The relationship between pain and associated characteristics of chronic ankle instability: A retrospective study

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Abstract

Background: Up to 74% of people with a history of ankle sprain develop chronic ankle instability (CAI). One commonly reported residual impairment is ankle pain; however, it has not been included in models or inclusion criteria for CAI. We investigated the prevalence of pain in people with CAI and the association between presence of pain and other CAI characteristics.

Methods: Retrospective data from 1147 participants with CAI (age 26.6 ± 10.7 years, 59% female) were collated from previous studies that used the Cumberland Ankle Instability Tool as an assessment tool. Pain was assessed from Item 1 of the Cumberland Ankle Instability Tool, which asks participants about ankle pain. Responses were divided into 3 categories: pain during daily activities, pain during moderate/vigorous physical activities, and no pain. The presence of pain was analyzed with descriptive statistics, the correlation between pain category and CAI characteristics was analyzed by \( \chi^2 \) tests and factors associated with each pain category were analyzed by logistic regression.

Results: Among the participants, 60.1% (n = 689) reported ankle pain. Of all participants, 12.4% (n = 142) reported pain during daily activities, 47.7% (n = 547) reported pain during moderate/vigorous physical activities, and 39.9% (n = 458) reported no pain. There was a strong association between ankle instability and ankle pain (\( \chi^2 = 122.2, p < 0.001, \text{OR} = 5.38, 95\% \text{confidence interval (CI)}: 3.84–7.53 \)). Perceived ankle instability, age and unilateral ankle sprains were independently associated with pain (ankle instability: \( \chi^2 = 43.29, p < 0.001 \); age: \( \chi^2 = 30.37, p < 0.001 \); unilateral ankle sprains: \( \chi^2 = 6.25, p < 0.05 \)). There was no significant difference in the presence of pain between genders.

Conclusion: The prevalence of pain in people with CAI was high and was related to perceived ankle instability. Number of sprains, age, gender and unilateral or bilateral sprain did not modify this result except for the first pain category (pain during daily activities). There is large gap in current knowledge about the impact of pain in people with CAI, and this topic needs further investigation.

Keywords: Ankle impairments; Ankle instability; Ankle sprain; CAIT; Pain

1. Introduction

Ankle sprains are among the most common injuries in sports and the general population. A high prevalence of this injury has been reported in school and college athletes and in military populations. Despite the high incidence and severe debilitating symptoms after a sprain, around 55% of people with acute sprain do not seek medical attention, and this injury is often thought to be relatively harmless and receives limited treatment. Acute symptoms of ankle sprain are usually resolved after the initial injury; however, persistent residual symptoms are commonly reported and remain for a long period. These difficulties include recurrent sprains, episodes of giving way, self-reported disability, diminished physical activities, and pain. As a result of such persistent impairments, people experience changes in their ability to perform activities of daily living and occupational activities, and consequently adverse impacts on quality of life usually occur.

A recent systematic review showed that around 58% of participants with chronic ankle instability (CAI) reported ankle pain. However, no studies have had pain as the primary outcome or investigated the effects of pain in people with CAI. A high prevalence of pain and functional limitations has been found in...
common musculoskeletal injuries such as groin-area injuries, anterior cruciate ligament injuries, and foot impairments.

Despite the fact that pain is one of the major impairments after an ankle sprain, pain is not considered as one of the inclusion criteria in many different models of CAI when identifying participants with CAI. Therefore, the first aim of this study was to investigate the prevalence of pain in people with CAI using a validated self-reported questionnaire. The second aim was to investigate whether the presence of pain was related to other CAI characteristics, such as recurrent sprains or demographic factors such as age and gender. We hypothesized that ankle pain would be prevalent in our sample and that the presence of persistent pain would be associated with increased number of sprains, older age, female gender, and ankle instability.

2. Methods

This study was a retrospective study using data from 26 previous studies on participants with CAI. All studies used the Cumberland Ankle Instability Tool (CAIT) as one of the assessment tools. Data from 1147 participants with CAI (age 26.6 ± 10.7 years (mean ± SD), range 10–86 years, 59% female) were included. All provided data were de-identified and came from studies that did not exclude the use of data in future research. The study was approved by the Human Research Ethics Committee at the University of Sydney. All the participants had provided written informed consent. Common variables were identified and included age, gender, tested leg, the number of sprains for the tested leg, time since the last sprain, unilateral or bilateral sprains, other injuries in the lower limb, rehabilitation history and CAIT score.

2.1. Inclusion and exclusion criteria

Participants with CAI were included if they met the following inclusion criteria: (1) history of an ankle sprain and (2) either (a) a CAIT score of <25 or (b) a CAIT score between 26 and 30 with either a recurrent sprain within the past 2 years or giving way or rolling over ≥2 times per year. We excluded participants with a recurrent acute ankle sprain within 6 weeks, missing data or a history of lower limb fractures.

2.2. CAIT questionnaire

CAIT is a 9-item questionnaire designed to evaluate the severity of perceived ankle instability. The level of ankle instability is reported in different activities, including running, walking, hopping, and descending stairs. The total CAIT score ranges from 0 to 30 on each side, in which 0 represents severe perceived instability and 30 represents normal stability.

We assessed pain from Item 1 of the CAIT, which asks participants about pain in their ankles. Participants selected 1 of the 6 answers to describe the level of pain in each ankle. Responses were divided into 4 categories: (1) people who reported no pain (CAIT answer = never), (2) people who reported pain during daily activities (CAIT answer = pain when walking on level surfaces, pain when walking on uneven surfaces), (3) people who had pain during moderate/vigorous physical activities (CAIT answer = pain when running on level surfaces, running on uneven surfaces, during sport), and (4) people who reported pain during any level of physical activities (CAIT answer = all categories of pain).

2.3. Variables

Out of the available data, we were able to identify 5 consistent variables: age, gender, ankle instability, number of sprains on each side, and unilateral or bilateral sprains. These variables were dichotomized for further analysis. Age was divided into younger adults and older adults, with the cutoff point occurring at 30 years. This decision was based on the likelihood that sports participation would have declined to recreational at best by age 30. Ankle instability was scored from the CAIT after eliminating the first Item (pain question) and resulted in a score between 0 and 25. The CAIT score cutoff point was 20; people with a score of <20 were considered to have ankle instability. The number of sprains was dichotomized at 3, so that a definite repeat sprain pattern was identified. Participants with ≥3 ankle sprains were coded as 1 whereas participants with <3 ankle sprains were coded as 0.

2.4. Data analysis

Age, gender, the presence of pain, ankle instability, unilateral or bilateral ankle sprain involvement, and the number of sprains were analyzed with descriptive statistics. The association between presence or absence of pain and each variable was determined by a χ² test. To determine the adjusted odds ratio for each variable and the presence of pain, a logistics regression was performed. In order of the magnitude of the χ² association, each variable was added to the regression model one at a time, from largest to smallest. All statistical analyses were performed using SPSS software, Version 22.0 (IBM Corp., Armonk, NY, USA).

3. Results

The total number of participants with CAI was 1147. Of these, 41% were male. The results revealed that 69.9% of the participants were young adults (<30 years old) and 58.1% of the participants reported bilateral ankle sprains (Table 1).

Table 1
Demographic data.

| Variables                          | Pain during daily activities | Pain during moderate/vigorous PA | No pain |
|-----------------------------------|------------------------------|---------------------------------|---------|
| F/M (n)                           | 80/62                        | 336/211                         | 261/197 |
| Age (year)                        | 32.5 ± 14.2                  | 25.6 ± 9.8                      | 26.0 ± 9.8 |
| Instability                       | 10.7 ± 5.3                   | 14.9 ± 4.3                      | 18.8 ± 4.2 |
| Number of sprains                 | 5.2 ± 6.3                    | 5.0 ± 6.0                       | 3.6 ± 3.3 |
| U/B sprain (n)                    | 72/70                        | 231/316                         | 178/280 |

Note: Data are presented as mean ± SD or number of participants.

Abbreviations: B = bilateral; CAIT = Cumberland Ankle Instability Tool; F = female; M = male; PA = physical activity; U = unilateral.
The prevalence of any pain at the ankle joint was 60.1% \((n = 689)\). Of these, 20.6% \((n = 142)\) reported ankle pain during daily activities and 79.4% \((n = 547)\) reported pain during moderate/vigorous physical activities (Table 1). The highest pain percentage was reported while running on uneven surfaces \(38.0\%\) followed by pain during sports \(31.8\%\) (Table 2).

Pain was reported in 58.1% of male participants and 61.4% of female participants. Recurrent sprains \((\geq 3)\) were reported in 57.3% of participants, 64.0% of whom reported ankle pain. From people who had \(<3\) ankle sprains, 55.1% had pain at their ankle joints. In addition, 58.1% of participants reported bilateral ankle sprains, of which 58.0% had ankle pain. When considering age, 59.1% of younger adult participants \((<30\text{ years})\) reported pain. Of these, 50.1% had pain during moderate/vigorous physical activities and 8.2% had pain during daily activities compared to older adults, where 40.3% had pain during moderate-to-vigorous physical activities and 22.0% had pain during daily activities. Only perceived instability was significantly associated with all pain groups (Fig. 1). In addition, pain during daily activities was associated with having ankle instability, being of older age, and having unilateral ankle sprain (Table 3).

Logistic regression analysis revealed that perceived ankle instability was the only independent factor associated with any pain \(\chi^2 = 122.2, p < 0.001\), odds ratio \((OR) = 5.38 (95\%CI 3.84–7.53)\) (Tables 3–4). People with unstable ankles were 5.3 times more likely to have any ankle pain (Fig. 1). Perceived ankle instability, age, and unilateral/bilateral ankle sprains were independently associated with pain during daily activities (ankle instability: \(\chi^2 = 43.29, p < 0.001\); age: \(\chi^2 = 30.37, p < 0.001\); unilateral ankle sprains: \(\chi^2 = 6.25, p < 0.05\) (Table 3) (Fig. 2). Adjusted odds ratios showed that people with ankle instability who were >30 years old and had unilateral ankle sprains were 30.4 times (multiplying of adjusted odds ratios 7.48 × 2.70 × 1.52) more likely to have ankle pain during daily activities (Table 5).

### Table 2

| CAIT question 1                                    | Answers | n   | %   |
|---------------------------------------------------|---------|-----|-----|
| During sport                                      |         | 219 | 31.8|
| Running on uneven surfaces                        |         | 262 | 38.0|
| Running on level surfaces                         |         | 66  | 9.6 |
| Walking on uneven surfaces                        |         | 117 | 17.0|
| Walking on level surfaces                         |         | 25  | 3.6 |

Abbreviation: CAIT = Cumberland Ankle Instability Tool.

### Table 3

The magnitude of \(\chi^2\) for CAI variables in different pain groups.

| Variables                  | Any pain |                       | Pain during daily activities |                       | Pain during moderate/vigorous PA |                       |
|----------------------------|----------|------------------------|----------------------------|------------------------|---------------------------------|------------------------|
|                            | \(\chi^2\) | df | \(p\)     | \(\chi^2\) | df | \(p\)     | \(\chi^2\) | df | \(p\)     |
| Ankle instability\(^a\)    | 122.2    | 1  | 0.000     | 43.29     | 1  | 0.000     | 99        | 1  | 0.000     |
| Number of sprains          | 8.8      | 1  | 0.226     | 1.40      | 1  | 0.965     | 9.5       | 1  | 0.188     |
| Unilateral/bilateral       | 2.9      | 1  | 0.123     | 6.25      | 1  | 0.049     | 1.1       | 1  | 0.313     |
| Gender                     | 1.3      | 1  | 0.518     | 0.19      | 1  | 0.744     | 2.3       | 1  | 0.499     |
| Age                        | 1.0      | 1  | 0.710     | 30.37     | 1  | 0.000     | 1.1       | 1  | 0.156     |

\(^a\)CAIT out of 25 (without Item 1).

Abbreviations: CAIT = Cumberland Ankle Instability Tool; PA = physical activity.

### Table 4

Binary logistic regression results of odds ratios of all variables vs. presence of any pain, pain during daily activities, and pain during physical activities.

| Variables                  | Any pain |                       | Pain during daily activities |                       | Pain during moderate/vigorous PA |                       |
|----------------------------|----------|------------------------|----------------------------|------------------------|---------------------------------|------------------------|
|                            | Exp (B)  | Lower | Upper | Exp (B)  | Lower | Upper | Exp (B)  | Lower | Upper |
| Ankle instability           | 5.38     | 3.84  | 7.53  | 7.48     | 3.65  | 15.34 | 5.05     | 3.54  | 7.23  |
| Number of sprains           | 1.18     | 0.90  | 1.53  | 1.01     | 0.66  | 1.54  | 1.20     | 0.91  | 1.59  |
| Unilateral/bilateral        | 0.81     | 0.63  | 1.04  | 1.51     | 1.00  | 2.29  | 0.87     | 0.66  | 1.14  |
| Gender                     | 1.09     | 0.84  | 1.42  | 0.93     | 0.61  | 1.42  | 1.10     | 0.84  | 1.44  |
| Age                        | 1.05     | 0.80  | 1.39  | 2.69     | 1.79  | 4.06  | 0.80     | 0.60  | 1.09  |

Abbreviations: CI = confidence interval; Exp = exponentiation of the coefficients; PA = physical activity.
Variables

Adjusted associations between pain during daily activities and ankle instability, age, and unilateral ankle sprain.

Table 5

| Variables                          | Participants reported pain during daily activities (%) | Participants reported no pain during daily activities (%) | Adjusted odds ratio (95% CI) | p    |
|-----------------------------------|-------------------------------------------------------|--------------------------------------------------------|-----------------------------|------|
| Ankle instability                  | 93.6                                                  | 65.3                                                  | 7.48 (3.65–15.34)           | 0.000|
| Age ≥ 30 years old                 | 53.5                                                  | 28.4                                                  | 2.70 (1.79–4.06)            | 0.000|
| Unilateral ankle sprain           | 50.7                                                  | 38.9                                                  | 1.52 (1.00–2.29)            | 0.049|

Abbreviation: CI = confidence interval.
fibromyalgia and carpal tunnel syndrome. The varying results of studies about pain and gender could be a result of differences in tissue damage, biases in pain reporting, psychological aspects, or genetic differences.

Although the recurrence of ankle sprains is one of the common impairments of CAI, we found no association between pain and the number of sprains. The international ankle consortium endorsed the definition of recurrent ankle sprain as ≥2 sprains on the same ankle. In this study the cutoff score for the mean number of ankle sprains for people who reported pain, we expected that the number of ankle sprains would be associated with pain. However, the results showed that 36.5% of people who had ≥3 ankle sprains did not report pain. Because of the lack of data about other characteristics of ankle sprain, it could be that the severity of 1 ankle sprain has a major impact on pain no matter how many sprains people had.

One major limitation of this study was its retrospective design, which did not allow us to investigate the causality relationship between pain and CAI. It is not possible to identify whether participants developed pain secondary to CAI or whether pain is a contributing factor to the development of CAI. Another limitation was the relative youth of our sample. Only 30% of participants were >30 years of age, and this may be reflected in the lack of association of age with pain during moderate or vigorous activities. In addition, there was a lack of data related to some important information, including rehabilitation history, impairments or disability, psychological factors or severity and frequency of ankle pain. Future work should consider all these aspects and their potential associations with pain.

5. Conclusion

The prevalence of pain in people with CAI was high and was related to perceived ankle instability. The number of sprains, age, gender, and unilateral and bilateral sprain did not modify this, except for ankle pain during daily activities. Older age and unilateral ankle sprain were associated factors in people with ankle pain during daily activities. Future work should investigate more detailed profiles of the pain associated with CAI and the effect of other factors such as pathology and biomechanics.

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Authors’ contributions

SAA carried out the study design, data collating, data analysis and interpretation, and drafted the manuscript; MM and FP conceived the study, and participated in its design and data interpretation, and helped to draft the manuscript; CEH conceived the study and design, assisted with statistical analysis and data interpretation, and provided a critical review of the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

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