

Prevalence of Chronic Ankle Instability and Associated Symptoms in University Dance Majors An Exploratory Study

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Abstract

Previous investigations have established that dancers suffer a large number of injuries to the lower leg, foot, and ankle, with a portion of these being significant time loss injuries or in some cases career ending. Lateral ankle sprain is a common injury in dancers and can often lead to recurrent instability and repetitive injuries. Research in other active populations has linked ankle sprains to the development of chronic ankle instability (CAI). Therefore, the purpose of this study was to identify the prevalence of CAI and related symptoms of ankle sprain in a student dance population. Individuals were included if they were currently a modern or ballet dance major at the investigators' university (exclusion criterion: a history of fracture or surgery in the lower extremities). A self-reported demographic questionnaire and the Identification of Functional Ankle Instability survey were used to identify the presence and characteristics of CAI. A total of 83 questionnaires were collected, and after exclusions, 77 participants remained: 43 modern dancers and 34 ballet dancers (10 males and 67 females, mean age 19.61 ± 2.53 years, mean dance experience 13.61 ± 3.16 years). Of all dancers surveyed, 41 (53.2%) had CAI, and of those 24 (58.5%) were modern dancers, and 17 (41.5%) were ballet

dancers. When looking only at those dancers who had a previous lateral ankle sprain, 75.9% were identified as having CAI. Chronic Ankle Instability can create long-term problems for anyone but especially female dancers, who place extreme stress on their feet and ankles from being en pointe or demi-pointe. It is important to educate dancers, instructors, and medical staff of the importance of recognizing CAI and seeking medical care for ankle sprains and their residual symptoms.

Dance is a highly demanding activity that requires balance, athleticism, and artistry. Participation in dance generally declines with age, in part due to the increased risk of injury.¹ There are numerous studies that have investigated the epidemiology of dance injuries, with overall incidence of injury ranging from 40% to 80%, depending on the level of participation.²⁻⁴ Additionally, 90% of dancers are said to have sustained an injury during their dance career.³ Foot and ankle make up roughly 40% of all injuries, while knee and hip injuries each account for 20%.^{3,5} By genre, rates of foot and ankle injuries are 17% to 24%

per 100 modern dancers and upwards of 67% to 95% per 100 professional ballet dancers.⁶⁻¹⁰

When an injury occurs dancers commonly feel stressed to return to activity as soon as possible, even if their injury might not be fully healed, or they may not report the severity of their symptoms for fear of being replaced. If a dancer does not have access to onsite medical care or health insurance (as is the case in many dance companies), he or she may delay seeking medical care. Such delay can impact the healing process and predispose the dancer to further injury.¹ This is especially true when dancers sustain an acute ankle sprain. Based on the physical demands placed on dancers (e.g., extreme ranges of motion, dancing en pointe and demi-pointe, adjusting to different choreographic styles, repetitive nature of class structure, and lack of an "off" season), the prevalence of ankle injuries may be exceptionally great in the dance population.

The anatomical structures at the ankle are complex, and the biomechanical alignment when the ankle is plantar flexed, as in the en pointe position, naturally creates an unstable situation. The two joints responsible for ankle movement are the talocrural and subtalar joints. The talocrural joint has the primary motion of dorsiflexion and plantar flexion, with a total range of 70° to 80° .^{11,12} The subtalar joint is responsible for supination and prona-

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tion and is measured clinically by the amount of inversion and eversion of the hindfoot.¹¹ A normal range for inversion is approximately 20° and 10° of eversion.¹¹ In the closed-packed position, the ankle is in maximal dorsiflexion; the ligaments are taut, and the talus, which is wider anteriorly, is fully engaged in the mortise of the ankle.^{11,12} This position is considered dynamically stable. However, when the ankle is in the open-packed situation, moving into various degrees of plantar flexion, the ligaments are loose, and the talus is not engaged in the mortise, creating an unstable position. This position allows for more rotational and transverse movements of the ankle joint. Dancers continually function in a more open-packed ankle position. When the body moves into extreme weightbearing plantar flexion (en pointe), the base of support is reduced, the ankle is placed in a more vulnerable position, and the risk of ankle sprain injury is increased.

Nearly 40% of individuals who sustain at least one acute (rapid onset) lateral ankle sprain experience residual symptoms, such as a sensation of the ankle “giving way,” which leads to chronic ankle instability (CAI).¹³⁻¹⁶ The definition of giving way, which has been supported by the International Ankle Consortium, is “the regular occurrence of uncontrolled and unpredictable episodes of excessive inversion of the rear foot, which do not result in an acute lateral ankle sprain.”¹⁷ Previously published work has established that CAI occurs in 20% to 47% of people.^{13,15,18-21} CAI is described as repeated bouts of ankle pathology that result in reoccurring ankle injuries.²² Individuals with CAI do not necessarily have ligamentous laxity in the ankle joint,^{23,24} but they do have proprioceptive and neuromuscular deficits.^{13,25} They also have decreased postural control in the injured ankle when compared to an uninjured ankle, which may be from improper rehabilitation or treatment of the initial lateral ankle sprain.^{13,26-30} This has led researchers to believe that there is a connection between a history of recurrent ankle sprains, improper

rehabilitation, and the development of CAI.³¹⁻³⁴ Although there are many studies that acknowledge the prevalence of lateral ankle sprains in the dance population, few such studies explore the prevalence and associated symptoms of CAI. Therefore, the purpose of this study is to analyze the prevalence of CAI and related symptoms in a university dance population.

Materials and Methods

Participants

Participants were included in this study if they were currently a modern or ballet dance major at the investigators' university. The exclusionary factor was a history of fracture or surgery in the lower extremities. There were approximately 100 dancers available to participate in the study, and a total of 83 questionnaires collected, for a response rate of 83%. Six of the 83 volunteers were excluded based on fractures (N = 6), surgeries, or neurological disorder. Of the remaining 77 participants, there were 43 modern dancers and 34 ballet dancers, with 10 males and 67 females (mean age 19.61 ± 2.53 years, mean dance experience 13.61 ± 3.16 years). All procedures were approved by the university's Institutional Review Board for the Protection of Human Subjects. Participants read and signed an informed consent form before starting the study.

Procedures

All data were collected during dance class or rehearsal by way of two questionnaires. The researchers were available when the dancers completed the questionnaires to answer any questions. One questionnaire addressed general demographics, including limb dominance (“Which leg would you kick a ball with?”), gender, age, year in school, years participating in dance, and history of ankle fracture and sprain for each limb. The other questionnaire, titled the Identification of Functional Ankle Instability (IdFAI), was used to determine the presence of CAI bilaterally. Traditionally, identifying individuals with CAI has been done through the use of self-report questionnaires. A recently published

position paper¹⁷ by the International Ankle Consortium suggested the use of the Ankle Instability Instrument (AII), Cumberland Ankle Instability Tool (CAIT), or the IdFAI to determine the presence of CAI. Since the IdFAI was created by combining both the AII and CAIT, we felt it was the most appropriate tool for our purposes.³⁵ Additionally, the IdFAI has undergone a series of tests that found it to be short, easy to administer and grade, capable of being applied to each limb independently, and both reliable and valid.³⁵⁻³⁷ The IdFAI is comprised of 10 questions, 9 of which use a Likert scale to quantify the answer (Fig. 1). Question 1 is a descriptive response and is not used in calculating the final score. Each IdFAI was scored, with values ranging from 0 to 37. Any dancer who scored an 11 or higher on the IdFAI was classified as having CAI.³⁵ The cutoff score was determined by calculating Youden's Index, which incorporates sensitivity and specificity.³⁸ This method was derived from a previous study.³⁸ Based on the discrimination score of 11, the IdFAI had an accuracy of 89.6% in separating individuals with and without CAI. The IdFAI had the best accuracy when compared to the other questionnaires. The sensitivity of the IdFAI is 0.92, and the specificity is 0.67.³⁵ Test-retest reliability ranged from 0.69 to 0.95 for individual items and 0.92 for the overall questionnaire.³⁷ Results of validity testing identified a statistically significant correlation ($\rho = -0.38$, $p = 0.001$) between the IdFAI and Lower Extremity Functional Scale (LEFS).³⁷ The Spearman correlation was negative because a low score on the LEFS indicates a high degree of lower extremity dysfunction, whereas a high score on the IdFAI is indicative of a high degree of ankle instability; this difference in scoring resulted in an inverse relationship.

Statistical Analysis

Questionnaires were scored and individuals were characterized based on the presence or absence of CAI. Dancers who were identified as having CAI were categorized as having either

IDENTIFICATION OF FUNCTIONAL ANKLE INSTABILITY (IdFAI)

Instructions: This form will be used to categorize your ankle stability status. A separate form should be used for the right and left ankles. Please fill out the form completely and if you have any questions, please ask the administrator. Thank you for your participation.

Please carefully read the following statement:

“Giving way” is described as a temporary uncontrollable sensation of instability or rolling over of one’s ankle.

I am completing this form for my **RIGHT/LEFT** ankle (circle one).

1.) Approximately how many times have you sprained your ankle? _____

2.) When was the last time you sprained your ankle?

- Never > 2 years 1-2 years 6-12 months 1-6 months < 1 month
 0 1 2 3 4 5

3.) If you have seen an athletic trainer, physician, or healthcare provider how did he/she categorize your most serious ankle sprain?

- Have **not** seen someone Mild (Grade I) Moderate (Grade II) Severe (Grade III)
 0 1 2 3

4.) If you have ever used crutches, or other device, due to an ankle sprain how long did you use it?

- Never used a device 1-3 days 4-7 days 1-2 weeks 2-3 weeks >3 weeks
 0 1 2 3 4 5

5.) When was the last time you had “giving way” in your ankle?

- Never > 2 years 1-2 years 6-12 months 1-6 months < 1 month
 0 1 2 3 4 5

6.) How often does the “giving way” sensation occur in your ankle?

- Never Once a year Once a month Once a week Once a day
 0 1 2 3 4

7.) Typically when you start to roll over (or ‘twist’) on your ankle can you stop it?

- Never rolled over Immediately Sometimes Unable to stop it
 0 1 2 3

8.) Following a typical incident of your ankle rolling over, how soon does it return to ‘normal’?

- Never rolled over Immediately < 1 day 1-2 days > 2 days
 0 1 2 3 4

9.) During “Activities of daily life” how often does your ankle feel **UNSTABLE**?

- Never Once a year Once a month Once a week Once a day
 0 1 2 3 4

10.) During “Sport/or recreational activities” how often does your ankle feel **UNSTABLE**?

- Never Once a year Once a month Once a week Once a day
 0 1 2 3 4

Version 1.0

Figure 1 Identification of Functional Ankle Instability (IdFAI) with Scoring. (Reprinted with Permission from Simon J, Donahue M, Docherty C. Development of the Identification of Functional Ankle Instability (IdFAI). Foot Ankle Int. 2012;33(9):755-63.)

Table 1 Ankle Sprain Frequencies of All Dancers (N = 77)

	Frequency	Percent
Unilateral Ankle Sprain	27	35%
Bilateral Ankle Sprains	27	35%
No History of Lateral Ankle Sprains	23	30%

unilateral or bilateral CAI. These categories are mutually exclusive. Only descriptive statistics and frequencies were calculated to determine the overall prevalence of giving way, lateral ankle sprains, and other symptoms associated with CAI.

Results

Fifty-four (70.1%) of the 77 dancers indicated a previous ankle sprain on the questionnaire, with 27 reporting a history of unilateral ankle sprains and 27 a history of bilateral ankle sprains (Table 1). Of these 54 dancers, 41 (75.9%) were identified as having CAI. Twenty-four (58.5%) of those were modern dancers, and 17 (41.5%) were ballet dancers. Approximately half of the modern dancers (13, 54.1%) had unilateral, and half (11, 45.8%) had bilateral CAI. However, in the ballet dancers, a majority had bilateral CAI (14, 82.4%; Table 2). Of the dancers with CAI (N = 41), only 2 were male, while 38 were female. The frequencies of associated symptoms of CAI are described in Table 3 for the dancers with and without CAI. Interestingly, a large number of participants with CAI did not seek medical care for their ankle sprains (21 of 41, 51.2%).

Discussion

The purpose of this study was to determine the prevalence of CAI in a student dance population. It is important to quantify if dancers are an at-risk population for developing

CAI and to educate dance instructors, physicians, and other healthcare professionals regarding the prevalence of CAI and its associated symptoms. In the typical sport setting, the prevalence of CAI has ranged from 20% to 47%.^{15,18-21} This study found that approximately 53% of dancers had CAI. Hence, when compared to more traditional athletes, it is apparent that the percentage of dancers with CAI is greater.

Chronic Ankle Instability in Modern and Ballet Dancers

Approximately half of all dancers included in this study had CAI. Of the modern dancers, there were approximately equal numbers with unilateral and bilateral CAI. However, of the ballet dancers with CAI, a majority had bilateral CAI (Table 2). Most of the individuals with CAI were female (95.1%). Of all males in the study, 20% had CAI, whereas of all females 58.2% had CAI. Regarding the male dancers, it is hard to draw conclusions of any kind as there were so few in the study (N = 10). As to the female dancers, these data support the theory that going en pointe may predispose female ballet dancers to sustaining a lateral ankle sprain and possibly developing CAI. When a dancer is en pointe, there is little ligament support on the lateral side of the ankle because it is in an open-packed position of the subtalar and talocrural joints.³⁹ This places the dancer at increased risk of the ankle rolling or giving way and

possibly predisposes her to developing CAI. In addition, with the ankle in full plantar flexion (open-packed), the anterior talofibular ligament is aligned vertically, which is one of the most vulnerable positions for damage to this ligament. The traditional ballet (pointe) shoe has less surface area than the shoes a modern dancer might wear. A modern dancer may perform barefoot or wearing a slip-on jazz shoe. These shoes create a greater contact area with the ground and also place the joint in a more closed-pack, stable position. The dancer with less ground contact may be more susceptible to spraining an ankle or having bouts of giving way.

Chronic Ankle Instability Symptoms

There are many complaints associated with CAI. These range from subjective feelings of ankle instability or giving way to ankle pain or weakness. The most common complaints relate to symptoms of the ankle giving way. In our study, the dancers with CAI all experienced such symptoms. When asked on the IdFAI "When was the last time your ankle gave way?" the most common response was "less than one month ago" (N = 18), which was the most "severe" answer. In addition, when the dancers were asked "How frequently does your ankle give way?" 10 answered once a week, and 6 others indicated an even higher frequency, once a day. Of those dancers who did not have CAI, only three had experienced giving way. The high prevalence of giving way in dancers with CAI does not seem surprising, as giving way is one of the fundamental symptoms of CAI.¹³ In addition, a systematic review of 118 research studies investigating CAI found over 90 variations of criteria for CAI.⁴⁰

Table 2 Percentage of Dancers with CAI as Identified by the IdFAI

	All Dancers (N = 77)	Modern Dancers (N = 43)	Ballet Dancers (N = 34)
Prevalence of CAI	53.2% (N = 41)	55.8% (N = 24)	50.0% (N = 17)
Unilateral CAI	39.1% (N = 16)	54.1% (N = 13)	17.6% (N = 3)
Bilateral CAI	60.9% (N = 25)	45.8% (N = 11)	82.4% (N = 14)

Table 3 Frequencies of Symptoms in Dancers with and without CAI (N = 77)

	CAI (N = 41)	No CAI (N = 36)
Number of Ankle Sprains	Mean 3.2 ± 3.6 Range 1-13	Mean 0.83 ± 0.8 Range 0-3
IdFAI Score	Mean 17.5 ± 3.4 Range 11-37	Mean 4.5 ± 2.8 Range 0-10
Ankle Sprain Grade		
N/A	0	24
Never seen by healthcare professional	21	7
Grade I	6	3
Grade II	8	2
Grade III	6	0
History of Last Sprain		
< 1 month	0	0
1-6 months	18	0
6-12 months	12	1
1-2 years	6	4
> 2 years	5	7
Never	0	24
Last Giving Way		
< 1 month	18	0
1-6 months	5	0
6-12 months	3	0
1-2 years	8	2
> 2 years	7	1
Never	0	33
Sport/Recreation Unstable		
Once a day	10	0
Once a week	8	0
Once a month	14	2
Once a year	5	4
Never	4	30

Nearly all of the variations required the participant to have experienced an ankle sprain, and most required previous incidents of giving way.⁴⁰ This provides further evidence that individuals with CAI do experience giving way; however, the severity of giving way has not been investigated.

Another common symptom of CAI is the ankle feeling unstable during sport or recreational activity. Thirty-seven of the 41 dancers in this study who had CAI reported feeling unstable in such situations. Most commonly, these dancers reported experiencing this sensation once a month (N = 14). On the other hand, of the dancers without CAI, only six indicated experiencing this symptom and at the lesser rate of once a year. The complaint of ankle instability

during sport or recreational activity could be multi-faceted, the result of the following: pathologic laxity,^{41,42} arthrokinematic impairments,^{4,43,44} synovial and degenerative changes,⁴⁵⁻⁴⁷ muscular weakness,^{48,49} decreased proprioception^{50,51} and postural control deficits,^{13,52} and impaired neuromuscular firing patterns.^{53,54} All of these deficits are associated with CAI and could be avoided if dancers received proper medical care and treatment following the initial ankle sprain.

Lateral Ankle Sprains

Foot and ankle injuries are known to occur in a substantial number of dancers.^{4,6-10} It is possible that the high rate of these injuries is due in large part to the presence of cavus feet in dancers.⁶⁻¹⁰ This predisposition results

in greater stress on the lateral aspect of the ankle, subsequently increasing the risk of ankle sprain. In a study by Wiesler and coworkers⁴ on 101 ballet and 47 modern dance students, 56% reported lower-limb injuries, with the most common being ankle sprains (28% of all dancers). The current study revealed that a total of 54 (70.1%) of our dancers experienced an ankle sprain. This percentage seems quite high, but research has shown the prevalence of lateral ankle sprains to be as high as 83.4% in a typical athletic population.^{16,55}

For dancers, the high incidence of ankle sprains is an issue with potential consequences for performance, progression to higher ranks within their companies, and overall career longevity. Anecdotally, dancers often continue to dance through injury and seek treatment only when they are physically unable to perform. The lack of treatment may be an important factor to consider when exploring the presence of recurrent injuries that could impact a dancer's career. In our research, it was found that a high number of dancers, approximately 28 (36%), did not seek medical care following their lateral ankle sprain. Of those that did not seek medical care, 21 (75%) developed CAI. Previous research with basketball players has shown similar results.⁵⁶ Of the 73% of all players who sustained a lateral ankle sprain, only half saw a healthcare professional, and even fewer completed rehabilitation for their injury.⁵⁶ Not seeking treatment for an ankle sprain could be a contributing factor to the development of CAI.

We speculate that many dancers did not seek medical care after a lateral ankle sprain because those injuries occur so frequently as to lead dancers to believe that they can treat them on their own. A second potential reason is that the dancer or the dance company does not have ready access to a healthcare provider, or the dancer does not feel that he or she can afford to pay the costs associated with medical care. However, it bears repeating that not obtaining proper treatment and rehabilitation for a lateral ankle

sprain can potentially eventuate in the development of CAI.^{26,57}

Limitations

The sample size for this study is quite small, especially when broken down by dance genre, with only 43 modern dancers and 34 ballet dancers participating. However, this type of research is the first to investigate the prevalence of CAI and associated symptoms in modern and ballet dancers, and since this population has such a high incidence of foot and ankle injuries, it is important to understand these aspects of CAI. Also, self-reported data was utilized exclusively in this study, and the dancers involved may have misconstrued an ankle sprain for another foot or ankle injury, especially when undiagnosed by medical personnel. Another limitation is that all participants in the study were university modern or ballet dancers, so that our findings may not translate to dancers who are adolescents, professionals, or involved in other dance genres.

Future Research

Future research should include other dance populations, such as tap, hip hop, etc. In addition, to get a better picture of the development of CAI, it may be beneficial to conduct prospective studies to obtain an accurate count of the number of lateral ankle sprains sustained, mechanism of injury, treatment or rehabilitation of the injury, progression of CAI, the presence and frequency of giving way, when the giving way occurs, and other associated symptoms. Other information that may be of interest to the dance community is the demographics of other sports, years of training, type of training, and what activity was being done when the ankle sprain occurred. Another piece of the puzzle is whether individuals lack access to medical care or simply do not seek it regarding their ankle sprains.

Conclusion

The purpose of this study was to identify the prevalence of CAI and associated symptoms among university modern and ballet dancers. From our

data, it is clear that ankle injuries are common in this population. Approximately 53% of study participants had CAI, and of dancers with a history of an initial lateral ankle sprain, approximately 75% had CAI. Ballet dancers had a higher prevalence of bilateral CAI, whereas modern dancers had approximately equal unilateral and bilateral CAI. Chronic ankle instability can create long-term problems for anyone, especially dancers. It is important to educate dancers, instructors, and medical staff regarding the need to identify CAI and seek early medical care for initial ankle sprains. Such education may reduce the incidence of ankle sprains and possibly the phenomenon of CAI.

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