Athlete fear avoidance and pain interference are related to return to competition time following an acute injury in athletes

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Abstract

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Context: Pain related fear and fear avoidance contribute to the development of chronic pain and longer rehabilitation times in the general population. Recent evidence suggests that fear avoidance might be associated with increased rehabilitation times in athletes with ACL reconstructions but there is little research on other injuries. **Objective:** The purpose of this study was to measure fear avoidance and return to competition times in athletes who have suffered an acute musculoskeletal injury. **Participants:** Thirty-five student-athletes (25 males, 10 females) participated in this study. Athletes competed in football, rugby, soccer, basketball, or hockey. **Measures:** Within 24 hours of suffering a musculoskeletal injury, participants completed a battery of questionnaires that assessed function, pain severity, interference and disability, depression, and psychosocial factors, which included (athlete) fear avoidance, catastrophizing and kinesiophobia. Return to competition was measured in days once the athlete returned to competition with no restrictions. **Results:** There was a significant improvement in pain and function from injury to return to competition. In addition, all participants experienced a decrease in pain disability, severity, and interference, as well as all psychosocial factors from injury onset to return to competition. Pearson correlations identified significant relationships between injury onset athlete fear avoidance, change in function, pain disability, pain interference, and depression, with return to competition. The regression analysis indicated a significant model, which accounted for 35.3% of the variance of return to competition times. **Conclusion:** It is possible that using injury onset measures of pain and athlete fear avoidance could predict rehabilitation times in athletes.

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INTRODUCTION:

Injuries are prevalent in exercise and sport but unfortunately the return rate to the pre-injury level of activity are not optimal [2]. One-third of injuries among Canadians that are severe enough to limit activities of daily living, occur during sport and exercise [3]. In the 2014 winter Olympics in the Sochi, the International Olympic Committee reported an injury rate of 141 injuries per 1000 athletes over the 18 days of competition [4]. Surprisingly, 39% of the injured athletes were prevented from further competition in the Olympics, despite having full access to highly qualified, multidisciplinary health care professionals [5]. Similarly, there is growing evidence that half of the people who received an anterior cruciate ligament reconstruction (ACLR) did not return to their previous level of competition 12 months post-operation, despite several reporting full function on a knee function scale [2, 6-8]. Therefore, despite advancements in surgery and post-surgical rehabilitation protocols, there has to be another factor that is acting as a barrier to rehabilitation and is part of the reason as to why athletes do not always return to the same level of activity after an injury. In the general population, biopsychosocial factors including the fear avoidance model have been widely reported as a critical component for rehabilitation of chronic low back pain [9-11], however not enough research has been done in the athletic population to know what effects psychosocial factors have on an athlete's rehabilitation and the time it takes for their return to competition (RTC).

The fear avoidance model (FAM) was developed to explain why some injuries heal in a physiologically acceptable or predictable time frame whereas others develop into a chronic state

[12]. Acknowledging the fact that people experience different emotional reactions when subjected to pain, the FAM emphasizes the detrimental effects that will occur when pain behaviours become dissociated with the physiological severity of the injury [12, 13]. Key psychosocial factors including; pain catastrophizing, kinesiophobia, and fear avoidance beliefs, as measured by the Pain Catastrophizing Scale (PCS), Tampa Scale for Kinesiophobia (TSK), and the Fear Avoidance Beliefs Questionnaire (FABQ) respectively, have gained substantial recognition as inhibitors and more importantly predictors of recovery from injury [14]. For example, in whiplash injuries, 80% of the subjects who reported an average score of 19 on the PCS were able to return to work. Conversely the return rate in subjects who reported a higher score on the PCS (average 30) was less than 35% [15]. A higher level of psychosocial factors measured pre-surgery has also successfully predicted an increase in pain severity and disability post-surgery [16-20]. Further to these examples, there are many other studies that also demonstrate the predictive value of the FAM's psychosocial factors, which have become very valuable tools for clinicians to use during the initial injury assessment and subsequent rehabilitation. The predictive power of the FAM has allowed clinicians to predict how long an individual's activities of daily living will be hindered and/or how much time they will miss from their respective employments. This information has become intriguing for health care professionals who work with athletes because it is very common that an athlete will ask how long they will be out for immediately following injury. If clinicians working with this type of population could have a tool that could reliably predict how long their athlete will be out of competition, this could improve rehabilitation by setting realistic goals for the appropriate timeframes. It is therefore important to investigate whether or not psychosocial factors influence an athlete's return to competition times in a similar way that it affects the return to work rate in the general population in order for us to establish a questionnaire specific to athletes that could help clinicians predict how long their athletes will be out of competition.

There are relatively few studies measuring fear avoidance in athletes and the results are mixed. The relationship between fear avoidance beliefs and functional levels in sport has been assessed in athletes who received an ACLR [16]. Only half of the FABQ could be utilized (FABQ-physical activity) due to the non-relating aspects of the FABQ-work portion of the questionnaire, however the results of the physical activity subscale did demonstrate a significant contribution to the functional assessment scores. The investigation of whether the fear of (re)injury is correlated with returning to competition post ACLR demonstrated that only 53% of patients were successful in returning to play at their previous level of competition after 4 years post-surgery [21]. Those who did not return to competition had greater levels of fear of (re)injuring themselves, as evaluated by a high TSK score. This increase in fear was also correlated with a lower subjective knee function, despite the objective evaluation of knee function being acceptable for return to competition. This is not the first time the level of knee function post-operation is not correlated with return to competition, suggesting that another factor other than strength and range of motion is contributing to the recovery of an athlete [8]. However, another study indicated that baseline psychosocial factors did not predict the pain intensity or level of knee function 12 weeks postoperatively [14]. One of the challenges researchers face is that the scales were developed for the general population and are not athlete-specific. There are multiple items on the TSK and FABQ that ask about work and activities of daily living that do not relate well to the distinct population of athletes. A new questionnaire entitled the Athlete Fear Avoidance Questionnaire (AFAQ) was recently developed to satisfy the need for an athlete-oriented scale [13]. If the AFAQ can successfully evaluate psychosocial factors and subsequently predict recovery and return to competition times in athletes, it could potentially affect the way in which health care professionals rehabilitate their athletes, which could positively affect the return to competition times. Therefore, the purpose of this study is to measure the influence of athletes fear avoidance on returning to competition following an acute musculoskeletal injury.

HYPOTHESES:

1) Scores on the NRS, BPI, PDI and DASH/LEFS/Oswestry will decrease from injury onset to return to competition
2) Scores on the AFAQ, PCS, FABQ, and TSK will decrease from injury onset to return to competition
3) The AFAQ will correlate significantly with return to competition times and the PCS, FABQ, TSK, PDI, BPI and DASH/LEFS/Oswestry will have a smaller correlation value with the return to competition times
4) The AFAQ will be a better predictor of return to competition times than PCS, FABQ, TSK PDI, BPI and DASH/LEFS/Oswestry

LITERATURE REVIEW

INTRODUCTION:

Pain, as a symptom, accounts for over 80% of physician visits and is therefore being considered as the fifth vital sign [22]. Chronic pain in particular, poses a threat to the public health system due to the overwhelming amount of patients who seek medical attention for their persistent pain, as it has been estimated to affect 37% of the population in developed countries and 41% in developing countries [23]. A variety of negative outcomes have been associated with the development of chronic pain including increases in absences from work and unemployment [24] where the US National Health Interview Survey estimated that chronic low back pain alone would account for 149 million lost workdays annually [25]. Other negative outcomes include a reduction in the participation of social and recreational activities [26] which can lead to a perceived decrease in social support [27] and has even been linked to an increase in psychological disorders where up to half of the chronic pain population has expressed signs of anxiety, depression, and some even develop suicidal thoughts [28, 29]. Therefore, as we can see, a variety of disabilities have the potential to develop along side chronic pain including physical, occupational, social, recreational and psychological [30].

For hundreds of years, the biomedical approach that focuses solely on the simple one-to-one ratio between tissue damage and the intensity and duration of pain has been a priority in the literature [31]. However, only focusing on the sensory account of pain was seemingly inconsistent as there was a great deal of variability in the self-reported pain levels in patients with both the presence and absence of verifiable physiological tissue damage [31]. Therefore, a patient with an increase of physical tissue damage as seen by an MRI could present with less pain symptoms than a patient with normal imaging. A theory as to why this variability existed was proposed in 1965 by Melzack and Wall as they defined gait control, which "conceptualized pain as a complex blend of sensory, emotional, cognitive-evaluative, interpersonal and cultural factors" [32]. Taking all of this into consideration, it is understandable why psychosocial factors have received a considerable amount of attention in the past 30 years.

A general assumption has been made throughout much of the literature that athletes and non-athletes vary greatly in their responses when faced with an injury [33, 34]. The focus on the effects of injury, specifically in athletes, has been continuously on the rise due to the ever-increasing amount of the population engaging in athletics. Statistics Canada demonstrated an increase in activity from 6.4 million Canadian habitants over the age of 12 when comparing their activity levels in 1994/1995 to 2010/2011 [35]. However, with all the health benefits that exercise has been known to offer, this 35% increase in physical activity levels has unfortunately also led to an increase in injuries [35]. Researchers who have heavily studied the psychological responses to injury have expressed the idea that the greater an athlete is emotionally and mentally committed to their sport and exercise, a greater amount of stress will accompany the injury if and when one arises [34, 36]. In addition, the well-documented psychological benefits of exercise will be compromised due to the injury, increasing the risk of negative consequences, including a diminished self-esteem, and increased amounts of anxiety and depression [37-39].

Several research studies have been conducted in an attempt to provide important insight to the relationships between various psychosocial factors including the magnification of pain, the fear of movement, and fear avoidance behaviours with the development of chronic pain and prolonged disability. A main concern is that the persistent pain may in fact still be present due to the patient's attitude towards pain and the coping mechanisms that they choose to implement.

FEAR AVOIDANCE MODEL

The fear avoidance model (FAM) attempts to describe the emotional reactions that patients may have to pain and how high levels of fear-avoidance may lead to dysfunction [40]. Developed by Lethem et al in 1983, the FAM has become well established. The development of the FAM intended to provide a reason as to why some acute injuries transform to the chronic phase whereas others are able to heal within the normal timeframes. Normal healing timeframes refer to the average time that a certain injury passes the 3 stages of inflammation, repair and remodeling. We now have to look at pain disability from a cognitive-behavioral perspective, because we now know pain is not only influenced by the "organic pathology" [1]. The FAM was expanded in 1995 by Vlaeyen et al to comprise of 4 components: fear of pain, fear of movement and/or (re)injury, fear-avoidance beliefs, and pain catastrophizing [41]. When a patient experiences a painful state, those who score low on all of the questionnaires pertaining to the above-said components, will most likely confront their pain and recover in a quick and effective manner [40, 42]. However, if the patient misinterprets that pain and magnifies the situation, then they will more than likely enter a maladaptive cycle where fear of pain arises, which leads to avoidance behaviours and the fear movement and (re)injury [43]. The avoidance behaviour and fear then, in turn, leads to the limitation of activities, which can actually enhance the disability due to the musculoskeletal and cardiovascular detriments that accompany a decline in regular physical activity [43]. The enhanced disability and decline in activities can lead to chronic pain and has been said to actually lower the threshold of pain and therefore decreases the tolerance for activity furthermore [44]. A viscous cycle then develops in which chronic pain is maintained and the different types of disabilities progress, as seen in figure 1 [1, 30].

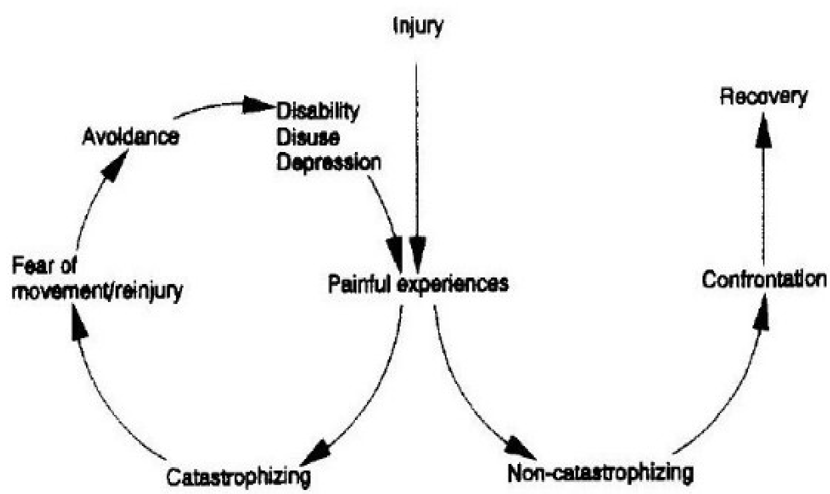


Figure 1: Cognitive-behavioural model of fear of movement/(re)injury [1]

FAM MEASURES:

PCS (refer to appendix 1): The Pain Catastrophizing Scale (PCS) was originally developed in 1995 [10]. The creation of the PCS was part of the primary research development process in which the goal was to decipher the underlying relationship that exists between catastrophizing and the disproportionate reactions to pain that some patients exhibit [10]. The term catastrophizing has become known to describe the “tendency to magnify or exaggerate the threat value or seriousness of pain sensations” [10]. The original PCS contains 13 self-rated questions that measure the level of catastrophizing in a person. All questions are self-rated and measured on a 5 point scale with 0 indicating “not at all” and 4 “all the time” [10]. The scale can be divided into three subscales measuring different aspects of catastrophizing including; rumination (4 items), magnification (3 items) and helplessness (6 items) [10]. The rumination questions evaluate the worry that pain brings to a person, such as “I worry all the time about whether the pain will end.” The magnification questions describe the exaggeration of the severity of painful situation such as “I wonder whether something serious may happen.” The helplessness items refer to the feelings of incapacity to deal with the painful situation such as “There’s nothing I can do to reduce the intensity of the pain” [10]. The PCS has been found to be a valid and reliable questionnaire that has, and can be used for a clinical and non-clinical population [10, 45].

A higher score on the PCS can predict a poorer rehabilitation outcome in low back pain patients [10]. In a recent systematic review, analysis was performed on 19 observational studies with a patient follow-up of at least 3 months [9]. If elevated levels of catastrophizing were present, a prognosis could be deemed poor and unfavourable for the rehabilitative outcome [46] and a lengthened sedentary period and bed rest at 1 year [47]. Different studies have found significant correlations between patients who scored high on the PCS with an increase in pain and disability at 3 months [48, 49], 6 months [50], 9 months [51] and at 1 year [52-54]. Health care professionals are therefore able to evaluate patients at baseline and predict how much disability the patient will be in up to 1 year. Due to the increase in pain and disability, catastrophizers also demonstrated an increase in persistent opioid use up to 1 year [55]. It is essential that catastrophizing be addressed in order to reduce the amount of opioid use and associated dependencies to the drugs. In 2 publications, cutoff values were stated to clearly define what the authors thought acceptable to differentiate between the levels of catastrophizing, where a patient was said to be a high catastrophizer if their score was >/= 23 [56], or >/=30 [57]. In these studies that applied cutoff values, it is suggested that it is easier for a health care professional to recognize a patient who is clinically at risk of experiencing a poorer outcome for their rehabilitation [48, 55, 58]. If a cutoff score of >/=30 is used to differentiate high catastrophizers from low catastrophizers, then a patient who scores over 30 at baseline will display a significantly higher amount of disability at 3 months when compared to a patient who scored lower than a 30 [48, 49]. A psychological intervention is warranted for the population of high catastrophizers due to the notion that if catastrophizing does not decrease, then a patient's disability will be prolonged.

Catastrophizing has been linked to an increase in post-operative pain [59]. Six prospective longitudinal studies, which included subjects who underwent total knee arthroplasty (TKA), were investigated in a systematic review done by Burns et al [59]. All 6 of these studies investigated the influence that pain catastrophizing has on TKA post-surgical pain [60-65]. During an evaluation of 89 TKA patients, a significantly higher pain intensity felt at 3 months post-operation for high catastrophizers was successfully predicted when those who scored high on the PCS, especially on the questions pertaining to the magnification of pain, were compared with those who scored low [62]. The overall heightened PCS score has also been found to have the same power of predicting pain intensity when 120 TSK patients were evaluated 1 year post-operatively [65]. Overall, 5 out of the 6 studies favoured the relationship between catastrophizing and poorer pain outcomes and they provided evidence that high catastrophizers are at an increased risk for developing chronic pain following a TKA. In a study done by Papaioannou et al, 61 patients who were undergoing elective instrumented lumbar fusion surgery were evaluated with the main goal of investigating whether or not there was a relationship between pain catastrophizing and the levels of postoperative pain outcomes [19]. Included in these outcomes were the intensity of pain measured by the 5-point verbal rating scale and the amount of patient-controlled analgesia used. The pain catastrophizing was measured by the Greek version of the PCS, which was completed on the day before surgery, and the postoperative pain outcomes were measured on day 1 and 2 following surgery. It was concluded that the level of patient catastrophizing determined by the PCS preoperatively was significantly correlated and therefore a predictor of both postoperative pain intensity and analgesic use [19]. The extensive literature that has been successful in demonstrating a strong predictive relationship between pain catastrophizing, measured preoperatively, and post-operation pain intensity may assist health care professionals in gaining more control over managing a patient's post-traumatic pain following a variety of surgical procedures [18].

While there is a lot of information about catastrophizing in a general patient population, there is a lack of information on catastrophizing in the athletic population. A study published by Sullivan et al, focused on 54 female and male varsity athletes and 54 sedentary individuals [45]. All subjects completed the PCS and then participated in a cold pressor test where they verbalized their pain on an 11-point Likert-type rating scale during the procedure. The results of this study were consistent with the previous research claiming that athletes report less intense pain than their sedentary counterparts and the PCS total score correlated significantly with the athlete's pain ratings. However, inducing pain through a cold pressor test in athletes may not be a reliable method due to their frequent encounters with ice, including ice bags on sore muscles or ice baths. Already being exposed frequently to the "painful stimuli" would have allowed the athlete to get accustomed to and mentally prepared for the cold pressor test, which would have affected the results significantly. Athlete catastrophizing was also evaluated in a study done by Tripp et al, where 49 recreational athletes who underwent an ACLR were enrolled [66]. They looked at catastrophizing and it's relation to confidence when returning to play 1 year after an athlete’s ACLR and the results showed a significant negative correlation with an athlete’s confidence in returning to sport. This means that when a patient displays a higher level of catastrophizing, they are less likely to return to their previous physical activities following ACLR. However after a second analysis, which adjusted for education and current levels of activity the model indicated that catastrophizing was not a significant predictor. Education may be related to athletes confidence while participating in sport and play a factor in terms of injury recovery [66]. Looking at both of these athlete specific studies, although the PCS has been shown to be reliable in this population, the lack of strong correlations could be due, in part, to the fact that the PCS was not developed with athletes as their main target and is not fully suited to asses sport-specific catastrophizing [13].

Currently cited over 1,600 times, the PCS has become a well-known and established tool that has helped health care professionals assess a patient's level of pain catastrophizing. A higher level of pain catastrophizing has been significantly correlated with an increase in pain and disability in a variety of post-trauma situations including surgery and musculoskeletal injury [10, 19, 67-70] and has been linked to an enhanced likelihood that the persistent pain leads to unemployment [71]. Pain catastrophizing has been studied in several different populations including low back pain patients [69], shoulder pain [72, 73], knee pain [64, 74], arthritic patients [68], athletes [45], soft-tissue injuries [71] and skeletal injuries [75, 76].

TSK (refer to appendix 3)**:** The term ‘kinesiophobia’ refers to “an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or (re)injury” [41]. Kinesiophobia, therefore, goes hand in hand with the development of an avoidance-type behaviour. An avoidance behaviour consists of a patient no longer engaging in certain activities because of the assumption that an increase in pain and disability will prevail [41]. While evaluating the appropriateness of an avoidance type behaviour, it is important to differentiate an acute injury with one that is entering the chronic phase. Avoidance behaviours such as resting, limping or using any physical aids or braces may be effective in reducing the amount of stresses put on a freshly injured structure. That said, chronicity will become reality if these protective, avoidance mechanisms, continue on past the acute stages in the anticipation of what may be painful [41]. If kinesiophobia persists into the subacute and chronic phases, the avoidance of activities and certain movements poses detrimental effects on both a patient's physical and psychological components as demonstrated in figure 1. A longer duration of pain, a higher frequency of pain, an increase in fear of pain and (re)injury as well as increased attention given to the pain was reported amongst the "avoiders" in a study done by [77], which was in conformity with a similar study done by [40].

The Tampa Scale for Kinesiophobia (TSK) is a questionnaire which aims to measure the patient's fear of (re)injury due to movement [43]. Created in 1990 by Miller et al, the TSK contains 17 questions measured on a 4-point Likert-type scale where 1 is strongly disagree and 4 is strongly agree. Included in this scale are statements such as "I am afraid that I might injure myself if I exercise" and "Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening" [41]. The higher the score a patient obtains upon completion, the higher the fear of movement, pain, and (re)injury they possess [41]. The TSK has been found to be both valid and reliable [41, 43] and several studies has suggested that it is capable of predicting disability in patients with both acute and chronic low back pain [78-80], fibromyalgia [80], musculoskeletal injuries [81], osteoarthritis [82], traumatic neck injuries [83] and ACL injuries [14, 20, 21, 66, 84, 85].

Psychological factors such as fear of (re)injury and a variety of social and emotional reasons can influence return to competition in an athlete [6, 7, 21, 86]. It is common, and expected, that an athlete will experience some type of negative reactions when faced with a potentially serious injury. A decrease in athletic identity and confidence may also be present due to the decrease in physical ability [21]. In a study done by Kvist et al, a negative correlation was found between the TSK and the knee-related quality of life (KOOS), meaning that an increase in kinesiophobia correlated with a decrease in subjective knee function [21]. Of the 47 patients who were active in contact sports pre-injury, only 19 of them returned to their pre-injury activities and levels. Those who did not return to the same pre-injury levels scored higher on the TSK than those who did return. In this study, 24% of the participants who did not return to competition self-reported that it was because of their fear of (re)injury that they chose to alter their activity levels. Fear of (re)injury has also been previously reported to be the main inhibitor for return to competition in 7% [7] and 30% [86] of patients. Similarly, when Mainwaring interviewed 10 ACL-injured participants, all admitted to being afraid of (re)injuring their knee which sometimes led to a decreased ability to comply with the rehabilitation program [87]. A greater focus on kinesiophobia from the health care professionals could therefore be of benefit in order to help athletes return to their pre-injury levels of activity.

Sustaining an ACL injury has been correlated with an increase in fear of (re)injury and hesitation to return to competition, with an associated decrease in athletic identity and confidence, which ultimately leads to a decline in maximal exertion and performance [88]. Unfortunately, ACL ruptures are common in the athletic environment, especially in sports involving twisting, cutting and pivoting movements [20]. A substantial amount of research has focused on the rehabilitation following an ACLR and it was commonly concluded that the majority of athletes had a minimal amount of symptoms which persisted following a complete rehabilitation program [84, 89]. However, despite a successful rehabilitation, it has also been reported that less than half will return to a competitive level 12 months post-operation [2, 6-8]. The literature also suggests that the level of knee function postoperatively is not correlated with return to competition, where an athlete with a poor knee function is as likely to return to sport as an athlete with a better knee function [8]. This undoubtedly is essential information that demands the attention of health care professionals because the positive subjective findings combined with a halt in RTC clearly demonstrates the importance of psychological factors including kinesiophobia in this athlete specific population.

Patients who undergo ACL reconstruction surgery within 3 months of the initial injury commonly express a subjectively higher knee function with an increase in postoperative activity compared with those with an increased delay in time to surgery [84, 90, 91]. Perhaps an explanation for this type of outcome can be found in the reasoning that as the days between injury and surgery increase, a patient has more time to experience an 'ACL deficient knee' and the increased duration of instability felt in everyday activities allows for an increase in kinesiophobia [84]. Even though it is not always possible, efforts made to get ACLR as close to the traumatic event as possible is warranted to increase the chances of a successful rehabilitation.

Psychological factors, including kinesiophobia, have been given a considerable amount of attention in the cases where return to activity is halted. An increase in the fear of movement and (re)injury is a main concern in all post traumatic injury populations. Psychological responses have the ability to be modified, therefore it is essential to acknowledge and work on eliminating a patient's kinesiophobia in order to not only increase their physical performance, but also to restore their social and emotional well beings.

FABQ (refer to appendix 3): Fear avoidance beliefs refer to the arousal of fear when a stimulus is perceived as a threat and subsequent avoidance of that type of situation [42]. A fearful response can include psychophysiological (i.e. an increase in reactivity of a muscle), behavioural (i.e. avoidance behaviour) and cognitive (i.e. magnification of the painful situation) components [42]. A patient can adopt an avoidance type behaviour to defer or prevent a painful situation from occurring [42]. The chronic pain population tends to avoid situations and activities in which an increase in pain or (re)injury is a possibility. Therefore, avoidance behaviour begins when the stimulus (the event) that occurs before a noxious experience, becomes known as a potentially negative situation and causes reactivity of muscles and an increase in fear [43]. The thought behind adopting an avoidance type of learning is if one is successful in their avoidance behaviours, then situations in which pain is thought to arise are evaded and no increase in pain occurs. Avoidance, however, can then lead to a downward spiral of negative effects (refer to figure 1). Due to the decrease in activity, a more sedentary lifestyle can lead to an increase in functional disability and introduces the patient to the disuse syndrome [92]. Unfortunately, the avoidance of activity and movements or behaviours that one might thinks causes the pain, does not actually get rid of the pain. The pain still remains evident and results in a reduced activity lifestyle, which subjects the person to more problems for the disuse syndrome has detrimental effects on the cardiorespiratory and musculoskeletal systems [43]. Therefore, one might think that avoiding all situations in which pain may arise is beneficial to their situation, however an increase in pain and disability are very common outcomes.

The Fear Avoidance Belief Questionnaire (FABQ) was developed by Waddell et al., in 1993 [11]. Health care professionals typically evaluate the severity of an injury based on the amount of physical tissue damage, however it is not uncommon for patients with chronic low back pain to show no identifiable tissue damage [11]. The FABQ was therefore established to try and at least partially explain why some patients develop chronic pain even though structurally they are uninjured. Focusing specifically on patients' subjective beliefs on how physical activity and their employment affect their low back pain, a 16-item questionnaire was developed. Each item is scored on a 7-point Likert scale ranging from 0 ("strongly disagree") to 6 ("strongly agree"). The FABQ contains two different subscales; the FABQ-W which asks questions pertaining to the patient's work, such as "I should not do my normal work with my present pain" and the FABQ(PA) which asks questions concerning their physical activity, such as "Physical activity might harm my back" [11]. A higher patient-reported score on the FABQ indicates a higher level of fear avoidance, which is considered part of the reason as to why some patients may develop a chronic disability [93, 94]. The FABQ was found to be valid and reliable and the results of the validation study provide substantial evidence to support the importance of fear-avoidance beliefs in the general low back pain population [11].

Fear-avoidance beliefs succeeding an ACLR can significantly influence the outcome of a patient's rehabilitation [16]. Being able to identify and understand the physical and psychological impairments that can render a patient more disabled after a painful experience is essential for health care professionals. In turn, the health care professionals will be able adjust their rehabilitation programs to fit the needs of each unique patient in order to truly increase the patient's chances of returning to pre-injury functional levels. Forty-eight highly active subjects who underwent an ACL repair a minimum of 12 months prior were evaluated for fear avoidance beliefs and if that fear impacted their activities of daily living and sporting activities in a study done by Ross [16]. Fear avoidance beliefs were evaluated using the FABQ and the functional limitations were determined by a combination of their scores on the Knee Outcome Survey (KOS), Activities of Daily Living Scale (ADLS) and the Sports Activity Scale (SAS). The results of this study suggested that a significant amount of the variance found in the levels of functional limitations could be explained by fear-avoidance beliefs of the patient. More specifically, the scores on the FABQ(PA) portion contributed to 12% of the difference that was found in the questionnaires pertaining to functional limitations. Fear avoidance behaviours can intensify the pain felt by a patient and can increase the amount of disability leading to a decrease in their functional performances. Reducing the amount of fear avoidance in patients undergoing knee surgery should therefore be of primary importance in order to achieve goals and outcomes effectively [16].

Changes in fear-avoidance beliefs, as measured by a decrease in scoring on the FABQ, have been significantly correlated with a decrease in the amount of patient disability [95], however, an evaluation of several cross sectional studies provide inconsistent results. Some studies have concluded that fear-avoidance beliefs pertaining to a patient's work explains a larger amount of the variance found in disability [11, 78, 96] whereas some have found that fear avoidance beliefs pertaining to physical activities accounts for more variance [78, 97, 98]. This discrepancy may lie in the fact that some of the questions may not be pertinent to each type of injured population and therefore the scale may lose some of its validity. If a clinician is giving a questionnaire to a patient in order to measure their fear avoidance beliefs, it is important to make sure the patient can relate, and understands each question. Assessing both sections is important for the FABQ to have its full prediction abilities, however, to reiterate, it is important to ensure the questions are pertinent to the patients in order for the results to be valid.

A high FABQ score has been significantly correlated with an increase in pain intensity and patient disability [42]. The FABQ has since been successfully used to assess patients fear avoidance in relation to multiple regions and structures of the body including; low back pain [42, 99-101], chronic headaches [102, 103], fibromyalgia [104, 105], neck pain [83, 106], knee pain [16], shoulder pain [107], and has even extended to patients with osteoarthritis [82], burn pains [108], and neuropathic pain [109]. The extensive list and tremendous research that has focused on the FABQ provides a clear reasoning as to why it is of utmost importance that all health care professionals become aware of this psychosocial factor. Health care professionals in all domains should be trained in a way that they are able to recognize fear avoidance beliefs in every different type of pain population and thoroughly understand that the fear needs to be addressed in order for a patient to rehabilitate fully.

NRS (refer to appendix 4): Assessment of pain intensity is one of the most common subjective measures taken in a clinical setting and in pain research [110], where the Numeric Pain Rating Scale (NRS) has been highly recommended as a quick, single-item method that expresses a patient's pain intensity [111]. The NRS measures pain intensity by using an 11-point scale where 0 indicates “no pain” and a 10 denotes “pain as bad as you can imagine” [112]

DASH/LEFS/Oswestry: A key component to any clinical assessment is the objective evaluation of functionality. Baseline measures are critical to assess as they are used to compare with future measurements in order to determine if there were any functional improvements during the rehabilitation sessions. Several different questionnaires have been established to evaluate a patient’s self-reported amount of disability. If the objective evaluation of functionality does not correlate with the subjective disability report, a psychological evaluation may be warranted.

DASH (refer to appendix 5): The Disability of the Arm, Shoulder and Hand (DASH) was established in order to assess the impact that a musculoskeletal disease or injury in the upper extremity has on function [113]. Multiple scales existed before the development of the DASH in 1996, however many were too specific and targeted specific joints (i.e. elbow) or conditions (i.e. carpal tunnel syndrome). The DASH was therefore designed to measure the functionality of the upper extremity as a whole, while evaluating any joint or condition [113]. The DASH was also established in order to give the patient a greater relevance in the evaluation of the complaint as compared to traditional measures like an X-ray, MRI, or blood tests [113]. The DASH entails a patient to self-report on 30-items, where the questions refer to the differing degree of difficulty they have while performing various physical activities due to their condition of the hand, shoulder or arm. The DASH is scored on a scale of 1-5, where 1 indicates “without difficulty” and 5 indicates “unable to engage in activity.” Therefore, the higher the score reported on the DASH, the more amount of disability a patient reports. Cited over 1,600 times, the DASH has become a widely used “psychometrically sound measure of disability” [81] in both the research environment as well as in the clinical setting [114].

LEFS (refer to appendix 6): The Lower Extremity Functional Scale (LEFS) was developed shortly after the DASH in 1999. The reason for the development of the LEFS was similar to that of the DASH in which a questionnaire was needed to measure the functionality of the lower extremity as a whole [115]. A common complaint voiced by many clinicians was that there were too many scales and questionnaires pertaining to different structures in the same joint. For example, several measures have been developed to assess people with knee dysfunction, which are condition-specific (patellofemoral syndrome [116], ligamentous strains [117], etc.). This could then require a clinician to administer at least 4-5 scales in order to account for all possible dysfunctional structures in the knee. The development of the LEFS by Binkley et al., was therefore done in order to satisfy the need for a single, easily administered questionnaire that is applicable to a variety of patients who have sustained an orthopedic condition of the lower-extremity [115]. The LEFS entails a patient to self-report on 20 items, where the questions are scored on the degrees of difficulty they have while performing a physical activity due to their condition of the lower extremity. A score of 0 on a question indicates “extreme difficulty”, whereas a 4 indicates “no difficulty”. The maximum score that one can obtain on this questionnaire is 80, meaning there are no functional limitations due to the lower extremity whereas a 0 would indicate severe limitations [118]. A systematic review done by Mehta et al supports the administration of the LEFS as reliable, valid and responsive to a wide variety of patients with a lower-extremity orthopedic condition [118].

Oswestry (refer to appendix 7)**:** The Oswestry Low Back Pain Questionnaire has been in use since its establishment in 1980 and since then, revisions have been made and the latest update of the questionnaire was published in 2000 [119]. Used in the clinical setting, this questionnaire allows for health care professionals to measure and track a patient's functional disability due to low back pain and injury. Patients must self-report their pain and disability in 10 different sections including: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and travelling. Each section is scored on a scale of 0-5, totalling a range of 0-50, where the higher the number, the more functional disability the patient has. This questionnaire can then clinically categorize a patient into minimal disability, moderate disability, severe disability, crippled or bed-bound (or exaggeration of symptoms). A change of 10% in a patient's results has been recognized as clinically significant [120].

PDI (refer to appendix 8): There has been the development and validation of numerous scales in order to fully assess painful experiences and pain intensities; however with the current research, we know that there is not a perfect relationship between pain intensity and disability. There have since been several scales developed to target the "complexity and multidimensionality of pain-related disability" [121]. Two excellent questionnaires were developed, however the items on which the patients needed to rate their disability ranged from 52-136 items. The time demands of these questionnaires has been a limiting factor in the usefulness in the clinical setting. The Pain Disability Index (PDI) is a self-report questionnaire that was developed in 1990 by Tait, Chibnall, and Krause. It is a clinical tool that was established to measure the degree of which pain interferes with a patient's ability to perform in 7 basic life activities. The activities include: family/home responsibilities, recreation, social activities, occupation, sexual behaviour, self care, and life-support activities. Where a 0 indicates no disability, and a 10 denotes the worst disability, scores can range from 0-70. The PDI can be used on any injury or disease in which pain is a prominent symptom [122].

BPI (refer to appendix 9): The Brief Pain Inventory (BPI) was developed in 1991 by Cleeland because the National Cancer Institute and the Cancer Unit of the World Health Organization deemed it necessary to have a measurement that could properly assess the severity as well as the impact on everyday life activities that a patient's pain has caused them. The BPI has been used in over 400 studies across the scientific world on over 15 different types of populations, the most common being cancer patients [112]. The BPI includes 4 questions that look at the "variability of pain over time: pain at its "worst", "least," "average," and "now" (current pain)." These 4 questions are summed together and divided by 4 in order to get the patient's average pain severity in the past 24 hours. There is also an additional 7 questions which look at how much pain has interfered with a variety of activities of daily living including "general activity, walking, work, mood, enjoyment of life, relations with others, and sleep." These 7 questions are scored on a scale of 0-10 where 0 indicates that the pain does not interfere with that specific activity and 10 signifies that the pain completely interferes with that activity. These 7 questions are then added up and divided by 7 to get the average pain interference score [112]. The BPI has been found to be valid and reliable in a variety of populations, and has a good test-retest reliability [123].

PHQ-9 (refer to appendix 10)**:** There has been a considerable amount of studies which focused on establishing questionnaires to detect the presence of depression however Spitzer et al., wanted a questionnaire that could also determine the severity of depression [124]. The Patient Health Questionnaire (PHQ-9) is currently used to recognize and evaluate depression. Multiple studies have been published suggesting the effectiveness of the PHQ-9 and results have revealed when a patient scores over 10 on the PHQ-9, (scores can range from 0-27, where the higher the score, the more severe the depression), the individual is between 7-13.6 times more likely to be diagnosed with depression upon evaluation by a mental health professional. On the contrary, patients who score a 4 or lower on the PHQ-9 have less than a

4% chance of being depressed. Requiring the patient to respond to only 9 questions, the PHQ-9 is much shorter than most other established questionnaires, yet has a similarly high amount of sensitivity and specificity [125].

AFAQ (refer to appendix 11)**:** A scale entitled the Athletic Fear Avoidance Questionnaire (AFAQ) has recently surfaced and specifically targets athletes on their thoughts about their injuries and returning to play [13]. The AFAQ was established to help the medical professionals involved in athletic rehabilitation to see how the FAM measures can influence an athlete's overall general health and progress rate in the therapy sessions. Eight experts in the field of athletic therapy, sport psychology, and knowledge on psychosocial factors, like fear avoidance, all took part in the development of the questionnaire. All of these experts had substantial experience working with the athletic population and have all witnessed athletic injuries. The use of terminology in which athletes would understand and could relate to were used in hopes of increasing the chance of obtaining a scale that would be valid for this distinct population. The final questionnaire contains 10 items pertaining to sports psychology, athletic injuries and athletic experiences, which includes statements like "I will never be able to play as I did before my injury" and "I believe that my current injury has jeopardized my future athletic abilities" and are rated on a 5-point scale with 1 meaning "not at all" and 5 "completely agree" [13]. Once the questionnaire was developed, 103 university athletes including 80 non-injured (but had a previous history of injury) and 23 injured athletes participated to establish the concurrent validity of the AFAQ. All athletes filled out the AFAQ, the FABQ, and the PCS for the purpose that correlating a new scale with one that is already established is a frequently used technique to determine concurrent validity [126]. Pearson correlations were able to determine significant correlations between the AFAQ and the PCS, the FABQ-Total and the FABQ-PA therefore the scale can be deemed validated. A high Cronbach α (0.805) was determined which signifies a high internal consistency [13].

Athletes versus Non-Athletes

Before the development of the AFAQ, the majority of psychometric scales and questionnaires primarily focused on and were utilized by health care providers in the general work-related population and the core of the research was performed on patients with chronic low back pain. This, however, posed a problem when evaluating the very large population of athletes, specifically competitive athletes. A popular expression is widely used in the athletic world stating “no pain, no gain,” which is relevant to the life of a competitive athlete as the environment poses many painful threats due to the fact that training and game playing puts a heavy amount of strain and force on the body. Delayed onset muscle soreness, ligament sprains, muscle strains and contusions are only a few of the painful events that an athlete is often subjected to when they train or take to the playing field. In order to stay in the line-up and perform throughout the season, an athlete most likely will have to play with a minor injury, at minimum, several times throughout a career. Playing with pain seems to be accepted and somewhat encouraged in the sports environment. Therefore one could deduce that since there is a high probability of experiencing pain, continued participation of the athlete throughout a season would require a higher pain tolerance and the ability to effectively cope with pain. Significant differences between 26 marathon runners and 26 age and sex matched non-runners were found in a study done by Johnson et al [127]. Using potassium iontophoresis as an experimental pain stimulus, pain threshold and pain tolerance was measured. The results concluded that both the pain threshold and pain tolerance was higher for marathoners (mean of 10.86 and 19.03 milliampers of iontophoretic current respectively) when compared with the non-runners (mean of 6.79 and 13.61 milliampers of iontophoretic current respectively) [127]. An interesting question was brought up in the discussion of this paper which asks whether or not people run marathons because they have a higher than average pain tolerance and pain threshold or is it actually the training and competitions that force and allow the body to change and accommodate the elevated levels [127]. Insight to this question was found in a study of 47 dancers from the Queens dance club and 26 psychology undergraduate students [128]. Through evoked pain by a cold pressor test, the results did not show a significant difference between dancers and non-dancers, however there was a distinction that could be made between dancers with over 10 years of experience and dancers with less than 10 years. The more experienced dancers had a significantly higher pain tolerance than those with less experience and skill [128]. Therefore, there is more than likely a change that takes place in an athlete's body and mind when subjected to stressors over a long period of time. With the increasing frequency of exposure to pain and injury, the familiarity of the more experienced athletes is able to help them in developing strong beliefs that they are able to tolerate a certain amount of pain and discomfort [127].

Research on 67 NCAA athletes and 20 non-athletes was conducted by Sternberg et al., in order to dive a little deeper into the physiological reasons as to why athletes have an elevated pain threshold and whether or not training and competing in events was the reason as to why they had a increased tolerance for the noxious stimuli [129]. Pain was induced by a cold-pressor test and the Gracely box scales were used for the participants to rate their pain, whereas heat that had a high enough temperature to be considered noxious was applied to the fingers and forearms to measure the withdrawal latency. The pain thresholds for the noxious heat and the ratings of pain due to the cold were measured 2 days before a competition, directly after the competition and 2 days after the competition. The results were significant in that all of the athletes felt a decrease in pain induced by the cold pressor test following their respective athletic events whereas the non-athletes expressed the same pain all 3 times. A majority of the athletes also demonstrated a high pain threshold when subjected to the noxious heat directly after the competition [129]. More research on this stress-induced analgesia should be done in order to fully understand how long exercise can reduce an athlete's sensitivity to a noxious stimuli and how many hours/years of training does it take to get an increase in pain threshold.

Coping Mechanisms:

Lazarus and Folkman define coping as “any cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person” [130]. Therefore in general, if one does not effectively cope with the acute pain, then chronic pain may result with the addition of increased feelings of fear, depression, anxiety [131, 132], increase in pain intensity [133], lowering of pain threshold and lowering of general health [75]. When talking specifically about athletes, there may even be some additional costs of ineffectively coping with pain because if the rehabilitation time takes longer than usual, an athlete may find it very difficult to regain his/her previous position on the sports team and this could severely affect one’s motivation, determination, and drive to get back to their competitive career. They may even decide to give up their sport and just focus on their social and family life [21].

Variations in the coping mechanisms utilized when faced with pain were observed between 90 male athletes and 30 healthy male non-athletes in a study done by Sharma et al [134]. These variations were measured through questionnaires concerning the reaction to pain, which were provided by the Vienna Testing System Apparatus [134]. Results showed that the athletes used an adaptive response to pain more frequently than non-athletes who relied more on a maladaptive pain response. The athletes found the social support they needed from their teammates and coaches and incorporated exercise into their rehabilitation whereas the non-athletes reverted to avoiding the painful situation, which did not allow for the confrontation of the injury but rather an elongated rehabilitation [134].

Different coping mechanisms that would allow an athlete to continue competing despite being in pain were the focus in a study by Deroche et al [135]. A total of 205 athletes competing in a martial art discipline (judo, taekwondo, karate, wrestling) who must have experience some sort of pain in the month leading up to the study consented to take part in this study. The pain intensity and behaviours were measured on a visual analog scale (VAS). The Coping Strategies Questionnaire was used to determine the type of coping strategies the subjects would use. Investigating whether or not strategies such as; distraction from pain, praying, ignoring the pain or reinterpreting it, are used by athletes in order for them to continue playing was their main objective. The results concluded that ignoring the pain significantly diminished the negative effects that pain normally poses on decision to continue to play [135]. To date, however, there has been limited studies done that identify the best coping strategies and on the amount that pain coping can predict the behaviour that an athlete has. It would therefore be of benefit for the health care providers to know which coping behaviours are the most effective in order to create and tailor a pain management program suitable for an athlete to return to competition even if the pain has not subsided (provided there is not an increased risk of injury).

LITERATURE REVIEW SUMMARY:

The athletic environment has embedded a culture that honours speed, strength, agility, and courage [136]. “No pain, no gain” and “pain is temporary, pride is forever” are commonly used expression in sports, which further suggests that ignoring the aches and pains is accepted and to a large extent, encouraged [136]. The pain may stem from a muscle strain, a ligamentous sprain, a contusion, or from delayed onset muscle soreness; all in which athletes may be subjected to every time they step foot in their training environment. Unfortunately, this injury prone environment can trigger a wide variety of responses, both acceptable and problematic when an athlete gets injured [137] and social, emotional and psychological factors have all been recognized as influential factors which can alter the time it takes for an athlete to return to competition [6, 7, 21, 86].

The development of the fear-avoidance model was a huge stepping-stone for the appreciation of psychosocial factors when faced with an injury and the development of chronic pain [42]. The FAM outlines the detrimental phenomenon of an exaggerated and magnified pain perception, which occurs when the painful experience and associated pain behaviours become dissociated with the actual injury severity [40]. Psychosocial factors including pain catastrophizing (the magnification of pain), the fear of (re)injury, and fear avoidance behaviours, respectively measured by the Pain Catastrophizing scale (PCS), the Tampa Scale for Kinesiophobia (TSK), and the Fear Avoidance Belief Questionnaire (FABQ) have all been correlated with an increase in pain and disability, post trauma, in the general, work related population. When a patient experiences a painful state, those who score low on all of the questionnaires pertaining to the above-said components, will most likely confront their pain and recover in a quick and effective manner [40, 42]. However, if the patient misinterprets that pain and magnifies the situation, then they will more than likely enter a maladaptive cycle where fear of pain arises, which leads to avoidance behaviours and the fear of movement and (re)injury [43].

The already established FAM questionnaires lack athlete specificity in the direction and wording of the items, and therefore, fear-avoidance in athletes is hard to measure [13]. The development of the AFAQ was a step in the right direction for future evaluation of these psychosocial factors in the athletic population. It is crucial to know if in fact fear avoidance plays a major role in the rehabilitation of the distinct group of athletes and if it does, it will be of utmost importance to establish an identification system and a subsequent rehabilitation plan to reduce the amount of time that it takes for the athlete to return to competition. More research on the type of athlete, level of competition, years of training, age and gender should also be the topic of future studies in order to truly understand how psychosocial factors differ between the general population and athletes and between different athletes themselves.

METHODS:

PARTICIPANTS:

All participants were University level athletes recruited from a single university. The institute's ethical review board approved this study. Participants were not compensated for their participation in this study. We collected injury onset measures for 62 participants, however 27 participants were excluded from the study because; 3 suffered a concurrent concussion, 6 sustained a fracture, 5 suffered a 3rd degree sprain which required surgery, 7 did not complete their return to competition (RTC) follow up, and 6 returned to play when they were in their off season. This study therefore included injury onset and RTC values for 35 varsity athletes (25 male and 10 female), with a mean age of 21.6 ± 1.5, height 177.4 cm ± 10.4, weight 87.2 kg ± 22.7, years involved in sport 13.8 years ± 4.3. The subjects were athletes recruited from a variety of varsity sports including; football, soccer, rugby, basketball and hockey.

Table 1.

Total number of athletes assessed and lost to follow-up (consort summary)

Athletes assessed	62
Included in the study	35
Excluded from the study	27
	3 Concurrent concussion
	6 Fracture
	5 Required surgery
	7 Missed follow-up appointment
	6 Was no longer in season

Table 2.

Demographic information of participants

Characteristics	Mean
n = 35	25 males, 10 females
Age	21.6 ± 1.5
Height	177.4 ± 10.4
Weight	87.2 ± 22.7
Years involved in sport	13.8 ± 4.3

MEASURES:

The participants were asked to self-report scores on 8 previously validated questionnaires that have been widely used in pain research and management. The participants were also asked to fill out 1 new athlete oriented questionnaire.

Self-Report Questionnaires

NRS: Pain severity was assessed through the Brief Pain Inventory (BPI), which includes a Numeric Pain Rating Scale (NRS) for pain intensity experienced in the last 24 hours. Measured on an 11-point scale, a participant would rate their worst intensity of pain they had experienced in the last 24 hours on a scale from 0 (“no pain”) to 10 (“pain as bad as you can imagine.”) The NRS has been highly recommended as a quick, single-item method that expresses a patient’s pain intensity [111].

DASH: For an upper extremity injury, the athletes were asked to fill out the Disability of the Arm, Shoulder and Hand (DASH), which was designed to measure the functionality of the upper extremity of any joint or condition [113]. The DASH requires a participant to self-report on 30-items, where the questions refer to the differing degree of difficulty they have while performing various physical activities due to their condition of the hand, shoulder or arm. The DASH is scored on a scale of 1-5, where 1 indicates “without difficulty” and 5 indicates “unable to engage in activity.” Scores are then calculated on a total of 100 where the higher scores reported on the DASH suggests more patient disability [113].

LEFS: Athletes who suffered a lower extremity injury were asked to fill out the Lower Extremity Functional Scale (LEFS). The LEFS entails a participant to self-report on 20 items, where the questions are scored on the degrees of difficulty they have while performing a physical activity due to their condition of the lower extremity. A score of 0 on a question indicates “extreme difficulty”, whereas a 4 indicates “no difficulty”. The maximum score that one can obtain on this questionnaire is 80, meaning there are no functional limitations due to the injury to the lower extremity whereas a 0 would indicate severe limitations [118]. To be able to compare the LEFS scores to the DASH and Oswestry scores, all results were transformed onto a number of 100, where 100 denoted the worst disability. This was done by subtracting the patient's acquired score from 80 then multiplying it by 100 and dividing it by 80.

Oswestry: If an athlete sustained an injury to their low back, they were asked to fill out the Oswestry Low Back Pain Disability Questionnaire (Oswestry). Participants must self-report their pain and disability in 10 different sections including: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and travelling. Each section is scored on a scale of 0-5, totalling a range of 0-50, where the higher the number, the more functional disability the patient has. This questionnaire can then clinically categorize a patient into minimal disability, moderate disability, severe disability, or crippled or bed-bound (or exaggeration of symptoms) [119]. A change of 10% in a patient's results has been recognized as clinically significant [120]. The total Oswestry score was then multiplied by 2 to get a number out of 100 for easy comparison with the LEFS and the DASH.

AFAQ: The Athlete Fear Avoidance Questionnaire (AFAQ) specifically targets athletes on their thoughts about their injuries and returning to play [13]. This questionnaire contains 10 items pertaining to sports psychology, athletic injuries and athletic experiences, which includes statements like "I will never be able to play as I did before my injury" and "I believe that my current injury has jeopardized my future athletic abilities." The questions are rated on a 5-point scale with 1 meaning "not at all" and 5 "completely agree" which gives a range of scores from 10-50 where the higher the score, the more fear avoidance the athletes possesses [13]. A high Cronbach α (0.805) was determined which signifies a high internal consistency [13].

PDI: The Pain Disability Index (PDI) is a self-report questionnaire used as a clinical tool that measures the degree of which pain interferes with a participant's ability to perform in 7 basic life activities. The activities include: family/home responsibilities, recreation, social activities, occupation, sexual behavior self care, and life-support activities. Where a 0 indicates "no disability", and a 10 denotes the "worst disability", scores can range from 0-70. The PDI can be used on any injury or disease in which pain is a prominent symptom [122].

BPI: The Brief Pain Inventory (BPI) was developed in order to assess the severity, as well as the impact on everyday life activities, that a participant's pain has caused them. The BPI includes 4 questions that look at the "variability of pain over time: pain at its "worst", "least," "average," and "now" (current pain)" [112]. These 4 questions are added up and divided by 4 in order to get the participant's average pain severity in the past 24 hours (BPI(PS)). There is also an additional 7 questions which look at how much a participant's pain has interfered with a variety of activities of daily living including "general activity, walking, work, mood, enjoyment of life, relations with others, and sleep" [112]. These 7 questions are scored on a scale of 0-10 where 0 indicates that the pain "does not interfere" with that specific activity and 10 signifies that the pain "completely interferes" with that activity [112]. These 7 questions are then added up and divided by 7 to get the average pain interference score (BPI(PI)). The BPI has been found to be valid and reliable in a variety of populations, and has a good test-retest reliability [123].

PHQ-9: The Patient Health Questionnaire (PHQ-9) is a self-report questionnaire that is currently used to recognize and evaluate depression. Participants are required to answer 9 questions where a 0 means "not at all" and a 3 signifies "nearly every day" and with that, scores can range from 0-27, where the higher the score, the more severe the depression [124]. Multiple studies have been published suggesting the effectiveness of the PHQ-9 and results have revealed when a patient scores over 10 on the PHQ-9, the individual is between 7-13.6 times more likely to be diagnosed with depression upon evaluation by a mental health professional. On the contrary, patients who score a 4 or lower on the PHQ-9 have less than a 4% chance of being depressed [125].

PCS: The Pain Catastrophizing Scale (PCS) was developed to decipher the underlying relationship that exists between catastrophizing and the disproportionate reactions to pain that some patients exhibit [10]. The PCS contains 13 self-rated questions that measure the level of catastrophizing in a person, where the term catastrophizing has become known to describe the “tendency to magnify or exaggerate the threat value or seriousness of pain sensations” [10]. All questions are self-rated and measured on a 5 point scale with 0 indicating “not at all” and 4 “all the time” [10]. The scale can be divided into three subscales measuring different aspects of catastrophizing including; rumination (4 items), magnification (3 items) and helplessness (6 items) [10]. The rumination questions evaluate the worry that pain brings to a person, such as “I worry all the time about whether the pain will end.” The magnification questions describe the exaggeration of the severity of painful situation such as “I wonder whether something serious may happen.” The helplessness items refer to the feelings of incapacity to deal with the painful situation such as “There’s nothing I can do to reduce the intensity of the pain” [10]. The PCS has been found to be a valid and reliable questionnaire that has, and can be used for a clinical and non-clinical population [10, 45].

TSK: The Tampa Scale for Kinesiophobia (TSK) is a questionnaire which aims to measure the participant's fear of (re)injury due to movement [43]. The TSK contains 17 questions measured on a 4-point Likert-type scale where 1 is “strongly disagree” and 4 is “strongly agree”. Included in this scale are statements such as “I am afraid that I might injure myself if I exercise” and “Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening” [41]. The higher the score a patient obtains upon completion, the higher the fear of movement, pain, and re-injury they possess [41]. The TSK has been found to be both valid and reliable [41, 43] and several studies has suggested that it is capable of predicting disability in patients with both acute and chronic low back pain [78-80], fibromyalgia [80], musculoskeletal injuries [81], osteoarthritis [82], traumatic neck injuries [83] and ACL injuries [14, 20, 21, 66, 84, 85].

FABQ: The Fear Avoidance Belief Questionnaire (FABQ) was established to try and at least partially explain why some patients develop chronic pain even though structurally they are uninjured. Focusing specifically on a patient's subjective belief on how physical activity and their employment affect their low back pain, a 16-item questionnaire was developed. Each item is scored on a 7-point Likert scale ranging from 0 (“strongly disagree”) to 6 (“strongly agree”). The FABQ contains two different subscales; the FABQ(W) which asks questions pertaining to the patient’s work, such as “I should not do my normal work with my present pain” and the FABQ(PA) which asks questions measuring their physical activity, such as “Physical activity might harm my back” [11]. A higher patient-reported score on the FABQ indicates a higher level of fear avoidance, which is considered part of the reason as to why some patients may develop a chronic disability [93, 94]. The FABQ was found to be valid and reliable and the results of the validation study provide substantial evidence to support the importance of fear-avoidance beliefs in the general low back pain population [11]. The original FABQ was developed to target back pain patients and therefore the wording in the questionnaire asks the patient to comment about their “back pain.” The PI, however, substituted “back pain” for the athlete’s actual injured site.

PROCEDURES:

The primary investigator (PI) met with all varsity teams during the pre-season to obtain informed consent. The consent forms were collected prior to injuries to allow for the open communication about the presence of an injury and specific injury characteristics between the PI and the team’s athletic therapists, student athletic therapists, and coaches. If an athlete signed the informed consent but after suffering an injury chose not to participate in the study, their injury information was not collected by the PI. Athletes were approached for participation if they sustained an acute musculoskeletal injury to the upper/lower extremity or to the low back. There has been much variability in the literature when it comes to defining a sports injury therefore, for the purpose of this study, an ‘injury’ referred to and encompassed the most common components, which included; 1) the injury was sustained while training for, or competing in a sporting event, 2) medical care from an health care professional was needed, and 3) the athlete could not partake in a minimum of 1 practice or game [137]; [138]. The exclusion criteria for this study were any of the following: if the athlete sustained an injury to the head, neck, thoracic spine or ribs, had a chronic injury, sustained an injury severe enough that it required surgery, or was able to return to competition only in their offseason. The head athletic therapists notified the PI upon any injury of their respective athletes in which the PI then approached and scheduled an appointment with all qualifying participants. Prior to the initial injury evaluation carried out by the athletic therapists, the PI asked the participants to respond to all questions on a series of self-reported measures including the NRS, DASH/LEFS/Oswestry, AFAQ, PDI, BPI, PCS, TSK and FABQ within 24 hours of the initial injury. All athletes then received their own personalized rehabilitation for their injury by their respective athletic therapists. When the athletic therapist, as well as the athlete, deemed it acceptable for the athlete’s return to competition, the PI was notified and the athlete was contacted to complete their follow up evaluation, which consisted of filling out the exact same battery of questions as their initial injury onset evaluation. All measures were taken every two weeks until the athlete returned to competition. The PI then calculated the amount of days it took for the athlete to rehabilitate and return to competition.

ANALYSIS:

Data was collected at the time of injury onset and every two weeks until the athlete's return to competition. Demographic information relevant to musculoskeletal injuries of the extremities was collected at injury onset. These variables included; age, sex, years of experience in sport, mechanism of injury, site of injury, and previous injuries or surgeries. Statistical analyses were conducted using the SPSS Version 24.0**.** Descriptive statistics were generated for demographic variables and the self-reported psychosocial questionnaire scores. A percent function score was generated since we used 3 different scales to asses disability (DASH, LEFS, Oswestry) asked the participants to answer a different amount of questions, where the total scores were on different scales. The questionnaires were all transformed onto the same scale of 0-100, where 0 means no disability and 100 means worst disability. Dependent t-tests were used to compare the injury onset pain (NRS), function (DASH/LEFS/Oswestry), AFAQ, PDI, BPI(PS), BPI(PI), PHQ-9, PCS, TSK and FABQ scores, to their respective RTC scores. Pearson correlations were then used to analyze the relationship between the NRS, function (DASH/LEFS/Oswestry), AFAQ, PDI, BPI(PS), BPI(PI), PHQ-9, PCS, TSK, and FABQ with the change in function and then again with the return to competition times. A linear regression model was then used to examine the variance in return to competition times explained by the change in function (DASH/LEFS/Oswestry), and scores on the AFAQ, PDI, BPI(PI), and PHQ-9. A further analysis involved changing the raw function scores into z-scores to attempt to reduce the increase variability when transforming the three scales into one measure (see appendix 12). A p value of 0.05 was used for all analyses.

RESULTS:

The athletes experienced a significant improvement in pain and function from time of injury to return to competition ($p < 0.001$ for all, see table 3), where the mean return to competition times was 13.7 days. In addition, all participants experienced a decrease in athlete fear avoidance, pain disability, pain severity, pain interference, depression, pain catastrophizing (as well as it's subsections of: rumination, magnification, helplessness), kinesiophobia, fear avoidance (as well as it's physical activity subsection) from injury onset to return to competition ($p \leq 0.013$ for all, see table 3). Pearson correlations were then performed which identified significant relationships between injury onset athlete fear avoidance, the change in function, pain disability, pain interference, and depression, with return to competition ($p \leq 0.035$ for all, see table 4). Pearson correlations were also performed to identify any significant relationships between the change in variables from injury onset to RTP and the change in function. The correlation matrix for all interactions can be found in appendix 12 a and 12 b. The regression analysis indicated a significant model, which accounted for 35.3% of the variance of return to competition time (refer to table 5), however there were no individual significant predictors (see appendix 13 for full regression analysis). A secondary analysis revealed that the PDI was significantly related to the change in function ($r=0.488$, $p=0.003$) and the BP(PI) ($r=0.653$, $p<0.001$), the PHQ-9 was significantly correlated to the BPI(PI) ($r=0.463$, $p=0.005$) and the AFAQ ($r=0.603$, $p<0.001$) and lastly, the BPI(PI) was significantly correlated to the AFAQ ($r=0.394$, $p=0.019$). Finally, the table of z-scores for the final function analysis can be found in the appendix as well.

Table 3.

Pain, function, and pain related fear measures from injury onset to return to competition (mean ± std)

Measures	Injury Onset	Return to Competition	Significance
Pain	6.5 ± 1.5	1.7 ± 1.9	p<0.001
Function	49.8 ± 21.3	9.3 ± 7.9	p<0.001
AFAQ	22.7 ± 5.5	13.6 ± 3.5	p<0.001
PDI	18.3 ± 12.2	3.0 ± 3.9	p<0.001
PBI(PS)	4.4 ± 1.4	0.87 ± 0.89	p<0.001
PBI(PI)	3.3 ± 1.7	0.42 ± 0.55	p<0.001
PHQ-9	3.00 ± 3.2	1.77 ± 2.8	p=0.013
PCS	12.9 ± 8.7	4.3 ± 6.2	p<0.001
PCS(R)	5.4 ± 3.2	1.6 ± 3.0	p<0.001
PCS(M)	3.2 ± 2.6	0.94 ± 1.5	p<0.001
PCS(H)	4.3 ± 4.3	1.8 ± 2.5	p<0.001
TSK	39.4 ± 7.6	31.3 ± 6.8	p<0.001
FABQ	19.5 ± 5.5	8.7 ± 6.6	p<0.001
FABQ(PA)	18.2 ± 4.5	8.7 ± 6.1	p<0.001
FABQ(W)	2.0 ± 5.0	0.54 ± 1.6	p=0.072

Table 4.

Pearson correlations between measures that were significantly correlated to the return to competition time (Refer to appendix for full correlation matrix)

Measures	r-value of variable	p-value of variable
AFAQ	r=0.371	p=0.028
Change in Function	r=0.363	p=0.032
PDI	r=0.358	p=0.035
BPI(PI)	r=0.543	p=0.001
PHQ-9	r=0.458	p=0.006

Table 5.

Summary of regression analysis (Refer to full regression analysis in appendix 14)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.594[a]	.353	.266	7.668

a. Predictors: (Constant), AFAQ Injury Onset (IO), PDI IO, PHQ-9 IO, BPI(PI) IO

DISCUSSION:

The purpose of this study was to investigate the influence that athlete fear avoidance has on the process of rehabilitation from an acute musculoskeletal injury in elite athletes. Developed with consideration and in alignment with the Fear Avoidance Model (FAM), the Athlete Fear Avoidance Questionnaire (AFAQ) was used in this study to extend previous works on psychosocial factors, which have been widely studied in the general population, to focus on and target elite athletes. As we hypothesized, pain and function improved from injury onset to return to competition and all psychosocial factors significantly decreased from injury onset to return to competition, which was indicative of an improvement in the athlete's psychological mind frame. We were the first to evaluate the efficacy of the AFAQ and as expected, the injury onset AFAQ correlated significantly (r=0.371, p=0.028) with RTC times and had a stronger correlation with RTC times when compared to the change in function, PDI, BPI(PS), as well as the previously established FAM questionnaires including the PCS, TSK, and FABQ. Contrary to our hypothesis, the BPI(PI) as well as the PHQ-9 had a stronger correlation with the return to competition days when compared to the AFAQ. There were two psychosocial questionnaires (AFAQ and PHQ-9) as well as two pain interference/disability questionnaires (BPI(PI) and PDI) that significantly correlated with the return to competition times and when inputted into the regression analysis, it did show a significant model which accounted for 35.3% of the variance in the return to competition times, however there were no significant individual predictors of RTC times that emerged. While looking at the regression analysis, we cannot make any conclusions as to whether or not the AFAQ can be used as a predictor tool for return to competition because this analysis seems to be flawed. The cause of the flawed model could stem from the fact that there were not enough participants in the study to avoid overfitting of the regression model. Chmielewski et al. mentioned that it has been suggested that a minimum of 10 participants is required for each predictor variable included in the regression model [14]. This would therefore put us below the required amount of participants and could have had an impact on the outcome of the analysis. Multicollinearity could also have also been a cause for a flawed model because as seen in the correlation matrix, several of the variables were correlated amongst each other. This therefore violates one of the regression analysis assumptions, which would therefore skew the results further. Due to the ladder, we cannot comment on the 4th hypothesis pertaining to the prediction capabilities of the various questionnaires and further analysis needs to be done in order to obtain clear results that could be used for its interpretation. Pearson correlations were also performed on the change in variables from injury onset to return to competition to see if the degree of change in scores correlated significantly with the amount of change in function. We wanted to identify if the amount of self-reported recovery was correlated with not only return to competition times but also with the change in all of the psychosocial and pain severity/interference questionnaires. Upon looking at the correlation matrix, we concluded that the injury onset scores showed a more interesting depiction of return to competition times than the change in scores did with self reported recovery.

Despite the fact that psychosocial factors have been studied in the athletic population previously and correlations have been suggested, this study provides novel evidence that pain related fear as measured by the AFAQ decreases during the rehabilitation time as noted in other injuries and populations. The strength of the AFAQ may be the questions which are suited well for athletes asking questions about their role with a team and injury changing. Taken together, the findings from this study suggest that 1) pain severity and pain interference decrease from injury onset to RTC, 2) function must increase from injury onset to RTC, 3) psychosocial factors including athlete fear avoidance, pain catastrophizing, kinesiophobia, fear avoidance, and depression decrease from injury onset to RTC, as seen in other studies and 4) athlete fear avoidance seems to be an important factor in the rehabilitation of athletes and therefore warrants further investigation in future studies. The AFAQ and the PHQ-9 were the only psychosocial questionnaires that were significantly correlated with RTC times, where we also found significance with the BPI(PI), PDI, and the change in function, meaning the more interference to ADLs, the more disabled, and the more depressed and athlete fear avoidance a patient felt 24 hours post injury, the longer it would take them to rehabilitate.

The pain and dysfunction of the athletes in our study were similar to some previous works. We compared the scores on the BPI for pain severity and pain intensity with those of 28 athletes of varying levels who suffered a 2nd-degree hamstring strain as well as 63 patients with shoulder pain. The injury onset BPI(PS) was 3.9+/-1.83 and the BPI(PI) was 3+/-1.36 for the hamstring group and their average RTC time was 26.7+-7 days [139] whereas the shoulder group had an average BPI(PS) of 4.5 +/- 1.9 [140]. These results are very similar to our study where the injury onset BPI(PS) was 4.4 +/- 1.4 and injury onset BPI(PI) was 3.3+/-1.7, where the average RTC was 13.7 days**.** On the contrary, in a study done on delayed onset muscle soreness (DOMS), the BPI(PS) was used to evaluate the participant's pain after 48 hours (1.97 +/- 1.92) and after 96 hours (0.59 +/- 0.90). In comparison, we could see that our patients had an average pain severity much higher than that of DOMS, which suggests that our athletes were experiencing more pain and dysfunction [141]. It is unclear at this point if a more significant injury would elicit a higher pain related fear reaction compared to a milder injury.

Injuries are a common occurrence in the athletic environment and when an elite athlete suffers from an injury, it can bring about significant challenges due to the increase in individual expectations that arise with the increase in competition level. Unfortunately, injury has been known to elicit harmful psychological responses, such as depression, when these expectations cannot be fulfilled [125]. A study completed on 465 NCAA division 1 student-athletes over 3 consecutive years revealed that 23.7% indicated signs and symptoms of being clinically depressed [142]. Similarly, a study that focused on 257 elite athletes identified depressive symptoms in 21% [143]. There has also been studies that suggest athletes have a lower prevalence of depressive symptoms as noted in a study done on 61 elite athletes and 51 age matched non-athletes where 15.6% of athletes compared to 29.4% of non-athletes had been identified as having depressive symptoms [144]. That being said, when examining depression levels in college athletes compared to graduate athletes, there was a significant difference of 17% vs 8%, respectively. This can be due to the stress that athletes feel to perform, which ultimately diminished when the athlete retires [145]. When looking at the current study, the Patient Health Questionnaire (PHQ-9) was significantly correlated with RTC times (r=0.458, p=0.006) and therefore provides more evidence to support the assessment of athletes during different time frames throughout the season to screen for depression. This may also help in increasing the awareness and acceptability of mental health issues, in hopes that athletes will be more opened to sharing their problems, decreasing the stigma around mental health diseases [146]. That being said, we also have to take into consideration that the PHQ-9 values were low to begin with (3.00 ± 3.2), which already put the athletes into the “normal range”, meaning no signs of depression. We could then conclude that even though the PHQ-9 was significantly correlated in this study to the RTC of our athletes, it was not clinically significant since our participants were not considered to be clinically depressed at any time frame.

Previous investigators have focused on the evaluation of psychosocial factors by using self-report questionnaires such as the Pain Catastrophizing Scale, the Tampa Scale for Kinesiophobia and the Fear Avoidance Beliefs Questionnaire. Although these questionnaires have been deemed valid and reliable and did show a decrease from injury onset to return to competition in the current study, our results revealed a minimal correlation between these questionnaires and the rehabilitation times of the elite athlete population. For example, some of the questionnaires on the PCS, such as; “I feel I can’t stand it anymore” and “I anxiously want the pain to go away” would not resonate with athletes immediately after injury due to the fact that athletes are regularly subjecting their bodies to pain and minor injuries therefore a certain amount of pain is normal and tolerable for an athlete. Only when the injury kept the athlete out of play for several consecutive days, was when we would notice an increase in the scores in the PCS. The PCS levels could have still be high upon the RTC measures because athletes typically do not wait until they are 100% pain free to return to activity. Despite demonstrating a significant decrease from injury onset to RTC, the lack of correlation between the PCS and RTC times suggests that the PCS may not be the best tool for evaluation of psychosocial factors in this population.

Kinesiophobia has been correlated to the recovery in ACLR patients. The results in our study did not identify a relationship between kinesiophobia and acute musculoskeletal injuries. This could be due to the fact that the questions on the TSK do not necessarily relate to an acute musculoskeletal injury that does not require surgery, but generalizes more about pain and injury itself. Questions like “I am afraid I might injure myself accidentally”, “I’m afraid that I might injure myself if I exercise”, and “Pain lets me know when to stop exercising so that I don’t injure myself” do not resonate with this population due the fact that most, if not all, elite athletes will have experienced some type of pain in their athletic career and if they have obtained that elite level, they typically are not afraid to exercise or hurt themselves accidentally. Another question states “I can’t do all the things normal people do because it is too easy for me to get injured” and is also not relevant to this population because they take on a lot more than the average person with all their gym trainings, practices and games. Also, general acute injuries may not generate enough kinesiophobia compared to the instability felt during the recovery process of the ACLR.

Some of our athletes struggled to complete the FABQ due to the fact that 7 out of the 11 questions that are used in the calculation of the final score are all about the participant’s work. Several athletes were confused whether the pain and work questions pertained to their sport or part time employment. That being said, the vast majority of elite athletes do not have a paying job during the season due to the amount of time and effort that needs to be put into all the practices and games and therefore did not fill out this portion of the questionnaire. It is possible that just the questions on the physical activities portion of the FABQ may be applicable.

The mechanisms underlying the influence of psychosocial factors on pain remain unclear however there have been several hypotheses have been suggested. For example, there have been some reports that suggest that catastrophizing might be associated with neurophysiological mechanisms that increase the perception of painful stimuli. Catastophizing has been found to be linked with the inflammatory process where when a patient had an elevated level of catastrophizing it was positively associated with an increase in disease activity and inflammation in patients with rheumatoid arthritis [147]. Catastrophizing may also have an effect on the immune system, which would promote the release of pro-inflammatory cytokines and this enhanced release would then prime the nervous system and would amplify the transmission of pain signals that the patient would feel [147]. There needs to be more research done on the variety of different psychosocial factors and how they influence the perception of pain, however preliminary research such as the one mentioned leads us to believe that high levels of psychosocial factors can alter healing processes in the human body.

Future studies should compare elite athletes that have the same type of injury and severity and be separated into those who scored high on the AFAQ and those who scored low to see if in fact those with an elevated score on the AFAQ will have a prolonged rehabilitation

LIMITATIONS:

There are limitations to the study that should be considered while interpreting the results. A numerous amount of athletes were hesitant about their answers on a variety of questions, which were found on the BPI, PDI, and the functional questionnaires, due to the fact that it was asking them questions about activities that they had not necessarily done at the time of assessment. This led athletes to assume as to what their pain or disability would be in those certain situations. Future studies should evaluate athletes at a later timeframe post acute injury to allow for all activities to take place, and for the athlete to actually digest the injury itself, which will give researchers and clinicians a better understanding of how the injury has actually affected the athlete. This study also came across 3 athletes that ended up quitting their respective teams post-injury, therefore their initial and return to competition assessments were potentially not reflective of their actual pain and disability because they were not planning on returning back to competition. The authors of the AFAQ should therefore consider the inclusion of a question that evaluates the level of commitment an athlete has towards their team asking them to assess their willingness to put in the time and effort into their rehabilitation in order to return to their team in a timely fashion. Furthermore, this study also used questionnaires that were not validated for the elite athlete population therefore the reliability of said questionnaires may differ from the norms. Another important factor that wasn't accounted for was the difference in rehabilitation treatments given by the different therapists. Not all the therapists will treat their athletes in the same manner or have the same interactions therefore the skill level of the therapist, and the ratio of biomedical to biopsychosocial techniques that were implemented could have affected the RTC times of the athletes.

CONCLUSIONS:

In conclusion, this study demonstrated that there seems to be a similar decrease in pain related fear during the rehabilitation of an acute musculoskeletal injury as seen in ACLR patients and it also seems similar to the decrease seen in patients who successfully rehabilitated from low back pain. This would then suggest that there is a natural progression of a decrease in pain severity with an increase in function that is accompanied by a decrease in pain related fear. This therefore means that in some athletes whose pain related fear remains high, it may have to be addressed in order for them to get better. This has been seen in athletes who underwent ACLR but more research is needed for acute injury patients who remain out for a prolonged period of time. Athletic therapists and athletic trainers are best suited to educate, inform and assist when our athletes are showing signs of fear avoidance, but we lack confidence and readiness in sports psychology. We have seen an improvement over the past years with the implementation of sports psychology competencies that need to be address and fulfilled in the athletic therapy/training curriculum as outlined by the CAATE and CATA however we still need to increase the emphasis in school to gain confidence and skill in this domain. Our results however do suggest that the AFAQ should be a tool used by therapists during the initial assessment to see if fear avoidance is something that needs to be addressed in the rehabilitation program. Furthermore, to accomplish the latter, this study warrants future research on the development and implementation of rehabilitation protocols that addresses athlete fear avoidance.

REFERENCES:

1. Vlaeyen JWS, KoleSnijders AMJ, Rotteveel AM, Ruesink R and Heuts P. The role of fear of movement (re)injury in pain disability. *Journal of Occupational Rehabilitation* 1995;5:235-252.
2. Kvist J. Rehabilitation following anterior - Cruciate ligament injury current recommendations for sports participation. *Sports Med* 2004;34:269-280.
3. Injuries in Sport, Recreation and Exercise *New Brunswick Health Indicators*. Fredericton, N.B.: Department of Health, 2013.
4. Soligard T, Steffen K, Palmer-Green D, Aubry M, Grant ME, Meeuwisse W, Mountjoy M, Budgett R and Engebretsen L. Sports injuries and illnesses in the Sochi 2014 Olympic Winter Games. *British journal of sports medicine* 2015;49:441-7.
5. Engebretsen L, Soligard T, Steffen K, Alonso JM, Aubry M, Budgett R, Dvorak J, Jegathesan M, Meeuwisse WH, Mountjoy M, Palmer-Green D, Vanhegan I and Renstrˆm PA. Sports injuries and illnesses during the London Summer Olympic Games 2012. *British journal of sports medicine* 2013;47:407-14.
6. Hamada M, Shino K, Horibe S, Mitsuoka T, Miyama T and Toritsuka Y. Preoperative anterior knee laxity did not influence postoperative stability restored by anterior cruciate ligament reconstruction. *Arthroscopy* 2000;16:477-482.
7. Mikkelsen C, Werner S and Eriksson E. Closed kinetic chain alone compared to combined open and closed kinetic chain exercises for quadriceps strengthening after anterior cruciate ligament reconstruction with respect to return to sports: a prospective matched follow-up study. *Knee Surgery Sports Traumatology Arthroscopy* 2000;8:337-342.
8. Boden BP, Sheehan FT, Torg JS and Hewett TE. Noncontact Anterior Cruciate Ligament Injuries: Mechanisms and Risk Factors. *Journal of the American Academy of Orthopaedic Surgeons* 2010;18:520-527.
9. Wertli MM, Eugster R, Held U, Steurer J, Kofmehl R and Weiser S. Catastrophizing-a prognostic factor for outcome in patients with low back pain: a systematic review. *Spine Journal* 2014;14:2639-2657.
10. Sullivan MJL, Bishop SR and Pivik J. The Pain Catastrophizing Scale: Development and validation. *Psychological Assessment* 1995;7:524-532.
11. Waddell G, Newton M, Henderson I, Somerville D and Main CJ. A FEAR-AVOIDANCE BELIEFS QUESTIONNAIRE (FABQ) AND THE ROLE OF FEAR-AVOIDANCE BELIEFS IN CHRONIC LOW-BACK-PAIN AND DISABILITY. *Pain* 1993;52:157-168.
12. Waddell G. A NEW CLINICAL-MODEL FOR THE TREATMENT OF LOW-BACK-PAIN. *Spine* 1987;12:632-644.
13. Dover G and Amar V. Development and Validation of the Athlete Fear Avoidance Questionnaire. *Journal of Athletic Training* 2015;50:634-642.
14. Chmielewski TL, Zeppieri G, Jr., Lentz TA, Tillman SM, Moser MW, Indelicato PA and George SZ. Longitudinal Changes in Psychosocial Factors and Their Association With Knee Pain and Function After Anterior Cruciate Ligament Reconstruction. *Physical Therapy* 2011;91:1355-1366.
15. Adams H, Ellis T, Stanish WD and Sullivan MJL. Psychosocial Factors Related to Return to Work Following Rehabilitation of Whiplash Injuries. *J Occup Rehabil Journal of Occupational Rehabilitation* 2007;17:305-315.

16. Ross MD. The relationship between functional levels and fear-avoidance beliefs following anterior cruciate ligament reconstruction. *Journal of orthopaedics and traumatology : official journal of the Italian Society of Orthopaedics and Traumatology* 2010;11:237-43.
17. Turner JA and Clancy S. Strategies for coping with chronic low back pain: relationship to pain and disability. *Pain* 1986;24:355-64.
18. Granot M and Ferber SG. The roles of pain catastrophizing and anxiety in the prediction of postoperative pain intensity - A prospective study. *Clin J Pain* 2005;21:439-445.
19. Papaioannou M, Skapinakis P, Damigos D, Mavreas V, Broumas G and Palgimesi A. The Role of Catastrophizing in the Prediction of Postoperative Pain. *Pain Medicine* 2009;10:1452-1459.
20. Ardern CL, Taylor NF, Feller JA, Whitehead TS and Webster KE. Psychological Responses Matter in Returning to Preinjury Level of Sport After Anterior Cruciate Ligament Reconstruction Surgery. *American Journal of Sports Medicine* 2013;41:1549-1558.
21. Kvist J, Ek A, Sporrstedt K and Good L. Fear of re-injury: a hindrance for returning to sports after anterior cruciate ligament reconstruction. *Knee Surgery Sports Traumatology Arthroscopy* 2005;13:393-397.
22. Lynch M. Pain as the fifth vital sign. *Journal of intravenous nursing : the official publication of the Intravenous Nurses Society* 2001;24:85-94.
23. Tsang A, Von Korff M, Lee S, Alonso J, Karam E, Angermeyer MC, Borges GLG, Bromet EJ, de Girolamo G, de Graaf R, Gureje O, Lepine JP, Haro JM, Levinson D, Browne MAO, Posada-Villa J, Seedat S and Watanabe M. Common Chronic Pain Conditions in Developed and Developing Countries: Gender and Age Differences and Comorbidity With Depression-Anxiety Disorders. *J Pain* 2008;9:883-891.
24. Braden JB, Zhang L, Zimmerman FJ and Sullivan MD. Employment outcomes of persons with a mental disorder and comorbid chronic pain. *Psychiatric Services* 2008;59:878-885.
25. Maetzel A and Li L The economic burden of low back pain: a review of studies published between 1996 and 2001. *Best Pract Res Clin Rheumatol*. 2002:23-30.
26. Closs SJ, Staples V, Reid I, Bennett MI and Briggs M. The impact of neuropathic pain on relationships. *Journal of Advanced Nursing* 2009;65:402-411.
27. Carr JL and Moffett JAK. The impact of social deprivation on chronic back pain outcomes. *Chronic illness* 2005;1:121-9.
28. Ilgen MA, Zivin K, McCammon RJ and Valenstein M. Pain and suicidal thoughts, plans and attempts in the United States. *General Hospital Psychiatry* 2008;30:521-527.
29. Von Korff M, Crane P, Lane M, Miglioretti DL, Simon G, Saunders K, Stang P, Brandenburg N and Kessler R. Chronic spinal pain and physical-mental comorbidity in the United States: results from the national comorbidity survey replication. *Pain* 2005;113:331-339.
30. Zale EL, Lange KL, Fields SA and Ditre JW. The Relation Between Pain-Related Fear and Disability: A Meta-Analysis. *J Pain* 2013;14:1019-1030.
31. Quartana PJ, Campbell CM and Edwards RR. Pain catastrophizing: a critical review. *Expert Rev Neurother* 2009;9:745-758.
32. Melzack R and Wall PD. Pain mechanisms: A new theory. *Pain Clinic* 1994;7:57-72.
33. Smith AM. Psychological impact of injuries in athletes. *Sports Med* 1996;22:391-405.

34. Brewer BW. Review and critique of models of psychological adjustment to athletic injury. *Journal of Applied Sport Psychology Journal of Applied Sport Psychology* 1994;6:87-100.
35. Physical activity level, changes between 1994/1995 and 2010/2011, by age group In: Health ed. Statistics Canada, 2012.
36. Scanlan TK, Carpenter PJ, Schmidt GW, Simons JP and Keeler B. AN INTRODUCTION TO THE SPORT COMMITMENT MODEL. *J Sport Exerc Psychol* 1993;15:1-15.
37. Chan CS and Grossman HY. PSYCHOLOGICAL EFFECTS OF RUNNING LOSS ON CONSISTENT RUNNERS. *Perceptual and Motor Skills* 1988;66:875-883.
38. DiLorenzo TM, Bargman EP, Stucky-Ropp R, Brassington GS, Frensch PA and LaFontaine T. Long-term effects of aerobic exercise on psychological outcomes. *Preventive Medicine* 1999;28:75-85.
39. Weyerer S and Kupfer B. PHYSICAL EXERCISE AND PSYCHOLOGICAL HEALTH. *Sports Med* 1994;17:108-116.
40. Lethem J, Slade PD, Troup JDG and Bentley G. OUTLINE OF A FEAR-AVOIDANCE MODEL OF EXAGGERATED PAIN PERCEPTION .1. *Behav Res Ther* 1983;21:401-408.
41. Vlaeyen JWS, Kolesnijders AMJ, Boeren RGB and Vaneek H. FEAR OF MOVEMENT (RE)INJURY IN CHRONIC LOW-BACK-PAIN AND ITS RELATION TO BEHAVIORAL PERFORMANCE. *Pain* 1995;62:363-372.
42. Leeuw M, Goossens MEJB, Linton SJ, Crombez G, Boersma K and Vlaeyen JWS. The fear-avoidance model of musculoskeletal pain: Current state of scientific evidence. *J Behav Med* 2007;30:77-94.
43. Vlaeyen JWS and Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain* 2000;85:317-332.
44. Lentz TA, Barabas JA, Day T, Bishop MD and George SZ. The Relationship of Pain Intensity, Physical Impairment, and Pain-Related Fear to Function in Patients With Shoulder Pathology. *J Orthop Sports Phys Ther* 2009;39:270-277.
45. Sullivan MJL, Tripp DA, Rodgers WM and Stanish W. Catastrophizing and pain perception in sport participants. *J Appl Sport Psychol* 2000;12:151-167.
46. Jellema P, van der Windt DAWM, van der Horst HE, Stalman WAB and Bouter LM. Prediction of an unfavourable course of low back pain in general practice: comparison of four instruments. *British Journal of General Practice* 2007;57:15-22.
47. Verbunt JA, Sieben J, Vlaeyen JWS, Portegijs P and Knottnerus JA. A new episode of low back pain: Who relies on bed rest? *European Journal of Pain* 2008;12:508-516.
48. van der Windt DAWM, Kuijpers T, Jellema P, van der Heijden GJMG and Bouter LM. Do psychological factors predict outcome in both low-back pain and shoulder pain? *Annals of the Rheumatic Diseases* 2007;66:313-319.
49. Kovacs FM, Seco J, Royuela A, Corcoll-Reixach J, Pena-Arrebola A and Spanish Back Pain Res N. The prognostic value of catastrophizing for predicting the clinical evolution of low back pain patients: a study in routine clinical practice within the Spanish National Health Service. *Spine Journal* 2012;12:545-555.
50. Valencia C, Robinson ME and George SZ. Socioeconomic Status Influences the Relationship between Fear-Avoidance Beliefs Work and Disability. *Pain Medicine* 2011;12:328-336.
51. Dozois DJA, Dobson KS, Wong M, Hughes D and Long A. Predictive utility of the CSQ in low back pain: Individual vs composite measures. *Pain* 1996;66:171-180.

52. Hill JC, Dunn KM, Lewis M, Mullis R, Main CJ, Foster NE and Hay EM. A primary care back pain screening tool: Identifying patient subgroups for initial treatment. *Arthritis & Rheumatism-Arthritis Care & Research* 2008;59:632-641.
53. Grotle M, Foster NE, Dunn KM and Croft P. Are prognostic indicators for poor outcome different for acute and chronic low back pain consulters in primary care? *Pain* 2010;151:790-797.
54. Burton AK, Tillotson KM, Main CJ and Hollis S. PSYCHOSOCIAL PREDICTORS OF OUTCOME IN ACUTE AND SUBCHRONIC LOW-BACK TROUBLE. *Spine* 1995;20:722-728.
55. Franklin GM, Rahman EA, Turner JA, Daniell WE and Fulton-Kehoe D. Opioid Use for Chronic Low Back Pain A Prospective, Population-based Study Among Injured Workers in Washington State, 2002-2005. *Clin J Pain* 2009;25:743-751.
56. Linton SJ, Nicholas MK, MacDonald S, Boersma K, Bergbom S, Maher C and Refshauge K. The role of depression and catastrophizing in musculoskeletal pain. *European Journal of Pain* 2011;15:416-422.
57. Chibnall JT and Tait RC. Long-Term Adjustment to Work-Related Low Back Pain: Associations with Socio-demographics, Claim Processes, and Post-Settlement Adjustment. *Pain Medicine* 2009;10:1378-1388.
58. Turner JA, Franklin G, Fulton-Kehoe D, Sheppard L, Stover B, Wu R, Gluck JV and Wickizer TM. ISSLS Prize Winner: Early Predictors of Chronic Work Disability A Prospective, Population-Based Study of Workers With Back Injuries. *Spine* 2008;33:2809-2818.
59. Burns LC, Ritvo SE, Ferguson MK, Clarke H, Seltzer Ze and Katz J. Pain catastrophizing as a risk factor for chronic pain after total knee arthroplasty: a systematic review. *Journal of Pain Research* 2015;8:21-32.
60. Edwards RR, Haythornthwaite JA, Smith MT, Klick B and Katz JN. Catastrophizing and depressive symptoms as prospective predictors of outcomes following total knee replacement. *Pain Research & Management* 2009;14:307-311.
61. Forsythe ME, Dunbar MJ, Hennigar AW, Sullivan MJL and Gross M. Prospective relation between catastrophizing and residual pain following knee arthroplasty: Two-year follow-up. *Pain Research & Management* 2008;13:335-341.
62. Masselin-Dubois A, Attal N, Fletcher D, Jayr C, Albi A, Fermanian J, Bouhassira D and Baudic S. Are Psychological Predictors of Chronic Postsurgical Pain Dependent on the Surgical Model? A Comparison of Total Knee Arthroplasty and Breast Surgery for Cancer. *J Pain* 2013;14:854-864.
63. Noiseux NO, Callaghan JJ, Clark CR, Zimmerman MB, Sluka KA and Rakel BA. Preoperative Predictors of Pain Following Total Knee Arthroplasty. *Journal of Arthroplasty* 2014;29:1383-1387.
64. Riddle DL, Wade JB, Jiranek WA and Kong X. Preoperative Pain Catastrophizing Predicts Pain Outcome after Knee Arthroplasty. *Clinical Orthopaedics and Related Research* 2010;468:798-806.
65. Sullivan M, Tanzer M, Reardon G, Amirault D, Dunbar M and Stanish W. The role of presurgical expectancies in predicting pain and function one year following total knee arthroplasty. *Pain* 2011;152:2287-2293.
66. Tripp DA, Stanish W, Ebel-Lam A, Brewer BW and Birchard J. Fear of reinjury, negative affect, and catastrophizing predicting return to sport in recreational athletes with anterior cruciate ligament injuries at 1 year postsurgery. *Rehabilitation Psychology* 2007;52:74-81.

67. Sullivan MJL, Thorn B, Haythornthwaite JA, Keefe F, Martin M, Bradley LA and Lefebvre JC. Theoretical perspectives on the relation between catastrophizing and pain. *Clin J Pain* 2001;17:52-64.
68. Keefe FJ, Brown GK, Wallston KA and Caldwell DS. COPING WITH RHEUMATOID-ARTHRITIS PAIN - CATASTROPHIZING AS A MALADAPTIVE STRATEGY. *Pain* 1989;37:51-56.
69. Jensen MP, Turner JA, Romano JM and Karoly P. COPING WITH CHRONIC PAIN - A CRITICAL-REVIEW OF THE LITERATURE. *Pain* 1991;47:249-283.
70. Sullivan MJL and Deon JL. RELATION BETWEEN CATASTROPHIZING AND DEPRESSION IN CHRONIC PAIN PATIENTS. *J Abnorm Psychol* 1990;99:260-263.
71. Sullivan MJL, Stanish W, Waite H, Sullivan M and Tripp DA. Catastrophizing, pain, and disability in patients with soft-tissue injuries. *Pain* 1998;77:253-260.
72. Parr JJ, Borsa PA, Fillingim RB, Tillman MD, Manini TM, Gregory CM and George SZ. Pain-Related Fear and Catastrophizing Predict Pain Intensity and Disability Independently Using an Induced Muscle Injury Model. *J Pain* 2012;13:370-378.
73. Parr J, Borsa P, Fillingim R, Kaiser K, Tillman MD, Manini TM, Gregory C and George S. Psychological Influences Predict Recovery Following Exercise Induced Shoulder Pain. *International Journal of Sports Medicine* 2014;35:232-237.
74. Rakel BA, Blodgett NP, Zimmerman MB, Logsden-Sackett N, Clark C, Noiseux N, Callaghan J, Herr K, Geasland K, Yang X and Sluka KA. Predictors of postoperative movement and resting pain following total knee replacement. *Pain* 2012;153:2192-2203.
75. Archer KR, Abraham CM and Obremskey WT. Psychosocial Factors Predict Pain and Physical Health After Lower Extremity Trauma. *Clinical Orthopaedics and Related Research* 2015;473:3519-3526.
76. Golkari S, Teunis T, Ring D and Vranceanu A-M. Changes in Depression, Health Anxiety, and Pain Catastrophizing Between Enrollment and 1 Month After a Radius Fracture. *Psychosomatics* 2015;56:652-657.
77. Crombez G, Baeyens F and Eelen P. Sensory and temporal information about impending pain: the influence of predictability on pain. *Behav Res Ther* 1994;32:611-22.
78. Crombez G, Vlaeyen JWS, Heuts P and Lysens R. Pain-related fear is more disabling than pain itself: evidence on the role of pain-related fear in chronic back pain disability. *Pain* 1999;80:329-339.
79. Swinkels-Meewisse IEJ, Roelofs J, Verbeek ALM, Oostendorp RAB and Vlaeyen JWS. Fear of movement/(re)injury, disability and participation in acute low back pain. *Pain* 2003;105:371-379.
80. Roelofs J, Goubert L, Peters ML, Vlaeyen JWS and Crombez G. The Tampa Scale for Kinesiophobia: further examination of psychometric properties in patients with chronic low back pain and fibromyalgia. *European Journal of Pain* 2004;8:495-502.
81. Roelofs J, Sluiter JK, Frings-Dresen MHW, Goossens M, Thibault P, Boersma K and Vlaeyen JWS. Fear of movement and (re)injury in chronic musculoskeletal pain: Evidence for an invariant two-factor model of the Tampa Scale for Kinesiophobia across pain diagnoses and Dutch, Swedish, and Canadian samples. *Pain* 2007;131:181-190.
82. Heuts P, Vlaeyen JWS, Roelofs J, de Bie RA, Aretz K, van Weel C and van Schayck OCP. Pain-related fear and daily functioning in patients with osteoarthritis. *Pain* 2004;110:228-235.

83. Nederhand MJ, Ijzerman MJ, Hermens HJ, Turk DC and Zilvold G. Predictive value of fear avoidance in developing chronic neck pain disability: Consequences for clinical decision making. *Archives of Physical Medicine and Rehabilitation* 2004;85:496-501.
84. Ardern CL, Taylor NF, Feller JA and Webster KE. Fear of re-injury in people who have returned to sport following anterior cruciate ligament reconstruction surgery. *Journal of Science and Medicine in Sport* 2012;15:488-495.
85. Gignac MA, Cao X, Ramanathan S, White LM, Hurtig M, Kunz M and Marks PH. Perceived personal importance of exercise and fears of re-injury: a longitudinal study of psychological factors related to activity after anterior cruciate ligament reconstruction. *BMC sports science, medicine and rehabilitation* 2015;7:4-4.
86. Bjordal JM, Arnoy F, Hannestad B and Strand T. Epidemiology of anterior cruciate ligament injuries in soccer. *American Journal of Sports Medicine* 1997;25:341-345.
87. Mainwaring L. Restoration of self: a model for the psychological response of athletes to severe knee injuries. *Canadian Journal of Rehabilitation* 1999;3:145-156.
88. Johnson U. Coping strategies among long-term injured competitive athletes. A study of 81 men and women in team and individual sports. *Scand J Med Sci Sports* 1997;7:367-372.
89. Beynnon BD, Uh BS, Johnson RJ, Abate JA, Nichols CE, Fleming BC, Poole AR and Roos H. Rehabilitation after anterior cruciate ligament reconstruction - A prospective, randomized, double-blind comparison of programs administered over 2 different time intervals. *American Journal of Sports Medicine* 2005;33:347-359.
90. Karlsson J, Kartus J, Magnusson L, Larsson J, Brandsson S and Eriksson BI. Subacute versus delayed reconstruction of the anterior cruciate ligament in the competitive athlete. *Knee Surgery Sports Traumatology Arthroscopy* 1999;7:146-151.
91. Laxdal G, Kartus J, Ejerhed L, Sernert N, Magnusson L, Faxen E and Karlsson J. Outcome and risk factors after anterior cruciate ligament reconstruction: A follow-up study of 948 patients. *Arthroscopy-the Journal of Arthroscopic and Related Surgery* 2005;21:958-964.
92. Bortz WM. THE DISUSE SYNDROME. *West J Med* 1984;141:691-694.
93. Klenerman L, Slade PD, Stanley IM, Pennie B, Reilly JP, Atchison LE, Troup JDG and Rose MJ. THE PREDICTION OF CHRONICITY IN PATIENTS WITH AN ACUTE ATTACK OF LOW-BACK-PAIN IN A GENERAL-PRACTICE SETTING. *Spine* 1995;20:478-484.
94. Fritz JM and George SZ. Identifying psychosocial variables in patients with acute work-related low back pain: The importance of fear-avoidance beliefs. *Physical Therapy* 2002;82:973-983.
95. Mannion AF, Junge A, Taimela S, Muntener M, Lorenzo K and Dvorak J. Active therapy for chronic low back pain Part 3. Factors influencing self-rated disability and its change following therapy. *Spine* 2001;26:920-929.
96. McCracken LM, Gross RT, Aikens J and Carnrike CLM. The assessment of anxiety and fear in persons with chronic pain: A comparison of instruments. *Behav Res Ther* 1996;34:927-933.
97. van den Hout JHC, Vlaeyen JWS, Heuts P, Sillen WJT and Willen A. Functional disability in nonspecific low back pain: The role of pain-related fear and problem-solving skills. *International Journal of Behavioral Medicine* 2001;8:134-148.
98. Woby SR, Watson PJ, Roach NK and Urmston M. Adjustment to chronic low back pain - the relative influence of fear-avoidance beliefs, catastrophizing, and appraisals of control. *Behav Res Ther* 2004;42:761-774.

99. Cleland JA, Fritz JM and Brennan GP. Predictive validity of initial fear avoidance beliefs in patients with low back pain receiving physical therapy: is the FABQ a useful screening tool for identifying patients at risk for a poor recovery? *European Spine Journal* 2008;17:70-79.
100. Elfving B, Andersson T and Grooten WJA. Low levels of physical activity in back pain patients are associated with high levels of fear-avoidance beliefs and pain catastrophizing. *Physiotherapy research international : the journal for researchers and clinicians in physical therapy* 2007;12:14-24.
101. Fujii T, Matsudaira K and Oka H. Factors associated with fear-avoidance beliefs about low back pain. *Journal of Orthopaedic Science* 2013;18:909-915.
102. Nash JM, Williams DM, Nicholson R and Trask PC. The contribution of pain-related anxiety to disability from headache. *J Behav Med* 2006;29:61-67.
103. Norton PJ and Asmundson GJG. Anxiety sensitivity, fear, and avoidance behavior in headache pain. *Pain* 2004;111:218-223.
104. de Gier M, Peters ML and Vlaeyen JWS. Fear of pain, physical performance, and attentional processes in patients with fibromyalgia. *Pain* 2003;104:121-130.
105. Turk DC, Robinson JP and Burwinkle T. Prevalence of fear of pain and activity in patients with fibromyalgia syndrome. *J Pain* 2004;5:483-490.
106. Sterling M, Kenardy J, Jull G and Vicenzino B. The development of psychological changes following whiplash injury. *Pain* 2003;106:481-489.
107. Mintken PE, Cleland JA, Whitman JM and George SZ. Psychometric Properties of the Fear-Avoidance Beliefs Questionnaire and Tampa Scale of Kinesiophobia in Patients With Shoulder Pain. *Archives of Physical Medicine and Rehabilitation* 2010;91:1128-1136.
108. Sgroi MI, Willebrand M, Ekselius L, Gerdin B and Andersson G. Fear-avoidance in recovered burn patients: Association with psychological and somatic symptoms. *Journal of Health Psychology* 2005;10:491-502.
109. de Jong JR, Vlaeyen JWS, Onghena P, Cuypers C, den Hollander M and Ruijgrok J. Reduction of pain-related fear in complex regional pain syndrome type I: The application of graded exposure in vivo. *Pain* 2005;116:264-275.
110. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, Kerns RD, Stucki G, Allen RR, Bellamy N, Carr DB, Chandler J, Cowan P, Dionne R, Galer BS, Hertz S, Jadad AR, Kramer LD, Manning DC, Martin S, McCormick CG, McDermott MP, McGrath P, Quessy S, Rappaport BA, Robbins W, Robinson JP, Rothman M, Royal MA, Simon L, Stauffer JW, Stein W, Tollett J, Wernicke J and Witter J. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. *Pain* 2005;113:9-19.
111. Jensen MP, Turner JA, Romano JM and Fisher LD. Comparative reliability and validity of chronic pain intensity measures. *Pain* 1999;83:157-162.
112. Cleeland CS Brief Pain Inventory User Guide. University of Texas M.D. Anderson Cancer Center 1991.
113. Hudak PL, Amadio PC, Bombardier C, Boland A, Fischer T, Flatow EL, Gartsman GM, Louis DS, Axelrod T, Buchbinder R, Hawker G, Hotchkiss R, Katz J, Bedard T, Lederman R, Louis D, McCormick C, Odriscoll S, Richards D, Richards R and Simmons B. Development of an upper extremity outcome measure: The DASH (Disabilities of the Arm, Shoulder, and Head). *Am J Ind Med* 1996;29:602-608.
114. Alotaibi NM. The cross-cultural adaptation of the disability of arm, shoulder and hand (DASH): a systematic review. *Occupational therapy international* 2008;15:178-90.

115. Binkley JM, Stratford PW, Lott SA and Riddle DL. The lower extremity functional scale (LEFS): Scale development, measurement properties, and clinical application. *Physical Therapy* 1999;79:371-383.
116. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M and Nelimarkka O. SCORING OF PATELLOFEMORAL DISORDERS. *Arthroscopy* 1993;9:159-163.
117. Tegner Y and Lysholm J. RATING SYSTEMS IN THE EVALUATION OF KNEE LIGAMENT INJURIES. *Clinical Orthopaedics and Related Research* 1985:43-49.
118. Mehta SP, Fulton A, Quach C, Thistle M, Toledo C and Evans NA. Measurement Properties of the Lower Extremity Functional Scale: A Systematic Review. *The Journal of orthopaedic and sports physical therapy* 2016;46:200-16.
119. Fairbank JCT and Pynsent PB. The Oswestry Disability Index. *Spine* 2000;25:2940-2952.
120. Yates M and Shastri-Hurst N. The Oswestry Disability Index. *Occup Med-Oxf* 2017;67:241-242.
121. Jerome A and Gross RT. PAIN DISABILITY INDEX - CONSTRUCT AND DISCRIMINANT VALIDITY. *Archives of Physical Medicine and Rehabilitation* 1991;72:920-922.
122. Soer R, Koke AJA, Vroomen P, Stegeman P, Smeets R, Coppes MH and Reneman MF. Extensive Validation of the Pain Disability Index in 3 Groups of Patients With Musculoskeletal Pain. *Spine* 2013;38:E562-E568.
123. Tan G, Jensen MP, Thornby JI and Shanti BF. Validation of the brief pain inventory for chronic nonmalignant pain. *J Pain* 2004;5:133-137.
124. Spitzer RL, Kroenke K, Williams JBW and Patient Hlth Questionnaire P. Validation and utility of a self-report version of PRIME-MD - The PHQ primary care study. *Jama-Journal of the American Medical Association* 1999;282:1737-1744.
125. Kroenke K, Spitzer RL and Williams JBW. The PHQ-9 - Validity of a brief depression severity measure. *Journal of General Internal Medicine* 2001;16:606-613.
126. Glazer DD. Development and Preliminary Validation of the Injury-Psychological Readiness to Return to Sport (I-PRRS) Scale. *Journal of Athletic Training* 2009;44:185-189.
127. Johnson MH, Stewart J, Humphries SA and Chamove AS. Marathon runners' reaction to potassium iontophoretic experimental pain: Pain tolerance, pain threshold, coping and self-efficacy. *European Journal of Pain* 2012;16:767-774.
128. Paparizos AL, Tripp DA, Sullivan MJL and Rubenstein ML. Catastrophizing and pain perception in recreational ballet dancers. *Journal of Sport Behavior* 2005;28:35+.
129. Sternberg WF, Bailin D, Grant M and Gracely RH. Competition alters the perception of noxious stimuli in male and female athletes. *Pain* 1998;76:231-238.
130. Lazarus RS and Folkman S. *STRESS APPRAISAL AND COPING*. 1984.
131. Fishbain DA, Goldberg M, Meagher BR, Steele R and Rosomoff H. MALE AND FEMALE CHRONIC PAIN PATIENTS CATEGORIZED BY DSM-III PSYCHIATRIC DIAGNOSTIC-CRITERIA. *Pain* 1986;26:181-197.
132. Turner JA, Jensen MP, Warms CA and Cardenas DD. Catastrophizing is associated with pain intensity, psychological distress, and pain-related disability among individuals with chronic pain after spinal cord injury. *Pain* 2002;98:127-134.
133. Degood DE and Shutty MS, Jr. *Assessment of pain beliefs, coping, and self-efficacy*. (see Book Title), 1992.
134. Sharma P SJ, Shenoy S. Variation in the response to pain between athletes and non-athletes. *Ibnosina J Med BS* 2011;3:165-171.

135. Deroche T, Woodman T, Stephan Y, Brewer BW and Le Scanff C. Athletes' inclination to play through pain: a coping perspective. *Anxiety Stress and Coping* 2011;24:579-587.
136. Shuer ML and Dietrich MS. Psychological effects of chronic injury in elite athletes. *The Western journal of medicine* 1997;166:104-9.
137. Wiese-Bjornstal DM. Psychology and socioculture affect injury risk, response, and recovery in high-intensity athletes: a consensus statement. *Scand J Med Sci Sports* 2010;20:103-11.
138. Hootman JM, Dick R and Agel J. Epidemiology of collegiate injuries for 15 sports: Summary and recommendations for injury prevention initiatives. *Journal of Athletic Training* 2007;42:311-319.
139. Hamid MSA, Mohamed MR, Yusof A, George J and Lee LPC. Platelet-Rich Plasma Injections for the Treatment of Hamstring Injuries A Randomized Controlled Trial. *American Journal of Sports Medicine* 2014;42:2410-2418.
140. Coronado RA, Simon CB, Lentz TA, Gay CW, Mackie LN and George SZ. Optimism Moderates the Influence of Pain Catastrophizing on Shoulder Pain Outcome: A Longitudinal Analysis. *J Orthop Sports Phys Ther* 2017;47:21-30.
141. Larkin-Kaiser KA, Parr JJ, Borsa PA and George SZ. Range of Motion as a Predictor of Clinical Shoulder Pain During Recovery From Delayed-Onset Muscle Soreness. *Journal of Athletic Training* 2015;50:289-294.
142. Wolanin A, Hong E, Marks D, Panchoo K and Gross M. Prevalence of clinically elevated depressive symptoms in college athletes and differences by gender and sport. *British Journal of Sports Medicine* 2016;50:167-171.
143. Yang JZ, Peek-Asa C, Corlette JD, Cheng G, Foster DT and Albright J. Prevalence of and risk factors associated with symptoms of depression in competitive collegiate student athletes. *Clinical Journal of Sport Medicine* 2007;17:481-487.
144. Proctor SL B-LC. Prevalence of depressive symptoms in male intercollegiate student-athletes and nonathletes. *J Clin Sport Psychol* 2010;4.
145. Trojian T. Depression is under-recognised in the sport setting: time for primary care sports medicine to be proactive and screen widely for depression symptoms. *British Journal of Sports Medicine* 2016;50:137-+.
146. Putukian M. The psychological response to injury in student athletes: a narrative review with a focus on mental health. *British Journal of Sports Medicine* 2016;50:145-+.
147. Edwards RR, Kronfli T, Haythornthwaite JA, Smith MT, McGuire L and Page GG. Association of catastrophizing with interleukin-6 responses to acute pain. *Pain* 2008;140:135-144.

Appendix 1 - PCS [10]

PCS-EN

Client No.: __________ Age: _____ Sex: M(__) F(__) Date: _______________

Everyone experiences painful situations at some point in their lives. Such experiences may include headaches, tooth pain, joint or muscle pain. People are often exposed to situations that may cause pain such as illness, injury, dental procedures or surgery.

We are interested in the types of thoughts and feelings that you have when you are in pain. Listed below are thirteen statements describing different thoughts and feelings that may be associated with pain. Using the following scale, please indicate the degree to which you have these thoughts and feelings when you are experiencing pain.

0 – not at all 1 – to a slight degree 2 – to a moderate degree 3 – to a great degree 4 – all the time

When I'm in pain …

1☐ I worry all the time about whether the pain will end.

2☐ I feel I can't go on.

3☐ It's terrible and I think it's never going to get any better.

4☐ It's awful and I feel that it overwhelms me.

5☐ I feel I can't stand it anymore.

6☐ I become afraid that the pain will get worse.

7☐ I keep thinking of other painful events.

8☐ I anxiously want the pain to go away.

9☐ I can't seem to keep it out of my mind.

10☐ I keep thinking about how much it hurts.

11☐ I keep thinking about how badly I want the pain to stop.

12☐ There's nothing I can do to reduce the intensity of the pain.

13☐ I wonder whether something serious may happen.

_______________ *…Total*

Updated 11/11

Appendix 2 – TSK [41]

Tampa Scale for Kinesiophobia

(Miller , Kori and Todd 1991)

1 = strongly disagree
2 = disagree
3 = agree
4 = strongly agree

1. I'm afraid that I might injury myself if I exercise	1	2	3	4
2. If I were to try to overcome it, my pain would increase	1	2	3	4
3. My body is telling me I have something dangerously wrong	1	2	3	4
4. My pain would probably be relieved if I were to exercise	1	2	3	4
5. People aren't taking my medical condition seriously enough	1	2	3	4
6. My accident has put my body at risk for the rest of my life	1	2	3	4
7. Pain always means I have injured my body	1	2	3	4
8. Just because something aggravates my pain does not mean it is dangerous	1	2	3	4
9. I am afraid that I might injure myself accidentally	1	2	3	4
10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening	1	2	3	4
11. I wouldn't have this much pain if there weren't something potentially dangerous going on in my body	1	2	3	4
12. Although my condition is painful, I would be better off if I were physically active	1	2	3	4
13. Pain lets me know when to stop exercising so that I don't injure myself	1	2	3	4
14. It's really not safe for a person with a condition like mine to be physically active	1	2	3	4
15. I can't do all the things normal people do because it's too easy for me to get injured	1	2	3	4
16. Even though something is causing me a lot of pain, I don't think it's actually dangerous	1	2	3	4
17. No one should have to exercise when he/she is in pain	1	2	3	4

Appendix 3 – FABQ [11]

Fear-Avoidance Beliefs Questionnaire (FABQ)
Waddell et al (1993) Pain , 52 (1993) 157 - 168

Here are some of the things which other patients have told us about their pain. For each statement please circle any number from 0 to 6 to say how much physical activities such as bending, lifting, walking or driving affect or would affect *your* back pain.

	Completely disagree			Unsure			Completely agree
1. My pain was caused by physical activity……………………………..	0	1	2	3	4	5	6
2. Physical activity makes my pain worse……………………………….	0	1	2	3	4	5	6
3. Physical activity might harm my back………………………………..	0	1	2	3	4	5	6
4. I should not do physical activities which (might) make my pain worse	0	1	2	3	4	5	6
5. I cannot do physical activities which (might) make my pain worse…...	0	1	2	3	4	5	6

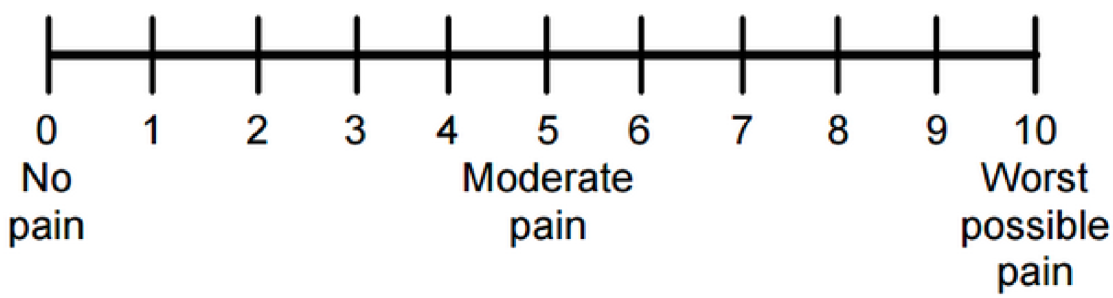
The following statements are about how your normal work affects or would affect your back pain

	Completely disagree			Unsure			Completely agree
6. My pain was caused by my work or by an accident at work…………	0	1	2	3	4	5	6
7. My work aggravated my pain………………………………………….	0	1	2	3	4	5	6
8. I have a claim for compensation for my pain………………………….	0	1	2	3	4	5	6
9. My work is too heavy for me…………………………………………..	0	1	2	3	4	5	6
10. My work makes or would make my pain worse……………………..	0	1	2	3	4	5	6
11. My work might harm my back………………………………………..	0	1	2	3	4	5	6
12. I should not do my normal work with my present pain……………….	0	1	2	3	4	5	6
13. I cannot do my normal work with my present pain…………………...	0	1	2	3	4	5	6
14. I cannot do my normal work till my pain is treated…………………..	0	1	2	3	4	5	6
15. I do not think that I will be back to my normal work within 3 months.	0	1	2	3	4	5	6
16. I do not think that I will ever be able to go back to that work………...	0	1	2	3	4	5	6

Scoring
Scale 1: fear-avoidance beliefs about work – items 6, 7, 9, 10, 11, 12, 15.
Scale 2: fear-avoidance beliefs about physical activity – items 2, 3, 4, 5.

Appendix 4: NRS

0–10 Numeric Pain Rating Scale



Appendix 5 – DASH [113]

Dash questionnaire

Disability of the Arm, Shoulder and Hand

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

		NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1	Open a tight or new jar	1	2	3	4	5
2	Write	1	2	3	4	5
3	Turn a key	1	2	3	4	5
4	Prepare a meal	1	2	3	4	5
5	Push open a heavy door	1	2	3	4	5
6	Place an object on a shelf above your head	1	2	3	4	5
7	Do heavy household chores (e.g., wash walls, wash floors)	1	2	3	4	5
8	Garden or do yard work	1	2	3	4	5
9	Make a bed	1	2	3	4	5
10	Carry a shopping bag or briefcase	1	2	3	4	5
11	Carry a heavy object (over 10 lbs).	1	2	3	4	5
12	Change a lightbulb overhead	1	2	3	4	5
13	Wash or blow dry your hair	1	2	3	4	5
14	Wash your back	1	2	3	4	5
15	Put on pullover sweater	1	2	3	4	5
16	Use a knife to cut food	1	2	3	4	5
17	Recreational activities which require little effort (e.g., cardplaying, knitting, etc....)	1	2	3	4	5
18	Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g golf, hammering, tennis, etc....)	1	2	3	4	5
19	Recreational activities in which you move your arm freely (e.g., playing freesby, badminton, etc....)	1	2	3	4	5
20	Manage transportation needs (getting from one place to another)	1	2	3	4	5
21	Sexual activities	1	2	3	4	5

		NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22	During the past week, to what extend has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

1

		NO LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

		NONE	MILD	MODERATE	SEVERE	EXTREME
24	Arm, Shoulder or hand pain	1	2	3	4	5
25	Arm, Shoulder or hand pain when you performed any specific activity	1	2	3	4	5
26	Tingling (pins and needles) in your arm, shoulder or hand	1	2	3	4	5
27	Weakness in your arm, shoulder or hand	1	2	3	4	5
28	Stiffness in your arm, shoulder or hand	1	2	3	4	5

		NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29	During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

		NONE	MILD	MODERATE	SEVERE	EXTREME
30	I feel less capable, less confident or less useful because of my arm, shoulder or hand problem *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = [(sum of n responses) – 1] x 25,
where n is equal of complete responses.

A DASH score may not be calculated if there are greater than 3 missing items.

2

Appendix 6 – LEFS [115]

LOWER EXTREMITY FUNCTIONAL SCALE

PATIENT NAME:__________________ **STUDY I.D. NUMBER:**____ - ____

DATE: __________________

We are interested in knowing whether you are having any difficulty at all with the activities listed below because of your lower limb problem for which you are currently seeking attention. Please provide an answer for each activity.

Today, do you or would you have any difficulty at all with:

(Circle one number on each line)

ACTIVITIES	Extreme Difficulty or Unable to Perform Activity	Quite a bit of Difficulty	Moderate Difficulty	A Little bit of Difficulty	No Difficulty
a. Any of your usual work, housework or school activities.	0	1	2	3	4
b. Your usual hobbies, recreational or sporting activities.	0	1	2	3	4
c. Getting into or out of the bath.	0	1	2	3	4
d. Walking between rooms.	0	1	2	3	4
e. Putting on your shoes or socks.	0	1	2	3	4
f. Squatting.	0	1	2	3	4
g. Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
h. Performing light activities around your home.	0	1	2	3	4
i. Performing heavy activities around your home.	0	1	2	3	4
j. Getting into or out of a car.	0	1	2	3	4
k. Walking 2 blocks.	0	1	2	3	4
l. Walking a mile.	0	1	2	3	4
m. Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
n. Standing for 1 hour.	0	1	2	3	4
o. Sitting for 1 hour.	0	1	2	3	4
p. Running on even ground.	0	1	2	3	4
q. Running on uneven ground.	0	1	2	3	4
r. Making sharp turns while running fast.	0	1	2	3	4
s. Hopping.	0	1	2	3	4
t. Rolling over in bed.	0	1	2	3	4
Column Totals:					

Score: ____ / 80 = _______ %

Scoring:
Total Possible Score = 80
Calculate score as percentage.

Appendix 7 – Oswestry [119]

Oswestry Low Back Pain Disability Questionnaire

Instructions

This questionnaire has been designed to give us information as to how your back or leg pain is affecting your ability to manage in everyday life. Please answer by checking ONE box in each section for the statement which best applies to you. We realise you may consider that two or more statements in any one section apply but please just shade out the spot that indicates the statement which most clearly describes your problem.

Section 1 – Pain intensity

- ☐ I have no pain at the moment
- ☐ The pain is very mild at the moment
- ☐ The pain is moderate at the moment
- ☐ The pain is fairly severe at the moment
- ☐ The pain is very severe at the moment
- ☐ The pain is the worst imaginable at the moment

Section 2 – Personal care (washing, dressing etc)

- ☐ I can look after myself normally without causing extra pain
- ☐ I can look after myself normally but it causes extra pain
- ☐ It is painful to look after myself and I am slow and careful
- ☐ I need some help but manage most of my personal care
- ☐ I need help every day in most aspects of self-care
- ☐ I do not get dressed, I wash with difficulty and stay in bed

Section 3 – Lifting

- ☐ I can lift heavy weights without extra pain
- ☐ I can lift heavy weights but it gives extra pain
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. on a table
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- ☐ I can lift very light weights
- ☐ I cannot lift or carry anything at all

Section 4 – Walking*

- ☐ Pain does not prevent me walking any distance
- ☐ Pain prevents me from walking more than 1 mile
- ☐ Pain prevents me from walking more than 1/2 mile
- ☐ Pain prevents me from walking more than 100 yards
- ☐ I can only walk using a stick or crutches
- ☐ I am in bed most of the time

Section 5 – Sitting

- ☐ I can sit in any chair as long as I like
- ☐ I can only sit in my favourite chair as long as I like
- ☐ Pain prevents me sitting more than one hour
- ☐ Pain prevents me from sitting more than 30 minutes
- ☐ Pain prevents me from sitting more than 10 minutes
- ☐ Pain prevents me from sitting at all

Section 6 – Standing

- ☐ I can stand as long as I want without extra pain
- ☐ I can stand as long as I want but it gives me extra pain
- ☐ Pain prevents me from standing for more than 1 hour
- ☐ Pain prevents me from standing for more than 30 minutes
- ☐ Pain prevents me from standing for more than 10 minutes
- ☐ Pain prevents me from standing at all

Section 7 – Sleeping

- ☐ My sleep is never disturbed by pain
- ☐ My sleep is occasionally disturbed by pain
- ☐ Because of pain I have less than 6 hours sleep
- ☐ Because of pain I have less than 4 hours sleep
- ☐ Because of pain I have less than 2 hours sleep
- ☐ Pain prevents me from sleeping at all

Section 8 – Sex life (if applicable)

- ☐ My sex life is normal and causes no extra pain
- ☐ My sex life is normal but causes some extra pain
- ☐ My sex life is nearly normal but is very painful
- ☐ My sex life is severely restricted by pain
- ☐ My sex life is nearly absent because of pain
- ☐ Pain prevents any sex life at all

Section 9 – Social life

- ☐ My social life is normal and gives me no extra pain
- ☐ My social life is normal but increases the degree of pain
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests eg, sport
- ☐ Pain has restricted my social life and I do not go out as often
- ☐ Pain has restricted my social life to my home
- ☐ I have no social life because of pain

Section 10 – Travelling

- ☐ I can travel anywhere without pain
- ☐ I can travel anywhere but it gives me extra pain
- ☐ Pain is bad but I manage journeys over two hours
- ☐ Pain restricts me to journeys of less than one hour
- ☐ Pain restricts me to short necessary journeys under 30 minutes
- ☐ Pain prevents me from travelling except to receive treatment

Appendix 8: PDI (Tait, Chibnall, and Krause, 1990)

Pain Disability Index

Pain Disability Index: The rating scales below are designed to measure the degree to which aspects of your life are disrupted by chronic pain. In other words, we would like to know how much pain is preventing you from doing what you would normally do or from doing it as well as you normally would. Respond to each category indicating the overall impact of pain in your life, not just when pain is at its worst.

For each of the 7 categories of life activity listed, please circle the number on the scale that describes the level of disability you typically experience. A score of 0 means no disability at all, and a score of 10 signifies that all of the activities in which you would normally be involved have been totally disrupted or prevented by your pain.

Family/Home Responsibilities: This category refers to activities of the home or family. It includes chores or duties performed around the house (e.g. yard work) and errands or favors for other family members (e.g. driving the children to school).
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Recreation: This disability includes hobbies, sports, and other similar leisure time activities.
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Social Activity: This category refers to activities, which involve participation with friends and acquaintances other than family members. It includes parties, theater, concerts, dining out, and other social functions.
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Occupation: This category refers to activities that are part of or directly related to one's job. This includes non-paying jobs as well, such as that of a housewife or volunteer.
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Sexual Behavior: This category refers to the frequency and quality of one's sex life.
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Self Care: This category includes activities, which involve personal maintenance and independent daily living (e.g. taking a shower, driving, getting dressed, etc.)
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Life-Support Activities: This category refers to basic life supporting behaviors such as eating, sleeping and breathing.
No Disability 0__. 1__. 2__. 3__. 4__. 5__. 6__. 7 __. 8__. 9__. 10__. Worst Disability

Signature________________________ **Please Print**______________________

Date ____________

Appendix 9: BPI [112]

1903

Date: ___ / ___ / ___
(month) (day) (year)

Subject's Initials : ____________

Study Subject #: ________

PLEASE USE BLACK INK PEN

Study Name: ______________________________

Protocol #: ______________________________

PI: ______________________________

Revision: 07/01/05

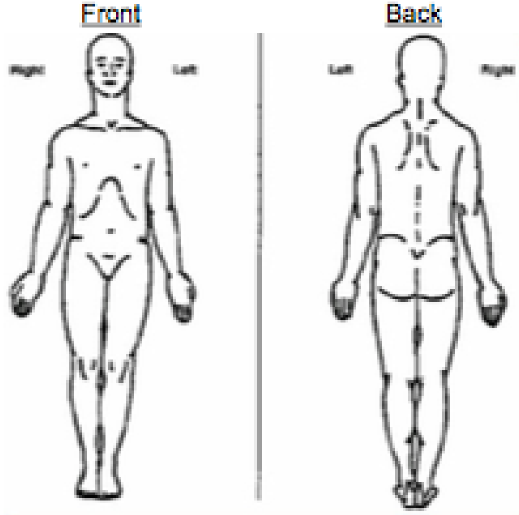
Brief Pain Inventory (Short Form)

1. Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, and toothaches). Have you had pain other than these everyday kinds of pain today?

☐ Yes ☐ No

2. On the diagram, shade in the areas where you feel pain. Put an X on the area that hurts the most.

Front Back



3. Please rate your pain by marking the box beside the number that best describes your pain at its worst in the last 24 hours.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

No Pain — Pain As Bad As You Can Imagine

4. Please rate your pain by marking the box beside the number that best describes your pain at its least in the last 24 hours.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

No Pain — Pain As Bad As You Can Imagine

5. Please rate your pain by marking the box beside the number that best describes your pain on the average.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

No Pain — Pain As Bad As You Can Imagine

6. Please rate your pain by marking the box beside the number that tells how much pain you have right now.

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

No Pain — Pain As Bad As You Can Imagine

Page 1 of 2

1503

PLEASE USE BLACK INK PEN

Date: ☐☐ / ☐☐ / ☐☐
(month) (day) (year)

Subject's Initials : ____________

Study Subject #: ☐☐☐☐

Study Name: ______________________________

Protocol #: ______________________________

PI: ______________________________

Revision: 07/01/05

7. What treatments or medications are you receiving for your pain?

8. In the last 24 hours, how much relief have pain treatments or medications provided? Please mark the box below the percentage that most shows how much relief you have received.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
No Relief										Complete Relief

9. Mark the box beside the number that describes how, during the past 24 hours, pain has interfered with your:

A. General Activity

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

B. Mood

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

C. Walking ability

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

D. Normal Work (includes both work outside the home and housework)

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

E. Relations with other people

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

F. Sleep

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

G. Enjoyment of life

☐ 0 Does Not Interfere ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Completely Interferes

Appendix 10: PHQ-9 [124]

Patient Health Questionnaire (PHQ-9)

Patient name: ________________________________ Date: __________________

1. Over the last 2 weeks, how often have you been bothered by any of the following problems?

	Not at all (0)	Several days (1)	More than half the days (2)	Nearly every day (3)
a. Little interest or pleasure in doing things.	☐	☐	☐	☐
b. Feeling down, depressed, or hopeless.	☐	☐	☐	☐
c. Trouble falling/staying asleep, sleeping too much.	☐	☐	☐	☐
d. Feeling tired or having little energy.	☐	☐	☐	☐
e. Poor appetite or overeating.	☐	☐	☐	☐
f. Feeling bad about yourself, or that you are a failure, or have let yourself or your family down.	☐	☐	☐	☐
g. Trouble concentrating on things, such as reading the newspaper or watching TV.	☐	☐	☐	☐
h. Moving or speaking so slowly that other people could have noticed. Or the opposite; being so fidgety or restless that you have been moving around more than usual.	☐	☐	☐	☐
i. Thoughts that you would be better off dead or of hurting yourself in some way.	☐	☐	☐	☐

2. If you checked off any problem on this questionnaire so far, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

☐ Not difficult at all ☐ Somewhat difficult ☐ Very difficult ☐ Extremely difficult

TOTAL SCORE ______________

Appendix 11: AFAQ [13]

Université Concordia University

Name: **Sport:** **Date:**

Athletic Fear Avoidance Questionnaire (AFAQ)

Instructions: We are interested in your feelings or thoughts when in pain as a result of a sport injury. Using the following scale, please indicate the degree to which you have these thoughts and feelings when you are in pain due to a sports injury.

Rating	**1**	**2**	**3**	**4**	**5**
Meaning	Not at all	To a slight degree	To a moderate degree	To a great degree	Completely agree

Statement	Rating
1. I will never be able to play as I did before my injury	
2. I am worried about my role with the team changing	
3. I am worried about what other people will think of me if I don't perform at the same level	
4. I am not sure what my injury is	
5. I believe that my current injury has jeopardized my future athletic abilities	
6. I am not comfortable going back to play until I am 100%	
7. People don't understand how serious my injury is	
8. I don't know if I am ready to play	
9. I worry if I go back to play too soon I will make my injury worse	
10. When my pain is intense, I worry that my injury is a very serious one	

Appendix 12: Z-Scores for functional questionnaires

Participant No.	IO Function	Function RTC	IO Z score	Z score RTP	Z score change
3	48.8	0	0.006	1.096	-1.089
4	30	6.3	0.847	0.304	0.543
6	46.3	7.5	0.119	0.146	-0.028
10	22.5	1.7	-0.983	-1.074	0.091
11	16.3	2.5	1.463	0.779	0.684
14	18.8	0	1.351	1.096	0.255
15	15	0	1.519	1.096	0.424
16	25	0	1.071	1.096	-0.025
17	12.5	13.8	1.631	-0.645	2.277
18	70	2.5	-0.946	0.779	-1.725
19	76.3	32.5	-1.226	-3.020	1.793
20	48.8	15	0.006	-0.804	0.810
21	37.5	11.3	0.511	-0.329	0.840
23	47.5	5	0.062	0.463	-0.400
25	30	0	0.847	1.096	-0.249
26	38.3	6.7	-0.135	-0.493	0.357
29	72.5	5	-1.058	0.463	-1.521
30	32.5	0	0.735	1.096	-0.361
31	80	18.8	-1.394	-1.278	-0.116
34	73.8	12.5	-1.114	-0.487	-0.627
35	49.2	12.5	0.449	0.182	0.268
36	78.8	20	-1.338	-1.437	0.098
37	37.5	25	-0.178	1.635	-1.813
39	32.5	20	-0.447	1.054	-1.500
40	22.5	13.3	-0.983	0.275	-1.258
42	67.5	11.3	-0.834	-0.329	-0.505
43	47.5	6.3	0.062	0.304	-0.242
44	83.8	5	-1.562	0.463	-2.025
46	70	15	-0.946	-0.804	-0.142
52	43.3	8.3	0.133	-0.307	0.439
53	45	11.3	0.175	-0.329	0.503
54	53.8	15	-0.218	-0.804	0.586
56	80.8	0	2.144	-1.272	3.416
58	43.8	8.8	0.231	-0.012	0.243

Appendix 12 a: Correlation matrix between injury onset values and days to RTC and the change in function

		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Days to RTC	.363*	.458**	0.228	.358*	0.314	.543**	.371*	0.135	0.08	0.151	-0.05	-0.065	0.012	0.133	0.045	.368*
2	Function Δ		0.212	0.083	.486**	-0.09	0.266	0.269	0.254	-0.083	0.124	0.161	-0.053	-0.033	-0.152	-0.103	.929**
3	PHQ-9	0.212		-0.012	0.305	-0.032	.463**	.603**	0.014	-0.108	-0.01	0.08	0.246	0.149	0.063	0.166	0.255
4	Pain Severity	0.083	-0.012		0.261	.639**	.398*	0.049	0.171	0.129	0.137	0.19	0.098	0.119	0.278	0.207	0.098
5	PDI	.486**	0.305	0.261		0.116	.653**	0.213	0.333	0.137	0.269	0.212	0.088	0.043	-0.029	0.031	.544**
6	BPI(PS)	-0.09	-0.032	.639**	0.116		.358*	0.104	0.018	0.081	0.099	-0.072	0.147	0.126	.363*	0.27	-0.044
7	BPI(PI)	0.266	.463**	.398*	.653**	.358*		.394*	.400*	0.066	.364*	0.328	0.131	0.063	0.286	0.207	.343*
8	AFAQ	0.269	.603**	0.049	0.213	0.104	.394*		.466**	-0.004	.369*	.334*	.382*	.411*	.336*	.428*	0.313
9	FABQ(PA)	0.254	0.014	0.171	0.333	0.018	.400*	.466**		0.136	.784**	.648**	.416*	.368*	.372*	.445**	0.331
10	FABQ(W)	-0.083	-0.108	0.129	0.137	0.081	0.066	-0.004	0.136		.506**	0.132	0.275	0.147	.495**	.388*	0.008
11	FABQ	0.124	-0.01	0.137	0.269	0.099	.364*	.369*	.784**	.506**		.655**	.567**	.442**	.617**	.642**	0.236
12	TSK	0.161	0.08	0.19	0.212	-0.072	0.328	.334*	.648**	0.132	.655**		.445**	.524**	.350*	.491**	0.231
13	PCS(Rum)	-0.053	0.246	0.098	0.088	0.147	0.131	.382*	.416*	0.275	.567**	.445**		.617**	.650**	.871**	0.068
14	PCS(Mag)	-0.033	0.149	0.119	0.043	0.126	0.063	.411*	.368*	0.147	.442**	.524**	.617**		.569**	.804**	0.105
15	PCS(Help)	-0.152	0.063	0.278	-0.029	.363*	0.286	.336*	.372*	.495**	.617**	.350*	.650**	.569**		.899**	-0.064
16	PCS	-0.103	0.166	0.207	0.031	0.27	0.207	.428*	.445**	.388*	.642**	.491**	.871**	.804**	.899**		0.025
17	Function	.929**	0.255	0.098	.544**	-0.044	.343*	0.313	0.331	0.008	0.236	0.231	0.068	0.105	-0.064	0.025	

Appendix 12 b: Correlation matrix between the change in variable scores from injury onset to RTC and days to RTC and change in function

		2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Days to RTP	.363*	.343*	0.315	.416*	.556**	0.332	0.015	0.051	0.022	-0.014	-0.193	0.064	0.05	-0.045
2	Function Change		0.175	.458**	0.047	0.302	0.283	0.113	-0.079	0.038	0.208	-0.03	-0.031	-0.231	-0.133
3	Δ in Pain Severity	0.175		0.237	.743**	0.225	0.142	0.182	-0.109	0.076	0.059	0.107	0.179	0.198	0.196
4	PDI Δ	.458**	0.237		0.239	.632**	0.247	0.21	0.037	0.175	0.326	0.187	0.072	0.019	0.115
5	BPI(PS) Δ	0.047	.743**	0.239		.362*	0.202	0.31	-0.075	0.283	0.207	0.055	0.086	0.278	0.183
6	BPI(PI) Δ	0.302	0.225	.632**	.362*		.338*	0.258	-0.06	0.206	0.25	0.204	0.093	0.297	0.261
7	AFAQ Δ	0.283	0.142	0.247	0.202	.338*		0.271	0.117	0.241	0.03	-0.043	0.252	0.16	0.131
8	FABQ(PA) Δ	0.113	0.182	0.21	0.31	0.258	0.271		-0.002	.895**	.629**	0.275	0.084	0.219	0.254
9	FABQ(W) Δ	-0.079	-0.109	0.037	-0.075	-0.06	0.117	-0.002		0.24	0.155	0.059	0.132	.376*	0.244
10	FABQ Δ	0.038	0.076	0.175	0.283	0.206	0.241	.895**	0.24		.617**	0.212	0.126	0.256	0.255
11	TSK Δ	0.208	0.059	0.326	0.207	0.25	0.03	.629**	0.155	.617**		.358*	0.211	0.221	0.331
12	PCS(Rum) Δ	-0.03	0.107	0.187	0.055	0.204	-0.043	0.275	0.059	0.212	.358*		0.259	.573**	.804**
13	PCS(Mag) Δ	-0.031	0.179	0.072	0.086	0.093	0.252	0.084	0.132	0.126	0.211	0.259		.577**	.689**
14	PCS(Help) Δ	-0.231	0.198	0.019	0.278	0.297	0.16	0.219	.376*	0.256	0.221	.573**	.577**		.906**
15	PCS Δ	-0.133	0.196	0.115	0.183	0.261	0.131	0.254	0.244	0.255	0.331	.804**	.689**	.906**	

Appendix 13: Full Regression analysis

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	960.954	4	240.239	4.086	.009[b]
	Residual	1763.732	30	58.791		
	Total	2724.686	34			

a. Dependent Variable: Days to RTP

b. Predictors: (Constant), AFAQ Baseline, PDI Baseline, PHQ-9 Baseline, PBI-PI Baseline

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	1.752	6.277		.279	.782	-11.068	14.572
	PHQ-9 Baseline	.624	.544	.222	1.148	.260	-.486	1.735
	PDI Baseline	.008	.143	.011	.055	.957	-.285	.300
	PBI-PI Baseline	2.184	1.148	.403	1.902	.067	-.161	4.529
	AFAQ Baseline	.123	.302	.076	.407	.687	-.494	.740

Coefficients[a]

Model		Correlations: Zero-order	Correlations: Partial	Correlations: Part	Collinearity Statistics: Tolerance	Collinearity Statistics: VIF
1	(Constant)					
	PHQ-9 Baseline	.458	.205	.169	.574	1.741
	PDI Baseline	.358	.010	.008	.570	1.755
	PBI-PI Baseline	.543	.328	.279	.481	2.077
	AFAQ Baseline	.371	.074	.060	.616	1.625

Collinearity Diagnostics[a]

Model	Dimension	Eigen-value	Condition Index	Variance Proportions: Constant	PHQ-9	PDI	BPI(PI)	AFAQ
1	1	4.330	1.000	.00	.01	.01	.00	.00
	2	.366	3.439	.01	.66	.02	.00	.00
	3	.214	4.496	.04	.00	.42	.02	.03
	4	.071	7.833	.02	.05	.53	.96	.01
	5	.020	14.850	.92	.28	.02	.01	.96