Accepted Manuscript

Title: A snapshot of chronic ankle instability in a cohort of netball players

Author: Alison S. Attenborough Peter J. Sinclair Tristan Sharp Andrew Greene Max Stuelcken Richard M. Smith Claire E. Hiller

PII: S1440-2440(15)00092-4
DOI: http://dx.doi.org/doi:10.1016/j.jsams.2015.04.010
Reference: JSAMS 1174

To appear in: Journal of Science and Medicine in Sport

Received date: 7-10-2014
Revised date: 24-3-2015
Accepted date: 12-4-2015

Please cite this article as: <doi>http://dx.doi.org/10.1016/j.jsams.2015.04.010</doi>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
A snapshot of chronic ankle instability in a cohort of netball players

Authors

Alison S Attenborough

Peter J Sinclair

Tristan Sharp

Andrew Greene

Max Stuelcken

Richard M Smith

Claire E Hiller

Institutions and affiliations

The University of Sydney, NSW, Australia. Exercise and Sport Science Discipline

The University of Sydney, NSW, Australia. Arthritis and Musculoskeletal Research Group

The University of Sydney, NSW, Australia. Sydney University Sport & Fitness

Anglia Ruskin University, Chelmsford, England. Postgraduate Medical Institute

University of the Sunshine Coast, QLD, Australia. School of Health and Sport Sciences

Corresponding author

Alison S Attenborough

aatt4376@uni.sydney.edu.au

Word count: 2978

Abstract word count: 250

Tables: 3

Figures: 0
A snapshot of chronic ankle instability in a cohort of netball players

Abstract

Objectives: Ankle injuries account for the highest percentage of injuries in netball, yet the chronic nature of ankle sprains is under reported within this population group. Chronic ankle instability (CAI) is a term used to describe certain insufficiencies that persist after an acute ankle sprain. The aim of this study was to investigate recurrent sprain, perceived ankle instability and mechanical ankle instability in a cohort of netball players.

Design: Cross-sectional study.

Methods: Ninety-six female netball players (24.1 ± 7.9 years) were recruited (42 club players and 54 inter-district players). Recurrent sprain was defined as two or more lifetime sprains to the same ankle. Perceived ankle instability was quantified with the Cumberland Ankle Instability Tool - Youth. Mechanical ankle instability was quantified via inversion-eversion rotations using an ankle arthrometer at torques of 3 Newton-metres.

Results: Forty-seven percent of the cohort had recurrently sprained an ankle. Of the 69 players with a previously sprained ankle, 64 % had a moderate-severe degree of perceived ankle instability. The total inversion-eversion angle was 31.1 ± 8.7 degrees. Club players had more cases of moderate-severe perceived ankle instability (p=0.01) and larger inversion-eversion angles (p=0.001) compared to inter-district players.

Conclusions: Recurrent ankle sprain and perceived ankle instability are easily identifiable aspects of CAI shown to be prevalent within this cohort. Additional research is required to quantify a cut-off value for mechanical instability. Club netball players were found to have more counts of moderate-severe perceived ankle instability and larger inversion-eversion angles when compared to the inter-district netball players.

Keywords: Joint instability; Sports; Sprain; Ankle joint; Ankle injury
Introduction

Netball is a highly popular sport in countries of the British Commonwealth. In Australia, it ranks second only to soccer in terms of population participation in organised team sports.¹ Netball is a physically demanding activity that requires participants to engage in jumping, bounding, pivoting and cutting manoeuvres.² Landing from these movements, together with the footwork rule in which a player in possession of the ball is required to stop suddenly to prevent a further step from occurring, make the lower limb highly susceptible to injury.³ Previous investigations have found the ankle to be the anatomical site most commonly injured in netball.³⁵ In a group of elite netball players, 39% of all injuries over the course of one playing season were reported to involve the ankle.⁶ Similarly, within a cohort of community netball players, 32% of total body injuries involved the ankle.⁷

A single history of ankle sprain predisposes the same ankle to recurrent damage,⁸ especially in the case of improper rehabilitation and premature return to play. Mechanical changes to the ankle joint complex often become evident following an acute ankle sprain, as do perceived limitations such as feelings of instability and sensations of ‘giving way’.⁹,¹⁰ There is a substantial amount of scientific literature that reports on the incidence of acute ankle sprains during specific sporting and recreational activities, yet only a small proportion of papers report on persisting chronic problems that remain after the injury is said to be healed.¹¹

Chronic ankle instability (CAI) is a condition that encompasses at least one of three individual components that persist following an acute ankle sprain: perceived ankle instability, mechanical ankle instability and recurrent sprain.¹² CAI has previously been defined on the premise that if an ankle has mechanical and perceived instability then it is susceptible to sprain.⁵ Whilst this remains true, research suggests that an individual can also repeatedly sprain an ankle in the absence of any functional
The Hiller\textsuperscript{12} model of CAI allows recurrent sprain to be included in the definition of CAI - irrespective of whether mechanical or perceived ankle instability are present.

No previous study investigating a netball cohort has reported all three aspects of CAI.\textsuperscript{11} A single study investigated the recurrent nature of ankle injuries sustained during netball tournaments in South Africa but only reported on the recurrence of injuries sustained during the tournament period.\textsuperscript{5} Another investigation examined only the perceived instability of previously sprained ankles in a population of state representative netball players.\textsuperscript{14} Of the previously sprained ankles in the study, 39\% were reported to be weak or unstable; however, no reliable tool was used to assess the level of perceived instability.

Mechanical ankle instability, perceived ankle instability and recurrent sprain, whilst used to define CAI, can also be thought of as independent risk factors for ankle sprains.\textsuperscript{15} It is important to identify the extent to which these individual contributors are observed in netball players in order to determine whether acute ankle sprains develop into long term problems. The primary aim of this study was to report the presence of CAI within a cohort of netball players. As the probability of sustaining an injury is increased with heightened exposure to sporting activity, the level of competition at which a player participates could influence their susceptibility to develop CAI from an initial sprain due to differing training loads. Therefore, a secondary aim was to determine any differences in the presence of CAI between club and inter-district level netball players.

**Methods**

The study was approved by The University of XX Human Research Ethics Committee (protocol number 2012/469). The study reports pre-season cross-sectional CAI data from a larger prospective study investigating ankle sprain risk factors during netball participation. Sample size requirements for the
prospective study were determined a priori. All participants were informed of procedures and volunteered for the study by signing a consent form. In the case of any participant being under the age of 18, consent was also obtained from her parent/guardian. All data for each participant were collected on a single day with questionnaires completed in the presence of a study investigator.

Ninety-six female netball players from the XX Metropolitan area participated in this study. Fifty-four played at an inter-district level and 42 played at a club level. The majority of the inter-district players (83%) were from the XX University Netball Club/City of XX Netball Association Elite Development Squad whilst the remaining inter-district players were individuals from a comparable representative netball association. The club players were largely a sample of convenience and were involved in netball at a social level which comprised no more than one netball specific training session per week.

For inclusion, participants had to be at least 15 years old at the time of pre-season testing, have at least one year of experience playing netball, and be registered to play in the subsequent netball season. Participants were excluded if they had sustained a lower limb injury in the six months prior to testing or had a history of ankle surgery or ankle fracture.

The definition of CAI used within the current study incorporates recurrent ankle sprain and/or perceived ankle instability and/or mechanical ankle instability following a previous ankle sprain.\cite{12} Owing to the current study’s exclusion criteria, all previous ankle sprains occurred a minimum of six months prior. Previous ankle sprains were recorded for each player by way of a self-administered form. The participants recorded the number of previous ankle sprains sustained to each ankle separately. Recurrent sprain was defined as two or more sprains occurring to the same ankle.\cite{16}

The Cumberland Ankle Instability Tool is a valid and reliable nine item questionnaire that is used to assess the perceived instability of an ankle.\cite{17} For this investigation the Cumberland Ankle Instability Tool
Youth was used; a simplified version of the original tool, where the layout and language of the questionnaire are structured to be more easily read and interpreted\textsuperscript{18}. An individual score was attained for each ankle of every participant. The youth version of the questionnaire has the same scoring protocol as the original Cumberland Ankle Instability Tool where a score of $\geq 28$ is indicative of an ankle showing no signs of perceived instability.\textsuperscript{17} In line with criteria used for the selection of CAI participants in controlled research,\textsuperscript{19} a score of 24 or less indicated an ankle with moderate-severe perceived ankle instability. A score of 25-27 denoted an ankle with mild perceived instability.

An instrumented ankle arthrometer (BlueBay Research, Milton FL) was used to measure ankle joint laxity during inversion-eversion at both ankles of each participant.\textsuperscript{20} Inversion-eversion ankle laxity was determined by the total inversion-eversion range when the ankle was loaded with torques of 3 Nm inversion and 3 Nm eversion.\textsuperscript{20} The angles achieved at this cut-off torque were determined by a linear interpolation between the data points either side of the 3 Nm inversion torque and the 3 Nm eversion torque respectively. For each participant the average of three trials were used to calculate means and standard deviations. As a threshold value to indicate the presence of mechanical ankle instability has not been established, the results of both ankles were analysed in regard to ankle sprain history.

All statistics were computed using SPSS version 22 with the level of significance set at 0.05. To satisfy the current study’s primary aim, descriptive statistics were used to characterise the cohort. To investigate the secondary aim, a Chi-square test was used to compare the distribution of sprain history between the two competitive levels of players (club versus inter-district). Fisher’s exact tests were used to analyse the presence of perceived ankle instability in relation to club versus inter-district players and the effect of sprain history and competitive level on total inversion-eversion laxity was analysed using a two-way analysis of variance.

\textbf{Results}
Club players had a mean ± SD age of 24.1 ± 7.9 years, height of 167.6 ± 5.4 cm and mass of 68.5 ± 15.9 kg. Inter-district players had a mean ± SD age of 19.4 ± 3.5 years, height of 172.8 ± 6.9 cm and mass of 72.0 ± 12.7 kg. Inter-district players were younger and taller than the club players (p≤0.001).

Sixty-nine participants reported a previous ankle sprain. Of these participants, 64 were classified as having CAI in terms of recurrent sprain and/or perceived ankle instability. Sixty-one participants reported some degree of perceived ankle instability following a previous ankle sprain and 45 participants had a history of recurrent ankle sprains. There were no significant differences between the distributions of sprain history when comparing club netball players to inter-district netball players (p=0.06) (Table 1).

The perceived ankle instability scores of netball players with previously sprained ankles are presented in Table 2. Of the 69 netball players with a previous ankle sprain, 44 (64%) had a moderate-severe degree of perceived ankle instability. There was a difference between club and inter-district players in terms of each group’s degree of perceived ankle instability following an ankle sprain (p=0.02). This difference resulted from a greater percentage of club netball players reporting moderate-severe perceived ankle instability compared to inter-district players (p=0.01).

The mean (±SD) total inversion-eversion angle for all 192 ankles was 31.1 ± 8.7 degrees. The club players recorded larger mean inversion-eversion angles compared to the inter-district players (p=0.001) (Table 3). Previous sprain history did not affect total inversion-eversion angles (p>0.05), nor were there any interactions between the competitive level of the players and previous sprain history (p>0.05).

Discussion
The current study found a high prevalence of CAI across the cohort of netball players in terms of recurrent sprain and perceived ankle instability. Mechanical ankle instability, the third aspect to the current CAI model, poses challenges when trying to quantify a cut-off value to determine a magnitude of ankle laxity that constitutes CAI. In terms of competitive level, club netball players were found to have more counts of moderate-severe perceived ankle instability and larger inversion-eversion angles when compared to the inter-district netball players. Due to the paucity of sporting literature investigating aspects of CAI - specifically the aspects of perceived and mechanical ankle instability, comparisons to previous research are difficult.

The movement patterns required for netball and basketball are similar and, as a result, comparisons can be drawn between the two sports. The findings of the current study differ to those previously reported in basketball. Two studies have investigated perceived ankle instability in basketball cohorts; one study indicated that 12% of players with a previous sprain report chronic feelings of ‘giving way’ at the ankle, whilst a second study reported a much higher percentage of 52%. A five year age difference between the participants of these two studies could be a contributing factor to the varied findings in terms of older individuals having a greater number of years in which to participate in basketball and potentially sustain ankle injuries. The results of a systematic review indicate that, within basketball cohorts, 60% of players have a history of recurrent sprain. By comparison to the previous basketball literature, the current study indicates that netball players have a higher percentage of participants with perceived ankle instability but a lower percentage of participants with recurrent ankle sprains. Diverse levels of skill across the research cohorts, group gender differences, or simply varying degrees of sporting exposure might explain these differences.

Of the netball players with a previously sprained ankle, 47% had sprained their ankle two or more times. In the only previous study to report on the recurrent nature of ankle injuries within a netball population, 49% of ankle injuries occurred to previously injured ankles. This previous finding did not include
recurrent ankle injury information pertaining to ankles that were injured outside of the study period and therefore represents a conservative estimate of the problem. Furthermore, the value does not reflect the number of individuals sustaining these recurrent injuries. To enable clear comparisons across a variety of cohorts, reporting the number of participants sustaining recurrent sprains is more informative than reporting the number of injuries.

In the current study, 64% of netball players with a prior ankle sprain continued to experience a moderate-severe degree of perceived instability in at least one of their ankles. Previously reported research in a cohort of state representative netball players found that 39% of ankles with a sprain history were chronically weak or unstable.\textsuperscript{14} While this is an important figure in terms of instability knowledge, the tool that was used to assess this measure has not been shown to be valid or reliable. This result may therefore be a misrepresentation of perceived ankle instability within the previous cohort. Of interest are the 21 netball players within the current study who, with no history of ankle sprain, reported perceived ankle instability scores indicative of mild-severe instability. At this stage it is not known whether the extent of perceived ankle instability is a factor in sustaining an initial ankle sprain or whether perceived ankle instability is the result of an injury itself.

In a clinical setting it is common practice to subjectively quantify mechanical ankle instability using a talar tilt test.\textsuperscript{23} The ankle arthrometer has provided an objective assessment of ankle laxity, but a threshold value to indicate the presence or absence of mechanical ankle instability has yet to be established. Mean inversion-eversion angles in the current study are lower than previously reported values for male and female volunteers with no history of ankle sprain.\textsuperscript{20} As ankles that have sustained previous sprains do not necessarily exhibit increases in ankle laxity,\textsuperscript{24} perhaps the large number of recurrent ankle sprains in the current cohort of netball players are due to arthrokinematic restrictions of the ankle joint complex\textsuperscript{8} resulting from a prior sprain.\textsuperscript{12,25} Future research should consider the inclusion of a weight bearing lunge
test using the knee-to-wall method to assess potential joint restriction at the ankle, independent of ankle laxity.

Despite a history of ankle sprains having the potential to cause an alteration or cessation of physical activity,\textsuperscript{10,26} it is clear that the presence of CAI within this cohort of netball players is not resulting in their retirement from the sport. It is noted that 70\% of this cohort with CAI report to regularly using prophylactic ankle support – conceivably for a heightened sense of confidence to perform sport specific tasks without apprehension.\textsuperscript{27} Unknown are the number of netball players who have withdrawn from the sport owing to aspects of CAI and/or the added costs of treatment and management of long term problems that persist following an initial ankle sprain. This is worthy of future investigation given that so many people in Australia choose netball as their preferred form of physical activity.

In terms of probability, an increased exposure to netball activity in the inter-district group would suggest that these players have a higher chance of sustaining an ankle sprain, and as a result, an increased risk of recurrently spraining.\textsuperscript{28} In addition, a larger training load and more intense matches, coupled with a heightened pressure to return to play, would perhaps make recovery from an ankle sprain more difficult in the inter-district group. In fact, it was the club netball players who displayed more counts of moderate-severe perceived ankle instability following an ankle sprain as well as larger magnitudes of inversion-eversion angles. With club players being older than the inter-district cohort, it is possible that more years of experience and a resulting greater total exposure to netball may explain the group differences observed within the current study. Group differences might also suggest that, depending on the competitive level at which an individual plays, the urgency and/or need for initial treatment of an ankle sprain could vary.

Lastly, one might hypothesise that differences between the competitive levels could be attributed to individuals with CAI limiting/reducing their netball involvement to club level participation where game intensity and therefore potential joint loading may not be as high.
No significant differences were found between the club and inter-district players in terms of the distribution of previous sprain history (Table 1). This finding could be due to a type II error because of small participant numbers in certain subgroups. There is the potential that with a larger cohort, differences in ankle sprain history could be found between these two competitive levels. It is also noted that the retrospective nature of the ankle sprain history acts as a limitation to the current study as recall bias is likely to have unintentionally altered injury reporting. Therefore, the recurrent sprain results reported in this study should be regarded as an estimate of the true representation of CAI within this netball cohort.

The results of the current study highlight that there are a substantial proportion of netball players who, despite still actively participating in their chosen sport, would be defined as having CAI. For clinicians treating patients with established CAI, strength training protocols have been reported to improve multidirectional strength measures and reduce the extent of perceived ankle instability reported by patients. In terms of clinical management of acute ankle sprains, there is evidently a need to further examine the rehabilitation period following an initial sprain to determine the factors influencing the development of CAI.

Conclusion

Ankle sprains are often thought of as a simple injury that can be rehabilitated quickly with limited consequences; however, CAI has been shown to be highly prevalent within this cohort - in particular perceived ankle instability and recurrent sprain. In agreement with the current CAI model, the results of this study highlight that the presence of a single characteristic of CAI does not necessarily confirm the presence of all aspects of CAI for an individual. By neglecting to measure each CAI aspect within research settings, the true problem of CAI within a specified population has the potential to be underestimated. These findings highlight the need for further research pertaining to the identification of
ankle sprain risk factors for netball players, the effect CAI has on continued netball participation and/or rates of dropout, and the associated costs of this chronic problem.

Practical implications

- When club and representative netball players sustain an acute ankle sprain it can have long term consequences in terms of future sprains and/or feelings of the ankle ‘giving way’.
- Comprehensive treatment and continued management of ankle sprains needs to be prioritised to minimise the number of netball players with chronic ankle instability.
- Aspects of chronic ankle instability may have an effect on the continued participation of netball players, and given the sport’s popularity, this could have negative health and well-being implications for individuals who have to limit their involvement.

Acknowledgements

The collection of data within this study was assisted by a New South Wales Sporting Injuries grant, New South Wales, Australia (2012).

References


27. Simon J, Donahue M. Effect of ankle taping or bracing on creating an increased sense of confidence, stability, and reassurance when performing a dynamic-balance task. *J Sport Rehabil* 2013; 22(3):229-33.


Table 1. Recurrent ankle sprain information divided into competitive level. n (%)

<table>
<thead>
<tr>
<th></th>
<th>No previous sprain</th>
<th>No recurrent sprain</th>
<th>Unilateral recurrent sprain</th>
<th>Bilateral recurrent sprain</th>
</tr>
</thead>
<tbody>
<tr>
<td>All players (n=96)</td>
<td>27 (28)</td>
<td>24 (25)</td>
<td>19 (20)</td>
<td>26 (27)</td>
</tr>
<tr>
<td>Club players (n=42)</td>
<td>16 (38)</td>
<td>9 (21)</td>
<td>4 (10)</td>
<td>13 (31)</td>
</tr>
<tr>
<td>Inter-district players (n=54)</td>
<td>11 (20)</td>
<td>15 (28)</td>
<td>15 (28)</td>
<td>13 (24)</td>
</tr>
</tbody>
</table>
Table 2. Perceived ankle instability scores for the 69 netball players with a history of previous sprain, divided into competitive level. If a single player had sustained bilateral sprains they are represented within this table with their lowest perceived ankle instability score. n (%)  

<table>
<thead>
<tr>
<th>CAITY score</th>
<th>No instability</th>
<th>Mild instability</th>
<th>Moderate-severe instability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥28</td>
<td>25-27</td>
<td>≤24</td>
</tr>
<tr>
<td>All players (n=69)</td>
<td>8 (12)</td>
<td>17 (25)</td>
<td>44 (64)</td>
</tr>
<tr>
<td>Club players (n=26)</td>
<td>1 (4)</td>
<td>3 (12)</td>
<td>22 (85)</td>
</tr>
<tr>
<td>Inter-district players (n=43)</td>
<td>7 (16)</td>
<td>14 (33)</td>
<td>22 (51)(^a)</td>
</tr>
</tbody>
</table>

CAITY = Cumberland Ankle Instability Tool – Youth.

\(^a\) Significantly different to club players (Fishers exact test, p=0.01).
Table 3. Total inversion-eversion angles (degrees) by competitive level and ankle sprain history (mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Previously sprained ankles</th>
<th>Previously un-sprained ankles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Club players</td>
<td>34.7 ± 10.3 (n=44)</td>
<td>32.0 ± 9.3 (n=40)</td>
</tr>
<tr>
<td>Inter-district players</td>
<td>28.9 ± 7.0 (n=62)</td>
<td>29.7 ± 7.4 (n=46)</td>
</tr>
</tbody>
</table>

*a Significantly different to club players (p=0.001)