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Risk Factors for Lateral Ankle Sprains and Chronic Ankle Instability

Eamonn Delahunt, PhD, BSc (Physiotherapy)*†; Alexandria Remus*‡

*School of Public Health, Physiotherapy and Sports Science, †Institute for Sport and Health, and ‡Insight Centre for Data Analysis, University College Dublin, Ireland

Lateral ankle sprains (LASs) are a common injury sustained by individuals who participate in recreational physical activities and sports. After an LAS, a large proportion of individuals develop long-term symptoms, which contribute to the development of chronic ankle instability (CAI). Due to the prevalence of LASs and the propensity to develop CAI, collective efforts toward reducing the risk of sustaining these injuries should be a priority of the sports medicine and sports physiotherapy communities. The comprehensive injury-causation model was developed to illustrate the interaction of internal and external risk factors in the occurrence of the inciting injury. The ability to mitigate injury risk is contingent on a comprehensive understanding of risk factors for injury. The objective of this current concepts review is to use the comprehensive injury-causation model as a framework to illustrate the risk factors for LAS and CAI based on the literature.

Key Words: sports, athletic injuries, sprains and strains, lower extremity, ankle

Lateral ankle sprains (LASs) are the lower limb musculoskeletal injuries most frequently incurred by individuals who participate in recreational physical activities and sports, as well as by the general public.[1] These injuries can have serious consequences for the injured individual in terms of treatment costs and time lost from work or sport.[1] This injury can be compounded by the high propensity to develop long-term symptoms, which contribute to chronic ankle instability (CAI).[1]

Musculoskeletal injury can negatively affect an individual's ability to participate in physical activity and may trigger long-term sequelae such as early-onset posttraumatic osteoarthritis.[2] This is concerning as LASs are especially prevalent in adolescent and young adult populations.[3,4] As such, efforts to reduce athletes' risk of incurring LASs should be a priority among the sports medicine and sports physiotherapy communities.

The ability to target and improve injury risk-reduction programs may be limited by an incomplete understanding of the causes of injuries. To this end, Bahr and Krosshaug[5] developed a comprehensive injury-causation model. It outlines the interaction of internal and external risk factors in the occurrence of the inciting injury; it is based on the epidemiologic model of injury developed by Meeuwisse[6] and the biomechanical model of injury proposed by McIntosh.[7] The Meeuwisse[6] epidemiologic model of injury attempts to account for the interaction of intrinsic risk factors (which predispose an athlete to injury) and extrinsic risk factors for injury, which together render an athlete susceptible to injury, before an injury-inciting event occurs. According to this model, each athlete has his or her own set of intrinsic risk factors that heighten the risk of sustaining an injury (ie, the *predisposed athlete*). The predisposed athlete becomes a *susceptible athlete* when exposed to extrinsic risk factors, which further heighten the risk of sustaining an injury. The McIntosh[7] biomechanical model of injury causation endeavors to account for additional factors that may influence the interplay between tissue load and tissue-load tolerance and, hence, injury risk. These factors include the athlete's behaviors and attitudes, training status, skill level, equipment, coaching, other competitors, and the external environment. The comprehensive injury-causation model developed by Bahr and Krosshaug[5] furthers these models by highlighting the importance of injury mechanisms. Detailing the activities during which injuries occur (eg, landing from a jump), the interaction between opposing players (eg, contact mechanisms of injury in team sports), and the biomechanics of the injury event (eg, inversion and internal rotation of the foot and ankle, resulting in injury to the lateral ligaments of the ankle joint) can provide useful information to help guide injury risk reduction strategies.

The purpose of our current concepts review was to use the comprehensive injury-causation model as a framework to illustrate the risk factors for LAS and CAI based on the published literature. For this article, *lateral ankle sprain* is considered "an acute traumatic injury to the lateral ligament complex of the ankle joint as a result of excessive inversion of the rear foot or a combined plantar flexion and adduction of the foot."[8(p2117)] Additionally, *CAI* is considered:

> . . . an encompassing term used to classify a subject with both mechanical and functional instability of the ankle joint. To be classified as having chronic ankle instability, residual symptoms ("giving way" and feelings of ankle joint instability) should be present for a minimum of 1 year postinitial sprain.[8(p2117)]

LATERAL ANKLE SPRAINS

Intrinsic Risk Factors

Age. Among the general public, the ankle-sprain injury incidence rate (IR) is influenced by age.

Using emergency department data from 4 urban health districts in the United Kingdom, Bridgman et al[3] reported that the highest ankle-sprain IR was observed among females between 10 and 14 years of age (12.8 per 1000 person-years), while the peak ankle-sprain injury IR for males occurred between the ages of 15 and 19 years. Similar observations have been reported in the United States: using data from the National Electronic Injury Surveillance System, Waterman et al[4] calculated an ankle-sprain IR of 2.15 per 1000 person-years. The highest IR of ankle sprain was incurred by those between 15 and 19 years old, with an estimated injury IR of 7.2 per 1000 person-years. Interestingly, individuals between 10 and 24 years of age sustained more than half of all ankle sprains. The peak IR of ankle sprain among females occurred between the ages of 10 and 14 years (5.4 per 1000 person-years), whereas the peak IR in males occurred between the ages of 15 and 19 years (8.9 per 1000 person-years). These data are also supported by the authors of a recent meta-analysis,[9] who reported that children had a higher ankle-sprain IR than adolescents and adults.

Additionally, Pourkazemi et al[10] recently observed that younger age (<24 years old; odds ratio [OR] = 8.41, 95% confidence interval [CI] = 1.48, 47.96) was an independent predictor of recurrent ankle sprain after first-time ankle sprain. Interventions to reduce the risk of ankle sprain should be targeted at preadolescents and early adolescents.

Sex. Among the general population, the IR of ankle sprains does not appear to be influenced by sex. Waterman et al[4] demonstrated that males and females had ankle-sprain IRs of 2.20 and 2.10 per 1000 person-years, respectively, equating to an IR ratio of 1.04.

Among sporting populations, no sex differences were noted in ankle-sprain IRs. Beynnon et al[11] found that the IR of first-time inversion ankle sprain did not differ between male (0.78 per 1000 person-days) and female (1.15 per 1000 person-days) collegiate athletes. The results were similar among high school athletes (male = 0.78 per 1000 person-days, female = 0.90 per 1000 person-days). The observation of no sex differences in the ankle-sprain IR was supported by a recent epidemiologic study[12] of 25 National Collegiate Athletic Association (NCAA) sports. In sex-comparable sports (baseball/softball, basketball, cross-country, ice hockey, soccer, indoor track, lacrosse, outdoor track, swimming and diving, and tennis), the overall rate of LASs did not differ (relative risk = 0.95, 95% CI = 0.86, 1.05).

Considering the substantial ankle-sprain IR among both male and female high school and collegiate athletes, players of both sexes should be exposed to risk-reduction interventions.

Body Composition. The risk of sustaining an ankle sprain is influenced by body composition. Fousekis et al[13] assessed 100 professional soccer players during the preseason to determine potential risk factors for noncontact ankle sprains. Both body mass (OR = 8.16, 95% CI = 1.42, 46.63) and body mass index (BMI; OR = 5.72, 95% CI = 1.37, 23.95) were independent predictors of noncontact ankle sprains.

Tyler et al[14] noted that BMI was a significant risk factor for ankle sprain in high school American football players. They reported ankle-sprain IRs (per 1000 exposures) of 0.52 (95% CI = 0.1, 1.6) for players with a normal BMI, 1.05 (95% CI = 0.3, 2.5) for players at risk of being overweight, and 2.03 (95% CI = 0.8, 4.2) for overweight players. Gribble et al[15] reported findings similar to those of Tyler et al[14]: body mass index (BMI) was a significant independent predictor of LAS among high school and collegiate American football players. The average BMI for football players who sustained an LAS was 29.32 ± 6.08 kg/m^2. This was different than the average BMI of players who did not sustain an LAS (26.70 ± 4.64 kg/m^2); the associated effect size was moderate.

A player's body composition is an important risk factor for ankle sprain. Emphasis should be placed on ensuring that soccer and American football players have and maintain the appropriate body composition for the unique positional demands of their sports.

Health: History of Previous Injury. In a prospective study of intrinsic risk factors for ankle sprain among active university students, de Noronha et al[16] showed that participants with a history of ankle sprain were twice as likely to incur a subsequent sprain (hazard ratio = 2.21, 95% CI = 1.07, 4.57). In a study of risk factors for noncontact ankle sprains among high school American football players, Tyler et al[14] observed that the ankle-sprain IR was higher in athletes with previous ankle injuries (2.60 per 1000 exposures versus 0.39 per 1000 exposures). Twenty six percent of the players with a history of ankle sprain incurred a subsequent ankle sprain during the study. In contrast, only 11% of those players without a history of ankle sprain incurred an ankle sprain during the study.

Ankle sprains had one of the highest reinjury rates of all lower limb musculoskeletal injuries, with up to a 2-fold increased risk of reinjury in the year after injury.[17] More recently, Doherty et al[18] reported that up to 40% of individuals who sustained an initial LAS developed CAI within the 12 months after their injury. Additionally, Pourkazemi et al[10] found that a recent first-time ankle sprain (OR = 8.23, 95% CI = 1.66, 40.72) was an independent predictor of recurrent ankle sprain.

A history of ankle sprain is a primary risk factor for recurrent injury. Individuals with a history of LAS and who participate in physical activities and sports with a high prevalence of ankle sprains should pursue specific, targeted, and ongoing exercise-based injury risk-reduction programs. Furthermore, clinicians should consider recommending ankle-joint braces, as strong evidence supports the use of such braces to reduce the risk of ankle sprains among high school athletes (football[19] and basketball[20]) with a history of ankle sprain.

Physical Fitness: Muscle Strength. Inadequate strength of the ankle- and hip-joint muscles may heighten the risk of sustaining an ankle sprain. Fousekis et al[13] reported that eccentric isokinetic strength asymmetries in the ankle-joint dorsiflexors and plantar flexors were independent risk factors for noncontact ankle sprains among soccer players. Specifically, soccer players with preseason eccentric strength asymmetries (>15%) in the ankle joint had 8.8

times the odds of sustaining a noncontact ankle sprain when compared with players who had no eccentric strength asymmetry.

In an investigation of hip strength as an intrinsic risk factor for LASs among youth soccer players, De Ridder et al[21] noted that reduced hip-extension strength was an independent risk factor. Specifically, players with greater hip-extension muscle strength had lower hazards of sustaining an LAS (hazard ratio = 0.3, 95% CI = 0.1, 0.9).

Specific strengthening exercises for the hip and ankle muscles may help to mitigate the risk of soccer players incurring an LAS.

Skill Level: Postural Balance. Impairments in postural balance increase the risk of sustaining an LAS. Trojian and McKeag[22] found an association between preseason performance on a single-legged balance test and ankle sprains sustained throughout the season. The relative risk of sustaining an ankle sprain was 2.43 (95% CI = 1.15, 5.14) among participants with a positive single-legged balance test. The single-legged balance test that they describe could be easily implemented in a clinical setting and does not necessitate any instrumented equipment. The test required the patient to stand on the test limb (without shoes), with the contralateral knee bent and not touching the test limb; the hips were in the same horizontal plane. With eyes open, the patient fixed his or her gaze on a spot marked on a wall and then closed the eyes for 10 seconds. A positive test was defined by any of the following: the patient reported a sense of instability, touching of the lower limbs, movement of the test foot on the floor, or touching down of the nontest limb.

Gribble et al[15] sought to identify clinically oriented outcome measures that predicted LASs among high school and collegiate American football players. Those players who sustained LASs had lower reach-distance scores (65.57% ± 7.90% versus 69.72% ± 7.53%; all scores were normalized as a percentage of leg length) in the anterior direction of the Star Excursion Balance Test when compared with those players who did not sustain an LAS. Recently, Attenborough et al[23] also reported that impaired dynamic postural balance as assessed via performance on the Star Excursion Balance Test was a risk factor for ankle sprains among netball players. A preseason reach-distance score in the posterior-medial direction ≤77.5% of leg length was associated with a heightened risk of ankle sprain (OR = 4.04, 95% CI = 1.00, 16.35).

Impairments in both static and dynamic postural balance are risk factors for LAS. Athletes who participate in sports with a high prevalence of LASs should perform postural-balance exercises on a regular basis.

Joint Anatomy and Psychological Factors

Joint anatomy and psychological factors (eg, competitiveness, motivation, perception of risk) are included as internal or intrinsic risk factors for injury in the comprehensive injury-causation model.[5] However, relative to LAS, few articles have been published in these areas. As such, future research is warranted.

Extrinsic Risk Factors

Participation in certain sports is associated with a higher risk of sustaining an LAS. Doherty et al[9] showed that indoor and court sports had the highest LAS IRs. The NCAA Injury Surveillance System has captured injury data across collegiate sports over the past 27 years in the United States. Using this database, Hootman et al[24] demonstrated that ankle sprains were the most common injury in NCAA sports, accounting for 15% of all reported injuries, with an overall incidence of 0.83 sprains per 1000 athlete-exposures (AEs).

Roos et al[12] determined that the NCAA sports in which LASs contributed the largest proportions of injuries were men's basketball (15.0%), women's basketball (14.5%), women's volleyball (10.7%), and women's lacrosse (10.2%). Additionally, LAS was the most common injury diagnosis in 12 sports and in the top 5 for an additional 9 sports. The sports with the highest rates of LAS were men's basketball (11.96 per 10 000 AEs), women's basketball (9.50 per 10 000 AEs), and women's soccer (8.36 per 10 000 AEs).

Athletes who participate in court sports are at a heightened risk of sustaining an LAS. These athletes should participate in an ongoing exercise-based injury risk-reduction program, and clinicians should consider recommending ankle-joint braces to reduce the risk of ankle sprains among high school athletes[19,20] with or without a history of ankle sprain.

Inciting Event

Lateral ankle sprains typically occur during the transition from nonweight bearing to weight bearing. Numerous researchers have detailed the kinematics associated with LASs.[25–30] In all instances, the characteristic biomechanical features were a rapid increase in inversion and internal rotation with or without plantar flexion. Thus, LASs appear to occur as a consequence of a sudden rapid inversion and internal-rotation loading of the foot-ankle complex, irrespective of sagittal-plane position.

Fong et al[30] described the kinematic characteristics of LASs recorded during 5 televised tennis matches by using a model-based image-matching process. Interestingly, in all cases, the ankle joint was inverted at the time of initial contact, which is a vulnerable position and theorized as an inciting mechanism of LASs.[31] Moreover, peak inversion occurred rapidly after initial contact (typically 0.09–0.13 seconds).

An inverted position of the ankle joint at initial contact is a particularly vulnerable position and has been identified as a key characteristic feature of the LAS injury mechanism. Exercises that challenge the control of frontal and transverse foot-ankle motion should be incorporated into exercise-based injury risk-reduction programs. Furthermore, ankle-joint braces can provide extra mechanical stability to the ankle joint and reduced the risk of ankle-joint injuries among high school football[19] and basketball[20] athletes. Hence, they should be considered a prophylactic intervention for athletes participating in sports with a high prevalence of ankle-joint injuries.

COMPREHENSIVE INJURY-CAUSATION MODEL: LAS

We have summarized the interactions of established intrinsic and extrinsic risk factors for LAS injury in the

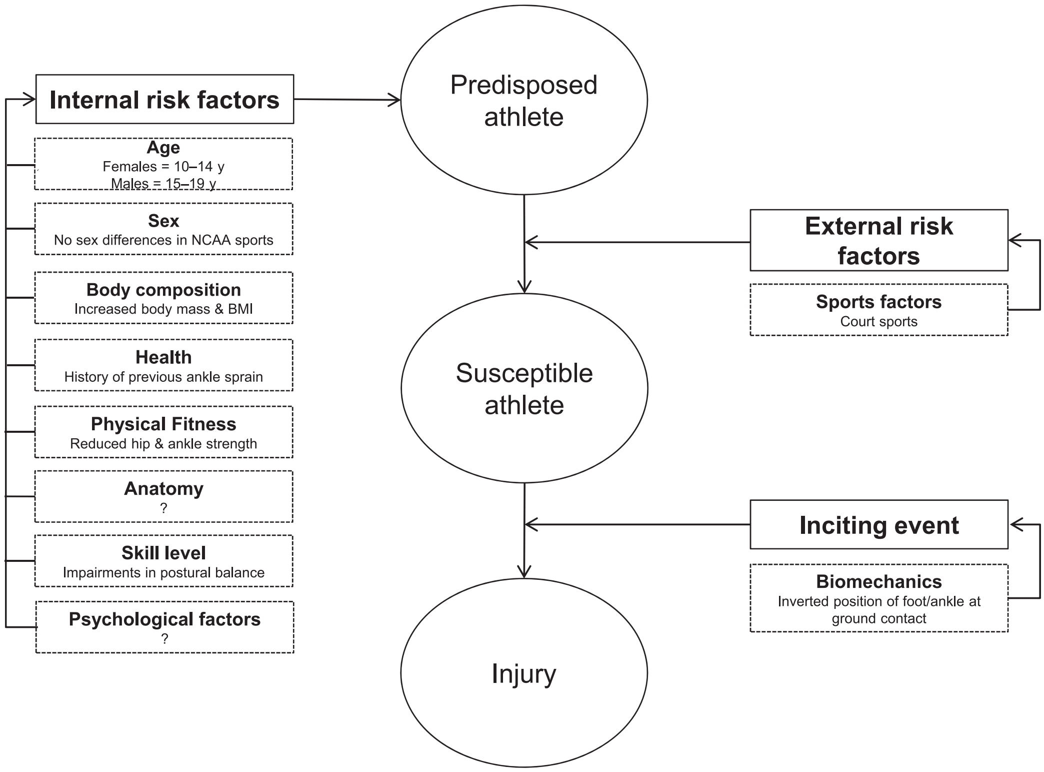

Figure. Established intrinsic and extrinsic risk factors for lateral ankle sprain. Abbreviations: BMI, body mass index; NCAA, National Collegiate Athletic Association.

Figure. These are presented in line with the comprehensive injury-causation model proposed by Bahr and Krosshaug.[5] The complex interaction of internal or intrinsic risk factors such as age, sex, body composition, health (a history of ankle-joint injury), physical fitness (muscle strength, anatomy), skill level (postural balance), and psychological factors predisposes an athlete to the risk of injury. The predisposed athlete becomes a susceptible athlete once exposed to extrinsic risk factors, which further heighten the risk of injury. Regarding the internal or intrinsic risk factors for LASs, the largest volume of supporting evidence relates to age and health: a history of ankle-joint injury. Regarding external risk factors for LASs, athletes who participate in court and field sports have the highest risk. Knowledge of these risk factors can guide clinicians toward an efficient use of resources. For example, it would be prudent to implement a risk-reduction intervention for a young adolescent basketball player with a history of LAS. If the clinician intended to introduce an exercise-based injury risk-reduction program, it would be necessary to also evaluate the athlete's body composition, physical health (muscle strength) and skill level (postural balance). To further mitigate the injury risk and provide external mechanical stability to the ankle joint, the clinician could recommend the athlete use an ankle-joint brace during practices and matches.

CHRONIC ANKLE INSTABILITY

To our knowledge, few prospective studies have been published that identified risk factors for the development of CAI. Rather, much of the literature in the area has focused on identifying variables that differentiate individuals with CAI from uninjured individuals or LAS copers.[32]

Doherty et al[33] conducted a prospective cohort study of the natural recovery from a first-ever LAS with the objective of identifying factors that contributed to the development of CAI. At 1-year follow up, 40% of their cohort had CAI. Being unable to perform a drop landing and a drop vertical jump within 2 weeks of initial injury was associated with the development of CAI; the associated positive likelihood ratio was 1.81. This resulted in a 50% posttest probability of developing CAI. Additionally, poorer dynamic postural balance and a lower level of self-reported function 6 months after initial injury were associated with CAI; the associated positive likelihood ratio was 8.33. This resulted in a posttest probability >80% for developing CAI.

More recently, Pourkazemi et al[10] reported that a first-time ankle sprain (OR = 8.23, 95% CI = 1.66, 40.72) and younger age (OR = 8.41, 95% CI = 1.48, 47.96) were both independent predictors of recurrent ankle sprain.

COMPREHENSIVE INJURY-CAUSATION MODEL: CAI

Due to the limited amount of research on risk factors for the development of recurrent ankle sprain and CAI, it is not possible to present a summary graphic in line with the comprehensive injury-causation model proposed by Bahr and Krosshaug.[5]

CONCLUSIONS

Our purpose for this current concepts review was to use the comprehensive injury-causation model to illustrate the risk factors for LAS and CAI. This was achieved for LAS, as a number of independent risk factors have been established. Knowledge of these will allow clinicians to implement appropriate risk-reduction interventions. More methodologically rigorous prospective cohort studies are required to establish risk factors for the development of CAI.

REFERENCES

1. Gribble PA, Bleakley CM, Caulfield BM, et al. Evidence review for the 2016 International Ankle Consortium consensus statement on the prevalence, impact and long-term consequences of lateral ankle sprains. *Br J Sports Med*. 2016;50(24):1496–1505.
2. Golditz T, Steib S, Pfeifer K, et al. Functional ankle instability as a risk factor for osteoarthritis: using T2-mapping to analyze early cartilage degeneration in the ankle joint of young athletes. *Osteoarthritis Cartilage*. 2014;22(10):1377–1385.
3. Bridgman SA, Clement D, Downing A, Walley G, Phair I, Maffulli N. Population based epidemiology of ankle sprains attending accident and emergency units in the West Midlands of England, and a survey of UK practice for severe ankle sprains. *Emerg Med J*. 2003;20(6):508–510.
4. Waterman BR, Owens BD, Davey S, Zacchilli MA, Belmont PJ Jr. The epidemiology of ankle sprains in the United States. *J Bone Joint Surg Am*. 2010;92(13):2279–2284.
5. Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med*. 2005;39(6):324–329.
6. Meeuwisse WH. Assessing causation in sport injury: a multifactorial model. *Clin J Sport Med*. 1994;4(3):166–170.
7. McIntosh AS. Risk compensation, motivation, injuries, and biomechanics in competitive sport. *Br J Sports Med*. 2005;39(1):2–3.
8. Delahunt E, Coughlan GF, Caulfield B, Nightingale EJ, Lin CW, Hiller CE. Inclusion criteria when investigating insufficiencies in chronic ankle instability. *Med Sci Sports Exerc*. 2010;42(11):2106–2121.
9. 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):123–140.
10. Pourkazemi F, Hiller CE, Raymond J, Black D, Nightingale EJ, Refshauge KM. Predictors of recurrent sprains after an index lateral ankle sprain: a longitudinal study. *Physiotherapy*. 2018;104(4):430–437.
11. Beynnon BD, Vacek PM, Murphy D, Alosa D, Paller D. First-time inversion ankle ligament trauma: the effects of sex, level of competition, and sport on the incidence of injury. *Am J Sports Med*. 2005;33(10):1485–1491.
12. Roos KG, Kerr ZY, Mauntel TC, Djoko A, Dompier TP, Wikstrom EA. The epidemiology of lateral ligament complex ankle sprains in National Collegiate Athletic Association sports. *Am J Sports Med*. 2017;45(1):201–209.
13. Fousekis K, Tsepis E, Vagenas G. Intrinsic risk factors of noncontact ankle sprains in soccer: a prospective study on 100 professional players. *Am J Sports Med*. 2012;40(8):1842–1850.
14. Tyler TF, McHugh MP, Mirabella MR, Mullaney MJ, Nicholas SJ. Risk factors for noncontact ankle sprains in high school football players: the role of previous ankle sprains and body mass index. *Am J Sports Med*. 2006;34(3):471–475.
15. Gribble PA, Terada M, Beard MQ, et al. Prediction of lateral ankle sprains in football players based on clinical tests and body mass index. *Am J Sports Med*. 2016;44(2):460–467.
16. de Noronha M, França LC, Haupenthal A, Nunes GS. Intrinsic predictive factors for ankle sprain in active university students: a prospective study. *Scand J Med Sci Sports*. 2013;23(5):541–547.
17. Verhagen EA, van Tulder M, van der Beek AJ, Bouter LM, van Mechelen W. An economic evaluation of a proprioceptive balance board training programme for the prevention of ankle sprains in volleyball. *Br J Sports Med*. 2005;39(2):111–115.
18. Doherty C, Bleakley C, Hertel J, Caulfield B, Ryan J, Delahunt E. Recovery from a first-time lateral ankle sprain and the predictors of chronic ankle instability: a prospective cohort analysis. *Am J Sports Med*. 2016;44(4):995–1003.
19. McGuine TA, Hetzel S, Wilson J, Brooks A. The effect of lace-up ankle braces on injury rates in high school football players. *Am J Sports Med*. 2012;40(1):49–57.
20. McGuine TA, Brooks A, Hetzel S. The effect of lace-up ankle braces on injury rates in high school basketball players. *Am J Sports Med*. 2011;39(9):1840–1848.
21. De Ridder R, Witvrouw E, Dolphens M, Roosen P, Van Ginckel A. Hip strength as an intrinsic risk factor for lateral ankle sprains in youth soccer players: a 3-season prospective study. *Am J Sports Med*. 2017;45(2):410–416.
22. Trojian TH, McKeag DB. Single leg balance test to identify risk of ankle sprains. *Br J Sports Med*. 2006;40(7):610–613.
23. Attenborough AS, Sinclair PJ, Sharp T, et al. The identification of risk factors for ankle sprains sustained during netball participation. *Phys Ther Sport*. 2017;23:31–36.
24. Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *J Athl Train*. 2007;42(2):311–319.
25. Fong DT, Hong Y, Shima Y, Krosshaug T, Yung PS, Chan KM. Biomechanics of supination ankle sprain: a case report of an accidental injury event in the laboratory. *Am J Sports Med*. 2009;37(4):822–827.
26. Kristianslund E, Bahr R, Krosshaug T. Kinematics and kinetics of an accidental lateral ankle sprain. *J Biomech*. 2011;44(14):2576–2578.
27. Gehring D, Wissler S, Mornieux G, Gollhofer A. How to sprain your ankle: a biomechanical case report of an inversion trauma. *J Biomech*. 2013;46(1):175–178.
28. Terada M, Gribble PA. Jump landing biomechanics during a laboratory recorded recurrent ankle sprain. *Foot Ankle Int*. 2015;36(7):842–848.
29. Skazalski C, Kruczynski J, Bahr MA, Bere T, Whiteley R, Bahr R. Landing-related ankle injuries do not occur in plantarflexion as once thought: a systematic video analysis of ankle injuries in world-class volleyball. *Br J Sports Med*. 2018;52(2):74–82.
30. Fong DT, Ha SC, Mok KM, Chan CW, Chan KM. Kinematics analysis of ankle inversion ligamentous sprain injuries in sports: five cases from televised tennis competitions. *Am J Sports Med*. 2012;40(11):2627–2632.
31. Tropp H. Commentary: functional ankle instability revisited. *J Athl Train*. 2002;37(4):512–515.
32. Hiller CE, Nightingale EJ, Lin CW, Coughlan GF, Caulfield B, Delahunt E. Characteristics of people with recurrent ankle sprains: a systematic review with meta-analysis. *Br J Sports Med*. 2011;45(8):660–672.

33. Doherty C, Bleakley C, Hertel J, Caulfield B, Ryan J, Delahunt E. Recovery from a first-time lateral ankle sprain and the predictors of chronic ankle instability: a prospective cohort analysis. *Am J Sports Med*. 2016;44(4):995–1003.

Address correspondence to Eamonn Delahunt, PhD, BSc (Physiotherapy), School of Public Health, Physiotherapy and Sports Science, University College Dublin, Health Science Centre, Belfield, Dublin 4, Ireland. Address e-mail to eamonn.delahunt@ucd.ie.