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ORIGINAL RESEARCH

Longitudinal Validation of a Specific Measure of Fear Avoidance in Athletes: Predicting Time from Injury to Return to Sports Competition

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Purpose: We developed the Athlete Fear Avoidance Questionnaire (AFAQ) to measure fear avoidance in athletes. Previous fear avoidance scales were developed for the general population and have demonstrated significant predictive capabilities regarding rehabilitation. No research to date has examined the association between athlete fear avoidance as measured by the AFAQ and the rehabilitation time in athletes.

Patients and Methods: Fifty-nine athletes who were injured during sport season participated in the study (40 males and 19 females). At injury onset, all participants completed self-report functional questionnaires. In addition, we measured multiple aspects of fear avoidance including athlete fear avoidance (AFAQ), kinesiophobia (TSK), and pain catastrophizing (PCS). Finally, we assessed pain severity and interference, as well as depression. Once the athletes were able to return to competition all participants answered the questionnaires again. Pearson correlations and a regression analysis were used to identify relationships between function, psychological variables, pain, and return to competition time.

Results: The AFAQ yielded the strongest correlation with return to competition time (r=0.544, p<0.001). In addition, function at initial injury time and pain interference were also significantly correlated with return to competition time (r=0.442, p<0.001 and r=0.356, p=0.006 respectively). Athlete fear-avoidance combined with function at the time of injury explained 34% of the variance of return to competition time in the multivariate regression model (p<0.001).

Conclusion: Athlete fear-avoidance as measured by the AFAQ is associated with rehabilitation time and returning to competition in injured athletes. Psychosocial factors including athlete fear avoidance may explain why some athletes take longer to rehabilitate than others and should be evaluated in athletes who are taking longer than anticipated to complete their rehabilitation. Reducing athlete fear avoidance may facilitate rehabilitation in future studies.

Keywords: catastrophizing, kinesiophobia, psychosocial factors, rehabilitation

Introduction

The biopsychosocial model for pain is a theoretical framework that has been widely accepted and used in the field of pain management by therapists who work with the general population.[1] However, the biopsychosocial model for pain has not been fully accepted in the sports world including athletes and clinicians. It is well established that biopsychosocial measures such as fear avoidance are significantly associated with chronic pain and are part of the standard guidelines for physical therapists' treating chronic low back pain.[2] In athletes, there is evidence to suggest that kinesiophobia or pain catastrophizing can affect the rehabilitation after an ACL reconstruction and with other injuries.[3–5] Recently, the International Olympic Committee acknowledged that psychosocial factors can be used for the non-pharmacological treatment of elite athletes.[6] However, there is evidence to suggest that clinicians who treat athletes are still using more of a biomedical approach to pain as opposed to the biopsychosocial model.[7] Something that might be contributing to the lack of overall acceptance is that most previous studies examining fear avoidance in athletes focus on specific injuries which means the results are less generalizable.[5,8–15]

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Another barrier to the acceptance of the biopsychosocial model in athletes is that the scales commonly used to measure pain-related fear were developed for the general population and not athletes.[8,16] The original biopsychosocial model was developed to explain why some people develop chronic pain and others do not.[17] The measures that are commonly used to assess pain-related fear include the Tampa Scale of Kinesiophobia (TSK) and the Fear Avoidance Beliefs Questionnaire (FABQ).[8,18] These scales have questions that athletes may not resonate with including "My accident has put my body at risk for the rest of my life" (TSK) and "My work aggravated my pain" (FABQ). It is possible that if the scales were more athlete specific, then the measurement of athlete fear avoidance might be more accurate and could better reflect changes in rehabilitation outcomes. Other measures such as depression and anxiety have also been associated with injuries, however athletes may have a different relationship with anxiety and depression compared to the general population.[19,20]

A more athlete-specific scale that can measure fear avoidance in athletes was needed which is why we developed the Athlete Fear Avoidance Questionnaire (AFAQ).[21] Our first study established the validity of the scale in healthy athletes.[21] The current purpose of our study is to test the longitudinal validity of the AFAQ and to examine the relationship between athlete fear avoidance and rehabilitation. This study serves as our proof-of-concept for testing the AFAQ if it can have a similar predictive capability regarding acute injury rehabilitation as what was established using the TSK and FABQ in the general population. If a psychosocial measure was able to predict how long an athlete would take to rehabilitate, that would be of interest to clinicians and athletes who are involved in competitive athletics. The hypothesis is that injured athletes with a high fear-avoidance score on the Athlete Fear Avoidance Questionnaire (AFAQ) will be associated with a longer return to competition. It is part of the purpose of the study to test the longitudinal validity of the AFAQ.

Materials and Methods

Since this is a proof-of-concept study to test the longitudinal validity of the AFAQ. There is no pre-existing data on athlete fear avoidance on injured athletes to complete the a priori power analysis. We recruited all participants for this study from one university over the 2017–2018 and 2018–2019 competition seasons. Participants included athletes from the men's American football team and the men and women's hockey, basketball, soccer and rugby teams. At the beginning of the pre-season for each sport, we met with and presented the research to each team as measuring the psychological impact of being injured and not specifically tied to return to competition time to avoid bias. Each student-athlete signed a consent form (IRB #30006430 approved by Concordia university's research ethics board) giving permission to the certified athletic therapist of every team to communicate with us when an athlete suffered an injury and thereafter participate if they qualified for the study. Our study complies with the Declaration of Helsinki.

The inclusion criteria of the study were that the participant had to be a member of a varsity team and have sustained a musculoskeletal injury which kept them out of sport for at least one practice or match. This definition of injury has been used in previous studies.[22] Exclusion criteria were 1) concomitant concussion, 2) fracture, 3) injury requiring surgery, 4) athletes who did not return to competition and 5) returning to competition after the season has ended. We excluded participants with concussions, fractures, and surgeries from the study as their healing rate can be influenced by many factors not associated with biopsychosocial factors. Moreover, an athlete who only recovered after the season or playoffs may have less desire to return to practice or training as they would during the season which could influence their return to competition time.

The measures assessed in this study were self-reported function, fear-avoidance measures (athlete fear-avoidance, fear-avoidance, kinesiophobia and pain catastrophizing), pain severity and interference, and depression which were all measured with questionnaires.

Function (Level of Injury)

Depending on the site of injury of the athlete, we used a different functional scale to assess the deficit in function due to injury. No objective measures of function were taken since it is challenging to compare range of motion and strength across body parts.

We used the Lower Extremity Functional Scale (LEFS) questionnaire to measure function in an athlete if they had a hip, quadriceps, hamstring, knee, lower leg, ankle or foot injury.[23] The LEFS is comprised of questions pertaining to the level of difficulty the athlete has when engaging in different physical activities targeting the lower extremity such as running and walking. Total scores range from 0 to 80 with 80 indicating no disability at all. The LEFS has been shown to be reliable (α=0.96) and has good construct validity when compared to the physical function subscale of the Short Health Form (SF-36) (r=0.80).[23] The LEFS instrument was validated in athletic populations by Alcock and Stratford in 2002.[24]

We used the Disability of the Arm, Shoulder and Hand questionnaire (DASH) to measure function in an athlete if they had a shoulder, upper arm, elbow, forearm, wrist or hand injury.[25] The DASH assesses the difficulty level experienced by the athlete when performing different physical activities targeting the upper extremity such as writing or putting on clothes. The DASH's scores range from 30 to 150 with higher scores indicating more disability. The DASH also demonstrated construct validity compared to the SF-36 (r=0.59) but more importantly the DASH had the best clinometric property ratings when compared to other upper extremity function scales.[25] The study by Hsu et al validated the DASH to assess levels of function in athletes and determined using the DASH that intercollegiate athletes have better upper extremity function compared to the general population.[13]

We used the Oswestry Low Back Disability questionnaire to measure low back function. The Oswestry is comprised of questions pertaining to the difficulty the athlete has in engaging in activities such as travelling, sitting and walking.[26] Total scores range from 0 to 50 with 50 indicating the greatest level of disability. The Oswestry questionnaire has been shown to have excellent construct validity (α=0.85) and the ability to discriminate between levels of severity of disability.[26] The Oswestry Low Back Disability questionnaire is a reliable and valid instrument for assessing disability in athletes with low back pain.[27]

Since each scale has a different range, we converted each score to a number out of 100. Also, since a higher level of disability is indicated by a lower score on the LEFS and a higher score on the DASH and Oswestry, we reversed the LEFS so that all the scales were out of 100 with a lower number being more functional. The raw LEFS score was transformed using the formula: x=80-((80*total score)/100). The raw DASH score was transformed using the formula: x=((total score/30)-1)*25. The raw Oswestry score was multiplied by two.

Fear-Avoidance, Kinesiophobia and Pain Catastrophizing

Athlete fear-avoidance was measured with the Athlete Fear Avoidance Questionnaire (AFAQ), fear-avoidance was measured with the Fear-Avoidance Belief Questionnaire (FABQ), kinesiophobia was measured with the Tampa Scale of Kinesiophobia (TSK) and pain catastrophizing was measured with the Pain Catastrophizing Scale (PCS).

The AFAQ was developed in 2015 to measure fear-avoidance beliefs in an athletic population.[21] One of the goals of this questionnaire was to provide potential insight into how athlete fear-avoidance behavior could influence an athlete's rehabilitation. The AFAQ's total scores range from 10 to 50 with a higher score indicating greater fear-avoidance beliefs. The AFAQ has been shown to have good reliability (α=0.805) and validity (r=0.587 when compared to the PCS).[21]

The FABQ is composed of two sections: fear-avoidance beliefs about physical activity and fear-avoidance beliefs about work. Only the section about physical activity (FABQ-PA) was used in the current study. It was originally developed for patients with low back pain in the general population.[8] The physical activity section's total scores range from 0 to 30 with a higher score indicating greater fear-avoidance regarding physical activity. The FABQ has been shown to be valid (r=0.88) and reliable (α=0.77).[8]

The TSK is a questionnaire that assesses kinesiophobia. The TSK's total scores range from 17 to 68 where higher scores indicate a higher level of kinesiophobia.[18] The TSK scale was established in 1990 and was originally developed to measure kinesiophobia in the general population experiencing low back pain and has been shown to be valid and reliable (α=0.77) in discriminating between an irrational phobia and normal fear of movement.[18] The TSK instrument has a significant research evidence to support its effectiveness in measuring lack of self-confidence or psychological readiness during sports activities in athletes with musculoskeletal injuries.[27] Suer et al, Huang et al, and Watson et al agreed with the finding that that kinesiophobia is an excellent specific psychological tool to assess for the readiness to return to sports in athletes.[31–33]

The PCS is used to assess the magnitude of pain catastrophizing thoughts (exaggeration of the negative threat value of pain) one engages in and was originally developed for the general population experiencing chronic pain.[28] Total scores range from 0 to 52 with a higher number indicating a greater pain catastrophizing tendency. The PCS has been shown to be valid (r=0.70) and reliable (α=0.87) and has been cited over 4000 times.[28] The Pain Catastrophizing Scale (PCS) is a tool that measures the degree to which an individual focuses on the worst possible outcome of their pain.[34] Sullivan et al, who created the PCS, published a study on the relationship between catastrophizing and pain in sports participants.[34] In athletes, catastrophizing was a significant predictor of pain experience.[34] In addition this scale has been translated into many languages and used in many countries.[35] For example, in 2013, a study by Olmedilla Zafra et al validated the PCS for use in Spanish athletes, showing that it is a valid and reliable tool for measuring pain catastrophizing in this population.[36] The study also found that the PCS can distinguish between athletes with different levels of pain catastrophizing.[36]

Pain Intensity and Pain Interference

The Brief Pain Inventory (BPI) is a questionnaire measuring several aspects of the pain a person is experiencing.[29] The main sections are pain location, pain severity, pain relief and pain interference. For the current study, we only used the pain severity (BPI-PS) and pain interference (BPI-PI) sections, both of which have shown to have good reliability (α=0.87–0.91) and validity (r=0.61–0.74 when compared to the Short Health Form-36).[29] The pain severity section is composed of four questions which assess the intensity of the pain on a 10-point scale, 0 being no pain at all and 10 being "pain as bad as you can imagine". We calculated the score of this section by adding the numerical value of each answer and dividing the sum by the number of questions (4). The pain interference section is composed of seven questions which assess to what extent the pain experienced interferes with different spheres of daily life such as sleeping and social interactions. We calculated the score of the pain interference section the same way as the pain intensity score. Mkumbuzi et al confirmed that the Brief Pain Inventory is a valid tool for measuring pain intensity and impact in athletes.[37] The study included a sample of athletes from various sports and found that the BPI can be used to accurately assess and manage pain in this population.[37]

Depression

We measured depression using the Patient Health Questionnaire (PHQ-9), a self-administered assessment tool for depression which asks the patient to rate the frequency at which they experience each depressive symptom entering in the criteria for depression diagnosis.[30] Total scores range from 0 to 27 with cut-off scores of 5, 10, 15 and 20 having been used as the lower thresholds for mild, moderate, moderately severe and severe depression. The PHQ-9 has been shown to be a valid (r=0.73 with the mental health section of the Short-Form General Health Survey-20 scale) and reliable (α=0.86–0.89) tool to measure depression severity.[30] Green (2019) validated the use of PHQ-9 for measuring depression symptoms in athletes.[38] The study included a sample of athletes from various sports and found that the PHQ-9 is a valid and reliable tool for identifying depression in athletes and can be used to monitor changes in depression symptoms over time.[38]

Procedures

Once an athlete suffered an injury, the research assistant evaluated the athlete within 24 hours of sustaining the injury to determine if they fit the inclusion criteria. If they did, we explained the questionnaires to the athlete who subsequently filled them out (injury onset time). Then, we would monitor the progress of the rehabilitation of the athlete until they were cleared to return to competition by the health care professional associated with their team. The treating healthcare professionals were not part of the research staff and therefore were blinded to the questionnaire and research results. Once they were cleared to return to competition, the athlete completed the same questionnaires as at the time of injury (return to competition time). If the athlete did not present themself to this follow-up appointment, they were no longer eligible to participate in the study and were excluded.

Statistical Analysis

We generated a participant demographic table using calculated means and standard deviations for age, stature, body mass and years of involvement in their sport. We used paired Student's t-tests to compare the injury onset values of function, AFAQ, FABQ-PA, TSK, PCS, BPI-PI, BPI-PS and PHQ-9 to their respective return to competition time values. We used the Bonferroni correction to adjust the *p*-value due to the multiple *t*-tests. Next, we used Pearson correlations to identify any significant relationships between all the variables at injury onset (function, AFAQ, FABQ-PA, TSK, PCS, BPI-PI, BPI-PS and PHQ-9) and return to competition time. Finally, we performed univariable and multivariable linear regression analyses in order to determine the association between the time to return to competition (dependent variable) and function, AFAQ, FABQ-PA, TSK, PCS, BPI-PI, BPI-PS and PHQ-9 as well as sex and injury site (independent variables). Variables with a univariate significance of <0.20 were candidates for the multivariable model. Variables with a *p*-value greater than 0.05 were removed from the multivariable model after being assessed as potential confounders (variables leading to a ±15% change in the beta coefficients of the significant variables included in the multivariable model). We used diagnostic plots and statistics to evaluate the final model assumptions and the effect of influential outliers. We checked for all assumptions and the diagnostic plots were used to verify the regression model assumptions and all assumptions were tenable.

Results

Fifty-nine athletes completed the study and were used in the analysis. See the CONSORT diagram (Figure 1) and Table 1 for demographic information.

The average return to competition time was 11.7 days with a standard deviation of 9.0 days. The shortest return to competition time was 2 days and the longest was 38 days. There was a significant improvement in all variables (function, AFAQ, FABQ-PA, TSK, PCS, BPI-PI, BPI-PS and PHQ-9) from injury onset time to return to competition time (Table 2).

Pearson correlations indicated that injury onset values of function, AFAQ and BPI-PI were significantly correlated to the time to return to competition (Table 3 and Table 4 for full correlation matrix).

The time to return to competition was significantly and positively associated with injury onset function, AFAQ and BPI-PI in the univariate analysis (Table 5). However, only function and AFAQ contributed significantly to return to competition time in the multivariate regression model (Table 5), explaining 34% of the variance in the time to return to competition.

The changes in the AFAQ and other variables as well as the regression were statistically significant with an R^2 of 0.36 and an adjusted R^2 of 0.33 and we have added the observed power and Cohen's for the results which will allow the reader to better interpret the results and outcomes of interest. Responsiveness was strong for the AFAQ with a Cohen's d effect size of 5.87 as seen in Table 6.

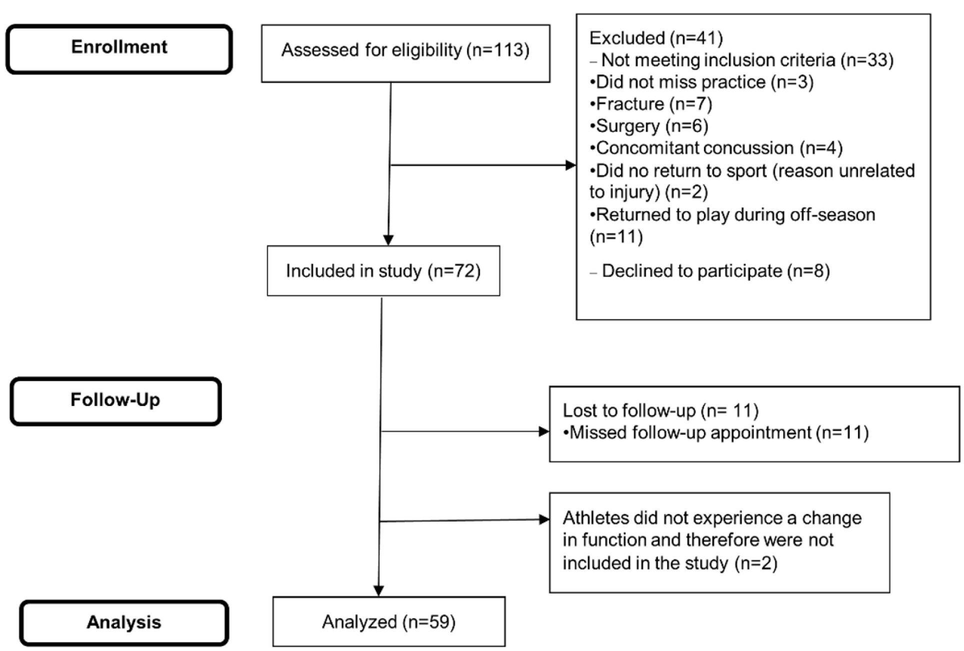

Figure 1 CONSORT flow diagram for athletes having suffered a musculoskeletal injury.

Table 1 Demographic Information of Athletes Having Suffered a Musculoskeletal Injury Included in the Study

Characteristic	Mean ± Standard Deviation
Participants = 59	40 males, 19 females
Age (years)	21.8±1.7
Stature (cm)	181.0±7.08 (male), 165.3±6.0 (female)
Body mass (kg)	94.0±18.4 (male), 65.8±10.3 (female)
Number of years involved in sports	13.7±4.6
Injury site	Lower: 44, Upper: 11, Back: 4

Table 2 Function, Fear-Avoidance Measures, Pain and Depression from Injury Onset to Return to Competition in Athletes Having Suffered a Musculoskeletal Injury

	Injury Onset Values	Return to Competition Values	*p*-value	Cohen's d	95% Confidence Interval	
					Lower	Upper
Function	43.2±20.9	8.5±8.4	<0.001	1.771	29.590	39.903
AFAQ	20.9±5.7	13.5±3.7	<0.001	1.538	5.827	8.885
FABQ-PA	20.0±5.2	11.2±7.0	<0.001	1.455	6.910	10.819
TSK	37.0±7.1	29.7±7.1	<0.001	1.035	5.262	9.246
PCS	10.7±8.4	4.1±6.4	<0.001	0.967	4.764	8.321
BPI-PS	3.9±1.3	0.9±1.0	<0.001	2.541	2.602	3.365
BPI-PI	3.0±1.6	0.3±0.5	<0.001	2.304	2.282	3.080
PHQ-9	2.9±3.2	1.9±2.6	0.004	0.365	0.341	1.761

Table 3 Pearson Correlations Identifying Significant Relationship Between Function, Athlete Fear-Avoidance and Pain Interference with Return to Competition Time in Athletes Having Suffered a Musculoskeletal Injury

Measure	Correlation Coefficient	*p*-value
Function	0.442	<0.001
AFAQ	0.544	<0.001
BPI-PI	0.356	0.006

Table 4 Pearson Correlation Matrix Between Function, Fear-Avoidance Measures, Pain and Depression at Injury Onset and Return to Competition Time in Athletes Having Suffered a Musculoskeletal Injury

AFAQ	**0.381***							
FABQ-PA	0.285*	0.228						
TSK	0.308*	0.475**	0.280*					
PCS	0.062	0.425**	0.038	0.432**				
BPI-PI	0.535**	0.453**	0.394**	0.370**	0.252			
BPI-PS	0.365*	0.260*	0.132	0.23	0.369**	0.299**		
PHQ-9	0.300*	0.340**	−0.056	−0.003	0.249	0.360**	0.009	
Days to RTC	0.442**	0.544**	0.222	0.195	0.156	0.356**	0.239	0.191
	Function	AFAQ	FABQ-PA	TSK	PCS	BPI-PI	BPI-PS	PHQ-9

Note: *p<0.05 and **p<0.001.

Table 5 Univariable and Multivariable Regression Models for Return to Competition Time Variance in Athletes Having Suffered a Musculoskeletal Injury

	RTC Time			
	Univariable Analysis [Coefficient, 95% CI]	***p*-value**	**Multivariable Analysis [Coefficient, 95% CI]**	***p*-value**
Function	0.19 [0.09, 0.29]	<0.001	0.68 [0.32, 1.05]	<0.001
AFAQ	0.85 [0.50, 1.20]	<0.001	0.12 [0.02, 0.22]	0.02
FABQ-PA	0.39 [−0.06, 0.84]	0.09		
TSK	0.25 [−0.08, 0.58]	0.12		
PCS	0.17 [−0.11, 0.44]	0.24		
BPI-PI	2.01 [0.61, 3.41]	0.006		
BPI-PS	1.59 [−0.12, 3.30]	0.07		
PHQ-9	0.54 [−0.20, 1.28]	0.15		
Sex	−3.25 [−8.21, 1.72]	0.20		
Injury site	−0.09 [−4.05, 3.87]	0.96		

Table 6 Paired Samples Effect Sizes of the Scores of Participants on the Athlete Fear Avoidance Questionnaire for Return to Competition After a Musculoskeletal Injury

		Paired Samples Effect Sizes			
		Standardizers	**Point Estimate**	**95% Confidence Interval**	
				Lower	**Upper**
AFAQ RTP – AFAQ Baseline	Cohen's d	5.87	−1.253	−1.592	−0.908
	Hedges' correction	5.91	−1.245	−1.582	−0.903

Discussion

Correlation Between Function, Athlete Fear-Avoidance, Pain Interference and Return to Competition Time

Only three factors measured at injury onset were significantly correlated to return to competition time: function, athlete fear avoidance, and pain interference. Athlete fear avoidance was the factor which was the most strongly correlated to return to competition time, more than the level of function and pain interference. In fact, athlete fear-avoidance had a univariate regression coefficient of 0.85 which indicates that for every increase of 1 on the AFAQ, the athlete would lengthen their return to competition time by 0.85 day. Our data suggests that athlete fear avoidance as measured by the AFAQ is related to rehabilitation of acute injuries in athletes. Moreover, the AFAQ was more associated with return to competition time compared to the other fear-avoidance model measures including the TSK and FABQ. Our data suggest that using an athlete-specific measure of fear avoidance may be better at assessing the influence of fear avoidance on the rehabilitation of musculoskeletal injuries in athletes. The AFAQ addresses some of the limitations of previous scales by including more sport-specific questions. Asking questions that are adapted to athletes makes it easier for them to answer correctly and gives a better idea of their fear-avoidance score. We believe that the AFAQ applies the principle of patient-centered approach and patient-specific medical care which has been associated with improved health outcomes.[39–41] In addition, our results support the importance of the fear-avoidance model in the rehabilitation of athletes from musculoskeletal injuries.

Elevated athlete fear-avoidance, or kinesiophobia may prolong rehabilitation time by interfering with completing rehabilitation exercises and subsequently altering muscle recruitment.[11,18] In patients with chronic low back pain, increased fear-avoidance as presented through hypervigilance and avoidance of painful situations was correlated with a higher rate of disuse.[11,18] Disuse presented itself either through a decrease in aerobic conditioning, weakened muscles or altered muscle coordination, owing to the patient's sub-par execution of the rehabilitation exercises.[11] Similarly, elevated fear of pain has been linked to a decrease in muscle endurance and activation, altered muscle recruitment strategies and neuromuscular deficits.[42] In fact, a study investigating an exercise-based treatment protocol for Achilles tendinopathy has indicated that 35% of muscle endurance recovery was explained by the participants' level of kinesiophobia.[42] It was hypothesized that the subjects exhibiting higher fear of movement were less likely to complete the exercises when experiencing pain, thus regaining less muscle endurance than those with lower levels of fear of movement.[42] Altered muscle activity such as decreased muscle endurance or altered coordination can then contribute to a lower functional level.

Function itself has also been shown to be influenced by fear-avoidance in athletes. This is supported by a study by Fischerauer et al indicating that fear-avoidance was the largest single factor, explaining 7.3% of the difference in self-reported physical function in a group of athletes having suffered a musculoskeletal injury.[43] Furthermore, there has been a consistent association between increased fear-avoidance and a decrease in self-reported function in the late stages of rehabilitation in a study investigating an ACL reconstruction population.[44] In the current study, kinesiophobia, fear avoidance, and athlete fear avoidance are significantly correlated with function at the time of injury onset which is consistent with previously published research.[43]

While pain interference was positively correlated to return to competition time, it was not significant when entered in the multivariate regression model and pain severity was not correlated to return to competition time at all. Pain interference can be hypothesized to be tied to function in light of the fear-avoidance model, since it is the erroneous interpretation of the pain rather than the severity of the pain that defines pain interference.[45] If the pain is seen to interfere greatly with activities, function will be perceived as low which is supported by a significant correlation between pain interference and function in the current study. Function then plays a role in return to competition time. It can also be hypothesized that greater pain interference can be a product of higher fear-avoidance beliefs and would play a role in athletes avoiding rehabilitation exercises. This is supported by a significant correlation between the AFAQ and pain interference scores in the current study.

Depression

Poor pain confrontation strategies including pain catastrophizing have been strongly associated with psychopathology such as depression and other negative emotions during the rehabilitation process.[19] This is not supported by the current study since depression scores were not associated with return to competition time, possibly because the levels of depression at injury onset were very low. Therefore, it would be important to monitor the depression scores in athletes who are repeatedly injured and the athletes who are not able to return to sport to the same level they once had. Adolescents and young adults who have shown to have higher levels of resilience and "mental toughness" have been shown to experience lower levels of depressive symptoms.[20] It is possible that our sample consisted of particularly resilient athletes whose injuries simply did not trigger high levels of depressive symptoms which in turn did not impact their return to competition time.

AFAQ as Compared to the FABQ, TSK, PCS

The FABQ, TSK and PCS measure factors within the fear-avoidance model which have been used in many studies which have helped establish the importance of the fear-avoidance model in injury rehabilitation in the general population.[18] However, in the current study, their injury onset values were not significantly correlated to the return to competition time while the AFAQ injury onset values were. As mentioned previously, a plausible explanation to the FABQ, TSK and PCS not being correlated to the return to competition time is that these scales are not specifically designed or worded for athletes and would not resonate with an athletic population.

Applicability of the Fear-Avoidance Model

The previously mentioned correlations occurred across the current sample of athletes with either a lower extremity, an upper extremity, or a low back musculoskeletal injury. While many fear-avoidance studies have solely looked at ACL reconstructions, an injury which is very consistent in its anatomical, functional and rehabilitation characteristics (with the exception of return to competition time), the current study design differs as it looks at a wide variety of injury sites and types. One of the strengths of our study was that the rehabilitation was completed at one university, therefore limiting the possible variability between different clinicians' rehabilitation. The continuity in rehabilitation techniques allowed us to standardize the rehabilitation to focus on the fear-avoidance model. The injury distribution in the current study was not homogenous but is consistent with that of the NCAA from 1988 to 2004 across 15 different sports which has shown that 53.8% of the injuries are lower extremity, 19.9% are upper extremity and 11.6% are trunk or back.[46] The heterogeneity of the injury sites and types in our study contributes to show that the fear-avoidance model can be applied independently of the injury site and type. The broad applicability of the fear-avoidance model is also supported by a study by Georges and Stryker[47] examining patients seeking physiotherapy treatment for musculoskeletal injuries. Their study indicated that fear-avoidance beliefs were similar across cervical, lumbar, lower extremity and upper extremity injuries. These results demonstrated that fear-avoidance beliefs contributed to pain intensity, function and clinical outcome independently from the site of injury.[47]

Biomedical versus Fear-Avoidance (Biopsychosocial) Models of Pain

The significant finding in the current study that athlete fear-avoidance beliefs were more strongly correlated to return to competition time than function contrasts with the typical biomedical model of pain. This biomedical model suggests a strong relationship between the level of injury and the decrease in function and posits that the more someone is injured, the more time they will take to heal. The athletes in this study had a significant level of injury as measured by the functional scales and was similar to patients with back, lower extremity, and upper extremity injuries in other studies suggesting that the athletes in this study were no less injured than in other studies.[48–50] Logically, it takes more time to rehabilitate someone to the level where they can return to competition if they have more physical damage thus more functional disability than someone who has less physical damage. This partially explains why function was significantly correlated to return to competition time in the current study. However, as per our results, the injury onset function was less correlated to the return to competition time than the injury onset athlete fear-avoidance. It is not necessary to completely abandon this biomedical model but rather understand the contribution that the fear-avoidance model has on injury rehabilitation.

Limitations

There are several limitations which should be kept in mind while interpreting the results of the current study. At times, the data collection had to occur in a very short span of time after the injury (a few hours). Some of the functional scales ask questions about different activities which the athletes might not have attempted since the injury. Thus, this required the athlete to imagine what their disability or pain was without having actually experienced the level of disability or pain associated to a certain activity which could have changed their answers in either direction.

The results of this study demonstrate that athlete fear-avoidance, function and pain interference at injury onset are significantly linked to return to competition time in university athletes after a musculoskeletal injury. Among these factors, the AFAQ, which specifically measures athlete fear-avoidance, was the factor which was the most strongly correlated with and can help predict return to competition time in this population. This research gives more support to the growing body of knowledge that psychological factors heavily influence return to competition time in athletes and should be addressed alongside the typical physical presentation of a musculoskeletal injury. The results are clinically important since they can give direction to what to investigate when certain athletes are taking longer to return to competition without an anatomical explanation. Our findings indicate that an increase in athlete fear avoidance was related to delayed return to competition. The AFAQ should be investigated in a larger sport cohort to establish cut-off scores and to provide clearer rehabilitation guidelines. In addition, future studies are needed to see if reducing an athlete's fear avoidance before getting injured could speed up the rehabilitation time.

Disclosure

The authors report no conflicts of interest in this work.

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