Jentashapir J Health Res. 2016 December; 7(6):e39249. doi: 10.17795/jjhr-39249.

Published online 2016 December 28. **Research Article**

The Correlation Between Self-Reported Instability, Balance and Health Status in Individuals with Chronic Functional Ankle Instability

Tara Azaran,[1] Fateme Esfandiarpour,[1] Reza Salehi,[1] and Shahin Goharpey[1,*]

[1]Department of Physical Therapy, Musculoskeletal Rehabilitation Research Center, Ahvaz Jundishapour University of Medical Sciences, Ahvaz, Iran

[*]*Corresponding author*: Shahin Goharpey, Musculoskeletal Rehabilitation Research Center, Ahvaz Jundishapour University of Medical Sciences, Ahvaz, Iran. Tel: +061-33743101, E-mail: shgoharpey@ajums.ac.ir

Received 2016 May 16; **Revised** 2016 August 09; **Accepted** 2016 December 27.

Abstract

Background: Functional ankle instability (FAI), characterized by feeling of "giving way" and instability of ankle, is the most prevalent problem following ankle sprains which causes deficits in balance and health status. However, little is known about the correlation between ankle instability measuring tools in individuals with FAI.

Objectives: The present study aimed at evaluating the correlation between self-reported instability with balance and health status in individuals with FAI.

Methods: Twenty-three patients with unilateral FAI and 23 healthy individuals participated in the present study. Ankle instability index and SF-36 questionnaire were completed by the participants; then balance error scoring system (BESS) was used to measure static balance. To compare balance and health status between the 2 groups, independent sample and Mann-Whitney tests were used; moreover, Spearman correlation coefficient was used to determine the correlation between the main variables.

Results: BESS scores in FAI group was significantly more than the control group ($P < 0.05$). The Spearman's correlation analysis revealed significant correlations between the ankle instability index with all of SF-36 subscales except for energy/fatigue and social function ($r = 0.43$ to 0.85, $P > 0.05$). However, no significant correlation was found between the balance tests scores and the instability index.

Conclusions: The results of the present study suggest that the individuals with FAI had greater activity limitations and participation restrictions compared with the control group. There were deficits in balance status in FAI group. Moreover, a significant correlation was observed between the ankle instability index and the subjective measures of health status.

Keywords: Ankle Sprain, Joint Instability, Postural Balance, Health, Questionnaire

1. Background

Functional ankle instability (FAI) is the most prevalent complication that occurs in 40% - 50% of the individuals following an ankle sprain. FAI is identified by self-reported instability and giving way during activity and recurrence of ankle sprain. Recurrent ankle sprain may lead to osteoarthritis of ankle joint in the long- term (1-6).

FAI affects sport and activities of daily living, balance, and health status of the individuals (7-9). To treat FAI, balance deficits should be evaluated first. Most studies asses balance deficits using stabilometric devices such as force plates, but these devices are expensive and not available in all clinics. On the other hand, objective clinical tests are more available and reliable (10).

Balance error scoring system (BESS), which was first used to asses mild head injuries (2, 11), is a valid and reliable method to assess static balance. It consists of 6 test conditions: 3 stances (double leg, single leg, and tandem) on 2 surfaces (firm and foam). The results of these tests are correlated with force plate results (10, 12).

The most important complication of patients with FAI is feeling instability and giving way during activity. Ankle instability index is a reliable method for measuring self-reported instability in the ankle (13). SF-36 questionnaire is one of the best tools to measur the health status that affects ankle joint instability.

Despite advances in the treatment of patients with ankle instability and according to the chief complaint of these patients (feeling of instability and giving way that affects activities of daily life), little is known about the correlation between self-reported instability and objective balance tests and health status.

2. Objectives

Thus, the main purpose of the present study was to investigate any correlation of self-reported instability with balance and health status in individuals with chronic functional ankle instability.

3. Methods

3.1. Participants

A total of 23 participants aged 18 to 40 years with functional ankle instability (FAI) (8 males, 15 females, 29.3 ± 4.6 years, 168.9 ± 8.2 cm height, 73 ± 13.8 kg mass) and 23 healthy participants (8 males, 15 females, 30.5 ± 5.2 years, 165.1 ± 7.1 cm height, 70.6 ± 10.2 kg mass) participated in the present study. Participants in the FAI group were matched to the healthy control group by age, body mass index, gender, and dominant leg. None of the participants was an athlete. Simple nonprobability method was used for sample collection. Sample size was obtained through consulting with a statistical specialist and the formula used in rehabilitation research by assuming à = 0/05 and β = 0/2. The power of this study was 80%. The inclusion criteria for FAI group were as follow: 1) any history of unilateral recurrent ankle sprain in the last year; and 2) repeated episodes of giving way or instability during activity in the ankle (2, 14-19). Participants were excluded from both groups under the following conditions: 1) any history of fractures or surgeries or any injuries to either lower extremities; 2) reported visual, vestibular or neurologic dysfunction; 3) acute symptoms of ankle sprain (pain, swelling, redness); 4) bilateral ankle instability; or 5) participation in elite sport activity or current physical rehabilitation program (2, 14, 16-20). The ethical committee of Ahvaz Jundishapur University of Medical Sciences approved the research procedures. The ethical code of the study is ajums.REC.1393.90. All participants read and signed the consent form before participation. Results were presented without mentioning the identity of the participants.

3.2. Procedures

At first, participants performed static balance (BESS) tests, which consist of 6 test conditions: 3 stances (double leg, single leg, tandem) and 2 various surfaces (foam 50 × 60 × 10 cm, firm). Participants had to stand barefoot and as motionless as possible with closed eyes and put their hands on hips for 20 seconds (12). The reliability of these test conditions was 0.78 to 0.96 (10). Participants performed a practical trial at first, followed by 2 trials for each test and 1 minute rest between the trials. Order of the tests was random. Score of each condition was calculated by counting the number of errors (deviations from the proper stance). Errors were as follow: 1) lifting the hands off the hips; 2) moving the hip into more than 30 degrees of flexion or abduction; 3) lifting the forefoot or heel; 3) remaining out of the test position for more than 5 seconds; 5) opening the eyes; 6) stepping, stumbling, or falling (2). The mean score of the 2 trials was used for statistical analysis.

Then participants completed 2 questionnaires: 1) ankle instability index (AII), which consists of 6 dichotomous questions about feeling instability in the ankle (appendix 1 in supplementary file); the maximum score of this index is 6 (participants in the control group scored 0 in this index). According to previous studies, reliability of this index is 0.70 to 0.86 (13, 21); 2) SF-36 questionnaire: this is a valid and reliable questionnaire about physical and mental health status of individuals (22). The physical domain includes physical health, physical function, pain, and general health; and the mental domain includes emotional problem, energy/fatigue, emotional well-being, and social function (22).

3.3. Statistical Analysis

Data were analyzed using SPSS version 19 for windows (SPSS Inc., Chicago, IL, USA), and the significance level was set at p b .05.

At first, Kolmogorov-Smirnov test was used to determine whether data were normally distributed. Comparison between FAI and control groups was done using independent sample t-test or the Mann-Whitney test.

Spearman correlation coefficient was used to determine the correlation between ankle instability index with static balance and health status.

4. Results

FAI group exhibited poorer balance performance than the control group as revealed by independent sample t-test. The number of balance errors in FAI group was significantly more than the control group ($P < 0.05$) (Table 1). Maximum errors were seen in one leg condition on foam in both groups. No errors were reported in double leg conditions.

The results of the Mann-Whitney statistical test revealed significant differences in the score of social function, physical health, physical function, and pain subscales of SF-36 between FAI and control groups ($P < 0.05$). No significant group difference was found for the emotional problem, energy/fatigue, emotional well-being, and general health domains. Overall, there was a significant difference between FAI and control groups in the physical domain, but not in the mental domain. Higher scores showed upper levels of health status (Table 2). Ankle instability index value was 4.3 ± 1.5 in the FAI and 0 in control groups.

Interpretation of the correlation was as follows: 0 - 0.25: little if any correlation; 0.26 - 0.49: fair correlation; 0.50 - 0.69: moderate correlation; 0.70 - 0.89: high correlation; and ≥ 90 very high correlation (23).

Table 1. The Mean ± Standard Deviation and P Value Compared with Static Balance Score Between FAI and Control Groups

Balance Test	FAI Group	Control Group	P Value
Double leg on firm	0 ± 0	0 ± 0	-
Double leg on foam	0.1 ± 0.3	0 ± 0.1	-
Single leg on firm	3.8 ± 1.9	1.9 ± 1.8	0.001
Single leg on foam	7.3 ± 1.4	4.7 ± 1.1	< 0.001
Tandem on firm	2.3 ± 1.8	0.6 ± 0.8	< 0.001
Tandem on foam	3.7 ± 2	1.7 ± 1.3	< 0.001

Table 2. The Mean ± Standard Deviation and P-Value Compared with SF-36 Questionnaire Score between FAI and Control Groups

SF-36 Subscales	FAI Group	Control Group	P Value
Physical function	75.9 ± 21.2	91.3 ± 8	0.01*
Physical health	67.4 ± 30.6	84.8 ± 25.8	0.03*
Emotional problem	62.3 ± 40.6	76.8 ± 34	0.19
Energy/fatigue	71.5 ± 13.5	77.4 ± 14.1	0.3
Emotional wellbeing	70.3 ± 18.9	72 ± 17.2	0.79
Social function	69.4 ± 26.4	90.2 ± 9.9	0.006*
Pain	63.2 ± 17.2	82 ± 16.4	0.001*
General health	71.7 ± 13.4	75.5 ± 14.5	0.27
Physical part	71.5 ± 17.2	84.3 ± 12	0.01
Mental part	68.8 ± 19.4	76.9 ± 16.4	0.12

No significant correlation was found between ankle instability index and static balance ($P > 0.05$). Ankle instability index had a fair to high significant correlation with all the SF-36 subscales except for social function and energy/fatigue (Table 3).

5. Discussion

Functional ankle instability is associated with balance deficits and limitations in activity and sport, resulting in decreased health and quality of life. The present study aimed at determining whether any correlation exists between self-reported ankle instability with balance and health status in patients with FAI.

Balance analysis revealed significant differences between FAI and control groups in single limb on firm and foam and tandem on firm and foam surface, but there were no differences in double leg conditions. Results of our study were similar to those of Reimann and Docherty studies (2, 10). Participants in FAI group had a more number of errors and higher scores than the control group. The maximum number of errors was in the single leg on foam followed by single leg on firm and tandem on foam, and tandem on firm surface, but there was not any error in double leg conditions. Docherty et al. also reported similar results. Standing on a single leg makes a smaller base of support and foam surfaces decrease somatosensory information to postural control system (10). Thus, we recommend to asses these 4 tests instead of all other static balance tests.

Health status analysis exhibited significant differences in physical health, physical function, pain, and social function between FAI and control groups. However, no significant difference was found for the emotional problem, energy/fatigue, emotional well-being, and general health domains. Functional ankle instability can influence physical but not mental health of the individuals, and this is against the Anandacoomarasamy and Barnsley's study. They found significant differences in the general health between ankle sprain and control group, but not in the other subscales (24). This is because the participants of our study were not athletes, so balance problems had not much influence on professional activities. Brent and Arnold achieved similar results to our study in which individuals in FAI group had lower scores in SF-36 physical component compared with the control group (25).

There was a high correlation between ankle instabil-

Table 3. P Value and Spearman Correlation Coefficient in the Correlation of Ankle Instability Index with SF-36

SF-36 Subscales	P Value	Correlation Coefficient
Physical function	< 0.001*	-0.69
Physical health	< 0.001*	-0.80
Emotional problem	0.02*	-0.47
Energy/fatigue	0.06	-0.39
Emotional wellbeing	0.03*	-0.43
Social function	0.2	-0.27
Pain	< 0.001*	-0.75
General health	< 0.001*	-0.73
Physical part	< 0.001*	-0.85
Mental part	< 0.001*	-0.54

ity index with general health, physical health, pain, and physical domain; there was a moderate correlation with physical function and mental domain, and a fair correlation with emotional problem and emotional well-being of SF-36 questionnaire. There was a high correlation between self-reported health status and functional ankle instability, which is the most important problem of these patients. Nonetheless, no correlation was found between ankle instability index and balance tests. Patients' subjective reports of their problems were not similar to results of objective tests like BESS, and this is because patients' perception of their problems is affected by their level of activity before the problem, profession, and life style. Thus, objective tests do not involve all aspects of patients' life.

5.1. Conclusion

Balance problems are associated with ankle sprain. BESS is a valid test to asses balance deficits. Single leg on foam is the most sensitive test among the other 6 conditions of BESS to determine balance deficits. A high correlation of ankle instability index with the physical domain of SF-36 questionnaire revealed that self-reported instability could affect physical health status of the individuals.

Supplementary Material

Supplementary material(s) is available here.

Acknowledgments

The authors gratefully acknowledge the assistance of Mr. Latifi in statistical analysis.

Footnote

Financial Disclosure: This study was supported by Ahvaz Jundishapur University of Medical Sciences (No: Pht-9312).

References

1. Hintermann B, Boss A, Schafer D. Arthroscopic findings in patients with chronic ankle instability. *Am J Sports Med.* 2002;**30**(3):402–9. [PubMed: 12016082].
2. Docherty CL, Valovich McLeod TC, Shultz SJ. Postural control deficits in participants with functional ankle instability as measured by the balance error scoring system. *Clin J Sport Med.* 2006;**16**(3):203–8. [PubMed: 16778539].
3. Delahunt E. Neuromuscular contributions to functional instability of the ankle joint. *J Bodyw Mov Ther.* 2007;**11**(3):203–13. doi: 10.1016/j.jbmt.2007.03.002.
4. Buchanan AS, Docherty CL, Schrader J. Functional performance testing in participants with functional ankle instability and in a healthy control group. *J Athl Train.* 2008;**43**(4):342–6. doi: 10.4085/1062-6050-43.4.342. [PubMed: 18668180].
5. Tanaka H, Mason L. Chronic ankle instability. *Orthopaedics and Trauma.* 2011;**25**(4):269–78.
6. Doherty C, Delahunt E, Caulfield B, Hertel J, Ryan J, Bleakley C. The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. *Sports Med.* 2014;**44**(1):123–40. doi: 10.1007/s40279-013-0102-5. [PubMed: 24105612].
7. Tropp H. Pronator muscle weakness in functional instability of the ankle joint. *Int J Sports Med.* 1986;**7**(5):291–4. doi: 10.1055/s-2008-1025777. [PubMed: 3793339].
8. Garn SN, Newton RA. Kinesthetic awareness in subjects with multiple ankle sprains. *Phys Ther.* 1988;**68**(11):1667–71. [PubMed: 3186791].
9. Lentell G, Katzman LL, Walters MR. The Relationship between Muscle Function and Ankle Stability. *J Orthop Sports Phys Ther.* 1990;**11**(12):605–11. [PubMed: 18787260].
10. Riemann BL, Guskiewicz KM, Shields EW. Relationship between Clinical and Forceplate Measures of Postural Stability. *J Sport Rehabilitation.* 1999;**8**(2):71–82. doi: 10.1123/jsr.8.2.71.
11. Iverson GL, Koehle MS. Normative data for the balance error scoring system in adults. *Rehabil Res Pract.* 2013;**2013**:846418. doi: 10.1155/2013/846418. [PubMed: 23577257].

12. Bell DR, Guskiewicz KM, Clark MA, Padua DA. Systematic review of the balance error scoring system. *Sports Health.* 2011;**3**(3):287–95. doi: 10.1177/1941738111403122. [PubMed: 23016020].
13. Docherty CL, Arnold BL, Gansneder BM, Hurwitz S, Gieck J. Functional-Performance Deficits in Volunteers With Functional Ankle Instability. *J Athl Train.* 2005;**40**(1):30–4. [PubMed: 15902321].
14. Wikstrom EA, Tillman MD, Borsa PA. Detection of dynamic stability deficits in subjects with functional ankle instability. *Med Sci Sports Exerc.* 2005;**37**(2):169–75. [PubMed: 15692310].
15. Lee A LW, Huang CH. Impaired properioception and poor static postural control in subjects with functional instability of the ankle.. *J Exerc Sci Fitness.* 2006;**4**(2):117–25.
16. Michell TB, Ross SE, Blackburn JT, Hirth CJ, Guskiewicz KM. Functional balance training, with or without exercise sandals, for subjects with stable or unstable ankles. *J Athl Train.* 2006;**41**(4):393–8. [PubMed: 17273464].
17. Hubbard TJ, Kramer LC, Denegar CR, Hertel J. Contributing factors to chronic ankle instability. *Foot Ankle Int.* 2007;**28**(3):343–54. doi: 10.3113/FAI.2007.0343. [PubMed: 17371658].
18. Hale SA, Hertel J, Olmsted-Kramer LC. The effect of a 4-week comprehensive rehabilitation program on postural control and lower extremity function in individuals with chronic ankle instability. *J Orthop Sports Phys Ther.* 2007;**37**(6):303–11. doi: 10.2519/jospt.2007.2322. [PubMed: 17612356].
19. Brown CN, Mynark R. Balance deficits in recreational athletes with chronic ankle instability. *J Athl Train.* 2007;**42**(3):367–73. [PubMed: 18059992].
20. Ross SE, Guskiewicz KM, Yu B. Single-leg jump-landing stabilization times in subjects with functionally unstable ankles. *J Athl Train.* 2005;**40**(4):298–304. [PubMed: 16404451].
21. Sharma N, Sharma A, Singh Sandhu J. Functional performance testing in athletes with functional ankle instability. *Asian J Sports Med.* 2011;**2**(4):249–58. [PubMed: 22375246].
22. Brazier JE, Harper R, Jones NM, O'Cathain A, Thomas KJ, Usherwood T, et al. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. *BMJ.* 1992;**305**(6846):160–4. [PubMed: 1285753].
23. Domholdt E. Physical therapy research: principles and applications. 2 ed. Philadelphia: Sounders; 2000. p. 275.
24. Anandacoomarasamy A, Barnsley L. Long term outcomes of inversion ankle injuries. *Br J Sports Med.* 2005;**39**(3):14. doi: 10.1136/bjsm.2004.011676. [PubMed: 15728682] discussion e14.
25. Arnold BL, Wright CJ, Ross SE. Functional ankle instability and health-related quality of life. *J Athl Train.* 2011;**46**(6):634–41. [PubMed: 22488189].