

# Sports injury profile of competitive Waka Ama (outrigger canoe) paddlers in New Zealand.

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## ABSTRACT

Using a self-reported retrospective cohort analysis the purpose of this research was to describe the type, frequency, severity, causative mechanisms, and exposure risk of injuries amongst competitive Waka Ama paddlers in New Zealand. An injury surveillance questionnaire of Waka Ama injuries and exposure was conducted using face to face interviews and a Web site-based interactive survey. Completed surveys were obtained from 240 individuals reporting 132 injuries amongst 101 athletes; 42% of those surveyed had sustained 1 or more injuries while participating in Waka Ama in the previous 12 months. The majority (79%, n=80) of the injured athletes sustained only 1 injury with the overall risk of injury being 1.82 per 1000 hours of exposure. Sprains/strains accounted for 62% of all injuries and the majority (35%) of recorded injuries were to the shoulder. Largely the injuries were not serious with 20% classified as slight, and there were no permanent disabilities or career ending injuries. Although a relatively safe sport, injuries to the shoulder and back, risks associated with long distance and multi-seat events, carrying the Waka Ama, and barriers to seeking medical attention warrant further investigation to reduce current injury incidence and severity in the sport of Waka Ama.

*Bell R, Carman A, Tumilty S (2013) Sport injury profile of competitive Waka Ama (outrigger canoe) paddlers in New Zealand. New Zealand Journal of Physiotherapy 41(1): 30-35.*

Key words: Outrigger Canoe, Epidemiology, Paddling, Survey, Injuries

## INTRODUCTION

In the 2011-12 season there were 2,731 registered competitive Waka Ama (Outrigger canoe) paddlers in New Zealand (WakaamaNewZealand 2012a). Although relatively small in number it is a highly competitive sport that is growing in popularity. On a global stage, the most recent 15<sup>th</sup> international world sprint Waka Ama championships were conducted in Calgary, Canada from August 11–15, 2012 in which over 20 countries were represented (Va'aWorldSprints 2012).

Sport participation as a form of exercise is encouraged for promoting physical activity and health as a preventative measure for many lifestyle related illnesses and diseases, such as cardiovascular disease and type-2 diabetes that are of increasing prevalence amongst the indigenous population of New Zealand (Feigin et al 2007, Kenealy et al 2008) and indigenous populations globally (Kritharides et al 2010). While encouraging increased physical activity in sports like Waka Ama is considered important it also entails a risk of sports related injury. The effects of injuries are multidimensional with physical, emotional, financial, occupational, psychological, and social consequences (Brooks 2012, Friery 2007, Maffulli et al 2011). Anecdotally, chronic injuries can adversely effect long term participation, and force early retirement, from the sport of Waka Ama. With both quantifiable and unquantifiable costs relating to injuries in Waka Ama it is desirable to identify and minimise injury risk within the sport.

The nature, incidences, and severity of injury in the sport of Waka Ama in New Zealand are unknown and few inferences

can be drawn from injury characteristics of other non-contact water sports such as rowing or sailing. Sports injury epidemiology research helps us identify risk of injury, risk factors, and injury mechanism, as well as guide implementation and assess efficacy of specific preventative interventions. Arguably, the most cited sports injuries prevention research framework presented in epidemiological literature of over the past two decades has been that of van Mechelen et al (1992), and further refined by Finch (2006), in the Translating Research into Injury Prevention Practice (TRIPP) model to address barriers to the wider implementation of intervention strategies. More recently van Tiggelen et al (2008) expanded these models to address attitudes, culture, traits, and behaviour in the assessment of compliance in the efficacy of preventative intervention measures. Establishing the nature, incidences, and severity of injury is clearly warranted in the sport of Waka Ama and is the first step in injury prevention strategies. This information allows injury priorities to be established and forms the basis on which to guide future research, such as identifying mechanisms of injury, interventions, and barriers to implementations aimed at reducing injury risk.

The primary aim of this research was to establish the nature, incidences, and severity of injury in competitive Waka Ama paddlers in New Zealand. Further, the purpose was to provide fundamental information to inform an injury prevention strategy that addresses injury priorities in establishing injury mechanisms and interventions to reduce injury risks.

## METHODS

This research was a retrospective injury surveillance of competitive Waka Ama paddlers in New Zealand in which participants completed a questionnaire to establish incidence, nature, and severity of sports injury over the preceding 12 month period. To facilitate comparability across studies (Caine et al 1996, Finch et al 2011,) the recommendations of Goldberg et al (2007) and Fuller et al (2006) with regard to injury surveillance methods and definitions of sports injury, severity, and exposure were adopted. The study was approved by the University of Otago Human Ethics Committee.

To be included in the study, participants were male or female aged between 18 - 60 years of age, registered athletes with NgāKaihoe O Aotearoa Council (NKOAC) (WakaamaNewZealand 2012a) and had competed in a sanctioned event of NKOAC (WakaamaNewZealand 2012a) in the preceding twelve months. An injury registration period covering the previous 12 months was selected to reduce any recall bias. Power calculations were calculated based on 2012 NKOAC (WakaamaNewZealand 2012a) data of 2731 registered competitive Waka Ama paddlers in New Zealand. The targeted sample size was estimated to be 303 (n), from a population size of 1424 (18 – 60 years of age) assuming a sampling error of ±5% and a confidence level of 95%.

The injury surveillance questionnaire comprised 3 sections: demographics, sports participation, and injury data. The questions comprised a mixture of single or multiple categorical or numerical responses as well as open ended responses (e.g. describing the events leading to injury). The injury surveillance questionnaire was administered at both competition and training via face to face interviews by the lead researcher or an online interactive version of the survey via a web-link to Survey Monkey (SurveyMonkey 2012) through the website of Waka Ama New Zealand (WakaamaNewZealand 2012b). Participation in the survey was on a voluntary basis and athletes were encouraged to participate in the study via attendance of the principal researcher at various competitive Waka Ama events sanctioned by NKOAC (WakaamaNewZealand 2012a). Correspondence via email and phone was also conducted with the six regional Waka Ama clubs around New Zealand promoting the survey.

To comply with the consensus statement on reporting injuries in sports, an injury was defined as any physical complaint sustained by a paddler that resulted from participating in Waka Ama, irrespective of the need for medical attention or time loss from that activity (Fuller et al 2006). This is considered a more sensitive and valid injury type of definition that enables reasonable comparisons used in epidemiological studies conducted in other sports ( Goldberg et al 2007). Information used to determine injury severity was based on the number of days unable to train or compete and was classified as follows: 'slight' (0–1 days), 'minor' (2–7 days), 'moderate' (7–14 days), 'moderately severe' (2 weeks – 1 month), 'severe' (> 1 month), and 'season or career ending' (Fuller et al 2006). The formula described by van Mechelen et al (1992) was used to calculate injury incidence. Exposure calculations were based on hours spent either training or competing each week during the current competitive season and extended over the preceding 12 month period. Time spent training in activities other than Waka Ama (e.g., gym, running, swimming) was not included in this study.

Information collected was coded and entered into a Microsoft Excel database. A descriptive analysis was employed to summarise and present the results of each question. Means and standard deviations are presented for continuous variables and two sided unpaired t-tests (alpha = 0.05) were utilised to test for differences between injured and non-injured groups while categorical variables were described by numbers and percentages of responses.

## RESULTS

In total, 281 athletes volunteered to participate in the survey; however, 41 athlete surveys were excluded for not meeting the inclusion criteria, incomplete surveys, or other anomalies. The resultant sample included in the final analysis comprised 240 Waka Ama paddlers (17% of the then 1424 registered competitive Waka Ama paddlers in New Zealand aged between 18 and 60 years of age) with a mean age 33.5 (SD 11.8) years, height 177.4 (SD 6.2) cm, weight 83.6 (SD 9.0) kg, and BMI 26.5 (SD 2.4) kg/m<sup>2</sup> (Table 1). There were no significant differences between the injured and non-injured groups with respect to anthropometric measures (age, height, weight, BMI) or training loads. Of the 240 respondents included in the final analysis, 101 suffered 132 distinct injury events. The injured (n = 101) and non-injured (n = 139) groups were relatively homogenous although the majority of participants in this study were male (60%, n=145), on average trained for 5.8 (SD 3.2) hours/week (Table 1) and had more than 5 year's competitive paddling experience (63%, n=151) (Table 2). Māori represented 58% of the injured population yet constituted only 51% of the total cohort (Table 3).

**Table 1: Athlete characteristics**

	Injured (n = 101)	Non- Injured (n = 139)	Total (n = 240)	P-value*
Male	62	83	145	
Female	39	56	95	
Characteristic	Mean (SD)	Mean (SD)	Mean (SD)	
Age (yrs)	35.4 (12.3)	32.1 (11.2)	33.5 (11.8)	0.03
Height (cm)	177.1 (7.8)	177.7 (4.8)	177.4 (6.2)	0.42
Weight (kg)	84.0 (10.7)	83.3 (7.6)	83.6 (9.0)	0.57
BMI (kg/m <sup>2</sup> )	26.8 (2.7)	26.4 (2.2)	26.5 (2.4)	0.23
Training (hrs/ wk)	6.2 (3.6)	5.5 (2.9)	5.8 (3.2)	0.07
Other training included	80%	75%	-	77%

\* Unpaired two tailed t-test for injured versus non-injured

Participants who participated in long distance events or paddled in multi-seat Waka (W6/OC6 [6 person Waka], W12/OC12 [12 person Waka]) events were more likely to sustain an injury than those who participated in sprint, middle distance events or single seat Waka (W1/OC1 [1 person Waka]) (Table 4). There were 132 injuries sustained by the 240 paddlers over

**Table 2: Injuries by athlete experience**

	Injured	Non-Injured	Total	Risk	Odds Ratio (95%CI)
Experience					
>5 years	65	86	151	43.0%	1.11 (0.65-1.89)
4-5 years	8	15	23	34.8%	0.71 (0.29-1.75)
3-4 years	16	25	41	39.0%	0.86 (0.43-1.71)
2-3 years	10	11	21	47.6%	1.28 (0.52-3.14)
1-2 years	1	1	2	-	-
<1 year	1	1	2	-	-

**Table 3: Injuries by participant and ethnicity**

	Injured	Non-Injured	Total	Risk	Odds Ratio (95%CI)
Male	62	83	145	42.8%	1.07 (0.63-1.81)
Female	39	56	95	41.1%	0.93 (0.55-1.58)
Ethnicity*					
Māori	59	64	123	48.0%	1.38 (0.84-2.28)
NZ European	38	65	103	36.9%	0.62 (0.37-1.03)
Other European	6	5	11	54.5%	1.57 (0.47-5.27)
Samoan	2	5	7	-	-
Tongan	1	1	2	-	-
Other	5	2	7	-	-

\*Totals are greater than 101 or 139 respectively as some identified more than one ethnicity

the 12 month retrospective period. The paddlers engaged in 1393 hours of sports participation/week equating to an injury incidence rate of 1.82 per 1000 hours of exposure (Table 5). There was no significant intra-group difference between male and female paddlers in injury incidence rate.

Injury to the shoulder was the most common injury (35%, n=46), followed by the spine (27%, n=36), and elbow (11%, n=14), while injuries to the lower limb (hip/knee/ankle/foot) were less common (6%, n=7) (Table 6). Almost half (47%, n=62) of the injurious events recorded in this study did not receive any formal treatment. The most common type of injury was ligamentous sprains/strains (62%, n=92), followed by other types (dislocation, subluxation, concussion, headache, bruise, hypothermia, non-descript) (18%, n=27) and bursitis/swelling (13%, n=19). The majority of injuries were sustained by the athletes while paddling (67%, n=88) with the next most injurious event mechanism being lifting or moving the Waka (20%, n=26). Injuries were most commonly sustained while training (58%, n=77) with a relatively small number occurring during competition (11%, n=15) (Table 6).

**Table 4: Injuries by Waka and event type**

	Injured	Non-Injured	Total	Risk	Odds Ratio (95%CI)
One person Waka	93	136	219	42.5%	0.46 (0.29-0.73)
Six person Waka	53	39	92	57.6%	1.80 (1.11-2.92)
12 person Waka	12	5	17	70.6%	2.85 (0.98- 8.28)
Other Event	3	2	5	-	-
Sprint <2 km	67	84	151	44.4%	0.81 (0.54-1.22)
Long >10 km	59	50	109	54.1%	1.44 (0.92-2.24)

Totals are greater than 101 or 139 respectively as some identified more than one Waka type or event.

In the preceding 12 months, 42% (n=101) of the participants had sustained at least one injury while training or competing in Waka Ama. Of these, 79% (n=80) sustained one injury, 14% (n=14) two injuries, and the remaining 7% (n=7) sustained three or more injuries (Table 6). The majority of injuries were not serious, with 20% classified as slight injuries (n=26), 17% minor (n=23), 29% (n=38) moderate, 24% (n=32) moderately severe, and 10% (n=13) severe. There were no season ending, career ending, or catastrophic injuries.

## DISCUSSION

The current study is the first to provide detailed information of the type, frequency, severity, and exposure risk of injuries

amongst competitive Waka Ama paddlers in New Zealand. Although the 240 final participants in this study were fewer than the targeted 303, the number of participants was still substantial and it is proposed the representativeness of the findings can be inferred with confidence. Of the 240 survey respondents, there were no significant differences between the injured and non-injured groups in sex, age (33.5 SD 11.8 years), height (177.4 SD 06.2 cm), weight (83.6 SD 9.0 kg) or BMI (26.5 SD 2.4 kg/m<sup>2</sup>). This is consistent with Haley and Nichols (2009) who surveyed 287 outrigger canoe paddlers in Oahu, Hawaii and found no significant differences in the number of injuries sustained by age or sex.

In the present study, 42% of Waka Ama paddlers who participated in the survey reported a least one injury over the previous 12 month period. This is significantly less than the 62% of outrigger canoe paddlers surveyed by Haley and Nichols (2009) who had experienced paddling-related musculoskeletal injuries over a competitive season. The overall injury rate in this study was 1.82 injuries per 1000 athlete hours of exposure and, in contrast to the findings of Abraham and Stepkovitch

**Table 5: Injury incidence**

	Male	Female	Total
Athletes	145	95	240
Injuries	81 (n=62)	51 (n=39)	132 (n=101)
Average exposure (hrs/ week)	5.90	5.65	5.80
Incidence (injuries/1000hrs)	1.82	1.83	1.82

**Table 6: Injury characteristics and treatment profile (n, %)**

Site	Nature	Severity	Onset	Injuries	Treatment	Type							
Shoulder	46 35%	Sprains/ strains	92 62% (0-1 days)	Slight 20%	26 20%	Delayed	33 25%	1 injury	80 79%	Yes	70 53%	Medical Doctor	25 36%
Elbow	14 11%	Bursitis/ swelling	19 13% (2-7 days)	Minor 17%	23 17%	Training	77 58%	2 injuries	14 14%	No	62 47%	Physio	53 76%
Wrist	7 5%	Blisters/ Abrasion/ Laceration	10 7%	Moderate (1-2 weeks)	38 29%	Competition	15 11%	3 injuries	4 4%			Sports Trainer	4 6%
Spine	36 27%	Other <sup>†</sup>	27 18% (2-4 weeks)	Mod. Severe 24%	32 24%	Unsure	7 5%	4 or more	3 3%			Other <sup>§</sup>	11 16%
Hip	1 1%			Severe (>1 month)	13 10%								
Knee	2 2%			Season <sup>‡</sup> ending	0 0%								
Ankle	4 3%												
Other*	22 16%												

Total injuries = 132, injured athletes = 101, as some athletes had more than one injury

Total treatment types = 93, athletes seeking treatment = 70, as some had more than one type

\* Other = ribs, hand/fingers, hypothermia, cramp, hamstring, non-descript

† Other = Dislocation, subluxation, concussion, headache, bruise, hypothermia, non-descript

‡Season or career ending injuries

§ Other = Osteopath, chiropractor, massage therapist, acupuncture

(2012) but consistent with Haley and Nichols (2009), there was no difference in risk of injury between male or female paddlers. This compares favourably with other popular sports in New Zealand with 3.7 injuries per 1000 hours of exposure for international rowers (Wilson et al 2010), 5.2 per 1000 hours for New Zealand elite cricketers (Frost and Chalmers, 2012), 14 per 1000 hours in non-elite netball (McManus et al 2006) and 22.4 per 1000 hours in New Zealand amateur rugby league players (King and Gabbett 2008).

The most common injury site for Waka Ama paddlers were the shoulder (35%, n=46), followed by spine (27%, n=36), then elbow and wrist (16%, n=21). These results are consistent with previous studies investigating outrigger canoe paddling and marathon canoe and kayak racing that depend on repetitive shoulder, back and arm motions. Haley and Nichols (2009) reported the most injuries to the shoulder (40%), followed by spine (35%) and then arm and hands (19%) for outrigger canoe

paddlers. Similarly, Stanton et al (2002) reported most injuries to the shoulder (28%) and the lower back (25%) for outrigger canoe paddlers attending the 1998 Australian championships. Unfortunately, incidence data (injuries per 1000 hours of exposure) from both of these studies were not reported. In marathon canoe and kayaking, Abraham and Stepkovitch (2012) also found shoulder injuries (36%) to be the most common, followed by the thoracic spine (23%), and lumbar spine (17%). Carmont et al (2004) reported high numbers of injuries to the hands and wrists (34%), followed by shoulders (19%) and back

(14%) during marathon kayak racing. Abraham and Stepkovitch (2012) suggest that the injury sites in paddling are consistent with the repetitive nature of paddling involving shoulder and spine rotation over long periods of time. Similarly, this study found paddling to be the mechanism of injury in the majority of cases (67%, n=88) but interestingly, lifting or moving the Waka was the next most prevalent (20%, n=26) injurious event.

The common injury sites in Waka Ama or outrigger canoe paddling do not appear directly comparable to rowers who most commonly injure their knees, backs and ribs (Hannafin and Hosea 2012, Rumball et al 2005, Wilson et al 2010). The lower limb collectively accounted for 6% (n=7) of all injuries in this current study, which is significantly lower than reports of up to 43% in rowing (Hannafin and Hosea 2012, Rumball et al 2005, Wilson et al 2010). This may be explained by the fact that the increased load through the lower limb, in particular the knee

with the repetitive flexion and extension that occurs in rowing is relatively absent in the sport of Waka Ama. Rumball et al (2005) suggest that the repetitive spine flexion that is characteristic of rowing but limited in outrigger canoe paddling may be the reasoning behind an increased prevalence of spinal injuries in rowing.

Competing in long distance events (>10 km) tended to increase injury risk (OR = 1.44) compared to the sprint (OR = 0.81) and middle distance (OR = 0.90) events (Table 4). It is likely that the higher incidence of injuries amongst long distance paddlers is more a result of the increase in repetitive movements, cardiovascular and muscular stress, and reduced rest and recovery periods when compared to the sprint and middle distance events. Haley and Nichols (2009) also found that paddlers who participated in the long distance events reported more musculoskeletal injuries (51%, n=143) than those paddlers who did not paddle long distance (14%, n=38). Unexpectedly training hours were not associated with injury, with 6.2 hours/week and 5.5 hours/week for the injured and non-injured groups respectively. Years of paddling experience was also not associated with injury. These results are consistent with Abraham and Stepkovich (2012) where having a faster finishing time (greater fitness and skill) in a marathon kayak race was correlated with a decreased injury presentation, although paddling experience and training mileage were not.

Importantly, in the sport of Waka Ama the majority of injuries were minor (37%, less than 1 week) or moderate (66%, less than 2 weeks) in severity, while a substantial number were classified moderately severe or worse (34%, n = 45). Although there were no recorded season or career ending injuries it is possible that an athlete with such an injury may have been missed by not being in attendance at one of the sanctioned NKOAC events. Conversely, the added value of this study's methodology to assist in such circumstance, was the availability of the survey online via the Waka Ama New Zealand website and awareness of the study being communicated through the respective club presidents as well as other athletes in the Waka Ama community. In outrigger canoe paddlers surveyed by Haley and Nichols (2009), injuries tended to be more severe where 11% lasted less than one week, 35% less than two weeks, 65% longer than 2 weeks, and 6% had developed permanent symptoms. It is noteworthy that nearly half of the reported injuries (47%, n=62) did not receive any medical intervention (Table 6). This same phenomena was also reported by Haley and Nichols (2009) where the majority of participants (55.8%) did not seek treatment. Fortunately, in the present study the majority of injuries did not limit paddling participation or activities of daily living, although it was evident from discussions with paddlers that many continue to train and compete when injured. The lack of medical treatment is of concern as a substantial number of athletes are potentially exposing themselves to the risk of chronicity and recurring problems. The reasons and barriers for not seeking medical treatment should be investigated further in Waka Ama with consideration to availability of medical advice/treatment, costs, knowledge of sports injuries or long term effects, peer pressure, pressure to compete, and sporting culture.

A major finding of this study is the increase injury risk for those participating in multi-seat Waka (W1/OC1 OR = 0.46, W6/OC6 OR = 1.80, and W12/OC12 OR = 2.85). This factor has

not been investigated previously, although Haley and Nichols (2009) found no significant difference in the numbers of injuries sustained by outrigger canoe seat position, and Abraham and Stepkovich (2012) found that type of craft (canoe or kayak) and number of seats (single or double) did not increase the chance of injury in marathon kayaking. The reasons why those participating in multi-seat Waka were more at risk of injury cannot be answered by this study but certainly warrants further investigation.

In summary, from the results of this study it can be concluded that the majority of injuries sustained in Waka Ama are typically not severe and provide compelling evidence to suggest that participation in Waka Ama is less injurious when compared to other sports. Based on this evidence it is encouraging that the potential health gains from participation are likely to outweigh the negative impact of sustaining an injury in the sport of Waka Ama.

Given time and budgetary constraints, the primary limitation of this study was its retrospective nature, when a prospective analysis is the preferred standard in sports epidemiology research. Consequently, the results obtained were potentially influenced by recall bias, although we did restrict the recall period to the previous 12 months. Other confounding factors were the subjectivity, and lack of detail of events surrounding injury. Additionally, the self-reporting nature of the survey potentially exposed itself to an over estimation of the hours of sports participation and to potential erroneous descriptions of injuries by non-medical responders when compared to an examination by a suitably qualified person at the time of the event of injury. Although the findings of this study apply to competitive paddlers in New Zealand, it is reasonable to assume that they can be generalized to the wider population of Waka Ama paddlers.

## CONCLUSION

This is the first study to retrospectively analyse injury data in competitive Waka Ama paddlers in New Zealand as part of a stepwise process towards providing a safer and more enjoyable environment for paddlers. Injuries were shown to be relatively minor and infrequent, with the current study showing an overall injury incidence of 1.82 injuries per 1000 athlete exposure hours. Sprains and strains to the shoulder were the most common in this survey population, and paddlers that participated in long distance events or multi-seat Waka were more at risk of sustaining an injury. While the majority of injuries occurred actually paddling, a significant number of athletes reported lifting or moving the Waka as the next most injurious mechanism of injury. Although the majority of injuries were classified as minor or moderate the barriers to seeking medical treatment warrant further investigation.

## KEY POINTS

- Waka Ama is relatively less injurious than other sports with an overall risk of 1.82 injuries per 1000 hours of exposure.
- The majority of injuries were sprains and strains with the shoulder most typically affected.
- The injured group was more likely to participate in long distance events and paddle in multi-seat Waka.
- Lifting and moving the Waka is also a mechanism of injury.

- The majority of injuries were not serious although a significant portion were moderate to severe and potentially received no treatment.

## ACKNOWLEDGEMENTS

We thank all athletes who participated in this study, officials at Waka Ama New Zealand and the School of Physiotherapy, University of Otago for their support in this project. The authors have no conflicts of interest that are directly relevant to the content of this research and no grants or financial support were received.

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