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Title	The impact of in-season national team soccer play on injury and player availability in a professional club
Type	Article
URL	https://clock.uclan.ac.uk/12334/
DOI	https://doi.org/10.1080/02640414.2015.1013051
Date	2015
Citation	Carling, C., McCall, A., Le Gall, F., and Dupont, G. (2015) The impact of in-season national team soccer play on injury and player availability in a professional club. <i>Journal of Sports Sciences</i> , 33 (17). pp. 1751-1757. ISSN 0264-0414
Creators	Carling, C., McCall, A., Le Gall, F., and Dupont, G.

It is advisable to refer to the publisher's version if you intend to cite from the work.
<https://doi.org/10.1080/02640414.2015.1013051>

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1 This is a pre-proof corrected manuscript, as accepted for publication, of an article published by
2 Taylore & Francis in *Journal of Sports Sciences* on 9th March 2015, available online:

3 [http://www.tandfonline.com/doi/abs/10.1080/02640414.2015.1013051?url_ver=Z39.88-](http://www.tandfonline.com/doi/abs/10.1080/02640414.2015.1013051?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#.Vbtks03bLcs)
4 [2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#.Vbtks03bLcs](http://www.tandfonline.com/doi/abs/10.1080/02640414.2015.1013051?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed#.Vbtks03bLcs)

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9 **Title: The impact of in-season national team soccer play on injury and player availability in a**
10 **professional club**

11
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1 **The impact of in-season national team soccer play on injury and player availability in a**
2 **professional club**

3
4 **Running head:** Injury in national team soccer

5
6 **Abstract**

7 This study investigated the impact of in-season national team duty on injury rates and player availability
8 in a professional soccer club. Time-loss injuries and exposure time during club and national team duties
9 were recorded prospectively over 5-seasons (2009-2014). A time-loss injury was sustained by 37.7% of
10 squad members participating in national duty; all injuries occurring in match-play. The incidence (per
11 1000hours exposure) for national team player match-play injuries did not differ ($p=0.608$) to that for all
12 players in club competitions: 48.0 (95% CI 20.9-75.5) vs. 41.9 (95% CI 36.5-47.4), incidence rate
13 ratio=1.2 (CI: 0.8-2.4). The majority (58%) of national team injuries resulted in a layoff ≤ 1 week. Of all
14 working days lost to injury generally, 5.2% were lost through injury on national duty. Injury incidence
15 in the week following national duty was comparable ($p=0.818$) in players participating or not: 7.8 (95%
16 CI 3.6-12.0) vs. 7.1 (95% CI: 4.6-9.6), incidence rate ratio=1.1 (CI: 0.7-2.7). While approximately forty
17 percent of participating players incurred a time-loss injury on national duty, no training injuries were
18 sustained and injuries made up a negligible part of overall club working days lost to injury. Following
19 duty, players had a similar injury risk to peers without national obligations.

20
21 **Key terms:** injuries, performance, football, match congestion, fatigue

1 **Introduction**

2 Soccer injuries result from a complex interaction of multiple internal and external risk factors
3 and player fatigue is perceived to be one of the most important factors related to injury risk in
4 contemporary professional soccer (McCall et al, 2014). Indeed, clubs can play over 60 competitive
5 matches per season with some players participating in up to 50 matches (Strudwick, 2012). In addition
6 to their domestic League and Cup programmes and European competition, many professional players
7 are regularly exposed to national team obligations both in-season (e.g., national team tournament
8 qualification and friendly matches) and post-season (e.g., FIFA World Cup, UEFA European
9 Championships). In a one-season study of injury in European professional soccer, a total of 148 (56%)
10 out of 266 players were exposed to some form of national team play on at least one occasion (Waldén,
11 Hägglund & Ekstrand, 2005). While injury rates in post-season national team soccer tournaments are
12 generally higher in comparison to those reported at professional club standards (Dvorak, Junge, Derman
13 & Schweltnus, 2011), little is known about injury rates and characteristics during in-season national
14 team training sessions or qualification and friendly matches and their subsequent impact on player
15 availability. Similarly, to our knowledge, no information is available on the proportion of players who
16 actually sustain an injury while on in-season national duty (training and match-play), the characteristics
17 of injuries incurred, or the subsequent effect of these injuries on availability for future training sessions
18 and competition in their club.

19 In-season national team matches are often closely preceded and followed by club matches.
20 These intensive in-season competitive schedules frequently lead to periods of match congestion thereby
21 requiring some players to play 2 matches per week consecutively over several weeks. Research in a
22 Champions League team (Dupont et al., 2010) reported injury rates over 6-times higher when players
23 participated in 2 club matches per week compared to only 1 match per week (25.6 vs. 4.1 per 1000
24 hours exposure). A study by Bengtsson and colleagues (2013) also demonstrated a strong association
25 between muscle injury rates and the recovery time available between successive matches (according to
26 the number of days) in 27 professional European clubs. In contrast, no significant difference was
27 reported in the incidence of injury in match (27.2 vs. 33.8 per 1000 hours) or training sessions (4.1 v 6.2
28 per 1000 hours) in players exposed or not to national duty over the course of a competitive season
29 despite the national team players having played significantly more matches (42 vs. 28) (Waldén et al,
30 2005). Up to now, no study has investigated the potential effect of competitive schedules prior to
31 national team duties in which players eventually sustained an injury or national team participation on
32 injury rates during club training sessions and match-play immediately following duty. This information
33 could eventually aid medical and coaching practitioners in making informed judgements on player
34 rotation and recovery strategies around national team duties.

35 The aims of this study were to document injury rates during in-season national team duties and
36 investigate the effects of duty on subsequent injury risk and player availability in a professional soccer
37 club.

1 **Methods**

2 In this prospective observational study, injuries in male professional soccer players belonging to the
3 first-team squad of a French Ligue 1 Club (highest competitive standard in France) sustained on both
4 national team soccer duty and in club competitions were investigated. While all data arose as a
5 condition of employment in which players were routinely monitored over the course of the competitive
6 season (Winter & Maughan, 2009), approval for the study from the present club and ethics committee
7 clearance from the 'Comité de Protection des Personnes Nord Ouest IV' (France) were obtained.

8 Data were prospectively collected in a cumulated total of 130 players (59 individual players)
9 who participated in one or more seasons over a five-season period (2009-10, 2010-11, 2011-12, 2012-
10 13 and 2013-14). A cumulated total of 58 players (44.6%) out of the 130 participated in national duties
11 in one or more seasons over the five-season period. The cumulated total of 58 players included 30
12 individual players of which 17 (53.3%) belonged to European, 12 to African (43.3%) and 1 (3.3%) to
13 South American national teams respectively. Altogether, 7 European, 6 African and 1 South American
14 teams were individually represented.

15 Individual exposure time to official club competitions (domestic league and cups, and European
16 Competition), pre-season friendly matches and training sessions was recorded for each individual player
17 belonging to the first-team squad by the club's sports scientist. Individual exposure time to in-season
18 national team match-play (including tournament qualification and friendly matches) was also recorded
19 for each player. Due to the non-presence of club medical and sports science staff, player exposure time
20 to training on national duty was estimated. After consultation with the participating national team
21 players, an average of 1.0 hours duration per training session was used to calculate training exposure
22 time.

23 Over the 5-season period, injuries sustained in club training and match-play were prospectively
24 diagnosed and documented by the same sports physician. Injuries incurred during national duties were
25 also diagnosed and documented on the player's return to the club. Essentially, diagnosis involved
26 routine clinical assessment of players by the physician at the time of presentation. Where necessary,
27 further examinations were ordered (e.g., sonography or magnetic resonance imaging) at the discretion
28 of the physician to assist with diagnosis.

29 The definitions of injury, injury severity and recurrent injuries were based on those
30 recommended by International Soccer Injury Consensus Groups (Fuller et al., 2006; Hagglund, Walden,
31 Bahr & Ekstrand, 2005). Injury: time-loss injury resulting from playing soccer and leading to a player
32 being unable to fully participate in future training or match play independent of whether a training
33 session actually took place on the day following injury or the player was selected to play in the next
34 match. The incidence of injury was reported as the number of injuries per 1000 player-hours exposure
35 to play. The severity of the injury (layoff time) was determined according to the number of days the
36 player was absent from and unable to take full part in training or competition: minimal=1-3 days,
37 mild=4-7 days, moderate=8-28 days and severe=>28days. All injuries were followed until the final day

1 of rehabilitation. The player was considered injured until the club physician permitted full participation
2 in collective training and availability for match selection. A recurrent injury (reinjury) was described as
3 an injury of the same type and at the same site as an index injury and that occurred within 2 months
4 after a player's return to full participation from the index injury. The cause of injuries was obtained
5 using post-match visualisation of the match video when available or alternatively via direct questioning
6 by the club physician of the player on the latter's return to the club.

7 All statistical analyses were conducted using SPSS for Windows Version 14.0 (SPSS Inc.,
8 Chicago, IL, USA). Standard statistical procedures were used to calculate frequencies, means,
9 proportions (%), standard deviations and ranges. Injury incidences (presented as injuries per 1000hours
10 play) and incidence rate ratios are both presented with 95% confidence intervals using respective
11 formulae presented in Dvorak et al (2011) and Knowles, Marshall & Guskiewicz, (2006). After
12 normality of the data was tested, an unpaired t-test was used to compare injury incidences observed in
13 national teams and at club level. A p-value <0.05 was considered statistically significant. The G*Power
14 3 (Faul, Erdfelder, Lang et al. 2007) software was used to determine statistical power ($1-\beta > 0.80$ was
15 considered large).

16 **Results**

17 **Results**
18 Players participated either fully or partly in a total of 206 national team matches over the 5-year period.
19 This resulted in a total participation time of 250.1 match hours of which 182.1 hours were spent in
20 tournament qualifying matches and 68.0 hours in friendly matches.

21 Of the 30 individual squad members participating in national duty at some time over the 5-
22 season period, 11 individual players (37.7%) sustained an injury resulting in time loss from play.
23 Altogether, 372 time-loss injuries (231 in match-play & 141 in training) were reported over the 5-
24 seasons with a total of 12 injuries sustained in national team match-play accounting for 3.2% of all
25 injuries sustained. No time-loss injuries were sustained in national team training sessions (estimated
26 exposure time: 679 hours). Of the 12 injuries, 3 were reported in friendly matches and 9 in qualifying
27 matches, 8 (66.7%) were diagnosed as muscle strains and 3 (25.0%) as sprains respectively, 8 (66.7%)
28 were sustained to the players dominant side, 10 (83.3%) were as a result of non-contact trauma and 2
29 were considered reoccurrences (16.7%) (Table 1). The upper leg was the most common injury location
30 (5 or 41.7% of which 3 affected the hamstrings and 2 the quadriceps muscles). In the week prior to the
31 12 injury occurrences on national team duty, the injured and non-injured national team players had both
32 played an identical mean number (and standard deviation) of 0.9 ± 0.6 matches.

33 The incidence of injuries incurred in national team training was 0.0 per 1000hours play while at
34 club level this was 3.0 (CI 2.8-3.3). The incidences of match injury occurring in national team soccer
35 compared to that in all players in club match-play were 48.0 (CI 20.9-75.5) and 41.9 (CI: 36.5-47.4)
36 respectively: incidence rate ratio of 1.2 (CI: 0.8-2.4). The t-test reported no significant difference

1 between these incidences ($p=0.608$) while statistical power ($1-\beta$) was 0.10. The respective incidences of
2 injury in tournament qualifying and friendly matches were 49.4 (CI 32.9-65.9) and 44.2 (CI 18.7-69.6).

3 A total of 288 days layoff time due to injuries sustained in national team match-play was
4 observed. The mean length of the injuries occurring in national team and club match-play respectively
5 was 24.0 ± 46.2 days (range 2-169 days, 16.7% were classed as minimal, 41.7% as mild, 33.3% as
6 moderate and 8.3% as severe) and 8.9 ± 15.0 days (range 1-94 days, 46.6% were classed as minimal,
7 24.7% as mild, 22.4% as moderate and 6.4% as severe). Of the 12 injuries, 10 (83.3%) forced the player
8 to miss the following club match. Of the total of 2856 training sessions, 4290 training hours, 638
9 matches and 3494 working days (training and matches combined) missed through injury generally, 182
10 sessions (6.4%), 281 hours (6.6%), 36 matches (5.6%) and 182 (5.2%) working days respectively were
11 missed directly through injuries sustained on national team duty. When the 182 club training sessions
12 and 281 training hours missed through injury sustained on national duty were coupled with the 1075
13 training sessions and 1634 hours of club training missed while away on duty, this led to player absence
14 from a total of 4.2% of all club training sessions and 4.3% of training hours.

15 In the week immediately following national team duty, players participated in 70.1% of their
16 club's matches (115 out of 164 matches). Players completed at least 75-minutes in 67.0% (77 out of 115
17 matches) and 90-minutes play in 55.7% (64 out of 115 matches) of matches respectively. Of the 29.9%
18 of matches (49/164) in which players did not compete, 14.3% (7 out of 49) were directly missed
19 through an injury sustained on national team duty. Altogether, 13 injuries (incidence per 1000hours
20 play= 7.8 , CI 3.6-12.0) were sustained in match-play and training combined in the week directly
21 following national duty compared to an incidence of 7.1 (CI: 4.6-9.6) in the players who were not
22 selected for their national team: incidence rate ratio of 1.1 (CI: 0.7-2.7). The t-test reported no
23 significant difference between these incidences ($p=0.818$) while statistical power ($1-\beta$) was 0.08. Of the
24 13 injuries sustained, 5 (38.5%) were diagnosed as muscle strains, 3 (23.1%) as contusions and 2
25 (15.4%) as tendinopathies while 61.5% were due to non-contact trauma. The mean layoff time per
26 injury incurred directly after national duty equalled 13.9 ± 25.4 days (range 1-94 days) with the majority
27 (76.9%) resulting in a layoff of one week or less. These injuries subsequently forced players to miss a
28 total of 136 training sessions (206 hours), 34 matches and 163 working days.

30 Discussion

31 In epidemiological studies conducted at the highest standards of soccer, it is important to account for
32 the impact of exposure to national team duty and injuries subsequently incurred (Waldén et al., 2005).
33 The aim of the present study was to analyse the impact of national team duty on injury and player
34 availability in players belonging to a professional soccer club over a 5-season period. Main findings
35 were that approximately 40% of players participating in national team match-play sustained an injury
36 accounting for ~3% of all the club's injuries reported over the 5-seasons while no injuries were reported
37 during national team training sessions. While the incidence of match-play injury was ~13% higher in

1 national versus club competitions, incidence rate ratios with corresponding confidence intervals and
2 inferential statistical testing indicated no significant difference between rates. The majority of injuries
3 sustained in national team matches resulted in absence from soccer for one week and or less. Of the
4 total number of club working days (training and matches combined) missed through injury generally,
5 ~5% were directly missed through injuries incurred in national team competition. The injury incidences
6 in play over the week immediately following national team participation did not differ between players
7 who had or had not participated in national team duty.

8 In the present study, ~3% of all injuries in the club's players sustained over 5-seasons occurred
9 in national team circumstances, a figure similar to the 4% reported in 11 top European soccer clubs
10 (Waldén et al., 2005). Altogether, ~38% of players sustained an injury during exposure to national duty
11 which compares to 29% in a population of 65 players monitored prior to and during the 2002 World
12 Cup (Ekstrand, Waldén & Hägglund, 2004). Positively, no injuries were reported during national team
13 training sessions in contrast to an incidence of 3.0 per 1000 hours (CI 2.5-3.5) in club training. It must
14 be acknowledged though that some slight injuries (0 days layoff) could have occurred in training and
15 might not have been reported. An explanation already put forward elsewhere for this positive finding
16 for training injury might be differences in the type and/or intensity of training sessions performed on
17 national team duty. As the preparation time available for national friendly and qualification matches is
18 habitually short, then it might be speculated that sessions were less intensive, more recovery-based and
19 tactical in nature (Hägglund, Waldén & Ekstrand, 2009; Waldén, Hägglund & Ekstrand, 2007). In
20 future studies, detailed logging and comparison of training activities and workloads in both club and
21 national contexts would be useful to confirm or refute this suggestion.

22 Results showed that the incidence of injury occurring in national team soccer match-play did
23 not differ statistically compared to that observed during club competitions (48.2 versus 41.9 injuries per
24 1000 hours, $p=0.608$). However, this difference represents a non-negligible 13% difference and could
25 nevertheless be interpreted as partly confirming the trend for general higher risk of injury in national
26 team tournament match-play in comparison to professional club soccer (Dvorak et al., 2011; Ekstrand,
27 Hägglund & Waldén, 2011). Whilst to our knowledge no comparative data exist on injury rates specific
28 to in-season national team qualification and friendly matches as presented here, the present incidence is
29 within the range previously reported for post-season national team tournaments over the last decade or
30 so: 2002 FIFA World Cup=50.7 (Junge, Dvorak & Graf-Baumann, 2004), 2006 FIFA World Cup=45.9
31 (Dvorak, Jungen, Grimm & Kirkendall, 2007), FIFA 2010 World Cup=40.1 (Dvorak et al., 2011),
32 FIFA 2009 Confederations Cup=60.1 (Theron, Schweltnus, Derman & Dvorak, 2013), EURO
33 2004=36.0 (Waldén et al., 2007), and EURO 2008=41.6 (Hägglund et al., 2009). Additional larger-
34 scale research in other professional clubs to quantify and compare injury rates during in-season national
35 team duty and identify the extent of the risk internationally is warranted.

36 The high injury rates observed above for post-season national team tournaments have been
37 linked to pressure and associated mental stress (Hägglund et al., 2009), as well as accumulated fatigue

1 and the density of matches played prior to the competition (Ekstrand et al., 2004). Match congestion at
2 club level (2 versus 1 game per week) has also been associated with a six-fold increased risk of injury
3 (Dupont et al., 2010). However, analyses of the 7-day period prior to the in-season national team
4 matches in which the 12 injuries were incurred showed that both the national team players who
5 subsequently sustained an injury and those who did not, had, on average, played a single game. Thus, it
6 would seem that exposure time to club match-play prior to national team duty was not linked to the
7 injuries sustained in players participating in national team play.

8 We also investigated how involvement with national teams affected injury in participating
9 players over the following week back in their club environment in comparison to peers not selected for
10 duty. Similar rates of injury were reported (incidence per 1000 hours play: 7.8 vs. 7.1, $p=0.818$)
11 suggesting that involvement in national teams had no effect on subsequent injury risk at club level. A
12 reasonable explanation for this finding might be management of player participation in the following
13 club game which tended to take place 3-4 days afterwards. Approximately 70% of the national team
14 players participated in the club's next match but only about half of these completed the full 90-minutes
15 of match-play. Out of the club's national team players habitually considered by the coaching staff as
16 'first-team starters', ~82% participated in the club's next match following national duty but only 54%
17 completed 90-minutes. Combined, these results imply that the present club coaching staff took into
18 account prior national duties when selecting and especially substituting players potentially with the aim
19 of reducing the recognised higher injury risk linked to match congestion (Bengtsson et al., 2013;
20 Dupont et al., 2010) and towards the latter end of play (Ekstrand et al., 2011; Hawkins et al, 2001).
21 Future work using interviews with coaching staff to determine their criteria for selection or not of
22 players who had recent involvement at national team level is warranted.

23 The impact of an injury on a club can be considered in relation to its severity and the number of
24 potential competitive matches missed (Hawkins et al., 2001). Here, the impact of injuries sustained
25 during national duty in relation to all injuries sustained during club obligations on the frequency of
26 training sessions (~6%) and hours (~7%), matches (~6%) and working days (~5%) subsequently missed
27 can be considered minimal. In contrast, an average of 3.0 matches was subsequently missed per national
28 team injury with ~83% of the injuries leading to absence in at least one club match. In national team
29 versus club competition, ~42% of injuries were classed as moderate/severe (≥ 8 days) compared to
30 ~29%. This suggests that when an injury occurred in national team competition, its severity and
31 subsequent effect on player availability was potentially greater. However, player absence and injury
32 severity must be interpreted with in the context of the low number of injury cases occurring during
33 national duty along with the presence of an important injury outlier. Indeed, when the outlier (169 days
34 layoff time for a tendon injury) is removed from the analysis, the mean length of the injuries occurring
35 in national team versus club match-play was relatively similar: 10.8 vs. 8.9 days.

36 Finally, of the 12 injuries reported in national team competition, ~80% were sustained in a non-
37 contact situation and two-thirds (~67%) were muscle strains versus ~50% and ~40% in club match-play

1 respectively. It is difficult to formulate solid explanations for these discrepancies in injury patterns
2 mainly again due to the small number of reported injuries and again additional research is necessary to
3 verify this trend.

4 In light of the present findings, we feel that future research into the potential ‘knock-on’ effects
5 of participation in tournaments such as the World Cup and Continental Championships on injury risk in
6 professional soccer players over the course of the following season is warranted. Previous research has
7 shown that forty-one per cent of injuries sustained in the European Championships 2006 to 2008
8 resulted in absence after the tournament, with an average of nearly four weeks subsequently spent in
9 rehabilitation (Hägglund et al., 2009). Research to examine whether players who participate in a large
10 number of in-season qualification and friendly matches followed by a post-season tournament are
11 consequently subjected to greater injury risk in the following season is warranted. We also suggest that
12 analysis of the potential effects of travel (e.g, duration and distance, time zones) especially in players
13 travelling to different continents on subsequent injury risk during exposure to national team play and on
14 return to their clubs would be pertinent. Finally, a multifactorial model of sports injury etiology (Bahr
15 & Homes, 2003) would help to explore the potential interrelationships between internal risk factors and
16 their contribution to injury rates and patterns in national team players.

17 A limitation acknowledged at the outset of this study was that only one soccer club was
18 investigated and the patterns observed are a reflection of this particular cohort. Sample size influences
19 the power to detect real and significant effects and similar investigations involving a larger sample of
20 professional clubs internationally to increase statistical power are necessary to verify the present
21 findings. Indeed, power for statistical comparisons reported here was ≤ 0.10 . Despite prospective data
22 collection from over 200 national team matches played over a 5-season period, only 12 injury cases
23 were reported in 11 individual players which is insufficient to detect moderate to strong associations
24 (20-50 injury cases) and small to moderate associations (~200 injured subjects) (Bahr & Holme, 2003).
25 However, despite these limitations, this study has merit in that it is the first to investigate the impact of
26 in-season national team duty on injury and player availability at professional soccer club level. In
27 addition, the strength of this investigation was its five-season span and prospective nature and
28 methodology the latter respecting internationally recommended injury recording systems (Fuller et al.,
29 2006; Hägglund et al., 2005) thereby allowing these results to be compared with future research
30 findings.

31 **Conclusion**

32 In conclusion, this study showed that while in the region of 40% of participating players sustained an
33 injury on national team duty, no injuries were sustained in national team training sessions. National
34 team match-play injury rates did not differ statistically compared to that in players in club competitions
35 making up a negligible part of all injuries incurred in the club over a 5-season period. Following
36

- 1 national duty, injury incidence in participating players was not greater than in peers who had no
- 2 national obligations.

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Table 1 Description of 12 injuries sustained in professional soccer players on international duty over a 5-season period

Competitive season	Playing position	Layoff time (days)	Training sessions absent		N° matches absent	Working days absent	Injury characteristics					
			N°	Hours			Type	Location	Dominant side	Reinjury	Contact	Cause
2009-10	Midfielder	13	8	14	1	7	Sprain	Toe	Yes	No	Yes	Tackle
2009-10	Forward	6	3	5	1	4	Strain	Pelvis	Yes	No	Yes	Collision
2010-11	Forward	2	2	3	0	2	Strain	Hamstring	No	No	No	Unknown
2010-11	Defender	2	2	3	1	2	Strain	Neck	Yes	No	No	Collision
2010-11	Forward	14	9	14	1	10	Strain	Hamstring	Yes	No	No	Kicking ball
2011-12	Defender	8	5	8	1	6	Strain	Quadriceps	Yes	No	No	Unknown
2012-13	Midfielder	17	5	8	1	6	Sprain	Knee	Yes	No	No	Tackled
2012-13	Defender	25	13	21	5	18	Strain	Foot	No	No	No	Change in direction
2012-13	Forward	7	9	14	1	9	Strain	Hamstring	No	Yes	No	Acceleration
2012-13	Midfielder	20	14	23	5	19	Sprain	Ankle	Yes	No	Yes	Collision
2012-13	Forward	169	108	162	19	95	Tendinopathy	Ankle	Yes	Yes	No	Change in direction
2013-14	Forward	5	4	6	0	4	Strain	Quadriceps	No	No	No	Change in direction