Sports **2013**, *1*, 69-77; doi:10.3390/sports1030069

OPEN ACCESS

sports

ISSN 2075-4663

www.mdpi.com/journal/sports

Article

A Comparison between Australian Football League (AFL) Injuries in Australian Indigenous *versus* Non-indigenous Players

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Received: 31 August 2013; in revised form: 10 September 2013 / Accepted: 11 September 2013 / Published: 16 September 2013

Abstract: It has previously been shown that being of aboriginal descent is a risk factor for hamstring injuries in Australian football. The aim of this study was to review the Australian Football League (AFL) injury database to determine whether there were any injuries where indigenous players had different relative risks to non-indigenous players. Analysis was conducted using data from the AFL injury database, which included data from 4,492 players over 21 years (1992–2012), covering 162,683 player-matches at AFL level, 91,098 matches at lower levels and 328,181 weeks (possible matches) of exposure. Compared to non-indigenous players, indigenous players had a significantly higher risk of hamstring injuries (RR 1.52, 95% CI 1.32–1.73) and calf strains (RR 1.30, 95% CI 1.00–1.69). Conversely, indigenous players had a significantly lower risk of lumbar/thoracic spine injuries (RR 0.61, 95% CI 0.41–0.91), groin strains/osteitis pubis (RR 0.75, 95% CI 0.58–0.96) and Achilles tendon injuries (RR 0.32, 95% CI 0.12–0.86). The results for the above injuries were also significant in terms of games missed. There was no difference between overall risk of injury (RR 1.03, 95% CI 0.96–1.10) or missed games (RR 1.00, 95% CI 0.97–1.04). This suggests that indigenous AFL players have the same overall number of injuries and missed games, but a slightly different injury profile.

Keywords: sports injuries; indigenous; aboriginal; Australian football; AFL

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1. Introduction

There is a sizeable health gap that exists in Australia between indigenous (aboriginal) and non-indigenous people. Sadly, this gap also applies to injuries, with aboriginal people recording higher rates of transport injuries [1], higher rates of hospitalisation for burn injuries [2] and higher rates of intentional and unintentional injuries [3]. In addition, aboriginal people often have worse outcomes from their injuries [4]. The explanation for this gap is likely to be multi-factorial. Geography is likely to play a role as aboriginal people generally live in more remote areas [1], roads are worse and access to medical services is more limited. Socio-economic status is also likely to play a role, as it does in so many health outcomes.

In relation to sporting injuries, there is very little published research analysing indigenous injury rates. It has previously been shown that being of aboriginal descent is a risk factor for hamstring injury, independent of previous posterior thigh injury [5,6]. Being of aboriginal descent has also been shown to be a risk factor for calf and quadriceps muscle injuries [6]. The evidence is mixed in relation to hip and groin injuries. One study has shown that senior elite Aboriginal Australian rules football players suffered fewer hip and groin injuries compared to non-indigenous players [6]. However, another study examined elite junior Australian rules football players and found they had a smaller range of passive hip internal rotation (and several other reduced hip and groin measures), suggesting that indigenous players may be predisposed to hip and groin injuries [7]. There was a major confounder in this paper in that the non-indigenous players (from South Australia) were in pre-season training at the time, while the indigenous players (from the Northern Territory) were mid-season because in the Northern Territory they play in summer, rather than winter. The aim of this study was to look at current trends in injuries suffered by indigenous players in the Australian Football League (AFL).

2. Methods

2.1. Data

Data were obtained from the annual AFL injury survey. The methods of the annual AFL injury survey are now well established and have been previously described in detail [8–10]. All teams now keep electronic records of injuries. Although teams use different systems, at the end of the season, injury data from each team are exported into a common system.

The standard AFL player contracts now include consent for players' injury records to be provided to researchers for the purposes of standard injury surveillance, on the condition that confidentiality is maintained over individual player injury records. The methods of the AFL injury survey have been approved by the AFL Research Board, which is the appropriate institutional review board for this type of study. The methods are observational only (non-interventional) and therefore this type of study (data analysis) is considered to be of negligible risk to participants by the Australian National Health and Medical Research Council [11].

2.2. Injury Definition and Coding

The definition of an injury is an "injury or medical condition which causes a player to miss a match" [8]. It includes any injury or medical condition, sustained at training or during a match, provided it causes a player to miss a match. This definition was chosen to promote consistency between different clubs and seasons, and has the advantage of being more accurate and reliable, despite having some obvious limitations [12,13]. Each club is required to complete weekly player movement reports which list the status of each player as either: (1) playing AFL (national league level) football; (2) playing football at a lower level (state/minor league level); (3) not playing football because of injury (either short or long term); or (4) not playing football for another reason (e.g., suspended or not selected at the AFL level and not participating in a lower level match that week). An injury is defined by this status, with the details then requested electronically by the injury surveillance coordinator at the end of the season for checking and analysis. These details include diagnosis, which is subsequently coded (using OSICS codes, version 9) [14,15].

For this study, data were used from 4,492 players over a 21 year period, covering a combined total of 162,683 player matches at AFL level, 91,098 matches at lower levels (e.g., state league) and a total of 328,181 weeks (possible matches) of exposure (1992–2012 seasons, inclusive). Indigenous status was self-identified and obtained from multiple sources [16–18].

Comparisons were made between indigenous and non-indigenous players across 33 different body categories, as well as overall. Relative risks and 95% confidence intervals were calculated in relation to both the risk of injury and the number of games missed.

Table 1. Indigenous players by season.

Season	Number of indigenous players	Number of non-indigenous players	% indigenous players
1992	21	664	3%
1993	21	653	3%
1994	31	607	5%
1995	38	641	6%
1996	41	635	6%
1997	40	644	6%
1998	41	629	6%
1999	45	671	6%
2000	47	683	6%
2001	50	645	7%
2002	46	641	7%
2003	43	633	6%
2004	46	639	7%
2005	53	639	8%
2006	58	644	8%
2007	69	639	10%
2008	69	644	10%
2009	83	655	11%
2010	79	663	11%
2011	69	728	9%
2012	63	778	7%
Total player seasons	**1053**	**13,775**	**7%**

3. Results

During the study period, 182 indigenous players were identified, which is about 4%. There was a bias towards a greater number of indigenous players in the latter years of this data collection period, as shown in Table 1. The average age (± SD) was 23.6 ± 3.6 years for indigenous players, compared to 23.6 ± 3.8 years for non-indigenous players. There were not enough data to compare height and weight. Indigenous players were listed for 7% of the "player seasons" over this time period which indicates that the average indigenous player had a slightly longer AFL career than the average non-indigenous player. During the study period, indigenous players played 13,156 matches at AFL level and 5,135 matches at lower levels (e.g., state league), compared to 149,527 matches at AFL level and 85,963 matches at lower level for non-indigenous players. This suggests that indigenous players were over-represented at AFL level (*i.e.*, they were generally playing at a higher level).

Comparisons of the relative risks for indigenous and non-indigenous cohorts, including 95% confidence intervals, are presented below with respect to risk of injury (Table 2) and number of games missed (Table 3).

Table 2. Indigenous (I) *vs.* non-indigenous (NI) relative risk of injury.

Body category		Relative Risk (I compared to NI)	95% Confidence Interval	Total number of injuries (n)
Head/neck				
	Concussion	0.67	0.37–1.20	242
	Facial fractures	1.06	0.64–1.77	209
	Neck sprains	0.57	0.14–2.35	47
	Other head and neck injuries	0.70	0.22–2.24	58
Shoulder/arm/elbow				
	Shoulder sprains and dislocations	0.69	0.44–1.06	414
	A/C joint injuries	0.73	0.45–1.20	314
	Fractured clavicles	1.60	0.86–3.00	99
	Elbow sprains or joint injuries	0.45	0.11–1.84	59
	Other shoulder/arm/elbow injuries	1.22	0.71–2.11	161
Forearm/wrist/hand				
	Forearm/wrist/hand fractures	* 1.43	1.05–1.95	448
	Other hand/forearm/wrist injuries	0.73	0.36–1.48	149
Trunk/back				
	Rib and chest wall injuries	1.16	0.75–1.80	265
	Lumbar and thoracic spine injuries	** 0.61*	0.41–0.91	550
	Other buttock/back/trunk injuries	0.65	0.36–1.16	249
Hip/groin/thigh				
	Groin strains and osteitis pubis	** 0.75*	0.58–0.96	1199
	Hamstring strains	** 1.52*	1.32–1.73	2253
	Quadriceps strains	1.21	0.93–1.57	709
	Thigh and hip haematomas	0.71	0.45–1.13	360
	Other hip/groin/thigh injuries	0.70	0.36–1.38	173

Table 2. *Cont.*

Body category		Relative Risk (I compared to NI)	95% Confidence Interval	Total number of injuries (n)
Knee~				
	Knee ACL	1.05	0.68–1.62	291
	Knee MCL	0.87	0.57–1.31	379
	Knee PCL	0.88	0.48–1.61	172
	Knee cartilage	0.96	0.68–1.35	517
	Patella injuries	0.84	0.37–1.91	98
	Knee and patella tendon injuries	1.16	0.70–1.93	193
	Other knee injuries	0.67	0.40–1.13	302
Shin/ankle/foot				
	Ankle sprains or joint injuries	1.05	0.83–1.35	922
	Calf strains	* *1.30*	1.00–1.69	653
	Achilles tendon injuries	* *0.32*	0.12–0.86	165
	Leg and foot fractures	1.19	0.76–1.86	247
	Leg and foot stress fractures	0.66	0.41–1.08	345
	Other leg/foot/ankle injuries	0.86	0.62–1.21	570
Medical illness				
	Medical illnesses	1.25	0.97–1.62	708
	All injuries	**1.03**	**0.96–1.10**	**13,520**

* indicates significance at $p \leq 0.05$; Italics indicates significance at $p \leq 0.05$ for both number of injuries and missed games; ~ACL, anterior cruciate ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament.

Table 3. Indigenous *vs*. non-indigenous relative risk of games missed through injury.

Body category		Relative Risk (I compared to NI)	95% Confidence Interval
Head/neck			
	Concussion	*0.52	0.31–0.89
	Facial fractures	0.97	0.71–1.33
	Neck sprains	*0.30	0.11–0.82
	Other head and neck injuries	0.64	0.33–1.25
Shoulder/arm/elbow			
	Shoulder sprains and dislocations	*0.83	0.70–0.98
	A/C joint injuries	0.91	0.68–1.23
	Fractured clavicles	*1.42	1.06–1.90
	Elbow sprains or joint injuries	*0.11	0.03–0.45
	Other shoulder/arm/elbow injuries	1.32	0.99–1.77
Forearm/wrist/hand			
	Forearm/wrist/hand fractures	*1.48	1.26–1.75
	Other hand/forearm/wrist injuries	0.82	0.56–1.19
Trunk/back			
	Rib and chest wall injuries	0.94	0.67–1.32

Table 3. *Cont.*

Body category		Relative Risk (I compared to NI)	95% Confidence Interval
	Lumbar and thoracic spine injuries	* *0.49*	0.39–0.62
	Other buttock/back/trunk injuries	* 0.47	0.31–0.72
Hip/groin/thigh			
	Groin strains and osteitis pubis	* *0.65*	0.57–0.75
	Hamstring strains	* *1.47*	1.36–1.58
	Quadriceps strains	* 1.34	1.17–1.55
	Thigh and hip haematomas	* 0.61	0.41–0.92
	Other hip/groin/thigh injuries	0.93	0.72–1.20
Knee~			
	Knee ACL	* 1.19	1.07–1.32
	Knee MCL	* 0.76	0.60–0.97
	Knee PCL	0.79	0.62–1.02
	Knee cartilage	* 1.20	1.05–1.37
	Patella injuries	* 0.61	0.41–0.91
	Knee and patella tendon injuries	0.98	0.74–1.30
	Other knee injuries	* 0.53	0.37–0.75
Shin/ankle/foot			
	Ankle sprains or joint injuries	1.09	0.94–1.25
	Calf strains	* *1.26*	1.06–1.50
	Achilles tendon injuries	* *0.37*	0.24–0.57
	Leg and foot fractures	1.04	0.87–1.23
	Leg and foot stress fractures	* 0.75	0.63–0.89
	Other leg/foot/ankle injuries	0.92	0.76–1.11
Medical illness			
	Medical illnesses	0.87	0.69–1.09
	All injuries	**1.00**	**0.97–1.04**

* indicates significance at $p \leq 0.05$; Italics indicates significance at $p \leq 0.05$ for both number of injuries and missed games; ~ACL, anterior cruciate ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament.

As can be seen from the tables, comparing indigenous AFL players to non-indigenous players, of the 33 categories examined, indigenous players had significantly greater risks of hamstring injuries (RR 1.52, 95% CI 1.32–1.73) and calf strains (RR 1.30, 95% CI 1.00–1.69). Conversely, indigenous players had significantly lower risks of lumbar and thoracic spine injuries (RR 0.61, 95% CI 0.41–0.91), groin strains/osteitis pubis (RR 0.75, 95% CI 0.58–0.96) and Achilles tendon injuries (RR 0.32, 95% CI 0.12–0.86). The results for the injuries listed above were also significant in terms of games missed. There was no difference between overall injury risk (RR 1.03, 95% CI 0.96–1.10) or risk of games missed through injury (RR 1.00, 95% CI 0.97–1.04).

The average injury severity (*i.e.*, the average number of matches missed per new injury) was very similar for indigenous (average of 3.69 games missed per injury) and non-indigenous (average of 3.78 missed games per injury) players. For hamstring injuries specifically, the injury severity was also

very similar (3.28 games missed per hamstring injury for indigenous players *versus* 3.39 for non-indigenous players).

4. Discussion

Indigenous AFL players have significantly a higher risk of hamstring and calf strains, and a significantly lower risk of lumbar and thoracic spine injuries, groin strains and osteitis pubis and Achilles tendon injuries. Whilst player speed and running distance during games were not measured as part of the study, the injury patterns are suggestive of a sprint-athlete injury bias for indigenous players. Indigenous players may have a higher proportion of fast twitch muscle fibres, which is a commonly-accepted belief in the Australian sporting world although to our knowledge has not been specifically tested (e.g., by comparative muscle biopsies). Running faster makes you more susceptible to muscle strains, although it may protect against some overuse injuries as fatigue may limit overall workload. This is supported by previous research which has shown that sprinters get more hamstring injuries [19], whereas backache and hip problems were more common in middle-distance running [20].

In addition, the results that show no overall difference in injuries are interesting. Perhaps it could be inferred that when indigenous people are active, and have equal access to medical care, there is no injury gap. This also refutes any possible theory that indigenous people have bodies that are more frail or prone to injury. Unsurprisingly, it suggests that socio-economic status and access to medical services are more relevant in terms of addressing the injury gap more broadly.

In terms of primary prevention of indigenous injury in Australian football, implementing evidence-based programs shown to prevent hamstring and calf injuries (such as strengthening exercises, e.g., the Nordic hamstring exercise [21]) is recommended.

More broadly, looking at secondary prevention (*i.e.*, reducing severity/morbidity), we consider that increasing access to medical services, in particular sports medicine services, is important. This is not just an issue for regional and remote areas. Specific sports medicine services for indigenous athletes are almost non-existent outside the elite football codes.

4.1. Limitations

We note that our study only compared indigenous and non-indigenous players. No other racial categories were used. However, there are no other major racial groups in the AFL, so this is unlikely to have been problematic.

Although there were more indigenous players in the cohort in the latter years of this study, the injury profile of the competition as a whole has not changed greatly over the 20 years so it is unlikely that the data analysis would be affected by the recent increase in indigenous player numbers in the competition. Interestingly, looking at the distribution of indigenous players in Table 1, it can be seen that indigenous players make up only 4% of the cohort, but 7% of the player seasons, meaning indigenous players tend to have longer playing careers. It is a minor potential confounder that indigenous players were, on average, more likely to be playing at AFL level than lower level although previous analysis has not found major variances in injury risk between the various match levels of play [6].

In addition, no multivariate analysis was conducted. This was primarily because player movement data were not available. If those data could be collected, this would be interesting to consider in future research, as comparisons of speed and distance could be made which would test our assumption/ hypothesis that the differing injury patterns may be due to different running patterns.

5. Conclusion

Indigenous AFL players have almost the same overall risk of injury and games missed through injury, but have a slightly different injury profile to non-indigenous players. They have significantly a higher risk of hamstring and calf strains, and a significantly lower risk of lumbar and thoracic spine injuries, groin strains and osteitis pubis and Achilles tendon injuries. The differing injury profile could be due to aboriginal players being 'speed' athletes, rather than endurance athletes. Primary prevention strategies could implement evidence based exercises to prevent muscle strains. Secondary prevention could focus on increasing access to sports medicine services.

Acknowledgements

The authors wish to acknowledge the medical staff of all AFL teams that have provided data to the injury survey over the 21-year period, AFL administration and also AFL sports scientists, coaches, and media who have contributed.

Conflicts of Interest

JWO is the paid co-ordinator of the AFL injury survey; HS is the CEO of the AFL Medical Officers Association.

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