

**Grant Final Report**  
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Grant title: *Identifying risk factors for lower limb injury in team sport athletes*  
Investigators: *Robin Callister and Andrew Miller*

**Project aim**

The aim of this project was to identify risk factors for lower limb injury in team sport athletes.

**Study Design**

Comprehensive preseason screening of football (soccer) and rugby league players was performed then the players were monitored for injuries over the following playing season. Details of the teams assessed and monitored and the playing seasons have been provided previously.

The unique feature of this study was that it pooled data from multiple teams and two sports in an attempt to identify risk factors for a range of lower limb injuries on the premise that there may be common risk factors for a number of types of injuries and this approach would provide economies of scale for investigation. In soccer, the investigation included both male and female players across a wide age range.

**Results of analysis**

It has become clear that our approach to try and identify new risk factors has met with limited success. Logistic regression analysis with the additional year of data has not resulted in any substantial new risk factors being identified at this stage. We have received a recommendation to rerun the analysis using poisson regression analysis, which will be undertaken.

Although this conclusion is disappointing, it is clear from our analysis that sport, age, gender and competition level do influence the risk of lower limb injury. Also, previous injury history is a risk factor for some injuries and some athletes. Although our approach has met with limited success as initially conceived, we are now reviewing our screening test variables and the specific measures used in the analyses with a view to re-examining risk factors for specific injuries in specific populations. A project that has been undertaken this year by a physiotherapy honours student (Ms Karrin Evans) using this approach has examined risk factors for ankle injuries in male soccer players. An interesting result of this analysis is that poor double stance balance (as assessed by a 20s test on an electronic balance board) is a risk factor for ankle injuries. Importantly previous injury was not a significant factor in this analysis because very few of the population examined (those on whom we had balance measures) had a previous ankle injury and none of the injured population had a previous ankle injury. We are planning a series of injury and population specific analyses of the data over the coming months to better inform future studies investigating sports injury risk factors.

We make the following recommendations for future studies attempting to identify risk factors for injury in sport.

### **Recommendations for future studies to identify risk factors for injury in sport**

- One sport
- One gender
- One competition level
- Narrow age range
- Single well-defined injury
- Include all teams in competition (at that level) if possible
- Use simple screening tools that can be taken out to teams for assessments
- Keep the number of screening tools to a minimum
- Substantial preliminary research is required to identify and refine potential screening tools
- Injury history data are essential
- Training history and rehabilitation history data are desirable
- A large team of experienced staff is necessary
- Be aware that risk factors identified will only be applicable to the population and sport investigated
- Male junior representative teams have the best compliance with attendance at screening and are therefore good groups in which to conduct these studies; senior more elite players are the least compliant with assessment participation
- Time spent developing relationships with teams and their staff involved with injury data collection are essential; even within clubs differences among staff attached to specific teams have enormous impact on the quality of data obtained.

## **Summary of project**

Soccer and rugby league players were recruited to participate in preseason screening and season-long injury monitoring. A total of 902 players were screened.

For soccer, preseason screening took place prior to the 2008 and 2009 playing seasons. For 2008, male and female players from ages 11-40 years were recruited from a number of clubs and across different levels of competition. For 2009, male and female players from ages 14-40 years were recruited as we had established that younger players sustained very few injuries.

For rugby league, preliminary preseason screening took place prior to the 2007 season (prior to this grant funding) which was used to inform the development of the screening for the 2008 and 2009 playing seasons; some additional screening took place prior to the 2010 season in order to increase the final number of players assessed and injuries available for investigation. Players were aged 14-35 years and all came from the Newcastle Knights rugby league teams. We will have the final monitoring data from the 2010 season by the end of October 2010.

The primary analyses that have been conducted to date were on the 2008 season data for both sports. In this season, 343 soccer players (278 male, 65 female) from 21 teams and 122 male rugby league players from 4 teams were screened, and season injury monitoring data were obtained on 385 players (83%). Of these 385 players, 53% incurred an injury or injuries; there were 416 injuries incurred during 89,453 player exposure hours for a total injury rate of 4.65 injuries per 1000 player hours.

### ***Injuries in male soccer players***

Of the 247 male soccer players monitored, 95 (39%) incurred 143 injuries; 66% incurred one injury, 22% two injuries, and 12% were injured more than twice. Only 6% of 10-12 year olds were injured, compared to 27% of 13-15 year olds, 42% of 16-18 year olds, and 59% of those aged 19 and older. Both training and match exposures were also much greater for those 19 years and older compared to all younger groups. Both contact and noncontact injury rates were much higher in the older age groups. Match injury rates were much higher than training injury rates across all age groups.

The majority of injuries were to the lower limb (88%) with the ankle (30%), knee (18%) and thigh (13%) the most affected areas. Joint injuries accounted for 33% of these injuries (mostly ankle), with bruising responsible for 28% (primarily thigh) and muscle strains 22% (also thigh). Most (66%) of the muscle strain injuries occurred in the older age group (19 years plus). Fractures accounted for only 6 injuries in total and only 1 injury in those younger than 19 years. There were only 4 reported overuse injuries.

Higher grade teams had significantly greater exposure time than age-matched lower competition level teams; the majority of this extra exposure time was spent in training. Match exposure increased primarily with age group as the length of playing seasons increased with age. Higher level teams had greater injury rates, particularly match-related injuries. In the older age group, higher level teams had a greater proportion of contact injuries whereas lower level teams had more noncontact injuries.

### ***Injuries in female soccer players***

Of the 49 female soccer players monitored, 18 (37%) incurred 25 injuries; 67% incurred one injury, 28% two injuries, and 5% were injured more than twice, which is similar to the rates in male soccer players. Only 6% of 13 year olds were injured, compared to 38% of 15 year olds, and 65% of those aged 17 and older. Most (84%) injuries occurred in matches and a large number (60%) of the injuries were noncontact. The oldest age group had 10 times the rate of noncontact injury compared to the two younger groups. The majority of injuries were to the

lower limb (88%) with the ankle (32%), knee (12%) and thigh (12%) the most affected areas, which is almost identical to the male players. The main injury types were joint (36%), muscle strains (24%) and bruising (16%); there were two fractures and no overuse injuries reported. In summary, male and female soccer players across the investigated performance levels had very similar injury patterns.

### ***Risk factors for noncontact injury in soccer players***

Risk factors identified for muscle strain injury were greater hamstring ROM as determined from an active knee extension, greater one-leg balance, and better single leg squat performance, with better sprint performance almost significant; together these suggest that better athletes were at greater risk of muscle strain injury. For noncontact ankle sprain, athletes with greater side-side differences in thigh girth and single leg squat performance were at greater risk (Odds ratios of 1.8 and 1.5, respectively).

Athletes with a history of previous ankle or knee ligament sprain injury demonstrated greater risk of incurring another injury of the same type, on the same side of the body during the competitive season. The increased risk of obtaining another sprain injury in the same site was close to five times greater for ankle ligament sprains and close to six times greater for knee ligament sprains in athletes who reported having an ankle or knee ligament injury in the previous season, or incurred an injury during the season compared to athletes who did not report having a ligament injury in the previous season.

In female players, playing in a higher age group competition at a younger age clearly increased risk of injury. This may be more likely to occur in females where there are fewer competition levels and opportunities at each age group and talented players may be recruited to higher-level teams at younger ages.

### **Summary of findings from study relating to football (soccer)**

- Male and female soccer players demonstrated similar patterns of injury
- Soccer players younger than 13 years of age experience very few injuries
- Injury risk increases with age up to 19 years (adult)
- Noncontact injuries increase with age
- Older players experience more match injuries
- Young females playing in higher age group competition are at increased injury risk
- Higher performance level players are at greater risk of injury
- Additional training exposure increased injury risk in players above 16 years of age
- Side-to-side differences in assessments may increase risk of ankle injury
- There are interactions between the influence of age, gender and competition level on injury risk:
  - In males, injury risk for all categories of injury (total, match, contact and non-contact) were greater in higher level competition up to 18 years of age whereas competition level did not exert a clear influence in adult players
  - In females, injury risk for total, contact and non-contact (but not match) injuries were greater in lower level competition for open age group players
- Players with a history of ankle or knee sprain injury are at increased risk of incurring the same injury on the same side of the body
- Anterior cruciate ligament injuries in this level female soccer players are rare

### ***Injuries in male rugby league players***

Monitoring data were not obtained from one team (U18s) over the 2008 season. Of the 90 rugby league athletes monitored, 80 athletes (89%) incurred 248 injuries. Of those injured, 31% incurred one injury, 26% incurred two injuries, 20% incurred three injuries, and 23% incurred greater than three injuries. This profile of injury and multiple injury rates is much higher than that observed in soccer players.

Both training and match exposure increased with age and competition level. Interestingly the U16s and U20s teams experienced higher injury numbers than the NRL squad in spite of reduced exposure. Contact injuries accounted for 60-70% and noncontact injuries 30-40% of total injuries. Most injuries were to the lower limb and ranged from 55-76% across the teams. Knee and ankle were the most common sites of lower limb injury; knee injuries were twice as frequent in the U16s and U20s compared to the NRL squad. Ankle injuries were much less common in the U16s (16% of ankle injuries). Head and neck injuries were greatest in the NRL squad (63%) as were calf injuries (77%), fractures (82%) and concussion (79%) whereas shoulder and upper extremity injuries were much greater in the U20s squad (76%). Joint injuries accounted for 41% of injuries, followed by muscle strains (30%) and bruising (16%). Joint injuries were mostly reported by the U20s (58%), muscle strains by U20s (42%) and NRL (44%) and bruising was primarily reported by the U20s (78%).

Noncontact injuries accounted for 35% of the total injury count. Relative to exposure, noncontact injuries were greatest in the U16s and least in the NRL squad. Few joint injuries were noncontact (14%) whereas most strain injuries were noncontact (95%). Of the noncontact muscle strains, calf strains were mostly reported by the NRL squad (77%), hamstring (83%) and thigh (83%) strains by the U20s and NRL, and no difference among the teams for groin strains.

The proportion of contact injuries that occurred in match play increased with age and performance level whereas the proportion of noncontact injuries decreased. Forwards experienced more injuries than backs in the NRL but there was no position dependent difference in the younger teams.

### ***Risk factors for noncontact injury in rugby league***

Previous ankle or knee ligament sprains were a significant risk for incurring another injury of the same type on the same side of the body. The increased risk of obtaining another sprain injury in the same site was over six times greater for ankle ligament sprains and 18 times greater for knee ligament sprains. Small numbers of injuries have limited the capacity to determine whether similar associations exist for muscle strain injuries. Other risk factors for injury in rugby league players are yet to be determined.

### **Summary of findings from study relating to rugby league**

- Players with a history of ankle or knee sprain injury are at increased risk of incurring the same injury on the same side of the body
  - For knee sprains, this risk is substantially greater in rugby league (Odds Ratio 18.3 (CI) (4.3, 78.2)) than in soccer (Odds Ratio (CI) 5.8 (1.3, 25.8))
- Players in the semiprofessional U20s squad were at greatest risk of injury
- Junior athletes incurred the greatest proportion of training injuries (which may reflect the quality of the training staff)
- Contact injuries increase with age/team level and noncontact injuries decrease
- Forwards are at greater risk of injury in the older teams whereas backs are at greater risk in the U16s

**Project budget**

The budget has been fully committed (final payment to statistician pending) or expended. All funds were spent as outlined in the grant on either statistical support or for wages for casual staff to undertake the assessments during preseason screening.

**Update on outcomes from the project**

Andrew Miller has submitted the thesis for his PhD based on analysis the 2008 data. He is now in the process of making final corrections following external review prior to final consideration by the University. Three physiotherapy students are this year undertaking their honours projects using data collected as part of this project. One study is examining risk factors for ankle injuries in football players, one is examining risk factors for leg cramps in rugby league players, and one is examining the role of posture in risk of lower limb injuries. Together these will increase the rate at which outcomes from the project can be finalised and submitted for publication.

Finally, I would like to thank the NSW Sporting Injuries Committee for funding this project and consequently providing an opportunity to not only address the specific research questions but also to assist in developing the skills of a number of young researchers in this important field of sports injury research.

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