Original research paper

Incidence and risk factors for injury in non-elite Australian football

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Key words: Australia football, injury, risk factors, incidence, non-elite

Word Count: 2616

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Date of submission: 4 March 2003

Background

Australian Rules Football was devised in 1868 as a means of keeping cricketers fit during their off-season(1). The game has flourished to the extent that there are now 16 teams competing in the national league, over 400 000 registered players in non-elite level competition, and approximately 100 000 children involved in school-based junior coaching clinics throughout Australia(1).

There have been numerous changes to the game of Australian football since its inception, with the most dramatic change at both the elite and non-elite levels being the speed of the game(2,3). Several studies have implicated the increased player speed and therefore, the increased momentum of collisions (at speed) as a major contributor to the elevated severity of injury now evident at all levels of participation(4,5). Other factors that are purported to have increased the risk of injury in Australian football are: environmental factors (such as ground hardness and weather)(3,6); the equipment used(7-9); player conditioning and training(10,11); increases in the number of times substitutions can be made in a game; and a greater emphasis on speed development at training(10)

It is estimated that 20% of all sports injuries requiring treatment each year in Australia are from Australian football, and the majority of these injuries are from community-level participants(12). To date, the majority of the research has focused on the elite level of competition(13). Based on the large player base in non-elite competition in comparison to elite levels, the significant number of injuries sustained in non-elite Australian football, and the inability to generalise results from elite studies to other levels of competition, it is imperative that research should also focus on prevention of injury at non-elite levels of competition(13-15).

A few studies have provided injury data from presentations at hospital emergency departments or at a limited number of sports medicine clinics by non-elite players(12,16). However these data do not include presentations to other health professionals or to independent sports medicine practitioners. Therefore, it is difficult to determine the true extent of sports injury associated with community level participation(17,18). There have been two community-based Australian football studies of note to date. One by Shawdon and Brukner(19) included data from games only and did not provide any details of the cause of injury. The second by Gabbe(20) provided detailed injury data from one amateur league in

Victoria however generalisation of the findings to all levels of non-elite competition is limited as only players from the highest levels of competition in one football league were included. This study is the first to provide population-based estimates of the magnitude of sports injury, along with the risk and protective factors associated with community level Australian football.

Methods

A random sample of sporting clubs representing Australian football, field hockey, netball and basketball, from the Perth metropolitan area were selected for inclusion in the Western Australian Sports Injury Cohort Study (WASIS)(15,21). Players from these clubs who had not sustained a sporting injury in the previous three months were invited to participate in the study. Participants agreed to complete a baseline questionnaire and were then followed monthly, via telephone interviews, throughout the 1997 and 1998 winter playing seasons.

This study investigated the aetiology of injury in Australian football at the community level of participation. Players who had completed a baseline questionnaire and at least one monthly telephone interview over the study period were included in the sample. The total exposure to training and games were also included in the analyses.

The baseline questionnaire included items about the participants' previous sports injury history, along with questions on their pre-season training, and warm-up and cool-down patterns. Specific items about the equipment used by participants, such as footwear and protective devices, were included as were general health, lifestyle and physical activity questions. To cover the domain of sports psychology, two validated instruments were incorporated into the questionnaire (the Five-Factor Personality Inventory Test(22) and the Athletic Life Experience Survey(23)). During the monthly interviews, participants were asked to report how many training sessions and/ or games they had played during the preceding four weeks and if injured, the nature of the injury, its severity and the treatment obtained. The response rate at baseline 92% and non-respondents not significantly different from respondents. Further detail on the methods are published elsewhere(15).

For the purposes of the study, a sports injury was defined according to the Council of Europe definition, as an injury that occurs whilst participating in sport and leads to one of the following consequences: a reduction in the amount or level of sports activity; need for advice or treatment and/or; has adverse economic or social effects(15). For the purposes of this study, recurrent injuries were counted as one injury if the original injury was not deemed to have resolved.

Frequencies of count variables and crude odds ratios were calculated using SPSS software(24). To take into account the numerous participants who were not injured, zero-inflated poisson regression was used to model the risk and protective factors for injury(25). All baseline variables were initially included in the model. A separate variable was then created for each level of the variables included in the model. For example, seven variables were created for the years of experience variable (1-11 months, 1yr>2yrs, 2yrs>3yrs, 3yrs>4yrs, 4yrs>5yrs, 5yrs>6yrs, 6yrs or >). A backward stepwise approach was adopted to identify the significant risk and protective factors for injury using the standard probability value of <0.05. Dummy variables were calculated for each level of each variable included in the model. After each computation, the variable with the highest p value was located, reviewed and deleted prior to any further computation.

The incidence rates were calculated using the total number of injuries sustained by cohort members as the numerator and the number of hours cohort members spent at training and games during the 1997 and 1998 winter playing seasons as the denominator. Incidence rates were calculated for each month and over the total study period. The standard errors of the rates were then used to calculate the 95% confidence intervals of the incidence rates for each month of the study period.

Results

Description of cohort

A total of 535 participants were recruited into the study. All participants were male with a mean age of 23 years (range 16-50 years). Most of the participants had completed secondary schooling (77%, n=412) and almost half had attained an additional qualification (42%, n=223). The majority of the participants were either in full-time employment (75%, n=401) or were students (15%, n=82).

Health behaviours

In relation to general health issues reported at baseline, 12% of participants (n=65) reported they had asthma and 27% (n=142) had a long term or recurrent back problem. Almost one third of the participants (28%, n=153) reported being diagnosed with a lower limb pathology including 22% (n=117) with a foot or ankle abnormality. Of those who reported they had long-term or recurrent back problems over the past five years, 68% (n=44/65) had been diagnosed with a back pathology by a health professional. Two thirds of the participants (74%, n=395) reported they were more physically active than others of the same age. Eighty four percent (n=449) had engaged in vigorous exercise other than football in the past month and almost 40% (39%, n=207) had exercised up to four additional hours in the past month.

Participation in sport

Seventy four percent (n=397) of the participants had at least six years football experience and 93% (n=495) training during the pre-season for their sport. Sixty four percent (n=341) trained for at least four hours per week and 25% (n=133) trained between two and four hours each week. More than three quarters of participants reported always warming up before training (78%, n=418) and before playing a game (85%, n=452). In contrast, only 40% (n=213) cooled down after training and 17% (n=92) after playing a game.

Incidence of sports injury

The majority of participants trained and/or played football between 11-15 hours (38%, n=201) or 16-20 hours (26%, n=139) each month. Sixty one percent of the participants (n=325) sustained at least one injury during the 1997 winter playing season and 41% (n=218) in 1998. This equates to 75% of the total sample (n=400) sustaining at least one injury during the two-year study period. Overall, 27% (n=146) of the participants sustained one, 18% (n=97) two, 11% (n=59) three and the remaining 18% (n=98) sustained four or more injuries during the two-year study period. The total number of injuries sustained in 1997 was 623, with 408 injuries in 1998.

Half of the players who sustained an injury (52%, n=206), received treatment from a health professional. Injury to the lower limb was the most common injury (64%, n=603). These included

injury to the knee (14%, n=133), ankle (13%, n=118), hamstring muscles (11%, n=101) and the quadriceps muscles (10%, n=91). Other common injuries were to the hand or wrist (8%, n=78) and to the back (5%, n=47). The most common mechanism of injury were muscular strains (33%, n=303), bruising (21%, n=193) and ligamentous sprains (19%, n=169) however the severity of the majority of these injuries was either moderate or mild.

The incidence rate over the observational period was 24/1000 player hours (see Figure 1). The incidence rate peaked in the first month of the 1997 season (39/1000 player hours) and levelled off, oscillating between 19 and 27 injuries per 1000 player hours for the remainder of the study period (see Figure 1).

Insert Figure 1

Risk and protective factors for injury

The key risk and protective factors for injury identified from the multifactorial model are presented in Table 1. Participants who reported being diagnosed with a long term or recurrent back problems in the past five years had a 29% increased risk of sustaining a subsequent injury compared to those who did not report an existing back pathology. Not wearing sports specific footwear increased the risk of injury by 40% when compared with those that wore sports-specific footwear. Participants who reported being diagnosed with excessive foot pronation had a 29% greater risk of sustained an injury that those who did not report excessive pronation. Being injury free in the previous 12 months reduced the risk of subsequent injury by 27% and cooling down after training reduced the risk of injury by 5%. Extroversion was significantly associated with an increased risk of injury but only marginally so (increased risk by 3%).

Insert Table 1

Discussion

The incidence of injury of 24/1000 player hours found in the study compares well with the injury rate of 27/1000 player hours in a similar study of amateur Victorian football players conducted by

Gabbe(20). The incidence of injury in Australian football is comparable with the other football codes but higher than team sports such as field hockey(15.2/1000 player hours) and netball (11.3/1000 player hours)(21). Despite the elevated incidence compared to injury among other non-elite level sports, it is considerably lower (68/1000 player hours(47)) compared to elite-level Australian football.

The highest incidence of injury occurred at the beginning of each season. The reason for the early season propensity to injury is unclear however contributing factors may include increased exposure to the physicality of games and inadequate player conditioning to meet the position-specific demands of games.

This study found that long term or recurrent back problems were a significant risk factor for injury among Australian football players, with a 29% increased risk of sustaining an injury if participants already had a back problem. This finding is similar to that of other team sports where players are required to decelerate rapidly whilst performing high velocity rotational(26,27). Rapid deceleration combined with contested vertical jumps is common in Australian football and the potential for injury is often highest when players land after these contests. There is some evidence to suggest that including back strengthening and flexibility exercises in conditioning programs reduces the incidence of injury to the back and assists in the management of long term or recurrent back problems(28-30). However, further research is required to understand the mechanisms of back injury in Australian football, and whether back strengthening and flexibility exercises assist in the reduction of injury associated with existing back pathologies.

Being injury free in the 12 months preceding the observational period was protective against injury for players. In fact, players who had not sustained an injury in the previous 12 months had a 27% reduced risk of injury when compared with players who had sustained an injury in the previous 12 months. There is strong evidence to support this finding with previous injury being second only to the level of exposure to the sport in published risk factor studies(31-33). The factors leading to subsequent injury are numerous. For example, participants may not comply with aspects of their rehabilitation program and/or return to play too early(5,17,34). Future research is required to investigate the reasons why there

is a high rate of subsequent injury to players who have sustained a previous injury in Australian football.

Players who did not wear sports-specific footwear had a 40% increased risk of injury when compared with players who wore sports-specific footwear. Much has been written about the importance of finding the right balance between the cleat size of boots and surface interaction. For example, a prospective study of American footballers found that the type of cleats used had a significant impact upon the risk of injury(35). Several studies in Australian football have also implicated footwear in the increased risk of injury, particularly when associated with a hard playing surface, particularly as all Australian football games are played on natural turf(36,37). The varying climatic conditions in Australia also impact upon the integrity of the natural playing surface(38). Other factors such as clinical biomechanics, also impact upon shoe-surface interaction. Extensive biomechanical research is needed to understand further the extent to which footwear and or the cleat size of the shoe contributed to particular injuries. The study also found that players who reported they had been diagnosed with excessively pronated feet had a 29% increased risk of injury compared to those who did not report excess pronation. There is clearly a need for further research to examine the relationship between footwear design, the biomechanics of the foot, the playing environment and the risk of injury in Australian football

The findings from the research indicate that most players reported warming up before training and the game. However, cooling down after training and the game was less frequent. Cooling down after exercise was found to be a significant protective factor against injury in the study. There is some controversy as to whether warm-up and cool-down are beneficial to the sportsperson, particularly as the quality of each may vary significantly(39,40). For example, research indicates that a warm-up performed in conjunction with prolonged and sustained eccentric exercise that incorporates a large aerobic component, does not reduce the effects of delayed onset muscle soreness(41). However cool-down is thought to be effective in reducing muscle soreness and stiffness after moderate exercise where a significant proportion of the exercise is anaerobic in nature(41-43). It has also been suggested that warming up assists with psychological preparation prior to competing and cooling down promotes

flexibility and assisting venous return(41-46). Clearly, there is a need for further research into the effectiveness of current warm-up and cool-down techniques.

A limitation of the study was the collection of data via self-report. Several measures were initiated to minimise bias associated with this mode of data collection. Firstly, recall bias was minimised by using trained researchers to collect the baseline data at each team's home clubrooms. Secondly, injury and exposure diaries were provided to each participant to assist recall of injury and exposure experiences during the monthly telephone interviews. One of the major strengths of the research was the collection of exposure data from both training and games. This allowed an estimate of the incidence of injury to be calculated.

Conclusions

There is a high risk of sustaining an injury whilst playing community level Australian football. Although this paper has identified potential risk and protective factors for injury in Australian football it does not identify why these factors increase or decrease the risk of injury. The next step is to investigate each of these factors to gain an understanding of the mechanisms behind them. Once we understand this we can target injury prevention measures and thereby significantly reduce the risk of injury for all participants in this sport.

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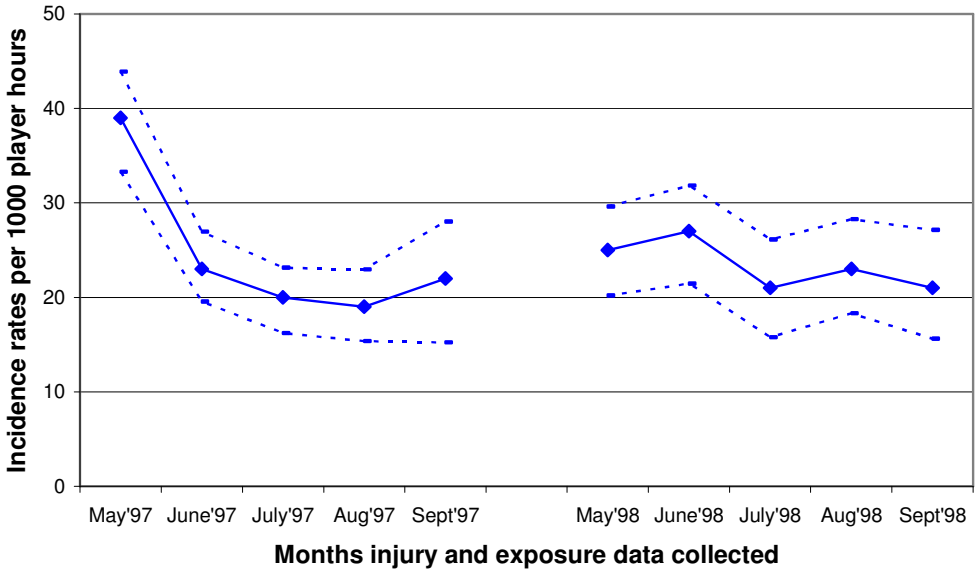
Figure 1 Incidence of injury in community level Australian football



Key: *The dotted lines represent the 95% confidence limit around the incidence rates*
The gap between Sept '97 and May' 98 represents the off-season

Table 1. Risk and protective factors in Australian football

Factor	p > |z| value	Incidence rate ratio (95%Confidence interval)
Not injured playing sport in the last 12 mths	0.001	0.73 (0.61 to 0.88)
Long term or recurrent back problems	0.001	1.29 (1.10 to 1.51)
Pronated feet	0.007	1.29 (1.07 to 1.56)
Extraverted personality	0.016	1.01 (1.00 to 1.03)
Did not wear sports specific footwear	0.028	1.40 (1.03 to 1.90)
Cooled down after training	0.032	0.95 (0.90 to 0.99)

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