Journal of Athletic Training 2022;57(11/12):1048–1054
doi: 10.4085/1062-6050-0605.21

www.natajournals.org

Perceived Instability, Pain, and Psychological Factors for Prediction of Function and Disability in Individuals With Chronic Ankle Instability

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Context: Chronic ankle instability (CAI) is associated with residual instability, pain, decreased function, and increased disablement. Injury-related fear has been associated with CAI, although its relationship to other impairments is unclear. The fear-avoidance model is a theoretical framework hypothesizing a relationship among pain catastrophizing, injury-related fear, chronic pain, and disability. It has been useful in understanding fear's influence in other musculoskeletal conditions but has yet to be studied in those with CAI.

Objective: To explore relationships among instability, pain catastrophizing, injury-related fear, pain, ankle function, and global disability in individuals with CAI.

Design: Cross-sectional study.

Setting: Anonymous online survey.

Patients or Other Participants: A total of 259 people, recruited via email and social media, with a history of ankle sprain completed the survey; of those, 126 participants (age = 32.69 ± 4.38 years, females = 84.92%, highly active = 73.81%) were identified as having CAI and were included in the analysis.

Main Outcome Measure(s): Demographics of gender identity, age, and physical activity level were recorded. Assessments used were the Identification of Functional Ankle Instability questionnaire (instability), the Pain Catastrophizing Scale (pain catastrophizing), the Tampa Scale of Kinesiophobia-11 (injury-related fear), a numeric pain rating scale and activity-based question (pain presence), the Quick Foot and Ankle Ability Measure (ankle function), and the modified Disablement in the Physically Active Scale (disability). Relationships among variables were explored through correlation and regression analyses.

Results: After we controlled for instability and pain, pain catastrophizing and injury-related fear were significantly related to function and disability ratings in individuals with CAI. Together, the variables predicted 48.7% ($P < .001$) of the variance in function and 44.2% ($P < .001$) of the variance in disability.

Conclusions: Greater instability, pain catastrophizing, injury-related fear, and pain predicted decreased function and greater disability in those with CAI. These findings are consistent with the hypothesized relationships in the fear-avoidance model, although further investigation is needed to determine causality of these factors in the development of CAI.

Key Words: ankle sprains, patient-reported outcomes, dimension-specific outcomes, health-related quality of life

Key Points

- Greater instability, pain catastrophizing, injury-related fear, and presence of pain were related to a lower level of function and greater disability in physically active individuals with chronic ankle instability.
- Clinicians should begin to identify these factors in patients with chronic ankle instability and explore intervention strategies for reducing injury-related fear and pain, which may assist in improving function and disability.
- Investigations demonstrating the influence of cognitive-affective factors such as pain catastrophizing and injury-related fear on the development of chronicity after ankle sprain are still needed.

Of 11.8 million US physician office visits annually, 23% involve a sprain or strain injury to the ankle or foot.[1] Disruption or stretch of the lateral ankle ligaments, most often the anterior talofibular and, in more severe cases, the calcaneofibular ligaments,[2] has the highest incidence (0.93 per 1000 exposures) when compared with other types of ankle sprains.[3] Lateral ankle sprains are often regarded as benign injuries that will resolve quickly with minimal treatment. Although some patients, known as *ankle-sprain copers*, seem to fully recover after their ankle sprains, evidence suggests that 40% of individuals continue to experience recurrent sprains, episodes of instability, and perceived ankle instability for more than 1 year after their initial injury.[3] These characteristics describe a condition known as *chronic ankle instability* (CAI).[4] Many other impairments have been identified in the CAI population, including stability and movement pattern alterations, decreased perceived levels of ankle function, increased levels of global disability, physical activity restrictions, and posttraumatic ankle osteoarthritis.[5] Despite decades of

research, which specific factor, or combination of factors, leads some patients down this continuum of disability is still not fully understood.

Chronic musculoskeletal conditions are typically characterized by both disability and pain[1]; however, pain has not been a major focus in the CAI literature, despite evidence of persistent pain after ankle sprains beyond the typical acute stage.[6] A recent retrospective analysis[7] revealed that 60% of participants with CAI in previous studies reported pain during different levels of activity. The role of pain in CAI is still unknown, but it has been associated with perceived instability[7] and function[8] in recent research. Despite this, the intensity of recurrent pain in this population was identified as mild,[9] which may not alone contribute to changes in function. It is well documented that pain is inextricably linked to emotional and cognitive functions.[10] Injury-related fear is a cognitive-affective factor that has been identified in individuals who develop CAI.[11] Injury-related fear has been associated with negative physical, recovery, and functional outcomes in other musculoskeletal conditions via the fear-avoidance model (FAM).[12–14]

The FAM is a cognitive-behavioral model postulating that exaggerated negative beliefs about pain, known as *pain catastrophizing*, can lead patients into a cycle of fear and activity avoidance.[15] These changes can result in disuse, which often creates new pathological pain pathways after healing of the originally injured tissue, taking these individuals down the path toward chronic pain and disability. On the other side of the model, individuals who do not prioritize pain-related thoughts after injury are hypothesized to be able to confront their pain and injury, which leads them toward full recovery and function.[15] The most recent CAI model proposed that after an ankle sprain, an individual can be characterized along a spectrum of outcomes ranging from coper (*fully recovered*) to CAI (*chronic disability*),[5] which mirrors the hypothesized outcomes in the FAM. As such, the FAM and its components may also serve as a theoretical model for understanding the development of CAI in some individuals after ankle sprain.

Therefore, the purpose of our study was to determine whether the FAM and its components may apply to patients with CAI by examining relationships among pain catastrophizing, injury-related fear, pain, ankle function, and global disability. This was tested through 3 aims. Our first aim was to examine the relationship between the 2 cognitive-affective model components—pain catastrophizing and injury-related fear. Pain catastrophizing is thought to contribute to the development of injury-related fear, but it is also possible that those who fear reinjury may adopt pain-catastrophizing cognitions that increase the focus on the feared stimulus of pain. Thus, our first hypothesis was that greater levels of pain-catastrophizing beliefs would be related to greater levels of reported injury-related fear. Our second aim was to determine the influence of pain presence on reported function and disability. We posited that the presence of pain would explain additional variance beyond reported instability in both ankle function and global disability outcomes. Our third aim was to determine the unique role of the cognitive-affective model components in predicting function and disability. We proposed that when controlling for instability and pain, both pain catastrophizing and injury-related fear would uniquely explain additional variance in both function and disability.

METHODS

This study used a cross-sectional, online survey design and was approved as exempt research by the Old Dominion University Health Sciences Human Subjects Review Committee in December 2020. Recruitment of potential participants occurred over a 4-week period via email in a university setting and social media posts (Facebook and Twitter) to broaden our geographic and demographic reach. Participants were required to be between the ages of 18 and 40 years. Inclusion and exclusion criteria for potential CAI participants followed the guidelines set forth by the International Ankle Consortium,[4] and questions pertaining to these criteria were included in the survey to determine eligibility.

Participants were classified as having CAI if they reported at least 1 significant ankle sprain sustained $\geq$12 months before the survey and residual symptoms, including recurrent ankle sprains; $\geq$2 giving-way episodes in the previous 6 months; perceived instability, classified as a score of $\geq$11 on the Identification of Functional Ankle Instability (IdFAI) questionnaire; or any combination of these.[4] Volunteers were excluded if they had sustained an acute lower extremity injury within the past 3 months or had a history of lower extremity fracture or surgery.

We used Qualtrics to create the anonymous survey, which consisted of 37 questions. The survey contained the informed consent, a demographic section, general inclusion and exclusion criteria, specific questions and tools to determine the classification of CAI, and the patient-related outcome assessments for collecting pain-catastrophizing, injury-related fear, pain, ankle function, and global disability outcomes. As each of the patient-related outcome assessments had established validity and reliability levels, we conducted no additional validation. Furthermore, the patient-related outcome assessments were organized into matrix-type questions to reduce the overall total number of questions in the survey.

Pain Catastrophizing

The Pain Catastrophizing Scale (PCS) was used to assess pain-catastrophizing beliefs.[16] It was chosen because it has been used in other populations with ligament injuries[13] and has also demonstrated strong internal consistency (α = 0.93), good test-retest reliability (intraclass correlation coefficient [ICC] = 0.75) and validity,[16,17] and factor stability across sexes and in both injured and uninjured, pain-free populations.[18] The PCS is a 13-item scale assessing the frequency of negative pain-related beliefs and ranges from 0 (*not at all*) to 4 (*always*). Total scores (ranging from 0 to 52) are calculated, along with 3 subscale scores evaluating magnification, rumination, and helplessness, with higher scores indicating higher levels of pain catastrophizing.

Injury-Related Fear

The Tampa Scale of Kinesiophobia-11 (TSK-11) was used to assess fear of movement and reinjury.[19] It has demonstrated good internal consistency (α = 0.79), test-

retest reliability (ICC = 0.81), and validity when compared with the original 17-item scale[19] and has shown differences between individuals with and those without CAI.[20] Answers to the 11-item scale range from 1 (*strongly disagree*) to 4 (*strongly agree*), yielding total scores ranging from 11 to 44, with higher scores indicating higher levels of fear related to movement and reinjury.

Pain

Pain was used as a binary outcome (*present* or *not present*) for the purpose of this study and was determined using the answer to 2 survey questions. The first question was from the Cumberland Ankle Instability Instrument and stated, "I have ankle pain," with 6 potential answers (*walking on level surfaces*, *walking on uneven surfaces*, *running on level surfaces*, *running on uneven surfaces*, *during sport*, or *never*). Participants who reported pain during any level of physical activity were considered to have pain.[7] Because this question describes conditional pain activities, a numeric rating scale for pain was also used to determine pain presence. Participants were asked to rate the highest level of ankle pain they had experienced within the past week on a scale from 0 (*none*) to 10 (*worst pain imaginable*). Any participant who responded with pain >0 was considered to have pain.

Ankle Function

The Quick Foot and Ankle Ability Measure (Quick-FAAM) is a regional scale designed to determine functional limitations in those with foot and ankle conditions.[21] It is a shortened version of the FAAM and retains 5 items from the FAAM–Activities of Daily Living and 7 items from the FAAM-Sport subscales. Answers to the 12-item scale range from 4 (*no difficulty at all*) to 0 (*unable to do*). Scores are totaled and transformed into percentages, with 100% representing no functional loss. It has demonstrated strong internal consistency ($\alpha = 0.94$)[21] and acceptable test-retest reliability[22] and was recently found to distinguish between individuals with CAI and copers, with CAI patients displaying lower scores.[23]

Global Disability

The modified Disablement in the Physically Active Scale (mDPA) is a global scale designed for individuals who are physically active.[24] The mDPA has shown high test-retest reliability (ICC = 0.943) and internal consistency (α = 0.890–0.908).[24] The mDPA contains 16 items with responses ranging from 0 (*no problem*) to 4 (*severe*) and addresses both physical and mental factors. Total scores range from 0 to 64, with higher scores indicating increased disablement. The mDPA detected differences in those with and those without CAI: individuals with CAI reported greater disablement.[20]

Statistical Analyses

We performed the statistical analyses using SPSS (version 27; IBM Corp) on the data of all participants who were classified as having CAI. Individuals were excluded if they did not complete the entire survey or did not meet the full inclusion or met any of the exclusion criteria. Demographic variables are summarized as either mean ± SD or as No. (%) overall. To test the first hypothesis, Pearson product moment correlations were used to evaluate the relationships between pain catastrophizing (PCS) and injury-related fear (TSK-11), and the correlation coefficients (r) was interpreted as *negligible* (<0.3), *low* (0.3–0.49), *moderate* (0.5–0.69), *high* (0.7–0.89), or *very high* (0.9–1.0).[25]

To test our second hypotheses, we generated 2 hierarchical linear regression models to determine the influence of pain presence on function and disability. The Quick-FAAM and mDPA served as the outcome variables in their respective models. For both models, the IdFAI score was a control variable and therefore entered in the first block. Pain was then entered as a 2-level predictor (0 = *no pain*, 1 = *pain*) in the second block to determine its additional utility in predicting function and disability.

To test our final hypotheses, 2 hierarchical linear regression models were calculated to detect the influence of the cognitive-affective outcomes on function and disability. Again, the Quick-FAAM and mDPA served as the outcome variables in their respective models. For these analyses, both IdFAI and pain were control variables and entered in block 1. The PCS and TSK-11 outcomes were then simultaneously entered into the second block to determine their additional utility in predicting function and disability.

We assessed the data for bias by identifying any cases that might be outliers or influential, and although in all models, a few cases had residuals >±2 SDs and 1 case in the mDPA model had residuals >±3 SDs, these cases were not influential (Cook distance <1) in their models. Linearity and additivity were examined by plotting the predictors and outcome to ensure this assumption was satisfied. Effects due to multicollinearity were limited by ensuring that the Pearson correlation coefficients between predictor variables in the final model were < 0.9, inspecting variance inflation factors and tolerances, and evaluating the variance distribution of the eigenvalues in the collinearity diagnostics table. The assumption of homoscedasticity was verified by inspecting the regression of standardized residual versus regression of standardized predicted value plot. Durbin-Watson testing yielded no problem with the assumption of independent errors, and although normality of errors testing indicated a slight skew in the data, we assumed normality based on the central limit theorem (>30 participants) and used bootstrapping to re-estimate the robustness of the significance testing of the model parameters and obtain 95% bias-corrected CIs using 1000 iterations. All assumptions were tested with strategies presented by Field.[26] Overall performance of the final model was evaluated using R^2, and significance was set a priori at $P < .05$.

RESULTS

Because of the nature of our recruitment strategy, we were unable to determine the number of potential participants that our survey could have reached; however, of those who accessed the survey (n = 314), 259 completed and submitted their answers, for a completion rate of 82.5%. Of those who completed the survey, 114 did not meet the basic inclusion and exclusion criteria (8 because of age, 56 because of a history of surgery, 36 because of a

Table 1. Participant Demographics and Patient-Reported Outcome Data

Demographic or Outcome	Value
Gender identity, No. (%) (n = 126)	
Male	17 (13.49)
Female	107 (84.92)
Other[a]	1 (0.79)
Prefer not to specify	1 (0.79)
Age, y, mean ± SD	32.69 ± 4.38
Physical activity score, No. (%) (n = 126)[b]	
1	5 (3.97)
2	11 (8.73)
3	17 (13.49)
4	45 (35.71)
5	48 (38.10)
Pain presence (n = 126)	
No pain	44 (34.92)
Pain	82 (65.08)
	Score, Mean ± SD
Identification of Functional Ankle Instability	17.31 ± 4.90
Pain Catastrophizing Scale	7.32 ± 7.46
Helplessness	2.30 ± 2.94
Magnification	2.16 ± 2.25
Rumination	2.87 ± 3.12
Tampa Scale of Kinesiophobia-11	21.36 ± 5.53
Quick-Foot and Ankle Ability Measure	83.22 ± 14.95
Modified Disablement in the Physically Active Scale	10.50 ± 10.67
Physical	8.68 ± 8.87
Mental	1.82 ± 2.85

[a] Participant identified as nonbinary.

[b] As described by Jurca et al,[27] 1 = *inactive or little activity other than usual daily activity*; 2 = *regular (≥5 d/wk) low-level exertion >10 min at a time*; 3 = *aerobic exercise, vigorous sport, or similar exertion for 20–60 min/wk*; 4 = *aerobic exercise, vigorous sport, or similar exertion for 1–3 h/wk*; 5 = *aerobic exercise, vigorous sport, or similar exertion for >3 h/wk*.

history of fracture, 13 because of a recent acute injury, and 1 reporting no history of a significant ankle sprain). An additional 19 did not meet our CAI criteria, which left a total of 126 CAI participant responses that were included in our analysis. Demographic data and mean outcome measure scores for participants are presented in Table 1.

We found a significant, low positive relationship between PCS and TSK-11 scores ($r = 0.493$; 95% bias-corrected CI = 0.357, 0.606; $P < .001$), indicating that as reported levels of pain catastrophizing increased, so did reported levels of injury-related fear.

The model with IdFAI entered as a single predictor significantly explained 23.4% of the variance in the Quick-FAAM scores ($R^2 = 0.234$, $P < .001$), and the addition of pain significantly improved the Quick-FAAM model by accounting for another 8.9% of the variance ($F\Delta_{1,123} = 16.099$, $P < .001$). For the final model, both the IdFAI and pain scores were significantly negatively related to the Quick-FAAM score ($R^2 = 0.322$, $P < .001$), and each predictor demonstrated unique predictive utility (Table 2).

The model with the IdFAI score entered as a single predictor significantly explained 21.4% of the variance in mDPA scores ($R^2 = 0.214$, $P < .001$), and again, the addition of pain significantly improved the mDPA model by accounting for another 6.6% of the variance ($F\Delta_{1,123} = 11.198$, $P = .001$). For the final model, both the IdFAI and pain scores were significantly positively related to the mDPA score ($R^2 = 0.280$, $P < .001$), and each predictor demonstrated unique predictive utility (Table 3).

As noted in the previous Quick-FAAM analysis, both the IdFAI and pain presence scores were significant predictors of Quick-FAAM scores, accounting for 32.2% of the variance. The addition of the cognitive-affective outcomes (PCS and TSK-11) to the model significantly improved the Quick-FAAM model by accounting for another 16.5% of the variance ($F\Delta_{2,121} = 19.434$, $P < .001$). For the final model, all predictors were significantly negatively related to the Quick-FAAM score ($R^2 = 0.487$, $P < .001$), and each predictor demonstrated unique predictive utility (Table 4).

Similarly, in the previous mDPA analysis, both the IdFAI and pain presence scores were significant predictors of mDPA scores, accounting for 28.0% of the variance. The addition of the cognitive-affective outcomes (PCS and TSK-11) to the model significantly improved the mDPA model by accounting for another 16.2% of the variance ($F\Delta_{2,121} = 17.578$, $P < .001$). For the final model, all entered predictors were significantly positively related to the mDPA score ($R^2 = 0.442$, $P < .001$), and each predictor demonstrated unique predictive utility (Table 5).

DISCUSSION

The purpose of our study was to apply the FAM to the population with CAI by investigating specific relationships between some of the model components. We were first interested in investigating whether a relationship existed between pain catastrophizing and injury-related fear, as no researchers have evaluated pain catastrophizing in the CAI population thus far. Our hypothesis was supported in that higher levels of pain catastrophizing were significantly related to higher levels of injury-related fear. This relationship is hypothesized to exist because individuals who catastrophize pain and injury appraise pain as highly threatening. This increase in the value given to the threat of pain is therefore believed to lead the person to develop fear

Table 2. Perceived Instability and Pain as Predictors of Function[a]

Model	*b* (95% Bias-Corrected CI)	SE *B*	β	*P* Value
1				
Constant	108.778 (101.081, 116.909)	3.764		<.001
IdFAI	−1.477 (−1.904, −1.044)	0.223	−0.484	<.001
2				
Constant	107.066 (100.162, 114.319)	3.405		<.001
IdFAI	−0.979 (−1.450, −0.527)	0.233	−0.321	<.001
Pain presence	−10.604 (−14.536, −6.257)	2.191	−0.339	<.001

Abbreviation: IdFAI, Identification of Functional Ankle Instability.

[a] The CIs, SE, and significance are based on 1000 bootstrap samples.

Table 3. Perceived Instability and Pain as Predictors of Disability[a]

Model	*b* (95% Bias-Corrected CI)	SE *B*	β	*P* Value
1				
Constant	−6.876 (−12.152, −1.099)	2.932		.022
IdFAI	1.004 (0.644, 1.353)	0.183	0.463	.001[b]
2				
Constant	−5.830 (−11.175, −2.56)	2.920		.046
IdFAI	0.700 (0.316, 1.103)	0.213	0.322	.003
Pain presence	6.482 (2.929, 10.242)	1.883	0.292	.002

Abbreviation: IdFAI, Identification of Functional Ankle Instability.

[a] The CIs, SE, and significance are based on 1000 bootstrap samples.

[b] $P < .001$.

regarding movements that are associated with pain and injury.[15] Although we cannot infer the direction of this relationship from our study, our results demonstrate that they are significantly related constructs. The uniqueness of these interrelated variables has been debated in the literature[18]; however, we found the strength of this relationship was just under moderate. So, although the constructs were related, our results indicate that they are unique and independent constructs and could both be used in further analyses. Others studying these variables have produced similar findings.[13,18] Further, as injury-related fear is an established factor related to CAI,[11] this relationship suggests that pain catastrophizing may be another cognitive-affective variable warranting further assessment in patients with ankle sprains.

It is well established that CAI can result in individuals reporting deficits in ankle function and greater levels of global disability. The FAM postulates that pain catastrophizing, pain, and injury-related fear would lead a person to avoidant behavior, which then would send him or her down the road of disability. Therefore, our remaining hypotheses specifically addressed how pain catastrophizing, pain, and injury-related fear related to reported ankle function and disability. Our second aim was to determine the predictive utility of symptom-related factors that have been established in the CAI population regarding function and disability: in particular, determining the additional utility of pain presence on these outcomes, as the role of persistent pain in those with CAI has been somewhat overlooked. Our findings indicate that greater levels of perceived instability were associated with less reported ankle function and greater reported disability in our participants with CAI. Perceived instability significantly predicted 23.4% of the variance in reported ankle function and 21.4% of the variance in reported disability. Perceived instability is one of the characteristic symptoms of CAI,[4] so it is not surprising that this variable would serve as an important predictor. Our hypothesis was further supported in that the models significantly improved when pain presence was added as a predictor, accounting for an increased 8.9% and 6.6%, respectively, of the variance in reported ankle function and disability. This outcome is consistent with that of a recent cross-sectional study,[8] whose authors observed relationships between reported pain and function in their sample with CAI and suggests that beyond perceived instability, individuals who reported pain during activities specified by the Cumberland Ankle Instability Instrument or pain within the past week reported lower levels of ankle function and greater disability. Perceived instability and pain demonstrated a relationship in a recent investigation,[7] but despite this, we noted that both variables were unique predictors of function and disability and contributed similar weights to the model.

Our final models, including all 4 variables, explained 48.7% of the total variance in reported ankle function and 44.2% of the total variance in reported disability. Each predictor significantly added to the model, revealing that greater perceived instability, greater pain catastrophizing, pain presence, and injury-related fear were related to less reported ankle function and greater reported disability. Our hypothesis was supported in that the models significantly improved when pain catastrophizing and injury-related fear were added as predictors while controlling for both instability and pain. Together, they accounted for an additional 16.5% and 16.2% of the variance in reported ankle function and disability, respectively, which highlights their importance in the models. The use of the FAM framework has garnered support across multiple musculoskeletal conditions,[28,29] including those with foot pain, ankle pain, or both,[30] and overall, our results demonstrated relationships that are similar to the theoretical framework presented in the FAM, suggesting it may prove useful for continued study of these variables in the population with ankle sprains. Many other theoretical models and frameworks have already been applied to this population. Interestingly, we believe our findings both provide support for and add important insight in describing the relationships between several of the sensory-perceptual alterations (pain,

Table 4. Perceived Instability, Pain, and Cognitive-Affective Variables as Predictors of Function[a]

Model	*b* (95% Bias-Corrected CI)	SE *B*	β	*P* Value
2				
Constant	120.620 (112.037, 129.231)	4.515		.001[b]
Identification of Functional Ankle Instability score	−0.650 (−1.104, −0.216)	0.230	−0.213	.006
Pain presence	−10.045 (−13.664, −6.072)	2.023	−0.322	.001[b]
Pain Catastrophizing Scale score	−0.393 (−0.714, −0.095)	0.163	−0.196	.016
Tampa Scale of Kinesiophobia-11 score	−0.783 (−1.182, −0.375)	0.210	−0.290	.001[b]

[a] The CIs, SE, and significance are based on 1000 bootstrap samples.

[b] $P < .001$.

Table 5. Perceived Instability, Pain, and Cognitive-Affective Variables as Predictors of Function[a]

Model	*b* (95% Bias-Corrected CI)	SE *B*	β	*P* Value
2				
Constant	−14.152 (−20.570, −7.159)	3.355		.001[b]
Identification of Functional Ankle Instability score	0.475 (0.083, 0.890)	0.206	0.219	.026
Pain presence	6.169 (2.660, 9.247)	1.644	0.278	.001[b]
Pain Catastrophizing Scale score	0.346 (0.098, 0.585)	0.120	0.243	.003
Tampa Scale of Kinesiophobia-11	0.463 (0.167, 0.743)	0.147	0.241	.002

[a] The CIs, SE, and significance are based on 1000 bootstrap samples.
[b] $P < .001$.

kinesiophobia, perceived instability, perceived ankle function, and perceived disability) proposed in the most updated model for CAI,[5] while also providing support to the perceptual-interdependence framework.[31] The perceptual-interdependence framework describes a nested relationship of perceptual alterations after ankle sprain that span the cellular (pain and inflammation) to the societal (activity participation) level.[31] Similar to the FAM, both theoretical proposals depict the likely importance of the relationship between the sensory-perceptual alterations and movement and activity changes associated with CAI. Our results suggest that pain, high levels of perceived instability, and injury-related fear reduce one's perceived level of ankle function during activity, which could promote activity-avoidance behaviors. Over time, these avoidant behaviors may lead to neural adaptations that promote further avoidance and lead to the movement-behavior impairments typical of those with CAI, such as poor balance and movement pattern alterations, as well as lower levels of physical activity. Overall, continued pursuit of the role of persistent pain and cognitive-affective factors, such as pain catastrophizing and injury-related fear, in the development and continuance of CAI and its associated impairments is warranted. Additionally, investigating intervention strategies that mitigate persistent pain and lower injury-related fear would likely assist in improving function and disability.

Pain is often considered a solely physical symptom; however, it is well established that pain—specifically persisting or recurring pain—is a multidimensional experience influenced by many factors.[32] Thus, although interventions specific to pain in patients with ankle sprains are warranted, our outcomes also support a multidimensional approach to rehabilitation. Psychologically informed intervention strategies may assist in reducing pain by targeting interrelated cognitive-affective factors, such as injury-related fear. Common psychological frameworks incorporated into rehabilitation protocols include education, imagery, self-talk or reframing, graded exposure, social support strategies, goal setting, and relaxation.[12] More work is needed to examine the application of psychologically informed practice in sport injury and specifically in populations with ankle sprains; however, the literature is promising for the potential benefits in individuals after injury.[33,34]

Limitations

This study was not without limitations that should be considered when interpreting our results. The biggest limitation was that the cross-sectional design prevented us from inferring causality. Further, all our participants were individuals with CAI, which limited our ability to determine the predictive utility of these variables in the development of the condition. Future researchers could prospectively measure these variables over time and evaluate their use in predicting CAI and its associated impairments.

Another potential limitation was the relatively low scores reported on the PCS instrument. To our knowledge we are the first to provide PCS scores from highly active individuals with CAI, and although our mean results were similar to recent findings in athletes, these low scores may be driving the relationships with the other variables in our study. As it is still unclear which threshold values are clinically meaningful to athletic populations and to those who develop CAI, future researchers may find it relevant to assess clinically meaningful cutoff scores.

Another limitation of our study was that approximately 50% of the variance was not explained by the variables. Because of institutional COVID-19 research restrictions that prohibited in-person data collection, only patient-reported outcomes were used, and the availability of clinician-rated measures was limited. For example, balance performance is established in the CAI literature as an important variable related to reported function and disability and likely another variable that could help to inform our models. This and other established clinician-rated variables may be considered in future investigations.

Lastly, we recognize the inherent limitations of self-reported outcome measures that can include memory and recall bias and play a role in skewing the data collected and used in our models. Despite the limitations, we do believe that our research lends support to the FAM being an important consideration for those with CAI.

CONCLUSIONS

We explored the influences of perceived instability, pain catastrophizing, pain, and injury-related fear on reported ankle function and disability in individuals with CAI. All of these variables served as predictors of function and disability, which continues to support the notion that the condition is multifactorial and that these variables are important for clinicians to consider when examining or treating an individual after an ankle sprain. Our design limitations warrant further investigations focused on the role these variables play in the transition from an acute ankle sprain to CAI and how these variables may relate to other known impairments in these populations.

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