3-2022

Comparison of the GAD-7 and ImPACT symptom cluster scores in measuring anxiety among college athletes

Robert Steven Cruz

Comparison of the GAD-7 and ImPACT symptom cluster scores in measuring anxiety among college athletes

by

Robert Steven Cruz

Master of Science
Clinical Psychology
Florida Institute of Technology
2020

Master of Arts
Marriage and Family Therapy
Alliant International University
2018

Bachelor of Arts
Psychology
California State University, Long Beach
2013

A doctoral research project submitted to the School of Psychology of
Florida Institute of Technology
in partial fulfillment of the requirements
for the degree of

Doctor of Psychology
in
Clinical Psychology

Melbourne, Florida
March, 2022

We the undersigned committee hereby approve the attached doctoral research project,
"Comparison of the GAD-7 and ImPACT symptom cluster scores in measuring anxiety among college athletes"

by
Robert Steven Cruz

_____

Anthony LoGalbo, Ph.D.
Associate Professor
School of Psychology
Major Advisor

_____

Natalie Dorfeld, Ph.D.
Associate Professor
School of Arts and Communication

_____

Victoria M. Follette, Ph.D.
Professor
School of Psychology

_____

Robert A. Taylor, Ph.D.
Professor and Interim Dean
College of Psychology and Liberal Arts

Abstract

Title: Comparison of the GAD-7 and ImPACT symptom cluster scores in measuring anxiety among college athletes
Author: Robert Cruz
Advisor: Anthony LoGalbo, Ph.D.

Assessing the needs of mental health among college athletes is important given the prevalence rates, stigma, and complications that may arise after experiencing a concussion. Utilizing the General Anxiety Disorder- 7 (GAD-7) as an independent measure of anxiety at concussion baseline evaluation was explored among Division II collegiate athletes (*n=568*), which also included the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) symptom clusters. ImPACT symptom clusters can be divided into four cluster (affective, cognitive, physical/somatic, and sleep) encompassing a 22-item self-report questionnaire. Simple linear regressions revealed that GAD-7 total score was significantly predicted by all four ImPACT symptom clusters. The cognitive cluster was the best predictor of GAD-7 total score (R^2 = 0.21, p < .001), followed by the affective cluster (R^2 = 0.19, p < .001), sleep cluster (R^2 = 0.11, p < .001), and physical cluster (R^2 = 0.10, p < .001). Most athletes did not endorse any anxiety (94.5%). However, 31 athletes (5.5%) fell above the cut-off score of 5 or more for anxiety. Of those athletes, sleep cluster was the best predictor of their GAD-7 total score. Meanwhile, within the group of 31 athletes, 13 of them endorsed 0 items on the ImPACT affective symptom cluster but fell above the cut-off on the GAD-7, 4 also endorsed scores below the cut-off on the PHQ-9. In conclusion, the incorporation of an independent face-valid anxiety screener such as the GAD-7 at concussion baseline evaluations is supported, as 41% of athletes would have been "missed" by ImPACT's affective symptom cluster alone.

Table of Contents

Abstract……iii

Chapter 1 Introduction ...…….....1

Background Review…….....1

Biomechanics of a Concussion……3

Concussion Symptoms and Recovery……..5

Concussion and Mental Health……7

Depression Symptomatology……...9

Anxiety and Depression……10

Anxiety in the United States……..11

Anxiety in College Students……..11

Anxiety Symptomatology……..12

Anxiety in College Athletes……...13

Chapter 2 Objectives……...16

Chapter 3 Aims and Hypotheses 17

Chapter 4 Methods and Procedures.....18

Measures.....18

Participants.....21

Data Analysis.....21

Chapter 5 Results 22

Chapter 6 Discussion 26

Chapter 7 Significance of This Study 31

Chapter 8 Practical Implications 32

Chapter 9 Limitations 34

Chapter 10 Future Research 35

Chapter 11 Conclusion 36

References 37

Chapter 1 Introduction

Background Review

A concussion is the most common type of mild traumatic brain injury (TBI) (Tator, 2013). The Centers for Disease and Control (2019) describes a concussion as a traumatic brain injury (TBI) that is caused by a bump, blow, or jolt to the head, which results in the head and brain moving back and forth in a rapid motion. A blow to the face, neck, and elsewhere in the body where the force of impact is transmitted to the head can also cause a concussion (McCrory et al., 2013). Subsequently, the rotational motion created by the impact can cause the brain to twist and create a disordered metabolic cascade (Vagnozzi et al., 2007). Although commonly seen and heard in athletes, it can present itself across all settings and ages. It is estimated that about 2.87 million of TBI-related emergency department visits, hospitalizations, and deaths occurred in the U.S. alone (Center for Disease and Control, 2019). Subsequently, 225,000 new patients each year show long-term impairment from a mild TBI, equaling the numbers of other prevalent diseases such as breast cancer, multiple sclerosis, and traumatic spinal cord injury combined (Langlois el at., 2006).

Approximately 1.6 to 3.8 million concussions occur in sports and recreational activities each year (Langlois et al., 2006). An estimated 900 deaths per year result from sport-related concussion and recreational activities (Gilchrest et al., 2011). These numbers may be vastly underestimated as not every individual who suffers a concussion seeks professional help. College and high school girls have higher rates of sport-related concussion than their male counterparts (Gessel et al., 2007). Among children, ages 10-14 have the highest rates of emergency room visits due to suffering a sports-related

concussion (Gilchrist et al., 2011). This is of concern as repeated blows to the head can lead to brain degeneration in the future, which can result to dementia similar to Alzheimer and Parkinson diseases (McKee et al., 2009). Thus, it is important to have preventative measures, assessment tools to know the signs and symptoms, and treatment management protocols in place when a concussion occurs to minimize long-term health effects.

Baseline concussion assessments are often conducted before formally participating in organized sports or athletic activity in order to determine how athletes are functioning when they are at 100% and/or not injured. This is the standard method of concussion management employed across all levels of sports (Echemendia et al., 2013). In order to document the most accurate information, methods to obtain information should include both subjective and objective accounts as athletes tend to underreport their symptoms (Delaney at al., 2002).

A thorough baseline concussion evaluation should include a clinical interview, neuromotor screening, and a neuropsychological screening (National Institute of Neurological Disorders and Stroke, 2017). Computerized neurocognitive assessments have become the new norm and are typically administered as they allow for efficient screening and minimizes practice effects with a plethora of baseline assessments available at one's disposal (Johnson et al., 2011). Collecting all this information prior to physical activity is vital as after an injury occurs, test data from injury can be compared with baseline data. Subsequently, these comparisons can potentially highlight changes in performance and mood, informing the clinical diagnosis.

Diagnosing a concussion is not always a simple task. Contrary to popular belief, a loss of consciousness is not commonly seen in concussions and accounts for only a minority of cases (Tator, 2013). Accurate diagnosis requires a willing patient to disclose their symptoms honestly and a knowledgeable clinician. Diagnosing concussion becomes an even more difficult task among athletes, as they may disregard their symptoms or conceal them from their athletic trainers because they do not want to be removed from participating in their sport (Echlin et al., 2010). Aside from the barriers an athlete may present, there is no single evaluation technique such as imaging of brain structure, blood test, or neuropsychological assessment that can always correctly identify that a concussion has occurred (Tator, 2013). Several tools must be incorporated and utilized to make an informed clinical diagnosis. An understanding of the physiological changes that occur in the brain with a concussion can be beneficial in knowing the signs, risks, and severity of symptoms.

Biomechanics of a Concussion

With advancements in neuroimaging, understanding the physiological and physical changes that are occur in the brain/head after an impact are becoming better understood. Computed Tomography (CT) scans are sensitive enough to detect bone fractures and hemorrhages alongside with magnetic resonance imaging (MRI) being able identify shear injury in the white matter of the brain (McCrea at al., 2013).

Another type of MRI, a diffuse tensor imaging (DTI), can detect diffuse axonal injury, which is an injury typically caused by acceleration/deceleration forces that damage white matter following a mild TBI (Smith et al., 2003). A functional magnetic

resonance (fMRI) can detect activation patterns that demonstrate strong correlations with concussion symptom severity and recovery time (Chen et al., 2004).

Despite these advances, there is still no certain direct linkage between the physiological changes and where exactly in the brain did the concussion originate from. In addition, these medical technologies may not be conducted and assessed routinely in every individual with a mild TBI. However, they still add to the growing body of literature on some of the changes the brain goes through after experiencing an injury.

After a blow, jolt, or bump to the head, biomechanical forces distort the cells in the brain as the brain collides against the intracranial surfaces with accelerating/decelerating trauma (Kushner, 2001). Acutely upon impact, there is a drastic uptake of cerebral glucose in the brain followed by a prolonged period of depression of the glucose metabolism (Prins et al., 2013). Neurons (brain cells) release potassium and an influx of sodium and calcium occurs, creating a physiological state that resembles that of a migraine (Gize & Kutcher, 2014). In addition, glutamate is released and the membrane ionic pump depletes intracellular energy stores, further exacerbating the metabolic dysfunction (Giza & Kutcher, 2014). Adenine nucleotides, a special molecule that stores and transfers energy, may become rearranged as well (Vagnozzi et al., 2007).

As the neuronal energy mechanisms in the brain start to alter, the decrease in glucose metabolism may increase the brain's vulnerability to suffering another injury (Prins et al., 2013). A second concussion can occur with less force and subsequently take even longer to resolve (Guskiewicz et al., 2003). This is more typically observed in adolescents and young adults (Tator, 2013). Although researchers do not know exactly why, it is believed to be due to a loss of autoregulation of cerebral vasculatures,

intracranial pressure, and brain herniation (Tator, 2013). Although it should be noted that even with no secondary injury, malignant brain swelling can still occur after experiencing a mild TBI (McCrory et al., 2012).

Concussion Symptoms and Recovery

Post-concussion symptoms are the subjective neurobehavioral impairments following a concussion. Most common symptoms include headache, dizziness, nausea, confusion, and imbalance (Zuckerman et al., 2016). Memory impairments such amnesia can occur as well, in that the athlete may not recall events either before or after the injury occurred (Kushner, 2001). In fact, post-traumatic amnesia is correlated with longer symptom remission (McCrea et al., 2013). In more severe cases of concussions, loss of consciousness can result (Ling et al., 2015). Sleep irregularities may develop 1 week into recovery along with emotional disturbances such as irritability and anxiety (Kontos et al., 2012). Other emotional disturbances include feelings of sadness, nervousness, and emotional numbing, with female athletes reporting significantly higher levels of these symptoms than male athletes (Kontos et al., 2012). Feelings of sadness and vomiting was much more common in concussed male athletes than in concussed female athletes (Comrey & Lee, 1992). Consequently, if emotional distress persists it may require formal psychological intervention as hypervigilance of somatic complaints, ruminative thinking, and feelings of hopelessness can exacerbate felt mood changes, especially those with preexisting mood conditions (Collings et al., 2014).

Although about 85-90% of collegiate athletes report being asymptomatic within 10-14 days after a concussion, a small percentage of them experience unremitting symptoms (McCrea et al., 2013; Conder & Conder, 2015). Psychosocial stressors, such

as financial strain, interpersonal relationships, and other environmental changes, that are not related to the injury can significantly slow down the rate of recovery (Sandel et al., 2017). In addition, a history of multiple concussions, especially 3 or more is strongly associated with a longer road to recovery as well (Conder & Conder, 2015). In fact, having experienced previous concussions is a risk factor for future concussions being associated with more physical, cognitive, and emotional symptoms (Abrahams et al., 2014; Iverson et al., 2015; Brooks et al., 2016). Psychiatric conditions have been shown to have a negative impact on concussion outcomes as well.

For example, a study with children and adolescents who suffered a concussion, pre-existing anxiety disorders prolonged symptom recovery in aspects of academics and physical activity when compared to others without an anxiety disorder. (Martin et al., 2020). In addition, there is strong evidence suggesting that higher levels of depression or depression like symptoms is positively correlated with higher levels of post-concussion symptoms and recovery (Suhr & Gunstad, 2002; Iverson and Lange, 2003; Garden & Sullivan, 2010).

It seems likely that an athlete's age also plays a factor in recovery times, in that younger athletes may take longer to recover. About 90% of high school athletes take approximately 4 weeks to return to their baseline functioning (Conder & Conder, 2015). With student athletes younger than high school, the research is lacking due to the lack of informal documentation in the leagues they play but there is a consensus that it takes young children even longer to recover than adults (Foley & Solomon, 2014; Baillargeon et al., 2012). One study conducted by Barlow & colleagues (2010) reported that 25-40% of children experienced a longer recovery period that lasted months to years following

the sports related mild TBI. Evidence is showing that a not fully developed brain like that of a child, may be more susceptible to concussions (Baillargeon et al., 2012). This may be due to a combination of blood vessels tearing easier, thinner skulls providing less protection to the brain, and poor body control/technique that can contribute to further injury (Boden et al., 2007).

Concussion and Mental Health

Mental health seems to play an important role when discussing concussions. Athletes with a previously diagnosed mental disorder demonstrate greater endorsement of symptoms following an injury (Edmed & Sulliven, 2012). In addition, student athletes with a history of mental health disorders are also at a greater risk of having their preexisting conditions worsen after a concussion (McCauley et al., 2013). Other factors, such as an athlete's family psychiatric history, can potentially predispose an athlete into developing a mental health disorder as well, further complicating concussion symptomatology (Belmaker & Agam, 2008). The lifetime prevalence of any mental health condition among athletes is 14%, with prevalence being higher for those in a contact sport at 16.4% (Sarac et al., 2018). Baseline assessments of more than 1,600 college and high school athletes revealed about 2% reported moderate to severe depression (Kontos et al., 2012). Despite no direct linkage of where in the brain a concussion originates, the growing body of work in this field have highlighted important factors to consider when discussing the intersection of mental health and concussions.

Similarities exist between symptoms of concussion and symptoms of various mental health disorders, creating difficulties determining the etiology of these symptoms which is not typically seen with other sport injuries (Sandel et al., 2017). For instance,

feelings of dizziness and balance impairments are associated with changes to the vestibular system after a concussion but are also common diagnostic criteria for individuals with panic disorders (Alsalaheen et al., 2010).

Another example can be seen with the presence of cognitive deficits after a concussion and with major depressive disorder (World Health Organization, 1992; American Psychiatric Association, 2013). There is evidence of a neurometabolic similarity in that an alteration in the limbic-frontal circuitry can be observed after both a sports-related concussion and among individuals with major depression (Chen et al., 2008). Furthermore, both athletes with concussions and individuals with depressive symptomatology showed reduced gray matter density in the brain regions critical pertaining to working memory tasks (Chen et al., 2008). Neurochemical changes in the brain such as serotonin disturbance and a decrease in dopamine in the prefrontal cortex and brain stem, perhaps provides the strongest evidence of just how similar the underlying mechanisms of mood disorders and concussions can be (Venzala et al., 2013).

Moreover, emotional dysregulation is quite common following concussion because this injury predisposes athletes to structural changes in the neurochemistry of the limbic system (Giza & Hodva, 2001). The limbic system is the key structure found in the brain that plays a central role in regulating emotions. Subsequently, even with no history of a mental health disorders, athletes are at a greater risk of developing depression after a concussion (Kontos et al., 2012). In fact, concussions may exacerbate depressive symptomatology among student athletes who reported a history of depression (Vargas et al., 2015). Approximately 6% of individuals who have experienced a mild TBI experience clinical levels of depression (Jorge & Robinson, 2002).

It seems that mental health plays an important factor in the road to recovery from a concussion and the nature of symptoms an athlete is more likely to endorse following an injury. These findings illustrate the importance of screening for mental health conditions in athletes to facilitate a better understanding of their emotional symptoms and the ramifications it can have on their well-being moving forward. In addition, consideration of family and personal history along with the exploration of neurochemical changes occurring in the brain can provide further insight into prevention and treatment. With concussions exacerbating preexisting mental health conditions, it may contribute to more novel emotional disturbances to form as well (Ellis et al., 2015).

In fact, psychiatric conditions are more predictive of persistent impairments following an injury than the nature of the concussion itself (Ponsford et al., 2012). As previously mentioned, emotional distress following a concussion include feelings of irritability, nervousness, hypervigilance, sadness, and anxiety. The majority of the experienced emotional disturbances following a mild TBI can be categorized into depression and anxiety symptomatology. Diving further into the prevalence rates, symptoms, and prognosis of depression and anxiety can help facilitate the connections between experiencing a concussion and the aftermath it has on a person's well-being moving forward.

Depression Symptomatology

Major depressive disorder is characterized by depressed mood, diminished pleasure and/or interest most of the day or nearly every day for at least two weeks (American Psychiatric Association, 2013). Depressive symptoms may exist without a clinical diagnosis. Symptoms may include low self-worth, hopelessness about the future,

changes in sleep and appetite, and low mood (Dekker et al., 2014). It is estimated that 17.3 million adults in the U.S. have experienced at least one episode of major depression (National Institute of Mental Health, 2019). The prevalence is higher among females than males along with rates being the highest among young adult ages 18-25 (National Institute of Mental Health, 2019). Of those adults with a major depressive episode, 63% experience severe impairments in daily functioning and deficits across several cognitive domains (Cambridge et al., 2018). Among college students specifically, seven to nine percent have been diagnosed with major depressive disorder (MDD) (Eisenberg et al., 2013).

Anxiety and Depression

Research has shown that anxiety may be a risk factor for developing depression later in life (Bittner et al., 2004). Despite being distinct diagnoses, anxiety and depression have a plethora of symptoms that overlap, making it sometimes difficult to distinguish one from the other. Using structured equation modelling, Segerstrom & colleagues (2000) found that intrusive thoughts and excessive worrying observed among individuals with anxiety do not differ than that commonly seen among individuals with depression. Biological mechanisms such as allostatic load, inflammation, hypothalamic-pituitary-adrenal reactivity, and other neuroendocrine responses are typically seen for both anxiety and depression (Pego et al., 2009; McEwen, 2000). This comorbidity is also common in children and adolescents (Garber & Weersing, 2010). The prognosis for having comorbid depression and anxiety is far worse than having one alone, with increased suicide attempts, significant impairments in daily functioning, and being less responsive to treatment (Ezpleta et al., 2006).

Anxiety in the United States

With preexisting anxiety prolonging recovery time and anxiety potentially arising as a symptom after experiencing a concussion, it is important to examine the prevalence rates, symptoms, and ramifications of anxiety in greater detail. Approximately 33.7% of U.S. adults will experience an anxiety disorder at some point in their lives (Bandelow & Michaelis, 2015). Anxiety roughly affects over 40 million Americans each year, with prevalence rates continuing to soar with the COVID-19 pandemic, societal factors, and environmental changes impacting the wellness of individuals (Hoyt et al., 2020). Women are more likely to be affected than men and experience more symptoms (Center for Disease Control, 2019). A possible explanation for gender differences could be the combination of neurological, biological, and psychosocial factors, such as sexual abuse and chronic stress, for higher prevalence rates among women (Bandelow & Domschke, 2015).

Regardless of gender differences, the majority of people with any anxiety disorder experience mild impairments significantly impacting their quality of life (National Institute of Mental Health, 2019). Despite the prevalence of anxiety, only 36.9% of individuals receive treatment for their disorders (Anxiety and Depression Association of America, n.d.). In fact, those receiving support and care reported taking roughly 2 years or more for their symptoms to be correctly diagnosed as an anxiety disorder (Baldwin et al., 2012), suggesting challenges to identifying individuals needing treatment.

Anxiety in College Students

Anxiety has become a more prevalent concern among college students as well. Many students opt to leave their family and homes to pursuit an education and that

transition in itself can pose several challenges to their mental well-being. Anxiety is ranked the highest mental health concern among college students (American Psychological Association, 2013). Similar to the general population, anxiety is much more common in female students than in males (Borgogna et al., 2019). In the U.S. alone, approximately 63% of college students reported feeling overwhelming anxiety while only 23% reported being diagnosed or treated for anxiety (Leblanc & Marques, 2019). For graduate students, depression and anxiety is seven times more common than in the general population (Preidt, 2018).

A plethora of factors can exacerbate symptoms of anxiety in college population such as sleep patterns, academic stress, relationship stress, low self-esteem, and social political factors. For example, Hoyt el al. (2020) found that transgender and gender diverse and sexual minority college students reported higher levels of anxiety when compared to cisgender college students. In addition, students coming from a lower social economic background experience significantly higher levels of anxiety than students with a high social economic support (Seehus, Moeller, & Peisch, 2019). Furthermore, with the COVID-19 pandemic most students are experiencing adverse effects to their mental well-being with anxiety being the most common disorder mentioned (Hoyt et al., 2020). Subsequently, the emphasis on remote learning, lack of peer interaction, and other barriers to limit COVID-19 transmission can further exacerbate the levels of felt anxiety among college students.

Anxiety Symptomatology

Anxiety disorders encompasses a wide variety of behavioral, emotional, and physiological disturbances. Anxiety can be defined as the anticipation of a future threat

or excessive fear of a perceive imminent threat (American Psychiatric Association, 2013). Typically, the age of onset of most anxiety disorders is around 11 years old, with specific phobia and separation anxiety starting as young as age 7 (Kessler et al., 2005). As it begins in childhood and adolescent years, it can continue to significantly impacts an individual's life through middle age, with levels of anxiety beginning to decrease with older age (Bandelow & Michaelis, 2015). Symptoms of anxiety typically include nervousness, excessive worrying, heart palpitations, irritability, muscle tension, difficulty sleeping, easily fatigued, and sensations of shortness of breath (National Institute of Mental Health, 2018).

Anxiety in College Athletes

It is commonly believed with the accolades achieved and bonds developed with teammates/coaches, student athletes should demonstrate a healthy well-being. However, despite being actively involved in sport activities and extracurriculars, athletes are no exception to experiencing mental health difficulties typically seen in the general population (Reardon & Factor, 2010). In fact, college athletes face unique challenges that contribute to their mental health difficulties, such as intensive time commitments, injuries, and conflicts, with teammates/coaches (Sudano et al., 2017). Furthermore, they are at a higher risk for developing maladaptive lifestyle behaviors (Nattiv & Puffer, 1991). College athletes are less likely to seek help for their mental health due to stigma and worries that their coaches will not understand (Proctor & Boan-Lenzo, 2010; Woalnian et al., 2015). Without addressing and receiving the proper care, anxiety symptoms may progressively worsen in this population.

An athlete's anxiety can be influenced by several factors, with one of them actually being the sport an individual participates. College athletes who partake in an individual sport can potentially experience an increased in anxiety due to their internalization of failure along with the lofty expectations they demand from themselves (Nixdord et al., 2013). In fact, the lifetime prevalence for any mental health condition is higher at 17.2% for individual sports when compared to those who participate in a team sport (Sarac et al., 2018; Pluhar et al., 2019). While student athlete's mental health has been given a spotlight more recently, it is important as ever to screen and monitor their levels of anxiety given the stigma and unique challenges they face being part of two worlds: the student life and their athletics.

Besides the physical nature of an injury, an athlete can experience feelings of loss due to less interactions with teammates, physical activity, and an end to their daily rituals (MacPherson et al., 2016). Subsequently, emotional distress may impact an athlete's performance and increase the risk for injury (Medicine and Science in Sport and Medicine, 2006). With preexisting conditions and stress resulting from injury, this can generate further complications and maladaptive coping strategies when recovering from an injury. For example, anxiety and depression have been linked to individuals being more likely to initiate opioids for treatment of chronic pain and greater likelihood for later opioid misuse (Carlson et al., 2016). This is extremely concerning as the physical nature of a concussion can exacerbate any pain an athlete is experiencing and have long-term ramifications on their well-being. Other studies have shown that depression and anxiety can potentially increase the risk of experiencing a cardiac event (Jansky et al., 2010).

A plethora of concussion symptoms such as nausea, dizziness, fatigue, and nervousness can mimic anxiety symptomatology (Kontos & Collins, 2018). With anxiety symptoms encompassing a wide spectrum of emotional and physiological effects, it may be challenging to correctly diagnose an anxiety disorder with any population, especially among athletes. For example, individuals with panic attacks usually believe they have a medical difficulty rather than a psychological one and do not get referred for the proper services (Bandelow & Michaelis, 2015). Another illustration can be seen with individuals who are shy and easily embarrassed, may be reluctant to disclose their symptoms and remain uncared for (Bandelow & Michaelis, 2015). Social anxiety disorder and the competitive nature of an athlete can generate maladaptive coping strategies. For instance, a player's timidness may make them reluctant to share their injury during a game, potentially resulting in a rare but serious consequence of re-injuring themselves (Ling et al., 2015). Given the comorbidity rates, impact anxiety can have on concussions and mental health, and the difficulty in diagnosing anxiety, screening for it is of the utmost importance.

Chapter 2 Objectives

There is a relative gap in the literature when it comes to the levels of anxiety an athlete is experiencing and the potential influence of anxiety on concussion recovery. The present study aims to provide normative data for baseline symptom reporting pertaining to anxiety among collegiate athletes and comparing multiple self-report symptom questionnaires. It is believed that using a brief and easily accessible anxiety screener may offer interpretations of symptom endorsements, potentially separating concussion symptoms and mental health disorders. Specifically, the Generalized Anxiety Disorder 7-item (GAD-7), the Patient Health Questionnaire 9-item (PHQ-9), and ImPACT's post-concussion symptom scale (PCSS) symptoms clusters will be compared. It is hypothesized that the GAD-7 will have a significant correlation with the ImPACT PCSS affective symptom cluster, which has items pertaining to mood.

However, it is also hypothesized that the GAD-7 will provide additional information regarding anxiety symptomology above and beyond what is contained in the ImPACT PCSS, such that it will identify individuals with notable anxiety symptoms who would otherwise be overlooked using the ImPACT PCSS alone. In addition, exploring how many athletes fall above the PHQ-9 cut-off only, the GAD-7 only, or both, as it will help identify individuals with anxiety issues who otherwise would be missed using the PHQ-9 alone. Finally, this study hopes to provide insight regarding specific symptom endorsements on the GAD-7 among NCAA Division II athletes by exploring the most commonly endorsed anxiety symptoms.

Chapter 3 Aims and Hypotheses

- **Aim #1**
  - To determine whether a face-valid anxiety screener (GAD-7) is better at identifying college athletes with anxiety symptoms compared to a post-concussive symptom list (ImPACT PCSS), suggesting that the anxiety screener provides useful clinical information.

Hypothesis #1

- The GAD-7 will identify students endorsing anxiety symptoms that are not identified using the ImPACT PCSS or cluster scores.

- **Aim #2**
  - To determine whether the GAD-7 better identifies athletes with anxiety than the ImPACT affective symptom cluster and PHQ-9 alone, indicating that administration of all three screeners is warranted.

Hypothesis #2

- A significant number of athletes endorsing a $\geq$ 5 on the GAD-7 will report minimal symptoms on the ImPACT affective symptom cluster and the PHQ9.

- **Aim #3**
  - To examine which ImPACT symptoms cluster best predicts total GAD-7 scores in athletes whose GAD-7 scores indicate mild to severe anxiety.

Hypothesis #3

- The ImPACT affect symptom cluster will be the best predictor of scores of $\geq$ 5, demonstrating mild to severe anxiety on the GAD-7.

- **Aim #4**
  - To investigate which ImPACT symptom cluster is most closely related to the GAD-7 total score.

Hypothesis #4

- GAD-7 total score will be correlated with and best predicted by the affective symptom cluster on ImPACT.

Chapter 4 Methods and Procedures

Archival data collected by the Concussion Management Program (CMP) at Florida Institute of Technology (FIT) was used in this study. FIT is a National Collegiate Athletic Association (NCAA) Division II institution and is located in East Central Florida. All athletes are required to complete a pre-participation baseline evaluation through the CMP in order to participate in their respective sport each year. Baseline evaluation consists of assessing mood, cognition, and effort which includes the Patient Health Questionnaire Nine Item (PHQ-9), General Anxiety Disorder Seven Item Scale (GAD-7), and the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT). Psychology students in a clinical doctoral program administered these assessments under the supervision of a board-certified clinical neuropsychologist. Athletes who scored a 5 or higher on the GAD-7, or the PHQ-9, or both were referred for counseling and psychological services. As the season progresses, athletes with a suspected concussion/head injury are referred by their athletic trainer for a post-trauma evaluation in which mood screeners, cognition, and effort batteries are administered again. This process is repeated until the concussion is resolved, determined by performance returning to baseline and absence of concussive symptoms.

Measures

General Anxiety Disorder-7 Item (GAD-7)

The GAD-7 is a 7-item self-administered scale that is designed to measure and assess generalized anxiety disorder symptoms. It has proven to be valid across different medical settings, including for patients after experiencing a TBI (Moore et al., 2006). Approximately 5 minutes is need to complete assessment. Example of items include,

"Feeling nervous, anxious, or on edge", "Becoming easily annoyed or irritable", and "Feeling afraid, as if something awful might happen". Each item is scored as 0 "not at all", 1 "several days", 2 "more than half the days, or 3 " nearly every day" to indicate symptoms frequency. If items were endorsed, the individual is asked how the symptoms have impacted their daily life functioning and respond with the following options: "Not difficult at all", "somewhat difficult", "very difficult", and "extremely difficult". The maximum score an individual can report is 21 and scores are categorized for anxiety severity as, "minimal anxiety" (1-4), "mild anxiety" (5-9), "moderate anxiety (10-14), and "severe anxiety" (15-21).

Patient Health Questionnaire-9 Item (PHQ-9)

The PHQ-9 is valid and reliable 9-item self-administered questionnaire utilized to detect and assess the level of severity of depression (Levis et al., 2020). The questionnaire takes approximately 5 mins to complete and can be easily accessed. It measures the frequency of symptoms over the past two weeks and it is consistent with the criteria found in the Diagnostic and Statistical Manual of Mental Disorders for a major depressive episode (He et al., 2020). Example of items include, "Feeling down, depressed, or hopeless", Trouble concentrating on things such as reading the newspaper or watching television", and "Thoughts that you would be better off dead, or of hurting yourself in some way". Each item is answered on a 4-point Likert-scale with 0 "not at all", 1 "several days", 2 "more than half the days, or 3 "nearly every day". Scores range from 0-27 and illustrates severity level. Total scores from 1-4 signify "minimal depression", 5-9 "mild depression", 10-14 "moderate depression", 15-19 "moderately severe depression", and total score of 20 or more "severe depression".

Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT)

The most commonly used computerized neurocognitive assessment in North America is ImPACT (Schatz & Sandel, 2013). It takes approximately 30 minutes to administer and can detect changes in neurocognitive performance after a concussion (Sandel et al., 2006). ImPACT is comprised of six modules that produce four output composite scores including verbal memory, reaction time, visual-motor speed, and visual memory composites (Broglio et al., 2006). In addition, ImPACT has a post-concussion symptom scale (PCSS) that measures 22 widespread symptoms of concussion. Athletes report their symptoms on how they are presently feeling on a 7-point scale (0= absence of the symptom; 6= symptom is severe) (Lovell, 2007). Furthermore, PCSS can be classified into four symptom clusters using exploratory factor analysis: affective, cognitive, physical/somatic, and sleep (Merritt et al., 2015). A detailed breakdown of these symptom clusters is provided in Table 1. These clusters include both emotional and physical/somatic symptoms of depression and anxiety.

Table 1.

ImPACT symptom clusters

Cognitive	Physical	Affective	Sleep
Feeling slowed down	Headache	Irritability	Fatigue
Feeling mentally "foggy"	Nausea	Sadness	Trouble falling asleep
Difficulty concentrating	Vomiting	Nervousness	Sleeping more than usual
Difficulty remembering	Balance problems	Feeling more emotional	Sleeping less than usual
	Dizziness		Drowsiness
	Sensitivity to light		
	Sensitivity to noise		
	Visual problems		

Participants

The sample consisted of 568 participants (384 males and 184 females), which includes undergraduate student athletes participating in sports at Florida Institute of Technology. FIT is a NCAA Division II institution. All athletes provided consent for their data to be utilized for research purposes. Students with attention-deficit/hyperactivity disorder and learning disabilities were not excluded from this study.

Data Analysis

All analyses were conducted using IBM SPSS version 27.0.1.0. Receiver operating characteristics (ROC) analysis were utilized to determine the maximum sensitivity and specificity of the ImPACT symptom clusters with the GAD-7. Furthermore, linear regressions were used to model how well each individual ImPACT symptom cluster predicts GAD-7 total score. Descriptive statistics including assessment of means, standard deviations, frequencies, with other demographics were calculated as well.

Chapter 5 Results

The mean GAD-7 score for the overall sample was *M* = .96, *SD* = 1.86, and scores ranged from 0 to 13. Women athletes (*n* = 184, *M* = 1.47, *SD* = 2.21) endorsed statistically, significantly higher levels of anxiety than men athletes (*n* = 384, *M* = .72, *SD* = 1.62), *t*(280) = -4.15, *p* = <.001. The effect size of this difference was moderate, *d* = -.41. Within the overall sample, 5.5% (*n* = 31) endorsed scores of 5 to >15, suggesting the presence of mild to severe anxiety. Among this group, the mean GAD-7 score was *M* = 6.94, *SD* = 2.32. A higher percentage of the women (10%, *n* = 18) in this study endorsed GAD-7 scores in the mild to severe range than the men (3%, *n* = 13) in the sample. With that said, of the men and women who endorsed scores of ≥5, the mean score endorsed by women (*M* = 6.78, *SD* = 2.34) was not statistically, significantly different than the mean score endorsed by men (*M* = 7.15, *SD* = 2.38), *t*(26) = .44.

The mean PHQ-9 score for the overall sample was *M* = 1.42, *SD* = 2.47. Women athletes (*n* = 184, *M* = 1.89, *SD* = 2.99) endorsed statistically significant higher levels of depression than men athletes (*n* = 384, *M* = 1.20, *SD* = 2.14), *t*(276): -2.77. The effect size of this difference was large, *d* = 2.45. Within the overall sample, 9.0% (*n* = 51) endorsed score greater than 5, suggesting the presence of mild to severe depression. Among this group, the mean PHQ-9 score was *M* = 7.71, *SD* = 3.21. The percentage of the men (51%, *n* = 26) and the women (49%, *n* = 25) samples in this study were similar in endorsing PHQ-9 scores in the mild to severe range. With that said, of the men and women who endorsed scores of ≥5, the mean score endorsed by women (*M* = 7.92, *SD* = 3.67) was not statistically significant different than the mean score endorsed by men (*M* = 7.50, *SD* = 2.76), *t*(44)= -.46, *p* = .65. Among the overall sample, 3.5% (*n* = 20) fell

above the cut-offs on both the PHQ-9 and the GAD-7. About 1.9% of athletes (n = 11) fell above the cut-off on the GAD-7 only, while 5.5 % (n = 31) fell above the cut-off for the PHQ-9 only.

The mean ImPACT symptom cluster scores are shown in Table 1 for the overall sample and separated by gender. When comparing symptom cluster scores by gender, statistical difference was only apparent for the physical symptom cluster, with women reporting more symptoms than men $t(257) = -4.00$ with a small effect size of $d = -.27$.

Table 2.

Means and Standard Deviations for ImPACT Symptom Clusters

	Overall Sample		**Women**		**Men**	
Cluster	*M*	*SD*	*M*	*SD*	*M*	*SD*
Affective	.47	1.34	.62	1.37	.39	1.40
Cognitive	.43	1.14	.53	1.30	.38	1.06
Sleep	1.21	2.11	1.38	2.29	1.13	2.01
Physical	.72	1.42	1.12*	1.78	.54*	1.12

Note. *p < .001

Because the mean scores for each symptom cluster were relatively low overall and across genders, a chi-square test of independence was conducted for each symptom cluster, coding symptom endorsement in a dichotomous fashion (endorsement of any symptoms in each cluster: yes or no). Endorsements of any affective symptoms occurred independent of gender, X^2 (1, N = 31) = .86, p = .35. Additionally, there did not appear to be an influence of gender on endorsement of physical symptoms, X^2 (1, N = 31) = 1.63, p = .20, sleep symptoms, X^2 (1, N = 31) = .05, p = .83 or the cognitive symptoms, X^2 (1, N = 31) = 1.15, p = .29. Thus, neither men nor women athletes were more or less likely to endorse any symptoms within each of these clusters. Meanwhile, of the overall sample,

most athletes (84%) did not endorse any items on the affective symptom cluster at all. Of the 31 athletes who endorsed mild to severe anxiety on the GAD-7, 13 of them (42%) endorsed 0 symptoms on the ImPACT affective symptom cluster. Meanwhile, within this group of 13 athletes who endorsed 0 items on the ImPACT affective symptom cluster but fell above the cut-off on the GAD-7, four endorsed symptoms falling below the cut-off on the PHQ-9, suggesting that their endorsement of mental health symptoms would have been missed using the ImPACT affective symptom cluster and the PHQ-9 alone.

ROC curve analysis revealed that an ImPACT affective symptom cluster score of 0.5 displayed the best classification accuracy with respect to GAD-7 categorization using a cut-off score of 5; however, sensitivity was only moderate (0.58), and specificity was very low (.16). This suggests that almost half of the individuals who fell above the cut-off for anxiety on the GAD-7 would be missed (false negatives) using this cut-off for the affective symptom cluster alone.

Simple linear regressions revealed that GAD-7 total score was significantly predicted by all four ImPACT symptom clusters. The cognitive cluster was the best predictor of GAD-7 total score ($R^2 = 0.21$, $p < .001$), followed by the affective cluster ($R^2 = 0.19$, $p < .001$), sleep cluster ($R^2 = 0.11$, $p < .001$), and physical cluster ($R^2 = 0.10$, $p < .001$). To focus on athletes who reported mild to severe anxiety, individuals who scored a 5 or higher on the GAD-7 ($n = 31$) were examined separately. Within this subsample, the ImPACT sleep cluster was the only predictor of GAD-7 total score and was a stronger predictor when looking specifically at this subgroup than the overall sample ($R^2 = 0.51$, $p = .003$). When comparing those with and without ADHD and learning disabilities, there

were no statistically significant differences found. As a result, athletes who reported diagnoses of ADHD and/or learning disabilities were not excluded from the study.

Chapter 6 Discussion

Findings from the current study support screening for anxiety in collegiate athletes prior to participation in sport as 1.9% of student athletes fell above the cut-off score on the GAD-7 alone, with no elevations on the other mood questionnaires. Furthermore, this study demonstrates the importance of administering a distinct face-valid anxiety screening measure. Using ImPACT's symptom list alone appears to limit detection of anxiety among athletes at concussion baseline testing. Specifically, 42% of athletes who endorsed mild to severe anxiety on the GAD-7 did not endorse any symptoms on the ImPACT affective symptom cluster, and thus would have been missed if the ImPACT affective symptom cluster score was used in isolation to detect anxiety. Perhaps it is not surprising that the affective symptom cluster did not identify anxiety well, as most of the symptoms that compromise this cluster are not typically associated with anxiety (feeling more emotional, sadness, and irritability). While the symptom of nervousness may be the most common symptom in this cluster that is associated with anxiety, only 29% of individuals who fell above the cut-off on the GAD-7 endorsed nervousness on the affective symptom cluster. This suggest that approximately 71% of athletes would be overlooked in regard to possibly having anxiety while only looking at the affective symptom cluster alone.

Although all ImPACT symptom clusters significantly predicted total GAD-7 score for the overall sample, the cognitive cluster was the best predictor followed by the affective cluster. This is consistent with prior research suggesting that anxiety can impact aspects of cognition and make it difficult to concentrate and focus on social and work environmental tasks (Robinson et al., 2013). In addition, given the ruminative symptoms

and intrusive thoughts associated with anxiety, an individual may be more inclined to perceive their cognitive processes as negatively affected by anxiety. Meanwhile, specifically for the athletes who fell above the cut-off of 5 or higher on the GAD-7, the sleep cluster was the best predictor of anxiety. This is consistent with the previous findings of the National Institute of Mental Health (2018), where individuals with anxiety endorsed difficulty sleeping and being easily fatigued as their primary concerns.

Of the overall sample of collegiate athletes in this study, 5.5% fell above the cut-off for anxiety on the GAD-7. While the estimated prevalence of anxiety in collegiate athletes is unknown, it is expected to be in the same range as depression given the common comorbidity and symptoms overlap that exists between the two disorders. Kontos et al. (2012) found prevalence rates of moderate to severe depression among athletes to be roughly 2%, lower than the rate of anxiety found in our study. This suggests that prevalence of anxiety among college athletes may be higher than the prevalence rates of depression. In addition, approximately 35% of athletes who fell above the cut-off score on the GAD-7 did not endorse any items on the PHQ-9. This suggests that these athletes would be overlooked in having other mental health concerns such as anxiety, a well-known predictor for developing depression later on in life (Bittner et al., 2004). Further investigation is warranted as mitigating these risk factors can lead to better prognosis and limit the number of comorbidities.

When examining symptom endorsement on the ImPACT symptom list, affective symptoms were underreported in comparison to endorsements of symptoms on GAD-7. Thus, collegiate athletes appear to be more inclined to endorse symptoms on the GAD-7 than on ImPACT. Further, in the group of athletes who endorsed anxiety symptoms

above the cut-off, 42% did not endorse any symptoms on the affective symptom cluster. This suggests that those athletes experiencing anxiety would be overlooked if the ImPACT symptom list was used in isolation. One possible explanation for this is individuals may be more inclined to be truthful when sitting across from an examiner as to opposed sitting in front of a computer screen on their own (Kissinger-Knox et al., 2019). With that being said, 13% of those athletes also did not endorse any symptoms on the PHQ-9, a face-to-face questionnaire. Again, this suggests that even if the ImPACT symptom list were used in combination with administration of the PHQ-9, the anxiety experienced by a significant number of collegiate athletes would be overlooked. Indeed, administration of a face-valid anxiety screener, such as the GAD-7, appears to be worthwhile.

The ROC curve analysis revealed that an affect symptoms cluster score of 0.5 demonstrated the best classification accuracy relative to a GAD-7 score above the cutoff. The sensitivity (0.58) was, however, only moderate. In other words, again it appears that using the ImPACT affect symptom cluster alone would falsely overlook athletes who indeed were experiencing significant anxiety (false negatives). In reality, the sensitivity level is likely less than moderate since it is not possible to obtain a score of 0.5 on the ImPACT symptom list since each item endorsed is worth 1-point. Using a cut-off score of 1 would result in poorer sensitivity and decreased accuracy in classifying anxiety. In other words, due to psychometric limitations, using a cutoff score for the affective symptom cluster alone would not likely be effective for detecting anxiety in college athletes.

In agreement with previous research, the Centers for Disease Control (2019) demonstrated that a higher proportion of females endorsed anxiety scores above the cutoff. That said, upon further analysis, there did not appear to be a statistically significant difference in the number of symptoms or symptom severity endorsed by each gender among those who fell above the cut-off. In other words, while more females self-reported experiencing anxiety compared to males, the relative degree of symptoms among those who endorsed clinically significant anxiety symptoms was similar. This is consistent with the study conducted by the National Institute of Mental Health (2019), which found regardless of prevalence rates, there are no gender differences as both men and women report similar severity symptoms of anxiety.

To summarize, relying only on the ImPACT symptom list to detect anxiety in college athletes is limiting and presents several challenges. Self-reporting symptoms of anxiety appears to be rather complex in the college athlete population with athletes willing to endorse symptoms on some measures and not others. The present study provides support for administering the GAD-7 at baseline since college athletes seem to endorse anxiety symptoms more reliably on the GAD-7 than on the ImPACT symptom list. Even when both the ImPACT symptom list and the PHQ-9 are administered in an effort to identify mental health concerns, some athletes experiencing significant anxiety without depression may go undetected. Further, since there is limited research on anxiety in the college athlete population, administration of a face-valid anxiety measure (e.g., GAD-7, BAI) should be included for the purpose of increased data collection and contribution to the existing literature. Of note, brief evidence-based anxiety screening measures are time-efficient and inexpensive to administer. Additionally, interpretation is

relatively straightforward, and scores can clearly indicate whether a referral should be made for mental health resources.

Chapter 7 Significance of This Study

The impact of the potential findings can be meaningful as they can enhance protocols used for concussion management programs in collegiate athletes. Findings can illustrate the need for mental health assessments to aid in the detection of mental health disorder among a population known for being reluctant to disclose complications. This will improve baseline testing and allow for clearer diagnosis. In addition, the use of a mood screener can provide further insight to items not endorsed on ImPACT's symptoms clusters. Most importantly, it can highlight the potential benefit of adding a stand-alone measure of anxiety as without it, clinically significant anxiety warranting treatment could be missed, further interfering and/or worsening athletic and academic performance in a college athlete population.

Chapter 8 Practical Implications

This study highlights the importance of screening for anxiety among college athletes at baseline and offering resources for support and intervention to prevent anxiety from persisting or worsening. At the beginning of the sport season, as the number of sport and academic activities begin to increase, higher levels of anxiety might be felt in this population. For individuals who report already high levels of anxiety at baseline, their anxiety symptoms might be exacerbated as they continue in their sport. Sudano & colleagues (2017) found that college athletes experience an increase in anxiety levels at the beginning of the season due to their lofty expectations and fears of failing to reach those goals.

As the season progresses, more stressors are introduced such as more time commitments, fears of injuries, and physical fatigued, which these factors increase susceptibility to other mental health concerns (Sutcliffe & Greenberger, 2020). This is critical as athletes are already a population reluctant to seek out help for their mental health due to stigma and perceived misunderstanding from team members (Proctor & Boan-Lenzo, 2010; Woalnian et al., 2015). Implementing and establishing protocols at baseline to detect anxiety levels of college athletes can potentially prevent comorbidities of mental health disorders from forming, optimize their performance, and decrease susceptibility to injuries and recovery time. Furthermore, assessing for anxiety at baseline and normalizing the prevalence may begin to combat the stigma associated with mental health among athletes, allowing those to openly disclose any concerns. Most importantly, it will illustrate a clearer distinction between mental health disorders and concussion symptoms.

In addition, collegiate athletes are not just athletes, but they are students as well. Their mental health will not only impact their performance on the field, but their academics as well. If academic performance begins to suffer, some collegiate athletes are at risk of losing their scholarship offer, thus creating further emotional distress. As anxiety being the number one reported mental health concern college students deal with (American Psychological Association, 2013), utilizing a face-valid screen such as the GAD-7 is cost-efficient tool, which does not require much administration time, in being able to detect those who might need help. Identifying individuals who need support is key in being able to provide services before they begin to worsen with the academic stressors that college athletes face.

Chapter 9 Limitations

One of the biggest limitations of this study is that a relative few athletes endorsed clinically significant anxiety (5.5%), so the sample size available for our analyses was small (31 who fell above this cutoff). In addition, our sample consists of a high number of international students so the generalizability to the entire population of college athletes in the U.S. may be limited. Furthermore, when it comes to research on collegiate athletes, an emphasis is often placed on Division I athletes (typically transitioning from college to professional) whereas this study's sample was made up entirely of Division II athletes, raising the possibility that discrepancies and different manifestations of anxiety might be present to some degree. Additionally, this study used self-report measures for which athletes may be inclined to underreport their symptoms to minimize their felt distress, given the culture and stigma associated with mental health among this population.

Chapter 10 Future Research

More research needs to be conducted to elucidate the prevalence rates of anxiety among collegiate athletes. Most of the literature that exists addresses both anxiety and depression due to the high comorbidities between the two but does discuss the rates of anxiety alone. With the results of this study, the prevalence of anxiety among collegiate athletes (5.5%) seems to be higher than the reported prevalence of depression at 2% (Kontos et al., 2012), which warrants further investigation. In addition, it would be interesting to see how other brief, cost-effective (free) face-valid mental health related assessments such as the Insomnia Severity Index (ISI) and The Drug Abuse Screening Test (DAST) perform in terms of being able to detect sleep and substance use issues among athletes, as these factors can potentially exacerbate mental health concerns.

Chapter 11 Conclusion

In conclusion, given the percentage of athletes who endorsed anxiety on the GAD-7, but not on the ImPACT symptom clusters, or on the PHQ-9, it is vital to include an independent measure of anxiety at baseline concussion assessment. Approximately 1.9% of athletes elevated on the GAD-7 only and would have been overlooked in having any mental health concerns. The GAD-7 is cost-efficient (free) and does not require much time in terms of administration/interpretation to retrieve valuable data. Overall, it can help in being able to identify anxiety symptoms due to mental health related issues presented before participation in sport, or anxiety as a result of concussion related symptoms.

References

Abrahams, S., Fie S. M., Patricios, J., Posthumus, M. & September, A.V. (2014). Risk factors for sports concussion: An evidence-based systematic review. *British Journal of Sports Medicine*: *48*(2), 91-97. doi: 10.1136/bjsports-2013-092734.

Alsalaheen, B. A., Mucha, A., Morris, L. O., Whitney, S. L., Furman, J. M., Camiolo-Reddy, C. E., Collins, M. W., Lovell, M. R., & Sparto, P. J. (2010). Vestibular rehabilitation for dizziness and balance disorders after concussion. *Journal of Neurologic Physical Therapy : JNPT*, *34*(2), 87–93. https://doi.org/10.1097/NPT.0b013e3181dde568

American College of Sports Medicine, American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, & American Osteopathic Academy of Sports Medicine (2006). Psychological issues related to injury in athletes and the team physician: a consensus statement. *Medicine and science in sports and exercise*, *38*(11), 2030–2034. https://doi.org/10.1249/mss.0b013e31802b37a6

American Psychological Association. (2013, June). *College students' mental health is a growing concern, survey finds*. Monitor on Psychology. https://www.apa.org/monitor/2013/06/college-students.

American Psychiatric Association. (2017). *Diagnostic and statistical manual of mental disorders: Dsm-5*.

Bandelow B, Domschke K. (2015) Panic Disorder. In: Stein D, Vythilingum B, eds. *Anxiety Disorders and Gender*. Cham, Switzerland: Springer; 2015.

Bandelow, B., & Michaelis, S. (2015). Epidemiology of anxiety disorders in the 21st century. *Dialogues in clinical neuroscience*, *17*(3), 327–335. https://doi.org/10.31887/DCNS.2015.17.3/bbandelow

Baillargeon, A., Lassonde, M., Leclerc, S., & Ellemberg, D. (2012). Neuropsychological and neurophysiological assessment of sport concussion in children, adolescents and adults. *Brain injury*, *26*(3), 211–220. https://doi.org/10.3109/02699052.2012.654590

Barlow, K. M., Crawford, S., Stevenson, A., Sandhu, S. S., Belanger, F., & Dewey, D. (2010). Epidemiology of postconcussion syndrome in pediatric mild traumatic brain injury. *Pediatrics*, *126*(2), e374–e381. https://doi.org/10.1542/peds.2009-0925

Baxter, A., Scott, K., Vos, T., & Whiteford, H. (2013). Global prevalence of anxiety disorders: A systematic review and meta-regression. *Psychological Medicine, 43*(5), 897-910. doi:10.1017/S003329171200147X

Bittner, A., Goodwin, R. D., Wittchen, H. U., Beesdo, K., Höfler, M., & Lieb, R. (2004). What characteristics of primary anxiety disorders predict subsequent major depressive disorder?. *The Journal of Clinical Psychiatry*, *65*(5), 618–730. https://doi.org/10.4088/jcp.v65n0505

Boden, B. P., Tacchetti, R. L., Cantu, R. C., Knowles, S. B., & Mueller, F. O. (2007). Catastrophic head injuries in high school and college football players. *The American Journal of Sports Medicine*, *35*(7), 1075–1081. https://doi.org/10.1177/0363546507299239

Broglio, S. P., Ferrara, M. S., Piland, S. G., Anderson, R. B., & Collie, A. (2006). Concussion history is not a predictor of computerised neurocognitive performance. *British journal of sports medicine*, *40*(9), 802–805. https://doi.org/10.1136/bjsm.2006.028019

Brooks, B. L., Mannix, R., Maxwell, B., Zafonte, R., Berkner, P. D., & Iverson, G. L. (2016). Multiple past concussions in high school football players: Are there differences in cognitive functioning and symptom reporting?. *The American Journal of Sports Medicine*, *44*(12), 3243–3251. https://doi.org/10.1177/0363546516655095

Caccese, J. B., Bodt, B. A., Iverson, G. L., Kaminski, T. W., Bryk, K., Oldham, J., Broglio, S. P., McCrea, M., McAllister, T., Buckley, T. A., & CARE Consortium Investigators (2020). Estimated age of first exposure to contact sports and neurocognitive, psychological, and physical outcomes in healthy NCAA collegiate athletes: A cohort study. *Sports Medicine (Auckland, N.Z.)*, *50*(7), 1377–1392. https://doi.org/10.1007/s40279-020-01261-4

Cambridge, O. R., Knight, M. J., Mills, N., Baune, B. T., (2018). The clinical relationship between cognitive impairment and psychosocial functioning in major depressive disorder: A systematic review. *Psychiatry Research,* 269, 157-171. https://doi.org/10.1016/j.psychres.2018.08.033

Centers for Disease Control and Prevention. (2019). Surveillance report of traumatic braininjury-related emergency department visits, hospitalizations, and deaths—United States, 2014. *U.S. Department of Health and Human Services*. https://www.cdc.gov/traumaticbraininjury/pdf/TBI-Surveillance-Report-FINAL_508.pdf

Chen, J. K., Johnston, K. M., Petrides, M., & Ptito, A. (2008). Neural substrates of symptoms of depression following concussion in male athletes with persisting postconcussion symptoms. *Archives of general psychiatry*, *65*(1), 81–89. https://doi.org/10.1001/archgenpsychiatry.2007.8

Collins, M. W., Kontos, A. P., Reynolds, E., Murawski, C. D., & Fu, F. H. (2014). A comprehensive, targeted approach to the clinical care of athletes following sport-related concussion. *Knee surgery, Sports Traumatology, Arthroscopy : Official Journal of the ESSKA*, *22*(2), 235–246. https://doi.org/10.1007/s00167-013-2791-6

Comrey, A. L., & Lee, H. B. (1992). *A First Course in Factor Analysis* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Conder, R. L., & Conder, A. A. (2015). Sports-related concussions. *North Carolina medical Journal, 76*(2), 89–95. https://doi.org/10.18043/ncm.76.2.89

Correia, M., & Rosado, A. (2019). Anxiety in athletes: Gender and type of sport differences. *International Journal of Psychological Research, 12*(1), 9-17. http://dx.doi.org.portal.lib.fit.edu/10.21500/20112084.3552

Dekker, R. L., Lennie, T. A., Doering, L. V., Chung, M. L., Wu, J. R., & Moser, D. K. (2014). Coexisting anxiety and depressive symptoms in patients with heart failure. *European Journal of Cardiovascular Nursing : Journal of the Working Group on Cardiovascular Nursing of the European Society of Cardiology*, *13*(2), 168–176. https://doi.org/10.1177/1474515113519520

Delaney, J. S., Lacroix, V. J., Leclerc, S., & Johnston, K. M. (2002). Concussions among university football and soccer players. *Clinical Journal of Sport Medicine: Official Journal of the Canadian Academy of Sport Medicine*, 12, 331–338.

Echemendia, R., Iverson, G., McCrea, M., Macciocchi, S., Gioia, G., Putukian, M., & Comper, P. (2013). Advances in neuropsychological assessment of sport-related concussion. *British Journal of Sports Medicine*, *47*(5), 294–298. https://doi.org/10.1136/bjsports-2013-092186

Echlin, P., Tator, C., Cusimano, M., Cantu, R., Taunton, J., Upshur, R., Hall, C., Johnson, A., Forwell, L., & Skopelja, E. (2010). A prospective study of physician-observed concussions during junior ice hockey: implications for incidence rates. *Neurosurgical Focus*, *29*(5), E4–E4. https://doi.org/10.3171/2010.9.FOCUS10186

Edmed, S., & Sullivan, K. (2012). Depression, anxiety, and stress as predictors of postconcussion-like symptoms in a non-clinical sample. *Psychiatry Research*, *200*(1), 41– 45. http://dx.doi.org/10.1016/j .psychres.2012.05.022

Eisenberg, D., Hunt, J., & Speer, N. (2013). Mental health in American colleges and universities: Variation across student subgroups and across campuses. *The Journal of Nervous and Mental Disease*, *201*(1), 60–67. https://doi.org/10.1097/NMD.0b013e31827ab077

Ellis, M. J., Ritchie, L. J., Koltek, M., Hosain, S., Cordingley, D., Chu, S., Selci, E., Leiter, J., & Russell, K. (2015). Psychiatric outcomes after pediatric sports-related concussion. *Journal of neurosurgery. Pediatrics*, *16*(6), 709–718. https://doi.org/10.3171/2015.5.PEDS15220

Ezpeleta, L., Domènech, J., & Angold, A. (2006). A comparison of pure and comorbid CD/ODD and depression. *Journal of Child Psychology and Psychiatry*, *47*(7), 704–712. https://doi.org/10.1111/j.1469-7610.2005.01558.x

Facts & statistics: Anxiety and Depression Association of America, ADAA. (n.d.). Retrieved March 07, 2021, from https://adaa.org/understanding-anxiety/facts-statistics

Foley, C., Gregory, A., & Solomon, G. (2014). Young age as a modifying factor in sports concussion management: What is the evidence?. *Current Sports Medicine Reports*, *13*(6), 390–394. https://doi.org/10.1249/JSR.0000000000000104

Garber, J., & Weersing, V. R. (2010). Comorbidity of anxiety and depression in youth: Implications for treatment and prevention. *Clinical Psychology : A Publication of the Division of Clinical Psychology of the American Psychological Association*, *17*(4), 293–306. https://doi.org/10.1111/j.1468-2850.2010.01221.x

Garden, N., Sullivan, K.A., 2010. An examination of the base rates of post-concussion symptoms: the influence of demographics and depression. *Applied Neuropsychology*, *17*(1), 1–7, http://dx.doi.org/10.1080/09084280903297495

Gessel, L. M., Fields, S. K., Collins, C. L., Dick, R. W., & Comstock, R. D. (2007). Concussions among United States high school and collegiate athletes. *Journal of Athletic Training*, *42*(4), 495–503.

(Gilchrest on paper) Centers for Disease Control and Prevention (2011). Nonfatal traumatic brain injuries related to sports and recreation activities among persons aged ≤19 years--United States, 2001-2009. *MMWR. Morbidity and Mortality Weekly Report*, *60*(39), 1337–1342.

Giza, C. C., & Hovda, D. A. (2001). The neurometabolic cascade of concussion. *Journal of Athletic Training, 36*(3), 228 –235.

Giza, C. C., & Kutcher, J. S. (2014). An introduction to sports concussions. *Continuum (Minneapolis, Minn.)*, *20*(6 Sports Neurology), 1545–1551. https://doi.org/10.1212/01.CON.0000458975.78766.11

Guskiewicz, K. M., McCrea, M., Marshall, S. W., Cantu, R. C., Randolph, C., Barr, W., Onate, J. A., & Kelly, J. P. (2003). Cumulative effects associated with recurrent concussion in collegiate football players: the NCAA Concussion Study. *JAMA*, *290*(19), 2549–2555. https://doi.org/10.1001/jama.290.19.2549

He, C., Levis, B., Riehm, K. E., Saadat, N., Levis, A. W., Azar, M., Rice, D. B., Krishnan, A., Wu, Y., Sun, Y., Imran, M., Boruff, J., Cuijpers, P., Gilbody, S., Ioannidis, J., Kloda, L. A., McMillan, D., Patten, S. B., Shrier, I., Ziegelstein, R. C., … Benedetti, A. (2020). The Accuracy of the Patient Health Questionnaire-9 Algorithm for Screening to Detect Major Depression: An Individual Participant Data Meta-Analysis. *Psychotherapy and psychosomatics*, *89*(1), 25–37. https://doi.org/10.1159/000502294

Hoshizaki, T. B., & Brien, S. E. (2004). The science and design of head protection in sport. *Neurosurgery*, *55*(4), 956–967. https://doi.org/10.1227/01.neu.0000137275.50246.0b

Hoyt, L. T., Cohen, A. K., Dull, B., Maker Castro, E., & Yazdani, N. (2021). "Constant stress has become the new normal": Stress and anxiety inequalities among U.S. college students in the time of COVID-19. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine*, *68*(2), 270–276. https://doi.org/10.1016/j.jadohealth.2020.10.030

Iverson, G. L., & Lange, R. T. (2003). Examination of "postconcussion-like" symptoms in a healthy sample. *Applied Neuropsychology*, *10*(3), 137–144. https://doi.org/10.1207/S15324826AN1003_02

Iverson, G. L., Silverberg, N. D., Mannix, R., Maxwell, B. A., Atkins, J. E., Zafonte, R., & Berkner, P. D. (2015). Factors associated with concussion-like symptom reporting in high school athletes. *JAMA Pediatrics*, *169*(12), 1132–1140. https://doi.org/10.1001/jamapediatrics.2015.2374

Janszky, I., Ahnve, S., Lundberg, I., & Hemmingsson, T. (2010). Early-onset depression, anxiety, and risk of subsequent coronary heart disease 37-year follow-up of 49,321 young Swedish men. *Journal of the American College of Cardiology*, *56*(1), 31–37. https://doi.org/10.1016/j.jacc.2010.03.033

Johnson, E. W., Kegel, N. E., & Collins, M. W. (2011). Neuropsychological assessment of sport-related concussion. *Clinics in Sports Medicine*, *30*(1), 73–ix. https://doi.org/10.1016/j.csm.2010.08.007

Jorge, R., & Robinson, R. G. (2002). Mood disorders following traumatic brain injury. *NeuroRehabilitation*, *17*(4), 311–324.

Kissinger-Knox, A., M., Norheim, N. J., Vagt, D. S., Mulligan, K. P., & Webbe, F. M. (2019). Baseline concussion symptoms scores vary between interview and computer self-report only for male college athletes. *International Journal of Athletic Therapy and Training, 24* (2), 64-69. http://doi.org/10.1123/ijatt.2018-0028

Kontos, A.P., & Collins, M.W. (2018). Concussion: A clinical profile approach to assessment and treatment. *American Psychological Association.* http://dx.doi.org/10.1037/0000087-004.

Kontos, A. P., Elbin, R. J., Schatz, P., Covassin, T., Henry, L., Pardini, J., & Collins, M. W. (2012). A revised factor structure for the post-concussion symptom scale: Baseline and postconcussion factors. *The American Journal of Sports Medicine, 40*(10), 2375–2384. http://dx.doi.org/10.1177/ 0363546512455400

Kushner, D. S. (2001). Concussion in sports: Minimizing the risk for complications. *American Family Physician, 64*(6):1007-1015

Langlois, J., Rutland-Brown, W., & Wald, M. (2006). The epidemiology and impact of traumatic brain injury - A brief overview. *The Journal of Head Trauma Rehabilitation, 21*(5), 375–378. https://doi.org/10.1097/00001199-200609000-00001

Levis, B., Sun, Y., He, C., Wu, Y., Krishnan, A., Bhandari, P. M., Neupane, D., Imran, M., Brehaut, E., Negeri, Z., Fischer, F. H., Benedetti, A., Thombs, B. D., Depression Screening Data (DEPRESSD) PHQ Collaboration, Che, L., Levis, A., Riehm, K., Saadat, N., Azar, M., Rice, D., … Zhang, Y. (2020). Accuracy of the PHQ-2 Alone and in Combination With the PHQ-9 for Screening to Detect Major Depression: Systematic Review and Meta-analysis. *JAMA, 323*(22), 2290–2300. https://doi.org/10.1001/jama.2020.6504

Ling, H., Hardy, J., & Zetterberg, H. (2015). Neurological consequences of traumatic brain injuries in sports. *Molecular and Cellular Neurosciences, 66*(Pt B), 114–122. https://doi.org/10.1016/j.mcn.2015.03.012

Lovell, M. R. (2007). Clinical Interpretive Manual Online ImPACT 2007–2012. ImPACT Web site. http://www.impacttest.com

MacPherson, E., Kerr, G., & Stirling, A. (2016). The influence of peer groups in organized sport on female adolescents' identity development. *Psychology of Sport and Exercise, 23,* 73– 81. http:// dx.doi.org/10.1016/j.psychsport.2015.10.002

Major Depression (February 2019). https://www.nimh.nih.gov/health/statistics/major-depression.shtml.

Martin, A., Petersen, A., Sesma, H., Koolmo, M., Ingram, K., Slifko, K., Nguyen, V., Doss, R., & Linabery, A. (2020). Concussion symptomology and recovery in children and adolescents with pre-existing anxiety. *Journal of Neurology, Neurosurgery and Psychiatry, 91*(10), 1060–1066. https://doi.org/10.1136/jnnp-2020-323137

McCrea, M., Guskiewicz, K., Randolph, C., Barr, W. B., Hammeke, T. A., Marshall, S. W., Powell, M. R., Woo Ahn, K., Wang, Y., & Kelly, J. P. (2013). Incidence, clinical course, and predictors of prolonged recovery time following sport-related concussion in high school and college athletes. *Journal of the International Neuropsychological Society : JINS*, *19*(1), 22–33. https://doi.org/10.1017/S1355617712000872

McCrea, H. J., Perrine, K., Niogi, S., & Härtl, R. (2013). Concussion in sports. *Sports Health*, *5*(2), 160–164. https://doi.org/10.1177/1941738112462203

McCrory, P., Davis, G., & Makdissi, M. (2012). Second impact syndrome or cerebral swelling after sporting head injury. *Current Sports Medicine Reports*, *11*(1), 21–23. https://doi.org/10.1249/JSR.0b013e3182423bfd

McCrory, P., Meeuwisse, W. H., Aubry, M., Cantu, R. C., Dvořák, J., Echemendia, R. J., Engebretsen, L., Johnston, K., Kutcher, J. S., Raftery, M., Sills, A., Benson, B. W., Davis, G. A., Ellenbogen, R., Guskiewicz, K. M., Herring, S. A., Iverson, G. L., Jordan, B. D., Kissick, J., McCrea, M., … Turner, M. (2013). Consensus statement on concussion in sport: The 4th International Conference on Concussion in Sport, Zurich, November 2012. *Journal of Athletic Training*, *48*(4), 554–575. https://doi.org/10.4085/1062-6050-48.4.05

McEwen B. S. (2000). Allostasis and allostatic load: implications for neuropsychopharmacology. *Neuropsychopharmacology: official publication of the American College of Neuropsychopharmacology*, *22*(2), 108–124. https://doi.org/10.1016/S0893-133X(99)00129-3

McKee, A. C., Cantu, R. C., Nowinski, C. J., Hedley-Whyte, E. T., Gavett, B. E., Budson, A. E., Santini, V. E., Lee, H. S., Kubilus, C. A., & Stern, R. A. (2009). Chronic traumatic encephalopathy in athletes: progressive tauopathy after repetitive head injury. *Journal of Neuropathology and Experimental Neurology*, *68*(7), 709–735. https://doi.org/10.1097/NEN.0b013e3181a9d503

Merritt, V. C., Meyer, J. E., & Arnett, P. A. (2015). A novel approach to classifying postconcussion symptoms: The application of a new framework to the Post-Concussion Symptom Scale. *Journal of Clinical and Experimental Neuropsychology*, 37(7), 764–775. https://doi.org/10.1080/13803395.2015.1060950

Moore, E. L., Terryberry-Spohr, L., & Hope, D. A. (2006). Mild traumatic brain injury and anxiety sequelae: a review of the literature. *Brain injury*, *20*(2), 117–132. https://doi.org/10.1080/02699050500443558

National Institute of Neurological Disorders and Stroke. (2017). Sport-related concussion common data elements. Retrieved from https://www.commondataelements.ninds.nih.gov/SRC.aspx# tabData_Standards

Nixdorf I., Frank R., Hautzinger M., Beckmann J. (2013) Prevalence of depressive symptoms and correlating variables among German elite athletes. *Journal of Clinical Sport Psychology* 7(4), 313-326

Niogi, S. N., Mukherjee, P., Ghajar, J., Johnson, C., Kolster, R. A., Sarkar, R., Lee, H., Meeker, M., Zimmerman, R. D., Manley, G. T., & McCandliss, B. D. (2008). Extent of microstructural white matter injury in postconcussive syndrome correlates with impaired cognitive reaction time: A 3T diffusion tensor imaging study of mild traumatic brain injury. *AJNR. American Journal of Neuroradiology*, *29*(5), 967–973. https://doi.org/10.3174/ajnr.A0970

Pêgo, J. M., Sousa, J. C., Almeida, O. F., & Sousa, N. (2010). Stress and the neuroendocrinology of anxiety disorders. *Current topics in behavioral neurosciences*, *2*, 97–117. https://doi.org/10.1007/7854_2009_13

Pluhar, E., McCracken, C., Griffith, K. L., Christino, M. A., Sugimoto, D., & Meehan, W. P., 3rd (2019). Team sport athletes may be less likely to suffer anxiety or depression than individual sport athletes. *Journal of Sports Science & Medicine*, *18*(3), 490–496

Ponsford, J., Cameron, P., Fitzgerald, M., Grant, M., Mikocka-Walus, A., & Schönberger, M. (2012). Predictors of postconcussive symptoms 3 months after mild traumatic brain injury. *Neuropsychology*, *26*(3), 304–313. https://doi.org/10.1037/a0027888

Preidt, R. (2018, March 30). Many grad students struggle with anxiety, depression. Retrieved March 07, 2021, from https://health.usnews.com/health-care/articles/2018-03-30/many-grad-students-struggle-with-anxiety-depression

Prins, M. L., Alexander, D., Giza, C. C., & Hovda, D. A. (2013). Repeated mild traumatic brain injury: mechanisms of cerebral vulnerability. *Journal of Neurotrauma*, *30*(1), 30–38. https://doi.org/10.1089/neu.2012.2399

Proctor, S. L., & Boan-Lenzo, C. (2010). Prevalence of depressive symptoms in male intercollegiate student-athletes and nonathletes. *Journal of Clinical Sport Psychology*, *4*(3), 204–220

Reardon, C. L., & Factor, R. M. (2010). Sport psychiatry: A systematic review of diagnosis and medical treatment of mental illness in athletes. *Sports Medicine, 40*, 961–980. http://dx.doi.org/10 .2165/11536580-000000000-00000

Robinson, O. J., Vytal, K., Cornwell, B. R., & Grillon, C. (2013). The impact of anxiety upon cognition: perspectives from human threat of shock studies. *Frontiers in Human Neuroscience, 7*, 203. https://doi.org/10.3389/fnhum.2013.00203

Sandel, N., Reynolds, E., Cohen, P. E., Gillie, B. L., & Kontos, A. P. (2017). Anxiety and mood clinical profile following sport-related concussion: From risk factors to treatment. *Sport, Exercise, and Performance Psychology, 6*(3), 304-323. http://dx.doi.org.librweb.laurentian.ca/10.1037/spy0000098

Sarac, N., Sarac, B., Pedroza, A., & Borchers, J. (2018). Epidemiology of mental health conditions in incoming division I collegiate athletes. *The Physician and Sportsmedicine, 46*(2), 242–248. https://doi.org/10.1080/00913847.2018.1427412

Schatz, P., Pardini, J. E., Lovell, M. R., Collins, M. W., & Podell, K. (2006). Sensitivity and specificity of the ImPACT Test Battery for concussion in athletes. *Archives of clinical neuropsychology : the official journal of the National Academy of Neuropsychologists, 21*(1), 91–99. https://doi.org/10.1016/j.acn.2005.08.001

Schatz, P., & Sandel, N. (2013). Sensitivity and specificity of the online version of ImPACT inhigh school and collegiate athletes. *The American journal of sports medicine, 41*(2), 321–326. https://doi.org/10.1177/0363546512466038

Segerstrom, S.C., Tsao, J.C.I., Alden, L.E., & Craske, M.G. (2000). Worry and rumination: Repetitive thought as a concomitant and predictor of negative mood. *Cognitive Therapy and Research, 24*, 671–688. https://doi.org/10.1023/A:1005587311498

Smith, D. H., Meaney, D. F., & Shull, W. H. (2003). Diffuse axonal injury in head trauma. *The Journal of head trauma rehabilitation, 18*(4), 307–316. https://doi.org/10.1097/00001199-200307000-00003

Sudano, L.E., Collins, G., & Miles, C.M. (2017). Reducing barriers to mental health care for student athletes: An integrated care model. *Families, Systems, & Health, 35*(1), 77-84. http://dx.doi.org/10.1037/fsh0000242

Suhr, J., & Gunstad, J. (2002). Postconcussive symptom report: The relative influence of head injury and depression. *Journal of Clinical and Experimental Neuropsychology, 24*(8), 981–993. https://doi.org/10.1076/jcen.24.8.981.8372

Sutcliffe, J. H., & Greenberger, P. A. (2020). Identifying Psychological Difficulties in College Athletes. *The journal of allergy and clinical immunology. In practice, 8*(7), 2216–2219. https://doi.org/10.1016/j.jaip.2020.03.006

Tator, C. (2013). Concussions and their consequences: current diagnosis, management and prevention. *Canadian Medical Association Journal (CMAJ)*, *185*(11), 975–979. https://doi.org/10.1503/cmaj.120039

U.S. Department of Health and Human Services. (2018, July). *Anxiety Disorders*. National Institute of Mental Health. https://www.nimh.nih.gov/health/topics/anxiety-disorders/index.shtml.

Vagnozzi, R., Tavazzi, B., Signoretti, S., Amorini, A., Belli, A., Cimatti, M., Delfini, R., Di Pietro, V., Finocchiaro, A., & Lazzarino, G. (2007). Temporal window of metabolic brain vulnerability to concussions: Mitochondrial-related impairment - Part I. *Neurosurgery*, *61*(2), 379–388. https://doi.org/10.1227/01.NEU.0000280002.41696.D8

Vargas, G., Rabinowitz, A., Meyer, J., & Arnett, P. A. (2015). Predictors and prevalence of postconcussion depression symptoms in collegiate athletes. *Journal of Athletic Training, 50*, 250 –255. http://dx.doi.org/10.4085/1062-6050-50.3.02

Venzala, E., García-García, A. L., Elizalde, N., & Tordera, R. M. (2013). Social vs. environmental stress models of depression from a behavioural and neurochemical approach. *European Neuropsychopharmacology: The journal of the European College of Neuropsychopharmacology*, *23*(7), 697–708. https://doi.org/10.1016/j.euroneuro.2012.05.010

Wolanin, A., Gross, M., & Hong, E. (2015). Depression in athletes: prevalence and risk factors. *Current sports medicine reports*, *14*(1), 56–60. https://doi.org/10.1249/JSR.0000000000000123

World Health Organization. (1992). The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines

Zuckerman, S. L., Yengo-Kahn, A. M., Buckley, T. A., Solomon, G. S., Sills, A. K., & Kerr, Z. Y. (2016). Predictors of postconcussion syndrome in collegiate student-athletes. *Neurosurgical Focus*, *40*(4), E13. https://doi.org/10.3171/2016.1.FOCUS15593