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Epidemiology of Ankle Sprains and Chronic Ankle Instability

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Objective: To provide a focused overview of the existing literature on the epidemiology of acute ankle sprains (lateral, medial, and high/syndesmotic) with an emphasis on incidence studies from the United States. In addition, we provide a brief overview of chronic ankle instability (CAI), posttraumatic osteoarthritis, and injury prevention to contribute to our understanding of the epidemiology of these injuries and the current state of the science on ankle sprains and ankle instability in sports medicine.

Background: Acute ankle sprains are one of the most common musculoskeletal injuries, with a high incidence among physically active individuals. Additionally, acute ankle sprains have a high recurrence rate, which is associated with the development of CAI. Understanding the epidemiology of these injuries is important for improving patients' musculoskeletal health and reducing the burden of lower limb musculoskeletal conditions.

Description: Acute ankle-sprain incidence rates are summarized among the general population, as well as among physically active populations, including organized athletics and military personnel, with a focus on incidence in the United States. The link between a prior ankle sprain and a future acute ankle sprain is described. We also discuss the association between the incident ankle sprain and adverse, long-term outcomes such as CAI and posttraumatic osteoarthritis. Finally, we summarize injury-prevention successes and future directions for research and prevention.

Clinical Applications: This information is useful for health care providers to understand the expected incidence rates of acute ankle sprains, be aware of the association between ankle sprains and negative short- and long-term outcomes, and be familiar with existing injury-prevention programs.

Key Words: posttraumatic osteoarthritis, injury prevention, incidence, recurrent injury, reinjury, musculoskeletal

Key Points

- Acute ankle sprains are among the most common musculoskeletal injuries, and up to 70% of individuals who sustain an acute ankle sprain may develop residual physical disability, which may include chronic ankle instability.
- Acute ankle sprains occur at high rates across all levels of sports participation and among other active populations such as active duty military personnel; however, half of all ankle sprains treated in US emergency departments reportedly did not occur during sport activity.
- Evidence suggests a strong link between a prior ankle sprain and an increased risk for a future ankle sprain.
- Continued investigation into the link between the incident ankle sprain and chronic ankle instability with the development of posttraumatic osteoarthritis is needed.

Many health benefits accrue from consistent physical activity across the lifespan. Participation in physical activities, however, carries an inherent risk for acute and chronic musculoskeletal injury.[1,2] Musculoskeletal injuries, particularly of the lower extremity, cause short-term disability, interfere with participation in physical activity, and are associated with joint disorders in later life.[3,4] Thus, the general goal of preventing acute and chronic musculoskeletal injuries and reducing the associated burden is of considerable interest. Quantifying the effects of these injuries is necessary to identify groups at high risk for injury, assess the results of injury-prevention interventions, and justify the need for future research.

Acute ankle sprains are one of the most common musculoskeletal injuries and have a particularly high incidence among physically active individuals.[4–10] Additionally, acute ankle sprains have a high recurrence rate, which is associated with the development of chronic ankle instability (CAI).[10,11] Subsequently, understanding the epidemiology of these injuries is important for improving patients' musculoskeletal health and reducing the burden of ankle sprains and their associated sequelae.

In 2016, the International Ankle Consortium published both a consensus statement and an evidence review on the prevalence, effects, and long-term consequences of lateral ankle sprains.[7,12] These publications provide an evidence foundation regarding lateral ankle-sprain occurrence, CAI, and the associated direct and indirect costs of these conditions to establish specific goals for future research. The purpose of our work was to provide a focused overview of the existing literature on the epidemiology of acute ankle

Table 1. Incidence of Ankle Sprains in the General Population

Citation	Study Population	Study Time Period	Rate per 1000 Person-Years
Kemler et al[16]	Denmark emergency department data; sport-related ankle sprains	1986–2010	3.2–2.1
Hlmer et al[17]	Hillerd County Hospital, Denmark	1994	7.0
Bridgman et al[18]	West Midlands health districts, United Kingdom; accident and emergency units	2000–2001	5.27
Kemler et al[16]	National Survey on Accidents and Injuries, Denmark; sport-related ankle sprains	2000–2010	19.0–26.6
Waterman et al[4]	National Electronic Injury Surveillance System; US emergency departments	2002–2006	2.15
Shah et al[19]	Nationwide Emergency Department Sample; US emergency departments	2010	3.29

sprains, including lateral, medial, and high/syndesmotic types, with an emphasis on incidence studies from the United States. We also provide brief overviews of CAI, posttraumatic osteoarthritis, and injury prevention to contribute to our understanding of the epidemiology of these injuries and the current state of the science on ankle sprains and ankle instability in sports medicine.

OVERVIEW OF INCIDENCE

Acute ankle sprains are characterized by the stretching or tearing of the ankle ligaments. A sprain of the lateral ankle ligament complex is the most common type of ankle sprain[6,7,10,12,13]; the authors[14] of a meta-analysis estimated an incidence rate of 0.93/1000 *athlete-exposures* (AEs; 1 AE is defined as 1 athlete participating in 1 competition or practice). In comparison, the reported incidence rates of acute medial and high/syndesmotic ankle sprains were lower at approximately 0.06 and 0.38/1000 AEs, respectively.[14] In fact, more than three-quarters of all acute ankle sprains are lateral ankle sprains, and approximately 73% of these are injuries to the anterior talofibular ligament.[6,10] The remaining ~25% of all acute ankle sprains are medial (deltoid ligament) or high ankle/syndesmosis (anterior-inferior tibiofibular ligament or posterior-inferior tibiofibular ligament injuries).[15] The focus of this review is on the broad category of acute ankle sprains, including lateral, medial, and high/syndesmotic sprains.

Incidence in the General Population

In the United States, approximately 2 million acute ankle sprains occur annually.[4] Data from emergency department visits suggest an incidence rate of 2 to 7 acute ankle sprains/1000 person-years (Table 1)[4,7]; however, this is likely a significant underestimation, given that many injured people may not present to an emergency department or seek medical care at all. In fact, 1 estimate suggests that the true incidence rate among the general population in the Netherlands was 5.5 times higher than the incidence rates provided by emergency department data.[16] This discrepancy in incidence rate corresponds to a rate of acute ankle sprains of 19.0 to 26.6/1000 person-years noted during a survey of the general population (including ankle sprains that were and were not treated in emergency departments) compared with an incidence rate of 2.1 to 3.2/1000 person-years from emergency department data in the same population.[16] Additionally, half of all ankle sprains treated in US emergency departments were not associated with sport participation, suggesting that these injuries may affect a large distribution of individuals and not only those who participate in organized sports or at high levels of physical activity.[4]

A meta-analysis[14] of 181 prospective epidemiology studies of ankle sprains among various populations and from various data sources showed that, overall, the incidence of acute ankle sprains was higher among females than among males (13.6 versus 6.9/1000 exposures). The incidence also appeared to decrease with age: children had an estimated incidence rate of 2.85/1000 exposures, which decreased to 1.94/1000 exposures among adolescents and 0.72/1000 exposures among adults.[14] However, the peak incidence may be different between males and females; 1 study[4] demonstrated the peak incidence among 10- to 14-year-old females versus 15- to 19-year-old males.

Gaps in our current understanding of the incidence of acute ankle sprains among the general population remain, due largely to limited availability of data. In particular, most of the existing incidence rates included only the patients with the most severe injuries who required treatment in an emergency department. As noted earlier, the vast majority of acute ankle sprains that occur among the general population are likely not treated in emergency department settings, and many injured people may not seek care at all. To gain a better understanding of the distribution of these injuries among the general population, alternative data sources, including administrative data sources, surveys of the general population, and primary care data, should be leveraged to gain a broader understanding of the true incidence and prevalence of ankle sprains.

Incidence Among Highly Active Populations

Among collegiate athletes in the United States, acute ankle sprains are the most commonly reported injury, representing 15% of all injuries reported in this population.[10,20] The incidence rate of acute ankle sprains among athletes in 15 National Collegiate Athletic Association sports ranged from 0.75 to 0.89 sprains/1000 AEs from 1988–1989 through 2003–2004.[20] In comparison, the incidence rate of concussions ranged from 0.15 to 0.41/1000 AEs, and the incidence rate of anterior cruciate ligament injuries was 0.11 to 0.17/1000 AEs among the same population over the same time period.[20] The incidence rate of acute ankle sprains also varied substantially by sport, as is the case with other sport-related injuries. The highest rates of acute ankle sprains were typically reported in sports that are characterized by running, cutting, and jumping, such as basketball, football, soccer, and volleyball.[7,9,10,14,20] For example, the reported incidence rates in men's spring football (1.34/1000 AEs), men's basketball (1.30/1000 AEs), and women's soccer (1.30/1000 AEs) were substantially higher than in men's and women's ice hockey (0.23 and 0.14/1000 AEs, respectively) and men's baseball (0.23/1000 AEs).[20]

Acute ankle sprains are frequent injuries at all levels, from high school athletics to elite competitions. Among high school sports in the United States, acute ankle sprains represented approximately 15% to 17% of all injuries reported, a prevalence similar to that demonstrated at the collegiate level.[21] Notably, the rate of acute ankle sprains among this population decreased over the study period from approximately 4.6 per 10 000 AEs in 2005–2006 to approximately 2.5 per 10 000 AEs in 2010–2011.[21] Researchers[22] who studied sport-related injuries reported to the Athletic Training Practice-Based Research Network, an interscholastic athletic training electronic medical record that includes high school–aged athletes in the United States, also identified acute ankle sprains as one of the most commonly sustained injuries, with the highest prevalence reported among basketball and volleyball players.

At the highest level of competition, acute ankle sprains were among the most frequent injuries reported during the 2004 Olympic Games.[23] Acute ankle sprains have a particularly high incidence among elite basketball players. The incidence rate of acute ankle sprains among National Basketball Association players was approximately 3.2 to 3.5/1000 player-games.[24–26] In comparison, the next most often sustained specific injury among National Basketball Association players was lumbar sprain/strain, with an incidence rate of 1.1/1000 player-games.[25] Similarly, although the overall injury incidence rate was low for professional volleyball players compared with other elite sporting populations, ankle sprains were the most common specific diagnosis, representing 19.8% of all injuries.[27] Interestingly, at the highest level of American football, acute ankle sprains were also a common injury affecting National Football League players; however, these athletes seemed to sustain a higher proportion of high/syndesmotic ankle sprains than other populations.[28] One National Football League team reported 36 high/syndesmotic sprains compared with 53 lateral ankle sprains over a 15-season period.[28] Therefore, high/sydesmotic sprains represented approximately 40% of ankle sprains in this population compared with approximately 6% in other populations.[15,28]

In addition to sporting populations, acute ankle sprains occur frequently among populations that participate in intense physical activity, such as military personnel. In the US active duty military population, the incidence rate was 58.3 injuries/1000 person-years.[13] Thus, compared with the general population incidence rate of 2 to 7 ankle sprains/1000 person-years[4,7] based on emergency department data, the rate among military personnel was substantially higher, even if we account for potential underestimation among the general population.[7] For a recent systematic review,[14] investigators compiled 173 studies of athletic populations and 8 studies of military populations published before July 2012 and identified an incidence rate of 11.55 ankle sprains/1000 exposures (95% confidence interval [CI] = 11.54, 11.55) and an overall period prevalence of 11.88% (95% CI = 0.56, 13.19) among the high-quality studies reviewed. In comparison with data from the general population, these rates illustrate a strong positive correlation between ankle-sprain prevalence and level of physical activity.

Data from high-quality injury-surveillance and research programs such as the National Collegiate Athletic Association Injury Surveillance Program, High School Reporting Information Online, and the Athletic Training Practice-Based Research Network provide insight into the consequences of ankle sprains on athletes, but we need assessments across multiple participation levels and a wider distribution of sports. In particular, evidence from the "tails" of the athletic participation spectrum, youth sports and professional sports, is lacking. Innovative data-capture methods will permit prospective epidemiologic studies among youth and recreational athletes, who represent the majority of athletic participants. In-depth assessments of injury incidence and risk factors for injury at the elite athlete level, while representing a smaller portion of total participants, provide detailed data from more uniform playing conditions, which can inform our understanding of injury causes and guide the development of injury-prevention interventions that may benefit multiple populations. Thus, these areas should be prioritized for future research.

In addition, much of the data on the injury incidence rate and prevalence of musculoskeletal conditions among athletic populations from high-quality surveillance systems focus on the most popular and large-population team sports, such as basketball, football, and soccer. More research on other athletic activities and sports such as acrobatics, figure skating, gymnastics, rugby, and snow sports is needed. Acrobatic and gymnastics populations are often not captured in large-scale surveillance data but it may be particularly important to assess incidence rates of ankle sprains among these athletes.

Risk of Reinjury

The high incidence rate of acute ankle sprains is due in part to the frequency of reinjury after an initial ankle sprain.[10,11] Authors of a systematic review[11] noted that a substantial proportion of all acute ankle sprains sustained during sports were recurrent. For example, 46% of acute ankle sprains that occurred in volleyball, 43% in American football, 28% in basketball, and 19% in soccer were recurrent injuries.[11] Other researchers[10,18,29–31] identified the proportion of recurrent ankle sprains as 12% to 47% (Table 2).

A history of lateral ankle sprain, in particular, has been described as one of the strongest risk factors for a future lateral ankle sprain.[8,32,33] In mixed-activity populations, the strongest evidence that a prior ankle sprain is a risk factor for subsequent ankle sprain comes from a prospective cohort study[34] of 9811 military cadets: individuals with a history of ankle sprain had an approximately 3.5 times greater risk of sustaining another sprain during the study period than those who had no history of ankle sprain, even after adjusting for age, participation in an injury-prevention program, number of high school sports, and distance running index. This effect was similar for men (adjusted risk ratio [RR] = 3.40, 95% CI = 2.72, 4.26) and women (adjusted RR = 3.53, 95% CI = 2.79, 4.48) and was not modified by a history of injury to the lower extremity other than to the ankle.

As noted earlier, not only are a high proportion of all ankle sprains recurrent, but the number of prior ankle injuries sustained by the athlete is also substantial. Among recreational and elite basketball players in Australia, 73% had a history of ankle injury, and of those, the mean

Table 2. Proportions of All Ankle Sprains Reported as Reinjuries (Selected Studies)

Citation	Study Population	Study Time Period	Proportion, %
Swenson et al[21]	High School Reporting Information Online: 20 Sports	2005–2006 through 2010–2011	15.7
Kemler et al[30]	20 general practice, 9 physical therapy, and 2 emergency departments, Netherlands	2006–2008	18.1
Jain et al[29]	1 English Premier League soccer club	2007–2011	26.8
Roos et al[10]	National Collegiate Athletic Association: 25 sports	2009–2010 through 2014–2015	11.9
Pasanen et al[31]	9 under-18 basketball teams, Finland	2011–2014	47.0
Clifton et al[33]	Youth Football Safety Study: 10- to 14-year-old football players	2012–2014	15.9
	National Athletic Treatment, Injury and Outcomes Network: high school football players		5.6
	National Collegiate Athletic Association: collegiate football players		7.0

number of prior injuries was 3.5, with a standard deviation of 2.7.[8] A survey[35] of elite, competitive, and recreational athletes in China showed that 73.5% of participants reported having sustained at least 2 sprains to the same ankle. Furthermore, 22% of all patients' ankles incurred 5 or more prior sprains.[35] Among first-year military cadets in the United States, 15.5% described an ankle sprain within the 6 months prior to entering the military academy.[35] Thus, both acute, first-time sprains, and recurrent sprains play significant roles in the overall incidence rate of these injuries in the population, and the developers of future injury-prevention interventions should consider the risk for subsequent injury after an initial ankle sprain.

Although the literature examines the prevalence of recurrent injuries, assessments of the time-dependent measure of history of ankle sprain as a predictor of ankle sprain are lacking. Further investigation of this topic will clarify the association between previous injury characteristics and the risk of reinjury. These results could also inform future injury-prevention initiatives to reduce the effects of these injuries. Additionally, more research is necessary to further elucidate the association between multiple injuries and adverse, long-term outcomes such as CAI and posttraumatic osteoarthritis.

Chronic Ankle Instability

Associated with the high reinjury rate after an acute lateral ankle sprain is the development of CAI, which is characterized by laxity and mechanical instability that interfere with activity.[7,36] Chronic ankle instability can develop after an initial ankle sprain, from multiple injuries to the same structure, or from other mechanisms, ultimately leading to insufficiency of the lateral ankle ligament complex.[7,11,36] Here, we briefly review the existing literature specific to the epidemiology of CAI; however, it is important to recognize the overlap between reinjury rates and CAI prevalence.

A recent review[7] of CAI prevalence suggested that up to 70% of individuals who sustain an acute, incident lateral ankle sprain may develop CAI over a short time period after the initial injury. Investigators in a prospective cohort study[37] found a CAI prevalence of 40% one year after a first-time lateral ankle sprain. However, this estimate likely involved a continuum of both reported symptoms and duration of disability that varied based on the population under study. Not surprisingly, the CAI prevalence seemed to be higher among individuals who participated in running, jumping, and cutting activities, as was observed for the incidence of acute ankle sprains.[11] Contrary to prior findings on the incidence of acute ankle sprains, however, is the literature indicating that individuals who participated in dance and gymnastics may have a higher prevalence of CAI than other sporting populations.[7,11] This finding underscores the differences between the occurrence of acute ankle sprains and CAI, where CAI encompasses a broader spectrum of disorders affecting ankle stability.

When the prevalence of CAI among high school and collegiate athletes was assessed using the Ankle Instability Instrument and Cumberland Ankle Instability Tool, 23.4% of athletes reported CAI.[38] Chronic ankle instability was reported nearly twice as often by female athletes (32%) compared with male athletes (17%).[38] Interestingly, the prevalence seemed to decrease with increasing levels of participation, with a prevalence of nearly 19% among collegiate athletes compared with 31% among high school athletes.[38] It is difficult to determine if these variations represent true differences in the risk of developing CAI among different sporting populations or a selection bias whereby healthier athletes were more likely to continue to higher levels of participation. Also notable from the previous study[38] was that nearly two-thirds of athletes who reported CAI did not indicate a prior ankle sprain on their assessment survey. This highlights the ambiguity in defining CAI and the broader spectrum of ankle disorders that may lead to CAI.

The significant number of individuals who reportedly experience insufficient ankle stability and associated disability underscores the importance of further research on this topic. Screening tools to assess this condition need to be evaluated and improved, building upon the work[37] of authors who identified motion predictors of CAI development after first-time lateral ankle sprain. Future researchers should also focus on identifying mechanisms of development of CAI that could be acted on to reduce the risk.

Posttraumatic Osteoarthritis

Potentially the most concerning long-term outcome of ankle-sprain injuries is the development of posttraumatic osteoarthritis. Authors of a recent review[7] determined that lateral ankle sprains contributed to 13% to 22% of all osteoarthritis cases involving the ankle and 80% of posttraumatic osteoarthritis cases. Other known causes of posttraumatic osteoarthritis of the ankle include fractures and osteochondral lesions.[39] Of the posttraumatic osteoarthritis cases that developed after lateral ankle sprain, half occurred after a single acute sprain, whereas the other half

were the result of recurrent sprains or CAI.[7] Individuals who have posttraumatic osteoarthritis of the ankle may develop this condition at a younger age than those who have idiopathic osteoarthritis, with the mean age of onset in the fifth decade of life and an age range that includes patients in their 20s.[7,39]

Although this review offers only a high-level overview of the association between ankle sprain and posttraumatic osteoarthritis, the evidence presented here and in the literature clearly suggests a link between the two. However, more research on this link is necessary because most of the literature addresses individuals with posttraumatic osteoarthritis. Future investigators should prospectively evaluate the development and progression of this condition, among both injured and uninjured individuals. Furthermore, the causes of posttraumatic osteoarthritis are not well understood and continued work in this area is required.

Injury Prevention

Injury-prevention interventions that focus on musculoskeletal strengthening, balance, proprioception, and improved biomechanics have well-known benefits for preventing lower extremity musculoskeletal injuries and for recovery from pain and dysfunction in select populations.[40–47] Specifically, the authors[45] of a cluster randomized trial among elite male basketball players compared the FIFA (Fédération Internationale de Football Association) 11+ injury-prevention protocol, a warm-up program that includes stretching, strengthening, and balance exercises tailored to the sport of interest, with a control group. A lower rate of all injuries (0.95 versus 2.16 injuries/1000 AEs; $P < .0001$) and lower extremity injuries in particular (0.68 versus 1.4; $P = .022$) occurred with the FIFA 11+ intervention.

Proprioceptive- and balance-training programs have been effective in reducing ankle sprains.[42,44,47–51] In a 6-year prospective analysis[52] of a balance-training program, acute ankle sprains were reduced by 81%. A randomized controlled trial[49] of a multistation proprioceptive exercise program resulted in a nearly 65% reduction in the odds of an ankle sprain compared with the control group and the number needed to treat of 7 athletes to prevent 1 acute ankle injury. This evidence suggests that proprioceptive exercise programs are beneficial in reducing the risk of acute ankle sprains.

However, it is important to note that research studies examining the effectiveness of such interventions are often limited in scope, despite their promising findings. First, the authors focused on ensuring strong internal validity (ie, experimental control of confounders to ensure the causal pathway between the intervention and reduced injury incidence); yet external validity (ie, generalizability of the findings from the sample used to the entire population) may consequently have been weakened. At the same time, such interventions have not been broadly implemented. In many cases, actual adherence to intervention protocols and effects on expected outcomes have seldom been investigated. Thus, continued evaluation of interventions is needed to estimate efficacy alongside the adoption, implementation, and maintenance of these programs.[53]

It is important to reiterate that the examination of injury prevention in any context does not solely consider interventions aimed at reducing the incidence and severity of injury. The van Mechelen et al sequence of prevention[54] proposed a cyclical, 4-step approach to evaluating injuries: (1) identify the incidence and severity, (2) identify the causes of the injury, (3) introduce preventive measures, and (4) evaluate the effect of the proposed preventive measures. Given the incidence of acute ankle sprains across a wide distribution of the general population, future researchers should assess injury-prevention programs for adaptation and implementation among the general population.[53] Such work will continue to aid the refinement of prevention strategies.

Because of the high prevalence of recurrent ankle sprains, CAI, and the link to posttraumatic osteoarthritis, the development and evaluation of secondary and tertiary injury-prevention interventions is also necessary to reduce the prevalence of recurrent ankle sprains and CAI. Rehabilitation after an initial ankle sprain acts as a secondary injury-prevention program to prevent recurrent injury, but relatively few data are available on the actual prevention of recurrent injury.[55] Tertiary prevention initiatives to reduce the likelihood of progression to posttraumatic osteoarthritis are also urgently needed to reduce the long-term consequences of these injuries, and the first step toward progress in this area is continuous investigation of the pathway from initial ankle sprain to posttraumatic osteoarthritis.

SUMMARY

Despite the numerous health benefits associated with physical activity, it is important to recognize the inherent risk for acute and chronic musculoskeletal injury,[1,2] with such conditions affecting up to 1.7 billion people worldwide as of 2010 and contributing to approximately 166 million years lived with disability.[56] Acute ankle sprains are among the most common musculoskeletal injuries, with an estimated 2 million occurring each year in the United States.[4] An anecdotal perception suggests that ankle injuries are minor[7]; however, up to 70% of individuals who sustain an acute ankle sprain may develop residual physical disability.[3,4,7]

Acute ankle sprains occur at high rates across all levels of sports participation, representing approximately 15% of all injuries sustained during participation in both high school and collegiate team sports.[10,20,21] Similar to other highly active populations, active duty military personnel experience a high incidence of acute ankle sprains.[13] However, these injuries do not exclusively affect individuals who engage in organized athletics or high levels of physical activity. In fact, half of all ankle sprains treated in US emergency departments did not occur during sport activity.[4] Studies of these injuries in physically active populations can provide important information about their causes and prevention that may be useful from a population-based health perspective.

In addition to the high incidence rate of acute, first-time ankle sprains, reinjuries are of concern. Individuals with a history of acute ankle sprain have an approximately 3.5 times greater risk of sustaining another ankle sprain compared with those who have no such history.[34] This strong link between a prior ankle sprain and an increased risk for future ankle sprain is evidenced by the finding that

Table 3. Gaps and Future Directions for Research on the Epidemiology of Ankle Sprains and Instability

Gaps	Future Directions
Most of the existing literature on the general population examines only the most severe injuries that require treatment in an emergency department.	Alternative data sources, such as administrative data sources, surveys of the general population, and primary care data, should be explored to quantify incidence and prevalence.
Evidence from youth and professional sports is lacking.	Innovative data-capture tools are needed to assess sport injuries among youth athletes and recreational athletes, and assessment of elite athletes provides detailed data that can inform injury-prevention interventions across multiple populations.
Existing literature among sports focused on highly popular team sports, such as football, soccer, and basketball.	Understanding the epidemiology of these injuries in dance and acrobatic populations is necessary.
Current understanding of reinjuries is limited to the prevalence of reinjuries.	Future researchers should investigate the time-dependent association between a prior ankle sprain and the risk for future sprain.
Defining and quantifying cases of CAI in the literature presents a unique challenge given the variety of synonyms and characteristics that could be used to describe this phenomenon.	Consensus on defining and diagnosing CAI is important; screening tools to assess this condition must be evaluated and improved.
Causal pathway between acute ankle sprain and CAI is not well understood.	Future research should focus on identifying the mechanisms of development of CAI with the goal of determining predictors that could be acted on to reduce the potential for its development.
Majority of the existing literature on posttraumatic osteoarthritis is limited to individuals who developed the condition.	Future research should prospectively evaluate the development and progression of this condition, including among injured and uninjured individuals.

Abbreviation: CAI, chronic ankle instability.

12% to 47% of all ankle sprains reported are recurrent.[10,21,29–31]

Related to the elevated risk of reinjury is the development of CAI, which involves chronic insufficiency of the lateral ligament complex.[7,11,36] Chronic ankle instability may develop in up to 70% of individuals who sustain an acute, incident lateral ankle sprain, leading to interference with normal activity and subsequent disability.[7] Even more worrisome is the link between both incident ankle sprain and CAI and posttraumatic osteoarthritis.[7] Future injury-prevention initiatives must continue to take into account the risk for subsequent injury after an initial ankle sprain, CAI, and the development of posttraumatic osteoarthritis in an effort to reduce the burden of these injuries across the population.

It is important to note the limitations of describing and comparing the epidemiology of acute ankle sprains and CAI over time. Given the continual progress in injury diagnosis, treatment, and preventive care, the identification and definitions of these conditions have changed over time as well. In particular, defining and quantifying cases of CAI in the literature presents a unique challenge because of the variety of synonyms and characteristics that could be used to describe this phenomenon.[57] Subsequently, we must consider the time periods and populations included in the referenced studies when drawing inferences in light of the progress that has been made in recent years.

Continued investigation into the epidemiology of acute ankle sprains and the development of adverse long-term outcomes such as CAI and posttraumatic osteoarthritis are needed to address gaps in the literature and further our understanding of this public health problem (Table 3). In addition, the adoption, evaluation, implementation, and maintenance of primary, secondary, and tertiary injury-prevention interventions are crucial if we are to translate prevention successes observed in specific groups to the broader population.

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