

Title: Female rugby union injuries in New Zealand: A review of five years of Accident Compensation Corporation moderate to severe claims and costs

Running title: ACC female rugby union injuries

Authors: King, D.,^{a,b} Hume, P.A.,^{a,c} Hardaker, N.,^{a,d} Cummins, C.,^{b,h} Clark, T.,^e Pearce, A.J.,^f Gissane, C.^g

- a. Sports Performance Research Institute New Zealand (SPRINZ),
Faculty of Health and Environmental Science
Auckland University of Technology, Auckland, New Zealand
- b. School of Science and Technology,
University of New England, Armidale, NSW, Australia
- c. National Institute of Stroke and Applied Neuroscience (NISAN)
Faculty of Health and Environmental Science
Auckland University of Technology, Auckland, New Zealand
- d. Accident Compensation Corporation,
Wellington, New Zealand
- e. Australian College of Physical Education
Department of Sport Performance, Sydney Olympic Park NSW, Australia
- f. Department of Rehabilitation, Nutrition and Sport,
La Trobe University, Melbourne, Australia
- g. School of Sport Health and Applied Science,
St. Mary's University, Twickenham, London, TW1 4SX, United Kingdom
- h. Institute for Sport Physical Activity and Leisure,
Leeds Beckett University, Leeds, United Kingdom

Correspondence to:

Doug King
Emergency Department
Hutt Valley District Health Board
Private Bag 31-907
Lower Hutt
New Zealand

Email: dking30@une.ed.au

Keywords: Sport-related injury; Costs; Injury; Entitlement; Women; Rugby Union

Submitted to: *Journal of Science and Medicine in Sport*

Abstract: 224 words
Manuscript: 2,623 words
References: 29
Tables: 4

Competing interests

The authors declare that there are no competing interests associated with the research contained within this manuscript.

Funding

No source of funding was utilised in the conducting of this study.

Contributor statement: According to the definition given by the International Committee of Medical Journal Editors (ICMJE), the authors listed above qualify for authorship based on making one or more of the substantial contributions to the intellectual content of:

- (i) Conception and design [DK; PH; NH]; and/or,
- (ii) Acquisition of data [NH; DK; PH]; and/or
- (iii) Analysis and interpretation of data [DK, PH, NH, CC, TC, AP, CG]; and/or
- (iv) Participated in drafting of the manuscript [DK, PH, NH, CC, TC, AP, CG]; and/or
- (v) Critical revision of the manuscript for important intellectual content [DK, PH, NH, CC, TC, AP, CG].

**Title: Female rugby union injuries in New Zealand: A review of five years
of Accident Compensation Corporation moderate to severe claims
and costs**

Running title: ACC female rugby union injuries

ABSTRACT

Objectives: To provide epidemiological data and related costs for moderate-to-serious and serious injury claims for women's rugby union in New Zealand.

Methods: A retrospective analytical review utilising detailed descriptive epidemiological data obtained from the Accident Compensation Corporation (ACC) database for 2013-2017.

Results: Over 2013 to 2017 there were 26,070 total claims for female rugby union costing \$18,440,812 [AD\$16,956,998]. The 15-19-year age group recorded 40% (n=1,009) of the total female rugby union MSC claims and 41% (\$5,419,157 [AD\$4,983,112]) of the total female rugby union MSC costs. The knee was the most commonly recorded injury site accounting for 40.3% (n=1,007) of MSC claims and 46.9% (\$6,229,714 [AD\$5,728,732]) of MSC costs with an average cost of \$1,245,943 \pm \$217,796 [AD\$595,351 \pm AD\$104,070] per-year for female rugby union.

Conclusions: This study reports for the first time the nature and related costs for moderate-to-serious and serious injury claims for women's rugby union in New Zealand. A total of 26,070 injury claims were lodged over the duration of the study but only 9.6% (n=2,501) of these were classified as MSC injury entitlement claims. Participants 25 years and older accounted for 31% of the female rugby union player claims. Females in the over 35-year age groups compete against younger participants which may account for the higher mean cost per-claim seen as the age groups increase in years until they retire from the game.

INTRODUCTION

In terms of female contact sports, New Zealand is the home of the Black Ferns (rugby union) having dominated at the international level of competition for much of the past 20 years.¹ Unlike their male counterparts, females participating in contact collisions sports have received minimal support and are sometimes seen as being of little importance in the scope of sporting activities.^{2,3} Traditionally seen as amateur sports for females, participation in these sports has necessitated that players partake in their sporting activities while still maintaining their normal lives either at work and/or with their families. As rugby union is a full contact collision sports, the players are at a high risk of sustaining injuries.⁴ These injuries may result in loss of income, financial costs for medical related care and employment limitations depending on the injury type and severity that occurred.

There are a limited studies specifically reporting on women's rugby union^{2,4-6} match injuries with the reported injury incidence ranging from 3.6⁵ to 46.3⁴ per 1,000 match hours. However, this can be influenced by the participation level and the injury definition used. A few epidemiological studies^{7,8} have reported on aspects of female sports participation injury costs but no paper to date has reported specifically on female rugby union injury costs. Therefore, this paper was undertaken to provide epidemiological data and related costs for moderate-to-serious and serious injury claims for women's rugby union in New Zealand over a five-year period from 2013-2017.

METHODS

The methods undertaken in this study are identical to previous studies^{7,9} reporting on injuries recorded through the national health provider, Accident Compensation Corporation (ACC). The ACC database was utilised to provide descriptive epidemiological data including the costs associated with treatment for injuries occurring in female rugby union activities. The ACC covers compensation for the injury (sporting or other) including medical treatment, income replacement, social and vocational rehabilitation and ancillary services (transportation and accommodation) as part of the rehabilitation. Coverage is guaranteed by ACC, but this is offset by the restriction to sue for personal injury except in rare circumstances for exemplary damages.⁹ ACC injury entitlement claims are categorised as minor (medical treatment only), moderate-to-serious⁹ or serious.^{10,11} The terms are defined under the Injury

Prevention, Rehabilitation and Compensation (IPRC) Act, 2001 with the ACC responsible for meeting the costs of these injuries.¹² Minor claims are lodged following an accident and generate a payment for the period reported to the registered licenced practitioner (e.g., physiotherapist, General Practitioner) for the medical treatment provided.¹² Typically minor claims do not require loss of time from employment, where the claimant does not require additional medical support and involves a few treatments with the ACC meeting most of the costs.¹² Moderate-to-serious injury entitlement claims occur following an accident, generate a payment for the period reported and require additional financial support for treatment, loss of earnings and related medical costs.^{9, 12} Serious injury entitlement claims require a prolonged period of financial support, loss of earnings and related medical support and are monitored by the Serious Injury Claim Unit, typically over a long period of time.^{10, 11} Moderate-to-serious and serious injury entitlement claims account for approximately 8% of total claims recorded, but can account for 80% of total costs.^{9, 12, 13}

This study focused on moderate-to-serious and serious-injury entitlement claims that occurred from 1st January 2013 to 31st December 2017 resulting from participating in female rugby union activities. The definition utilised for this study was “*any injury that had been assessed and reported by a registered health practitioner as a result of sports participation*”.⁸ The injury also had to have been accepted as an ACC claim during the study period to be recorded in the study dataset. All costs were inflation adjusted using the Reserve Bank inflation adjustor (<https://www.rbnz.govt.nz/monetary-policy/inflation-calculator>) to reflect all costs at 2017 rates with a mean inflation of $3.7 \pm 1.0\%$ per-year.

Ethical consent

Ethical consent was sought from the central region Health and Disability Ethics Committee (HDEC) but was not required. Informed consent from the injured participants was not obtained as de-identified data were collected from the ACC database without individual participant identification or follow-up.

Statistical Analysis

All data collected were entered into a Microsoft Excel spreadsheet and analysed with SPSS (IBM Corp, Released 2017. IBM SPSS Statistics for Windows, Version 25.0 Armonk, NY: IBM Corp). Data are

reported as means and standard deviations (\pm SD).¹⁴ Comparisons of the number of claims and costs over the reporting years were calculated using an independent *t*-test. A one-sample chi-squared (χ^2) test was utilised for comparison between reporting years for the number of claims recorded and between 2013 and 2017. These years were chosen as they were the start and the end of the study duration. Injury incidence was not calculated for the study as the sporting codes participation rates were not available as part of the data analysis. All costs are reported in NZ Dollars (\$) and Australian Dollars (AD\$) unless otherwise indicated.

RESULTS

Over 2013 to 2017 there were 26,070 total claims for female rugby union costing \$18,440,812 [AD\$16,957,399]. This resulted in an average of 5,214 \pm 452 claims per-year costing \$705 \pm \$49 [AD\$648 \pm AD\$45] per-claim per-year. Total costs increased by an average of 13.3% \pm 5.5% per reporting year over the duration of the study. The moderate-to-severe (MSC) claims accounted for 9.7% (n=2,516) of the total female rugby union claims but 75.7% (\$13,962,238 [AD\$12,839,596]) of the total costs. Female rugby union recorded an average of 504.0 \pm 78.1 MSC claims per-year costing \$2,657,888 \pm \$474,008 [AD\$24,442,411 \pm AD\$435,906]).

Reporting years

There were more MSC claims recorded in 2015 (n=508) for female rugby union when compared with 2014 (n=439; $\chi^2_{(1)}=5.0$; $p=0.0249$) and 2013 (n=406; $\chi^2_{(1)}=11.4$; $p=0.0007$) (see Table 1). There were differences in the total costs for female rugby union in 2015 (\$2,694,115 [AD\$1,806,212]) when compared with 2014 (\$2,283,404 [AD\$2,099,832]; $\chi^2_{(1)}=33889.1$; $p<0.0001$) and 2013 (\$2,095,132 [AD\$1,926,654]; $\chi^2_{(1)}=8095.5$; $p<0.0001$).

Age group

The 15-19-year age group recorded 40% (n=1,009) of the total female rugby union MSC claims and 41% (\$5,419,157 [AD\$4,982,862]) of the total female rugby union MSC costs (see Table 2). The 45-49-year age group recorded the highest (\$23,270 \pm \$8,096 [AD\$21,367 \pm AD\$7,444]) while the 00-04-year age group recorded the lowest (\$614 \pm \$820 [AD\$565 \pm AD\$754]) female rugby union mean cost

per-claim per-year. There were differences identified in the number of MSC claims and costs for female rugby union over the duration of the study for the 20-24 year age group (claims: $t_{(4)}=17.9$; $p=0.0001$; costs: $t_{(4)}=12.5$; $p=0.0002$) and 40-44 year group (claims: $t_{(4)}=11.4$; $p=0.0003$; costs: $t_{(4)}=4.7$; $p=0.0095$).

Injury site

There were more MSC claims for the lower limb ($n=1,577$) than head/neck ($n=248$; $t_{(4)}=-15.2$; $p=0.0001$), upper limb ($n=576$; $t_{(4)}=-14.3$; $p=0.0001$) and chest/back/other ($n=74$; $t_{(4)}=-15.3$; $p=0.0001$) for female rugby union (see Table 3). The knee was the most commonly recorded injury site accounting for 40.3% ($n=1,007$) of MSC claims and 46.9% (\$6,229,714 [AD\$5,728,689]) of MSC costs with an average cost of \$1,245,943 \pm \$217,796 [AD\$1,145,738 \pm AD\$200,280] per-year for female rugby union. There was a notable increase in the number of MSC claims ($\chi^2_{(1)}=14.1$; $p=0.0002$) and costs ($\chi^2_{(1)}=21827.6$; $p<0.0001$) for the head between 2013 and 2017. The upper and lower arm recorded the highest cost per MSC claim (\$12,338 \pm \$5,148 [AD\$11,346 \pm AD\$4,734]) for female rugby union.

Injury type

Soft tissue injuries were the most commonly recorded MSC injury claim ($n=1581$, 63.2%) and cost (\$8,887,847 [AD\$8,172,188]) for female rugby union (see Table 4). There were notable differences in the number of MSC claims ($t_{(4)}=20.4$; $p<0.0001$) for fracture/dislocations for female rugby union over the duration of the study. Recording only 5% ($n=126$) of female rugby union MSC claims, concussions recorded an average cost of \$94,337 \pm \$37,598 [AD\$86,741 \pm AD\$34,571] or \$3,901 \pm 726 [AD\$3,587 \pm AD\$668] per-claim per-year.

DISCUSSION

This study reports for the first time on the number of ACC claims lodged, and the associated costs of sports-related injuries that occur in female rugby union over a five-year period. As shown there were 26,070 injury claims lodged over the duration of the study but only 9.6% ($n=2,501$) of these were classified as MSC injury entitlement claims. Most of the ACC claims (23,569; 90.4%) reflect the number of sports related injuries that did not require further additional rehabilitation assistance. The numbers reported in this study are not a reflection of how many injuries were occurring⁷ but how many

injuries were recorded by the individual participants as a result of participating in that sport. The results of this study could be biased as they exclude those female rugby union participants that did not lodge an ACC injury entitlement form for injuries that the participants would deal with themselves resulting in an under-reporting of the actual number and costs of these injuries. The term MSC is an accounting term utilised by ACC and is not a reflection of the severity classification of the injury recorded. All the injuries recorded in this study required additional assistance beyond medical treatment alone.¹²

Previous epidemiological studies reporting on the costs of sports related injuries^{7, 8} reported that there were more male than female MSC claims and costs. It was suggested that this may be due to the differences in how males participate in sport when compared with females. Although previous studies¹⁵⁻²¹ have reported that females participating in sports such as rugby union have increased risk factors, when compared male participants this may not be the case. These risk factors reported are that when compared with males, females are of a smaller stature, have weaker neck muscles,¹⁸⁻²⁰ have a lower head/neck mass¹⁵⁻¹⁷ and have a greater acceleration of their head and neck with a lower ability to protect their heads²¹ when compared with males. It has also been suggested that females partake in sport in a less aggressive manner than males and this would result in a lower injury rate being reported. Despite this, females have similar attitudes to males in terms of sports participation in areas such as aggression, physical danger and injury.^{22, 23} Females have also demonstrated that they are as willing as males to expose themselves to physical risk, injury and aggression.²² When comparing the results of this study to previous studies,^{7, 8} the differences in the MSC claims reported would be related to the lower number of females participating in the sport, not the lack of aggression.

As shown by Table 2, the number of injuries increased as the age-groups increased peaking at age 15-19 in female rugby union. It has been reported for rugby league²⁴ that there is a sudden change in the injury rate at the 11-12 year age group and this may be reflective of physiological changes occurring and/or increasing numbers of people participating in these sports. Participants 25 years and older accounted for 31% of the female rugby union player claims. There are many possible reasons for the decline in players after this age including change in family situation, occupation or loss from the sport due to other factors. What was unexpected was the finding that the mean cost per-claim peaked in the

45-49-year group at \$23,270 [AD\$21,396]. Males participate in a restricted version of the game in rugby union (Presidents) for players over the age of 35 years old but there are no similar modifications of the respective sports codes for female participants. As such females in the over 35-year age groups who wish to play rugby union must compete in the full version of the game against younger participants and this may account for the higher mean cost per-claim seen as the age groups increase in years until they retire from the game. Another possible explanation for the older adult's being recorded in this study is that they may have been a spectator at a game and were injured on the sideline. This is a limitation to utilising the ACC database as in lodging the claim the venue and the sporting activity are recorded, not if the claimant was a player, team management or spectator.

The lower limb recorded more than half of the MSC claims for female rugby union (62.3%) over the duration of the study. This was not unexpected as the nature of rugby union require tackling, being tackled, acceleration, deceleration and change of direction at all levels of participation.²⁵ The percentage of lower limb injuries recorded in this study are similar to previous studies reporting on rugby union (44%,⁶ 46%,² 52%²⁶ and 66%⁵). The most commonly injured anatomical site was the knee for both rugby union (40.3%) and again this was not unexpected. This is similar to a previous studies of male rugby union^{4, 27-29} participation where the knee and lower limb where more commonly injured during match participation. Although research is being undertaken in female rugby union, further research is warranted specifically focusing on female rugby union to identify the etiological factors and mechanisms in these injuries for sex specific injury prevention strategies to be developed.

In reporting⁷ on the costs of concussions over a 10-year period (2001 to 2011), it was identified that the mean cost per MSC claim for rugby union was \$9,078 [AD\$8,347]. When compared with the current study, the mean cost of a concussion for rugby union has decreased over the duration of the study to \$3,901 [AD\$3,587] per-claim. Although rugby union team management must undertake yearly training in the form of RugbySmart,¹³ this is not a mandatory yearly coaching requirement for all levels of rugby union, particularly school based competition. In addition, as female rugby union are deemed to be less important³ when compared with the male version, there may not be the medical infrastructure available

for the identification and management of these injuries. Further research is warranted to identify the medical training and support provided for female rugby union match and training activities.

Limitations

Although the majority of ACC claims (23,569; 90.4%) reflect the number of injuries that resolved without further medical assistance, the data recorded through ACC should not be reflective of the total incidence of the injuries that occurred through participation in women's rugby union in New Zealand.⁷

The results reported in this study exclude those participants that did not make an injury entitlement claim for more minor injuries.⁷ Although the injuries recorded through the ACC database identify the sporting activity, it does not identify whether the injuries recorded were from participation in the sport, just that they occurred at a rugby union activity. Additionally, the terminology of 'moderate-to-serious' and 'serious' are not a reflection of the severity classification of the injury, but are the accounting terms applied by ACC to the costs involved with the rehabilitation of the injury. The moderate-to-serious claims recorded in this study may not necessarily have been lodged or the accident have occurred, during the same period reported. Moderate-to-serious claims are recorded if there has been any entitlement received during the life of the claim and they are backdated to the day the claim was lodged. If there were to be future entitlements, then the data reported here would change accordingly. As such, there was no indication as to whether the injury claims recorded were for new, recurrent or exacerbation of previous injuries within these sporting activities.

CONCLUSION

This study reports for the first-time epidemiological data and related costs for moderate-to-serious and serious injury claims for women's rugby union in New Zealand. The number of female rugby union injuries increased as the age-groups increased peaking at age 15-19. The lower limb recorded more than half of the MSC claims (62.3%) over the five years of the study. Females in the over 35-year age groups compete against younger people which may account for the higher mean cost per-claim seen as the age groups increase in years until they retire from the game. Further research is warranted specifically focusing on female rugby union to identify the etiological factors and mechanisms for the injuries that occur to enable sex specific injury prevention strategies to be developed.

TABLES

Table 1: Years of injury reported as total number, average per-year, total costs, average costs per-year and average costs per MSC claim in New Zealand Dollars (\$) with 95% standard deviations for female rugby union by reporting years from 2013 to 2017.

Table 2: Age group injured reported as total number, average per-year, total costs and average costs per-year in New Zealand Dollars (\$) with 95% standard deviations of MSC claims for female rugby union from 2013 to 2017.

Table 3: Injured body part reported as total number, average per-year, total costs and average costs per-year in New Zealand Dollars (\$) with 95% standard deviations of MSC claims for female rugby union from 2013 to 2017.

Table 4: Injury type reported as total number, average per-year, total costs and average costs per-year in New Zealand Dollars (\$) with 95% standard deviations of MSC claims for female rugby union from 2013 to 2017.

REFERENCES

1. Curtin J. Before the 'Black Ferns': Tracing the beginnings of women's rugby in New Zealand. *Int J Hist Sport*. 2016; **33**(17):2071-2085.
2. Carson J, Roberts M, White A. The epidemiology of women's rugby injuries. *Clin J Sports Med* 1999; **9**(2):75-78.
3. Harris J. Outside the fields of praise: women's rugby in Wales. *Intl J Sport Manage Market*. 2009; **6**(2):167-182.
4. Ma R, Lopez VJ, Weinstein MG, et al. Injury profile of American women's rugby-7s. *Med Sci Sport Exerc*. 2016; **48**(10):1957-1966.
5. Doyle C, George K. Injuries associated with elite participation in women's rugby over a competitive season: An initial investigation. *Phys Ther Sport* 2004; **5**:44-50.
6. Schick D, Molloy M, Wiley J. Injuries during the 2006 women's rugby world cup. *Br J Sports Med* 2008; **42**(6):447-451.
7. King D, Gissane C, Brughelli M, Hume P, Harawira J. 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**(3):250-255.
8. King D, Hume P, Milburn P, Gianotti S. 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**(8):595-602.
9. Gianotti S, Hume P. A cost-outcome approach to pre and post-implementation of national sports injury prevention programmes. *J Sci Med Sport* 2007; **10**(6):436-446.
10. Gianotti S, Quarrie K, Hopkins W. The prevention of serious injuries in New Zealand rugby union. *Br J Sports Med*. 2005; **39**(6):386.
11. Quarrie K, Gianotti S, Hopkins W, Hume P. Effect of nationwide injury prevention programme on serious spinal injuries in New Zealand rugby union: Ecological study. *BMJ*. 2007; **334**(7604):1150-1153.
12. Gianotti S, Hume P. Concussion sideline management intervention for rugby union leads to reduced concussion entitlement claims. *NeuroRehabilitation*. 2007; **22**(3):181-189.
13. Gianotti S, Quarrie K, Hume P. Evaluation of RugbySmart: A rugby union community injury prevention programme. *J Sci Med Sport* 2009; **12**(3):371-375.
14. Twellaar M, Verstappen F, 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**(4):528-534.
15. Barnes B, Cooper L, Kirkendall D, McDermott T, Jordan B, Garrett W. Concussion history in elite male and female soccer players. *Am J Sports Med*. 1998; **26**(3):433-438.

16. Dick R. Is there a gender difference in concussion incidence and outcomes? *Br J Sports Med* 2009; **43**(Suppl 1):i46-i50.
17. Covassin T, Moran R, Elbin III R. Sex differences in reported concussion injury rates and time loss from participation: An update of the National Collegiate Athletic Association injury surveillance program from 2004–2005 through 2008–2009 *J Ath Train*. 2016; **51**(3).
18. Garcés G, Medina D, Milutinovic L, Garavote P, Guerado E. Normative database of isometric cervical strength in a healthy population. *Med Sci Sport Exerc*. 2002; **34**(3):464-470.
19. Staudte H-W, Dühr N. Age- and sex-dependent force-related function of the cervical spine. *Eur Spine J*. 1994; **3**(3):155-161.
20. Jordan A, Mehlsen J, Bülow P, Ostergaard K, Danneskiold-Samsøe B. Maximal isometric strength of the cervical musculature in 100 healthy volunteers. *Spine (Phila Pa 1976)*. 1999; **24**(13):1343-1348.
21. Eckner JT, O'Connor KL, Broglio SP, Ashton-Miller JA. Comparison of head impact exposure between male and female high school ice hockey athletes. *Am J Sports Med*. 2018; doi: 10.1177/0363546518777244.
22. Young K, White P. Sport, physical danger, and injury: the experiences of elite women athletes. *J Sport Soc Iss* 1995; **19**(1):45-61.
23. Pearce AJ, Young JA, Parrington L, Aimers N. Do as I say: Contradicting beliefs and attitudes towards sports concussion in Australia. *J Sports Sci*. 2016; **35**(19):1911-1919.
24. Raftery M, Parker R, Stacey E, Peat J, Wang H. Incidence of injury in junior rugby league in the Penrith and district junior rugby league area: A report submitted to the NSW sporting injuries committee and Australian rugby league: Children's Hospital Institute of Sports Medicine, Research and Development office, The New Children's Hospital, Westmead; 1999.
25. Austin D, Gabbett T, Jenkins D. The physical demands of Super 14 rugby union. *J Sci Med Sport*. 2011; **14**(3):259-263.
26. Comstock R, Fields S. The fair sex? Foul play among female rugby players. *J Sci Sport Med* 2005; **8**(1):101-110.
27. Quarrie K, Hopkins W. Tackle injuries in professional rugby union. *Am J Sports Med*. 2008; **36**(9):1705-1716.
28. Lopez V, Galano G, Black C, et al. Profile of an American amateur rugby union sevens series. *Am J Sports Med*. 2012; **40**(1):179-184.
29. Brooks J, Kemp S. Recent trends in rugby union injuries. *Clin J Sports Med*. 2008; **27**(1):51-73.

Table 1: Years of injury reported as total number, average per-year, total costs, average costs per-year and average costs per MSC injury claim in New Zealand Dollars (\$) with 95% standard deviations for female rugby union by reporting years from 2013 to 2017.

Year	Injury claims		Injury costs		
	Total n= (%)	Average per yr. Mean \pm SD	Total costs NZD \$ (%)	Average cost per yr. (NZD\$) Mean \pm SD	Mean cost per yr. (NZD\$) Mean \pm SD
2013	406 (16.2)	23.8 \pm 24.5	\$2,095,132 (15.8)	\$123,243 \pm \$156,186	\$3,965 \pm \$2,331
2014	439 (17.6)	27.7 \pm 27.6	\$2,283,404 (17.2) ^{ab}	\$142,713 \pm \$156,075	\$5,851 \pm \$2,966
2015	508 (20.3) ^{ab}	31.5 \pm 35.9	\$2,694,115 (20.3) ^{ab}	\$168,382 \pm \$247,470	\$4,537 \pm \$2,547
2016	567 (22.7) ^b	35.4 \pm 37.5	\$2,976,915 (22.4) ^{ab}	\$186,057 \pm \$208,039	\$5,391 \pm \$2,235
2017	581 (23.2) ^b	34.4 \pm 41.5	\$3,239,876 (24.4) ^{ab}	\$202,398 \pm \$256,358	\$6,846 \pm \$5,332
Total	2,501* (100.0)^{ab}	504.0 \pm78.1	\$13,289,442* (100.0)^{ab}	\$2,657,888 \pm\$474,008	\$5,259 \pm\$162

SD = Standard Deviation; (%) = percentage; NZD = New Zealand Dollars; * = due to data rounding and confidentiality requirements, numbers do not add to the total number of total injury claims and costs reported; Significant difference ($p < 0.05$) than (a) = difference from previous year; (b) = difference from 2013

Table 2: Injured age group reported as total number, average per-year, total costs and average costs per-year in New Zealand Dollars (\$) with 95% standard deviations of MSC injury claims for female rugby union from 2013 to 2017.

Age group yr.	Injury claims		Injury costs		
	total n= (%)	Average per yr. Mean \pm SD	Total costs NZD \$ (%)	Average cost per yr. (NZD\$) Mean \pm SD	Mean cost per yr. (NZD\$) Mean \pm SD
00-04	6 (0.2)	3 -	\$3,684 (0.0)	\$737 \pm \$1,590	\$614 \pm \$820
05-09	9 (0.4)	3 -	\$12,098 (0.1) ^b	\$2,420 \pm \$3,172	\$1,344 \pm \$1,073
10-14	254 (10.2) ^{ab}	50.8 \pm 15.3	\$806,987 (6.1) ^{ab}	\$161,397 \pm \$69,710	\$3,157 \pm \$834
15-19	1,009 (40.3) ^{ab}	201.8 \pm 26.2	\$5,419,157 (40.8) ^{ab}	\$1,083,831 \pm \$154,928	\$5,387 \pm \$499
20-24	483 (19.3) ^{ab}	96.6 \pm 12.1	\$2,361,412 (17.8) ^{ab}	\$472,282 \pm \$84,742	\$4,863 \pm \$359
25-29	332 (13.3) ^{ab}	66.4 \pm 16.0	\$1,915,280 (14.4) ^{ab}	\$383,056 \pm \$135,288	\$5,659 \pm \$846
30-34	197 (7.9) ^{ab}	39.4 \pm 12.2	\$975,031 (7.3) ^{ab}	\$195,006 \pm \$81,414	\$4,835 \pm \$567
35-39	129 (5.2) ^a	25.8 \pm 6.5	\$927,108 (7.0) ^{ab}	\$185,422 \pm \$88,864	\$6,918 \pm \$2,155
40-44	49 (2.0) ^a	9.8 \pm 1.9	\$222,171 (1.7) ^{ab}	\$44,434 \pm \$15,672	\$4,445 \pm \$699
45-49	24 (1.0) ^a	4.8 \pm 2.5	\$501,211 (3.8) ^{ab}	\$100,242 \pm \$28,102	\$23,270 \pm \$8,096
50-54	12 (0.5)	2.4 \pm 1.3	\$66,465 (0.5) ^{ab}	\$13,293 \pm \$16,130	\$5,539 \pm \$5,510
55-59	9 (0.4)	1.8 \pm 1.6	\$24,113 (0.2) ^b	\$4,823 \pm \$8,927	\$2,679 \pm \$3,661
60-64	12 (0.5)	2.4 \pm 1.3	\$46,447 (0.3) ^b	\$9,289 \pm \$10,634	\$3,465 \pm \$3,981
65-69	3 (0.1)	3 -	\$1,861 (0.0) ^b	\$372 \pm \$832	\$620 \pm \$0
80-84	0 -	0 -	\$0 -	\$0 -	\$0 -
Total	2,501* (100.0)	504.0 \pm78.07	\$13,289,442* (100.0)	\$2,657,888 \pm\$474,008	\$5,259 \pm\$162

SD = Standard Deviation; (%) = percentage; NZD = New Zealand Dollars; * = due to data rounding and confidentiality requirements, numbers do not add to the total number of total injury claims and costs reported; Significant difference ($p < 0.05$) than (a) = difference from previous year; (b) = difference from 2013

Table 3: Injured body part reported as total number, average per-year, total costs and average costs per-year in New Zealand Dollars (\$) with 95% standard deviations of MSC injury claims for female rugby union from 2013 to 2017.

	Injury claims		Injury costs		
	total n= (%)	Average per yr. Mean \pm SD	Total costs NZD \$ (%)	Average cost per yr. (NZD\$) Mean \pm SD	Mean cost per yr. (NZD\$) Mean \pm SD
Head/Neck	248 (9.9)^{ab}	49.6 \pm13.9	\$846,257 (6.4)^{ab}	\$169,251 \pm\$42,602	\$3,433 \pm\$380
Head (Except Face)	146 (5.8) ^{ab}	29.2 \pm 11.3	\$509,527 (3.8) ^{ab}	\$101,905 \pm \$28,798	\$3,611 \pm \$503
Face	24 (1.0) ^a	4.8 \pm 1.5	\$66,359 (0.5) ^{ab}	\$13,272 \pm \$7,149	\$2,591 \pm \$1,144
Eye	9 (0.4)	1.8 \pm 1.6	\$18,578 (0.1) ^b	\$3,716 \pm \$3,496	\$2,064 \pm \$399
Nose	30 (1.2) ^a	6.0 \pm 2.0	\$115,857 (0.9) ^{ab}	\$23,171 \pm \$12,114	\$3,709 \pm \$1,599
Ear	6 (0.2)	1.2 \pm 1.6	\$24,592 (0.2) ^b	\$4,918 \pm \$9,471	\$4,099 \pm \$4,440
Neck/ Back of Head	33 (1.3) ^{ab}	6.6 \pm 2.6	\$111,344 (0.8) ^a	\$22,269 \pm \$7,776	\$3,905 \pm \$2,150
Upper Limb	576 (23.0)^{ab}	115.2 \pm15.5	\$2,951,597 (22.2)^{ab}	\$590,319 \pm\$85,729	\$5,136 \pm\$418
Shoulder	324 (13.0) ^a	64.8 \pm 4.0	\$1,823,749 (13.7) ^{ab}	\$364,750 \pm \$20,846	\$5,637 \pm \$318
Upper and Lower Arm	41 (1.6) ^a	8.2 \pm 4.1	\$430,328 (3.2) ^{ab}	\$86,066 \pm \$18,773	\$12,338 \pm \$5,148
Elbow	23 (0.9) ^{ad}	4.6 \pm 1.8	\$60,132 (0.5) ^{ab}	\$12,026 \pm \$6,362	\$2,576 \pm \$784
Hand/ Wrist	71 (2.8) ^a	14.2 \pm 4.0	\$287,299 (2.2) ^{ab}	\$57,460 \pm \$40,310	\$4,125 \pm \$2,616
Finger/ Thumb	117 (4.7) ^a	23.4 \pm 5.9	\$350,089 (2.6) ^{ab}	\$70,018 \pm \$26,679	\$2,912 \pm \$627
Lower Limb	1,557 (62.3)^{ab}	311.4 \pm45.2	\$8,527,695 (64.2)^{ab}	\$1,705,539 \pm\$287,767	\$5,467 \pm\$330
Hip/ Upper Leg/ Thigh	27 (1.1) ^a	5.4 \pm 2.9	\$126,696 (1.0) ^b	\$25,339 \pm \$32,650	\$3,425 \pm \$3,781
Knee	1,007 (40.3) ^a	201.4 \pm 24.2	\$6,229,714 (46.9) ^{ab}	\$1,245,943 \pm \$217,796	\$6,162 \pm \$539
Lower Leg	140 (5.6) ^a	28.0 \pm 5.0	\$1,082,068 (8.1) ^{ab}	\$216,414 \pm \$24,963	\$7,803 \pm \$600
Ankle	313 (12.5) ^{ab}	62.6 \pm 16.3	\$958,267 (7.2) ^{ab}	\$191,653 \pm \$35,055	\$3,125 \pm \$364
Foot	58 (2.3) ^a	11.6 \pm 1.9	\$117,971 (0.9) ^{ab}	\$23,594 \pm \$10,962	\$2,025 \pm \$916
Toe	12 (0.5) ^d	2.4 \pm 1.3	\$12,979 (0.1) ^b	\$2,596 \pm \$3,446	\$1,082 \pm \$1,203
Chest/Back/Other	74 (3.0)^a	14.8 \pm2.5	\$963,894 (7.3)^{ab}	\$192,779 \pm\$87,148	\$12,753 \pm\$4,592
Chest	15 (0.6)	3.0 -	\$19,820 (0.1) ^{ab}	\$3,964 \pm \$3,031	\$1,321 \pm \$1,010
Back/Spine	38 (1.5) ^a	7.6 \pm 2.9	\$189,537 (1.4) ^b	\$37,907 \pm \$33,037	\$4,443 \pm \$2,944
Abdomen/ Pelvis	12 (0.5) ^a	2.4 \pm 1.3	\$53,844 (0.4) ^b	\$10,769 \pm \$10,628	\$4,487 \pm \$3,371
Multiple Locations	6 (0.2)	1.2 \pm 1.6	\$11,579 (0.1) ^b	\$2,316 \pm \$3,224	\$1,930 \pm \$386
Unknown	3 (0.1)	0.6 \pm 1.3	\$689,114 (5.2) ^{ab}	\$137,823 \pm \$63,116	\$66,003 \pm \$0
Total	2,501* (100.0)	504.0 \pm78.1	\$13,289,442* (100.0)	\$2,657,888 \pm\$474,008	\$5,259 \pm\$162

SD = Standard Deviation; (%) = percentage; NZD = New Zealand Dollars; * = due to data rounding and confidentiality requirements, numbers do not add to the total number of total injury claims and costs reported; Significant difference ($p < 0.05$) than (a) = difference from previous year; (b) = difference from 2013

Table 4: Injury type reported as total number, average per-year, total costs and average costs per-year in New Zealand Dollars (\$) with 95% standard deviations of MSC injury claims for female rugby union from 2013 to 2017.

Injury Type	Injury claims		Injury costs		
	total n= (%)	Average per yr. Mean \pm SD	Total costs NZD \$ (%)	Average cost per yr. (NZD\$) Mean \pm SD	Mean cost per yr. (NZD\$) Mean \pm SD
Soft Tissue Injury	1,581 (63.2) ^{ab}	316.2 \pm 53.5	\$8,887,847 (66.9) ^{ab}	\$1,777,569 \pm \$307,601	\$5,621 \pm \$282
Fracture/ Dislocation	691 (27.6) ^a	138.2 \pm 15.16	\$3,175,345 (23.9) ^{ab}	\$635,069 \pm \$111,849	\$4,606 \pm \$700
Other	80 (3.2) ^{ab}	16.0 \pm 5.6	\$678,246 (5.1) ^{ab}	\$135,649 \pm \$64,323	\$8,220 \pm \$1,720
Concussion/ Brain Injury	126 (5.0) ^{ab}	25.2 \pm 10.0	\$471,686 (3.5) ^{ab}	\$94,337 \pm \$27,598	\$3,901 \pm \$726
Wounds	21 (0.8) ^a	4.2 \pm 2.2	\$57,293 (0.4) ^b	\$11,459 \pm \$9,409	\$2,656 \pm \$1,374
Unknown	9 (0.4) ^c	1.8 \pm 1.6	\$6,097 (0.0) ^b	\$2,032 \pm \$2,799	\$677 \pm \$933
Gradual Onset	9 (0.4)	1.8 \pm 1.6	\$7,652 (0.1)	\$1,530 \pm \$2,762	\$850 \pm \$1,123
Foreign Body	3 (0.1)	0.6 \pm 1.3	\$5,131 (0.0) ^b	\$5,131 \pm \$0	\$1,710 \pm \$0

SD = Standard Deviation; (%) = percentage; NZD = New Zealand Dollars; Significant difference ($p < 0.05$) than (a) = difference from previous year; (b) = difference from 2013