

Research Article

The Risk Factors for Ankle Sprain in Cadets at a Male Military School in Iran: A Retrospective Case-control Study

Farzad Najafipour^{1*}, Farshad Najafipour², Mohammad Hassan Majlesi³ and Milad Darejeh⁴

¹Allameh Tabataba'i University, Department of physical education and sport Sciences, Mac in Sport Injury and Corrective Exercises, Tehran, IR Iran

²Department of Epidemiology, AJA University of Medical Sciences, Tehran, IR Iran

³Faculty of Physical Education and Sport science, Central Tehran Branch, Islamic Azad University, Tehran, Iran

⁴Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, Iran

***Address for Correspondence:** Farshad Najafipour, Department of Epidemiology, AJA University of Medical Sciences, Tehran, IR Iran, Email: drnajafipour2002@yahoo.com

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ABSTRACT

Introduction: Ankle sprain is a widespread impairment in sport groups; this impairment leads to an absence from the workplace. The ankle sprains incidence rates are induced by height, weight, BMI, physical fitness, level of match, classification of sport, and personal exposure to sport.

Methods: A longitudinal case-control study was executed to verify the outcome of risk factors for ankle sprain at a Military Male School between 2012 and 2013 of 4987 people at risk for ankle sprain, a total of 234 cadets sustained new ankle sprains during the study, 432 non-injured cadets randomly selected as the control group.

Results: Regarding to the total people at risk in our study the incidence rate was approximately 5/1000 ankle sprain-years. Cadets with ankle sprains had higher weight, BMI and higher scores in Army Physical Fitness test than the control group. Ankle sprain occurred most commonly during athletics (51.4%). Ankle sprain incidence rate did not significantly vary from different athletic competitions after controlling for athlete-exposure. Soccer and Ball Games had the highest ankle sprain incidence rate.

Conclusion: Higher weight, increased BMI, greater physical conditioning and athlete exposure to selected sports were all risk factors for ankle sprain.

INTRODUCTION

Many researchers have identified the ankle sprain responsible for 15% to 45% of whole injuries in contact and noncontact sports and also responsible for 75% of ankle injuries and inversion mechanisms cause 85% to 90% of these injuries [1,2].

An ankle sprain can affect not only the function of the ankle and foot but also the knees and spine [3]. Mainly ankle sprains are caused by medial or lateral forces contacting the ankle or foot and end in a corresponding eversion or inversion [4]. Baumbach, et al. [5], affirm that a case history of ankle sprains is an important risk factor for recurrent injury. Ankle sprains are also cause of resisting pain or instability

in 20% to 50% of sportsmen [6]. Ankle sprains and their occurrence have been studied in depth [4,5,7,8].

Ankle sprain occurs frequently in the sports population. It is resulted by the stretching of fibers or collagen in the ligaments of ankle, whereby the some or all fibers are ruptured. Because almost all sport activities require running, jumping and turning, extreme pressures are repeatedly load on the lower extremities joints, especially the ankle joint. Cohen, et al. [9], reported that 67% of their patients had sports induced ankle sprains. Dubin et al. [10] showed that 70% of the basketball players had previous ankle sprain and 80% of them had recurrent sprains. Chronic ankle disorders for instance chronic pain, muscular weaknesses and instability were common for those cases with a previous ankle sprain [11-13].

Many studies on sports injuries have indicated the high incidence of recurrence of ankle sprain [13-16]; although, investigations on the outcomes of ankle injuries and their influences on the sports performance level are rare. Ankle sprain is considered to be a very common type of cadets training injury [17,18]. Further problems, such as instability, chronic pain, are also expected after ankle sprain [19-24]. Many researchers studied the risk factors of lower extremity injuries on various kinds of sports. Hand dominance, age, body mass index (BMI), skill level, and shoe type have been identified as the main risk factors [18-24]. Differences in the measurement techniques, dissimilar baseline risks associated with different sports, disparities in statistical analyses, the differences in methods of data collection and differences in definitions of injury and severity caused the lack of consensus [2]. There was little evidence about the risk factors of ankle sprain in uniformed groups in the literature [8]. Ankle sprains occur commonly and are often creates further problems, in order to develop preventive strategies and education programs, risk factors associated with ankle sprain must be understood and identified.

Severe ankle sprains are associated with both short and long term disability [3]. Their management is controversial [3]. Surgical treatment of damaged ligaments has been advocated, but overall there is little strong evidence which shows it cost effectiveness [4]. There is some evidences that braces may be less effective than functional treatments, but the trials are generally small and of limited quality Braces can be useful to enable patients to return to activities more quickly, but may have the disadvantages of joint stiffness and muscle atrophy [3]. Protected immobilization with a boot or brace may offer the best outcomes [5]. Mechanically speaking walking boots may restrict ankle and subtalar joint motion, while permitting the boot to be removed at rest for a range of motion and dynamic exercises. Braces mechanically restrict inversion and eversion movements at the subtalar joint, while permitting free plantar and dorsiflexion. It has been argued; even the approach of a double layer of tubular bandage is a waste of considerable resources [6]. The purpose of our study was to recognize the risk factors for ankle sprain in cadets.

MATERIAL AND METHODS

This was a case-control study which was executed to verify the outcome of risk factors for ankle sprain at a Military Male School, in Iran between 2012 and 2013 of 4987 people at risk for ankle sprain, a total of 234 cadets sustained new ankle sprains during the study, 432 non-injured cadets randomly selected as the control group.

A questionnaire was used to record the cadets' personal data (name, age, dominant hand, history of ankle sprains during their careers, supplementary data on ankle sprains).

In order to facilitate understanding for the participants as well as reducing the errors, the questionnaire comprised of objective questions (marking the answer that

is fit was needed). The questionnaire was given to the cadets by their commanders and returned to the researchers.

Along with the questionnaire there was an informed consent document in which the cadets agreed to participate in the research after the study objective and its design were explained to them. This document stated that there would be no remuneration that the study posed no risk to participants' health, their personal data would remain confidential and they could leave the study whenever they wanted. The study was approved by a local clinical research ethics committee.

Participants demographics variables measured were; age, height, body mass index (BMI) and the Military Physical Fitness Test (MPFT) score.

SPSS 18.0 (Statistical Package for Social Sciences) for Windows® was employed for statistical analysis. The student test was applied to compare the differences between the variables. Accepted error in this study was lower than 0.05.

RESULTS

Of 4987 people at risk for ankle sprain, a total of 234 cadets sustained new ankle sprains during the study (4.69%).

The average age of the injured and non-injured cadets were 23.08 (SD=4.39) and 22.91(SD=4.31) respectively. (P=0.68). The mean and standard deviation of height, weight, body mass index and MPTF score can be seen in table 1. Of the 234 cadets in the study, with recent ankle sprain, 41.45% (n=97) dominant ankle injuries, 43.58% (n=102) non-dominant ankle injuries, and 14.95 % (n=35) reported sprains in both ankles.

Inversion mechanisms were responsible for 81.25% and (18.75%) recognized as eversion mechanisms and 50% of the injuries were recurrences, and 88 cadets (37.5%) showed persistent clinical symptoms (as pain, instability, insecurity or staggering).

Activities performed by cadets were divided into match, training, "informal game" (a recreational game), or other (not related to the sporting practice). Five sports activities priority recorded (Soccer, Ball games, Running/Jogging, Martial Arts and Others). Ankle sprain incidence rate in these five activities were: Soccer (50.85%, Ball games (26.06%), Martial Arts (16.66%), Running/Jogging (13.24%) and others (10.25%). The athletes were categorized into four main groups: Of the total 234 cadets, 97 (41.45%) participated four or more times per week in sports. Only 16 (6.83%) participated less often than once a week in sports. 66.67% of injuries occurred in collective training while 22.22% occurred in recreational training and 11.11% reported in tactical training.

The main treatments employed for the cadets in the ankle sprain injuries were as follows: 62.5% of the cadets did withdrawal from the sporting activities, immobilization was used for 6.25%, and 50% required physiotherapy and no cadets underwent surgical intervention.

Table 1: The mean and standard deviation of study variable.

Variables		Mean (SD)	P value
Height (cm)	Injured cadets	176.08(SD=5.83)	0.78
	Non-injured cadets	176.86 (SD=5.93)	
Weight (kg)	Injured cadets	75.84 (SD=5.32)	0.041
	Non-injured cadets	74.48 (SD=7.72)	
BMI	Injured cadets	24.46 (SD=1.56)	0.021
	Non-injured cadets	23.85 (SD=2.19)	
MPFT score	Injured cadets	80.12(SD=12.08)	0.002
	Non-injured cadets	74.89 (SD=21.92)	

Among all the 234 cadets, 196 (83.76%) reported previous history of ankle sprain. 52.99% (n=124) had sprains in both ankles, 20.51% (n=48) showed injury only in the dominant ankle, and 2.56% (n=6) showed injury in the non-dominant ankle. Among the 196 cadets, 100 (51.02%) of them used some type of protection (tightening of the limb with bandages, adhesive tape boot, etc.) in this area, whereas 96 (48.98%) trained and participated without any protection.

DISCUSSION

Ankle sprains are frequent in cadets, affecting more than 75% of the test subjects at least once in their careers. In fact studies addressed the proportion of ankle sprains in association to the total number of injuries; therefore we cannot compare our results with most of the studies of the area. It is tried to relate the cadet's dominant hand with the affected ankle. Bergmann, et al. [7], also concluded that most of the ankle sprains influenced the dominant side limb.

Cadets with a history of ankle sprain, 61.22% already had at least one recurrence. This finding is consistent with the results of Baumbach, et al. [5], who noted that a previous history of this injury is the main risk factor for ankle sprains.

Tenacious symptoms including pain, insecurity, instability (feeling of a "limp" ankle), and staggering were described by 18.37% of the cadets in the ankles with a previous sprain history. The interval between injuries was not specified. Cosby et al. [6] stated that symptoms such as instability and pain account for 20% to 50% of the cases of ankle sprains.

To prevent ankle sprains the use of external immobilization methods is suggested. Among these, the review by Baumbach, et al. [5], stands out, where the authors mention more than 40 studies on the subject. In our research, of the 196 cadets who already had ankle sprains, 100 (51.02%) used some type of protection (tightening of the limb with bandages, adhesive tape boot, etc.) in that area. O'Connor, et al. [1], in a review of 14 randomized studies, concluded that the use of some external ankle supports can prevent sprains during sports, especially for cases with previous history of sprains.

O'Connor, et al. [1], also stated that neuromuscular (or proprioceptive) training is an important factor in injury prevention. According to Sinnott, et al. [11], proprioceptive exercises has been applied to hamper ankle sprains from 1965, when Freeman was the first to propose it. However, Cohen et al. [9] concluded that the ideal method, modality, duration, and frequency have not yet been scientifically determined.

Sinnott, et al. [11] suggested that improvements in technique can be an important injury prevention measure and should be taught. This author mentions the works of Witjes, et al. [8], who reduced the incidence of ankle sprains with a program of specific technical training. In a group of amateur players, O'Connor, et al. [1], implemented a prevention program consolidating special technical training and proprioceptive exercises. Finally, he achieved a 50% education in the incidence of ankle sprains.

Of the 234 cadets who participated in our study, 6 cadets (42.86%) injured the dominant side limb, 100 (42.86%) injured the non-dominant side limb, and 33(14.28%) had sprains in both ankles. This equal injury incidence in the dominant and non-dominant side limb limbs contradicts both the data collected by Klykken, et al. [13], and our own findings relating to the cadets' histories of ankle sprains.

Of the 234 injuries, 190 (81.25%) resulted from inversion mechanisms and 44 (18.75%) from eversion mechanisms. It is believed that the inversion mechanisms are responsible for 85% to 90% of ankle sprains [2]. As for activity practiced by the cadet when he had the injury, the most ankle sprains (56.25%) occurred in training, compared with only 37.5% in matches. This fact is probably because cadets spend more

time in practices and training than in competitions. Yet, just 15 injury (representing 6.41% of the total), happened during a recreational practice (informal match), which shows us that cadets are subject to injuries during leisure activities.

“Collective training” (matches between the training sessions) were responsible for 66.67% of all ankle sprains sustained in training. Recreational training was responsible for 22.22% of training injuries. Here, the cadets play mostly for fun (almost like a recreational game). The reduced concentration level may predispose cadets to injuries.

Of all the injuries, 50% were recurrences and 37.5% had persistent clinical symptoms (such as pain and instability) at the time of data collection. These findings are consistent with those of authors such as Baumbach, et al. [5], and Cosby, et al. [6], concerning the predisposition of injured ankles to recurrent sprains and the possibility of chronic pain or instability after a sprain. Inadequate rehabilitation and previous history of ankle sprain are considered as risk factors for future injuries by Dubin, et al. [9], Mohamed, et al. [12], Klykken, et al. [13], and Lionberger, et al. [14].

CONCLUSION

Withdrawal from sporting activities was necessary in 62.5% of our subjects. In 6.25%, temporary immobilization of the ankle with braces, tape or bandages, was enough. Physiotherapy was carried out in 50% of the cadets, and surgical intervention in any subjects.

Based on the literature available, it is difficult to establish guidelines for the treatment received by the cadets, because we did not determine the severity of our cadets' injuries. Thus, withdrawing the cadet from sport matches for a few term of time seems to be the choice. The excellent results achieved by physiotherapy in cadets receiving conservative treatment of ankle sprains have been described by Lionberger, et al. [15]. This study confirms the ankle sprain as a common injury in cadets. Epidemiology studies can be considered the first step to enhance our knowledge regarding an injury. Thus, we hope that the data presented here serve as a base to improve ankle sprain injury prevention and rehabilitation programs for cadets.

Most of the cases in the study had lateral ankle sprain, which was consistent with that of other studies. Van Rijn, et al. [16] stated that common mechanisms of injury for most ankle sprains are forced ankle inversion and plantar flexion. Because of the structural stability of the deltoid ligament medial ankle sprain is less common [19].

Subjects who were overweight (BMI>22) have higher loading force to their joints of lower limbs that increase the chance of getting injured and they are prone to ankle sprain [23,24]. Those who had four or more times of training in the weak are higher risk, which may be related to the increased exposure to ankle injury. Past history of ankle sprain and past history of ankle problems were other risk factors.

REFERENCES

1. O'Connor SR, Bleakley CM, Tully MA, McDonough SM. Predicting functional recovery after acute ankle sprain. *PLoS One*. 2013; 8. Ref.: <https://goo.gl/T8XL0p>
2. González de Vega C, Speed C, Wolfarth B, González J. Traumeel vs. diclofenac for reducing pain and improving ankle mobility after acute ankle sprain: a multicentre, randomised, blinded, controlled and non-inferiority trial. *Int J Clin Pract*. 2013; 67: 979-989. Ref.: <https://goo.gl/Voq6PM>
3. Wähnert D, Grüneweller N, Evers J, Sellmeier AC, Raschke MJ, et al. An unusual cause of ankle pain: fracture of a talocalcaneal coalition as a differential diagnosis in an acute ankle sprain: a case report and literature review. *BMC Musculoskelet Disord*. 2013; 14: 111. Ref.: <https://goo.gl/DevRcJ>
4. Park J, Hahn S, Park JY, Park HJ, Lee H. Acupuncture for ankle sprain: systematic review and meta-analysis. *BMC Complement Altern Med*. 2013; 13: 55. Ref.: <https://goo.gl/bdEQIK>
5. Baumbach SF, Fasser M, Polzer H, Sieb M, Regauer M, et al. Study protocol: the effect of whole body

- vibration on acute unilateral unstable lateral ankle sprain-a biphasic randomized controlled trial. *BMC Musculoskelet Disord.* 2013; 14: 22. [Ref.: https://goo.gl/QwmuzM](https://goo.gl/QwmuzM)
6. Cosby NL, Koroch M, Grindstaff TL, Parente W, Hertel J. Immediate effects of anterior to posterior talocrural joint mobilizations following acute lateral ankle sprain. *J Man Manip Ther.* 2011; 19: 76-83. [Ref.: https://goo.gl/yMGdgF](https://goo.gl/yMGdgF)
 7. Bergmann G, Ciritsis BD, Wanner GA, Simmen HP, Werner CM, et al. Gastrocnemius muscle herniation as a rare differential diagnosis of ankle sprain: case report and review of the literature. *Patient Saf Surg.* 2012; 6: 5. [Ref.: https://goo.gl/bgxCGV](https://goo.gl/bgxCGV)
 8. Witjes S, Gresnigt F, van den Bekerom MP, Olsman JG, van Dijk NC. The ANKLE TRIAL (ankle treatment after injuries of the ankle ligaments): what is the benefit of external support devices in the functional treatment of acute ankle sprain? A randomised controlled trial. *BMC Musculoskelet Disord.* 2012; 13: 21. [Ref.: https://goo.gl/PQJkZa](https://goo.gl/PQJkZa)
 9. Cohen M, Parker S, Taylor D, Smit de V, Ben-Meir M, et al. Acupuncture as analgesia for low back pain, ankle sprain and migraine in emergency departments: study protocol for a randomized controlled trial. *Trials.* 2011; 12: 241. [Ref.: https://goo.gl/F920vN](https://goo.gl/F920vN)
 10. Dubin JC, Comeau D, McClelland RI, Dubin RA, Ferrel E. Lateral and syndesmotic ankle sprain injuries: a narrative literature review. *J Chiropr Med.* 2011; 10: 204-219. [Ref.: https://goo.gl/qC1nzh](https://goo.gl/qC1nzh)
 11. Sinnott BA, Strote J. Severe open ankle sprain. *West J Emerg Med.* 2011; 12: 581-582. [Ref.: https://goo.gl/Rs5UBt](https://goo.gl/Rs5UBt)
 12. Mohamed M, Wong CK. More than meets the eye: clinical reflection and evidence-based practice in an unusual case of adolescent chronic ankle sprain. *Phys Ther.* 2011; 91: 1395-1402. [Ref.: https://goo.gl/HsGpLX](https://goo.gl/HsGpLX)
 13. Klykken LW, Pietrosimone BG, Kim KM, Ingersoll CD, Hertel J. Motor-neuron pool excitability of the lower leg muscles after acute lateral ankle sprain. *J Athl Train.* 2011; 46: 263-269. [Ref.: https://goo.gl/SoOZ9K](https://goo.gl/SoOZ9K)
 14. Lionberger DR, Jousselein E, Lanzarotti A, Yanchick J, Magelli M. Diclofenac epolamine topical patch relieves pain associated with ankle sprain. *J Pain Res.* 2011; 4: 47-53. [Ref.: https://goo.gl/Z84of1](https://goo.gl/Z84of1)
 15. Lionberger DR, Jousselein E, Yanchick J, Magelli M, Lanzarotti A. Pooled analysis of clinical trial data evaluating the safety and effectiveness of diclofenac epolamine topical patch 1.3% for the treatment of acute ankle sprain. *Open Access J Sports Med.* 2011; 2: 75-84. [Ref.: https://goo.gl/WoHaat](https://goo.gl/WoHaat)
 16. Van Rijn RM, Willemsen SP, Verhagen AP, Koes BW, Bierma-Zeinstra SM. Explanatory variables for adult patient's self-reported recovery after acute lateral ankle sprain. *Phys Ther.* 2011; 91: 77-84. [Ref.: https://goo.gl/yF21hT](https://goo.gl/yF21hT)
 17. Steffen K, Nilstad A. Ankle exercises in combination with intermittent ice and compression following an ankle sprain improves function in the short term. *J Physiother.* 2010; 56: 202. [Ref.: https://goo.gl/4WePSa](https://goo.gl/4WePSa)
 18. Sandoval MC, Ramirez C, Camargo DM, Salvini TF. Effect of high-voltage pulsed current plus conventional treatment on acute ankle sprain. *Rev Bras Fisioter.* 2010; 14: 193-199. [Ref.: https://goo.gl/LH3Osf](https://goo.gl/LH3Osf)
 19. Bleakley CM, O'Connor SR, Tully MA, Rocke LG, Macauley DC, et al. Effect of accelerated rehabilitation on function after ankle sprain: randomised controlled trial. *BMJ.* 2010; 340: c1964. [Ref.: https://goo.gl/opsXyo](https://goo.gl/opsXyo)
 20. Hubbard TJ, Wikstrom EA. Ankle sprain: Pathophysiology, Predisposing factors, and Management strategies. *Open Access J Sports Med.* 2010; 1: 115-122. [Ref.: https://goo.gl/XMXbnl](https://goo.gl/XMXbnl)
 21. Struijs PA, Kerkhoffs GM. Ankle sprain. *Clin Evid (Online).* 2010; 1115. [Ref.: https://goo.gl/zChOyH](https://goo.gl/zChOyH)
 22. Fong DT, Chan YY, Mok KM, Yung PSh, Chan KM. Understanding acute ankle ligamentous sprain injury in sports. *Sports Med Arthrosc Rehabil Ther Technol.* 2009; 1: 14. [Ref.: https://goo.gl/8ZF1h1](https://goo.gl/8ZF1h1)
 23. Hupperets MD, Verhagen EA, Van Mechelen W. Effect of unsupervised home based proprioceptive training on recurrences of ankle sprain: randomised controlled trial. *BMJ.* 2009; 339: b2684. [Ref.: https://goo.gl/kME0FB](https://goo.gl/kME0FB)
 24. Cooke MW, Marsh JL, Clark M, Nakash R, Jarvis RM, et al. Treatment of severe ankle sprain: a pragmatic randomized controlled trial comparing the clinical effectiveness and cost-effectiveness of three types of mechanical ankle support with tubular bandage. *The CAST trial. Health Technol Assess.* 2009; 13: 1-121. [Ref.: https://goo.gl/Qc8mVd](https://goo.gl/Qc8mVd)

