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Injury location, type, and mechanism

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Retrospective analysis of acute injuries in recreational and competitive surfers: injury location, type and mechanism

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Abstract

Objectives: To identify the location, type and mechanisms of acute injury in Australian recreational and competitive surfers.

Design: A cross-sectional retrospective observational study.

Methods: 1,348 participants completed an online survey consisting of two sections: demographics and acute injury.

Results: 1,348 participants (91.3% males, 43.1% competitive surfers) were included in the data analysis. A total of 1,047 acute injuries were reported with 739 classified as major. The shoulder, ankle and head/face regions had the largest distributions of acute injury representing 16.4%, 14.6% and 13.3% respectively. Competitive surfers revealed a significantly ($p<0.05$) higher number of knee injuries compared to recreational surfers (n=50 versus 29). Injuries were predominantly of muscular, joint and skin origin representing 30.3%, 27.7% and 18.9% respectively. Skin injuries were primarily a result of direct trauma, joint and muscular injuries were mainly a result of manoeuvres performed and repetitive actions. Key risk factors which significantly increased the incidence of sustaining an acute injury included increase hours surfed (> 6.5 hrs/wk), the inclusion of aerial manoeuvres and the age of the surfer (< 35 years old).

Conclusion: The results of this study compliment previous injury specific research. The shoulder region is one of the highest injury distributions and highlights the need of more detailed and specific assessment in a surf specific population. The high number of muscular and joint injuries indicates that surfing injuries are not predominantly lacerations. This additionally emphasises the stresses on the musculoskeletal system and the relevance of being well conditioned to take part in this sport.

Key words: Survey, Surfing, Injury, Incidence, Epidemiology.

Introduction

There are an estimated 18 million surfers worldwide (Nathanson, Haynes, & Galanis, 2002) and 2.5 million recreational surfers within Australia (Surfing Australia: Annual report, 2010). The recreational activity and sport of surfing has grown dramatically since the 1960's, however scientific research has been poorly mirrored in comparison to most other mainstream sports.

Currently it is difficult to draw clear conclusions from previous research specific to acute surfing injuries, due to variations in research methodologies. Early research tends to reveal high frequencies of lacerations mainly to the head and leg regions (Allen, Eiseman, Straehley, & Orloff, 1977; Barry, Kleinig, & Brophy, 1982) with more recent research reporting an increase in soft tissue sprains and strains to the lower body regions (Meir, Zhou, Gilleard, & Coutts, 2011; Nathanson, Bird, Dao, & Tam-Sing, 2007). Collection of data in emergency departments (Roger, 2002; Taylor, Bennett, Carter, Garewal, & Finch, 2004) have demonstrated trends parallel to early research conducted, however data collected outside these environments (Meir, et al., 2011) or with the inclusion of competitive surfers (Nathanson, et al., 2007) has demonstrated trends similar to recent research with higher numbers of soft tissue injuries to the lower body regions.

Injury definition involving severity, location and type of injury appeared to vary between studies (Heggie & Caine, 2012). Mechanism of injury has been scarcely reported and often not linked with injury location and type. These factors highlight the need to capture new injury related data encompassing injury severity, location, type and mechanisms dependently of each other.

With the current growth of surfing numbers and world-wide increase in musculoskeletal injuries (Vos et al., 2012) an understanding of acute surfing injuries is needed in order to aid in prevention strategies. Therefore the aim of this study was to present a retrospective

analysis of acute surfing related injury for recreational and competitive surfers within Australia.

Methods

This was a cross-sectional descriptive survey design. Research ethics approval was granted by Bond University Human Research Ethics committee (RO 1540). Due to the coastal location of surfers and the accessibility of the internet a survey was selected as the data collection method. Survey monkey was the tool used to construct and deliver the online survey. To take part in the online survey respondents had to be active surfers and have at least 12 months of experience. In an attempt to encourage completion, questions were a range of "yes/no", checklist and drop down options, text boxes were offered when categorical options could not describe the injury. The survey was active online on the 25/10/12 and remained active til the 25/03/13.

The survey consisted of two primary sections. Section one had questions which included demographic information and participation levels (age, height, weight, hours surfed, level of competition). Section two included questions related to acute injury for all the major regions of the body, and also incorporated injury type, mechanism, severity and injury management. To determine the severity, injuries were classified as either minor or major. Major injuries required one day or more of time off work and/or surfing and/or the participant required treatment from a health professional. Minor injuries did not interfere with work, surfing or involve treatment from a health professional.

Results

A total of 1,348 participants (91.3% males, 43.1% competitive surfers) responded to the survey. The mean age was 35.84 (SD±13.08; range 11-70) years, with a median of 35 years. Males were significantly older ($t=4.00$, $p<0.001$) with the mean age being 36.21 years compared to females (31.87 years). Key physiological and surfing demographics are summarized in Table 1.

Of 1,348 surfers 708 (52.5%) reported suffering one or more acute injuries in the preceding 12 months. A total of 1,047 acute injuries were reported, however 739 (70.6%) were classified as major. An injury rate of 2.44 injuries per 1,000 hours of surfing was calculated with this rate decreasing to 1.79/1000 hours when analysing major injuries (n=739) only.

The shoulder, ankle and head/face regions had the largest distributions of major acute injury representing 16.4%, 14.6% and 13.3% respectively. Competitive surfers revealed a significantly ($p<0.05$) higher number of knee injuries compared to recreational surfers (n=50 versus 29). Recreational surfers were found to have a higher distribution of head/face injuries compared to competitive surfers (16.0% versus 10.4%). Table 2 summarises the site and severity of acute injuries with comparisons between recreational and competitive surfers.

Injuries were predominantly of muscular, joint and skin origin representing 30.3%, 27.7% and 18.9% respectively (Table 3). Of the total number of mechanisms of injuries 47.1% were a result of direct trauma with either a surfer's board or contact with the ocean floor. The remaining mechanisms occurred while the surfer was paddling (10.9%), duck diving (4.6%), surfing the wave (28.4%) or tube riding (8.9%). Acute shoulder injuries commonly resulted from paddling (25.6%); meanwhile head and face injuries were predominantly a result of direct board or ocean floor contact (83.7%). Ankle injuries resulted from direct board or ocean floor contact (54.6%), actual wave riding (take off, performing manoeuvres, riding the face of the wave, tube riding) (30.6%) and aerial manoeuvres (13.9%). The major mechanisms of acute knee injuries occurred during actual wave riding (73.7%).

As expected those suffering an acute injury (major or minor) on average spent significantly ($t=5.2$, $p<0.001$) more time surfing (343.1 ± 312.0 vs. 263.1 ± 259.9 hours/year) than those who were uninjured. Independent t tests revealed a significant difference ($t=5.2$, $p<0.001$) between age and incidence of acute injury with younger surfers (34.1 ±12.3 vs. 37.8 ±13.6 years) more likely to sustain an acute injury in the previous twelve months.

There was a significant difference ($t=11.0$, $p<0.001$) between hours surfed for competitive versus recreational surfers (mean values 406.9 ± 343.7 vs. 228.7 ± 214.3 hours/year). Despite greater hours surfing in the competitive population and a higher acute injury incidence found in those spending more time surfing, competitive surfers incurred less acute injuries than recreational surfers (53.2% vs. 51.6% respectively), however this difference was not significant.

Surfers completing aerial manoeuvres reported a significantly ($\chi^2=10.3$, $p<0.01$) higher incidence of acute injury (62.4% versus 50.9%). Of the 194 participants who completed aerial manoeuvres, 44.3% suffered from an acute lower body injury which was significantly higher ($\chi^2=27.3$, $p<0.001$) than for those that did not regularly perform aerials (27.6%). Conversely there were an increased percentage of acute upper body injuries in those surfers that did not perform aerials as compared to surfers who did (32.1% vs. 29.4%). Though this difference was non-significant ($\chi^2=0.7$), it indicated that the association between aerial manoeuvres and acute injury was only applicable to the lower body.

Discussion

This study appears to be the largest national survey to date conducted on acute surf specific injuries. The purpose of this study was to explore injury severity, location, type and mechanism for recreational and competitive surfers. Results have revealed both similarities and differences to previous research.

The demographical data (Table 1) of this survey revealed that surfers on average have BMI's within the normal range (male's avg. 25.0 + 3.8 kg/m^2, females 21.9 + 2.4 kg/m^2). However, BMI does not take into consideration tissue differences (i.e., lean body mass versus adiposity). Given their high degree of participation levels (exceeds the World Health Organisation (World Health Organisation. Global recommendations on physical activity for health, aged 18-64 years, 2011) guidelines on physical activity), it is assumed the higher BMI's seen in male surfers may actually be a reflection of increased lean body mass, which we are currently investigating.

The current injury rate of 1.74 injuries per 1000 hours was similar to previous surf specific research (Meir, et al., 2011; Taylor, et al., 2004) where injury rates were based on hours of exposure. However several other surf specific and surf life-saving studies(Lowdon, Pitman, Pateman, & Kenneth, 1987; Mitchell, Brighton, & Sherker, 2013; Roger, 2002) have either not included injury rates due to lack of participation data or have calculated injury rates based on days of exposure, therefore it is difficult to draw comparisons. Surfing however appears to be relatively safe compared to mainstream sports such as Australian football where the injury rate is 25.7 injuries per 1000 playing hours (Orchard & Seward, 2002). It could be hypothesised that the lack of sudden acute injuries and high participation levels may allow for the surfer to develop chronic or over-use injuries which may not present as a sudden injury or even painful until the condition is well established (Leadbetter, 1992).

The shoulder had the highest number of acute major injuries followed by the ankle and the head and face region. High numbers of acute shoulder injuries has not previously been

reported; previous research has shown high incidence of head and lower limb injuries (Meir, et al., 2011; Nathanson, et al., 2002; Taylor, et al., 2004). The ankle and the head/ face region had the second and third highest distribution of injuries and also revealed significant differences between the number of minor and major injuries (Table 2). The results highlight the importance of having strict definitions which determine injury severity as many of the non-significant head/ face and ankle injuries resolve quickly and do not limit participation in work or surfing or require health professional treatment.

The most common types of injury were related to a muscular, joint and skin origin representing 30.3%, 27.7% and 18.9% respectively. This differed to previous research (Lowdon, et al., 1987; Nathanson, et al., 2002; Taylor, et al., 2004) especially if the data was collected out of emergency departments (Roger, 2002; Taylor, et al., 2004) where the main type of injury was of skin origin. The results of this study may be a reflection in the current surfing style and board design. Advances in board design have allowed for lighter, smaller boards with the incorporation of leashes and therefore less direct trauma caused from the board resulting in skin injuries. Changes in surfing style has allowed for the introduction of aerials and torsional movements which place increased stresses on ligamentous and contractile tissues, hence the rise in muscular and joint injuries.

This study has revealed that approximately half of the mechanisms of injuries occur while the surfer is paddling, duck diving or actual wave riding; the remaining mechanisms were due to direct trauma. Previous research (Meir, et al., 2011) has either not included specific mechanisms of injury or partially reported and or hypothesised the mechanism of injury (Bentley, Macky, & Edwards, 2006; Nathanson, et al., 2002). Research conducted by Roger (Roger, 2002) revealed that 100% of all injuries were a result of direct trauma. Several other studies have previously reported the mechanisms of injuries mainly due to direct trauma(Barry, et al., 1982; Lowdon, Pateman, & Pitman, 1983; Lowdon, et al., 1987). The rise in non-contact mechanisms could be attributed to the inclusion of a wide range of

selections for injury mechanism in this current survey and the current changes in surfing style.

This research has highlighted a number of risk factors for acute injury including increased participation levels, age of the surfer and incorporation of aerial manoeuvres. Identifying these factors may assist clinicians identifying high risk surfers. Interestingly competitive status did not increase the chance of injury despite the higher rates of participation levels. This poses the assumption that this sub-group of surfers are more conditioned for the sport.

A limitation of this survey is that the data gathered is retrospective. As this relies upon the memory of the participant there is clearly room for error (Jenkins, Earle-Richardson, Slingerland, & May, 2002). Future surfing injury surveillance studies should consider prospective data collection methods. Another limitation of the study is that surfers who were already injured were possibly more likely to participate in the survey. To limit bias towards injured surfers the advertisements clarified that all surfers were able to participate injured or not.

Conclusion

This research provides key information for further injury prevention efforts for recreational and competitive surfers. An extensive analysis of injury location, type and mechanisms has been presented. Of particular importance key areas such as the shoulder need to be objectively assessed to assist in identifying possible causes of injury. The high number of muscular and joint injuries and non-contact mechanisms of injury suggest surfers need to be well conditioned to negate these types of injuries. Our results suggest that asymmetry and imbalance identified may aid in prevention strategies for surfers.

Practical implications

- Younger surfer (<35 years), performing aerials and those surfing greater than 6.5 hours per week are at greater risk of acute injury.

- The shoulder is the most commonly injured region; imbalances in range of motion and strength should be addressed to prevent future injuries.
- Injuries are mainly of joint or muscular origin and over half of the total numbers of mechanisms of injury are non-contact. Bearing this in mind surfers should maintain high levels of flexibility and strength.

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Table 1: Physiological and surfing demographics

Physiological Demographics		Male			Female		
	Total (%)	*Mean*	*±S.D*	*n (%)*	*Mean*	*±S.D*	*n (%)*
Gender	1348 (100)	-	-	1,231 (91.3)	-	-	117 (8.7)
Age (yrs)	-	36.2	13.2	-	31.9	11.1	-
Weight (kg)	-	80.2	11.9	-	61.4	8.2	-
Height (cm)	-	179.2	8.5	-	167.3	7.6	-
BMI (kg/m²)	-	25.0	3.8	-	21.9	2.4	-
Surfing Demographics							
Hours per week	-	6.7	5.6	-	7.3	6.8	-
Weeks out of the year	-	40.7	13.5	-	38.5	15.8	-
Natural (left foot forward)	977 (72.5)	-	-	896 (91.7)	-	-	81 (8.3)
Goofy (right foot forward)	371 (27.5)	-	-	335 (90.3)	-	-	36 (9.7)
Short Board	1105 (82.0)	-	-	1032 (93.4)	-	-	73 (6.6)
Mini Mal	96 (7.1)	-	-	75 (78.1)	-	-	21 (21.9)
Long Board	147 (10.9)	-	-	124 (84.4)	-	-	23 (15.6)
1-5 years surfing	214 (15.9)	-	-	173 (80.8)	-	-	41 (19.2)
5-10 years surfing	218 (16.2)	-	-	189 (86.7)	-	-	29 (13.3)
10-15 years surfing	217 (16.1)	-	-	194 (89.4)	-	-	23 (10.6)
15-20 years	154 (11.4)	-	-	142 (92.2)	-	-	12 (7.8)
20-25 years	119 (8.8)	-	-	113 (95.0)	-	-	6 (5.0)
25-30 years	123 (9.1)	-	-	119 (96.7)	-	-	4 (3.3)
30-35 years	99 (7.3)	-	-	98 (99.0)	-	-	1 (1.0)
35 years plus	204 (15.1)	-	-	203 (99.5)	-	-	1 (0.5)
Competitive involvement*	581 (43.1)	-	-	526 (90.5)	-	-	55 (9.5)

*Applies to any surfer who currently or has previously been involved in competitive surfing

Table 2: Site and severity of acute injury and comparisons between recreational and competitive surfers

	Total			Major vs. Minor	Recreational	Competitive	Recreational vs. Competitive
Site	No.	Minor n (%)	Major n (%)	Chi Square Value *(p<0.05)	Major n (%)	Major n (%)	Chi Square Value *(p<0.05)
Head/Face	152 (14.5)	54 (17.5)	98 (13.3)	4.410 **(0.036)***	61 (16.0)	37 (10.4)	1.232 (0.267)
Neck	85 (8.1)	17 (5.5)	68 (9.2)	0.915 (0.339)	37 (9.7)	31 (8.7)	0.181 (0.671)
Shoulder	154 (14.7)	33 (10.7)	121 (16.4)	3.336 (0.068)	60 (15.7)	61 (17.1)	2.898 (0.089)
Elbow	27 (2.6)	9 (2.9)	18 (2.4)	0.123 (0.726)	7 (1.8)	11 (3.1)	2.413 (0.120)
Wrist/Hand	43 (4.1)	24 (7.8)	19 (2.6)	0.349 (0.554)	11 (2.9)	8 (2.2)	0.008 (0.930)
Upper Back	42 (4.0)	13 (4.2)	29 (3.9)	0.289 (0.591)	15 (3.9)	14 (3.9)	0.324 (0.569)
Rib/Sternum	49 (4.7)	10 (3.2)	39 (5.3)	0.300 (0.584)	27 (7.1)	12 (3.4)	2.490 (0.115)
Lower Back	94 (9.0)	24 (7.8)	70 (9.5)	1.338 (0.247)	32 (8.4)	38 (10.6)	3.766 (0.052)
Hip/Groin	82 (7.8)	20 (6.5)	62 (8.4)	0.979 (0.323)	29 (8.1)	33 (8.6)	0.358 (0.550)
Knee	101 (9.6)	22 (7.1)	79 (10.7)	1.392 (0.238)	29 (7.6)	50 (14.0)	13.949 **(0.001)***
Shin/Calf	56 (5.3)	28 (9.1)	28 (3.8)	0.607 (0.436)	14 (3.7)	14 (3.9)	0.555 (0.456)
Ankle	162 (15.5)	54 (17.5)	108 (14.6)	4.899 **(0.027)***	56 (14.7)	52 (14.6)	1.220 (0.269)
Totals	1047 (100)	308 (100)	739 (100)		382 (100)	357 (100)	

Table 3: Injury type and location for major injuries and comparisons between recreational and competitive surfers

Site (n, %)	Type of Injury	Total No. of major injuries n, (%)	Recreational n, (%)	Competitive n, (%)	Recreational vs. Competitive (Chi Square Value (p<0.05)*
Head/Face 98, (13.3)	Skin Injury[1]	76 (64.4)	46 (65.7)	30 (62.5)	0.425 (0.514)
	Bone Injury[2]	15 (12.7)	11 (15.7)	4 (8.3)	0.927 (0.336)
	Marine Injury[3]	7 (5.9)	2 (2.9)	5 (10.4)	3.637 (0.056)
	Ear Injury[4]	12 (10.2)	7 (10.0)	5 (10.4)	0.089 (0.765)
	Eye Injury[5]	5 (4.2)	2 (2.9)	3 (6.25)	1.109 (0.292)
	Concussion[6]	3 (2.5)	2 (2.9)	1 (2.1)	2.863 (0.239)
Neck 68, (9.2)	Skin Injury	1 (1.0)	1 (1.8)	-	0.850 (0.356)
	Bone Injury	7 (7.2)	4 (7.3)	3 (7.1)	0.023 (0.878)
	Joint Injury[7]	24 (24.7)	16 (29.0)	8 (19.0)	2.246 (0.134)
	Muscular Injury[8]	40 (41.2)	21 (38.2)	19 (45.2)	0.143 (0.705)
	Nerve Injury[9]	24 (24.7)	12 (21.8)	12 (28.6)	0.291 (0.590)
	Marine Injury	1 (1.0)	1 (1.8)	-	0.850 (0.356)
Shoulder 121, (16.4)	Skin Injury	4 (2.5)	3 (4.1)	1 (1.2)	1.069 (0.301)
	Joint Injury	70 (44.6)	38 (52.1)	32 (38.1)	1.467 (0.226)
	Bone	7 (4.5)	3 (4.1)	4 (4.8)	0.135 (0.714)
	Muscular Injury	62 (39.5)	27 (37.0)	35 (41.7)	1.855 (0.173)
	Nerve Injury	10 (6.4)	1 (1.4)	9 (10.7)	6.834 (0.009)*
	Marine Injury	4 (2.5)	1 (1.4)	3 (3.6)	1.000 (0.317)
Elbow 18, (2.4)	Skin Injury	3 (15.0)	1 (11.1)	2 (18.2)	0.47 (0.829)
	Joint Injury	6 (30.0)	3 (33.3)	3 (27.3)	0.468 (0.494)
	Bone	3 (15.0)	2 (22.2)	1 (9.1)	1.169 (0.280)
	Muscular Injury	7 (35.0)	3 (33.3)	4 (36.4)	0.076 (0.783)
	Nerve Injury	1 (5.0)	-	1 (9.1)	0.674 (0.412)
Wrist/Hand 19, (2.6)	Skin Injury	7 (30.4)	6 (42.9)	1 (11.1)	3.519 (0.061)
	Joint Injury	9 (39.1)	5 (35.7)	4 (44.4)	0.038 (0.845)
	Bone	3 (13.0)	1 (7.1)	2 (22.2)	0.882 (0.348)
	Muscular Injury	2 (8.7)	1 (7.1)	1 (11.1)	0.057 (0.811)
	Nerve Injury	2 (8.7)	1 (7.1)	1 (11.1)	0.057 (0.811)
Upper-back 29, (3.9)	Skin Injury	2 (6.1)	2 (11.1)	-	2.005 (0.157)
	Joint Injury	7 (21.2)	4 (22.2)	3 (20.0)	0.109 (0.742)
	Bone	4 (12.1)	2 (11.1)	2 (13.3)	0.006 (0.941)
	Muscular Injury	18 (54.5)	8 (44.4)	10 (66.7)	1.007 (0.316)
	Nerve Injury	2 (6.1)	2 (11.1)	-	2.005 (0.157)
Ribs/Sternum 39, (5.3)	Skin Injury	6 (12.2)	4 (11.1)	2 (15.4)	0.022 (0.882)
	Joint Injury	7 (14.3)	3 (8.3)	4 (30.8)	2.786 (0.095)
	Bone	23 (46.9)	19 (52.8)	4 (30.8)	4.710 (0.030)*
	Muscular Injury	10 (20.4)	7 (19.4)	3 (23.1)	0.004 (0.951)
	Nerve Injury	1 (2.0)	1 (2.8)	-	0.456 (0.499)
	Marine Injury	1 (2.0)	1 (2.8)	-	0.456 (0.499)
	Pneumothorax	1 (2.0)	1 (2.8)	-	0.456 (0.499)
Lower-back 70, (9.5)	Skin Injury	10 (10.0)	5 (11.1)	5 (9.1)	0.086 (0.769)
	Bone Injury	4 (4.0)	2 (4.4)	2 (3.6)	0.031 (0.859)
	Joint Injury	31 (31.0)	13 (28.9)	18 (32.7)	0.321 (0.572)
	Muscle Injury	32 (32.0)	15 (33.3)	17 (30.9)	0.032 (0.858)
	Nerve Injury	18 (18.0)	9 (20.0)	9 (16.4)	0.179 (0.672)
	Marine Injury	5 (5.0)	1 (2.2)	4 (7.3)	1.435 (0.231)
Hip 62, (8.4)	Skin Injury	6 (7.4)	3 (7.0)	3 (7.9)	0.28 (0.868)
	Bone Injury	4 (4.9)	2 (4.7)	2 (5.3)	0.018 (0.894)
	Joint Injury	20 (24.7)	11 (25.6)	9 (23.7)	0.037 (0.847)
	Muscular Injury	45 (55.6)	26 (60.5)	19 (50.0)	1.366 (0.243)
	Nerve Injury	5 (6.2)	1 (2.3)	4 (10.5)	2.412 (0.120)
	SIJ[10]	1 (1.2)	-	1 (2.6)	1.157 (0.282)
Knee 79, (10.7)	Skin Injury	5 (5.0)	3 (8.8)	2 (3.0)	1.246 (0.264)
	Joint Injury	52 (52.0)	17 (50.0)	35 (53.0)	1.056 (0.304)
	Bone	7 (7.0)	4 (11.8)	3 (4.5)	1.380 (0.240)
	Muscular Injury	36 (36.0)	10 (29.4)	26 (39.4)	2.271 (0.132)
Shin/Calf 28, (3.8)	Skin Injury	16 (47.1)	8 (47.1)	8 (47.1)	0.00 (1.000)
	Bone	4 (11.8)	2 (11.8)	2 (11.8)	0.00 (1.000)
	Muscular Injury	12 (35.3)	6 (35.3)	6 (35.3)	0.00 (1.000)
	Marine Injury	2 (5.9)	1 (5.9)	1 (5.9)	0.00 (1.000)
Ankle 108,	Skin Injury	44 (31.4)	25 (34.7)	19 (27.9)	0.734 (0.392)

(14.6)	Joint Injury	38 (27.1)	18 (25.0)	20 (29.4)	0.472 (0.492)
	Bone	32 (22.9)	16 (22.2)	16 (23.5)	0.062 (0.803)
	Muscular Injury	24 (17.1)	12 (16.7)	12 (17.6)	0.042 (0.837)
	Marine Injury	2 (1.4)	1 (1.4)	1 (1.5)	0.003 (0.958)

[1] Skin injuries includes lacerations, abrasions, bruising and haematomas. [2] Bone injuries includes fractures and other bony pathologies (avulsions, bone bruising). [3] Marine injuries include stings and bites (the type of sea creature is not defined). [4] Ear injury includes ear drum perforations and any other acute ear pathologies. [5] Eye injury includes, eye ball and eye socket pathologies. [6] Concussion includes loss of consciousness and other brain injuries. [7] Joint injury includes ligamentous sprain, cartilage damage, discal injury, dislocation, subluxation, bursitis. [8] Muscular injury includes, strain, tear and rupture. [9] Nerve injury includes neural compression, stretch or other nervous injury. [10] SIJ includes sacro-iliac joint injuries or dysfunction.