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Fear Effects on Subjective and Objective Measures of Function in Chronic Ankle Instability, Coper and Healthy Participants

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Abstract

Objective: Identifying the role of psychological issues such as fear on function, in various orthopedic conditions, can help improve the rehabilitation process, especially in chronic recurrent injuries such as chronic ankle instability (CAI). Therefore we designed this study to identify fear measures capable of explaining clinical and laboratory measures of function in individuals with CAI compared with coper and healthy participants.

Methods: This is a laboratory Cross-sectional study. Seventy-five participants with CAI, copers and healthy control (25 in each group) attended a single testing session. Participants completed health-related quality of life questionnaires related to fear and physical function and dynamic postural control tests.

Results: The result of ANOVA test, showed that fear scores were higher and functional scores were lower in the CAI group in almost all variables, compared to the other groups. Based on linear regression analysis, in the CAI group, fear had a significant effect ($p<0.05$) on the subjective variables (foot and ankle ability measures and foot and ankle outcome scores), but fear had no significant ($p>0.05$) effect on objective variables.

Conclusion: Greater fear associated with lower health-related quality of life. Measures of fear contributed to a significant proportion of the variance associated with subjective measures of function in those with CAI. This should be taken into consideration when treating individuals with CAI, possibly with doing cognitive behavioral therapy in addition to physical therapy.

Keywords: Postural control; Counter-movement jump-landing; Star excursion balance test; Fear; Function; Chronic ankle instability; Coper; Questionnaire

Introduction

Lateral ankle sprain is one of the most prevalent lower extremity injuries especially in physically active population [1]. A large percent of individuals who have sustained a lateral ankle sprain seems also report residual symptoms such as activity induced pain, recurrent swelling, ankle's giving way and repetitive injury for more than one year, these individuals are considered to have chronic ankle instability (CAI) [2,3]. The individuals experienced ankle sprain for more than one year ago and recovered completely without having giving way or other related symptoms determined as ankle sprain "copers" [4].

The most important and frequent complaints in patients with CAI are recurrent ankle sprains and fear or feeling of the "ankle giving way" [5]. Functional impairments and fear of reinjury, decrease activity level of patients with CAI over the life span and potentially may lead to early onset degenerative changes in the ankle joints [6-8]. Fear of reinjury has dimensions such as kinesiophobia, fear-avoidance beliefs, or reinjury anxiety and such psychological measures could reveal more about the condition and its recovery [6]. Two questionnaires commonly used to measure fear of movement/(re)injury in patients with chronic musculoskeletal conditions include Tampa Scale of Kinesiophobia (TSK) and Fear-Avoidance Beliefs Questionnaire (FABQ) [9].

The TSk measures fear of movement or kinesiophobia, which has been defined as an excessive, aberrant and debilitating fear of movement resulting from a feeling of vulnerability to injury [10]. The FABQ assesses patient's beliefs in relation to the effect of physical activity and work on their condition [10].

Although little evidence including systematic reviews supports the presence of kinesiophobia or fear-avoidance beliefs [11, 12], to our knowledge fear measures such as TSK and FABQ have yet to be examined in the CAI population [6].

Fear of movement/(re)injury has been reported to be associated with functional limitations in CAI [13].

One of the most common functional limitations in participants with CAI is postural control deficit [14]. The mechanism of ankle sprain injury may be related to dynamic tasks; therefore tasks like counter-movement jump-landing test (CMJLT) which impose large and rapid loads to the ankle complex can be used to evaluate the dynamic function of patients suffering from ankle sprain [15].

The usual laboratory assessment measures for dynamic postural control are the time to stabilization (TTS) and the dynamic postural stability index (DPSI). Both of them can evaluate the ability of subjects to maintain the center of gravity (COG) within the base of support while transferring from a dynamic to static situation [16].

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Clinical assessment methods like the Star Excursion Balance Test (SEBT) are available to evaluate the clinical dynamic postural stability deficits [17].

In addition, questionnaires like Foot and Ankle Ability Measures (FAAM) and Foot and Ankle Outcome Scores (FAOS) were used to assess the participant's ability to perform common activities of daily living and sports activities [18]. They are the most appropriate outcome instruments to quantify functional limitations in patients with varying leg, foot and ankle disorders [19, 20].

Despite identifying clinical and laboratory functional and psychological deficits in those with CAI, more research is required to determine the extent to which psychological measures such as fear affect "recurrent" nature of CAI in comparison with "coper" group who experienced a same primary accident. The multidimensional evaluation will enhance the clinician's ability to incorporate patient values and perspectives into prevention, rehabilitation and outcome assessment of their condition.

Therefore, the primary purpose of our study was to determine whether functional and psychological health related outcomes differed between individuals with CAI, ankle sprain copers and healthy controls. The secondary purpose was to examine relationships between fear and clinical and laboratory measures of function in all three groups to identify if fear questionnaires are capable of explaining clinical and laboratory measures of function, in individuals with CAI.

We hypothesized reverse relationships would exist between fear scores and functional scores. Identifying these potential relationships may guide us towards developing more effective holistic evidence-based rehabilitation strategies for those with CAI.

Methods

Design

A cross-sectional design was employed for this study. Five questionnaires, two laboratory and one clinical measures of function including measures of dynamic postural control were assessed during a single-testing session.

Two questionnaires including TSK and FABQ are about self-reported fear. The TSK has 17 items, each question is scored on a 4-point Likert scale with 1 indicating "strongly disagree" and 4 indicating "strongly agree." A total score is calculated after inversion of individual scores of items 4, 8, 12 and 16, summed score range from 17 and 68 with higher score representing increased fear of movement [9].

The FABQ has 16 items and two subscales about physical activity (FABQ-PA) which has 4 items and work (FABQ-W) which has 7 items and 5 items not used in the scoring of the sub-scales. Responses range from 0 (strongly disagree) to 6 (completely agree) on a 7 point scale. Summed maximum score of 42 for the FABQ-W and 24 for FABQ-PA; higher scores represent more fear avoidance beliefs [9].

These questionnaires have demonstrated good psychometric properties [10].

Participants

A total of 75 volunteers (in three groups of 25) were recruited into the study, from the university campus, hospitals and general community through local advertisements from May 2016 to May 2017 in Tehran, Iran. Using nonprobability convenience sampling, young, physically active (exercise at least 3 times a week) adults were included once 25 eligible participants per group were tested. The groups were matched according to age, gender and body mass index (BMI).

The healthy group included 25 physically active individuals without history of ankle sprain.

Copers were defined as individuals who had an index (first) lateral ankle sprain within the 12 months, with no episodes of recurrent ankle injury, instability and giving way [8]. Their score in the IdFAI questionnaire were less than 11. In functional assessment, the score of >90% in the ADL scale and >80% in Sport scale of FAAM and score of >75% in three or more categories of FAOS were considered as a coper [5].

The CAI was defined according to the International Ankle Consortium, those individuals who experienced at least one index lateral ankle sprain in the past 12 months prior to the experiment and experienced at least two episodes of giving way within the past six months. They have instability assessment score of more than 11 in IdFAI questionnaire. In addition for functional assessment, score of <90% in the ADL scale and <80% in Sport scale of FAAM or score of <75% in three or more categories of FAOS [6].

The volunteers were excluded from every group if they had any musculoskeletal surgery (i.e. due to injury to bones, joint structures and/or nerves) in either lower extremities, positive history of lower extremity fracture in either side requiring realignment or acute injury to the musculoskeletal structures of the lower extremities within last three months. Two physical therapist who were blinded to the study protocol and groups evaluated volunteers. All participants signed an informed consent form approved by the Human Research Ethics Committee of the Iran University of Medical Sciences, Tehran, Iran.

Procedures

First, all participants with "unilateral" ankle sprain were asked by an expert supervisor physiotherapist who was blinded to the group allocation, to complete the Persian versions of the IdFAI [2], FAAM [19], FAOS [20], TSK and FABQ [10] questionnaires. Then another physiotherapist divided participants into CAI and coper groups based on their scores on different questionnaires. Then the first physiotherapist completed all of the postural control tests. All tests were undertaken by an expert blinded physiotherapist and all participants were blinded to group allocations. A participant's body weight was recorded as the average of vertical ground reaction force (GRF) variations during a five second static stance on the force plate before data collection. The CMJLT and SEBT, were applied to evaluate dynamic postural control.

All measurements were made while barefoot for homogenization between participants. For the coper and CAI groups, the injured foot was evaluated, and the matched limb of healthy participants was evaluated to compare with the other groups.

Three familiarization trials were performed for each test prior to data collection. Then, three trials were also performed to record each outcome measure. All tasks were conducted in a random order by concealed envelope containing the name of experimental condition.

Instrumentation

The force plate (Kistler, Instrument Type: 5691A) was embedded in the landing zone and captured kinetic data. Center of pressure (COP) data for CMJLT was sampled at 500 Hz and analyzed as TTS and DPSI variables.

Counter-movement jump-landing test (CMJLT)

The CMJLT consists of an initial downward movement toward squat position, followed by immediate upward movement lead to

taking off with forceful hip, knee, and ankle extension, and then, landing on the ground [15]. Participants stood on the force plate and looked straight forward, then they were instructed to jump as high as possible with both legs and to land on the evaluative leg in the center of the force plate while hands placed on the hips (Akimbo position); the free leg was flexed at the knee joint without touching the stance leg.

After landing, all participants were asked to stabilize themselves quickly and remained in a single-leg stance for 30 seconds without any sway. The above tasks were performed three times with 60 seconds' rest between trials. Failed trials due to having sway or loss of balance (e.g. free foot touched the floor or other leg or hands detached from the hips) were excluded from data collection. The average of the three successful trials was used for further analysis.

The TTS and DPSI were calculated and analyzed using the above-mentioned task. The main difference between TTS and the DPSI is the time component. The TTS measures the time it take for an individual to stabilize, whereas the DPSI is a comprehensive measure of overall stability that is sensitive to change in 3 directions so we used both of them. We used the calculation methods [20].

Star Excursion Balance Test (SEBT)

The SEBT test was used as a second measure to evaluate the dynamic postural control as a clinical measure of function. This test included a single-leg stance on the evaluating leg while reaching as far as possible with the opposite. The SEBT grid was arranged on the laboratory floor with a 1.5 meter measuring tape projected from the center of the grid along the three directions: the angle between the anterior (SEBT-Ant), posteromedial (SEBT-PM), and posterolateral (SEBT-PL) directions were 135˚ and the angle between the posteromedial and posterolateral directions was 90˚ [17].

The participant was asked to start standing on the evaluative leg in the center of the gird with the Akimbo position. The evaluative leg was fixed in the center of the grid and then to reach the opposite leg as far as possible in each direction, touches down slightly with the big toe, and return to a double-legged stance position. The reach distance (in centimeters) was considered as the distance from the center of the grid into the point of maximum reach.

The recorded reach distances were normalized to the limb length percentage by dividing the reach distance (in cm) into the limb length. The limb length measured from the anterior-superior iliac spine to the ipsilateral medial malleolus during supine position for each participant. Before evaluation, 3 familiarization trials were made. Participants performed three consecutive trials in each direction randomly with 60 seconds' rest period between them. The mean of three successful trials was calculated for analysis. Trials were considered to be unsuccessful, if the participants lost their balance any way (e.g. moving the stance foot, transferring the weight on the reach foot, not touching the tape, not returning the reach foot to the starting position, or unable to maintain a unilateral-stance position during the trial.

The SEBT is a highly reliable and valid tool and can be used for both research studies and clinical practices [17].

Statistical Analysis

All force plate data was processed using MATLAB software. Statistical analysis was performed in SPSS version 21 (SPSS Inc, Chicago, Illinois 60606, U.S.A.). Descriptive statistics were calculated as mean ± standard deviation for all variables. The one-way ANOVA test and the Tukey post hoc analysis was used to identify the differences between groups.

We defined a dummy variable for comparison between groups with linear regression analysis. In other words, we consider coper group as a reference and compare healthy and CAI groups with coper one, D1 is a comparison of healthy group with coper and D2 is a comparison of CAI group with coper.

Based on the sample size (n = 75), the number of explanatory variables were reduced to 7 per model.

Seven separate backward multiple linear regression analyses were conducted with each functional measure serving as the criterion variable and the fear measures serving as explanatory variables. The backward regression method was selected due to the limited amount of theoretical literature available.

In this study, demographic properties (Age, sex, BMI), IdFAI, TSK, FABQ, are independent (explanatory) variables and FAAM, FAOS, TTS, DPSI and SEBT are dependent (criterion) variables.

The level of significance was set at 0.05 for all procedures.

Results

A total of 75 participants, including 25 participants with CAI completed the study.

Descriptive statistics for explanatory and criterion variables and results of one-way ANOVA test are shown in Tables 1 and 2 respectively.

All seven backward regression models are summarized (beta, p-value & CI) with the final explanatory variables in Table 3. The regression models for only two of seven dependent variables (FAAM and FAOS) were significant. The significant effect of fear on FAAM and FAOS variables with Beta of 0.41 and 0.61 in CAI group compare with coper and Beta of 0.68 and 0.38 in healthy group compare with coper group, respectively.

Discussion

Our primary finding was that individuals with CAI had more TTS,

Table 1: Descriptive Statistics for explanatory variables in three groups with p-value of Anova.

Independent variables	Healthy (Mean ± SD)	Coper (Mean ± SD)	CAI (Mean ± SD)	p-value
Age	34.84 (7.46)	33.12 (6.63)	32.36 (7.86)	0.48
Sex	M:15 F:10	M:15 F:10	M:15 F:10	1.00
BMI	27.11 (4.12)	26.79 (3.24)	27.98 (6.22)	0.65
IdFAI	0.92 (1.08)	4.08 (3.16)	30.16 (8.54)	<0.001
TSK	22.84 (9.99)	26.40 (7.46)	50.48 (8.27)	<0.001
FABQ-PA	0.76 (0.92)	10.24 (7.64)	21.96 (2.07)	<0.001
FABQ-W	0.28 (0.54)	15.76 (13.33)	18.16 (12.09)	<0.001

Abbreviations: CAI: Chronic Ankle Instability, BMI: Body Mass Index, TSK: Tampa Scale of kinesiophobia, FABQ-PA: Fear Avoidance Belief Questionnaire (physical activity subscale), FABQ-W: Fear Avoidance Believe Questionnaire (work subscale).

Table 2: Descriptive statistics for the criterion variables in three groups with p-value of Anova.

Measures of function	Healthy (Mean ± SD)	Coper (Mean ± SD)	CAI (Mean ± SD)	p-value
DPSI	0.12 (0.053)	0.18 (0.03)	0.24 (0.15)	0.03
TTS (s)	1.44 (1.69)	0.95 (0.51)	1.72 (0.59)	0.04
Ant SEBT (cm)	82.00 (7.20)	79.76 (8.93)	74.19 (10.20)	0.008
PM SEBT (cm)	86.14 (12.56)	83.23 (14.08)	81.43 (12.86)	0.45
PL SEBT (cm)	77.54 (7.69)	73.79 (9.48)	73.72 (10.36)	0.25
FAAM	111.20 (3.93)	72.44 (15.06)	10.68 (9.08)	0.01
FAOS	152.92 (12.42)	69.88 (29.83)	16.60 (8.79)	0.01

Abbreviations: DPSI: Dynamic Postural Stability Index, TTS: Time To Stabilization, S: second, CAI: Chronic Ankle Instability, SEBT: Star Excursion Balance Test, Ant: Anterior, CM: Centimeter, PM: Posteromedial, PL: Posterolateral, FAAM: Foot And Ankle Ability Measures, FAOS: Foot And Ankle Outcome Scores.

Table 3: Results summaries of linear regression analysis.

Dependent variables	Independent factors	Adjusted B	95.0% Confidence Interval for B		P value
		Beta	Lower Bound	Upper Bound	
DPSI	**D1**	.189	-.039	.115	.331
	D2	.194	-.067	.145	.469
	age	-.025	-.003	.003	.836
	sex	-.036	-.053	.039	.760
	BMI	.118	-.002	.007	.317
	TSK	.151	-.002	.004	.470
	FABQ pa	-.004	-.005	.005	.987
	FABQ W	.116	-.001	.003	.458
TTS	**D1**	.204	-.426	1.378	.296
	D2	.443	-.210	2.277	.102
	age	-.095	-.051	.022	.435
	sex	.043	-.438	.629	.721
	BMI	-.105	-.081	.031	.372
	TSK	-.160	-.042	.019	.446
	FABQ pa	.034	-.057	.064	.901
	FABQ W	-.029	-.029	.024	.854
AP SEBT	**D1**	.089	-5.624	9.114	.638
	D2	-.469	-19.394	.919	.074
	age	.018	-.274	.321	.875
	sex	-.141	-7.026	1.688	.226
	BMI	.049	-.355	.553	.664
	TSK	.167	-.146	.355	.409
	FABQ pa	.121	-.380	.610	.644
	FABQ W	-.169	-.337	.094	.263
PM SEBT	**D1**	.202	-5.350	16.557	.311
	D2	-.313	-23.779	6.414	.255
	age	-.011	-.462	.423	.929
	sex	-.198	-11.753	1.199	.108
	BMI	.038	-.568	.782	.754
	TSK	.129	-.259	.485	.547
	FABQ pa	.267	-.378	1.093	.335
	FABQ W	-.070	-.391	.250	.662
PL SEBT	**D1**	.202	-3.805	11.726	.312
	D2	-.007	-10.838	10.567	.980
	age	-.052	-.380	.248	.677
	sex	-.072	-5.942	3.240	.559
	BMI	.104	-.271	.686	.389
	TSK	-.104	-.328	.200	.629
	FABQ pa	.130	-.399	.644	.640
	FABQ W	-.070	-.277	.177	.662
FAAM	**D1**	-.684	-70.545	-53.206	.000*
	D2	.411	25.257	49.152	.000*
	age	-.029	-.520	.181	.338
	sex	.012	-4.085	6.165	.687
	BMI	-.026	-.777	.292	.368
	TSK	.044	-.168	.422	.392
	FABQ pa	-.027	-.699	.465	.689
	FABQ W	.003	-.242	.265	.930
FAOS	**D1**	-.379	-63.691	-31.454	.000*
	D2	.613	54.766	99.193	.000*
	age	-.048	-1.045	.258	.232
	sex	.004	-9.090	9.967	.927
	BMI	-.030	-1.376	.611	.445
	TSK	.048	-.357	.738	.489
	FABQ pa	.016	-.988	1.176	.863
	FABQ W	.047	-.256	.687	.364

Abbreviations: DPSI: Dynamic Postural Stability Index, CAI: Chronic Ankle Instability, D1: Healthy vs Coper, D2: CAI vs Coper, TTS: Time to Stabilization, CAI: Chronic Ankle Instability, SEBT: Star Excursion Balance Test, Ant: Anterior, PM: Posteromedial, PL: Posterolateral, FAAM: Foot And Ankle Ability Measures, FAOS: Foot And Ankle Outcome Scores.

DPSI, TSK, FABQ and less SEBT-A, FAAM, FAOS scores compared to coper and control groups. In other words, our study shows significant differences in fear, subjective and objective measures of functions between groups. The CAI group have significantly greater functional deficit than two other groups. Our findings and those of previous studies confirm the impaired function hypothesis in participants with CAI [11, 13, 18, 20].

To our knowledge this is the first study that has analyzed the relationship between fear and subjective and objective (clinical and laboratory) measures of function between three groups. Our purpose was to determine whether fear was capable of explaining subjective and objective functional scores in individuals with CAI in comparison to the other groups. The results of this study indicate that fear of CAI participants have significant effect on the subjective functional outcomes but could not explain the significant amount of the variance in objective functional outcomes. This was supported by the small beta exhibited by five of the seven variables.

None of the explanatory independent variables (i.e., age, sex, BMI, TSK, FABQ-PA, FABQ-W) contributed to the variance of the objective functional outcome scores. But a combination of variables contributed to subjective components of region-specific functional outcome scores (FAAM and FAOS). According to the results of other studies, this is not surprising as elevated levels of fear have been associated with limitations in subjective physical function in participants with CAI [6,13].

Although fear of reinjury has been associated with a variety of orthopaedic conditions [12], there is little evidence regarding its association with CAI [6]. Previously reported fear of reinjury among

individuals with CAI have been controversial, Wikstrom et al. reported that the TSK scores did not differ between those with CAI and copers [20]. In Contrast, athletes with a history of ankle sprain [19] and physically active individuals with FAI [12] had greater fear avoidance compared to healthy controls. In previous investigations, individuals with CAI have reported decreased function, increased fear of reinjury and decreased health related quality of life on patient-oriented assessments [6,13,20].

To our knowledge this is the first study to identify fear contributors to clinical and laboratory measures of function in individuals with CAI in comparison with coper and healthy participants. Our findings indicate that subjective measures of fear contributed to the subjective functional scores in this sample of individuals with CAI. But Fear cannot much contributed to the clinical (i.e., SEBT) and laboratory measures (i.e., DPSI and TTS) of function. Subjective and objective measures are different entities so it is possible they do not be matched. Postural control is about movement strategies and kinematic analysis [20] but questionnaires are about self-impression of each individual about health's status [13]. The CAI has a multifactorial biopsychosocial nature therefore, the individual perceptions of fear and function as measured by the questionnaires contributed to the condition [13].

In addition, we can refer to the biopsychosocial model of health care as we can justify our finding by difference in sensory-perceptual and motor-behavioral impairment as different components of this model. It means that questionnaires which assessed health related quality of life (i.e., FAAM, FAOS, TSK and FABQ) are about, both conscious and unconscious perceptions of individuals about their health. Motor-behavioral impairments in CAI individuals constitute changes in muscle contractility, motion patterns, and physical activities. These factors constitute the motor aspect of sensorimotor function such as postural control tasks (i.e., jumping or SEBT). Therefore these two impairment categories (sensory-perceptual and motor behavioral), are not necessarily coincided to each other.

We could also refer to "disease-oriented" and "patient-oriented" impairments which can be different matters. Postural control impairments are disease-oriented and subjective functional impairments are patient-oriented impairments.

In addition, considering that race, ethnicity, and sociocultural factors could affect fear of reinjury and should be take into account [12].

In our study, sensation of instability in the ankle joint, fear of a recurrent sprain, and low postural control while on the affected ankle might have increased the anxiety levels of participants with CAI. Therefore, it is possible that sequential balance perturbation training might decrease such anxiety levels, leading to better function in the individual with CAI. In addition, Cognitive behavioral therapy also can assist in this purpose.

Ultimately, contribution of fear of reinjure to functional deficits remains to be elucidated. These findings confirm that a combination of factors play a role in CAI and show the overlap between patient, clinical, and laboratory-oriented evidence. This emphasis the importance of whole-person health cares and suggests an integration of treatment strategies to improve patient outcomes. Although there are a variety of strategies to influence the impairments associated with CAI for evidence-based practice, it is necessary to consider the integration of clinical finding, the best available evidence, and the unique needs of each individual patient. Thus, if a patient does not report elevated levels of fear or functional limitations on a patient reported outcome, the aforementioned treatment strategies may be unnecessary. Furthermore, patient-oriented, clinical-oriented, and laboratory-oriented measures, when accessible, should be evaluated periodically to monitor patient progress and formulate treatment modifications as needed.

Conclusion

Individuals with CAI have an elevated fear of reinjury and decreased function compared with control groups. Therefore, providing an intervention that could decrease the fear of reinjury such as sensorimotor training and cognitive behavioral therapy would be beneficial for returning to the previous physical activity and preventing recurrence of injury.

Conflict of Interest

The authors declare that they have no conflict of interest.

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