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

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1 **A snapshot of chronic ankle instability in a cohort of netball players**

2

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27 **A snapshot of chronic ankle instability in a cohort of netball players**

28 **Abstract**

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

34 Design: Cross-sectional study.

35 Methods: Ninety-six female netball players (24.1 ± 7.9 years) were recruited (42 club players and 54
36 inter-district players). Recurrent sprain was defined as two or more lifetime sprains to the same ankle.

37 Perceived ankle instability was quantified with the Cumberland Ankle Instability Tool - Youth.

38 Mechanical ankle instability was quantified via inversion-eversion rotations using an ankle arthrometer at
39 torques of 3 Newton-metres.

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

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

49 **Keywords:** Joint instability; Sports; Sprain; Ankle joint; Ankle injury

50 **Introduction**

51
52 Netball is a highly popular sport in countries of the British Commonwealth. In Australia, it ranks second
53 only to soccer in terms of population participation in organised team sports.¹ Netball is a physically
54 demanding activity that requires participants to engage in jumping, bounding, pivoting and cutting
55 manoeuvres.² Landing from these movements, together with the footwork rule in which a player in
56 possession of the ball is required to stop suddenly to prevent a further step from occurring, make the
57 lower limb highly susceptible to injury.³ Previous investigations have found the ankle to be the
58 anatomical site most commonly injured in netball.³⁻⁵ In a group of elite netball players, 39% of all injuries
59 over the course of one playing season were reported to involve the ankle.⁶ Similarly, within a cohort of
60 community netball players, 32% of total body injuries involved the ankle.⁷

61
62 A single history of ankle sprain predisposes the same ankle to recurrent damage,⁸ especially in the case of
63 improper rehabilitation and premature return to play. Mechanical changes to the ankle joint complex often
64 become evident following an acute ankle sprain, as do perceived limitations such as feelings of instability
65 and sensations of ‘giving way’.^{9,10} There is a substantial amount of scientific literature that reports on the
66 incidence of acute ankle sprains during specific sporting and recreational activities, yet only a small
67 proportion of papers report on persisting chronic problems that remain after the injury is said to be
68 healed.¹¹

69
70 Chronic ankle instability (CAI) is a condition that encompasses at least one of three individual
71 components that persist following an acute ankle sprain: perceived ankle instability, mechanical ankle
72 instability and recurrent sprain.¹² CAI has previously been defined on the premise that if an ankle has
73 mechanical and perceived instability then it is susceptible to sprain.⁸ Whilst this remains true, research
74 suggests that an individual can also repeatedly sprain an ankle in the absence of any functional

75 limitations.¹³ The Hiller¹² model of CAI allows recurrent sprain to be included in the definition of CAI -
76 irrespective of whether mechanical or perceived ankle instability are present.

77

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

84

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

94

95

96 **Methods**

97

98 The study was approved by The University of XX Human Research Ethics Committee (protocol number
99 2012/469). The study reports pre-season cross-sectional CAI data from a larger prospective study
100 investigating ankle sprain risk factors during netball participation. Sample size requirements for the

101 prospective study were determined a priori. All participants were informed of procedures and volunteered
102 for the study by signing a consent form. In the case of any participant being under the age of 18, consent
103 was also obtained from her parent/guardian. All data for each participant were collected on a single day
104 with questionnaires completed in the presence of a study investigator.

105

106 Ninety-six female netball players from the XX Metropolitan area participated in this study. Fifty-four
107 played at an inter-district level and 42 played at a club level. The majority of the inter-district players
108 (83%) were from the XX University Netball Club/City of XX Netball Association Elite Development
109 Squad whilst the remaining inter-district players were individuals from a comparable representative
110 netball association. The club players were largely a sample of convenience and were involved in netball at
111 a social level which comprised no more than one netball specific training session per week.

112

113 For inclusion, participants had to be at least 15 years old at the time of pre-season testing, have at least
114 one year of experience playing netball, and be registered to play in the subsequent netball season.

115 Participants were excluded if they had sustained a lower limb injury in the six months prior to testing or
116 had a history of ankle surgery or ankle fracture.

117

118 The definition of CAI used within the current study incorporates recurrent ankle sprain and/or perceived
119 ankle instability and/or mechanical ankle instability following a previous ankle sprain.¹² Owing to the
120 current study's exclusion criteria, all previous ankle sprains occurred a minimum of six months prior.

121 Previous ankle sprains were recorded for each player by way of a self-administered form. The participants
122 recorded the number of previous ankle sprains sustained to each ankle separately. Recurrent sprain was
123 defined as two or more sprains occurring to the same ankle.¹⁶

124

125 The Cumberland Ankle Instability Tool is a valid and reliable nine item questionnaire that is used to
126 assess the perceived instability of an ankle.¹⁷ For this investigation the Cumberland Ankle Instability Tool

127 – Youth was used; a simplified version of the original tool, where the layout and language of the
128 questionnaire are structured to be more easily read and interpreted¹⁸. An individual score was attained for
129 each ankle of every participant. The youth version of the questionnaire has the same scoring protocol as
130 the original Cumberland Ankle Instability Tool where a score of ≥ 28 is indicative of an ankle showing no
131 signs of perceived instability.¹⁷ In line with criteria used for the selection of CAI participants in controlled
132 research,¹⁹ a score of 24 or less indicated an ankle with moderate-severe perceived ankle instability. A
133 score of 25-27 denoted an ankle with mild perceived instability.

134
135 An instrumented ankle arthrometer (BlueBay Research, Milton FL) was used to measure ankle joint laxity
136 during inversion-eversion at both ankles of each participant.²⁰ Inversion-eversion ankle laxity was
137 determined by the total inversion-eversion range when the ankle was loaded with torques of 3 Nm
138 inversion and 3 Nm eversion.²⁰ The angles achieved at this cut-off torque were determined by a linear
139 interpolation between the data points either side of the 3 Nm inversion torque and the 3 Nm eversion
140 torque respectively. For each participant the average of three trials were used to calculate means and
141 standard deviations. As a threshold value to indicate the presence of mechanical ankle instability has not
142 been established, the results of both ankles were analysed in regard to ankle sprain history.

143
144 All statistics were computed using SPSS version 22 with the level of significance set at 0.05. To satisfy
145 the current study's primary aim, descriptive statistics were used to characterise the cohort. To investigate
146 the secondary aim, a Chi-square test was used to compare the distribution of sprain history between the
147 two competitive levels of players (club versus inter-district). Fisher's exact tests were used to analyse the
148 presence of perceived ankle instability in relation to club versus inter-district players and the effect of
149 sprain history and competitive level on total inversion-eversion laxity was analysed using a two-way
150 analysis of variance.

151

152 **Results**

153

154 Club players had a mean \pm SD age of 24.1 ± 7.9 years, height of 167.6 ± 5.4 cm and mass of 68.5 ± 15.9
155 kg. Inter-district players had a mean \pm SD age of 19.4 ± 3.5 years, height of 172.8 ± 6.9 cm and mass of
156 72.0 ± 12.7 kg. Inter-district players were younger and taller than the club players ($p \leq 0.001$).

157

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

163

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

170

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

175

176 **Discussion**

177

178 The current study found a high prevalence of CAI across the cohort of netball players in terms of
179 recurrent sprain and perceived ankle instability. Mechanical ankle instability, the third aspect to the
180 current CAI model,¹² poses challenges when trying to quantify a cut-off value to determine a magnitude
181 of ankle laxity that constitutes CAI. In terms of competitive level, club netball players were found to have
182 more counts of moderate-severe perceived ankle instability and larger inversion-eversion angles when
183 compared to the inter-district netball players. Due to the paucity of sporting literature investigating
184 aspects of CAI - specifically the aspects of perceived and mechanical ankle instability¹¹, comparisons to
185 previous research are difficult.

186

187 The movement patterns required for netball and basketball are similar and, as a result, comparisons can be
188 drawn between the two sports. The findings of the current study differ to those previously reported in
189 basketball. Two studies have investigated perceived ankle instability in basketball cohorts; one study
190 indicated that 12% of players with a previous sprain report chronic feelings of ‘giving way’ at the ankle,²¹
191 whilst a second study reported a much higher percentage of 52%²². A five year age difference between
192 the participants of these two studies could be a contributing factor to the varied findings in terms of older
193 individuals having a greater number of years in which to participate in basketball and potentially sustain
194 ankle injuries. The results of a systematic review indicate that, within basketball cohorts, 60% of players
195 have a history of recurrent sprain.¹¹ By comparison to the previous basketball literature, the current study
196 indicates that netball players have a higher percentage of participants with perceived ankle instability but
197 a lower percentage of participants with recurrent ankle sprains. Diverse levels of skill across the research
198 cohorts, group gender differences, or simply varying degrees of sporting exposure might explain these
199 differences.

200

201 Of the netball players with a previously sprained ankle, 47% had sprained their ankle two or more times.
202 In the only previous study to report on the recurrent nature of ankle injuries within a netball population¹¹,
203 49% of ankle injuries occurred to previously injured ankles.⁵ This previous finding did not include

204 recurrent ankle injury information pertaining to ankles that were injured outside of the study period and
205 therefore represents a conservative estimate of the problem. Furthermore, the value does not reflect the
206 number of individuals sustaining these recurrent injuries. To enable clear comparisons across a variety of
207 cohorts, reporting the number of participants sustaining recurrent sprains is more informative than
208 reporting the number of injuries.

209

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

220

221 In a clinical setting it is common practice to subjectively quantify mechanical ankle instability using a
222 talar tilt test.²³ The ankle arthrometer has provided an objective assessment of ankle laxity, but a threshold
223 value to indicate the presence or absence of mechanical ankle instability has yet to be established. Mean
224 inversion-eversion angles in the current study are lower than previously reported values for male and
225 female volunteers with no history of ankle sprain.²⁰ As ankles that have sustained previous sprains do not
226 necessarily exhibit increases in ankle laxity,²⁴ perhaps the large number of recurrent ankle sprains in the
227 current cohort of netball players are due to arthrokinematic restrictions of the ankle joint complex⁸
228 resulting from a prior sprain.^{12, 25} Future research should consider the inclusion of a weight bearing lunge

229 test using the knee-to-wall method to assess potential joint restriction at the ankle, independent of ankle
230 laxity.

231
232 Despite a history of ankle sprains having the potential to cause an alteration or cessation of physical
233 activity,^{10,26} it is clear that the presence of CAI within this cohort of netball players is not resulting in
234 their retirement from the sport. It is noted that 70% of this cohort with CAI report to regularly using
235 prophylactic ankle support – conceivably for a heightened sense of confidence to perform sport specific
236 tasks without apprehension.²⁷ Unknown are the number of netball players who have withdrawn from the
237 sport owing to aspects of CAI and/or the added costs of treatment and management of long term problems
238 that persist following an initial ankle sprain. This is worthy of future investigation given that so many
239 people in Australia choose netball as their preferred form of physical activity.

240
241 In terms of probability, an increased exposure to netball activity in the inter-district group would suggest
242 that these players have a higher chance of sustaining an ankle sprain, and as a result, an increased risk of
243 recurrently spraining.²⁸ In addition, a larger training load and more intense matches, coupled with a
244 heightened pressure to return to play, would perhaps make recovery from an ankle sprain more difficult in
245 the inter-district group. In fact, it was the club netball players who displayed more counts of moderate-
246 severe perceived ankle instability following an ankle sprain as well as larger magnitudes of inversion-
247 eversion angles. With club players being older than the inter-district cohort, it is possible that more years
248 of experience and a resulting greater total exposure to netball may explain the group differences observed
249 within the current study. Group differences might also suggest that, depending on the competitive level at
250 which an individual plays, the urgency and/or need for initial treatment of an ankle sprain could vary.
251 Lastly, one might hypothesise that differences between the competitive levels could be attributed to
252 individuals with CAI limiting/reducing their netball involvement to club level participation where game
253 intensity and therefore potential joint loading may not be as high.

254

255

256 No significant differences were found between the club and inter-district players in terms of the
257 distribution of previous sprain history (Table 1). This finding could be due to a type II error because of
258 small participant numbers in certain subgroups. There is the potential that with a larger cohort, differences
259 in ankle sprain history could be found between these two competitive levels. It is also noted that the
260 retrospective nature of the ankle sprain history acts as a limitation to the current study as recall bias is
261 likely to have unintentionally altered injury reporting.²⁹ Therefore, the recurrent sprain results reported in
262 this study should be regarded as an estimate of the true representation of CAI within this netball cohort.

263

264 The results of the current study highlight that there are a substantial proportion of netball players who,
265 despite still actively participating in their chosen sport, would be defined as having CAI. For clinicians
266 treating patients with established CAI, strength training protocols have been reported to improve
267 multidirectional strength measures and reduce the extent of perceived ankle instability reported by
268 patients.³⁰ In terms of clinical management of acute ankle sprains, there is evidently a need to further
269 examine the rehabilitation period following an initial sprain to determine the factors influencing the
270 development of CAI.

271

272 **Conclusion**

273 Ankle sprains are often thought of as a simple injury that can be rehabilitated quickly with limited
274 consequences; however, CAI has been shown to be highly prevalent within this cohort - in particular
275 perceived ankle instability and recurrent sprain. In agreement with the current CAI model,¹² the results of
276 this study highlight that the presence of a single characteristic of CAI does not necessarily confirm the
277 presence of all aspects of CAI for an individual. By neglecting to measure each CAI aspect within
278 research settings, the true problem of CAI within a specified population has the potential to be
279 underestimated. These findings highlight the need for further research pertaining to the identification of

280 ankle sprain risk factors for netball players, the effect CAI has on continued netball participation and/or
281 rates of dropout, and the associated costs of this chronic problem.

282

283

284 **Practical implications**

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

292

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296

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368
- 369

369

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

	No previous sprain	No recurrent sprain	Unilateral recurrent sprain	Bilateral recurrent sprain
All players (n=96)	27 (28)	24 (25)	19 (20)	26 (27)
Club players (n=42)	16 (38)	9 (21)	4 (10)	13 (31)
Inter-district players (n=54)	11 (20)	15 (28)	15 (28)	13 (24)

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374

375 **Table 2. Perceived ankle instability scores for the 69 netball players with a history of previous**
 376 **sprain, divided into competitive level. If a single player had sustained bilateral sprains they are**
 377 **represented within this table with their lowest perceived ankle instability score. n (%)**

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

CAITY = Cumberland Ankle Instability Tool – Youth.

^a Significantly different to club players (Fishers exact test, p=0.01).

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379

380

380

381 **Table 3. Total inversion-eversion angles (degrees) by competitive level and ankle sprain history**382 **(mean \pm SD)**

	Previously sprained ankles	Previously un-sprained ankles
Club players	34.7 \pm 10.3 (n=44)	32.0 \pm 9.3 (n=40)
Inter-district players ^a	28.9 \pm 7.0 (n=62)	29.7 \pm 7.4 (n=46)

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

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