The Financial and Performance Cost of Injuries to Teams in Australian Professional Soccer.

Abstract

Objective: To determine the relationship between injury incidence, player-salary cost and team performance in the professional Australian soccer league. *Design:* Prospective observational cohort study. *Methods:* Injury incidence, player-salary cost and team performance data were collected from the 10-club A-League competition (n=27 matches/season) over 6 seasons from 2012/13. Player-salary cost of injury was calculated from the salary cap, injury-induced missed matches and player exposure, and trends were reported from Poisson regressions. Team performance was determined from ranking, points, goals (scored, conceded and difference) and match outcome (win, loss or draw) per season and analysed via a mixed-effects Poisson models to estimate association with injury. *Results:* Nine-hundred-and-sixteen injuries resulted in 3148 missed matches. Injury incidence remained stable apart from a decrease in 2015/16 (p=0.01). Missed matches were significantly higher in season 2013/14 (55.1[50.7-59.9]; p<0.01) and 2014/15 (71.4 [66.4-76.8]; p<0.001) compared to 2012/13, without differences between other seasons. Player-salary cost ranged between AUD$187,990-AUD$332,680/team, peaking in 2014/15 (p<0.01). Multi-collinearity was detected for team performance variables except for matches lost. Teams who finished the season with greater positive goal differences were associated with 1% less injuries (p=0.003). Similarly, more missed matches were associated with 1% less league points and losses (p<0.001). *Conclusion:* Player-salary costs remained stable, concomitant with stable injury rates and missed matches. Despite injury being associated with goals difference, points and match losses; the magnitude of these relationships are small and team performance is more complex than injury occurrence alone. Injury prevention remains necessary for reducing injury-induced player-salary costs; however, additional services are required to improve team performance.

Key words: Performance Cost, Financial Cost, Injury Prevention, Football, Soccer

Practical Implications

- Longitudinal profiling of player-salary costs of A-League injuries highlights the need to strategically invest in player injury prevention resources.
- Association between injuries and goal differences, points, and matches losses in the A-League suggest that coaches and competition organisers should consider effective injury prevention as a crucial component of performance.
- Although injuries may affect team performance, further context needs to be provided to accurately understand injury ramifications. In the A-League, the effect of injuries on goals conceded and matches drawn is small, indicating the effect of injury on team performance may be more complicated than previously suggested.

Introduction

Injury is the most common reason for player unavailability, resulting in a strain on resources for medical care and negative effects on team performance.[1] However, the severity of injury and the ensuing impact on club finances are seldom reported; often because comparing data is problematic due to differing league competition types, sizes and models.[2] Additionally, inconsistent findings exist regarding the relationship between injuries and team performance i.e. league ranking, points, goals and match outcome; partly due to previous analyses using single seasons and reduced number of teams analysed.[3,4] Thus, further understanding of the effect of injuries on club salary cost and team performance, respectively, can inform decision making regarding injury prevention at a league level. In turn, player-salary and team performance cost information can be used as part of a wider reaching multidisciplinary approach to injury prevention and optimal club operations.

Financial stability of clubs and continuity of leagues is grounded in competition success of clubs and minimisation of unnecessary expenditure on unavailable players.[5] Ekstrand [6] reports the average financial cost for an injured player with a time-loss injury of at least 4 weeks to be estimated at ~€500,000 at elite European levels. Comparatively, in a smaller and salary-capped A-League in Australia, the Professional Footballers Australia (2018) report recently outlined a total league salary cost of injury to be AUD$4million.[7] Previous to this report, Gouttebarge et al.[8] reported a continuous decrease from an accumulated league cost of AUD$6million in season 2010/11 to AUD$3.3millon in 2012/13. Collectively, a lack of reliable continuous data exists at a world setting, whilst current Australian domestic soccer league data is outdated, and thus a more recent player-salary cost of injury profile is warranted.

It is not uncommon for team performance to be favourably viewed at the expense of player health and welfare, given injuries may hinder the chance of team success.[4] Injury-induced missed matches resulting in reduced player availability have been shown to be negatively associated with league ranking, number of goals scored and wins accrued in European and Qatari professional football teams.[3,4] An 11-year study of 24 Union of European Football Association (UEFA) teams reported less days lost to injury and greater match availability of players were significantly associated with better league ranking and more points per match.[4] Similarly, in a one season study in the Qatari professional league, lower injury incidence was significantly associated with final league rank (r=0.93), wins (r=0.88), more goals scored (r=0.89) and total points (r=0.93).[3] However, none of the latter performance indicators were associated with days lost from injury. In contrast, one team from the French Ligue 1 over 5 consecutive seasons between 2008 and 2013 reported no association between injury incidence and league ranking.[9] Indeed, the lack of association may have been due to player availability being high enough within season so performance was not constrained.[6] Accordingly, it is still unclear to what extent reduction in injuries are associated with more successful team performance. Further multi-season, league-wide data is required to have more robust understanding of the relationship between injury and team performance.

Meaningful data on multi-year, league-wide performance and financial costs of soccer injury provides evidence to evaluate the effects of preventative strategies and uphold responsibility of performance optimisation, financial sustainability, and athlete care. Therefore, this study aims to describe the player-salary cost of injury in the professional Australian soccer league between 2012/13 to 2017/18 seasons. A secondary aim was to determine the relationship of team performance makers and injury in the A-League in those same seasons.

Methods

Injury epidemiology analysis of 421 players was conducted in the A-League over six consecutive seasons between 2012/13 and 2017/18. Injury data were collected via a standardised Football Federation Australia (FFA) Injury Surveillance form emailed to a centralised Injury Surveillance Officer weekly from each teams' full-time physiotherapist. The Injury Surveillance Officer collected, collated and analysed the injury data. Quality of injury data was cross-checked with media reporting. Injury data was submitted by each club for all 27 regular season rounds for each season equating to 810 matches played by all 10 A-League teams. Submission of injury data was compulsory for all teams as part of the A-League 'Minimum Medical Standards' and thus compliance to injury surveillance was 100%. *Injury* definition was adapted from the Fuller et al.[10] definition with specific references to A-League matches as *'any physical complaint requiring medical attention resulting in a missed A-League match'.* A player was considered injured until the player was no longer listed as injured. Injury count and injury-induced missed matches was determined from the injury surveillance data for analysis. Each player signed a release of medical records as part of their A-League contract. Approval to use data was provided by Football Federation Australia. The study design was approved by the Human Research Ethics Committee (UTS REF: ETH18-2324).

Salary-cap information was collected from the A-League website,[11] where the data is publicly available, and confirmed internally in consultation with the FFA League Operations department. A conservative estimate of the financial cost of injury each season was calculated by dividing the salary-cap by players available and further divided by the rounds played by each team (i.e. 27 rounds) and multiplied by the sum of missed matches as a result of injury, as per the methods established by Gouttebarge et al.[8]

In order to analyse the relationship between injury incidence and missed matches, and team performance a team's final competition rank, league points, goals (scored, conceded and goal difference), and the outcome of each match played by a team (win, loss or draw) was obtained. All performance data was collected by FFA's League Operations department and accessed through internal databases. League ranking was obtained from a team's final rank upon the conclusion of the regular season. Three points were allocated if a team won, one point for a draw, and no points for a loss. The unit of analysis in this study a team's injury and performance metrics throughout one season.

All analyses were conducted in the R statistical language with the packages 'lme4' and 'emmeans'.[12,13,14] To analyse injury, missed matches and player-salary cost trends over 6 seasons, three generalised linear models (Poisson with log link) were created. Pre-modelling assumptions were checked, including homogeneity of variance at the *season* level. Separate models were developed with injuries per team, another with missed matches per team and the last with player-salary cost per team as the response variable. Season was entered as a fixed variable and likelihood-ratio test compared each full model to a null model. Least-square means of the model coefficients reported the respective average team-injury rate, missed matches and team player-salary cost. Back log-transformation of the injury-model coefficients provided a rate ratio (RR), whereby 1 indicates no change, more than 1 indicated an increase and less than 1 indicates a decrease in rates. Model fits where further checked visually with Quantile-Quantile plots.

To analyse the association between injury and missed matches with team performance variables, two Poisson log-linear mixed models were developed, one with injury count as the response variable and another with the amount of missed matched as the response variable.

Prior to analysis, pre-modelling assumptions were checked, including the presence of homogeneity of variance at the *team* and *season* level. Team performance variables of league ranking, points, goals -scored, -conceded and goal-difference, and match wins presented with high multi-collinearity. Goal difference had the strongest association with injury and points with missed matches and therefore was retained for the models with match losses to avoid pseudo-replication. A step-up approach was used by which additional predictors were added to the model with each step. The model fit was evaluated using the Aikaike Information Criterion (AIC), observation of degrees of freedom, distribution of model residuals and comparison of marginal to conditional R^2. Due to eigenvalue, penalized iteratively reweighted least squares method was used for the missed matches model. Log-transformed injury and missed matches were entered as response variables whilst goals difference, points and match outcomes were entered as fixed predictors, while random team intercepts accounted for the random variance associated with inter-team differences in missed matches or injury counts, and to account for the clustering of team's repeated measures over multiple seasons. Model coefficients were back-transformed to obtain RR's and reported with 95% CI. Model residuals were also obtained and used for a visual inspection of how well the obtained models fit the data. Of note, the direction injury-performance associations are reported as per analyses; however, has been inversed for more intuitive reading further in the discussion.

Results

The analysis included 916 injuries from 421 A-League players over the six seasons of data collection. The sum of injuries resulted in 3148 missed matches. The range of players training regularly with an A-league team at any one time was between 18-27. As shown in Table 1, injury count per team in Season 2015/16 significantly decreased by RR:0.7(0.6-0.9) from season 2012/13 ($p=0.01$). Additionally, missed matches per team increased in season 2013/14 (55.1[50.7-59.9];$p<0.01$) and 2014/15 (71.4[66.4-76.8];$p<0.001$) compared to 2012/13; however, returned to the reference season rate in 2017/18(50.5[46.3-55.1];$p=0.28$). Average player-salary cost of injuries per club per season ranged between AUD$187,990 to AUD$332,680 (Table 1). Injuries in season 2014/15 showed the highest average player-salary cost of AUD$332,680 per team per season ($p<0.01$).

Insert Table 1 near here

Upon using the step-up approach for the construction of models to explain the variance in injury counts and missed matches, two final models were retained. The first model consisted of a univariate model in which goal difference is entered as a fixed effect, injury rate is the response variable and team-injury rate variation is considered a random intercept (Table 2). Back-transformed coefficients from this model demonstrate that injury count and goal difference were negatively associated. The mixed model calculated average injury rate when there was a goal difference of 15.03 (95CI%:13.52-16.70) injuries per team per season and every additional goal difference was associated with higher injury rates (RR:0.99[95%CI:0.99-1.00];Table 3).

In the second generalised mixed effects regression model, points and loses were retained as fixed effects, with missed matches as the outcome variable and random intercepts at the team level. Back-transformed coefficients obtained from this model's output show a negative association between matches missed, points and match losses. The expected missed matches was 75.12 (95%CI:62.11-91.00) per team per season and every point acquired (RR:0.99[95%:0.90-1.00]) and match loss (RR:0.99[95%CI:0.98-1.01]; Table 3) was associated with lower missed matches.

***Insert Table 2 near here ***

***Insert Table 3 near here ***

Discussion

This is the first study to profile the association between injury, missed matches, player-salary cost, and team performance over multiple seasons that include all teams from one domestic competition. Injury and ensuing missed matches remained relatively stable across the six seasons analysed. Similarly, mean player-salary cost of injury was also relatively stable, though did spike in 2014/15 to $AUD332,680. From a team performance perspective, injury rate and missed matches showed positive association with greater goal differences. However, teams who acquired more points and fewer losses more often appeared to have fewer number of matches missed. In the discussion here, the direction of the mentioned injury-performance associations has been inversed for more intuitive reading, although it should be noted here that the magnitude of the relationships cannot be inversed in these models. Regardless, in a smaller, salary-capped league (A-League) findings show 1) the player-salary cost of injuries remains constant in alongside relatively constant injury rates, and 2) although association between team performance and injury are evident, these association are small.

In the A-League seasons prior to the present study (i.e. 2012/13), a peak in player-salary cost of injury was reported in 2010/11 at ~AUD$6million, though ensuing reductions were evident to ~AUD$3.3 million in 2012/13.[8] Player-salary cost from injury reduced and stabilised (~AUD$2.3million) in this study compared to 5 seasons prior. Gouttebarge et al. [8] suggested the A-League specific Minimum Medical Standards that directs club medical provisions and infrastructure may be a factor on reduced injury and player-salary costs, and current findings would further support that assertion. Stability in player-salary cost in the present 6 seasons reflects stability of injuries and ensuing missed matches and was one of the principles of introducing a 'Minimal Medical Standards'. Regardless, mean player-salary cost due to injury reported here (~AUD$2370,000) is still equivalent to the investment of two A-league player's

184 average yearly salary. Thus, the longitudinal profile of player-salary cost of A-League injuries
185 presented here highlights the importance of strategically investing in players, resources
186 particularly in a salary-capped league, to budget for injury prevention resources.

187

188 Driven by the accumulation of league points, soccer league competition success is ultimately
189 determined by the top-ranked team/s. However, such factors may be hindered by player
190 unavailability due to injury.[3] Prior to analysis all performance variables were test for
191 collinearity and removed to avoid inflation of least squares estimators of coefficients as a
192 result of large variances.[15] Unsurprisingly, multi-collinearity was observed between league
193 ranking, league points, goals, matches won here. Goal difference was retained for analysis
194 and represents the association also seen between the previously mentioned variables and team
195 performance variables. Previously, strong associations were reported in both univariate
196 analyses of injury and league ranking (r=0.93, p=0.003), and injury and league points
197 accumulated (r=0.93, p=0.003) in one season of the Qatari professional league supporting the
198 linearity noted here.[3] Injury-performance associations reported in the Qatari professional
199 league were also observed in UEFA Champions League.[4] Hägglund et al.[4] reported teams
200 with higher injury burden (i.e. injury incidence and days lost) decreased the likelihood of
201 finishing with higher league ranking (OR:0.99 (95%CI:0.98-0.10);p=0.011) and more
202 accumulated league points (OR: 0.99 (95%CI:0.99-1.00); p=0.031). However, it should be
203 highlighted that the magnitude of the aforementioned associations were small. The present
204 and mentioned studies suggest that despite the association the extent of the relationship
205 between injury, missed matches, league ranking, points, and matches won are small at best.

206

Goal differences may provide context of a team's ability to be successful in any particular match and may be influenced by a host of reasons, including injuries.[3,9] In the present study, goal difference is associated with 1% lower injury rate. The association in this study supports the positive linear relationship between injury rate and number of goals scored (r=0.893, p=007) reported in the Qatari professional league.[9] Comparably to a multi-season study, there was no differences in goals scored or conceded across 5 seasons for a French Ligue 1 team (p=0.233 and p=0.994, respectively) despite decreased injury incidence.[9] However, differences between the abovementioned studies may arise from different sampling periods and number of teams included for analyses. Another limitation of the former studies is the lack of reporting of the extent to which conceded goals is related to injury rates. Of note, factors such as match location, opposition league ranking and period of season were not considered here and should be noted as a limitation of this study. However, despite association between goal differences and injuries reported, the current study suggests teams with greater goal differences at the end of a season (given the average injury rate is 15 injuries per team per season) only had 0.15 less injuries. Thus, despite the reported negative association, the magnitude of the effect suggests that the relationship between goal difference and injury is small. Further, such small increase in injury may suggest other variables may have greater effects on team performance.

Winning matches is the fundamental tenant of team performance and remains the primary concern with regards to the insidious effects of injuries. There was no association reported between injury and match loss; however, multivariate analysis showed teams with more injury-induced missed matches also have fewer points and match losses. Although the second analysis is seemingly partially counter intuitive, Bengtsson et al.[15] reported a positive association between injury and match draws, with increased odds of a drawn match compared

232 to a win (OR:1.39[95%CI:1.15-1.69],p=0.001) when teams sustained two or more injuries.
233 Additionally, 2 or more injuries resulting in more than 1 week absence increased the odds of
234 a match resulting in a draw (OR:2.14 [95%CI:1.69-2.88], p<0.0001) compared to a win.[15] In
235 contrast, winning teams typically have more shots and more shots on target,[5] though once
236 leading, teams shoot less and concede less.[17] Accordingly, given higher injury rates are
237 associated with bigger goal difference, it could be speculated that team defensive style is
238 affected in situations where teams have a goal advantage, thus preventing a winning match
239 outcome.[9] However, such conclusions are speculative given player quality and tactical aspects
240 of performance were not considered in the current analysis. Regardless, the current findings
241 show teams with more missed matches from injury per season has accumulated fewer league
242 points and match losses, though the magnitude of this relationship is small.

243

244 Previous studies have reported generalised relationships between injury and team
245 performance. The current findings do not confirm a strong existence of such a relationship
246 given the rate ratios and confidence intervals suggest uncertainty. However, there are several
247 limitations of the present study that may have contributed to the unclear findings. For
248 example, the impact of player quality unavailable due to injury, injury replacements,
249 competition demands, climate and squad rotation were not considered in this analysis.[9,18] It is
250 likely that current analyses without consideration of other factors which may have real impact
251 on injuries and team performance may provide misleading associations and remains of interest
252 for further research. Additionally, injury and missed matches were analysed separately.
253 Current research suggests there are practical benefits of contextualising reported data with an
254 injury burden.[22] Lastly, it is acknowledged that injury exposure in hours was not collected in
255 this injury surveillance system during this period; however, current practices have changed to
256 allow inclusion in future reporting.

Conclusion

In conclusion, this study reports that injury rate, missed matches and player-salary cost of injuries in the A-League between 2012/13 and 2017/18 remained stable. Further, injury is associated with goal differences whilst missed matches is associated with points and losses; however, the magnitude of these association is small which may reflect the complexity of successful team performance. The present study suggests reducing injuries will not improve performance alone and further strategies are additionally required. However, injury prevention is still necessary to reduce player-financial costs.

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