 259) | *Pittsburgh Sleep Quality Index* | Validation of PSQI SRI and SD item banks have measurement properties and used for assessment of general aspects of sleep and SRI within various groups of patients and interventions |
| Fietze, 2009 | Ballet dancers (n = 24) | *Pittsburgh Sleep Quality Index*  
Epworth Sleepiness Scale  
Quality of Life Questionnaire  
d2 Test of Attention Minimitter Monitors (Actiwatch) | Specific extended work schedule of ballet dancers influences their sleep-wake schedule |
Table 6 continued

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Instruments</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gerber, 2010</td>
<td>German-speaking students (n = 862)</td>
<td>Pittsburgh Sleep Quality Index</td>
<td>Participants with high fitness levels and no perceived lack of physical activity exhibited lower insomnia scores and reported less excessive intrusive thoughts about sleep difficulties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Office in Motion questionnaire</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insomnia Severity Index</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>FEPS II</td>
<td></td>
</tr>
<tr>
<td>Lee, 2007</td>
<td>Female college students (n = 291)</td>
<td>Pittsburgh Sleep Quality Index</td>
<td>Subjects with poor sleep quality were more likely to have lower levels of muscular endurance, flexibility, and cardiovascular fitness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Index</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical fitness testing</td>
<td></td>
</tr>
<tr>
<td>Orzech, 2011</td>
<td>Undergraduate students (n = 675-1,823)</td>
<td>Pittsburgh Sleep Quality Index</td>
<td>Poor sleep interacted with academics and mental health</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Index</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personal interviews</td>
<td></td>
</tr>
</tbody>
</table>

*PSQI and athletes.* Physical and sleep quality are directly related in a cause and effect manner. Research shows physical activity enhances sleep quality and decreases sleep problems. Athletes are a physically active population and have significantly different sleeping patterns than nonathletes. Ideally, athletes have better sleep quality even with a decreased amount of sleep quantity. However, a decrease in physical activity leads to associated sleep problems.

The college athlete population has not been studied thoroughly in relation to sleep quality. Because the college athlete is both a student and an athlete, sleep quality may be different in the population due to the commitments associated with being a student-athlete. The PSQI is an ideal instrument to use in the college athlete population.
**Epworth Sleepiness Scale (ESS).** The ESS is an instrument that measures daytime sleepiness. The ESS allows individuals to measure the chances they are likely to doze off during specific situations used in daily life. The individuals rate eight questions on a scale of 0-3, 0 representing “would never doze” and 3 representing “high chance of dozing,” for a total score of 24. ESS scores greater than 16 indicate a high level of daytime sleepiness. A total of 180 subjects completed the questionnaire: 30 control subjects and 150 patients with various sleep disorders. The patients’ ages ranged from 17 to 78 years old and were subjected to an overnight polysomnography. The ESS gives valid measurements of daytime sleepiness in adults as well is reliable in the test-retest sense with a high level of internal consistency. The internal consistency is high for patients with sleep disorders. The ESS is significant correlated with the PSQI as well as the PROMIS sleep-related impairment and sleep disturbance instruments. The PSQI and ESS are directly correlated in the college population.

**Sleep quality, sleep quantity and daytime sleepiness in collegiate athletes.** Sleep is essential for humans to maintain healthy and functional lives. If sleep quality and quantity are disrupted, mental functioning and physical functioning problems can occur, which can in turn affect overall functioning, especially in athletes. There are three main characteristics associated with sleep assessment: quality, quantity, and daytime sleepiness. Currently, there is scant research in athletic training examining the relationship between these characteristics in collegiate athletes. In 2012, a research study conducted by Dettl included female collegiate athletes who were asked to wear an accelerometer at night, measuring sleep quantity using the ActiLife software. After seven nights of wearing the accelerometer, subjects took the PROMIS sleep-related impairment
instrument and sleep disturbance computer adaptive tests online, measuring daytime sleepiness and sleep quality, respectively.

For the PROMIS sleep instruments, the average score is 50 in the US general population.\textsuperscript{49} For the participants in the study, the average score for sleep-related impairment instrument was 55 and the sleep disturbance instrument score was 50. The participants’ sleep-related impairment scores were slightly higher than the general population (worse daytime sleepiness); the sleep disturbance scores were the same as the general population. The PROMIS sleep instrument scores were predicted to have negative correlations with sleep efficiency and total sleep time and to have positive correlations with awakenings, average awakenings, time awake, and latency. There were significant correlations between SRI and SD ($r = .42; P < 0.05$) and SD and TS ($r = -0.31; P < 0.05$); however, there were no other significant correlations. The average efficiency was 81.33\%, the average latency was 8.93 minutes, the average total sleep time was 375.04 minutes (6.25 hours), the average time awake was 64.87 minutes, the average awakenings were 3.19 times, and the average of the average awakenings was 3.36 times.\textsuperscript{51}

Sleep quality is more important to athletes than nonathletes. Research theorizes that athletes are able to sleep more deeply (better sleep quality) while sleeping less (sleep quantity).\textsuperscript{4} The results indicate that the three important characteristics of sleep in a college population are independent of each other and need to be assessed individually. Researchers should be aware that sleep quality, sleep quantity, and daytime sleepiness should be assessed and PROMIS adaptive instruments and accelerometry together provide a clinically useful and easy way of measuring sleep.\textsuperscript{52}
Why subjectively measure sleep in the college athlete population? In order to assess sleep’s impact on athletic performance in the college athlete population, a profile is needed to determine the quality of sleep in the population. Research on sleep quality has been performed on specific athletic populations (e.g., professional ballet dancers and men’s basketball players) studying the effects sleep has on performance and injuries. However, the college population and sleep quality as a whole has not been studied. In order to assess athletic performance affected by sleep quality, the sleep profile must be developed first.

A sleep profile of the college athlete population will help future research in studying sleep quality, daytime sleepiness and functioning, as well as athletic performance. College athletes have inconsistent schedules and pertinent commitments: classes, practices, games/matches, trainings and conditionings, making for longer days and shorter sleep durations, affecting the circadian rhythm. An example of a softball college athlete’s day while in season is shown in Table 7.

Due to the chaotic schedule a college athlete withstands, it is predicted that there is a potential for performance deficits as well as an increase risk for injury. Because mental functioning and physical functioning are dependent on the circadian rhythm, any changes in the circadian rhythm (e.g., sleep disturbances, shortened sleep), could greatly affect performances. Daytime sleepiness could potentially affect the athlete’s ability to perform maximally and efficiently during practices and games. Poor decisions and improper skill mechanics due to daytime sleepiness can lead an athlete to sustain an injury.
Another need for a sleep profile for college athletes is optimal performance for rehabilitation purposes. If an athlete sustains an injury, sleep might be affected due to pain and discomfort, affecting rehabilitation due to daytime sleepiness. Therefore, rehabilitation and peak physical and mental performances are not in sync with the circadian rhythm, potentially leaving the athlete to a longer recovery. A sleep profile of college athletes will provide a baseline for future research on the impact injury has on sleep, athletic performance, and rehabilitation.

**Table 7. Example of a College Softball Athlete’s Weekday**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:00-6:00 AM</td>
<td>Wake Up, Breakfast</td>
</tr>
<tr>
<td>6:00-7:00 AM</td>
<td>Team Conditioning</td>
</tr>
<tr>
<td>7:00-9:00 AM</td>
<td>Defensive Practice</td>
</tr>
<tr>
<td>9:00-11:00 AM</td>
<td>Batting Cages</td>
</tr>
<tr>
<td>11:00-12:00 PM</td>
<td>Lunch</td>
</tr>
<tr>
<td>12:00-2:00 PM</td>
<td>Class #1</td>
</tr>
<tr>
<td>2:00-3:00 PM</td>
<td>Class #2</td>
</tr>
<tr>
<td>3:00-4:00 PM</td>
<td>Team Meeting/Video</td>
</tr>
<tr>
<td>4:00-5:00 PM</td>
<td>Team Lifting</td>
</tr>
<tr>
<td>5:00-6:00 PM</td>
<td>Dinner</td>
</tr>
<tr>
<td>6:00-8:00 PM</td>
<td>Class #3</td>
</tr>
<tr>
<td>8:00-11:00 PM</td>
<td>Homework, Bed time</td>
</tr>
</tbody>
</table>
Specific Aims

1. To compare sleep quality in the college athlete population and the college nonathlete population using the PSQI, PROMIS SD, PROMIS SRI, and ESS.

2. To determine if there are relationships with sleep quality and perceived stress and/or overall health in the college athlete population and college nonathlete population.
Chapter 3: Methods

Design of Study/Setting

The design of the study was a cross-sectional study, measuring the sleep quality and stress in a college population. The setting of the study occurred via online using the Assessment Center created by the PROMIS, college/university classrooms as well as the online social media, Facebook.

Participants. The participants were selected from both the varsity teams of NCAA’s college athlete populations as well as the college nonathlete populations, with equal distribution among genders. Participants from the college athlete population were recruited from NCAA Division I and Division II schools. Participants from the college nonathlete population were recruited from various classrooms as well as on the online social media site, Facebook.

Inclusion/exclusion criteria. Participants had to be enrolled as a full-time student in a college or university setting. Participants selected to represent the college athlete population had to be currently participating on a university sanctioned, NCAA sport and self-reported that they were actively participating. Subjects could not participate if they qualified as a minor (under the age of 18).

Sample size. There were 285 participants selected for this study. The minimum target population was 280 and was justified by a power analysis. According to the power analysis, for the effect size to be 0.25, the alpha level set at 0.05, and the power set at 0.8, the minimum number of participants to be studied needed to be 280.
Instruments

**Basic demographic form.** The basic demographic form is a questionnaire used to identify participants’ background as well as necessary information needed to determine eligibility based upon the inclusion and exclusion criteria established for the study. Participants were questioned regarding (1) weight, (2) height, (3) age, (4) sex, (5) marital status, (6) ethnicity, (7) education status (full-time student or part-time student), (8) athletic status (NCAA-sanctioned team, club team/intramural sports, or none), (9) school year (freshman, redshirt-freshman, sophomore, redshirt-sophomore, junior, redshirt-junior, senior, redshirt-senior, graduate student), (10) scholarship status (academic, athletic, both, none), (11) major; minor; current cumulative GPA, (12) current medications, (13) injuries in the last month, (14) and diagnosis of medical disorder affecting sleep.

**Physical activity guidelines.** U.S. Department of Health and Human Services has developed criteria for physical activity levels. An inactive person does not participate in physical activity above baseline activities of daily living. Low activity level consists of activity above baseline but less than 150 minutes a week with some health benefits. An individual at a medium level of activity participates in activity 150 minutes to 300 minutes a week, providing substantial health benefits. Finally, a person participating in more than 300 minutes of physical activity is considered to have a high level of physical activity, including additional health benefits.³²

**PROMIS sleep-related impairment instrument.** The PROMIS sleep-related impairment instrument assesses self-reported perceptions of alertness, sleepiness, and tiredness associated with sleep problems over the past 7 days. The instrument was used
in the computerized adaptive form from the full item bank (16 items total). The item bank is correlated at 0.84 and also as a correlation of 0.70 with PSQI and 0.45 with the ESS.°

**PROMIS sleep disturbance instrument.** The PROMIS sleep disturbance instrument assesses self-reported perceptions of sleep quality, sleep depth, and restoration associated with sleep over the past 7 days. The instrument was used in the computerized adaptive form from the full item bank (16 items total). The item bank is correlated at 0.75 and also as a correlation of 0.85 with PSQI and 0.25 with the ESS.°

**Pittsburgh Sleep Quality Index (PSQI).** The PSQI measures sleep quality as well as discriminates between “good” and “bad” sleepers. Based on a monthly time frame, the PSQI assesses sleep duration, sleep latency, sleep efficiency, sleep disturbances, use of sleeping medications, daytime dysfunction, and sleep quality using 19 self-rated questions.° The PSQI has been validated in the college population in multiple studies.°, 13, 14, 36, 37 The PSQI and PROMIS sleep instruments are directly correlated where PSQI, ESS, PSS, and CHIPS are directly correlated in the college population.°

**Epworth Sleepiness Scale (ESS).** The ESS measures self-rated daytime sleepiness using 8 questions regarding 8 different situations. The ESS is rated on a 4-point Likert scale (0-would never doze to 3-high chance of dozing). The ESS ranges from 0-24 with a higher score resulting in greater daytime sleepiness.°, 50

**Perceived Stress Scale (PSS).** The Perceived Stress Scale (PSS) measures psychological and physical symptoms using a 10-item Likert scale (0-never to 4-very often). The PSS scores range from 0-40 with higher scores representing more stress.°
SF-12v2 Health Survey Standard Version. The SF-12 is a short form survey asking the participant’s views about their health. The information keeps track of how the participants feel and how well they are able to do their usual activities.\textsuperscript{53}

Cohen-Hoberman Physical Symptoms (CHIPS). The CHIPS is symptoms survey consisting of 33-items each ranked 0-4 based on how much a specific problem has bothered or distressed the participant in the last 2 weeks including today.\textsuperscript{14}

Recruitment

Athlete population. A letter of support of the research study as well as the specific aims was electronically mailed to 16 athletic trainers across the nation working in collegiate settings. Eight letters of support were signed and faxed back to the researcher stating the site can be used as a collecting site. Approval was obtained from the Institutional Review Board at two sites (Catawba College and Bowling Green State University). The link to access the instruments were sent to the athletic trainers who, in turn, distributed the link to the athletes. The link was also available on the social media website, Facebook, as an open group for college athletes to take.

Nonathlete population. The research study was presented to several classes at Ohio University for recruitment. Potential participants either received the link to access the questionnaires online or they received the questionnaires in paper form. The link was also available on the social media website, Facebook as an open group for college nonathletes to take.

Data Collection

Three different modes of data collection added variety to the population. Participants were recruited in classrooms at a college setting or were given the hyperlink
via e-mail. Participants were also invited to join an open group on Facebook, having access to the hyperlink.

**Electronic delivery.** Participants who received the link to access the questionnaires electronically signed the consent form and answer all the questions to the different instruments. Incomplete online surveys were deleted from the sample.

**Social media.** Participants were invited to join an open group on the social media website, Facebook, and had access to take the instruments online via the hyperlink. The group was open to any full time college student to take the surveys online, adding variety to the samples. Incomplete online surveys were deleted from the samples.

**Paper delivery.** Participants received the consent form, signed it, and returned it to the principal investigator. They answered all the questions to the instruments on the paper forms. Any instruments not fully completed/answered resulted in deletion from the sample.

**Data Analysis**

The dependent variables are the instrument scores: PROMIS SD and SRI, PSQI, and ESS. The independent variables are the instrument scores of PSS, CHIPS, SF-12v2 Health Survey Standard Version, and physical activity level. Independent $t$ test measures were used on both independent and dependent variables. Correlation tests were run on the PROMIS SD and SRI, PSQI, and ESS as well.
Chapter 4: Results

Introduction

This chapter describes the results of the study, including the descriptive statistics, group mean differences, and correlations of the instruments. This study intended to develop a sleep profile of college athletes and compare to college nonathletes as well as compare stress and overall health with sleep quality measurements.

Response rates. The paper forms of the instruments received a 100% return rate when given to participants. As for the online version of the instruments, the return rate was less: 191 participants accessed the hyperlink, 171 registered, 162 started taking the instruments, and 136 were fully completed, therefore leading to a 71.2% return rate (136 complete/191 accessed).

Basic Demographics

The population was divided into two groups: college athlete and college nonathlete. A total of 285 participants completed the instruments, 166 athletes and 119 nonathletes. The following demographics were collected and measured: (1) Age, (2) sex, (3) height (cm), (4) weight (kg), (5) academic year, (6) scholarship status, (7) GPA, (8) medications, (9) injury, (10) medical disorder, (11) NCAA division level, and (12) physical activity level. The demographics are described in Table 8.
Table 8. Demographics of Total Population

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Athlete (n = 166)</th>
<th>Nonathlete (n = 119)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yr)</strong></td>
<td>20.14 ± 1.48</td>
<td>21.84 ± 1.97</td>
</tr>
<tr>
<td><strong>(mean ± SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>n = 83, 50%</td>
<td>n = 42, 35.39%</td>
</tr>
<tr>
<td>Female</td>
<td>n = 83, 50%</td>
<td>n = 77, 64.71%</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>175.71 ± 10.99</td>
<td>170.12 ± 9.53</td>
</tr>
<tr>
<td><strong>(mean ± SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>76.94 ± 18.73</td>
<td>71.31 ± 14.19</td>
</tr>
<tr>
<td><strong>(mean ± SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Academic Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>n = 44, 26.51%</td>
<td>n = 5, 4.2%</td>
</tr>
<tr>
<td>Sophomore</td>
<td>n = 46, 27.71%</td>
<td>n = 17, 14.29%</td>
</tr>
<tr>
<td>Junior</td>
<td>n = 46, 27.71%</td>
<td>n = 25, 21.01%</td>
</tr>
<tr>
<td>Senior</td>
<td>n = 37, 22.29%</td>
<td>n = 31, 25.05%</td>
</tr>
<tr>
<td>Graduate</td>
<td>n = 3, 1.8%</td>
<td>n = 41, 34.45%</td>
</tr>
<tr>
<td><strong>Scholarship Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic</td>
<td>n = 10, 11.45%</td>
<td>n = 57, 47.9%</td>
</tr>
<tr>
<td>Athletic</td>
<td>n = 82, 49.4%</td>
<td>n = 1, 0.8%</td>
</tr>
<tr>
<td>Both</td>
<td>n = 59, 35.54%</td>
<td>n = 1, 0.8%</td>
</tr>
<tr>
<td>None</td>
<td>n = 15, 9.04%</td>
<td>n = 60, 50.42%</td>
</tr>
<tr>
<td><strong>GPA (4.0 scale)</strong></td>
<td>3.17 ± .53</td>
<td>3.29 ± .44</td>
</tr>
<tr>
<td><strong>(mean ± SD)</strong></td>
<td>(n = 160)</td>
<td>(n = 114)</td>
</tr>
<tr>
<td><strong>(n = 274)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>n = 44, 26.51%</td>
<td>n = 39, 32.77%</td>
</tr>
<tr>
<td>No</td>
<td>n = 122, 73.49%</td>
<td>n = 80, 67.23%</td>
</tr>
<tr>
<td><strong>Injury</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>n = 64, 38.55%</td>
<td>n = 9, 7.56%</td>
</tr>
<tr>
<td>No</td>
<td>n = 102, 61.45%</td>
<td>n = 110, 92.44%</td>
</tr>
</tbody>
</table>
Table 8 continued

<table>
<thead>
<tr>
<th>Medical Disorder</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 4, 2.41%</td>
<td>n = 10, 8.4%</td>
</tr>
<tr>
<td></td>
<td>n = 162, 97.59%</td>
<td>n = 109, 91.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NCAA Division Level</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 133, 80.12%</td>
<td>n = 33, 19.78%</td>
<td>n = 0, 0%</td>
</tr>
<tr>
<td></td>
<td>n = 108, 90.76%</td>
<td>n = 9, 7.56%</td>
<td>n = 2, 4.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Activity Level</th>
<th>None</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 2, 1.2%</td>
<td>n = 4, 2.41%</td>
<td>n = 18, 10.84%</td>
<td>n = 142, 85.54%</td>
</tr>
<tr>
<td></td>
<td>n = 7, 5.88%</td>
<td>n = 34, 28.57%</td>
<td>n = 49, 41.18%</td>
<td>n = 29, 24.37%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Season</th>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 112, 67.47%</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>n = 54, 33.53%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Abbreviation: GPA, grade point average; N/A, not applicable. Age (yr), height (cm), weight (kg), and GPA are displayed as mean ± standard deviation.
**NCAA division level and sport.** The athletes’ sports as well as the NCAA Division Level are displayed in Table 9. A majority of the college athlete population was collected from a Division I college, from 13 different sports.

<table>
<thead>
<tr>
<th>Sport</th>
<th>Division</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Baseball</td>
<td>24</td>
</tr>
<tr>
<td>Basketball, M</td>
<td>1</td>
</tr>
<tr>
<td>Basketball, W</td>
<td>5</td>
</tr>
<tr>
<td>Field Hockey</td>
<td>2</td>
</tr>
<tr>
<td>Football</td>
<td>23</td>
</tr>
<tr>
<td>Soccer, M</td>
<td>2</td>
</tr>
<tr>
<td>Soccer, W</td>
<td>7</td>
</tr>
<tr>
<td>Softball</td>
<td>19</td>
</tr>
<tr>
<td>Swimming &amp; Diving, W</td>
<td>2</td>
</tr>
<tr>
<td>Track &amp; Field/Cross Country, M</td>
<td>11</td>
</tr>
<tr>
<td>Track &amp; Field/Cross Country, W</td>
<td>29</td>
</tr>
<tr>
<td>Volleyball</td>
<td>0</td>
</tr>
<tr>
<td>Wrestling</td>
<td>12</td>
</tr>
</tbody>
</table>

**Total:** 137 | 31

Abbreviations: M, men’s; W, women’s.
Descriptive Statistics of Instruments

The descriptive statistics of the 7 instruments is described in Table 9. The PROMIS SD and SRI have a \( t \) score of 50 (general population) and a standard deviation of 10. For the PSQI, any value above 5 is considered a poor sleeper whereas below 5 is a good sleeper. The ESS scores above 10 indicate a sleepy person and above 18 indicate a very sleepy person. The PSS scores are based on ranges: 0-7 = much lower than average with a very low health concern; 8-11 = slightly lower than average with a low health concern; 12-15 = average with an average health concern; 16-20 = slightly higher than average with a high health concern; and 21+ = much higher than average with a very high health concern. The CHIPS survey does not have general norms for comparison. The SF12v2 has age group (18-34 years old) mean scores of 53.2 (\( t \) score) for the physical part and 51.3 (\( t \) score) for the mental part of the instrument. Higher scores indicate worse mental or physical health.
<table>
<thead>
<tr>
<th>Statistic</th>
<th>Athlete (n = 166)</th>
<th>Nonathlete (n = 119)</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROMIS Sleep Disturbance</td>
<td>50.35 ± 7.58</td>
<td>50.10 ± 6.81</td>
<td>t score = 50&lt;br&gt; &gt; 50 = more sleep disturbances&lt;br&gt; &lt; 50 = less sleep disturbances</td>
</tr>
<tr>
<td>PROMIS Sleep-Related Impairment</td>
<td>53.94 ± 6.36</td>
<td>55.66 ± 6.16</td>
<td>t score = 50&lt;br&gt; &gt; 50 = more sleep-related impairments&lt;br&gt; &lt; 50 = less sleep-related impairments</td>
</tr>
<tr>
<td>Pittsburgh Sleep Quality Index</td>
<td>5.38 ± 3.35</td>
<td>6.14 ± 3.35</td>
<td>&gt; 5 = bad sleeper&lt;br&gt; &lt; 5 = good sleeper&lt;br&gt; (Range 0-19)</td>
</tr>
<tr>
<td></td>
<td>44.58% &lt; 5</td>
<td>26.69% &lt; 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55.52% &gt; 5</td>
<td>73.31% &gt; 5</td>
<td></td>
</tr>
<tr>
<td>Epworth Sleepiness Scale</td>
<td>7.87 ± 3.92</td>
<td>7.68 ± 3.74</td>
<td>&gt; 10 = sleepy&lt;br&gt; &gt; 18 = very sleepy&lt;br&gt; (Range 0-24)</td>
</tr>
<tr>
<td>Perceived Stress Scale</td>
<td>15.70 ± 6.02</td>
<td>17.32 ± 5.96</td>
<td>0-7 = Much lower than average&lt;br&gt; 8-11 = Slightly lower than average&lt;br&gt; 12-15 = Average&lt;br&gt; 16-20 = Slightly higher than average&lt;br&gt; 21+ = Much higher than average&lt;br&gt; (Range 0-40)</td>
</tr>
<tr>
<td>(n = 284)</td>
<td>(n = 165)</td>
<td>(n = 119)</td>
<td></td>
</tr>
<tr>
<td>Cohen-Hoberman Inventory of Physical Symptoms</td>
<td>18.37 ± 14.3</td>
<td>14.95 ± 12.41</td>
<td>Higher scores = more symptom reporting&lt;br&gt; (Range 0-132)</td>
</tr>
</tbody>
</table>
Table 9 continued

<table>
<thead>
<tr>
<th>SF-12v2</th>
<th>Physical</th>
<th>Mental</th>
<th>Age 18-34 mean score:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>46.44 ± 7.43</td>
<td>50.31 ± 5.2</td>
<td>&gt;53.2 = worse physical symptoms</td>
</tr>
<tr>
<td>(n = 283)</td>
<td>44.57 ± 8.66</td>
<td>37.66 ± 6.82</td>
<td>&gt;51.3 = worse mental symptoms</td>
</tr>
<tr>
<td>(n = 164)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The athlete and nonathlete values are displayed as mean ± standard deviation. 284 participants completed the Perceived Stress Scale instrument. 283 participants completed the SF12v2 instrument.
**Descriptive statistics results.** The PROMIS SD scores of both populations were slightly higher compared to a general population $t$ score of 50, resulting in more sleep disturbances during the night. Both populations exceeded the general population $t$ score of 50 for the PROMIS SRI scores, indicating more sleep-related impairments during the day. Both populations scored less than their age population on both mental and physical SF12v2 instruments, showing they have less reported mental and physical symptoms.

Both populations are considered “bad” sleepers, scoring above 5 on the PSQI as well as scored below the “sleepy” score for the ESS. As for the PSS range, the college athlete population scored just above the average range, indicating an average health concern level. The college nonathlete population scored in the slightly higher than average, indicative of a high health concern. Lastly, both populations scored relatively low on the CHIPS instrument (out of a possible total score of 132).

**Sleep Differences in the Populations**

Four of the 7 instruments had significant differences between the college athlete and college nonathlete populations. The college athlete population scored lower on the PROMIS SRI, PSQI, and PSS but scored higher on the CHIPS instrument compared to the college nonathlete population. The PROMIS SD and ESS were not significant. Table 10 displays the comparison between the two populations. Figures 7 and 8 visually display the differences.
<table>
<thead>
<tr>
<th>Measure</th>
<th>$t$ score</th>
<th>$df$</th>
<th>$P$ value</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROMIS Sleep Disturbance</td>
<td>0.29</td>
<td>283</td>
<td>0.78</td>
<td>0.25</td>
</tr>
<tr>
<td>PROMIS Sleep-Related Impairment</td>
<td>-2.29</td>
<td>283</td>
<td>0.02*</td>
<td>-1.72</td>
</tr>
<tr>
<td>Pittsburgh Sleep Quality Index</td>
<td>-1.99</td>
<td>283</td>
<td>0.05*</td>
<td>-0.76</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale</td>
<td>0.40</td>
<td>283</td>
<td>0.69</td>
<td>0.19</td>
</tr>
<tr>
<td>Perceived Stress Scale</td>
<td>-2.25</td>
<td>283</td>
<td>0.03*</td>
<td>0.19</td>
</tr>
<tr>
<td>Cohen-Hoberman Inventory of Physical Symptoms</td>
<td>2.10</td>
<td>283</td>
<td>0.04*</td>
<td>3.42</td>
</tr>
<tr>
<td>SF12v2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>-4.89</td>
<td>281</td>
<td>.00</td>
<td>-3.87</td>
</tr>
<tr>
<td>Mental</td>
<td>7.5</td>
<td>281</td>
<td>.00</td>
<td>6.91</td>
</tr>
</tbody>
</table>

Abbreviations: $df$, degrees of freedom. *$P < 0.05$. 
Figure 7. PROMIS SD & SRI and SF12v2 scores. Abbreviations: avg, average; Phys, physical; Ment, mental. Figure 7 displays the PROMIS SRI, SD and SF12v2 physical and mental scores.
Figure 8. PSQI, ESS, PSS, & CHIPS scores. Figure 8 displays the PSQI, ESS, PSS and CHIPS scores. PSS is compared to a range instead of norm scores: 0-7; 8-11; 12-15; 16-20; and 21+. 
Relationship Between Instruments

All of the instruments were correlated in the college athlete sample except for ESS, PROMIS sleep disturbance and PSQI did not correlate with each other. The SF12v2 physical part of the survey correlated with PSQI and CHIPS whereas the mental part of the survey correlated with PROMIS SRI, PSQI, ESS and PSS but not PROMIS sleep disturbance or CHIPS. The correlations are displayed in Table 11.

The sleep instruments were similarly correlated in the nonathlete sample as the athlete sample (the ESS, PROMIS sleep disturbance and PSQI did not correlate with each other). However, the SF12v2 was only correlated with the PSS in the nonathlete sample. The correlations were significant at the 0.05 level (2-tailed). The correlations are displayed in Table 12.
Table 12. Correlation of Instruments in College Athlete Sample

<table>
<thead>
<tr>
<th></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>1. PROMIS Sleep Disturbance</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PROMIS Sleep-Related Impairment</td>
<td>0.4**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Pittsburgh Sleep Quality Index</td>
<td>0.55**</td>
<td>0.33**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Epworth Sleepiness Scale</td>
<td>0.06</td>
<td>0.33**</td>
<td>0.09</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Perceived Stress Scale (n = 164)</td>
<td>0.34**</td>
<td>0.16**</td>
<td>0.35**</td>
<td>0.22**</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. CHIPS</td>
<td>0.45**</td>
<td>0.48**</td>
<td>0.36**</td>
<td>0.3**</td>
<td>0.36**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>7. SF-12v2 Physical Mental</td>
<td>-0.11</td>
<td>-0.11</td>
<td>-0.16**</td>
<td>-0.03</td>
<td>-0.03</td>
<td>-0.17**</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>-0.11</td>
<td>-0.17**</td>
<td>-0.19**</td>
<td>-0.19**</td>
<td>-0.35**</td>
<td>-0.09</td>
<td>--</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.05 level (2-tailed).
## Table 13. Correlation of Instruments in College Nonathlete Sample

<table>
<thead>
<tr>
<th></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>1. PROMIS Sleep Disturbance</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PROMIS Sleep-Related Impairment</td>
<td>0.51**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Pittsburgh Sleep Quality Index</td>
<td>0.64**</td>
<td>0.44**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Epworth Sleepiness Scale</td>
<td>0.02</td>
<td>0.29**</td>
<td>0.2**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Perceived Stress Scale (n = 164)</td>
<td>0.47**</td>
<td>0.39**</td>
<td>0.5**</td>
<td>0.35**</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. CHIPS</td>
<td>0.36**</td>
<td>0.38**</td>
<td>0.44**</td>
<td>0.42**</td>
<td>0.42**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>7. SF-12v2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>0.02</td>
<td>-0.65</td>
<td>0.03</td>
<td>0.1</td>
<td>0.23**</td>
<td>0.04</td>
<td>--</td>
</tr>
<tr>
<td>Mental</td>
<td>0.09</td>
<td>-0.15</td>
<td>0.03</td>
<td>-0.14</td>
<td>-0.26**</td>
<td>-0.09</td>
<td>--</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.05 level (2-tailed).
Chapter 5: Discussion

The research questions for this study were: Does the college athlete population have better sleep quality than the college nonathlete population; and is there a relationship between stress, overall health, and sleep in the college athlete and nonathlete populations? This study produced three major themes overall: the college athlete has better sleep quality than the nonathlete; a relationship between stress, overall health, and sleep was established in both sample populations; and a sleep profile was created of the college athlete population using the PROMIS sleep instruments, PSQI, and ESS to measure sleep quality and daytime functioning.

College Athletes are Athletes

The college athlete population has two roles in a college/university setting: student and athlete. The college athlete sample can be described more as an athlete than a student based on the high levels of physical activity and better sleep quality scores.

Sleep quality and physical activity in college athletes. The college athlete has a high level of physical activity: Over 85% of the college athlete sample in this study scored a high level of physical activity, exercising more than 300 minutes a week (a minimum of 1 hour of physical activity, 5 times a week). Higher levels of physical activity have shown less sleep disturbances in individuals. The PROMIS sleep disturbance group means were similar between the two samples as well as similar to the general population average. Because both samples had a high levels of physical activity overall (60% of high level, 23.5% of moderate level), sleep disturbance scores were scored low and closer towards the general population. The similarities in low sleep disturbance scores and high physical activity levels in the college athlete sample with the
general population shows that the college athlete population has efficient and better
sleep quality.

According to Dickinson and Hanrahan,²⁰ previous studies suggest that the athlete
population has better sleep quality when compared to a nonathlete population because of
the positive effects exercise has on sleep quality. The college athlete sample in this study
participates in physical activity regularly based on the high physical activity level
reported (ie, practices, strength and conditioning work outs, competitions), and also has
better sleep quality compared to the college nonathlete sample, supporting Dickinson and
Hanrahan’s claims.

The study conducted by Gerber, Brand, Holsboer-Trachsler, and Pühse⁸ showed
that participants with high fitness levels reported less sleep difficulties and lower
insomnia scores as well as higher sleep quality scores during the weekends and
weekdays. This study supports Gerber et al⁸ research by demonstrating high levels of
physical activity and less sleep-related impairments and sleep disturbances in the college
athlete sample compared to the college nonathlete sample.

Both samples scored in the “bad” sleeper range on the PSQI instrument (scoring
over 5 out of 19). However, the college athlete sample scored significantly lower in the
‘bad’ sleeper range compared to the college nonathlete sample. This study showed that
the college athlete sample has better sleep quality when compared to the college
nonathlete sample.

According to Lee and Lin,¹³ sleep quality and physical activity are directly
related. Female college students with low levels of physical activity were seen with
higher PSQI scores (ie, “bad” sleepers). This study supports Lee and Lin’s research by
demonstrating the college athlete sample has high levels of physical activity that is directly associated with better sleep quality. The college nonathlete sample has worse sleep quality measures as well as lower levels of physical activity compared to the college athlete sample.

**Stress and Overall Health in College Athletes**

Research has shown that better sleep quality leads to improved mood states and lower stress levels. This study supports the previous research in the college athlete sample: the college athlete sample showed less perceived stress compared to the college nonathlete sample. Because the college athletes exercise regularly and have better sleep quality, stress levels were decreased compared to the college nonathlete sample.

Both college athlete and nonathlete samples scored below their age group mean on the SF12v2 instrument on both the physical and mental aspects. The samples have better physical and mental well being compared to their age group. However, the college athlete sample reported more physical symptoms compared to the nonathlete sample. The cause of increase in physical symptoms is unknown based on the small number of injuries reported in the basic demographics form. It is hypothesized that because the college athlete sample has an increased level of physical activity, there is an increased allostatic load on the body, leading to an increase in physical symptoms reported. The increase of physical symptom reporting did not have a negative effect on sleep quality or perceived stress in the college athlete sample.

**Daytime functioning in college athletes.** The college athlete sample has better sleep quality than the nonathlete sample in the study resulting in less sleep-related impairments during the day. The college athlete sample scored significantly lower on the
PROMIS sleep-related impairments instrument compared to the nonathlete sample population. Having less sleep-related impairments greatly affects peak athletic performances: College athletes perform mentally and physically at optimal levels because they do not suffer from daytime sleepiness.

**Sleep Profile and Instruments**

A sleep profile of the college athlete population can be developed using subjective measurements of sleep quality and daytime sleepiness/functioning. Because the college athlete population is large in numbers, using self-reported questionnaires are ideal to measure sleep quality and daytime sleepiness/functioning.

The four sleep-related instruments used in this study (PSQI, PROMIS sleep disturbance, PROMIS sleep-related impairment, and ESS) are ideal instruments to use for the college athlete population to develop a sleep profile. The sleep-related instruments (PSQI, PROMIS sleep disturbance, PROMIS sleep-related impairment) are significantly correlated with each other in the college athlete sample population, justifying using the instruments in order to develop a sleep profile. The ESS and PROMIS SD are the only two instruments that did not correlate with each other; however, both surveys measure different aspects of sleep: daytime sleepiness and sleep disturbances respectively.

The sleep profile consisting of sleep quality and daytime sleepiness/functioning subjective measurements was created using subjective measurements. Overall, the college athlete sample reported better sleep quality, less perceived stress, higher levels of physical activity, and more physical symptoms compared to the college nonathlete sample. Although the college athlete has two roles in the college/university setting, the college athlete represents more of an athlete rather than a student in this study.
Limitations

This study had a couple of limitations. One limitation is the online assessment center terminated the instruments early. Participants were able to start completing the instruments online but would end prematurely. The cause of the early termination is unknown; however, a cause could be due to poor Internet connection. The early termination of the participants’ instruments resulted in incomplete data that could not be scored. Therefore, the return rate was significantly lower using the hyperlink than using the paper form of the instruments.

Another limitation is the absence of variety in the population studied. A majority of the population studied consisted of college students from NCAA Division I schools. The type of sports the subjects participated in is also another limitation. A limited selection of sports participated was collected due to the type of sports offered at the different data collecting sites. Another limitation of the study with the college athlete population is the transition of seasons for the sports. As data was being collected, there was a transition in season for sports. Winter sports were ending and spring sports were beginning, whereas fall sports were in off-season or starting a spring season. Because of the length of time to collect data, the winter sports (i.e., men’s and women’s basketball) were still in season as well as out of season, depending on the time the participants took the surveys. Therefore the data collected in the same sport over the period of might have produced different results if data were collected at a time period that did not include a transition of seasons.

The last limitation in the study is the level of physical activity in the overall population. A majority of the athlete sample consisted of moderately to high levels of
physical activity whereas the nonathlete sample varied from low to high levels of physical activity. Because some of the nonathlete sample had levels of physical activity similar to the athlete sample, a true “nonathlete” population with none to low levels of physical activity was not studied and compared to the athlete sample.

**Conclusions**

This study identified a relationship between sleep quality and college athletes. Sleep quality in the college athlete sample does differ significantly from a college nonathlete sample: the college athlete sleeps “better” than the college nonathlete. Additionally, this study proved there is a relationship between stress and overall health between the college athlete sample and college nonathlete sample: the college athlete has less stress but more physical symptoms.

Further studies should address some of the limitations with the college populations. Furthermore, future research needs to be done on the college athlete population for a longer period of time in order to see if sleep quality changes over time; a college athlete’s academic year has a lot of variability due to the different seasons (in-season, post-season, off-season, etc) and class schedules. Other areas of future research could include identifying potential relationships between injured college athletes and sleep quality measurements as well as the effects that sleep quality has on performance during rehabilitation.
References


52. Dettl MG. Phase 1: validation of PROMIS sleep-related impairment and sleep disturbance instruments in collegiate athletic population. Poster presented at: Ohio Athletic Trainers’ Association Annual Meeting and Symposium; May 12, 2012; Akron, OH.

Appendix A: Basic Demographic Form

1. Height: _________________________

2. Weight: _________________________

3. Gender (Circle one):
   
   Male

   Female

4. Date of Birth: _________________________

5. Marital Status (Circle one):
   
   Single

   Married

   Divorced

   Separated

   Widow

6. Ethnicity (Circle one):
   
   American Indian or Alaska Native

   Asian

   Black or African American

   Native Hawaiian Other Pacific Islander

   White

7. Education status (Circle one):
   
   Full-time student

   Part-time student
8. **Athletic Status (Circle one)**

NCAA-sanctioned team

*If so, what sport(s) do you play?*

Club team or intramural sports

*If so, what sport(s) do you play?*

Do not play sports

9. **School year (Circle one)**

FR or RS-FR

SO or RS-SO

JR or RS-JR

SR or RS-SR

Graduate Student

10. **Scholarship Status (Circle one)**

Academic

Athletic

Both

None

11. **Major:** _________________________

12. **Minor (If applicable):** _________________________

13. **Current cumulative GPA:** _________________________

14. **Current medications?** _________________________
15. Have you been injured in the last month?
   Yes or No
   a. If so, what was/were your injury/injuries?

16. Have you been diagnosed with a medical disorder that affects your sleep?
   Yes or No
   a. If so, what is the medical disorder?
Appendix B: Physical Activity Guidelines

What is your level of physical activity? Check the box that applies appropriately.

<table>
<thead>
<tr>
<th>Check Box:</th>
<th>Level of Physical Activity</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No activity above baseline</td>
<td>Sedentary lifestyle, no physical activity</td>
</tr>
<tr>
<td>☐</td>
<td>Activity beyond baseline but fewer than 150 minutes</td>
<td>30 minutes of exercise, 5 days a week</td>
</tr>
<tr>
<td></td>
<td>a week</td>
<td>or 1 hour of exercise, less than 3 days a week</td>
</tr>
<tr>
<td>☐</td>
<td>150 minutes to 300 minutes a week</td>
<td>30 minutes of exercise, 5 days a week</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 1 hour of exercise, 5 days a week</td>
</tr>
<tr>
<td>☐</td>
<td>More than 300 minutes a week</td>
<td>1 hour or more of exercise, 5 days or more a week</td>
</tr>
</tbody>
</table>
Appendix C: PROMIS Sleep-Related Impairment Item Bank

Please respond to each item by marking one box per row.

**In the past 7 days...**

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at all</th>
<th>A little bit</th>
<th>Somewhat</th>
<th>Quite a bit</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>I had a hard time getting things done because I was sleepy...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had a hard time concentrating because I was sleepy...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt alert when I woke up...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I woke up I felt ready to start the day...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had difficulty waking up...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I still felt sleep when I woke up...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt tired...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had problems during the day because of poor sleep...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had a hard time concentrating because of poor sleep...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt irritable because of poor sleep...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had enough energy...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I was sleepy during the daytime…

☑️ ☐ ☐ ☐ ☐ ☐

I had trouble staying awake during the day…

☐ ☐ ☐ ☐ ☐ ☐

**In the past 7 days…**

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I tried to sleep whenever I could…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

My daytime activities were disturbed by poor sleep…

☐ ☐ ☐ ☐ ☐ ☐
Appendix D: PROMIS Sleep Disturbance Item Bank

Please respond to each item by marking one box per row.

**In the past 7 days…**

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at all</th>
<th>A little bit</th>
<th>Somewhat</th>
<th>Quite a bit</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>My sleep was restful…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My sleep was light…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My sleep was deep…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My sleep was restless…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I was satisfied with my sleep…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My sleep was refreshing…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I felt lousy when I woke up…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I had a problem with my sleep…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I had difficulty falling asleep…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I was worried at bedtime…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I had trouble stopping my thoughts at bedtime…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I felt sad at bedtime…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I had trouble getting into a comfortable position to sleep…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
I tried hard to get to sleep…

Stress disturbed my sleep…

I tossed and turned at night…

I was afraid I would not get back to sleep after waking up…

**In the past 7 days…**

<table>
<thead>
<tr>
<th>I got enough sleep…</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

It was easy for me to fall asleep…

I laid in bed for hours waiting to fall asleep…

I woke up too early and could not fall back asleep…

I had trouble staying asleep…

I had trouble sleeping…

I woke up and had trouble falling back to sleep…

**In the past 7 days…**

<table>
<thead>
<tr>
<th>My sleep quality was…</th>
<th>Very poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Appendix E: Pittsburgh Sleep Quality Index (PSQI)

1. During the past month, what time have you usually gone to bed at night?  
   BED TIME ___________

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? NUMBER OF MINUTES ___________

3. During the past month, what time have you usually gotten up in the morning?  
   GETTING UP TIME ___________

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)  
   HOURS OF SLEEP PER NIGHT ___________

For each of the remaining questions, check the one best response. Please answer all questions.
5. During the past month, how often have you had trouble sleeping because you . . .

<table>
<thead>
<tr>
<th>Question</th>
<th>Not during the past month</th>
<th>Less than once a week</th>
<th>Once or twice a week</th>
<th>Three or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Cannot get to sleep within 30 minutes</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. Wake up in the middle of the night</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Have to get up to use the bathroom</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. Cannot breathe comfortably</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Cough or snore loudly</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f. Feel too cold</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>g. Feel too hot</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>h. Had bad dreams</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>i. Have pain</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
j) Other reason(s), please describe__________________________________________
________________________________________________________________________

How often during the past month have you had trouble sleeping because of this?

<table>
<thead>
<tr>
<th>j. other reason(s)</th>
<th>Not during the past month</th>
<th>Less than once a week</th>
<th>Once or twice a week</th>
<th>Three or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

6. During the past month, how would you rate your sleep quality overall?

<table>
<thead>
<tr>
<th>Very good</th>
<th>Fairly good</th>
<th>Fairly bad</th>
<th>Very bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

7. During the past month...

<table>
<thead>
<tr>
<th>Not during the past month</th>
<th>Less than once a week</th>
<th>Once or twice a week</th>
<th>Three or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

7. How often have you taken medicine to help you sleep (prescribed or "over the counter")?

| ☐                          | ☐                     | ☐                    | ☐                         |

8. How often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

| ☐                          | ☐                     | ☐                    | ☐                         |

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

<table>
<thead>
<tr>
<th>No problem at all</th>
<th>Only a very slight problem</th>
<th>Somewhat of a problem</th>
<th>A very big problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
10. Do you have a bed partner or room mate?

<table>
<thead>
<tr>
<th>No bed partner or room mate</th>
<th>Partner/room mate in other room</th>
<th>Partner in same room, but not same bed</th>
<th>Partner in same bed</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

If you do not have a room mate or bed partner, skip to next Epworth Sleepiness Scale. If you have a room mate or bed partner, ask him/her how often in the past month you have had . . .

<table>
<thead>
<tr>
<th></th>
<th>Not during the past month</th>
<th>Less than once a week</th>
<th>Once or twice a week</th>
<th>Three or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Loud snoring</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) Long pauses between breaths while asleep</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) Legs twitching or jerking while you sleep</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) Episodes of disorientation or confusion during sleep</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>e) Other restlessness while you sleep; please describe</th>
<th>☐</th>
<th>☐</th>
<th>☐</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. other restlessness(s)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

© 1989, University of Pittsburgh. All rights reserved. Developed by Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R., and Kupfer, D.J. of the University of Pittsburgh using National Institute of Mental Health Funding.
## Appendix F: Epworth Sleepiness Scale

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Use the following scale to choose the most appropriate number for each situation:

<table>
<thead>
<tr>
<th>SITUATION</th>
<th>No chance of dozing</th>
<th>Slight chance of dozing</th>
<th>Moderate chance of dozing</th>
<th>High chance of dozing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watching TV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting inactive in a public place (e.g., a theater or a meeting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after a lunch without alcohol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix G: Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by checking the box how often you felt or thought a certain way.

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Almost never</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often have you been upset because of something that happened unexpectedly?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you felt that you were unable to control the important things in life?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you felt nervous and “stressed”?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you felt confident about your ability to handle your personal problems?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you felt that things were going your way?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you found that you could not cope with all things that you had to do?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you been able to control irritations in your life?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you felt that you were on top of things?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you been angered because of things that were outside of your control?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How often have you felt difficulties were piling up so high that you could not overcome them?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Appendix H: SF-12v2™ Health Survey Standard Version

This survey asks for your views about your health. This information will help you keep track of how you feel and how well you are able to do your usual activities.

Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully, and check the box that best describes your answer. Thank you for completing this survey!

1. In general, would you say your health is:
   The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

   ![Excellent](□)  ![Very good](□)  ![Good](□)  ![Fair](□)  ![Poor](□)

   Yes, limited a lot
   Yes, limited a little
   No, not limited at all

2. **Vigorous Activities**, such as running, lifting heavy objects, participating in strenuous sports

3. **Moderate Activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

   ![All of the time](□)  ![Most of the time](□)  ![Some of the time](□)  ![A little of the time](□)  ![None of the time](□)

4. **Accomplished less** than you would like

5. **Were limited in the kind** of work or other activities
During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Accomplished less than you would like

7. Didn’t do work or other activities as carefully than usual

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

<table>
<thead>
<tr>
<th>Not at All</th>
<th>A little bit</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The next three questions are about how you feel and how things have been DURING THE PAST 4 WEEKS. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the PAST 4 WEEKS –

9. Have you felt calm and peaceful?

10. Did you have a lot of energy?

11. Have you felt downhearted and depressed?

12. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix I: Cohen-Hoberman Inventory Of Physical Symptoms (CHIPS)

Mark the number for each statement that best describes HOW MUCH THAT PROBLEM HAS BOTHERED OR DISTRESSED YOU DURING THAT PAST TWO WEEKS INCLUDING TODAY. Mark only one number for each item.

**RESPONSE KEY**
At one extreme, **0 means that you have not been bothered by the problem.**
At the other extreme, **4 means that the problem has been an extreme bother.**

**HOW MUCH WERE YOU BOTHERED BY:**

| 1. Sleep problems: can't fall asleep, wake up in middle of night or early in morning | 0 1 2 3 4 |
| 2. Weight change (gain or loss of 5 lbs. or more) | 0 1 2 3 4 |
| 3. Back pain | 0 1 2 3 4 |
| 4. Constipation | 0 1 2 3 4 |
| 5. Dizziness | 0 1 2 3 4 |
| 6. Diarrhea | 0 1 2 3 4 |
| 7. Faintness | 0 1 2 3 4 |
| 8. Constant fatigue | 0 1 2 3 4 |
| 9. Headache | 0 1 2 3 4 |
| 10. Migraine headache | 0 1 2 3 4 |
| 11. Nausea and/or vomiting | 0 1 2 3 4 |
| 12. Acid stomach or indigestion | 0 1 2 3 4 |
| 13. Stomach pain (e.g., cramps) | 0 1 2 3 4 |
| 14. Hot or cold spells | 0 1 2 3 4 |
| 15. Hands trembling | 0 1 2 3 4 |
| 16. Heart pounding or racing | 0 1 2 3 4 |
RESPONSE KEY
At one extreme, 0 means that you have not been bothered by the problem.
At the other extreme, 4 means that the problem has been an extreme bother

HOW MUCH WERE YOU BOTHERED BY:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Poor appetite</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18. Shortness of breath when not exercising or working hard</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19. Numbness or tingling in parts of your body</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20. Felt weak all over</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21. Pains in heart or chest</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22. Feeling low in energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23. Stuffy head or nose</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24. Blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25. Muscle tension or soreness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26. Muscle cramps</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27. Sever aches and pains</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28. Acne</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>29. Bruises</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>30. Nose bleed</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>31. Pulled (strained) muscles</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>32. Pulled (strained) ligaments</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>33. Cold or cough</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
A determination has been made that the following research study is exempt from IRB review because it involves:

Category 2. research involving the use of educational tests, survey procedures, interview procedures or observation of public behavior

Project Title: Sleep Quality in College Athletic Population and College Population

Primary Investigator: Martha Grace Dettl

Co-Investigator(s):

Advisor: Brian Ragan

Department: School of Applied Health Sciences and Wellness

Rebecca Cale, AAB, CIP
Office of Research Compliance

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved (as an amendment) prior to implementation.
Appendix K: Approval Notice for Alternate Data Collection

OHIO UNIVERSITY
Office of the Vice President for Research

The amendment, detailed below, and submitted for the following research study has been approved by the Institutional Review Board at Ohio University.

Project: Sleep Quality in College Athletic Population and College Population

Amendment: Add two collection sites; Bowling Green State University and Catawba College.

Primary Investigator: Martha Grace Dettl
Co-Investigator(s):

Advisor: Brian Ragan

Department: School of Applied Health Sciences and Wellness

Robin Stack, CIP, Human Subjects Research Coordinator
Office of Research Compliance

March 7, 2013
February 27, 2013

MEMORANDUM

To: Martha Dettl  
Graduate Student  
Ohio University

From: Lee A. Meserve  
For the ICA Research Subcommittee

Re: Your Proposal to Do Research Using Student-Athletes  
Project title: Sleep quality in college athletic population and college population.

The Intercollegiate Athletics Committee Research Subcommittee has reviewed your proposal to use BGSU men’s student-athletes as subjects for the survey research project for your master’s degree, the title of which is mentioned above. The ICA Research Subcommittee approves your use of student-athletes to collect data by means of your survey instrument for this project. Best wishes for successful collection of data and information. The Intercollegiate Athletics Committee Research Subcommittee would be interested in your findings, and would request that you provide us with a summary of the findings of this study at its completion.

cc: Hillary Harms, Compliance Office  
ICA Committee Research Subcommittee  
Greg Christopher, Director of intercollegiate Athletics
Institutional Review Board Committee
Office of Research Compliance
Research and Technology Center 317
Ohio University
Athens, OH 45701

Dear Review Committee,

I am writing to express my enthusiastic support for allowing my place of employment to serve as a data collection site for faculty and students from Ohio University's Athletic Training Program. The research project, Sleep Quality and Stress in the Athletic College Population, is exciting and has the potential to make a significant impact to sports medicine research.

I am aware that Ohio University personnel will do all data collection for the research study. I recognize that I will be helping with recruitment for this study and potentially fulfilling the role as the participant's athletic trainer. I will not answer any questions concerning the project; however, I will refer the questions to the appropriate OU investigators.

Sincerely,

[Signature]

Rob Whitehurst
whitehr@bgsu.edu
Subject: Re: Ohio University Research at Catawba College

Dr. Brownlow,

I have attached a copy of my IRB request, approval, as well as the amendment I will submit to IRB to add Catawba College as an additional collecting site. May I please have a formal letter stating I have approval to collect data at Catawba College to include in the amendment?

Thank you for your help,

Martha Dett, AT
Athletic Training Graduate Assistant
Ohio University
Athens, OH 45701
215-264-6090

[Attachment: IRB Request Form]

https://mail.ohio.edu/uwsa?fiem=Item&eh=IPM.Note&de=QgAAAAADc/mqkEcIC8R7M6g5S68R=nlhB/nC5SJaeQOkdM4FFGmOZ2xlLMAAaqlG8H325SjQ0an... 1/1
I am writing to express my enthusiastic support for allowing my place of employment to serve as a data collection site for faculty and students from Ohio University’s Athletic Training Program. The research project, Sleep Quality and Stress in the Athletic College Population, is exciting and has the potential to make a significant impact to sports medicine research.

I am aware that Ohio University personnel will do all data collection for the research study. I recognize that I will be helping with recruitment for this study and potentially fulfilling the role as the participant’s athletic trainer. I will not answer any questions concerning the project; however, I will refer the questions to the appropriate OU investigators.

Sincerely,

Robert Casmus, M.S., ATC
Catawba College
2300 West Innes St.
Salisbury, NC 28144
bcasmus@catawba.edu
Institutional Review Board Committee  
Office of Research Compliance  
Research and Technology Center 317  
Ohio University  
Athens, OH 45701

Dear Review Committee,  

I am writing to express my enthusiastic support for allowing my place of employment to serve as a data collection site for faculty and students from Ohio University’s Athletic Training Program. The research project, Sleep Quality and Stress in the Athletic College Population, is exciting and has the potential to make a significant impact to sports medicine research.

I am aware that Ohio University personnel will do all data collection for the research study. I recognize that I will be helping with recruitment for this study and potentially fulfilling the role as the participant’s athletic trainer. I will not answer any questions concerning the project; however, I will refer the questions to the appropriate OU investigators.

Sincerely,  

Leslie Dent, MS, ATC, LAT  
ladent@catawba.edu  
704-637-4267
Institutional Review Board Committee  
Office of Research Compliance  
Research and Technology Center 317  
Ohio University  
Athens, OH 45701

Dear Review Committee,

I am writing to express my enthusiastic support for allowing my place of employment to serve as a data collection site for faculty and students from Ohio University's Athletic Training Program. The research project, Sleep Quality and Stress in the Athletic College Population, is exciting and has the potential to make a significant impact to sports medicine research.

I am aware that Ohio University personnel will do all data collection for the research study. I recognize that I will be helping with recruitment for this study and potentially fulfilling the role as the participant's athletic trainer. I will not answer any questions concerning the project; however, I will refer the questions to the appropriate OU investigators.

Sincerely,

[Signature]

Mike Eden  
mseden@catawba.edu
Appendix M: Approval for Data Collection via Facebook

Office of Research Compliance
RTEC 117
Athens, OH 45701-2879
T: 740-593-0864
F: 740-593-9838
www.research.ohiou.edu

The amendment, detailed below, and submitted for the following research study has been approved by the Institutional Review Board at Ohio University.

Project: Sleep Quality in College Athletic Population and College Population

Amendment: Recruit via Facebook

Primary Investigator: Martha Grace Detri
Co-Investigator(s):

Advisor: Brian Ragan

Department: School of Applied Health Sciences and Wellness

Rebecca G. Cale, AAB, CIP
Office of Research Compliance
3/15/13
Group Name: Sleep Profile of College Students

Group Description:

My thesis is studying sleep quality in college athletes and non-athletes. Sleep is an important component of health and can affect normal psychological and physiological function. Poor sleep has been associated with suboptimal performance; therefore, it is important for athletic trainers to assess sleep in college athletes and non-athletes.

Please take the survey if you are:
1. A full-time student in a college or university setting
2. Over the age of 18 years old

The online sleep survey is available online for your convenience.

(insert hyperlink)

Thank you!

Martha Detl, AT
Ohio University
Appendix N: Permissions for Figures

Thesis/Dissertation Reuse Request
Taylor & Francis is pleased to offer reuses of its content for a thesis or dissertation free of charge contingent on resubmission of permission request if work is published.

BACK CLOSE WINDOW
This is a License Agreement between Martha Dettl ("You") and Elsevier ("Elsevier") provided by Copyright Clearance Center ("CCC"). The license consists of your order details, the terms and conditions provided by Elsevier, and the payment terms and conditions.

All payments must be made in full to CCC. For payment instructions, please see information listed at the bottom of this form.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Elsevier Limited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered Company Number</td>
<td>1982084</td>
</tr>
<tr>
<td>Customer name</td>
<td>Martha Dettl</td>
</tr>
<tr>
<td>Customer address</td>
<td>14 Townsend Place</td>
</tr>
<tr>
<td>Athens, OH 45701</td>
<td></td>
</tr>
<tr>
<td>License number</td>
<td>3111720871962</td>
</tr>
<tr>
<td>License date</td>
<td>Mar 18, 2013</td>
</tr>
<tr>
<td>Licensed content publisher</td>
<td>Elsevier</td>
</tr>
<tr>
<td>Licensed content publication</td>
<td>Pharmacology &amp; Therapeutics</td>
</tr>
<tr>
<td>Licensed content title</td>
<td>Treating insomnia: Current and investigational pharmacological approaches</td>
</tr>
<tr>
<td>Licensed content author</td>
<td>Bjarke Ebert, Keith A. Wafford, Stephen Deacon</td>
</tr>
<tr>
<td>Licensed content date</td>
<td>December 2006</td>
</tr>
<tr>
<td>Licensed content volume number</td>
<td>112</td>
</tr>
<tr>
<td>Licensed content issue number</td>
<td>3</td>
</tr>
<tr>
<td>Number of pages</td>
<td>18</td>
</tr>
<tr>
<td>Start Page</td>
<td>612</td>
</tr>
<tr>
<td>End Page</td>
<td>629</td>
</tr>
<tr>
<td>Type of Use</td>
<td>reuse in a thesis/dissertation</td>
</tr>
<tr>
<td>Intended publisher of new work</td>
<td>other</td>
</tr>
<tr>
<td>Portion</td>
<td>figures/tables/illustrations</td>
</tr>
<tr>
<td>Number of figures/tables/illustrations</td>
<td>1</td>
</tr>
<tr>
<td>Format</td>
<td>both print and electronic</td>
</tr>
</tbody>
</table>
INTRODUCTION

1. The publisher for this copyrighted material is Elsevier. By clicking "accept" in connection with completing this licensing transaction, you agree that the following terms and conditions apply to this transaction (along with the Billing and Payment terms and conditions established by Copyright Clearance Center, Inc. ("CCC"), at the time that you opened your Rightslink account and that are available at any time at http://myaccount.copyright.com).

GENERAL TERMS

2. Elsevier hereby grants you permission to reproduce the aforementioned material subject to the terms and conditions indicated.

3. Acknowledgement: If any part of the material to be used (for example, figures) has appeared in our publication with credit or acknowledgement to another source, permission must also be sought from that source. If such permission is not obtained then that material may not be included in your publication/copies. Suitable acknowledgement to the source must be made, either as a footnote or in a reference list at the end of your publication, as follows:

"Reprinted from Publication title, Vol./Edition number, Author(s), Title of article / title of chapter, Pages No., Copyright (Year), with permission from Elsevier [OR APPLICABLE SOCIETY COPYRIGHT OWNER]." Also Lancet special credit - "Reprinted from The Lancet, Vol. number, Author(s), Title of article, Pages No., Copyright (Year), with permission from Elsevier."

4. Reproduction of this material is confined to the purpose and/or media for which permission is hereby given.

5. Altering/Modifying Material: Not Permitted. However figures and illustrations may be altered/adapted minimally to serve your work. Any other abbreviations, additions, deletions and/or any other alterations shall be made only with prior written authorization of Elsevier Ltd. (Please
contact Elsevier at permissions@elsevier.com

6. If the permission fee for the requested use of our material is waived in this instance, please be advised that your future requests for Elsevier materials may attract a fee.

7. Reservation of Rights: Publisher reserves all rights not specifically granted in the combination of (i) the license details provided by you and accepted in the course of this licensing transaction, (ii) these terms and conditions and (iii) CCC's Billing and Payment terms and conditions.

8. License Contingent Upon Payment: While you may exercise the rights licensed immediately upon issuance of the license at the end of the licensing process for the transaction, provided that you have disclosed complete and accurate details of your proposed use, no license is finally effective unless and until full payment is received from you (either by publisher or by CCC) as provided in CCC’s Billing and Payment terms and conditions. If full payment is not received on a timely basis, then any license preliminarily granted shall be deemed automatically revoked and shall be void as if never granted. Further, in the event that you breach any of these terms and conditions or any of CCC's Billing and Payment terms and conditions, the license is automatically revoked and shall be void as if never granted. Use of materials as described in a revoked license, as well as any use of the materials beyond the scope of an unrevoked license, may constitute copyright infringement and publisher reserves the right to take any and all action to protect its copyright in the materials.

9. Warranties: Publisher makes no representations or warranties with respect to the licensed material.

10. Indemnity: You hereby indemnify and agree to hold harmless publisher and CCC, and their respective officers, directors, employees and agents, from and against any and all claims arising out of your use of the licensed material other than as specifically authorized pursuant to this license.

11. No Transfer of License: This license is personal to you and may not be sublicensed, assigned, or transferred by you to any other person without publisher's written permission.

12. No Amendment Except in Writing: This license may not be amended except in a writing signed by both parties (or, in the case of publisher, by CCC on publisher's behalf).

13. Objection to Contrary Terms: Publisher hereby objects to any terms contained in any purchase order, acknowledgment, check endorsement or other writing prepared by you, which terms are inconsistent with these terms and conditions or CCC's Billing and Payment terms and conditions. These terms and conditions, together with CCC's Billing and Payment terms and conditions (which are incorporated herein), comprise the entire agreement between you and publisher (and CCC) concerning this licensing transaction. In the event of any conflict between your obligations established by these terms and conditions and those established by CCC's Billing and Payment terms and conditions, these terms and conditions shall control.

14. Revocation: Elsevier or Copyright Clearance Center may deny the permissions described in this License at their sole discretion, for any reason or no reason, with a full refund payable to you. Notice of such denial will be made using the contact information provided by you. Failure to receive such notice will not alter or invalidate the denial. In no event will Elsevier or Copyright
Clearance Center be responsible or liable for any costs, expenses or damage incurred by you as a result of a denial of your permission request, other than a refund of the amount(s) paid by you to Elsevier and/or Copyright Clearance Center for denied permissions.

LIMITED LICENSE

The following terms and conditions apply only to specific license types:

15. Translation: This permission is granted for non-exclusive world English rights only unless your license was granted for translation rights. If you licensed translation rights you may only translate this content into the languages you requested. A professional translator must perform all translations and reproduce the content word for word preserving the integrity of the article. If this license is to re-use 1 or 2 figures then permission is granted for non-exclusive world rights in all languages.

16. Website: The following terms and conditions apply to electronic reserve and author websites:

Electronic reserve: If licensed material is to be posted to website, the web site is to be password-protected and made available only to bona fide students registered on a relevant course if:
This license was made in connection with a course,
This permission is granted for 1 year only. You may obtain a license for future website posting,
All content posted to the website must maintain the copyright information line on the bottom of each image,
A hyper-text must be included to the Home page of the journal from which you are licensing at http://www.sciencedirect.com/science/journal/xxxxx or the Elsevier homepage for books at http://www.elsevier.com, and
Central Storage: This license does not include permission for a scanned version of the material to be stored in a central repository such as that provided by Heron/XanEdu.

17. Author website for journals with the following additional clauses:

All content posted to the website must maintain the copyright information line on the bottom of each image, and the permission granted is limited to the personal version of your paper. You are not allowed to download and post the published electronic version of your article (whether PDF or HTML, proof or final version), nor may you scan the printed edition to create an electronic version. A hyper-text must be included to the Home page of the journal from which you are licensing at http://www.sciencedirect.com/science/journal/xxxxx. As part of our normal production process, you will receive an e-mail notice when your article appears on Elsevier’s online service ScienceDirect (www.sciencedirect.com). That e-mail will include the article’s Digital Object Identifier (DOI). This number provides the electronic link to the published article and should be included in the posting of your personal version. We ask that you wait until you receive this e-mail and have the DOI to do any posting.

Central Storage: This license does not include permission for a scanned version of the material to be stored in a central repository such as that provided by Heron/XanEdu.

18. Author website for books with the following additional clauses:
Authors are permitted to place a brief summary of their work online only.
A hyper-text must be included to the Elsevier homepage at http://www.elsevier.com. All content
posted to the web site must maintain the copyright information line on the bottom of each image.
You are not allowed to download and post the published electronic version of your chapter, nor
may you scan the printed edition to create an electronic version.

Central Storage: This license does not include permission for a scanned version of the material to
be stored in a central repository such as that provided by Heron/XanEdu.

19. Website (regular and for author): A hyper-text must be included to the Homepage of the
journal from which you are licensing at http://www.sciencedirect.com/science/journal/xxxxx, or for
books to the Elsevier homepage at http://www.elsevier.com

20. Thesis/Dissertation: If your license is for use in a thesis/dissertation your thesis may be
submitted to your institution in either print or electronic form. Should your thesis be published
commercially, please reapply for permission. These requirements include permission for the Library
and Archives of Canada to supply single copies, on demand, of the complete thesis and include
permission for UMI to supply single copies, on demand, of the complete thesis. Should your thesis
be published commercially, please reapply for permission.

21. Other Conditions:

v1.6

If you would like to pay for this license now, please remit this license along with your
payment made payable to "COPYRIGHT CLEARANCE CENTER" otherwise you will be
invoiced within 48 hours of the license date. Payment should be in the form of a check or
money order referencing your account number and this invoice number RNIKS0979245.
Once you receive your invoice for this order, you may pay your invoice by credit card.
Please follow instructions provided at that time.

Make Payment To:
Copyright Clearance Center
Dept 001
P.O. Box 843066
Boston, MA 02284-3006

For suggestions or comments regarding this order, contact RightsLink Customer Support:
customercare@copyright.com or +1-877-622-5543 (toll free in the US) or +1-978-646-
2777.

Gratis licenses (referencing $0 in the Total field) are free. Please retain this printable
license for your reference. No payment is required.
This is a License Agreement between Martha Dettl ("You") and Wolters Kluwer Health ("Wolters Kluwer Health") provided by Copyright Clearance Center ("CCC"). The license consists of your order details, the terms and conditions provided by Wolters Kluwer Health, and the payment terms and conditions.

All payments must be made in full to CCC. For payment instructions, please see information listed at the bottom of this form.

<table>
<thead>
<tr>
<th>License Number</th>
<th>3097180165349</th>
</tr>
</thead>
<tbody>
<tr>
<td>License date</td>
<td>Feb 27, 2013</td>
</tr>
<tr>
<td>Licensed content publisher</td>
<td>Wolters Kluwer Health</td>
</tr>
<tr>
<td>Licensed content publication</td>
<td>Current Sports Medicine Reports</td>
</tr>
<tr>
<td>Licensed content title</td>
<td>The Role of Sleep Dysfunction in Physical Inactivity and its Relationship to Obesity</td>
</tr>
<tr>
<td>Licensed content author</td>
<td>Donald Watenpaugh</td>
</tr>
<tr>
<td>Licensed content date</td>
<td>Jan 1, 2009</td>
</tr>
<tr>
<td>Volume Number</td>
<td>8</td>
</tr>
<tr>
<td>Issue Number</td>
<td>6</td>
</tr>
<tr>
<td>Type of Use</td>
<td>Dissertation/Thesis</td>
</tr>
<tr>
<td>Requestor type</td>
<td>Individual</td>
</tr>
<tr>
<td>Author of this Wolters Kluwer article</td>
<td>No</td>
</tr>
<tr>
<td>Title of your thesis / dissertation</td>
<td>Does sleep quality differ in college athletes?</td>
</tr>
<tr>
<td>Expected completion date</td>
<td>May 2013</td>
</tr>
<tr>
<td>Estimated size(pages)</td>
<td>100</td>
</tr>
<tr>
<td>Billing Type</td>
<td>Invoice</td>
</tr>
<tr>
<td>Billing address</td>
<td>14 Townsend Place</td>
</tr>
<tr>
<td></td>
<td>Apt B</td>
</tr>
<tr>
<td></td>
<td>Athens, OH 45701</td>
</tr>
<tr>
<td></td>
<td>United States</td>
</tr>
<tr>
<td>Customer reference info</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.00 USD</td>
</tr>
<tr>
<td>Terms and Conditions</td>
<td></td>
</tr>
</tbody>
</table>

Terms and Conditions

1. A credit line will be prominently placed and include: for books - the author(s), title of

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=c4de0812-8d81-4b98-ae0b-cbc9... 2/28/2013
book, editor, copyright holder, year of publication; For journals - the author(s), title of article, title of journal, volume number, issue number and inclusive pages.

2. The requestor warrants that the material shall not be used in any manner which may be considered derogatory to the title, content, or authors of the material, or to Wolters Kluwer.

3. Permission is granted for a one time use only within 12 months from the date of this invoice. Rights herein do not apply to future reproductions, editions, revisions, or other derivative works. Once the 12-month term has expired, permission to renew must be submitted in writing.

4. Permission granted is non-exclusive, and is valid throughout the world in the English language and the languages specified in your original request.

5. Wolters Kluwer cannot supply the requestor with the original artwork or a "clean copy."

6. The requestor agrees to secure written permission from the author (for book material only).


8. If you opt not to use the material requested above, please notify Rightslink within 90 days of the original invoice date.

9. Please note that articles in the ahead-of-print stage of publication can be cited and the content may be re-used by including the date of access and the unique DOI number. Any final changes in manuscripts will be made at the time of print publication and will be reflected in the final electronic version of the issue.

Disclaimer: Articles appearing in the Published Ahead-of-Print section have been peer-reviewed and accepted for publication in the relevant journal and posted online before print publication. Articles appearing as publish ahead-of-print may contain statements, opinions, and information that have errors in facts, figures, or interpretation. Accordingly, Lippincott Williams & Wilkins, the editors and authors and their respective employees are not responsible or liable for the use of any such inaccurate or misleading data, opinion or information contained in the articles in this section.

10. This permission does not apply to images that are credited to publications other than Wolters Kluwer journals. For images credited to non-Wolters Kluwer journal publications, you will need to obtain permission from the journal referenced in the figure or table legend or credit line before making any use of the image(s) or table(s).

11. The following statement needs to be added when reprints the material in Open Access publications: "promotional and commercial use of the material in print, digital or mobile device format is prohibited without the permission from the publisher Lippincott Williams & Wilkins. Please contact journalpermissions@lww.com for further information."

12. Other Terms and Conditions:

v1.5

If you would like to pay for this license now, please remit this license along with your payment made payable to "COPYRIGHT CLEARANCE CENTER" otherwise you will be invoiced within 48 hours of the license date. Payment should be in the form of a check or money order referencing your account number and this invoice number RLNK500966327.

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=c4de0812-8d81-4b98-ae0b-cbc9... 2/28/2013
Once you receive your invoice for this order, you may pay your invoice by credit card. Please follow instructions provided at that time.

Make Payment To:
Copyright Clearance Center
Dept 001
P.O. Box 843006
Boston, MA 02284-3006

For suggestions or comments regarding this order, contact RightsLink Customer Support: customearcare@copyright.com or +1-877-622-5543 (toll free in the US) or +1-978-646-2777.

Gratia licenses (referencing 0 in the Total field) are free. Please retain this printable license for your reference. No payment is required.
JOHN WILEY AND SONS LICENSE
TERMS AND CONDITIONS

Feb 28, 2013

This is a License Agreement between Martha Dettl ("You") and John Wiley and Sons ("John Wiley and Sons") provided by Copyright Clearance Center ("CCC"). The license consists of your order details, the terms and conditions provided by John Wiley and Sons, and the payment terms and conditions.

All payments must be made in full to CCC. For payment instructions, please see information listed at the bottom of this form.

License Number 3097181491574
License date Feb 27, 2013
Licensed content publisher John Wiley and Sons
Licensed content publication Stress and Health
Licensed content title Sleep: an important factor in stress-health models
Licensed copyright line Copyright © 2010 John Wiley & Sons, Ltd.
Licensed content author Grant Benham
Licensed content date Feb 5, 2010
Start page 204
End page 214
Type of use Dissertation/Thesis
Requestor type University/Academic
Format Print and electronic
Portion Figure/table
Number of figures/tables 1
Number of extracts
Original Wiley figure/table number(s) Figure 1: Stress-health model in which both sleep and psychological stress contribute to illness as a result of increased allostatic load
Will you be translating? No
Order reference number
Total 0.00 USD

TERMS AND CONDITIONS

This copyrighted material is owned by or exclusively licensed to John Wiley & Sons, Inc. or one of its group companies (each a "Wiley Company") or a society for whom a Wiley Company has exclusive publishing rights in relation to a particular journal (collectively WILEY*). By clicking "accept" in connection with completing this licensing transaction, you agree that the following terms and conditions apply to this transaction (along with the billing and payment terms and conditions established by the Copyright Clearance Center Inc., ("CCC’s Billing and Payment terms and conditions"), at the time that you opened your Rightslink account (these are available at any

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=392e366b-2acc-4b43-8111-a85b3...  2/28/2013
Terms and Conditions

1. The materials you have requested permission to reproduce (the "Materials") are protected by copyright.

2. You are hereby granted a personal, non-exclusive, non-sub licensable, non-transferable, worldwide, limited license to reproduce the Materials for the purpose specified in the licensing process. This license is for a one-time use only with a maximum distribution equal to the number that you identified in the licensing process. Any form of republication granted by this licence must be completed within two years of the date of the grant of this licence (although copies prepared before may be distributed thereafter). The Materials shall not be used in any other manner or for any other purpose. Permission is granted subject to an appropriate acknowledgement given to the author, title of the material/book/journal and the publisher. You shall also duplicate the copyright notice that appears in the Wiley publication in your use of the Material. Permission is also granted on the understanding that nowhere in the text is a previously published source acknowledged for all or part of this Material. Any third party material is expressly excluded from this permission.

3. With respect to the Materials, all rights are reserved. Except as expressly granted by the terms of the license, no part of the Materials may be copied, modified, adapted (except for minor reformating required by the new Publication), translated, reproduced, transferred or distributed, in any form or by any means, and no derivative works may be made based on the Materials without the prior permission of the respective copyright owner. You may not alter, remove or suppress in any manner any copyright, trademark or other notices displayed by the Materials. You may not license, rent, sell, loan, lease, pledge, offer as security, transfer or assign the Materials, or any of the rights granted to you hereunder to any other person.

4. The Materials and all of the intellectual property rights therein shall at all times remain the exclusive property of John Wiley & Sons Inc or one of its related companies (WILEY) or their respective licensors, and your interest therein is only that of having possession of and the right to reproduce the Materials pursuant to Section 2 herein during the continuance of this Agreement. You agree that you own no right, title or interest in or to the Materials or any of the intellectual property rights therein. You shall have no rights hereunder other than the license as provided for above in Section 2. No right, license or interest to any trademark, trade name, service mark or other branding ("Marks") of WILEY or its licensors is granted hereunder, and you agree that you shall not assert any such right, license or interest with respect thereto.

5. NEITHER WILEY NOR ITS LICENSORS MAKES ANY WARRANTY OR REPRESENTATION OF ANY KIND TO YOU OR ANY THIRD PARTY, EXPRESS, IMPLIED OR STATUTORY, WITH RESPECT TO THE MATERIALS OR THE ACCURACY OF ANY INFORMATION CONTAINED IN THE MATERIALS; INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, ACCURACY, SATISFACTORY QUALITY, FITNESS FOR A PARTICULAR PURPOSE, USABILITY, INTEGRATION OR NON-INFRINGEMENT AND ALL SUCH WARRANTIES ARE HEREBY EXCLUDED BY WILEY AND ITS LICENSORS AND WAIVED BY YOU.

6. WILEY shall have the right to terminate this Agreement immediately upon breach of this Agreement by you.

7. You shall indemnify, defend and hold harmless WILEY, its Licensors and their respective directors, officers, agents and employees, from and against any actual or threatened claims, demands, causes of action or proceedings arising from any breach of this Agreement by you.

8. IN NO EVENT SHALL WILEY OR ITS LICENSORS BE LIABLE TO YOU OR ANY OTHER PARTY OR ANY OTHER PERSON OR ENTITY FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR PUNITIVE DAMAGES, HOWEVER CAUSED, ARISING OUT OF OR IN CONNECTION WITH THE DOWNLOADING, PROVISIONING, VIEWING OR USE OF THE MATERIALS REGARDLESS OF THE FORM OF ACTION, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, INFRINGEMENT OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, DAMAGES BASED ON LOSS OF PROFITS, DATA, FILES, USE, BUSINESS OPPORTUNITY OR CLAIMS OF THIRD PARTIES), AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE
POSSIBILITY OF SUCH DAMAGES. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY
FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY PROVIDED HEREIN.

9. Should any provision of this Agreement be held by a court of competent jurisdiction to be
illegal, invalid, or unenforceable, that provision shall be deemed amended to achieve as nearly as
possible the same economic effect as the original provision, and the legality, validity and
enforceability of the remaining provisions of this Agreement shall not be affected or impaired
thereby.

10. The failure of either party to enforce any term or condition of this Agreement shall not
constitute a waiver of either party's right to enforce each and every term and condition of this
Agreement. No breach under this agreement shall be deemed waived or excused by either party
unless such waiver or consent is in writing signed by the party granting such waiver or consent.
The waiver by or consent of a party to a breach of any provision of this Agreement shall not
operate or be construed as a waiver of or consent to any other or subsequent breach by such
other party.

11. This Agreement may not be assigned (including by operation of law or otherwise) by you
without WILEY's prior written consent.

12. Any fee required for this permission shall be non-refundable after thirty (30) days from
receipt.

13. These terms and conditions together with CCC's Billing and Payment terms and conditions
(which are incorporated herein) form the entire agreement between you and WILEY concerning
this licensing transaction and (in the absence of fraud) supersedes all prior agreements and
representations of the parties, oral or written. This Agreement may not be amended except in
writing signed by both parties. This Agreement shall be binding upon and inure to the benefit of
the parties' successors, legal representatives, and authorized assigns.

14. In the event of any conflict between your obligations established by these terms and
conditions and those established by CCC's Billing and Payment terms and conditions, these terms
and conditions shall prevail.

15. WILEY expressly reserves all rights not specifically granted in the combination of (i) the
license details provided by you and accepted in the course of this licensing transaction, (ii) these
terms and conditions and (iii) CCC's Billing and Payment terms and conditions.

16. This Agreement will be void if the Type of Use, Format, Circulation, or Requestor Type was
misrepresented during the licensing process.

17. This Agreement shall be governed by and construed in accordance with the laws of the State
of New York, USA, without regards to such state's conflict of law rules. Any legal action, suit or
proceeding arising out of or relating to these Terms and Conditions or the breach thereof shall be
instituted in a court of competent jurisdiction in New York County in the State of New York in the
United States of America and each party hereby consents and submits to the personal jurisdiction
of such court, waives any objection to venue in such court and consents to service of process by
registered or certified mail, return receipt requested, at the last known address of such party.

Wiley Open Access Terms and Conditions

All research articles published in Wiley Open Access journals are fully open access: immediately
freely available to read, download and share. Articles are published under the terms of the
Creative Commons Attribution Non Commercial License. which permits use, distribution and
reproduction in any medium, provided the original work is properly cited and is not used for
commercial purposes. The license is subject to the Wiley Open Access terms and conditions:
Wiley Open Access articles are protected by copyright and are posted to repositories and websites
in accordance with the terms of the Creative Commons Attribution Non Commercial License. At
the time of deposit, Wiley Open Access articles include all changes made during peer review,
copyediting, and publishing. Repositories and websites that host the article are responsible for
incorporating any publisher-supplied amendments or rejections issued subsequently.

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=392c366b-2acc-4b43-8111-a8b3... 2/28/2013
Wiley Open Access articles are also available without charge on Wiley's publishing platform, Wiley Online Library or any successor sites.

Use by non-commercial users

For non-commercial and non-promotional purposes individual users may access, download, copy, display and redistribute to colleagues Wiley Open Access articles, as well as adapt, translate, text- and data-mine the content subject to the following conditions:

• The authors' moral rights are not compromised. These rights include the right of "paternity" (also known as "attribution" - the right for the author to be identified as such) and "integrity" (the right for the author not to have the work altered in such a way that the author's reputation or integrity may be impugned).
• Where content in the article is identified as belonging to a third party, it is the obligation of the user to ensure that any reuse complies with the copyright policies of the owner of that content.
• If article content is copied, downloaded or otherwise reused for non-commercial research and education purposes, a link to the appropriate bibliographic citation (authors, journal, article title, volume, issue, page numbers, DOI and the link to the definitive published version on Wiley Online Library) should be maintained. Copyright notices and disclaimers must not be deleted.
• Any translations, for which a prior translation agreement with Wiley has not been agreed, must prominently display the statement: "This is an unofficial translation of an article that appeared in a Wiley publication. The publisher has not endorsed this translation."

Use by commercial "for-profit" organisations

Use of Wiley Open Access articles for commercial, promotional, or marketing purposes requires further explicit permission from Wiley and will be subject to a fee. Commercial purposes include:

• Copying or downloading of articles, or linking to such articles for further redistribution, sale or licensing;
• Copying, downloading or posting by a site or service that incorporates advertising with such content;
• The inclusion or incorporation of article content in other works or services (other than normal quotations with appropriate citation) that is then available for sale or licensing, for a fee (for example, a compilation produced for marketing purposes, inclusion in a sales pack)
• Use of article content (other than normal quotations with appropriate citation) by for-profit organisations for promotional purposes
• Linking to article content in e-mails redistributed for promotional, marketing or educational purposes;
• Use for the purposes of monetary reward by means of sale, resale, licence, loan, transfer or other form of commercial exploitation such as marketing products
• Print reprints of Wiley Open Access articles can be purchased from: corporatesales@wiley.com

Other Terms and Conditions:

BY CLICKING ON THE "I AGREE..." BOX, YOU ACKNOWLEDGE THAT YOU HAVE READ AND FULLY UNDERSTAND EACH OF THE SECTIONS OF AND PROVISIONS SET FORTH IN THIS AGREEMENT AND THAT YOU ARE IN

https://s100opyright.com/CustomerAdmin/PLF.jsp?ref=392c366b-2acc-4b43-8111-a8b3... 2/28/2013
AGREEMENT WITH AND ARE WILLING TO ACCEPT ALL OF YOUR OBLIGATIONS AS SET FORTH IN THIS AGREEMENT.

v1.7

If you would like to pay for this license now, please remit this license along with your payment made payable to “COPYRIGHT CLEARANCE CENTER” otherwise you will be invoiced within 48 hours of the license date. Payment should be in the form of a check or money order referencing your account number and this invoice number RLNK500966355.

Once you receive your invoice for this order, you may pay your invoice by credit card. Please follow instructions provided at that time.

Make Payment To:
Copyright Clearance Center
Dept 001
P.O. Box 843006
Boston, MA 02284-3006

For suggestions or comments regarding this order, contact RightsLink Customer Support: customerservice@copyright.com or +1-877-622-5543 (toll free in the US) or +1-978-646-2777.

Gratiss licenses (referencing $0 in the Total field) are free. Please retain this printable license for your reference. No payment is required.
**JOHN WILEY AND SONS LICENSE TERMS AND CONDITIONS**  
Feb 28, 2013

This is a License Agreement between Martha Detl ("You") and John Wiley and Sons ("John Wiley and Sons") provided by Copyright Clearance Center ("CCC"). The license consists of your order details, the terms and conditions provided by John Wiley and Sons, and the payment terms and conditions.

All payments must be made in full to CCC. For payment instructions, please see information listed at the bottom of this form.

<table>
<thead>
<tr>
<th>License Number</th>
<th>3097190286107</th>
</tr>
</thead>
<tbody>
<tr>
<td>License date</td>
<td>Feb 27, 2013</td>
</tr>
<tr>
<td>Licensed content publisher</td>
<td>John Wiley and Sons</td>
</tr>
<tr>
<td>Licensed content publication</td>
<td>Journal of School Health</td>
</tr>
<tr>
<td>Licensed content title</td>
<td>Adolescents' Sleep Behaviors and Perceptions of Sleep</td>
</tr>
<tr>
<td>Licensed copyright line</td>
<td>© 2009, American School Health Association</td>
</tr>
<tr>
<td>Licensed content author</td>
<td>Heather Noland, James H. Price, Joseph Dake, Susan K. Telljohann</td>
</tr>
<tr>
<td>Licensed content date</td>
<td>Mar 27, 2009</td>
</tr>
<tr>
<td>Start page</td>
<td>224</td>
</tr>
<tr>
<td>End page</td>
<td>230</td>
</tr>
<tr>
<td>Type of use</td>
<td>Dissertation/Thesis</td>
</tr>
<tr>
<td>Requestor type</td>
<td>University/Academic</td>
</tr>
<tr>
<td>Format</td>
<td>Print and electronic</td>
</tr>
<tr>
<td>Portion</td>
<td>Figure/table</td>
</tr>
<tr>
<td>Number of figures/tables</td>
<td>1</td>
</tr>
<tr>
<td>Number of extracts</td>
<td></td>
</tr>
<tr>
<td>Original Wiley figure/table number(s)</td>
<td>Figure 1. Reduced Sleep Duration-Overweight Cycle</td>
</tr>
<tr>
<td>Will you be translating?</td>
<td>No</td>
</tr>
<tr>
<td>Order reference number</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.00 USD</td>
</tr>
</tbody>
</table>

**TERMS AND CONDITIONS**

This copyrighted material is owned by or exclusively licensed to John Wiley & Sons, Inc. or one of its group companies (each a "Wiley Company") or a society for whom a Wiley Company has exclusive publishing rights in relation to a particular journal (collectively WILEY). By clicking "accept" in connection with completing this licensing transaction, you agree that the following terms and conditions apply to this transaction (along with the billing and payment terms and conditions established by the Copyright Clearance Center Inc., ("CCC's Billing and Payment terms and conditions"), at the time that you opened your Rightslink account (these are available at any

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=d185e42d-26f6-47e1-8402-09ae...  
2/28/2013
Terms and Conditions

1. The materials you have requested permission to reproduce (the "Materials") are protected by copyright.

2. You are hereby granted a personal, non-exclusive, non-sublicensable, non-transferable, worldwide, limited license to reproduce the Materials for the purpose specified in the licensing process. This license is for a one-time use only with a maximum distribution equal to the number that you identified in the licensing process. Any form of republication granted by this licence must be completed within two years of the date of the grant of this licence (although copies prepared before may be distributed thereafter). The Materials shall not be used in any other manner or for any other purpose. Permission is granted subject to an appropriate acknowledgement given to the author, title of the material/book/journal and the publisher. You shall also duplicate the copyright notice that appears in the Wiley publication in your use of the Material. Permission is also granted on the understanding that nowhere in the text is a previously published source acknowledged for all or part of this Material. Any third party material is expressly excluded from this permission.

3. With respect to the Materials, all rights are reserved. Except as expressly granted by the terms of the license, no part of the Materials may be copied, modified, adapted (except for minor reformatting required by the new Publication), translated, reproduced, transferred or distributed, in any form or by any means, and no derivative works may be made based on the Materials without the prior permission of the respective copyright owner. You may not alter, remove or suppress in any manner any copyright, trademark or other notices displayed by the Materials. You may not license, rent, sell, loan, lease, pledge, offer as security, transfer or assign the Materials, or any of the rights granted to you hereunder to any other person.

4. The Materials and all of the intellectual property rights therein shall at all times remain the exclusive property of John Wiley & Sons Inc or one of its related companies (WILEY) or their respective licensors, and your interest therein is only that of having possession of and the right to reproduce the Materials pursuant to Section 2 herein during the continuance of this Agreement. You agree that you own no right, title or interest in or to the Materials or any of the intellectual property rights therein. You shall have no rights hereunder other than the license as provided for above in Section 2. No right, license or interest to any trademark, trade name, service mark or other branding ("Marks") of WILEY or its licensors is granted hereunder, and you agree that you shall not assert any such right, license or interest with respect thereto.

5. NEITHER WILEY NOR ITS LICENSORS MAKES ANY WARRANTY OR REPRESENTATION OF ANY KIND TO YOU OR ANY THIRD PARTY, EXPRESS, IMPLIED OR STATUTORY, WITH RESPECT TO THE MATERIALS OR THE ACCURACY OF ANY INFORMATION CONTAINED IN THE MATERIALS, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, ACCURACY, SATISFACTORY QUALITY, FITNESS FOR A PARTICULAR PURPOSE, USABILITY, INTEGRATION OR NON-INFRINGEMENT AND ALL SUCH WARRANTIES ARE HEREBY EXCLUDED BY WILEY AND ITS LICENSORS AND WAIVED BY YOU.

6. WILEY shall have the right to terminate this Agreement immediately upon breach of this Agreement by you.

7. You shall indemnify, defend and hold harmless WILEY, its Licensors and their respective directors, officers, agents and employees, from and against any actual or threatened claims, demands, causes of action or proceedings arising from any breach of this Agreement by you.

8. IN NO EVENT SHALL WILEY OR ITS LICENSORS BE LIABLE TO YOU OR ANY OTHER PARTY OR ANY OTHER PERSON OR ENTITY FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR PUNITIVE DAMAGES, HOWEVER CAUSED, ARISING OUT OF OR IN CONNECTION WITH THE DOWNLOADING, PROVISIONING, VIEWING OR USE OF THE MATERIALS REGARDLESS OF THE FORM OF ACTION, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, INFRINGEMENT OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, DAMAGES BASED ON LOSS OF PROFITS, DATA, FILES, USE, BUSINESS OPPORTUNITY OR CLAIMS OF THIRD PARTIES), AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE
POSSIBILITY OF SUCH DAMAGES. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY PROVIDED HEREIN.

9. Should any provision of this Agreement be held by a court of competent jurisdiction to be illegal, invalid, or unenforceable, that provision shall be deemed amended to achieve as nearly as possible the same economic effect as the original provision, and the legality, validity and enforceability of the remaining provisions of this Agreement shall not be affected or impaired thereby.

10. The failure of either party to enforce any term or condition of this Agreement shall not constitute a waiver of either party's right to enforce each and every term and condition of this Agreement. No breach under this agreement shall be deemed waived or excused by either party unless such waiver or consent is in writing signed by the party granting such waiver or consent. The waiver by or consent of a party to a breach of any provision of this Agreement shall not operate or be construed as a waiver of or consent to any other or subsequent breach by such other party.

11. This Agreement may not be assigned (including by operation of law or otherwise) by you without WILEY's prior written consent.

12. Any fee required for this permission shall be non-refundable after thirty (30) days from receipt.

13. These terms and conditions together with CCC's Billing and Payment terms and conditions (which are incorporated herein) form the entire agreement between you and WILEY concerning this licensing transaction and (in the absence of fraud) supersedes all prior agreements and representations of the parties, oral or written. This Agreement may not be amended except in writing signed by both parties. This Agreement shall be binding upon and inure to the benefit of the parties' successors, legal representatives, and authorized assigns.

14. In the event of any conflict between your obligations established by these terms and conditions and those established by CCC's Billing and Payment terms and conditions, these terms and conditions shall prevail.

15. WILEY expressly reserves all rights not specifically granted in the combination of (i) the license details provided by you and accepted in the course of this licensing transaction, (ii) these terms and conditions and (iii) CCC's Billing and Payment terms and conditions.

16. This Agreement will be void if the Type of Use, Format, Circulation, or Requestor Type was misrepresented during the licensing process.

17. This Agreement shall be governed by and construed in accordance with the laws of the State of New York, USA, without regards to such state's conflict of law rules. Any legal action, suit or proceeding arising out of or relating to these Terms and Conditions or the breach thereof shall be instituted in a court of competent jurisdiction in New York County in the State of New York in the United States of America and each party hereby consents and submits to the personal jurisdiction of such court, waives any objection to venue in such court and consents to service of process by registered or certified mail, return receipt requested, at the last known address of such party.

**Wiley Open Access Terms and Conditions**

All research articles published in Wiley Open Access journals are fully open access: immediately freely available to read, download and share. Articles are published under the terms of the Creative Commons Attribution Non Commercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes. The license is subject to the Wiley Open Access terms and conditions:

Wiley Open Access articles are protected by copyright and are posted to repositories and websites in accordance with the terms of the Creative Commons Attribution Non Commercial License. At the time of deposit, Wiley Open Access articles include all changes made during peer review, copyediting, and publishing. Repositories and websites that host the article are responsible for incorporating any publisher-supplied amendments or retractions issued subsequently.

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=d185e42d-268f-47e1-8402-09ae... 2/28/2013
Wiley Open Access articles are also available without charge on Wiley's publishing platform, Wiley Online Library or any successor sites.

Use by non-commercial users

For non-commercial and non-promotional purposes individual users may access, download, copy, display and redistribute to colleagues Wiley Open Access articles, as well as adapt, translate, text-and data-mine the content subject to the following conditions:

- The authors' moral rights are not compromised. These rights include the right of "paternity" (also known as "attribution" - the right for the author to be identified as such) and "integrity" (the right for the author not to have the work altered in such a way that the author's reputation or integrity may be impugned).
- Where content in the article is identified as belonging to a third party, it is the obligation of the user to ensure that any reuse complies with the copyright policies of the owner of that content.
- If article content is copied, downloaded or otherwise reused for non-commercial research and education purposes, a link to the appropriate bibliographic citation (authors, journal, article title, volume, issue, page numbers, DOI and the link to the definitive published version on Wiley Online Library) should be maintained. Copyright notices and disclaimers must not be deleted.
- Any translations, for which a prior translation agreement with Wiley has not been agreed, must prominently display the statement: "This is an unofficial translation of an article that appeared in a Wiley publication. The publisher has not endorsed this translation."

Use by commercial "for-profit" organisations

Use of Wiley Open Access articles for commercial, promotional, or marketing purposes requires further explicit permission from Wiley and will be subject to a fee. Commercial purposes include:

- Copying or downloading of articles, or linking to such articles for further redistribution, sale or licensing;
- Copying, downloading or posting by a site or service that incorporates advertising with such content;
- The inclusion or incorporation of article content in other works or services (other than normal quotations with an appropriate citation) that is then available for sale or licensing, for a fee (for example, a compilation produced for marketing purposes, inclusion in a sales pack);
- Use of article content (other than normal quotations with appropriate citation) by for-profit organisations for promotional purposes;
- Linking to article content in e-mails redistributed for promotional, marketing or educational purposes;
- Use for the purposes of monetary reward by means of sale, resale, licence, loan, transfer or other form of commercial exploitation such as marketing products;
- Print reprints of Wiley Open Access articles can be purchased from: corporatesales@wiley.com

Other Terms and Conditions:

BY CLICKING ON THE "I AGREE..." BOX, YOU ACKNOWLEDGE THAT YOU HAVE READ AND FULLY UNDERSTAND EACH OF THE SECTIONS OF AND PROVISIONS SET FORTH IN THIS AGREEMENT AND THAT YOU ARE IN

https://s100.copyright.com/CustomerAdmin/PLF.jsp?ref=d185e42d-26f6-47e1-8402-09ae... 2/28/2013
AGREEMENT WITH AND ARE WILLING TO ACCEPT ALL OF YOUR OBLIGATIONS AS SET FORTH IN THIS AGREEMENT.

v1.7

If you would like to pay for this license now, please remit this license along with your payment made payable to "COPYRIGHT CLEARANCE CENTER" otherwise you will be invoiced within 48 hours of the license date. Payment should be in the form of a check or money order referencing your account number and this invoice number RLNK500966355.

Once you receive your invoice for this order, you may pay your invoice by credit card. Please follow instructions provided at that time.

Make Payment To:
Copyright Clearance Center
Dept 001
P.O. Box 843006
Boston, MA 02284-3006

For suggestions or comments regarding this order, contact RightsLink Customer Support: customercare@copyright.com or +1-877-622-5543 (toll free in the US) or +1-978-646-2777.

Gratis licenses (referencing $0 in the Total field) are free. Please retain this printable license for your reference. No payment is required.
Appendix O: Permission to Use PSQI Instrument

FW: PSQI - Ohio University
Willrich, Linda [willrich1@upmc.edu]
Sent: Tuesday, May 29, 2012 1:45 PM
To: Detli, Martha
Cc: Buyse, Daniel [buyse001@upmc.edu]

Sent on behalf of Dr. Buyse:

Dear Martha,

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.phpc.pitt.edu under the Instruments tab. Please be sure to cite the 1989 paper in any publications that result.

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. Buyse, M.D.
Professor of Psychiatry and Clinical and Translational Science
University of Pittsburgh School of Medicine
E: 1127 WPIC
3811 O’Hara St.
Pittsburgh, PA 15213
T: (412) 246-6413
F: (412) 246-5300
buyse001@upmc.edu

This e-mail may contain confidential information of UPMC or the University of Pittsburgh. Any unauthorized or improper disclosure, copying, distribution, or use of the contents of this e-mail and attached document(s) is prohibited. The information contained in this e-mail and attached document(s) is intended only for the personal and confidential use of the recipient(s) named above. If you have received this communication in error, please notify the sender immediately by e-mail and delete the original e-mail and attached document(s).

From: Buyse, Daniel
Sent: Tuesday, May 29, 2012 1:44 PM
To: Willrich, Linda
Subject: FW: PSQI - Ohio University

From: Detli, Martha [mailto:md14411@ohio.edu]
Sent: Tuesday, May 29, 2012 1:13 PM
To: Buyse, Daniel
Cc: Ragan, Brian
Subject: PSQI - Ohio University

https://mail.ohio.edu/uow?e=rar-83-epM-Note&d=bgAAAAADdmpBEIC8RMp8S0R6QmBbRvbcSSJuueKqO6qV4FFQnOAE7FqCCAAM6vocSSJwaeKqO6m...
My name is Martha Dettl and I am a two year graduate student at Ohio University, studying athletic training. I am currently trying to validate the PROMIS instruments in the collegiate athletic population using accelerometers. Next year, I aim to develop a sleep profile of the collegiate athletic population as well as look at the effect acute injuries have on sleep, and possibly affecting in the long run, the rehabilitation process. In order to do the profile and sleep/Injuries, I would like to use the Pittsburgh Sleep Quality Index in conjunction with the PROMIS instruments and Epworth Sleepiness Scale. I am asking permission to use the PSQI for the study.

Thank you for your time.

Sincerely,

Martha Dettl, AT
Athletic Training Graduate Assistant
Ohio University
E330 Grover Center
Athens, OH 45701
215-264-6090
Appendix P: Consent Form

Ohio University Consent Form

Title of Research: Sleep Quality in College Athletic Population and College Population

Researchers: Martha Dettl, AT; Brian Ragan, PhD

You are being asked to participate in research because you are a full-time college/university student. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you.

Explanation of Study
This study is being done to get a better understanding of the sleep quality in the college population. The goal of this study is to develop a sleep profile using subjective questionnaires in order to complete further research in the collegiate population.

If you agree to participate, you will be asked to fill out a demographic sheet regarding your basic information, including information that will be helpful to the study.

You will answer different questionnaires regarding your sleeping habits, daytime functioning as well as your overall health. The questionnaires will take 20-30 minutes to complete.

Risks and Discomforts
There is no risk or discomfort for you if you participate.

Benefits
There is no direct benefit for you to participate.

This study is important to athletic training because athletic trainers’ main concerns are focused on what the impact an injury has on the psychological and physical functions; however, sleep is an external factor that may affect your overall performance, especially during rehabilitation.
Confidentiality and Records

Your study information will be kept confidential by the research team working for Ohio University. The information collected will not be released to anyone outside of the research team including the coaching staff.

Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
* Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU;

Contact Information

If you have any questions regarding this study, please contact:

Martha Dettl, AT  Dr. Brian Ragan
Primary Investigator  Research Advisor
(215) 264-6090  740-597-1875
md114411@ohio.edu  ragan@ohio.edu

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

By signing below, you are agreeing that:

- you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered
- you have been informed of potential risks and they have been explained to your satisfaction.
- you understand Ohio University has no funds set aside for any injuries you might receive as a result of participating in this study
- you are 18 years of age or older
- your participation in this research is completely voluntary
- you may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you and you will not lose any benefits to which you are otherwise entitled.

Signature ___________________________________________ Date ________

Printed Name ____________________________________________

Version Date: 2/28/2013
Appendix Q: Electronic Mail Recruitment to Athletes

Dear NCAA athlete,

My current research project is studying sleep quality in collegiate athletes. Sleep is an important component of health and can affect normal psychological and physiological function. Poor sleep has been associated with suboptimal athletic performance; therefore, it is important for athletic trainers to assess sleep in athletes.

Participants have to be enrolled as a full-time student in a college or university setting. Participants selected to represent the athletic collegiate population have to be currently participating on a university sanctioned, NCAA sport. Subjects may not participate if they qualify as a minor, under the age of 18. There will be a basic demographic form for subjects to fill out as well as the following instruments: Patient Report Outcomes Measurement Information System (PROMIS) sleep-related impairment and sleep disturbances, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale, Perceived Stress Scale, CHIPS and SF-36v2™ Health Survey Standard Version.

(Insert hyperlink here)

Thank you for your help.

Sincerely,

Martha Dettl, AT