New Zealand cricket injury analysis based on 12 years of Accident Compensation Corporation data

Sibi Walter,1,3 Doug King,2 Patria Hume1

ABSTRACT

Objectives To provide epidemiological data for cricket injuries in New Zealand.

Methods A retrospective analytical review using epidemiological cricket data obtained from the national Accident Compensation Corporation (ACC) for 2005–2016. Injury incidence was calculated per 1000 participants.

Results There were 86,562 injuries (77,212 males and 9,350 females) during the 12 years with higher injury incidence for males (64.1) than females (36.1). While cricket-related injury claims increased by 42.6%, the injury incidence decreased from 59.0 in 2006 to 42.8 in 2016. The pooled injury rate per 1000 participants was highest for hand/fingers (9.2) and lumbar (8.1) body regions, and for contact (44.7) activities. Players aged 10–20 years were more likely to experience injury.

Conclusions Analysis of 12 years of ACC cricket-related injury claims showed only minimal reductions in injury incidence over the years. Therefore, cricket-related contact injuries to the hand/fingers and head need to be the focus of injury prevention programmes (eg, via promoting use of protective gear and correct technique), particularly in players aged 10–20 years.

INTRODUCTION

Cricket is a popular summer sport traditionally played by Commonwealth nations.1,2 New Zealand (NZ)’s domestic outdoor cricket season runs from October to March. All age groups in the country play cricket, often formally starting in primary school, and progressing to recreational weekend cricket, with the pinnacle being elite first-class cricket. Globally, the introduction of the shorter franchise-based Twenty20 (T20) game format and internet streaming of cricket matches has coincided with increased spectator popularity and has likely contributed to larger participation numbers.2 In NZ, nationwide cricket participation numbers have increased by 75%, with 97,263 registered cricketers in the 2005–2006 season to 170,344 registered in the 2015–2016 season.3 With these sizeable public participation numbers, it is essential to monitor potential injury risks and ascertain if there is a widespread sports injury problem.

The first stage in sports injury prevention is identifying the extent of the problem via quantification by conducting sports injury surveillance.4,5

Currently, there is no published nationwide study reporting injury incidence across all participation levels of cricket. In NZ, the last published cricket injury surveillance study was in 2008, and was focused solely on elite cricketers.6 Given the popularity of cricket in NZ, quantifying nationwide cricket injury incidence will help better understand cricket injury aetiology. Therefore, this study’s objective was to describe cricket-related injuries in the NZ population requiring medical treatment (as determined from the Accident Compensation Corporation (ACC) database) from 2005 to 2016.

METHODS

Participants

NZ residents of all age groups who claimed medical treatment and rehabilitation costs from the ACC for a cricket-related injury from 2005 to 2016 were included in this study.
**Data collected**

The NZ national cricket organisation does not capture nationwide cricket-related injury data across all levels of cricket, so data from the ACC database were obtained to describe the epidemiological extent of cricket-related injuries during the 12-year study period.

NZ’s ACC scheme provides registered medical practitioner information related to the patients’ injury diagnosis and medical care provided. Compensation covers costs towards medical treatment and rehabilitation. Details on the ACC injury reporting system and data are available in our series of papers.

Acute personal injury claims, termed minor or moderate-to-serious claims (MSC) terms are defined under the Injury Prevention, Rehabilitation and Compensation Act, 2001 and identify ACC as responsible for providing costs of the injury claims lodged. For a claim to be classified as MSC, the injury typically requires assistance beyond medical treatment alone (ie, a combination of medical care, rehabilitation costs and income replacement for employment time lost because of the injury). This study included MSC claims from 1 January 2005 to 31 December 2016 that resulted in an injury from participation in cricket. No analyses were completed to identify multiple injuries per participant, so the number of participants is not provided.

**Injury definition**

The injury definition for this study was ‘any injury (minor, moderate-to-serious and serious injury) that had been assessed and reported by a registered health practitioner as a result of sports participation’. To be included in the dataset for analysis, the ACC injury claim had to have been recorded as related to cricket.

**Pooled analysis**

Injury incidence data were pooled to provide a more accurate injury incidence estimate. All data included in analysis needed to have similar definitions, have a comparable population and have adequacy and specificity of exposure data. This approach has been reported for rugby league injury epidemiological studies. An overall estimation of injuries was recorded by incorporating data provided by prior studies. Although there are limitations of a pooled analysis methodology, the strength is that it provides more accurate estimates of injury rates.

**Statistics**

ACC data were analysed by age group, injured body area (reclassified according to the Orchard sports injury and illness classification system), type and diagnosis. Injury causes were grouped into contact, non-contact and other mechanism of injury. Only new injury claims from 2005 to 2016 were considered; all previous injury claims data were removed from the data to calculate the injury incidence rate only for each calendar year’s original injury claims and pooled to provide an overall injury incidence rate.

All collected data entered into a Microsoft Excel spreadsheet were analysed with SPSS (released 2017, IBM SPSS Statistics for Windows, V.25.0, IBM, Armonk, New York, USA). Data were reported as means and 95% CIs with an independent t-test used for comparisons. A one-sample $\chi^2$ test was used for comparison between reporting years for the number of claims. Injury incidence was calculated using participation data supplied by NZ cricket. Paired sampled t-tests were used to compare between male and female injury claims. Cohen’s d effect sizes were computed to complement interpretation of results, with effect sizes being interpreted as negligible/very small (d<0.20), small (d=0.20–0.49), medium (d=0.50–0.79) or large (d>0.80). Statistical significance was set at $p<0.05$.

**Patient and public involvement**

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**RESULTS**

There were 86562 injuries (77212 males and 9350 females) over the 12 years.

Results presented were analysed by sex-specific differences in injury incidence over the years, ages, injured body site and injury type.

**Years**

There were more injury claims in 2016 for males ($t_{(17)}=-4.2; p=0.0006$) and females ($t_{(17)}=-3.0; p=0.0073$) compared with 2005 (table 1). Males recorded more claim numbers over all years for males ($t_{(17)}=28.8; p<0.0001$), females ($t_{(17)}=39.2; p<0.0001$) and for all claims recorded ($t_{(17)}=29.9; p<0.0001$). Although total claim numbers increased from 2005 to 2016 (5737 vs 8183; $t_{(17)}=-4.2; p=0.0005; d=0.31$), the injury incidence decreased (59.0 (95% CI 57.5 to 60.5) vs 42.8 (95% CI 58.7 to 59.6) per 1000 participants).

**Age group**

Males recorded more injuries across the study than females in all the age groups except the 80–84 ($t_{(11)}=-1.3; p=0.2118; d=0.53$) and 85+ ($t_{(11)}=-1.3; p=0.2064; d=0.57$) years age groups (table 2). Females recorded the most injuries in the 10–14 years age group (n=2168), whereas males recorded the most injuries in the 15–19 years age group (n=13531).

**Body site**

Males recorded more injuries to the head/neck (Relative risk (RR) 1.23 (95% CI 1.17 to 1.29); $p<0.0001$; d=1.81), upper limb (RR 1.88 (95% CI 1.81 to 1.95); $p<0.0001$; d=8.73), lower limb (RR 1.73 (95% CI 1.67 to 1.79); $p<0.0001$; d=9.40) and chest/back/other (RR 2.36 (95% CI 2.21–2.52) vs 1.54 (95% CI 1.43–1.67) per 1000 participants).
Table 1  Injury claims by reporting years for total, mean claims per year with 95% CI, total registered participants and injury rate per 1000 participants by male, female and combined total for cricket in New Zealand from 2005 to 2016

| Gender | Injury rate (95% CI)* | Total participants | Injuries per year Mean (95% CI) | Total injuries Year |
|--------|-----------------------|--------------------|--------------------------------|---------------------|
| **Males** | | | | |
| 2005  | 5044abcdg | 280.2 (121.9 to 438.5) | N/A | – |
| 2006  | 5199abcdg | 288.8 (124.5 to 453.2) | 85215 | 59.2 (57.6 to 60.8) |
| 2007  | 6194abcdef | 344.1 (148.9 to 539.3) | 86514 | 60.1 (58.5 to 61.8) |
| 2008  | 6343abcdef | 352.4 (155.9 to 548.9) | 88517 | 70.0 (68.3 to 71.7) |
| 2009  | 6658abcdef | 369.9 (165.8 to 574.0) | 93342 | 71.3 (69.6 to 73.1) |
| 2010  | 6484abcdef | 360.2 (162.0 to 558.5) | 95603 | 67.8 (66.2 to 69.5) |
| 2011  | 5915abcdef | 328.6 (148.1 to 509.1) | 93743 | 63.1 (61.5 to 64.7) |
| 2012  | 6527abcdef | 362.6 (161.4 to 563.8) | 95836 | 68.1 (66.5 to 69.8) |
| 2013  | 6904abcdef | 383.4 (176.0 to 590.8) | 112780 | 61.2 (59.8 to 62.7) |
| 2014  | 7036abcdef | 390.7 (180.0 to 501.4) | 112956 | 62.3 (60.8 to 63.7) |
| 2015  | 7619abcdef | 423.3 (198.2 to 648.4) | 116093 | 65.6 (64.2 to 67.1) |
| 2016  | 7295abcdef | 405.3 (194.2 to 616.4) | 125316 | 58.2 (56.9 to 59.6) |
| **Total†** | **77212** | **6434.3 (5943.1 to 6925.6)** | **1105915** | **64.1 (63.6 to 64.6)** |

| **Females** | | | | |
| 2005  | 693abcdef | 38.5 (12.0 to 65.0) | N/A | – |
| 2006  | 651abcdef | 36.2 (13.4 to 59.0) | 12048 | 57.5 (53.4 to 62.0) |
| 2007  | 789abcdef | 43.8 (17.5 to 70.2) | 11650 | 55.9 (51.7 to 60.3) |
| 2008  | 774abcdef | 43.0 (17.9 to 68.1) | 11831 | 66.7 (62.2 to 71.5) |
| 2009  | 846abcdef | 47.0 (22.5 to 71.5) | 11538 | 73.3 (68.5 to 78.4) |
| 2010  | 784abcdef | 43.8 (18.3 to 68.8) | 11668 | 67.2 (62.6 to 72.1) |
| 2011  | 743abcdef | 41.3 (16.9 to 65.6) | 18231 | 40.8 (37.9 to 43.8) |
| 2012  | 744abcdef | 41.3 (17.0 to 65.7) | 15993 | 46.5 (43.3 to 50.0) |
| 2013  | 782abcdef | 43.4 (16.5 to 70.4) | 25964 | 30.1 (28.1 to 32.3) |
| 2014  | 781abcdef | 43.4 (16.4 to 70.4) | 31760 | 24.6 (22.9 to 26.4) |
| 2015  | 875abcdef | 48.6 (19.0 to 78.2) | 41895 | 20.9 (19.5 to 22.3) |
| 2016  | 888abcdef | 49.3 (19.6 to 79.1) | 45028 | 19.7 (18.5 to 21.1) |
| **Total†** | **9350**abc | **772.2 (735.5 to 822.8)** | **237606** | **36.1 (35.3 to 36.9)** |

| **Total** | | | | |
| 2005  | 5737abcdefg | 318.7 (135.1 to 502.3) | N/A | – |
| 2006  | 5850abcdefg | 325.0 (139.0 to 511.0) | 97263 | 59.0 (57.5 to 60.5) |
| 2007  | 6983abcdefg | 387.9 (167.3 to 608.5) | 97913 | 59.7 (58.2 to 61.3) |
| 2008  | 7117abcdefg | 395.4 (174.8 to 615.9) | 100348 | 69.6 (68.0 to 71.2) |
| 2009  | 7504abcdefg | 416.9 (189.1 to 644.7) | 104860 | 71.6 (70.0 to 73.2) |
| 2010  | 7268abcdefg | 403.8 (181.2 to 626.3) | 107271 | 67.8 (66.2 to 69.3) |
| 2011  | 6658abcdefg | 369.9 (166.9 to 572.8) | 111947 | 52.8 (51.5 to 54.2) |
| 2012  | 7277abcdefg | 403.9 (180.2 to 627.7) | 111744 | 49.7 (48.6 to 50.8) |
| 2013  | 7683abcdefg | 426.8 (195.5 to 658.1) | 138744 | 49.7 (48.6 to 50.9) |
| 2014  | 7814abcdefg | 434.1 (199.6 to 668.7) | 144717 | 48.6 (47.5 to 49.7) |
| 2015  | 8494abcdefg | 471.9 (221.2 to 722.5) | 157988 | 48.2 (47.2 to 49.3) |
| 2016  | 8183abcdefg | 454.6 (216.4 to 692.8) | 170344 | 42.8 (41.9 to 43.8) |
| **Total†** | **86562** | **4809.0 (2174.2 to 7443.8)** | **1343521** | **59.1 (58.7 to 59.6)** |

*Significant difference (p<0.05) than (a)=over reporting years; (b)=male; (c)=female; (d)=2005; (e)=2006; (f)=2007; (g)=2008; (h)=2009; (i)=2010; (j)=2011; (k)=2012; (l)=2013; (m)=2014; (n)=2015; (o)=2016.

*Injury rate per 1000 registered participants.
†Pooled data.
2.23 to 2.49); p<0.0001; d=8.47) than females over the study (table 3). The upper limb sustained the most injuries (22.4 (95% CI 22.2 to 22.7) per 1000 participants) and the hand and fingers sustained the highest injury rate (9.2 (95% CI 9.0 to 9.3) per 1000 participants) for injury site.

**Injury type**
There were notable differences in the number of soft tissue injuries recorded over the study for males (3734.1 (95% CI 2149.3 to 5319.0); t (15)=5.0; p=0.0002), females (448.4 (95% CI 285.4 to 611.3); t (11)=5.9; p<0.0001) and total (4182.5 (2445.0 to 5920.0); t(11)=5.1; p=0.0001) injury claims recorded.

**Cause of injury**
There were more injuries recorded due to contact than non-contact for males (RR 2.26 (95% CI 2.23 to 2.30); p=0.0344; d=0.80), females (RR 2.76 (95% CI 2.63 to 2.89); p=0.0215; d=0.92) and total (RR 2.31 (95% CI 2.28 to 2.34); p=0.0319; d=0.82) injury claims.

**DISCUSSION**
This study provided an epidemiological description of cricket-related injuries among the NZ resident population from the years 2005 to 2016. The key findings of this study were: (1) although injury claims increased, the incidence of injuries decreased; (2) males recorded more injuries than females in most age groups; (3) the upper limb sustained the most injuries and the hand and fingers sustained the highest injury rate and (4) there were more injuries due to contact than non-contact actions.

**Years**
The number of cricket-related injury claims increased by 42.6% but the injury incidence decreased from 59% to 42.8% over the 12 years. The introduction of the T20 cricket format along with the availability of streaming international cricket matches may have caused a surge in the popularity of the sport and might have led to larger participation numbers. The introduction of shorter cricket competitions across different cricket levels such as club cricket, school cricket, regional cricket and metro cricket might have caused people to play more cricket. While it is hard to discern the cause of the 42.8% increase in injury claims, there was a related increase in cricket participation across NZ with a 47% increase with 85 215

---

**Table 2** Injury claims for age groups for total, mean claims per year with 95% CI by male, female and combined total for cricket in New Zealand from 2005 to 2016

| Age group | Male          | Average injuries per year | Female         | Average injuries per year | Total          | Average injuries per year |
|-----------|---------------|----------------------------|----------------|----------------------------|----------------|---------------------------|
|           | Total injuries| Mean (95% CI)              | Total injuries| Mean (95% CI)              | Total injuries| Mean (95% CI)          |
| 0–4       | 180ab         | 15.0 (11.1 to 18.9)        | 55ab           | 4.6 (3.4 to 5.8)           | 235a          | 19.6 (15.2 to 23.9)     |
| 5–9       | 2795ac        | 232.9 (212.3 to 253.5)     | 542ab          | 45.2 (40.3 to 50.1)        | 3337a         | 278.1 (255.6 to 300.6)  |
| 10–14     | 12941ac       | 1078.4 (1016.5 to 1140.3)  | 2168ab         | 180.7 (161.9 to 199.4)     | 15 109b       | 1259.1 (1182.4 to 1335.7)|
| 15–19     | 13531ac       | 1127.6 (1062.3 to 1192.9)  | 1830ab         | 152.5 (143.9 to 161.1)     | 15 361a       | 1280.1 (1213.7 to 1346.4)|
| 20–24     | 10282ac       | 856.8 (799.0 to 914.7)     | 1062ab         | 88.5 (83.9 to 93.1)        | 11 344a       | 945.3 (888.0 to 1002.7) |
| 25–29     | 10029ac       | 835.8 (759.1 to 912.4)     | 766ab          | 63.8 (55.4 to 72.3)        | 10 795a       | 899.6 (819.6 to 979.6)  |
| 30–34     | 7882ac        | 656.8 (582.3 to 731.4)     | 514ab          | 42.8 (38.1 to 47.5)        | 8396a         | 699.7 (623.5 to 775.9)  |
| 35–39     | 5694ac        | 497.0 (438.1 to 555.9)     | 589ab          | 49.1 (42.5 to 55.7)        | 6553a         | 546.1 (483.6 to 608.6)  |
| 40–44     | 5055ac        | 421.3 (370.1 to 472.4)     | 630ab          | 52.5 (46.0 to 59.0)        | 5685a         | 473.8 (418.6 to 528.9)  |
| 45–49     | 3825ac        | 318.8 (282.7 to 354.8)     | 479ab          | 39.9 (35.1 to 44.7)        | 4304a         | 358.7 (319.9 to 397.4)  |
| 50–54     | 2141ac        | 178.4 (157.6 to 199.2)     | 269ab          | 22.4 (18.5 to 26.4)        | 2410a         | 200.8 (177. to 224.4)   |
| 55–59     | 1201ac        | 100.1 (91.0 to 109.2)      | 141ab          | 11.8 (9.1 to 14.4)         | 1342a         | 111.8 (100.7 to 123.0)  |
| 60–64     | 715ac         | 59.6 (53.6 to 65.5)        | 117ab          | 9.8 (7.9 to 11.6)          | 832a          | 69.3 (62.4 to 76.3)     |
| 65–69     | 364ac         | 30.3 (24.9 to 35.8)        | 92ab           | 7.7 (5.8 to 9.5)           | 456a          | 38.0 (31.4 to 44.6)     |
| 70–74     | 181ac         | 15.1 (12.4 to 17.8)        | 49ab           | 4.1 (2.9 to 5.2)           | 230a          | 19.2 (15.5 to 22.8)     |
| 75–79     | 83ac          | 6.9 (4.1 to 9.7)           | 20ab           | 1.7 (0.7 to 2.6)           | 103a          | 8.6 (5.4 to 11.8)       |
| 80–84     | 28a           | 2.3 (1.4 to 3.3)           | 19a            | 1.6 (0.9 to 2.3)           | 47a           | 3.9 (2.8 to 5.0)        |
| 85+       | 15a           | 1.3 (0.5 to 2.0)           | 8a             | 0.7 (0.0 to 1.3)           | 23a           | 1.9 (1.0 to 2.9)        |

Significant difference (p<0.05) than (a)=over reporting years; (b)=male; (c)=female.
Table 3  Injury claims by and type for total, mean claims per year with 95% CI and pooled injury rate per 1000 participants by male, female and combined total for cricket in New Zealand from 2005 to 2016

| Injury site | Male | Female | Total |
|-------------|------|--------|-------|
|              | Total no | Average claiams per year | Mean (95% CI) | Injury rate (95% CI)* | Total no | Average claims per year | Mean (95% CI) | Injury rate (95% CI)* |
| Head/Neck    | 10267^acdefg | 855.6 (802.7 to 908.4) | 9.3 (9.1 to 9.5) | | 12060^acdeg | 1005.0 (945.7 to 1064.3) | 9.0 (8.8 to 9.1) |
| Head         | 8192 | 682.7 (633.8 to 731.5) | 7.4 (7.2 to 7.6) | 1433 | 119.4 (111.4 to 127.4) | 6.0 (5.7 to 6.4) | 9625 | 802.1 (748.0 to 856.2) | 7.2 (7.0 to 7.3) |
| Neck         | 2075 | 172.9 (152.7 to 193.1) | 1.9 (1.8 to 2.0) | 360 | 30.0 (24.6 to 35.4) | 1.5 (1.4 to 1.7) | 2435 | 202.9 (178.6 to 227.2) | 1.8 (1.7 to 1.9) |
| Upper limb   | 27053^acdefg | 2254.4 (2049.6 to 2459.2) | 24.5 (24.2 to 24.8) | 3087^abdg | 257.3 (240.7 to 273.8) | 13.0 (12.5 to 13.5) | 30140^acdeg | 2511.7 (2292.9 to 2730.5) | 22.4 (22.2 to 22.7) |
| Shoulder     | 8636 | 719.7 (633.6 to 805.7) | 7.8 (7.6 to 8.0) | 821 | 68.4 (60.0 to 76.8) | 3.5 (3.2 to 3.7) | 9457 | 788.1 (695.4 to 880.8) | 7.0 (6.9 to 7.2) |
| Upper and lower limb | 2153 | 179.4 (159.1 to 199.7) | 1.9 (1.9 to 2.0) | 304 | 25.3 (21.2 to 29.5) | 1.3 (1.1 to 1.4) | 2457 | 204.8 (181.9 to 227.6) | 1.8 (1.8 to 1.9) |
| Elbow        | 1085 | 90.4 (82.6 to 98.2) | 1.0 (0.9 to 1.0) | 141 | 11.8 (10.1 to 13.4) | 0.6 (0.5 to 0.7) | 1226 | 102.2 (93.7 to 110.7) | 0.9 (0.9 to 1.0) |
| Wrist        | 4085 | 340.4 (314.8 to 366.1) | 3.7 (3.6 to 3.8) | 603 | 50.3 (44.7 to 55.8) | 2.5 (2.3 to 2.7) | 4688 | 390.7 (363.8 to 417.5) | 3.5 (3.4 to 3.6) |
| Hand and fingers | 11094 | 924.5 (844.4 to 1004.6) | 10.0 (9.8 to 10.2) | 1218 | 101.5 (94.5 to 108.5) | 5.1 (4.85 to 5.4) | 12312 | 1026.0 (943.2 to 1108.8) | 9.2 (9.0 to 9.3) |
| Lower limb   | 25159^acdeg | 2096.6 (1922.1 to 2271.1) | 22.7 (22.5 to 23.0) | 3126^abdg | 260.5 (242.2 to 278.8) | 13.2 (12.7 to 13.6) | 28285^acdeg | 2357.1 (2167.5 to 2546.7) | 21.1 (20.8 to 21.3) |
| Hip, thigh   | 5656 | 471.3 (428.9 to 513.7) | 5.1 (5.0 to 5.2) | 504 | 42.0 (36.6 to 47.4) | 2.1 (1.9 to 2.3) | 6160 | 513.3 (467.1 to 559.5) | 4.6 (4.5 to 4.7) |
| Knee         | 8272 | 689.3 (631.5 to 747.2) | 7.5 (7.3 to 7.6) | 998 | 83.2 (78.1 to 88.2) | 4.2 (3.9 to 4.5) | 9270 | 772.5 (712.5 to 832.5) | 6.9 (6.8 to 7.0) |
| Lower leg    | 2822 | 235.2 (209.6 to 260.7) | 2.6 (2.5 to 2.6) | 384 | 32.0 (27.5 to 36.5) | 1.6 (1.5 to 1.8) | 3206 | 267.2 (239.6 to 294.7) | 2.4 (2.3 to 2.5) |
| Ankle        | 5405 | 450.4 (412.3 to 488.5) | 4.9 (4.8 to 5.0) | 832 | 69.3 (63.1 to 75.6) | 3.5 (3.3 to 3.7) | 6237 | 519.8 (476.7 to 562.8) | 4.6 (4.5 to 4.8) |
| Foot         | 3004 | 250.3 (231.0 to 269.7) | 2.7 (2.6 to 2.8) | 408 | 34.0 (30.4 to 37.6) | 1.7 (1.6 to 1.9) | 3412 | 284.3 (262.6 to 306.1) | 2.5 (2.5 to 2.6) |
| Chest/Back/ Other | 14733^acdef | 1227.8 (1109.7 to 1345.8) | 13.3 (13.1 to 13.5) | 1344^abdef | 112.0 (103.1 to 120.9) | 5.7 (5.4 to 6.0) | 16077^abdef | 1339.8 (1217.2 to 1462.3) | 12.0 (11.8 to 12.2) |
| Chest        | 1830 | 152.5 (143.3 to 161.7) | 1.7 (1.6 to 1.7) | 158 | 13.2 (11.7 to 14.6) | 0.7 (0.6 to 0.8) | 1988 | 165.7 (155.9 to 175.5) | 1.5 (1.4 to 1.5) |

Continued
### Table 3 Continued

| Injury type | Male Total | Average claims per year Mean (95% CI) | Injury rate (95% CI)* | Female Total | Average claims per year Mean (95% CI) | Injury rate (95% CI)* | Total | Average claims per year Mean (95% CI) | Injury rate (95% CI)* |
|-------------|------------|--------------------------------------|-----------------------|--------------|--------------------------------------|-----------------------|--------|--------------------------------------|-----------------------|
| Abdomen     | 767        | 63.9 (55.1 to 72.7)                  | 0.7 (0.6 to 0.7)      | 62           | 5.2 (3.7 to 6.6)                    | 0.3 (0.2 to 0.3)      | 829    | 69.1 (59.8 to 78.3)                  | 0.6 (0.6 to 0.7)      |
| Lumbar      | 10022      | 835.2 (72.4 to 946.0)                | 9.1 (8.9 to 9.2)      | 865          | 72.1 (64.3 to 79.8)                 | 3.6 (3.4 to 3.9)      | 10887  | 907.3 (791.4 to 1023.1)             | 8.1 (8.0 to 8.3)      |
| Unknown     | 2114       | 176.2 (161.5 to 190.8)               | 1.9 (1.8 to 2.0)      | 259          | 21.6 (16.9 to 26.3)                 | 1.1 (1.0 to 1.2)      | 2373   | 197.8 (180.1 to 215.4)              | 1.8 (1.7 to 1.8)      |

### Injury type

**Soft tissue**
- 59746<sup>bc</sup> Total: 3734.1 (2149.3 to 5319.0) Mean: 54.0 (53.6 to 54.5) Injury rate: 717.4<sup>ab</sup> (285.4 to 611.3) 30.2 (29.5 to 30.9) 66,920<sup>a</sup> 4182.5 (2445.0 to 5920.0) 49.8 (49.4 to 50.2)

**Fracture/Dislocation**
- 8250<sup>c</sup> Total: 515.6 (28.4 to 1059.6) Mean: 7.5 (7.3 to 7.6) Injury rate: 794<sup>b</sup> (5.5 to 93.8) 3.3 (3.1 to 3.6) 9044 565.3 (22.4 to 1152.9) 6.7 (6.6 to 6.9)

**Laceration/Puncture**
- 5599<sup>bc</sup> Total: 349.9 (62.0 to 637.8) Mean: 5.1 (4.9 to 5.2) Injury rate: 603<sup>ab</sup> (6.0 to 69.4) 2.5 (2.3 to 2.7) 6,202<sup>a</sup> 387.6 (68.3 to 707.0) 4.6 (4.5 to 4.7)

**Dental injury**
- 2347 Total: 146.7 (66.0 to 459.3) Mean: 2.1 (2.0 to 2.2) Injury rate: 481 30.1 (4.0 to 94.1) 2.0 (1.9 to 2.2) 2828 176.8 (20.0 to 553.5) 2.1 (2.0 to 2.2)

**Other**
- 1714 Total: 107.1 (89.3 to 303.6) Mean: 1.5 (1.5 to 1.6) Injury rate: 214 13.4 (9.5 to 36.3) 0.9 (0.8 to 1.0) 1928 120.5 (98.7 to 339.7) 1.4 (1.4 to 1.5)

**Concussion**
- 424 Total: 26.5 (30.0 to 83.0) Mean: 0.4 (0.3 to 0.4) Injury rate: 75 4.7 (5.3 to 14.7) 0.3 (0.3 to 0.4) 499 31.2 (5.3 to 97.7) 0.4 (0.3 to 0.4)

**Gradual inflammation**
- 132 Total: 8.3 (1.4 to 17.9) Mean: 0.1 (0.1 to 0.1) Injury rate: 9 0.6 (0.0 to 1.1) 0.0 (0.0 to 1.1) 141 8.8 (1.3 to 18.9) 0.1 (0.1 to 0.1)

### Injury cause

**Contact**
- 53283<sup>adj</sup> Total: 3330.2 (1850.1 to 4810.2) Mean: 48.2 (47.8 to 48.6) Injury rate: 6807<sup>abj</sup> (221.4 to 629.5) 28.6 (28.0 to 29.3) 60090<sup>g</sup> 3755.6 (2082.8 to 5428.5) 44.7 (44.4 to 45.1)

**Non-contact**
- 23536<sup>adj</sup> Total: 1,471.0 (515.8 to 2426.2) Mean: 21.3 (21.0 to 21.6) Injury rate: 2468<sup>abf</sup> (69.7 to 238.8) 10.4 (10. to 10.8) 26004<sup>gj</sup> 1625.3 (587.4 to 2663.1) 19.4 (19.1 to 19.6)

**Other**
- 393<sup>acjv</sup> Total: 24.6 (8.0 to 41.1) Mean: 0.4 (0.3 to 0.4) Injury rate: 75<sup>abtv</sup> (0.2 to 9.2) 0.3 (0.3 to 0.4) 468<sup>tv</sup> 29.3 (8.4 to 50.1) 0.3 (0.3 to 0.4)

Significant difference (p<0.05) than:
- (a)=reporting years
- (b)=male
- (c)=female
- (d)=head/neck
- (e)=upper limb
- (f)=lower limb
- (g)=chest/back/other
- (h)=contact
- (i)=non-contact
- (j)=other

*Pooled data.
†Injury rate per 1000 registered participants.
people registered to play in 2005 and 125,316 registered to play in 2016.

**Age group**
Adolescent athletes can encounter more epiphysial and stress-related injuries due to the undergoing hormonal changes which might then predispose them to acute injuries. The opportunity to play cricket at various levels such as school cricket, club cricket, recreational weekend cricket and regional age-group cricket may contribute to an increased volume of cricket participation in this age group. More frequent participation and training can improve skill development and provide opportunities for some to compete in representative teams at a regional or national level. It should be noted that injury onset at a younger age will affect performance and may limit further participation in the sport. Hence, monitoring this injury-prone age group of 10–19 years and implementing early preventative strategies is strongly recommended.

**Body site**
Reviewing the injuries by body areas across the 12 years has highlighted that the injury prone areas differ between male and female participants. A higher incidence of hand injuries has also been reported among elite cricketers. It may be that contact and impact with the hand injuries has also been reported among elite male and female participants. A higher incidence of injuries has highlighted that the injury prone areas differ between male and female participants. A higher incidence of injuries has also been reported among elite cricketers.

**Injury type**
The prevalence of impact-contact injuries to the hand and wrist area (e.g., fractures and dislocations) are likely due to an improper technique employed while catching the ball, or potentially due to the absence of effective protective equipment when fielding. This may be due to the requirement that the only hand protection equipment allowed in cricket are wicket-keeping and batting gloves.

Contact injuries in cricket could be sustained due to impacts with balls, objects marking the boundaries or other equipment related to the game. The injuries recorded in the study were classified as either of contact or non-contact nature. In the current study, contact injuries were mostly due to impact with an object, the ground or a person and non-contact injuries are mainly due to repetitive strenuous movement.

In the upper limb, the hand and fingers may experience more contact type injuries, whereas the shoulder may sustain more non-contact type injuries. As non-contact injury type is mainly due to repetitive strenuous movement, the shoulder was most likely to have been injured due to repetitive movement in cricket. The repetitive strenuous shoulder movement is likely to have been due to a combination of throwing and bowling.

Unlike hand injuries, two-thirds of all lumbar injuries were of a non-contact nature. A commonly cited reason for elite cricketers’ lumbar injuries has been increased playing/training workload. Non-contact lower back soft tissue injuries occur mostly in the lumbar muscles and intervertebral discs, ‘as’ injury surveillance among South African provincial age-group cricketers revealed lower back muscle strains (78 injuries) were higher than stress fractures (33 injuries).

Participants in this study included a nationwide population with data including primary school level cricketers to elite first-class cricketers. Therefore, an acute lumbar injury could have occurred to a recreational cricketer due to improper warmup or to an elite first-class cricketer due to training/bowling workload or vice versa.

While conducting injury surveillance, it is essential to record the level of the player given that elite players are likely to have access to a lot of injury prevention support, whereas recreational cricket players may not have access to or use protective equipment frequently.

Elite cricketers undergo intense workload, playing frequent matches and training several times per week, increasing their predisposition to overuse injuries. By contrast, recreational cricketers may not partake in regular warmups, may forego conditioning sessions and may just play cricket during the weekends, exposing them to sudden loading and greater risks of acute injuries. Therefore, elite cricketers may not experience impact-related face or finger injuries as often as recreational cricketers. However, elite cricketers may encounter greater overuse-related injuries. Therefore, elite cricketers’ injury surveillance may reveal a higher incidence of overuse injuries, whereas impact injuries may have a higher incidence among a nationwide cricketing population. Hence, while conducting cricket injury surveillance, it is critical to question the nature of the reported injury. Generalising injury aetiology of elite cricketers to a nationwide cricketing population may not always be applicable.

Data obtained from ACC did not reveal the injury-specific medical diagnosis; if such information was available, the nature of injuries could be classified as either acute or overuse. If injury onset data were available, it would provide insight into whether bowling, batting or fielding was a predominant factor for injury, and it would highlight the most injury-prone playing positions. Some cricket injury data may not have been recorded if the injury was not severe enough to qualify for an injury entitlement claim. Some individuals might not have sought medical care, which is a limitation to the current study.

**CONCLUSIONS**
This study provided evidence that as cricket participation numbers increased there was a substantial increase in cricket-related injury claims. Analysis of 12 years of ACC cricket-related injury claims showed only minimal reductions in injury incidence over the years. Injury prevention
programmes for cricket need to target the prevention of hand and finger, and head injuries particularly in players aged 10–20 years.

Contributors According to the definition given by the International Committee of Medical Journal Editors (ICMJE), the authors listed qualify for authorship based on making one or more of the substantial contributions to the intellectual content of conception and design (SW); and/or acquisition of data (SW); and/or analysis and interpretation of data (SW, DK, PH); and/or participated in drafting of the manuscript (SW, DK, PH) and/or critical revision of the manuscript for important intellectual content (SW, DK, PH). The guarantor (SW) accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval After consulting with the University of Canterbury Human Ethics committee and the New Zealand Accident Compensation Corporation (ACC), neither an ethics application nor informed consent from participants was required as obtained data were secondary de-identified claimant suppressed information.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement The data that support the findings of this study are available on request.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution 4.0 Unported (CC BY 4.0) license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited, a link to the licence is given, and indication of whether changes were made. See: https://creativecommons.org/licenses/by/4.0/.

ORCID iDs
Sibi Walter http://orcid.org/0000-0002-7480-5296
Patria Hume http://orcid.org/0000-0003-1847-8128

REFERENCES
1 Walter S, Petersen C, Basu A. International cricket injury surveillance: A media-based injury report on the ICC men’s Cricket World Cup 2015. J Sport Exerc Sci 2020;4:84–9.
2 Khondker HH, Robertson R. Glocalization, consumption, and cricket: the Indian premier League. Journal of Consumer Culture 2018;18:279–97.
3 Cricket NZ. 2016: Available: https://www.nzcricket.nz/archive/records2016
4 van Mechelen W, Hobili H, Kemper HC. Incidence, severity, aetiology and prevention of sports injuries. A review of concepts. Sports Med 1992;14:82–99.
5 Walter S. Shoulder injuries of cricket fast bowlers in New Zealand. University of Canterbury, 2020.
6 Frost WL, Chalmers DJ. Injury in elite New Zealand cricketers 2002–2008: descriptive epidemiology. Br J Sports Med 2014;48:1002–7.
7 King DA, Hume PA, Milburn P, et al. Rugby League injuries in New Zealand: a review of 8 years of accident compensation Corporation injury entitlement claims and costs. Br J Sports Med 2009;43:595–602.
8 King D, Gissane C, Brughelli M, et al. Sport-Related concussions in New Zealand: a review of 10 years of accident compensation Corporation moderate to severe claims and costs. J Sci Med Sport 2014;17:250–5.
9 King D, Hume PA, Hardaker N, et al. Female rugby Union injuries in New Zealand: a review of five years (2013-2017) of accident compensation Corporation moderate to severe claims and costs. J Sci Med Sport 2019;22:532–7.
10 King D, Hume PA, Hardaker N, et al. Sports-Related injuries in New Zealand: National insurance (accident compensation Corporation) claims for five sporting codes from 2012 to 2016. Br J Sports Med 2019;53:1026–33.
11 King D, Hume PA, Hardaker N, et al. Traumatic brain injuries in New Zealand: National insurance (accident compensation Corporation) claims from 2012 to 2016. J Neurol Sci 2019;399:61–8.
12 King DA, Hume PA, Gianotti S, et al. Neck back and spine injuries in amateur rugby League: a review of nine years of accident compensation Corporation injury entitlement claims and costs. J Sci Med Sport 2011;14:126–9.
13 King DA, Hume PA, Milburn P, et al. Women’s rugby League injury claims and costs in New Zealand. Br J Sports Med 2010;44:1016–23.
14 Gianotti S, Hume PA. A cost-outcome approach to pre and post-implementation of national sports injury prevention programmes. J Sci Med Sport 2007;10:436–46.
15 Gianotti S, Hume PA. Concussion sideline management intervention for rugby Union leads to reduced concussion claims. NeuroRehabilitation 2007;22:181–9.
16 Gissane C, Jennings D, Kerr K, et al. A pooled data analysis of injury incidence in rugby League football. Sports Med 2002;32:211–6.
17 Cheekway H, Data pooling in occupational studies. J Occup Med 1991;33:1257–60.
18 Blettner M, Sauerbrei W, Schlehofer B, et al. Traditional reviews, meta-analyses and pooled analyses in epidemiology. Int J Epidemiol 1999;28:1–9.
19 McElvenny DM, Armstrong BG, Jürup L, et al. Meta-Analaysis in occupational epidemiology: a review of practice. Occup Med 2004;54:336–44.
20 Wong O, Raabe GK. Application of meta-analysis in reviewing occupational cohort studies. Occup Environ Med 1986;53:793–800.
21 King D, Hume P, Gissane C, et al. Semi-Professional rugby League players have higher concussion risk than professional or amateur participants: a pooled analysis. Sports Med 2017;47:197–205.
22 Ewoood M. Critical appraisal of epidemiological studies and clinical trials. Oxford University Press, 2017.
23 Shapiro S. Meta-analysis/Shmeta-analysis. Am J Epidemiol 1994;140:771–8.
24 Twellaar M, Vrenstappen FT, Huson A. Is prevention of sports injuries a realistic goal? A four-year prospective investigation of sports injuries among physical education students. Am J Sports Med 1996;24:528–38.
25 Cohen J. Statistical power analysis for the behavioural sciences. 2nd ed. New York: Routledge, 1988: 567.
26 Frush Tj, Lindenfeld TN. Peri-epiphyseal and overuse injuries in adolescent athletes. Sports Health 2009;1:201–11.
27 Orchard J, James T, Alcott E, et al. Injuries in Australian cricket at first class level 1995/1996 to 2000/2001. Br J Sports Med 2002;36:270–4.
28 Ranson C, Hurley R, Rugless L, et al. International cricket injury surveillance: a report of five teams competing in the ICC cricket world cup 2011. Br J Sports Med 2013;47:637–43.
29 Olivier B, Taljaard T, Burger E, et al. Which extrinsic and intrinsic factors are associated with non-contact injuries in adult cricket fast bowlers? Sports Med 2016;46:79–101.
30 Walter S, Petersen C, Basu A. Are there any differences in shoulder muscle strength and range of motion between fast bowlers with and without shoulder pain? NZ J Sport Med 2021;48:17.
31 Elliott BC. Back injuries and the fast bowler in cricket. J Sci Med Sport 2000;18:983–91.
32 Stretch RA. Cricket injuries: a longitudinal study of the nature of injuries to South African cricketers. Br J Sports Med 2003;37:250–3. discussion 53.
33 Orchard JW, James T, Portus M, et al. Fast bowlers in cricket demonstrate up to 3- to 4-week delay between high workloads and increased risk of injury. Am J Sports Med 2009;37:1186–92.
34 Walter S, Petersen C, Basu A. Quantifying injuries among New Zealand cricket fast bowlers: a 12-month retrospective injury surveillance. NZ J Sport Med 2022;48:46–51.
35 Orchard JW, James T, Portus MR. Injuries to elite male cricketers in Australia over a 10-year period. J Sci Med Sport 2006;9:459–67.
36 Walter S, Petersen C, Basu A. Cricket-Related injury epidemiology among the women in New Zealand. J Sci Med Sport 2021;25:E7–8.