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2023

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Recommended Citation

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April 24, 2023

Introduction

Injury is an unfortunate, yet common occurrence that athletes across all age groups experience over the course of their careers. Athletes at the collegiate level are highly susceptible to injury, with 13.8 injuries occurring per 1000 athletes in a competitive game setting, which equates to about one athlete getting injured every two games with a team of fifty participants (Hootman et al., 2007). One of the main goals, when athletes are injured, is to get back on the field and be able to play with their teammates. If it's a short-term injury, athletes might only be sidelined for one to two games or even only practices without missing a beat in the fast-paced game schedule of a season. If the injury is more severe, athletes could find themselves sidelined for weeks to months with their hopes of playing in their competitive season fading away.

These injuries have a greater impact on an athlete than just not being able to play for an extended period of time. Research has shown that injuries, especially major and long term injuries, impact an athlete's life both on and off the sport's field. Athletes who had major injuries were found to experience higher levels of perceived stress and a lessened sense of life satisfaction in comparison to other athletes who had minor injuries (Malinauskas, 2010). The higher levels of stress and lessened sense of life satisfaction are points of concern for injured athletes as their negative experiences in dealing with their injury are making their way into their daily lives and overall well-being. Sports are such a critical part of many athlete's lives and to be injured and separated from such an important identifying piece of their lives can be a major challenge for these athletes. When it comes to emotional concerns of all injured athletes, one of the biggest concerns is the loss of athletic identity from being unable to play in their sport (Marshall & Paterson, 2017). Athletic identity is found to be associated with several factors of an athlete's recovery outcomes, including psychological, behavioral, and injury-specific outcomes

(Renton et al., 2021). This loss of athletic identity extends into all facets of an injured athlete's life as they work to recover from an injury. They are more likely to interact with those in higher ranking positions in a negative manner and are more likely to interact with those in their similar ranking as a player in a positive manner (Udry et al., 1997). This psychological impact of how stress affects injured athletes' interactions and how they view members of their team can distance themselves from figures of authority on their team and thus impact their relationships with their coaches once they do happen to return to the playing field. Injuries have an impact that goes far beyond physical implications. Associated psychological and interpersonal issues could prove to be detrimental in the process of returning an athlete to their sport following an injury.

The current, common process of returning an athlete to their sport following an injury is one that works to put an athlete in the best position physically to be able to get back on the playing field. This process typically follows a linear progression of medical treatment, to rehabilitation, and ends with restorative generic and sport-specific development to put the athlete in the best position to return healthy (Kraemer et al., 2009). These physical considerations of the return to sport process for injured athletes are always of heavy emphasis as an athlete cannot return to playing a sport if they are not physically healthy enough to engage in sports activities. Yet, even when athletes are determined to be physically healed, there are often issues that persist. Coaches might not feel ready to reintroduce the previously injured athlete right away due to lack of stamina or other physical considerations. Teammates could feel a loss of chemistry as the team has formed new styles of playing chemistry without the injured athlete included on the playing field. A frequently identified issue in literature for such newly healed athletes is the fear of reinjury. The fear of reinjury would relate to certain movements and activities that these athletes would engage in as they return to playing that might trigger a psychological response that

debilitates them from being able to give full effort due to their previous injury, as they do not want to become injured again. This fear can affect both the psychological and physical functioning of an athlete, as this fear of reinjury has been shown to negatively affect physical recovery and self-reported functioning for injured athletes working through the later stages of the return to sport process (Hsu et al., 2017). There also is an emotional aspect to returning to play once an athlete is physically healthy enough following rehabilitation. It is common to see overall affect, also known as mood, shift from negative affect to positive affect as an injured athlete progresses and reaches milestones in their rehabilitation process. However, as the return to play date gets closer, research has shown that negative affect increases due to various reasons. One of which is the fear of reinjury as mentioned earlier, but other possible reasons for this increase in negative affect include the unpredictability of future performance once an injured athlete returns, along with worries that post-injury rehabilitation goals have not been met (Podlog et al., 2014). Completion of the physical rehabilitation process by an injured athlete does not ensure that they will be ready to play on the field to their pre-injury level of play due to the issues that might arise and persist beyond this process. There are further considerations that are of high importance that allow a healthy return to sport to be achievable for an injured athlete in addition to their physical rehabilitation process.

Several previous research studies have begun to address these further considerations in the rehabilitation process, but there are still considerable gaps in the literature that this research works to begin to address in its own, unique manner. Crossman (1997) outlined many of the psychological considerations during sports injury rehabilitation, including stress management, social support, and a specific psychological approach to the rehabilitation process she describes as the athlete-centered approach (Crossman, 1997). Podlog et al. (2014) looked at both social and

psychological factors that are involved with the rehabilitation of an injured athlete, but there were certain considerations that were not included that are crucial for the holistic approach to rehabilitation for an injured athlete. The further considerations that should have been included are trait characteristics of the athlete such as motivation, hope, and confidence along with other factors.

There has been a major gap found in the research regarding sports injury rehabilitation, with an overfocus on addressing the physical and biological factors of a sports injury and a lack of focus and attention given to the psychosocial needs of an injured athlete during their rehabilitation process.

Many models and theoretical frameworks have attempted to address this gap, but the model that has shown high promise and the most comprehensive method of looking at the phenomenon of psychological needs and considerations of injured athletes during sport injury rehabilitation is the Biopsychosocial Model of Sport Injury Rehabilitation. The theoretical framework of this model suggests that biological, psychological, and social factors play significant roles in the rehabilitation process of an injured athlete and they all work in unison during the rehabilitation process to create the outcomes of the rehabilitation process for an injured athlete (Brewer et al., 2002).

The researcher will be addressing the psychosocial considerations through the theoretical framework of this model, as presented and described in *Medical and Psychological Aspects of Sport and Exercise* (Mostofsky & Zaichkowsky, 2002). As many of the biological factors of the biopsychosocial model have been addressed in previous studies, the focus of this research is to gain more insight into the psychological and social/contextual components that have been understudied within this model to optimize the injury rehabilitation process. The purpose of this

research study is to utilize pre-injury trait characteristics of athletes, through the framework of the psychological and social factors of the biopsychosocial model, in an effort to optimize the rehabilitation process if they were to become injured in future research.

As demonstrated throughout academic literature, an individual's trait characteristics are important in creating an individual's unique psychological profile. However, what if there are commonalities between such profiles that could create a small number of homogeneous groups that share similar traits? What if there were trait characteristic commonalities between athletes that could allow for them to be clustered together based on these commonalities for the optimization of sport injury rehabilitation? The peers, coaches, and clinicians that work with injured athletes might not understand what the psychological needs of an injured athlete are if they aren't made aware of them. This clustering of trait characteristics could be the beginning to future research that asks athletes to assess their psychological trait characteristics so those involved in their rehabilitation program can best address not just their physical needs, but also their psychological needs in an effort to have the most successful sport injury rehabilitation outcomes. Sport injury isn't just one-dimensional, there are several ways it can affect an athlete. This research starts to bring light to the gap in the sport injury rehabilitation field where the focus of sport injury rehabilitation is to treat an injured athlete holistically, not just physically.

The research question for this research is: When looking at a population of student athletes, do they cluster into groups with similar pre-injury psychological traits, therefore having different psychological needs and considerations for their sport injury rehabilitation program?

Review of Literature

Physical/Biological Considerations of Injury Rehabilitation

One of the first things that is considered in regard to the injury rehabilitation of an athlete is the characteristics of the injury. Injures can vary in many ways, including the type of injury, location of injury, and severity of an injury (Flint, 1998). Understanding the characteristics of the injury determines the creation of the rehabilitation program which is centered around rehabilitating the injury site to be able to regain many of the functions and abilities lost due to the occurrence of an injury.

Injury rehabilitation for athletes has been centered around progressing an athlete through a physical rehabilitation program that allows them to recover from their physical injuries to get back on the playing field as soon as possible. Physical therapists and other clinicians construct programs that work to improve the physical components of an athlete that might have been diminished following an injury, including joint mobility, strength, flexibility, and power (Lorenz et al., 2010). There are other physical components that are of considerable importance for injured athletes beyond addressing their diminished physical abilities, such as nutrition. Injured athletes may experience muscle atrophy during their recovery process from an athletic injury due to immobilization, as an athlete is resting to allow for recovery before a physical rehabilitation program begins (Phillips et al., 2009). One way that an injured athlete can address their muscular atrophy and also promote more efficient physical rehabilitation outcomes once they do eventually return to physical activity is through proper nutrition. A simultaneous combination of both carbohydrates with an adequate amount of protein intake can help an injured athlete combat both the atrophy of their muscle tissue along with the rate of the muscle atrophy (Papadopoulou, 2020). In addition to these macronutrients, studies have shown that omega-3 fatty acids also are

an important nutritional component for an injured athlete. Omega-3 fatty acids have been found to have positive effects in anti-inflammatory efforts during injury rehabilitation as well as protecting against disturbances to an injured individual's immune system (Quintero et al., 2018; Rand & Gellhorn, 2016). Nutrition has been heavily studied as a biological component of the injury rehabilitation process for an athlete, with another component that aids in the injury rehabilitation process for injured athletes being sleep.

Sleep has both positive and negative effects on the recovery processes of injured athletes depending on how much sleep an injured athlete is able to get every night. Athletes who experience chronically insufficient sleep and don't allow their bodies to recover through the processes of sleep report an increased feeling of onset in pain levels in addition to amplified feelings of pain (Halson, 2008). This can be detrimental to injured athletes who are working through a strenuous physical rehabilitation program dealing with pain management as they progress, which could potentially lead to setbacks and delayed return to sport. Sleep loss not only affects pain tolerance and onset but it also has an effect on other biological factors considered within the biopsychosocial model, such as the endocrine system and immune system functioning. Sleep, specifically during the non-rapid eye movement phase of the sleep cycle, is when about 95% of growth hormones are naturally produced within the endocrine system (Gunning, 2001). These growth hormones allow the body to restore and repair itself, so with sleep loss, there are serious concerns about the detrimental effects that the lack of growth hormones has on the restoration and repair of an athlete's physical injury (Venter, 2012). Regarding the immune system functioning, lack of sleep quality has been found to increase vulnerability to infections (Venter, 2012). This can threaten injured athletes as they might be recovering from a surgical procedure following an athletic injury and infections could result in a complication from the

procedure. Sleep is important in several manners following a surgical procedure such as the one previously mentioned, and also in regard to tissue healing. Sleep loss has been found to have a negative effect on tissue healing, which can pose threats to the recovery rate at which an injured athlete can begin and progress through their physical rehabilitation program (Nadler et al., 2003). Sleep loss has been addressed in several different manners throughout the exploration of literature regarding rehabilitation for injured athletes, due to its implications and interactions with various bodily and biological processes.

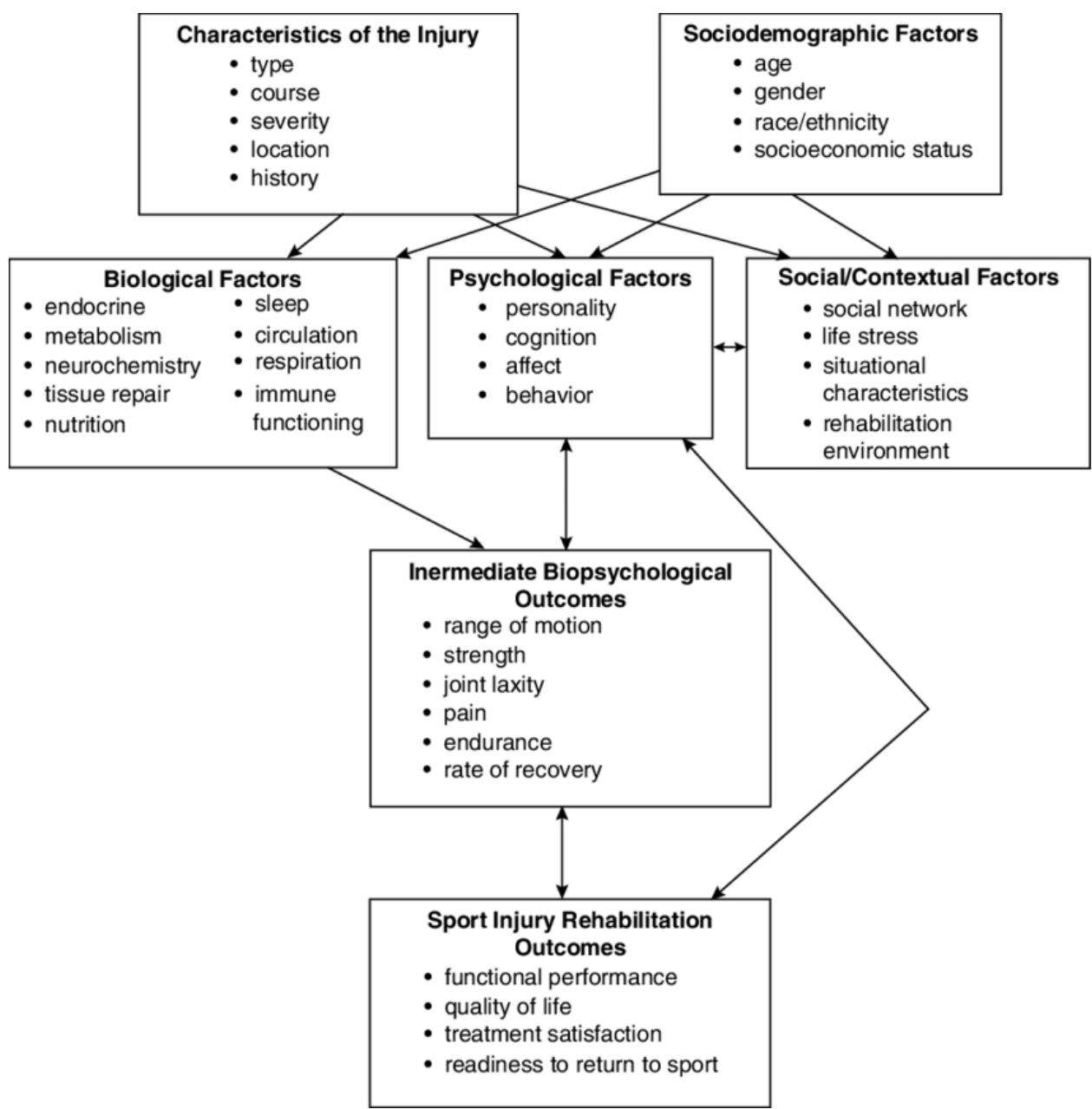**The Biopsychosocial Model of Sport Injury Rehabilitation**

This model is structured to address all the considerations for an athlete's rehabilitation program after injury in an effort to help the athlete rehabilitate and return to their respective playing field not only physically but also psychologically. The outcomes of the rehabilitation model are centered around the athlete, both on and off the playing field. There are several factors that can influence sport injury rehabilitation outcomes, and this model works to holistically address how these factors interact with each other to contribute to such outcomes for an injured athlete (Brewer et al., 2002).

The model highlights five factors that play a role in the two outcomes of a sport injury rehabilitation program. The five factors that are addressed and discussed in the model are characteristics of the injury, sociodemographic factors, biological factors, psychological factors, and social/contextual factors. The two outcomes that are included in this model are intermediate biopsychological outcomes and sport injury rehabilitation outcomes. It is important to note that these factors and outcomes are related to each other and do not function or influence the outcomes by themselves. This is an interactive approach to understanding the considerations and

complexities of sport injury rehabilitation, as these factors all work to influence rehabilitation

outcomes in a significant manner (Brewer et al., 2002). This model is shown in Figure 1.

Figure 1

The Biopsychosocial Model of Sport Injury Rehabilitation

Characteristics of the Injury	Sociodemographic Factors
• type • course • severity • location • history	• age • gender • race/ethnicity • socioeconomic status

Biological Factors
- endocrine   • sleep
- metabolism   • circulation
- neurochemistry • respiration
- tissue repair   • immune
- nutrition   functioning

Psychological Factors
- personality
- cognition
- affect
- behavior

Social/Contextual Factors
- social network
- life stress
- situational characteristics
- rehabilitation environment

Inermediate Biopsychological Outcomes
- range of motion
- strength
- joint laxity
- pain
- endurance
- rate of recovery

Sport Injury Rehabilitation Outcomes
- functional performance
- quality of life
- treatment satisfaction
- readiness to return to sport

The first tier of the model considers both the characteristics of the injury and the sociodemographic factors. As mentioned earlier in the physical and biological considerations of injury rehabilitation section, it was noted that the characteristics of an injury can significantly influence the rehabilitation process (Flint, 1998). Sociodemographic factors play a role in various areas of the rehabilitation process, specifically the psychological, biological, and contextual areas of rehabilitation. For example, there can be gender differences for an injured athlete which can influence how the rehabilitation functions, such as hormonal responses, expectations from a societal viewpoint, and different emotional responses to the rehabilitation process (Brewer et al., 2002). This first tier of the biopsychosocial model isn't the focus of this present study being conducted as the literature surrounding sport injury rehabilitation covers these topics extensively mostly as a secondary aspect to biological and contextual factors. The gap in the literature that this model works to address is located in the second tier of this model.

The second tier of the biopsychosocial model of sport injury rehabilitation incorporates psychological factors into the considerations of the rehabilitation process for an injured athlete. These factors hold a prominent spot within the model as they are the centerpiece of the entire model, with various influences and relationships to the other factors of the model and the resulting outcomes of the model (Brewer et al., 2002). The psychological factors as highlighted in the model include personality, cognition, affect, and behavior.

Previous literature has shown that psychological factors are of high importance in the considerations of an injured athlete's rehabilitation program and can influence the outcomes of the rehabilitation program. Physical therapists working closely with injured athletes found there are significant psychological needs and considerations for injured athletes that are greater than those physical, yet these physical therapists feel incapable of addressing such needs and

considerations due to the lack of knowledge on how to address them from a sport injury (Piussi et al., 2021). Much of the training and narrative is around treating physical considerations, but the psychological considerations in rehabilitation are of high importance and need proper attention in order to obtain successful rehabilitation outcomes as outlined in the biopsychosocial model. One way that it has been explored in the literature to help physical therapists address psychological considerations and needs due to sport injury is to further understand the personality types of their patients. Personality is one of the psychological factors listed in the biopsychosocial model, and research suggests that understanding the personality type of an injured athlete could help their physical therapists in their anticipation of how an athlete might respond to certain stressful components of the rehabilitation process (Hedgpeth and Sowa, 1998). Hedgpeth and Sowa in this study referenced an injured athlete who showed a Type B personality in times of stress, which is characterized by avoidance, withdrawal, and a diminished sense of time urgency. The researchers suggested that this athlete and their athletic trainer, if they were understanding and made aware of this athlete's personality type through a personality assessment, could discuss how their personality type could interact with their psychological traits to interfere with the progress that could be made. They finally suggest that the athletic trainer can make recommendations based on these understandings to help the injured athlete best engage with and achieve their rehabilitation outcomes (i.e. cognitive restructuring and other techniques such as relaxation and visualization) (Hedgpeth & Sowa, 1998). This highlights not only the interactions and intertwining of personality traits and other psychological attributes, but also the importance of pre-injury psychological trait understandings of an injured athlete for those who are involved in their rehabilitation process, such as trainers, clinicians, peers, and coaches.

Much of the literature regarding personality outlines how those involved in the rehabilitation process, but not the injured athlete, can utilize knowledge of personality types for sport injury rehabilitation. There needs to be a further utilization of the understanding of psychological factors, not just personality, by both the injured athlete and those involved in the rehabilitation to optimize the rehabilitation process and foster more positive sport injury rehabilitation outcomes. There have been other components of the psychological factors that have been found in previous literature to have an impact on the rehabilitation of an injured athlete, with three of the main factors being cognitive appraisals, emotional reactions, and behavioral responses (Podlog et al., 2014). Cognitive appraisals have been shown to affect an athlete's behaviors and emotions in a rehabilitation setting, emotional reactions are affected by both personal and situational factors, and behavioral responses to rehabilitation through coping skills and adherence to the rehabilitation program are of high importance to rehabilitation outcomes (Podlog et al., 2014). Psychological factors alone play a significant role as shown in the literature, but one of the critiques regarding existing literature on psychological factors in sport injury rehabilitation is that these factors are addressed alongside social/contextual factors, such as stress and social support. This makes it troublesome to find literature that solely focuses on psychological factors outlined in the biopsychosocial model. However, it does further the importance of using a holistic and interactive model to optimize sport injury rehabilitation as the biopsychosocial model functions to do.

The social/contextual factors within the second tier of the biopsychosocial model are related to many of the other factors, both within and outside the second tier of this model. The four social/contextual factors include social networks, life stress, situational characteristics, and rehabilitation environment. As mentioned previously, social/contextual factors are oftentimes

found in research in combination with psychological factors. However, there are many studies that have findings pertaining directly to these factors and combinations of multiple social/contextual factors.

The literature surrounding this set of factors outlined in the biopsychosocial is dense and applicable to many facets of the rehabilitation process. When looking at key factors that influence rehabilitation outcomes, injured athletes mentioned three factors the most: patient attributes, relationship qualities with their physical therapist, and elements of their rehabilitation system including the rehabilitation environment (Paterno et al., 2019). Patient attributes include both psychological factors such as motivation and confidence and also the social/contextual factor of the social network. The social network is mentioned in this research through the relationship between an injured athlete and a physical therapist influencing rehabilitation outcomes for the injured athlete. Having a strong relationship with a physical therapist could influence the rehabilitation outcomes in a positive manner as the physical therapist could gain a better understanding of the psychological profile of the injured athlete which could better optimize the rehabilitation, in reference to Hedgpeth & Sowa, 1998. The third factor mentioned, the elements of the rehabilitation system, relate to the situational characteristics of an injured athlete along with the rehabilitation environment as highlighted in the biopsychosocial model. The research highlighted components of these factors such as the availability of appointments, coordination between care providers, and the environment of the therapy clinic (Paterno et al., 2019). These contextual factors can lead to the optimization of the rehabilitation process for an injured athlete as it tends to the Wed m needs of the individual, whether it be a clinic environment that fosters progress or a clinic that allows for flexibility in scheduling to allow for an injured athlete to make it to their rehabilitation appointments. This study mentioned was

conducted on injured athletes who have sustained an injury to their anterior cruciate ligament only, so there might be some limitations on certain situational applications to the rehabilitation of other sports injuries. As mentioned in the Yang et al., 2010 study, the social network of injured athletes throughout their rehabilitation process plays a significant role in their outcomes following rehabilitation. Injured collegiate athletes report greater postinjury satisfaction when compared to other injured athletes if they had a strong social network consisting of friends, coaches, athletic trainers, and physicians (Yang et al., 2010). This is important for the applicability of the social/contextual factors to the sport injury rehabilitation outcomes as outlined in the biopsychosocial model. The social network is utilized as an aid throughout the rehabilitation process, as many injured athletes report relying on their coaches, trainers, and physicians more than they did before they were injured for social support (Yang et al., 2010). While these social networks might exist before an athlete becomes injured, the reliance on these social networks becomes more evident which speaks to the importance of social networks in rehabilitation outcomes. Social networks can aid in the feeling of social support which, as shown in the literature mentioned, is a crucial component to the achievement of rehabilitation outcomes. Another component of the social/contextual factors that could have a more negative influence on rehabilitation outcomes is life stress. Perceptions of life stress tend to increase with the occurrence of an athletic injury, in addition to stress being found to have a direct negative effect on the psychological adjustment ability of injured athletes (Malinauskas, 2010). This can be worrisome for injured athletes in their rehabilitation program dealing with significant life stress from their injury as they could experience troubles in progressing through their program due to their diminished ability of psychological adjustment. The type of injury is also worthy of consideration with life stress, as injured athletes with major injuries were found to have greater

perceived life stress associated with lessened feelings of life satisfaction (Malinauskas, 2010). It is important to note the type of injury, which is a first-tier component of the biopsychosocial model found in the characteristics of the injury, having a significant implication on a second-tier social/contextual factor of the model. This illustrates the correlations and relationships between factors, which is a fundamental characteristic of the biopsychosocial model.

The biological factors located in the second tier of the model are of prominent focus in much of the literature that addresses sport injury rehabilitation, as outlined in the various examples included in the previous section of this literature review.

The third tier of the biopsychosocial model incorporates the intermediate biopsychosocial outcomes, the first of two outcome components of the model. These outcomes are more so focused on the physical outcomes of the sport rehabilitation program, including joint laxity, endurance, pain, and strength (Brewer et al., 2002). As these outcomes are closely related to the physical and biological components of the model, they will not be the focus of this research. This research is focusing more deliberately on the psychological and social/contextual factors that relate to the injury rehabilitation outcomes highlighted in the fourth and final tier of the biopsychosocial model.

The fourth tier of the biopsychosocial model consists of the sport injury rehabilitation outcomes. These outcomes include functional performance, quality of life, readiness to return to sport, and treatment satisfaction (Brewer et al., 2002). Readiness to return to sport has been found in the literature to be associated with several of the psychological and social/contextual factors mentioned in the biopsychosocial model. Research has suggested that the psychological needs of an injured athlete and the ability of the sporting environment to meet such needs play a significant role in the successful return to sport for an injured athlete (Podlog & Eklund, 2007).

Previous literature has shown the relationships between psychological and social/contextual factors, yet this research allows the second-tier components of the biopsychosocial model to have direct implications on the fourth-tier component of readiness to return to sport. Another way in which readiness to return to sport is influenced by psychological factors is through the fear of reinjury, as mentioned in the introduction, where the fear of reinjury experienced in an injured athlete can diminish the ability to have a successful return to sport once their rehabilitation program is completed (Hsu et al., 2017). The readiness to return to sport is the end outcome that all the previous tiers within the biopsychosocial model work to make possible in the most successful manner. A successful return to sport, according to the biopsychosocial model of sport injury rehabilitation, is achieved through an intervention that addresses all the psychological, biological, and social/contextual factors that could influence an injured athlete's sport injury rehabilitation outcome (Brewer et al., 2002).

Constructs of Consideration

Several factors of the biopsychosocial model of sport injury rehabilitation have been addressed in previous literature, especially the biological factors located in the second tier of the model. With the biological factors, it is much easier to measure these factors with single scales and their data points. With psychological and social/contextual factors, it is much harder to collect discrete data points than it would be for biological factors. For example, a clinician could measure respiration rate or ask the injured athlete how many hours they slept to measure these biological factors. With psychological and social/contextual factors, models and assessments are utilized based on theoretical frameworks to try and best measure a trait of an individual's profile based heavily on self-reporting by the individual. The literature has yet to explore how one's cognition, affect, and behavior influences the return to sport success for injured athletes as a part

of a holistic model with other psychological factors intertwined through a constellation of trait characteristic variables. These variables consist of perceived social support, hope, confidence, motivation, and personality. The researcher chose not to include the social/contextual factors of life stress, situational characteristics, and rehabilitation environment due to the nature of this research being pre-injury trait characteristics. These factors could be influenced by injury in more of a state manner, and it doesn't make sense to look at dynamic, state social/contextual factors such as these three factors if the researcher aims to utilize pre-injury trait data of its student-athlete participants for this study.

Perceived social support is the feeling of connectedness and care from peers and family, as well as coaches for injured athletes. As social support is a perception, this construct relates to the cognition (thoughts) of an injured athlete as they are progressing through their sport injury rehabilitation. This construct relies heavily on the influence of the social network, which is a component of the biopsychosocial model that plays a significant role in the social/contextual factors of an injured athlete's rehabilitation along with life stress and the characteristics of the rehabilitation environment and sport situation (Wiese-Bjornstal et al., 1998). The perceived social support construct has a lot of overlap with both psychological and social/contextual factors of the biopsychosocial model, making it a construct of high importance for this study. When an athlete becomes injured, there is a greater reliance on social support from the athlete's social network than there was before the injury (Wiese-Bjornstal et al., 1998). Even though the perception of social support is a trait characteristic of an athlete that won't change regardless of injury or not, it can be inferred from Wiese-Bjornstal et al., 1998, that an injured athlete might think and feel as if they need more support from their social network during their struggles of an athletic injury. Social support in regard to the applications to the sport injury rehabilitation of an

injured athlete is a trait characteristic, and not a state characteristic, as the social network that is going to be providing the prominent support for the injured athlete is already established prior to injury. This would include teammates, coaches, and clinicians. Social support has also been tied to another construct, as hope and social support have been found to be beneficial in the rehabilitation of an injured athlete and also for the subjective well-being of an individual (Lu & Hsu, 2013). These two constructs can be utilized in efforts to return an athlete back to sport after an injury successfully both psychologically and physically.

Hope works to address an injured athlete's affect, which is the emotions felt and experienced. Affect is one of the psychological factors found in the second tier of the biopsychosocial model of sport injury rehabilitation, so this construct has high implications for this study. Hope as a trait characteristic of an injured athlete, as utilized in this study, is important for the understanding of how an injured athlete might perceive the past, present, and future. For example, an athlete with high trait hope might go into the rehabilitation process feeling optimistic about a successful rehabilitation outcome. Hope not only influences the emotions of an injured athlete, but it can have a significant effect on many of the other psychological factors present in the biopsychosocial model such as cognition and behavior. Hope has been found to be helpful in predicting rehabilitation behavior in addition to rehabilitation beliefs (Lu & Hsu, 2013) If an injured athlete has a low sense of trait hope, they could experience negative thoughts about how long an injury could take to recover from. This could then, in turn, lead to behaviors that are less motivated to engage in physical rehabilitation of their injury due to how long the recovery process is and the feelings of diminished hope of returning to sport. As illustrated in this example, hope has an influence on motivation for behaviors throughout the rehabilitation process.

Motivation is strongly related to the behavior of an injured athlete. Simply put, if someone is motivated to do something, they will be more likely to engage in behaviors that will work to achieve their goals and vice versa. Motivation is directly linked to the psychological factor of behavior in the biopsychosocial model of sport injury rehabilitation. Motivation can also work to influence the cognitive thought process of injured athletes through their motivations to engage in certain rehabilitative behaviors. If an injured athlete is not motivated to engage in certain rehabilitative exercises, for example, their thought processes will work against the beliefs of potential benefits for physical rehabilitation in an effort toward a successful return to sport. Research has shown that an injured athlete's motivation to return to sport and engage in their rehabilitative program has a significant impact on several return-to-sport outcomes, such as anxiety to return to play as well as confidence (Podlog & Eklund, 2007). Motivation, along with other personal attributes such as social support and confidence, have also been found to be one of the key factors that influence the rehabilitative outcomes for injured athletes following anterior cruciate ligament reconstruction surgeries (Paterno, 2019). Motivation has a direct impact on an injured athlete's behaviors, but it can have several implications on other factors presented by the biopsychosocial model.

Confidence is a feeling or belief that is often present despite rational thought. There are situations in which confidence can be experienced at high levels by an individual, yet data might suggest that the individual could be experiencing an inflated sense of confidence. This feeling of confidence can have several beneficial implications on the rehabilitation outcomes for an injured athlete, as mentioned in previous literature (Podlog & Eklund, 2007; Paterno, 2019). It is an important characteristic of an injured athlete's trait profile as it can play a significant role in the return to sport criteria following the completion of a rehabilitation program. Researchers and

clinicians utilize trait sport confidence by analyzing how the feelings of confidence measure up against potential fears of returning to sport (Podlog & Eklund, 2007). The feelings of confidence can influence how an injured athlete thinks about their rehabilitation program and their eventual return to sport, which offers insight into how this construct plays into the psychological factors of affect and cognition located within the second tier of the biopsychosocial model. For example, if an injured athlete is confident in their ability to complete their rehabilitation program and the necessary steps to return to the playing field, then this can have potentially beneficial implications on how successful they're going to be in their rehabilitation outcomes. This construct intertwines multiple psychological factors together in an effort to draw further implications of the applicability of the biopsychosocial model in sport injury rehabilitation.

Personality is the most holistic of the constructs, as it has an influence on what kind of behaviors, thoughts, and feelings an injured athlete might have. Personality has been described in previous literature as the individual differences between people that could contribute to the sport rehabilitation outcomes for an injured athlete (Brewer et al., 2002). This construct is directly identified as a psychological factor within the second tier of the biopsychosocial model. There are many ways to classify one's personality including into types of personalities, such as A, B, and, C, which was utilized in an earlier section regarding personality and athletic injury rehabilitation implications (Hedgpeth & Sowa, 1998). However, the dimensions of the Big Five factor structure have been identified as one of the most prominent methods of addressing one's personality structure. Personality has been broken down into five subcategories in an effort to analyze and differentiate between potential individual differences. These five subcategories include openness, conscientiousness, extroversion, agreeableness, and neuroticism (Goldberg, 1990). An injured athlete's personality can have significant implications on the sport injury

rehabilitation outcomes of an injured athlete, as personality is an important factor in the thoughts, behaviors, and feelings of an injured athlete not just generally but also directly in the considerations of sport rehabilitation (Grove, 1993). If an injured athlete has a trait personality profile that implies low levels of extroversion, for example, this athlete might run into troubles early on in their rehabilitation program creating a strong relationship with their physical therapist which could also lead to feelings of lesser perceived social support from the injured athlete's rehabilitation environment. Personality intertwines with the majority of psychological and social/contextual factors located within the second tier of the biopsychosocial model, and this construct is necessary for the considerations of a psychological intervention for injured athletes in their sport injury rehabilitation programs.

Methodology

Subject Description

The sample in this study is a convenience sample of student-athletes, who participate at the National Collegiate Athletic Association (NCAA) Division III level at a residential, liberal arts institution. This study required student-athletes to be over the age of 18, a varsity sports athlete, and that they could not be currently injured. Athletes could not be currently injured as this researcher was looking into pre-injury trait characteristics of student-athletes. "Currently injured" was defined in this study as being unable to participate in sports activities for two weeks or more. The initial sample collected from the survey was N=170. The number of varsity student-athletes at the present institution is 595. This yields a response rate of about 28.5%.

The Institutional Review Board (IRB) at the host institution approved the present

research. The researcher contacted varsity sports coaches at the university and met with them in person to discuss the research further. Coaches then sent out a scripted email written by the researcher to their team roster explaining what the study was about and encouraging athletes to participate. The researcher then sent out reminder emails across the next six weeks to have the coaches remind athletes to participate in the study. The researcher also spoke at a student-athlete club meeting and at the beginning of a highly student-athlete-populated class in an effort to recruit as many participants as possible.

Instrumentation

The instrument consisted of 118 items with six sections: demographics, the Multidimensional Scale of Perceived Social Support (MSPSS), the Big Five Personality Test, Vealey's Trait-Sport Confidence Inventory, the Sport Motivation Scale (SMS-28), and the Trait Hope Scale. It began with an informed consent form and a series of force-answered demographic questions to qualify the participant for the study. These questions asked if the participant was on a varsity sports team, if they were age eighteen or older, and if they were currently injured, which was defined in this study to be unable to participate in sports activities for two weeks or more. The MSPSS, the Big Five Personality Test, Vealey's Trait-Sport Confidence Inventory, SMS-28, and the Trait Hope Scale followed the demographics section.

MSPSS was initially developed as a measure of perceived social support from three sources: friends, family, and a significant other (Zimet et al., 1990). The MSPSS self-report scale measures the participant's feelings of support from the three sources described above through questions such as "I can talk about my problems with my friends." The participant is asked to score their feelings of social support to each of the 12 items on a 7-point Likert scale. The total score is calculated by adding up all of the scores from each of the 12 items and dividing this sum

by 12. The MSPSS has been proven through previous research, to be valid, reliable, and also easily administrable as a scale which offers justification for its usage in this present study to analyze the perception of social support in an athlete (Kazarian & McCabe, 1991)

The Big Five Personality Test was adopted after Lewis Goldberg's 1990 study found that individual differences in adult personalities can be categorized into five domains: openness, conscientiousness, extroversion, agreeableness, and neuroticism. This test works to identify the personality type of an individual as they respond to questions that fall into each of the five domains mentioned above. The questions consist of statements such as, "feel comfortable around people" and "pay attention to details" and participants respond on a 5-point Likert scale, with a response of "1" meaning "disagree" and a response of "5" meaning "agree" in regard to the statement. The scoring for this test is based on scores that are coded to correlate with one of the five domains of this test. These total scores that are gathered from specific coding to align with each domain allow for five separate total scores to be generated. The Big Five Personality test has been utilized in many studies, represented in 54 meta-analyses with a total sample size of 554,778 (Zell & Lesick, 2022). This indicates that the Big Five Personality test is a reasonable and reliable measure of personality for this present study.

Vealey's Trait-Sport Confidence Inventory was developed from a conceptual model of sport confidence that separated sport confidence into the two constructs of trait and state sport confidence (Vealey, 1986). This inventory is only analyzing the trait characteristics of sport confidence in an athlete, not the state characteristics. It is important to utilize trait characteristics of sport confidence instead of the state characteristics as this present study is using pre-injury data to offer suggestions for psychological interventions of an athlete if they were to become injured. Trait characteristics will stay consistent over time, while state characteristics may be

influenced and could be expected to fluctuate after an injury occurs. The questions in this inventory consist of statements about trait sport confidence comparisons, such as "compare your confidence in your ability to be consistently successful to the most confident athlete you know." Participants respond to questions on a 9-point Likert scale. The total score is calculated by simply adding up the values from each Likert scale item. Vealey's Trait-Sport Confidence Inventory was found to have a test-retest reliability of .86 across time and samples (Vealey, 1986). This is significantly above the accepted criterion for test-retest reliability, which is .60 (Nunnally, 1978).

SMS-28 was developed in 1995 as a measure of extrinsic motivation, intrinsic motivation, and amotivation for athletes (Pelletier et al., 1995). The scale works to identify what motivates athletes and whether the motivation comes from internal efforts or external efforts. The items on the scale ask questions to identify these motivation sources and general motivators for athletes. The scale starts with the general guiding question, "Why do you practice your sport?" The items following this general question consist of statements such as, "for the pleasure of discovering new training techniques," and "to show others how good I am good at my sport." Participants respond to each item on a 7-point Likert scale. The total score of this scale, as utilized in this research, is calculated by totaling up the scores from each item within the scale. The Sport Motivation Scale has a mean test-retest reliability of .69 over a one-month period (Pelletier et al., 1995). This test-retest reliability value is above the accepted criterion for test-retest reliability of .60 (Nunnally, 1978).

The Trait Hope Scale was developed to analyze the hope of an individual through their hope agency and hope pathways (Babyak et al., 1993). The scale consists of 12 items that intertwine questions regarding agency and pathways of hope for an individual to gain a broader

understanding of the trait hope profile of an individual. This is important to this present study as it utilizes psychological trait characteristics of an injured athlete, which this scale works to address. These items within the scale consist of statements such as, "I energetically pursue my goals," and "I can think of many ways to get out of a jam." Participants respond to each scale item in the form of an 8-point Likert scale. The total score of this scale is calculated by totaling up the scores from each item within the scale. The scores from the Trait Hope Scale show to have high temporal stability, as the test-retest reliability scores have been found to be .85, .73, .76 and .82 across four separate sample studies (Snyder et al., 1991).

Data Analysis

Cleaning the Data

The initial sample collected from the survey was N=170. The number of varsity student-athletes at the present institution is 595. This yields a response rate of about 28.5%. Of that initial sample, 65 cases were removed as the extent of missing data was too great. The cases removed were missing 100% of Vealey's Trait-Sport Confidence Inventory, SMS-28, and Trait Hope Scale. These participants simply stopped taking the instrument, and they were able to do this due to IRB processes and the researcher's efforts to negate feelings of coercion to answering any particular question. This left the remaining sample to be N=105. However, there was still a great deal of missing data present in the sample. Table 1 indicates the percentage of missing values for each scale item. 34 different scale items had at least one missing value (34/118). This equates to about 28% of the scale items having at least one missing value.

Table 1

Missing Values Summary

Variable Summary[a,b]

	Missing		
	N	Percent	Valid N
Q5_19	23	21.9%	82
Q5_18	23	21.9%	82
Q5_17	23	21.9%	82
Q5_16	23	21.9%	82
Q5_15	23	21.9%	82
Q5_14	23	21.9%	82
Q5_13	23	21.9%	82
Q5_4	23	21.9%	82
Q5_12	22	21.0%	83
Q5_11	22	21.0%	83
Q5_10	22	21.0%	83
Q5_9	22	21.0%	83
Q5_8	22	21.0%	83
Q5_7	22	21.0%	83
Q5_6	22	21.0%	83
Q5_5	22	21.0%	83
Q5_3	22	21.0%	83
Q5_2	22	21.0%	83
Q5_1	22	21.0%	83
Q4_8	13	12.4%	92
Q4_6	13	12.4%	92
Q4_2	13	12.4%	92
Q4_1	13	12.4%	92
Q4_13	12	11.4%	93
Q4_12	12	11.4%	93
Q4_11	12	11.4%	93
Q4_10	12	11.4%	93
Q4_9	12	11.4%	93
Q4_7	12	11.4%	93
Q4_5	12	11.4%	93
Q4_4	12	11.4%	93
Q4_3	12	11.4%	93
Q3_34	1	1.0%	104
Q3_17	1	1.0%	104

a. Maximum number of variables shown: 118

b. Minimum percentage of missing values for variable to be included: 0.1%

Figure 2
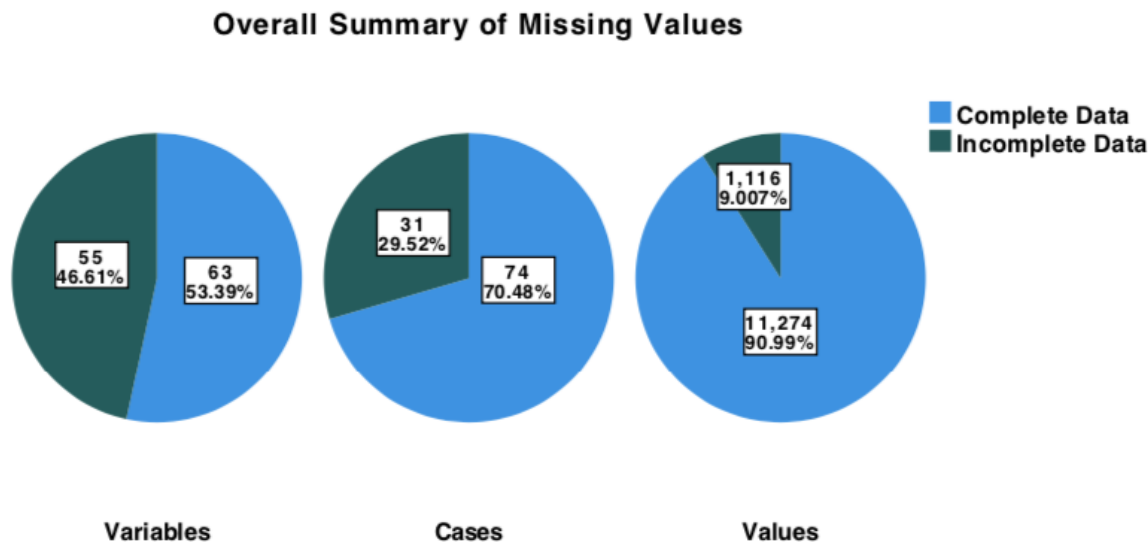
The data that was missing for questions 34 and 17 of the Big Five Personality Test was only found in two cases and there were more cases found missing in Vealey's Trait-Sport Confidence Inventory, SMS-28, and Trait Hope Scale. The researcher did this to avoid any potential feelings of discomfort for the participants if they were forced to answer every question without skipping. The researcher wanted to design this research in a manner that would minimize any potential risks for participants.

According to Tabachnick & Fidell (2001), there are various options of how to address and fix the missing data scattered throughout a sample. One option is deletion, where a researcher would decide to delete entire variables from the dataset if there was a high prevalence of missing data in variables that are not deemed crucial to the later analysis of the dataset. Another option that would not result in the entire deletion of variables could be mean substitution, where a researcher can calculate the mean of a particular variable and/or group and set all the missing values in a dataset to the mean value of their respective variable. This might

be useful when there is a lot of missing data in the dataset and the researcher doesn't want to resort to guessing about a value in a variable. This procedure is deemed fairly conservative in nature as the mean for the entire distribution will not be affected if this procedure is used. A third option could potentially be imputation, where variables are determined to be the best predictors and estimations in the logical regression for missing values in another variable. This option is particularly useful in that it allows for sample variability to be retained unlike many of the other options. This procedure could be particularly useful in a dataset where there is missing data in certain variables but not in others, and there could be relationships and correlations between variables that could help the researcher best fill in the missing values other than just using the group mean for every missing value from a variable.

In addressing the missingness of the data in this study, the most important factor is the pattern of the missing data, as missing data scattered randomly throughout the data poses a less serious problem in comparison to the nonrandom missing data because nonrandom missing data affects how a researcher can generalize their findings (Tabachnick & Fidell, 2001). There are three characterizations of missing data: missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). MCAR is the best-case scenario for missing data with the data being missing completely at random and MNAR is undesirable due to the missing data being attributed to a specific variable (Tabachnick & Fidell, 2001).

Through the missing value analysis, Little's MCAR test value for the missing data from this dataset was 1.000. Any non-significant p-value (greater than or equal to 0.1) is preferred, which would indicate that the missing data is missing completely at random. The researcher thus decided to use imputation as the method of addressing the missing data due to Little's MCAR test result. Through data imputation, the researcher arrived at a total sample of N=105.

Variables for Analysis

Variable scores were created by totaling up the scores for each item within its respective variable for four of the variables: MSPSS, Vealey's Trait-Sport Confidence Inventory, SMS-28, and the Trait Hope Scale. For the Big Five Personality Test, subscores for each of the five distinct dimensions (openness, conscientiousness, extroversion, agreeableness, and neuroticism) were tabulated to create separate variables for analysis. This led to nine variables being included for consideration in the cluster analysis, with four total scores for the MSPSS, Vealey's Trait-Sport Confidence Inventory, SMS-28, and the Trait Hope Scale, and then five personality trait characteristics scores from the Big Five Personality Test.

With these nine variables, a statistical description of the raw data was constructed from the responses in the dataset. The raw data statistical description is found in Table 2 below.

Table 2

	MSPSS	Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Confidence	Motivation	Hope
count	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000
mean	72.885714	22.219048	30.676190	28.342857	20.161905	27.819048	212.504762	126.428571	69.314286
std	12.009063	7.893499	6.262672	6.916853	6.781088	5.770917	29.138965	15.421549	7.625002
min	12.000000	6.000000	6.000000	9.000000	5.000000	12.000000	134.000000	71.000000	44.000000
25%	70.000000	15.000000	28.000000	25.000000	15.000000	24.000000	191.000000	119.000000	65.000000
50%	76.000000	23.000000	32.000000	29.000000	20.000000	28.000000	214.000000	125.000000	70.000000
75%	81.000000	28.000000	35.000000	34.000000	24.000000	32.000000	233.000000	137.000000	74.000000
max	84.000000	38.000000	40.000000	39.000000	39.000000	40.000000	279.000000	164.000000	91.000000

The scales that measured each variable in the dataset utilized a Likert scale, with response possibilities from 1 to 5, 1 to 7, 1 to 8, or 1 to 9. Since the likert scales for each instrument did not have the same parameters (i.e. 1-5 v. 1-9), the raw data was not usable for the desired type of data analysis. Therefore, the researcher decided to scale each attribute from 0 to 1. The scaled attribute statistical description is found in Table 3.

Table 3

	MSPSS	Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Confidence	Motivation	Hope
count	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000	105.000000
mean	0.845635	0.506845	0.725770	0.644762	0.445938	0.564966	0.541412	0.596006	0.538602
std	0.166793	0.246672	0.184196	0.230562	0.199444	0.206104	0.200958	0.165823	0.162234
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.805556	0.281250	0.647059	0.533333	0.294118	0.428571	0.393103	0.516129	0.446809
50%	0.888889	0.531250	0.764706	0.666667	0.441176	0.571429	0.551724	0.580645	0.553191
75%	0.958333	0.687500	0.852941	0.833333	0.558824	0.714286	0.682759	0.709677	0.638298
max	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

Having attributes scaled to the same range allows for easier comparisons between attributes. As shown in the figure above, MSPSS has a higher mean in comparison to the other attributes. This means that most participants scored higher on the MSPSS and only a small number scored low on the MSPSS. This has implications for the commonalities between student-athletes at the present institution where the data was collected. This could also mean that due to the higher mean, there could be some outliers shown through visual separation in the 2-dimensional figures that were constructed after the cluster analysis. It is also important to note the higher standard deviations of extroversion and conscientiousness in comparison to the other attributes. This indicates there could be more data separation in these two attributes in comparison to the other seven attributes.

Cluster Analysis

This form of analysis works to classify responses into groups that share similarities based on characteristics and do not share characteristics with other groups that might form in a dataset (Tabachnick & Fidell, 2001). The analysis is done on the basis of a defined set of variables, which in this research was nine variables. The analysis worked to create groups of participants

that share similar characteristics based on the nine variables, and these groups are referred to as clusters.

There are two main options for consideration in regard to how to run an analysis of the data from this research, as described in Tabachnick & Fidell, 2001. One of the ways is by hierarchical clustering, where a researcher can decide to utilize agglomerative or divisive procedures. Agglomerative procedures in hierarchical clustering is where the analysis starts with each case as a cluster, and then it funnels down based on similar characteristics to get a single cluster. Divisive procedures work backwards, in that the analysis starts with a single cluster and works backwards based on similar characteristics in participant responses. A third way to analyze the data through cluster analysis is the k-means clustering method, which is a nonhierarchical clustering procedure. This method utilizes an initial set of aggregation centers to see how close the cases are to each aggregation center in hopes that the cases will be visualized to be closely together around an aggregation center. This would indicate a cluster in the dataset. The researcher chose to utilize a hierarchical clustering method to find the optimal number clusters, and then utilized k-means clustering to form the clusters. This combination of both hierarchical clustering and nonhierarchical clustering addresses the issues of how to choose the amount of clusters and how to form the clusters that are many times present in clustering analyses.

Results

With the k-means clustering analysis, the researcher is looking for the optimal number of clusters (*k*) given the characteristics of the data. This can be done by computing the Mean

Squared Error (MSE), which is the average distance squared for each sample from its cluster center. The researcher plotted the results shown in Figure 3.

Figure 3
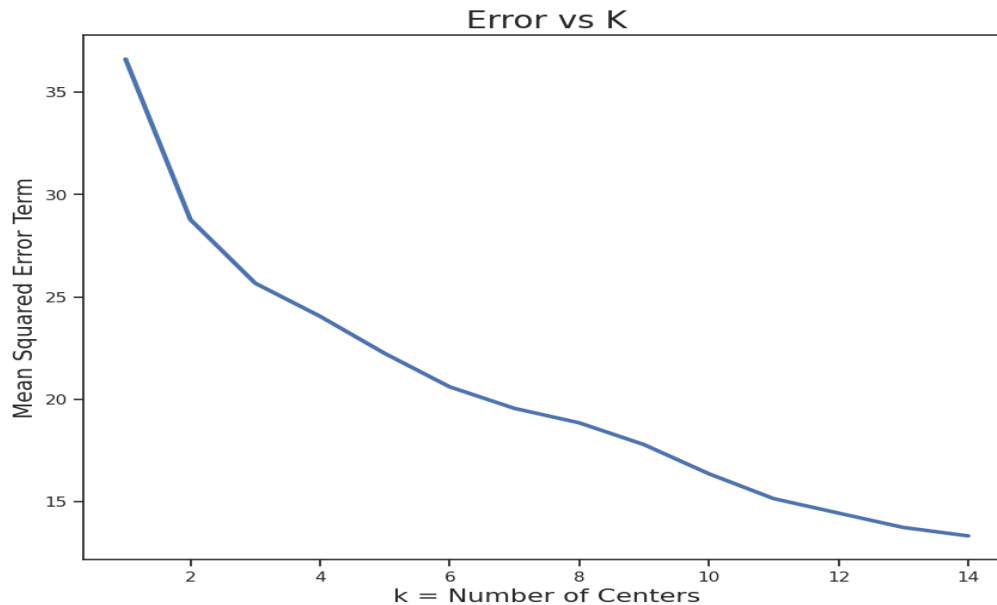
The above graph shows that the MSE error drops as there are more added clusters. We are looking for the elbow, which is the inflection point in the graph where the slope of the error drop decreases suddenly. In a perfect scenario of k-means clustering, this would look like an uppercase "L" shape, with the inflection point at a discrete k value on the graph. In the above graph, there is not a sharp and definitive elbow formation in the graph, but there are a few inflection points that can be visualized to determine potential cluster solutions. In comparison to the rest of the graph, there are sharper inflection points at $k=2$, $k=3$, and $k=6$. $k=2$ was not chosen to represent the dataset as there was a sharper inflection point at $k=3$, and $k=6$ was also not chosen to represent the dataset as there would be too few cases in each cluster for the clusters to be meaningful. It was therefore most appropriate to examine a three-cluster solution.

A three-cluster solution was determined to be the optimal result: Cluster 0 (*n*=40),

Cluster 1 (*n*=49), and Cluster 2 (*n*=16). The characteristics of the three clusters are shown in

Figure 4.

Figure 4
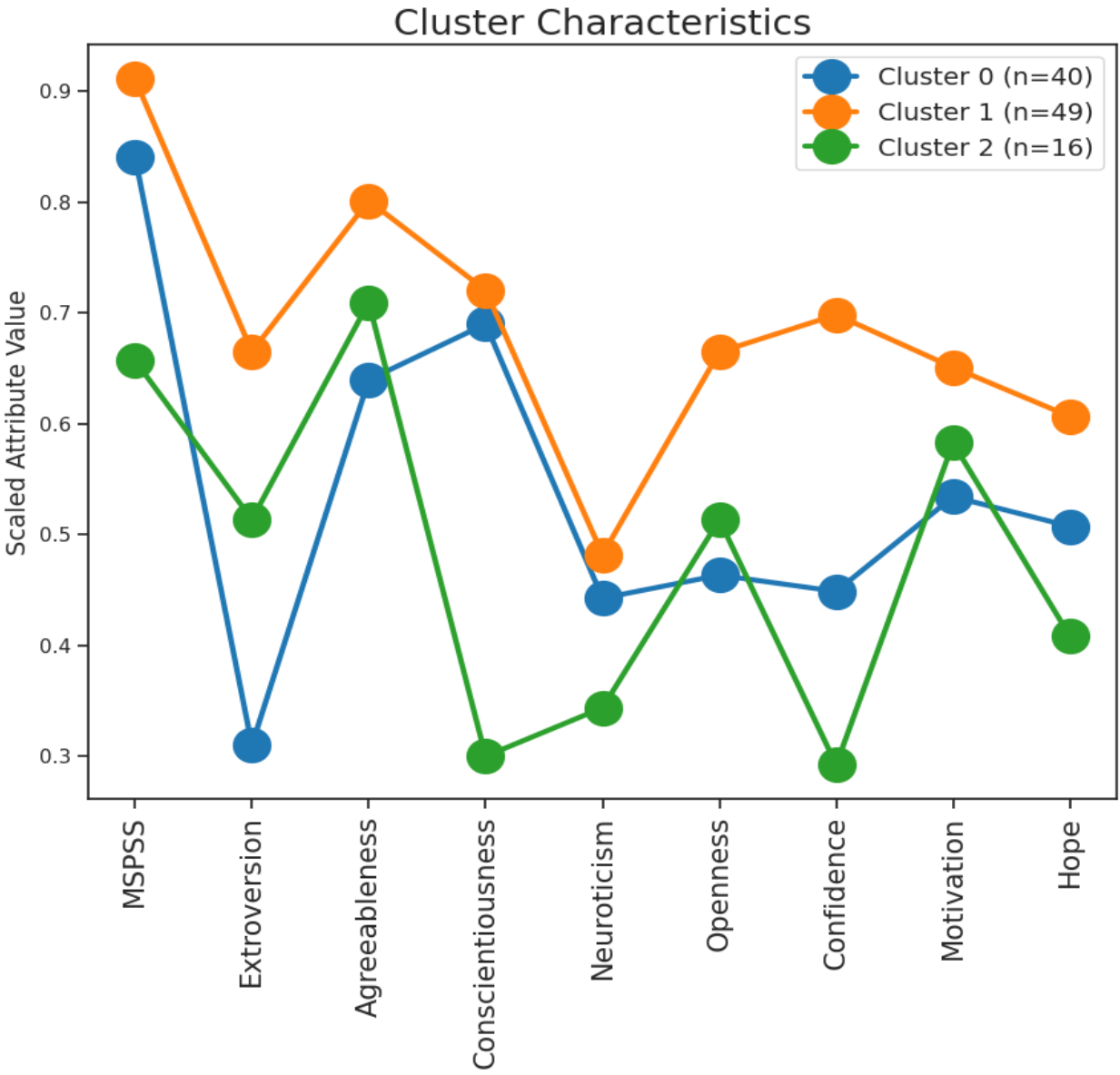
The characteristics of these clusters through their scaled attribute values for each variable

have many similarities but some distinct differences. For the extroversion variable, there is a

substantial difference between average scores for each cluster, with Cluster 0 having the lowest

extroversion scores and Cluster 1 having the highest. This is similar to the confidence variable, with Cluster 1 having the highest scores but now Cluster 2 is showing the lowest scores out of the three clusters. It is important to note the lower scores for Cluster 2 in conscientiousness, neuroticism, and confidence in comparison to the two other clusters. Lastly, from this visualization, it can be concluded that Cluster 1 participants tended to score higher on all variables in comparison to the two other clusters. While it is relevant to look at cluster differences based on scaled attribute scores to attempt to visualize the differences in participants located in each cluster, it can also be important to look at relationships between other variables and how the clusters were similar or different based on these relationships. This is shown in Figure 5 below.

Figure 5

There are two different kinds of graphs within the figure: area charts and scatter plots. Area charts show the overlapping of the clusters for a specific attribute, and the scatter plots show the overlapping of data points characterized by their cluster as indicated by the blue, orange, or green color of the data point as shown in the key. The two-dimensional graphs in this figure allow for visualization of how participants in each cluster responded to certain attributes in comparison to one another and also allow for a clearer visualization of how the three clusters seemed to have higher overlapping in their characteristics than the researcher would have desired. The high overlapping in the clusters was first indicated as a potential occurrence by the lack of a very sharp inflection point at k=3 in Figure 3. It can be visualized clearly in Figure 5 as the two-dimensional area charts of neuroticism and motivation, for example, look as if the clusters are stacked on top of each other. This indicates to the researcher that the clusters formed from the dataset do not show a significant natural separation of responses across all variables.

There are practical considerations to be made about the cluster characteristics. Cluster 0 is characterized by low extroversion, high conscientiousness, and low motivation. Cluster 0 scored the lowest of the three clusters in extroversion and motivation, yet scored a similar level for conscientiousness in comparison to Cluster 1. Cluster 1 scored highest in every attribute in comparison to the other two clusters. It scored similarly to Cluster 0 in conscientiousness and neuroticism but was still the highest-scoring cluster. Cluster 2 scored the lowest in five of the nine attributes included in this analysis, including significantly low scores for conscientiousness, neuroticism, confidence, and hope.

In regard to the practical implications of the attribute characteristics, the closest attribute to a desired cluster separation was shown in the area chart for confidence in Figure 5, with the three clusters having considerable separation in comparison to the area charts of other attributes.

The scatter plots for confidence in comparison to other attributes also show this separation relatively well, as the majority of data points for Cluster 1 are located above the majority of data points for Cluster 0, and the data points of Cluster 2 are scattered below the data points of the other clusters. The extroversion attribute also shows some separation in its scatter plots in comparison to other attributes with the majority of data points in Cluster 1 being located above Cluster 0, and the data points for Cluster 2 located in between the majority of the other two clusters. This separation within the extroversion responses was first indicated as a point of potential interest by the high standard deviation for extroversion found in the scaled data statistical description that was discussed previously in the results.

The undesirable cluster separation can be best visualized clearest in the agreeableness, neuroticism, and motivation attributes in Figure 5. The area charts for these attributes show clear overlapping between the clusters, and the data points on their respective scatter plots form a singular blob with no clear separation. This was also indicated in Figure 4, as the scaled attribute values are located much closer together in comparison to other attributes such as confidence or extroversion.

Discussion

The primary aim of this study was to analyze pre-injury psychological and social characteristics of student-athletes in an effort to optimize their rehabilitation programs based on potential psychological trait characteristic clusters that form from comparing student-athlete's psychological trait profiles. Athletic injuries are common at the collegiate level, with about one athlete getting injured every two games with a team of fifty players (Hootman et al., 2007). The typical timeline for an injured athlete includes medical treatment and then rehabilitation which

leads to sport-specific activities (Kraemer et al., 2009). Physical rehabilitation is important to the recovery and return-to-sport outcomes for an injured athlete, but what about the psychological struggles that might follow an athletic injury? When athletes are injured, the focus is to rehabilitate them physically, but often psychological attributes of athletes are not considered or addressed properly in rehabilitation programs (Piussi et al., 2021). This has been a significant gap in previous literature and this study works to bring light to the importance of psychological needs and considerations for injured athletes during their rehabilitation programs. However, it can be difficult for peers, clinicians, coaches, and others involved in the rehabilitation process to address the injured athlete's psychological attribute needs following an injury if they are not made aware of them. This research works to make that problem easier for both the athletes and those involved in their rehabilitation environment, as pre-injury psychosocial trait characteristic data was collected in an effort to identify clusters of student-athletes that have similar psychosocial needs and considerations for their potential future rehabilitation programs.

This research utilized the psychological and social/contextual factors of the Biopsychosocial Model of Sport Injury Rehabilitation, shown in Figure 1, to capture the most prominent psychosocial needs and considerations for injured athletes when they are in their rehabilitation programs. The five psychosocial trait attributes that this research looked to analyze based on previous literature and the components of the biopsychosocial model were personality, motivation, hope, confidence, and perceived social support. The researcher decided to separate personality into the Big Five personality traits of openness, conscientiousness, extroversion, agreeableness, and neuroticism to gain a better understanding of how personality types can also relate to other psychological trait attributes that are relevant to injured athletes and their

rehabilitation programs. In total, there were nine attributes analyzed in the results of this research.

A k-means clustering analysis was conducted based on the final sample of *N*=105, and based on the inflection point and visual inspection, a three-cluster analysis was run giving the researcher three distinct clusters: Cluster 0, Cluster 1, and Cluster 2. Based on visual interpretations of Figure 4 and Figure 5, the researcher was able to identify specific characteristics of certain clusters that made them unique from one another.

Starting numerically with Cluster 0, this cluster is characterized by low extroversion, high conscientiousness, and low motivation. Cluster 0 scored lowest of the three clusters in extroversion, so athletes in this cluster can be expected to be more introverted and might struggle to build initial relationships with their clinician and/or physical therapist once they begin their rehabilitation process. This cluster also scored lowest in motivation, so athletes in this cluster might not have the motivation to give it their all in their physical rehabilitation program and could be less motivated to get back on the playing field due to their psychological response to injury with lessened motivation. However, this cluster did score just about the same level of conscientiousness as Cluster 1, which could indicate that although they might struggle early on with building relationships and fostering the motivation to complete their rehabilitation program, they are intrinsically goal-oriented and hard-working which could help kickstart their rehabilitation efforts toward a successful return to sport. This relationship that exists between personality profiles, such as low extroversion and moderate conscientiousness in Cluster 0, and other psychological variables is important to note, which is similar to the suggestions from Hedgpeth & Sowa's 1998 study. Personality can potentially affect the expression of certain psychological attributes, such as in this cluster the low motivation attribute scores could be an

initial concern with the injured athlete feeling a drive to complete their rehabilitation program, but with the moderate scores in the personality trait of conscientiousness the injured athlete could be more goal-oriented which could then lead to more motivation and drive to meet their goals of their sport injury rehabilitation programs. This interaction and intertwining of personality characteristics and other psychological attributes is present in the other clusters as well.

Cluster 1 is characterized by being the best of the best in their trait characteristic profiles. This cluster shows higher levels of every single attribute in comparison to the two other clusters. They show the largest difference between other clusters in confidence, so athletes in this cluster could be more confident in how they approach their rehabilitation program in an effort to complete it to return to sport. Athletes in this cluster could also have fewer fears of reinjury due to their confidence in the rehabilitation process in that it worked to heal their injury, so they can return to full effort and intent without worry. In looking at the perceived social support for this cluster, they have significantly high perceptions of social support. Athletes in this cluster have an already strong and reliable social support network that could play an important role in addressing any potential psychological needs or concerns if they were ever to become injured. The only prevalent low score for Cluster 1 is neuroticism, which in this instance is a great sign for athletes. This indicates that athletes in this cluster could be less likely to experience substantial negative responses to an injury if it were to occur, which is beneficial for both the athlete and those who might be involved in the rehabilitation process.

Cluster 2 is the cluster group of major concern for those involved in the rehabilitation process of an injured athlete, as it scores lowest in five of the nine. The attributes of particular concern for this cluster are the significantly low levels of conscientiousness, confidence, and hope. Conscientiousness being extremely low is concerning for how an injured athlete within this

cluster might go about their rehabilitation program procedures, as this could predict a lack of responsibility for the injured athlete in completing their exercises outside of a monitored setting, along with potential hardships due to low conscientiousness indicating an athlete that is not hard-working. Low levels of confidence and hope could indicate a diminished sense of optimism which could be detrimental to a rehabilitation program if an athlete was to become injured. This could suggest that injured athletes identified to be in this cluster will have a strong negative psychological response to their injury where they won't feel hopeful about their return to sport and will have doubts about whether they will even be able to return to sport as they might not be confident in their ability to perform as they once did prior to the injury. Fear of reinjury could also be a prevalent concern for this cluster group, so the physical therapists and other clinicians could work to alleviate feelings of this if they were made aware of the athlete's psychological profile throughout the rehabilitation program. Understanding the psychological trait profiles of injured athletes allows for the personalization of their rehabilitation program that takes into account their predisposing psychological risk factors in an effort to create the most successful return to sport outcomes for the athletes.

Study Limitations

This study was presented with many limitations relating to data collection and response rate by eligible student-athletes. Due to IRB guidelines, the researcher elected to not require any questions to be completed within the instrumentation, other than the demographics in order to qualify for the study. This posed challenges for the researcher as there was missing data scattered randomly throughout the instruments as well as entire instruments within the 118-item survey that were left unanswered in the initial sample. The researcher also had to guarantee anonymity due to IRB guidelines which didn't allow for a follow-up email or any communication to

participants who might have either started the survey and not finished or just left entire instruments unanswered.

The researcher could not also require participation in this study from all student-athletes. The recruitment forms were heavily reliant on conversations with coaches and emails distributed to varsity sports rosters asking eligible student-athletes to participate in the study. Some student-athletes could have been out of their playing season, which could influence their willingness to participate and respond to emails regarding the study, and another influence on the low sample size could be the difficulties of getting contact with a varsity sports coach while their team is in the playing season. A higher sample size could have given a better understanding of the psychological needs and considerations of student-athletes at the present university used in this study.

Future Research

It is clear that this study needs further research based on the results collected from our sample size and the potential to address specific similarities of psychological needs and considerations in groups of student-athletes. This study was exploratory in nature, as the researcher analyzed ample previous research in the field to address the gap that this study starts to fill. The researcher explored the possibilities of clusters of student-athlete's psychological trait characteristics forming, which they did based on visual inspection of inflection points on Figure 3, and this research can be the groundwork for some highly meaningful future research.

It would be interesting to see how a larger sample size would influence the clusters that would form, and how distinct the differences would be in psychological needs and considerations based on the attribute responses for each cluster that formed. A three-cluster analysis was run in

this study, but it could be that a larger sample size allows a researcher to understand that more clusters might form with very specific attribute scores and relationships for each cluster.

The researcher had future research in mind when conducting this study. The hopes for future research are that it will not only expand the sample size and run similar analytics to determine clusters of student-athletes that may arise, but also use the findings to eventually refer back to previous literature and offers suggestions, programs, and other implementations into practice that address these psychological needs and characteristics of student-athletes if they were to become injured. Different clusters show different attribute levels, and thus show different psychological needs and considerations for student-athletes within those clusters. Future research could identify these needs and considerations shown in the characteristics of each cluster that forms, and then create action plans for what troubles might arise for a student-athlete that shows these trait characteristic profiles. Peers, coaches, clinicians, and others involved in the rehabilitation process could greatly benefit from these understandings as it puts the injured athlete in the best position for a successful sport injury rehabilitation outcome if their psychological needs and considerations are addressed along with their evident physical considerations to sport injury rehabilitation.

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