Hamstring injuries in England and Wales elite men's domestic cricket from 2010 to 2019

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ABSTRACT

Objectives: To describe hamstring injury incidence across competition formats, activity at time of injury, and time of season to facilitate the identification of injury risk factors in elite men's senior First-Class County Cricket.

Design: Prospective cohort analysis.

Methods: Hamstring time loss injuries defined in accordance with the updated international consensus statement on injury surveillance in cricket, with incidence (between format, activity, and time of season) calculated for the elite men's senior First-Class County Cricket seasons 2010 to 2019.

Results: The diagnosis with the highest seasonal incidence was 'Biceps femoris strain grade 1 – 2' (2.5 injuries/100 players). Hamstring injury incidence was highest in One-Day cricket (Mean 27.2 injuries/1,000 team days). Running between wickets when batting was the activity associated with the highest incidence in the shorter competition formats (8.4 and 4.8 injuries/1,000 team days for One-Day and T20, respectively). The bowling delivery stride or follow through was the activity with the highest incidence for the longer multi-day Test format (Mean 2.3 injuries/1,000 team days), although similar incidence was observed across all formats for this activity. Most injuries were sustained at the start of the season (April; 22.7 injuries/1,000 team days), with significantly fewer injuries at end of the season (September; 4.1 injuries/1,000 team days).

Conclusion: The similar bowling injury incidence across formats suggests hamstring injury risk is associated more with the activity itself as opposed to injury risk when batting, which was susceptible to changes in match intensity. The notably higher (albeit non-significant) incidence in April may allude to a lack of preparedness to meet the physical demands of the start of the season. The findings have practical relevance for practitioners, identifying potential opportunities for future research and preventative strategies.

Key words: prevention, risk factors, incidence, sports, cricket, conditioning

INTRODUCTION

Thigh injuries have consistently been reported as one of the most frequently occurring injuries in elite men's cricket, based on surveillance studies in Australia, and England and Wales.[1-3] This is particularly true for hamstring injuries,[4] which are common in sports involving high speed running, accelerations, and decelerations.[5-7]

Previous exploration of hamstring injury risk factors in cricket has been conducted in a cohort of professional male players in Australia.[4] Over a 20-year period (1995-1996 to 2014-2015 seasons), 276 match time-loss hamstring injuries were recorded at state or national competitive level, of which 170 occurred in one of the 40,145 player matches analysed, with an overall match onset rate of 22.5 hamstring injuries per 1,000 team days. Significant risk factors for hamstring injuries were found to be hamstring injury history, being a fast bowler, and playing a match in Australia. These factors are thought to contribute to the increased hamstring injury risk as playing conditions in Australia are more favourable for fast bowlers, who are consequently exposed to greater bowling workload.[4]

Fast bowling involves more sprinting compared to other roles in cricket, as measured by Global Positioning System (GPS).[8] The delivery stride phase when bowling involves considerable acceleration and deceleration, which is a known hamstring injury risk factor.[5-7] For fast bowlers, an increased risk for hamstring injuries has been found from First Class (multi-day) cricket; however, in One-Day (50 over) cricket, it is batsmen that are more likely to get injured.[4] This increased injury risk for batsmen in the shorter One-Day and T20 competitions (compared to multi-day cricket), may be due to the increased sprinting required in these more intense formats,[8-9] but these hypotheses require further exploration and validation.

To date, no study has formally established the extent of the hamstring injury situation in elite men's domestic cricket in England and Wales. Accordingly, this study aimed to describe hamstring injury incidence between competition formats, activity at time of injury, and time of season to facilitate the identification of potential risk factors for sustaining this injury in this setting.

METHODS

This prospective cohort study included all male players registered to play 1st XI domestic cricket from all 18 First Class County Cricket (FCCC) clubs in England and Wales from April to September from 2010 through 2019 inclusive (mean n = 402 players registered at the start of each season). The players have consented to participate in the England and Wales Cricket Board (ECB) injury surveillance programme and all injuries recorded during this period were included in the study.

This study included time loss injuries only, which in line with the updated consensus on cricket injury surveillance, was defined as: "any injury (or medical condition) that either: 1) prevents a player from being fully available for selection for a major match or 2) during a major match, causes a player to be unable to bat, bowl or keep wicket when required by either the rules or the team's captain".[10] All injuries were recorded by FCCC club's medical staff, most often the lead physiotherapist on a purpose built central online medical records systems: Profiler (The Profiler Corporation, New Zealand, 2010-2016 inclusive), and Cricket Squad (The Sports Office, UK, 2017-2019 inclusive). Included in the medical record for each injury, the squad physiotherapists and/or Club Medical Officer records the injury location and diagnosis based on the Orchard Sports Injury Classification System Version 10[11] as well as cricket specific activities at the time of onset. Diagnosis is made by the club's medical staff via a mixture of clinical assessment and/or a scan (e.g., ultrasound or magnetic resonance imaging [MRI]). However, it is important to note that only the outcome of the diagnosis is included on the central online medical records system, not the method used in the diagnosis. As a result, it is not possible to identify which injuries were diagnosed through just clinical assessment (with no imaging) and how many were confirmed by imaging. Thigh injuries were identified by filtering on injury location and then split into hamstring by the Orchard code, description and, if needed, the additional notes provided.

Before the ECB shared the injury surveillance data with the University research partner, the data was anonymised and checked for any errors by the ECB Injury Surveillance Officer who removed any identifiable data and assigned numerical IDs to players and injury records. Errors in the data included duplicate records and injures recorded that either remained open or needed updating or contained discrepancies, such as the body region recorded not matching the selected Orchard code. Such records were investigated by the ECB Injury Surveillance Officer (who is a trained physiotherapist with applied medical experience) and if needed, checked with the relevant practitioner or club who recorded the injury and updated accordingly. Any duplicate records were removed. All players provided informed written consent for their data to be routinely collected and analysed by the ECB and a University research partner, arranged in conjunction with the players' union, 'The Professional Cricketers Association'. Player consent was taken at the time of annual registration and reviewed if there were any significant process or contractual changes at the start of pre-season. Ethics approval was obtained from the University of Bath, Research Ethics Approval Committee for Health (REACH) [reference: EP 17/18 111].

Injury incidence was calculated following guidance in the updated consensus and to enable comparison to previous research, two injury incidence units are used, both applied retrospectively:

1. Match injury incidence includes all new and recurring (injury of the same type, on the same side, in the same body region, in the same season as an injury from which a player has previously recovered) match injuries reported for all phases (batting, bowling and fielding). It considers only injuries occurring during major matches[10] and is provided for each competition

format and then body region and activity at time of injury with the unit of injuries per 1,000 team days.[2-4]

2. Seasonal injury incidence is calculated from all new and recurring injuries per 100 players per season (183 days each domestic season) and allows for match and training injuries to be contained in one measurement. The consensus statement recommends the incidence unit of 'annual injuries per 100 players per year',[10] but given the fixed six-month nature of the domestic season in England and Wales, extrapolating the seasonal incidence to provide an annual incidence did not seem appropriate as it over-estimated the extent of the injury situation for the year. Particularly when there is distinct six-month off season for cricket in England and Wales with a greatly reduced number of injuries.

It is important to note some players may travel abroad to compete in professional competitions during the off-season, as well as some players being involved with international training and matches throughout the year. These additional duties would add to the cumulative load for the players concerned, but such instances were not captured and included in this study.

Injury incidence was summarised with descriptive statistics (mean and 95% Poisson confidence intervals [CI]). Significant differences were identified when the 95% CIs of individual categories did not overlap.

RESULTS

During the study period, 236 time loss hamstring injuries were recorded, averaging 24 injuries per season and resulting in an overall average seasonal time loss injury incidence of 5.9 injuries/100 players. Biceps femoris strain grade 1-2 (Orchard code: TMHB) was the diagnosis with the highest seasonal injury incidence (2.5 injuries/100 players), which was significantly different to the injury incidence rates for all other hamstring Orchard codes (Supplementary table 1).

One-Day cricket was the format presenting the highest risk for hamstring injuries, with the highest match injury incidence (mean 27.2 injuries/1,000 team days). Both the shorter formats (One-Day and T20 cricket) had significantly higher mean match time loss injury incidence to the longer First-Class format (Fig 1).

For all formats combined, 'Batting – Running between wickets' (2.5 injuries/1,000 team days) and 'Bowling – Delivery stride or follow through' (2.3 injuries/1,000 team days) were the activities with the highest hamstring match time loss injury incidence. Both activities had significantly higher injury incidence than other activities, except for 'Fielding – Running' (Table 1).

For the multi-day First-Class format, 'Bowling – Delivery stride or follow through' (Mean 2.3 injuries/1,000 team days) and 'Bowling – Run up' (Mean 1.1 injuries/1,000 days) were the activities with the highest match time loss injury incidence. 'Bowling – Delivery stride or follow through' was the only activity that was different to others, with it being significantly different to all but the second to fifth ('Bowling – Run up'; 'Batting – Running between wickets'; 'Fielding – Running'; 'Bowling') most common activities (Supplementary table 2).

For the One-Day match format, 'Batting – Running between wickets' (Mean 8.4 injuries/1,000 team days) and 'Batting' (Mean 3.7 injuries/1,000 team days) were the activities that had the highest mean hamstring time loss match injury incidence rates. The injury incidence rate for 'Batting – Running between wickets' was not significantly different from the second ('Fielding – Running'), third ('Bowling – Delivery stride or follow through') and fourth ('Fielding – Diving') most common activities, but significantly greater than the rest (Supplementary table 3).

For T20 cricket, 'Batting – Running between wickets' (4.8 injuries/1,000 team days) and 'Fielding – Running (3.5 injuries/1,000 team days) had the highest match time loss injury incidence, although these were not significantly different to other activities for this format (Supplementary table 4).

April (the start of season) was the month with the highest hamstring match injury incidence rates (22.7 injuries/1,000 team days), with the second lowest exposure (mean competitive team days played). September was the lowest for injury incidence (4.1 injuries/1,000 team days) and mean team days played. The injury incidence rate for September was significantly lower than all other months in the season (Fig 2).

DISCUSSION

The aim of this study was to examine hamstring injury risk factors for elite men's cricket in England and Wales, focusing on competition format, activity at time of injury, and time of season. The injury diagnosis with the highest seasonal incidence was 'Biceps femoris strain grade 1 – 2', with the highest risk for hamstring injuries from One-Day cricket. Both shorter competition formats (One-Day and T20 cricket) had significantly higher injury incidence than the longer First-Class format. Batting (running between the wickets) and bowling (particularly the delivery stride or follow through) were the activities with significantly higher risk of hamstring injury. The highest injury rates were observed at the start of the season in April, with the fewest injuries at end of the season in September, although differences in incidence between months was only significantly lower for September.

Batting, in particular the activity of running between the wickets, had the highest match time loss injury incidence in the shorter competition formats of One-Day and T20 cricket, which supports the findings from previous research.[4] Considering the findings from the previous hamstring injury risk in cricket study were based on data over a 20-year period (1995-1996 to 2014-2015 inclusive) in Australia,[4] along with the current study (over a 10-year period), there are now two longitudinal studies with similar findings, providing a solid empirical base for the different activity injury risks between competition formats. Using GPS data, One-Day and T20 cricket have been shown to be more intense than the multi-day test format, with the emphasis on quick runs requiring more sprinting from batsmen during these shorter formats.[8-9] Given the link between hamstring injuries and high-speed running,[5-7] increased sprinting/acceleration brings with it an increased risk of injury, particularly when 'grounding the bat', where batsmen are required to decelerate in a lengthened position.

The differences in activity risk between competition formats have practical implications for sport practitioners working within cricket. Medical staff need to be prepared to manage the increased injury risk for specific activities in certain formats, particularly with the introduction of another shorter format in England and Wales for the 2021 season ('The Hundred'), which increases player exposure to these shorter, more intense formats. The finding from the current study of a high incidence of hamstring injuries when running whilst fielding in the current shortest format of the game (T20), can be further monitored with the new 100 ball format, which will replace T20 as the shortest format of the game. The evidence for the specific risks associated with the shortest formats is not as strong as it is with the other formats, as the injury profile of elite senior men's domestic T20 cricket has only been reported in one previous study[3] and so further validation is needed.

Bowling, in particular the delivery stride or follow through (a phase of bowling particularly susceptible to injury due to the required acceleration and deceleration), was the activity with the highest match time loss injury incidence in longer multi-day Test cricket. The incidence for this activity was significantly higher relative to other activities (aside from the top five activities with the highest time loss match injury incidence rates) in this format. However, it is important to highlight that unlike differences between formats for injury risk of running between the wickets when batting, the bowling delivery stride or follow through injury incidence for Test cricket was similar to what was found in the other shorter formats. This suggests hamstring injury risk in this instance is potentially related more to the activity itself as opposed to being affected by different competition formats and match intensity.

Match time loss injury incidence was highest in April, the first month of the competitive season. It may be that players are not adequately prepared to meet the increase in intensity of competitive matches, increasing the risk of soft tissue injuries. The season typically starts with a block of multi-day cricket, which, as the least intense of the match formats,[8-9] should present less of an injury risk compared to the season starting with a shorter format. However, multi-day cricket does contain the highest workload volume (out of all the formats), with sudden increases in workload found to be associated with increased injury, particularly in fast bowlers.[12-13] Ensuring players are suitably conditioned to meet the demands of the start of the competitive season is a noted challenge for sports practitioners in this setting. Not least as it can be difficult in pre-season training to replicate the intensity and distances covered in competitive matches, due to factors like weather at that time of year,[14] which restricts access to suitable outdoor training environments. However, it is worth noting, the higher injury rates for April were not significantly different statistically to other months (except for September that had significantly lower incidence compared to other months). The absence of significant differences may be a result of the small injury sample when broken down by month and more research is needed to understand the potential increased risk of injury at the start of the season, which may provide an opportunity for preventative strategies in this area. Consideration must also be given to the cumulative workload for players who have competed overseas during the off-season, which may have skewed the results, particularly in relation to the high incidence observed in the first month of the season. Future research should look to identify such players and quantify the effect such involvement in overseas leagues may have on injury risk.

Given how common hamstring injuries are across all sports involving sprinting,[5-7] various approaches to prevention have been explored that could be employed in this setting. The most effective of which appears to be a combination of eccentric Nordic hamstring exercises[15] and regular exposure to high-speed running.[16-18] However as encouraging as the evidence may be for Nordic hamstring exercises, there can be some noted barriers to adoption, such as a lack of positive perception from players and the resulting muscle soreness, which was reported in a sample of English professional soccer clubs.[19] But this is not just limited to Nordic exercises, strength imbalance in general (identified with pre-season isokinetic testing), has been shown to increase the risk of hamstring injury, which can be decreased by the restoration of a normal strength profile.[5] Though hamstring strength is just one risk factor that can be targeted with preventative initiatives and although the identification of single risk factors provides direction for practitioners, it fails to account for the complex nature of injuries and the interactions between multiple risk factors.[20] It can be difficult to capture such interactions with conventional data model approaches,[21] but algorithmic modelling, which includes supervised learning techniques, may provide a solution that can account for these kind of multifaceted interactions.[22] Such techniques have been shown to be reasonably effective in developing a preventive model for hamstring injuries in professional Spanish soccer.[23] However, the usefulness of such models can be limited to the extent the intricate methodologies can be widely adopted by practitioners.

There are also limitations to consider with the findings of this study. As with any descriptive epidemiology study utilising human data entry, there is risk of error not just in the data entered but the maintenance and updating of records. Over time, processes have been introduced to reduce such potential error and provide some assurance in the validity of the data. Standardised processes and definitions set by the ECB and the international consensus statement should help in reducing potential misclassification bias but with 18 different clubs in the County Championship, this remains a small but tangible risk. This is particularly pertinent around diagnosis and accuracy of the Orchard codes and descriptions selected. Furthermore, due to the way data was collected and stored it was not possible to identify what injuries were diagnosed through clinical assessment without or with imaging (the most accurate method for hamstring strain or tear injury diagnosis). Although there is confidence in the experience of the club's medical staff to diagnose correctly, in some instances where a broader diagnosis is provided (e.g., 'TMXX:Thigh Muscle strain/ Spasm/ Trigger Points'; 'TXXX:Thigh Injuries'), the injury was included in the current study if the additional notes included a mention or description related to a 'hamstring injury'. However, this identification was not always possible if there were no additional notes provided, which may have resulted in some hamstring injuries being excluded from the study. It is worth highlighting this only related to a small number of injuries (*n* = 6 across the study period) and it was deemed their exclusion would not affect the overall findings of the study.

CONCLUSION

This study described hamstring injury incidence between competition formats, activity at time of injury, and time of season to identify risk factors for sustaining this injury in this setting. The highest injury incidence was found for One-Day cricket and running between the wickets when batting for the shorter competition formats. The bowling delivery stride or follow through was the activity with the highest incidence for the longer multi-day Test format, although similar incidence was observed across all formats, suggesting that with bowling, hamstring injury risk is associated more with the activity itself as opposed to changes in workload or match intensity. The start of the season had the highest hamstring injury incidence, which may allude to players not having adequate conditioning and preparedness to meet physical demands at the commencement of the competitive season. Although not all the differences observed in the study were significant, they still have practical relevance for sport practitioners working in this context and identify potential opportunities for future research and preventative strategies.

Practical implications

- Similar bowling injury incidence across competition formats suggests relative equal hamstring injury risk for this activity, whereas higher injury incidence for running between wickets when batting in the shorter formats, implies hamstring injury risk for this activity is more susceptible to changes in match intensity.

- These findings highlight the differing hamstring injury risk for competition format and activity that can inform how sport practitioners approach managing the risk of this frequently occurring injury.
- Identifying increased injury risk at the start of the season may help guide pre-season preparations to ensure players are more conditioned and better prepared physically to meet the demands of the competitive season commencing.

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Table legends

Table 1: Match time loss injury incidence (injuries/1,000 team days) for activity at time of injury for all competition formats

Activity at time of injury	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean (95% CI)
Batting - Running between wickets	0.6	5.1	3.4	4.0	2.0	2.7	1.3	1.5	0.8	3.2	2.5 (1.8, 3.5)
Bowling - Delivery stride or follow through	1.9	7.0	2.1	3.3	2.0	0.0	0.7	2.3	3.2	0.8	2.3 (1.6, 3.2)
Fielding - Running	1.3	2.5	1.4	0.7	1.3	0.7	1.3	0.8	3.2	2.4	1.5 (1.0, 2.3)
Bowling - Run up	0.6	1.3	2.1	2.0	0.0	2.0	0.0	0.0	0.8	0.8	1.0 (0.7, 1.4)
Bowling	1.9	0.6	0.0	0.7	0.7	0.0	0.7	0.8	0.8	1.6	0.8 (0.5, 1.5)
Fielding - Diving	0.6	0.0	0.0	0.7	0.0	0.7	0.7	0.0	1.6	1.6	0.6 (0.3, 1.2)
Batting	2.5	0.6	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.8	0.5 (0.2, 1.0)
Fielding	0.0	0.6	0.0	0.0	0.0	0.7	0.0	0.0	0.8	0.0	0.2 (0.1, 0.6)
Batting - Playing shot	0.0	1.3	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2 (0.1, 0.6)
Fielding - Catching	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.1 (0.0, 0.4)
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.1 (0.0, 0.7)
Wicket keeping	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1 (0.0, 0.7)
Fielding - Sliding	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1 (0.0, 0.7)

Graphic legends

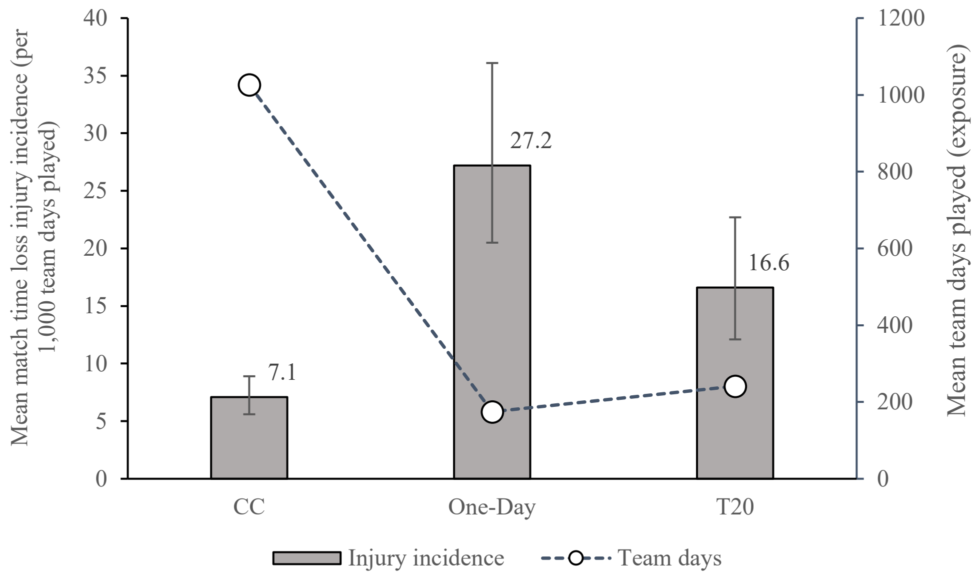

Figure 1: Mean match time loss hamstring injury incidence (per 1,000 team days played) for competition format along with exposure in mean team days played on the second axis

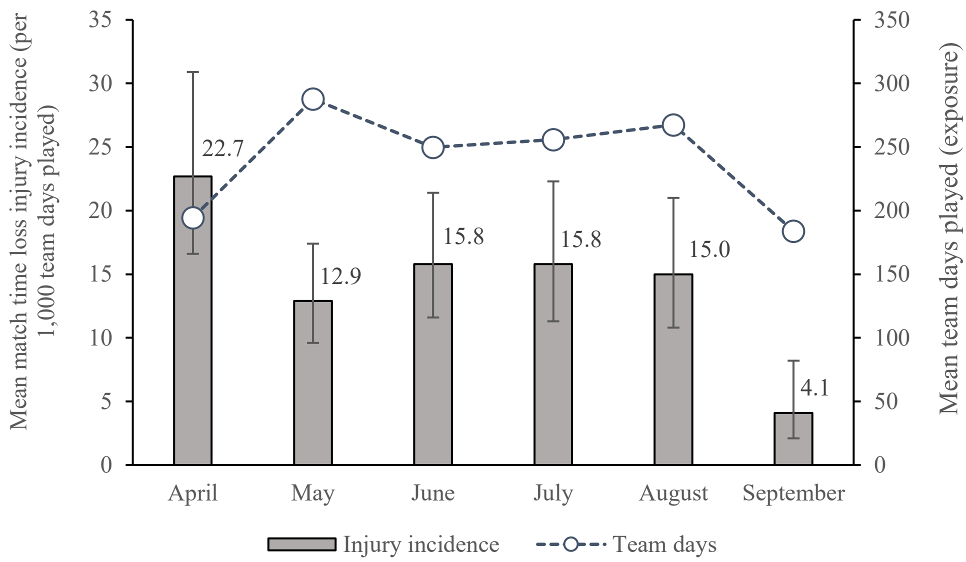

Figure 2: Mean match time loss hamstring injury incidence (per 1,000 team days) for month injured and mean team days played on the second axis

Supplementary tables

Supplementary table 1: Seasonal time loss injury incidence (injuries/per 100 players) for Orchard code hamstring diagnosis

Orchard code	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean (95% CI)
TMHB:Biceps femoris strain grade 1 - 2	2.0	3.6	2.7	2.5	2.1	2.7	1.3	2.0	3.5	3.0	2.5 (2.1, 3.0)
TMHS:Semimembranosis/ tendinosis strain (grade 1 - 2)	2.0	2.6	0.7	2.5	1.3	0.7	1.3	1.7	1.5	1.0	1.5 (1.2, 1.9)
TMHX:Hamstring strain	2.5	2.9	1.0	1.3	0.5	0.5	0.5	1.2	1.0	1.5	1.3 (1.0, 1.7)
TMHR:Grade 3 hamstring strain	0.0	0.2	0.0	0.3	0.0	0.0	0.0	0.0	0.8	0.0	0.1 (0.0, 0.2)
TXXX:Thigh Injuries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1 (0.0, 0.4)
BTHR:Hamstring origin tendon rupture (excl growth plate fracture - see JBFI)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0 (0.0, 0.0)
BTHT:Hamstring origin tendinopathy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0 (0.0, 0.0)
TMLH: Back referred hamstring tightness	0.2	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 (0.0, 0.2)
TMCH: Hamstring cramping during exercise	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 (0.0, 0.0)
TMYH:Hamstring trigger points	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0 (0.0, 0.0)
TTXX:Thigh Tendon Injuries (see Hip/ groin or knee depending on tendon location)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0 (0.0, 0.0)
TMXX:Thigh Muscle strain/ Spasm/ Trigger Points	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.5	0.1 (0.0, 0.3)

Supplementary table 2: Match time loss hamstring injury incidence (injuries/1,000 days play) for activity at time of injury during First-Class cricket

Activity at time of injury	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean (95% CI)
Bowling - Delivery stride or follow through	1.9	6.5	1.8	1.8	1.8	0.0	0.9	3.2	3.4	1.1	2.3 (1.5, 3.5)
Bowling - Run up	0.9	0.9	0.9	2.8	0.0	2.8	0.0	0.0	1.1	1.1	1.1 (0.6, 2.0)
Batting - Running between wickets	0.0	1.8	1.8	0.9	0.9	1.9	0.9	1.1	0.0	0.0	0.9 (0.5, 1.7)
Fielding - Running	1.9	0.9	0.9	0.0	0.9	0.0	0.0	1.1	2.3	1.1	0.9 (0.5, 1.7)
Bowling	0.9	0.0	0.0	0.9	0.9	0.0	0.9	1.1	0.0	2.3	0.7 (0.3, 1.5)
Fielding - Diving	0.9	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.2 (0.1, 0.8)
Fielding	0.0	0.9	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.2 (0.1, 0.8)
Fielding - Catching	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.1 (0.0, 0.7)
Batting - Playing shot	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1 (0.0, 0.7)
Fielding - Sliding	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1 (0.0, 0.7)

Supplementary table 3: Match time loss hamstring injury incidence (injuries/1,000 days play) for activity at time of injury during One-Day cricket

Activity at time of injury	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean (95% CI)
Batting - Running between wickets	0.0	14.4	12.3	5.2	7.9	0.0	0.0	4.0	0.0	4.5	4.8 (2.7, 8.7)
Fielding - Running	0.0	10.8	6.2	5.2	0.0	4.0	0.0	0.0	3.9	4.5	3.5 (1.8, 7.0)
Bowling - Delivery stride or follow through	3.3	7.2	0.0	10.3	4.0	0.0	0.0	0.0	0.0	0.0	2.5 (1,1, 5.6)
Fielding - Diving	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	7.9	4.5	1.6 (0.6, 4.3)
Bowling - Run up	0.0	3.6	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0 (0.3, 4.0)
Bowling	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.7 (0.2, 2.8)
Batting - Playing shot	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.5 (0.1, 3.5)
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.4 (0.1, 2.8)

Supplementary table 4: Match time loss hamstring injury incidence (injuries/1,000 days play) for activity at time of injury during T20 cricket

Activity at time of injury	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean (95% CI)
Batting - Running between wickets	4.7	9.2	4.9	18.4	0.0	13.7	6.5	0.0	6.9	19.7	8.4 (5.1, 13.9)
Batting	18.6	4.6	0.0	0.0	0.0	0.0	0.0	6.8	0.0	6.6	3.7 (1.8, 7.8)
Fielding - Running	0.0	0.0	0.0	0.0	6.8	0.0	13.0	0.0	6.9	6.6	3.3 (1.4, 7.9)
Bowling - Delivery stride or follow through	0.0	9.2	4.9	4.6	0.0	0.0	0.0	0.0	6.9	0.0	2.6 (1.1, 6.2)
Fielding - Diving	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	6.6	1.1 (0.3, 4.4)
Bowling	4.7	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9 (0.2, 3.6)
Fielding	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.7 (0.1, 5.0)
Bowling - Run up	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5 (0.1, 3.5)
Wicket keeping	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5 (0.1, 3.5)
Batting - Playing shot	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5 (0.1, 3.5)
Fielding - Catching	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5 (0.1, 3.5)