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ORIGINAL STUDY

Hamstring injury prevention in Belgian and English elite football teams

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Hamstring injury is the most common injury in European professional football. The purpose of this study was to provide insight into the content of hamstring injury prevention programmes in English and Belgian elite football teams.
Fifteen premier league teams (10 from Belgium and 5 from England) completed a questionnaire on hamstring injury prevention.
Most football teams (93%) screened for hamstring injury risk factors. Less than 60% screened for risk factors including gluteus muscle strength, neural tension and body posture during running. While 80% of the teams had a hamstring injury prevention programme during preseason and official season ; only 47% had a prevention programme during mid-season break. Hamstring muscle strength exercises were mainly performed before (77%) instead of after warming-up.
In conclusion, while most investigated football teams perform hamstring injury prevention, the content and implementation of the prevention programmes is suboptimal in many Belgian and English elite football teams.

Keywords : hamstring injury ; injury prevention ; football ; soccer ; questionnaire.

INTRODUCTION

Hamstring injury is the most common injury in European professional football *(42)*. The incidence rate of hamstring injury in professional football is 12-37% *(13,42)* with high recurrence rates up to 63% *(8,12,42)*. Recently, it was reported that the average yearly financial cost of matches missed due to hamstring strain injuries in Australian football league increased by 71% between 2003 and 2012 *(18)*. This increase is explained by a combination of failure to lower the amount of hamstring injuries and the rise of player salaries. It was estimated that a first-team European soccer player who is out for 14 days due to a hamstring injury costs the club approximately €250,000 *(18)*. These numbers show the current magnitude of hamstring injuries in football teams and the need for prevention.

To prevent hamstring injuries, knowledge on risk factors and underlying mechanisms is essential. A previous hamstring injury has been reported as

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the most important risk factor for future hamstring injuries *(37)*. Although this risk factor is widely accepted, it does not provide specific risk factors where clubs can screen for. There is conflicting evidence about risk factors but in general flexibility, strength, fatigue and core stability have been mentioned as possible risk factors *(29)*.

Hamstring injuries most often occur in explosive sports during sprinting. Especially during the late stance and late swing phase of the running gait cycle, when hamstring muscles contract eccentrically, they are most at risk for injury *(42,43)*. Based on this mechanism, eccentric hamstring muscle strength exercises have been proposed to prevent hamstring injuries. Studies indeed indicate that eccentric hamstring muscle exercises are an effective approach to prevent hamstring injury *(1,2,14,28)*. Brockett and colleagues developed an eccentric hamstring strength training exercise *(5)* that has been further developed by Mjolsnes et al. *(23)* and has been known as the 'Nordic hamstring exercise'. An eccentric training programme has been shown very effective in the prevention of hamstring injuries. Petersen et al. showed a reduction of 59% in hamstring injuries in a randomised controlled trial in the group following the eccentric training programme in comparison to a group following their usual training programme *(28)*.

Whilst this approach has already been introduced in 2001-2002 ; the incidence of hamstring injuries in football teams did not decrease during the last decade *(13,17,39)*. Poor implementation of hamstring injury prevention programmes has been shown to be one of the reasons why these incidence rates remain high *(4,15)*. It is therefore important to investigate the content of the hamstring injury prevention programmes and compliance in European elite football teams. The purpose of this study was to describe the content of the hamstring injury prevention programmes in elite football teams from England and Belgium.

METHODS

Participants

All English (Premier League, n=20) and Belgian (Pro League, n=16) elite football teams were invited to complete a retrospective questionnaire on hamstring injury prevention. Fifteen of the 36 invited elite teams (10 Belgian and 5 English teams) completed the questionnaire (Fig. 1).

An email was sent to the head of the medical department who was asked to complete the questionnaire. The email explained the aim of the study and the contact persons were asked to complete and return the survey by email.Data were collected between January and June 2014 and addresses six football seasons : from 2008 until 2014. All data were anonymised.

Fig. 1. — Included football teams Of the 36 invited teams 15 teams were included (5 English and 10 Belgian football teams).

Questionnaire

The questionnaire consisted of 24 detailed questions (Table I). The questionnaire was developed based on a review of recent literature on hamstring injuries *(1-3,7,9-12,14,16,17,19,23-28,30-34,36-38,40,41,43)* and expert opinion of two professors in sports medicine (K. Peers and J. Bellemans) and two sports medicine physicians (G. Van Crombrugge and K. Van Crombrugge). The questionnaire consisted of 6 open and 18 closed questions (multiple choice). Questions were developed to obtain information about the content of hamstring injury prevention programmes including timing, duration and type of exercises. To include as much teams and data as possible, all questions were marked as optional answer. Because answers were marked as optional, the total number of teams might differ for each subject of the results, based on the amount of teams who filled in that specific question. The absolute and relative values were calculated from the completed questionnaires.

Table I. — Questionnaire details

Question 1-5	Question 6-10	Question 11-15	Question 16-20
1. How many players of the first team (+/- 30 players) suffered from a hamstring injury during each season?*	6. What type of hamstring muscle exercises are used in the prevention programme?	11. Do you monitor hamstring muscle strength during the season?	16. Does the coach or staff pay attention to hamstring stretching?
2. Do players (first team of +/- 30 players) get screened for risk factors of hamstring injuries?	7. During which period of the training/match are these exercises given?	12. How do you measure the hamstring muscle strength?	17. Does the coach or staff pay attention to quadriceps stretching?
3. Which of the following points are parts of the screening for hamstring injury related risk factors?	8. Is the Nordic hamstring exercise part of the eccentric exercises?	13. When do you monitor hamstring muscle strength?	18. When does the coach or staff pay attention that players stretch?
4. On what basis do you conclude that a player is at higher risk for hamstring injuries and needs prevention?	9. Since when does the team use this Nordic hamstring exercise in the prevention programme for hamstring injuries?	14. How many times do you monitor hamstring muscle strength?	19. What type of stretching?
5. When do these players get hamstring injury prevention?	10. When do you use the Nordic hamstring exercise?	15. Are core balance exercises part of the prevention?	20. What is the holding time of the stretching?

*Definition of hamstring injury: Posterior tight pain with signs of a hamstring injury found during clinical examination (tenderness on palpitation, with or without pain on stretch or contraction of the hamstring muscle group) and the player being not able to participate in at least one training or match. **Biomechanical evaluation, body posture during running, core balance, gluteus muscle strength, hamstring muscle strength, hamstring tightness, hamstring-quadriceps strength balance, lumbar spine and sacro-iliacal joint examination, neural tension testing, pelvic mobility, quadriceps tightness

RESULTS

Hamstring injury prevention

60% of all teams submitted every player of the team for hamstring injury prevention and 33% of the teams submitted only players who were at increased risk for hamstring injuries (Fig 2 ; data complete for n=14). Increased risk was defined by these teams as a previous hamstring injury or having at least one risk factor for hamstring injuries found during screening. One team did not have a specific hamstring injury prevention programme ; however hamstring injury prevention exercises were included in a general injury prevention programme. The majority of the teams (14/15) screened for hamstring injury risk factors. In the 14 teams screening for risk factors, hamstring muscle strength testing was part of the screening in all of these teams (Fig. 3). The other most commonly screened risk factors (93%) were hamstring tightness, lumbar spine pathology and sacroiliac joint dysfunction. Less commonly screened risk factors were gluteus muscle strength (57%), neural tension (43%) and body posture during running (29%).

Type and timing of hamstring injury prevention

80% of the teams performed hamstring injury prevention during preseason and during the official season, 47% also performed hamstring injury prevention during the mid-season break

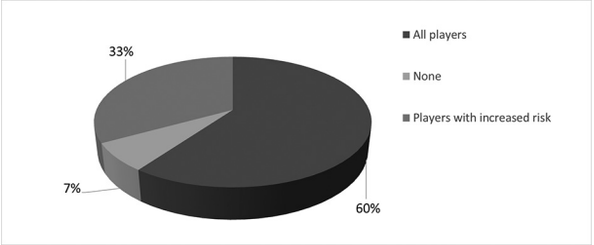

Fig. 2. — Players receiving hamstring injury prevention. 60% of the teams submitted every player of the team for hamstring injury prevention, 33% of the teams submitted players who were at increased risk for hamstring injuries and 7% did not have a specific hamstring injury prevention programme (data complete for n=14).

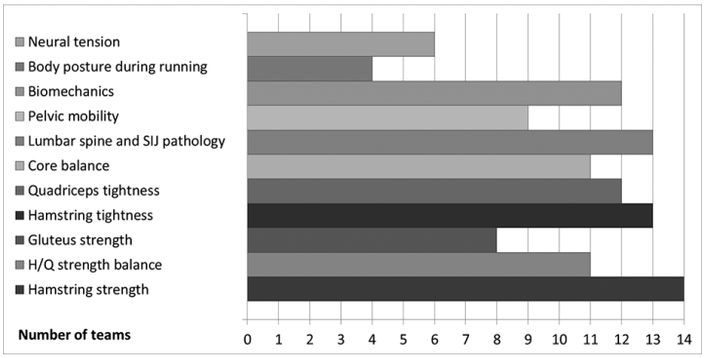

Fig. 3. — Hamstring injury risk factors in screening programme SIJ: sacroiliac joint ; H/Q: hamstrings/quadriceps.

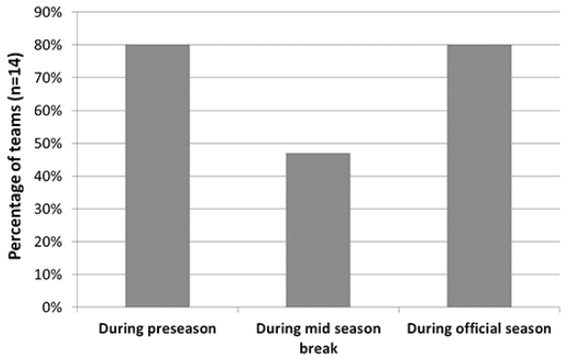

Fig. 4. — Screening for hamstring injury risk factors during the season. 80% percent of the teams screened for hamstring injury risk factors during preseason and the official season, 47% of the teams screened during mid-season break.

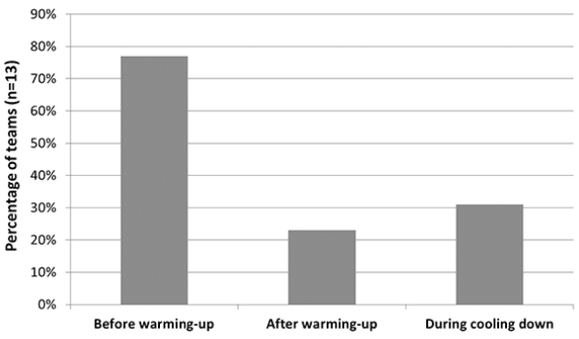

Fig. 5. — Timing of hamstring muscle exercises. 77% of the teams performed hamstring muscle exercises before warming-up, 23% after warming-up and 31% during cooling down.

(Fig. 4 ; data complete for n=14). The type of hamstring muscle exercises were divided into three categories : isometric, concentric and eccentric. All teams performed eccentric type of hamstring muscle strength exercises. In addition, 93% of them performed concentric exercises and 36% isometric exercises (data complete for n=14). Concerning timing of hamstring muscle strength exercises, 77% performed them before warming-up, 23% after warming-up and 31% during cooling down (Fig. 5 ; data complete for n=13). In addition, 92% of the teams used core balance exercises in the hamstring injury prevention programme (data complete for n=13).

Nordic hamstring muscle exercise

The Nordic hamstring muscle exercise was part of the eccentric exercises in 93% of all teams (data complete for n=14). 92% of these teams performed the Nordic hamstring muscle exercise during the official football season and 85% also used them during preseason. Five teams implements this exercise since 2007, 1 team since 2008, 1 team since 2010 and 3 teams since 2011.

Stretching

In 83% of the teams, the football players performed hamstrings and quadriceps stretching (data complete for n=12). 44% stretched before warming-up, in between exercises and after training ; 78% also stretched after warming-up (data complete for n=9). Concerning the type of stretching (data complete for n=8) : 50% used static stretching ; 50% used proprioceptive neuromuscular facilitation (PNF) ;

38% used ballistic type of stretching and 38% used another type of stretching. 75% of the teams had a stretching time below 15 seconds or had no specific stretching time, 25% had a stretching time longer than 15 seconds (data complete for n=8).

DISCUSSION

The purpose of this article was to present the content of hamstring injury prevention programmes in English and Belgian elite football teams. The results concerning hamstring injury prevention programme implementation revealed that almost every team screened for possible hamstring injury risk factors. Hamstring muscle strength, hamstring tightness, lumbar spine and sacroiliac joint dysfunction were risk factors which most teams in our study screened for. Less teams screened for gluteus muscle strength, neural tension and body posture during running. There is conflicting evidence about most risk factors *(7,9,11,19,25,27,30 31,33,34,36,37,40,41)*. In a recent systematic review of van Beijsterveldt and colleagues, only a previous hamstring injury was strongly associated with hamstring injuries *(37)*. They concluded that more prospective studies with larger sample sizes are needed, including a greater number of variables to conduct multivariate analysis. As Mendiguchia et al. suggested, it is likely that hamstring injuries are the result of an inter-relationship between multiple risk factors *(22)*. Future research using a multidirectional model might be able to identify more specific risk factors in order to provide better advice on hamstring injury risk screening.

Whilst the effectiveness of prevention programmes has been established *(1,2,14,28)* only 60% of the teams in our study submitted all team players for hamstring injury prevention. Most of the other teams only submitted players with increased risk for hamstring injuries. In addition, our results indicated that prevention is mostly performed during preseason and the official season. However, most hamstring injuries occur during the mid-season period *(42)* when most teams did not perform hamstring injury prevention.

The most important aim of this study was to investigate the content of the hamstring injury prevention programmes in elite European football teams. We observed that most of the teams used a combination of concentric and eccentric hamstring strength exercises. The eccentric Nordic hamstring exercise was part of these exercises in 93% of the teams. Petersen et al. as well as other authors showed that these eccentric hamstring exercises reduce the number of overall, new and recurrent hamstring injuries with 50-90% *(1,2,14,28)*. Mounting evidence showed that Nordic hamstring exercises are effective in reducing hamstring injuries *(1,2,6,14,28)*. Most teams in our study performed the hamstring muscle exercises before warming-up. However, without pre-stimulation, muscles might be more prone to strain *(26)*. It has been recommended that these eccentric exercises are performed after warming-up or during cooling down when the muscles are in fatigued state. It has been suggested that eccentric hamstring exercises, performed during cooling down, are more effective in maintaining eccentric hamstring strength during the later stages of a football match and this is important since most injuries occur during the later stages of a football match *(32,42)*.

This study showed that the Nordic hamstring exercise is applied in most of the elite football teams of England and Belgium but the implementation and compliance still needs more attention. We found that not all players performed the Nordic hamstring exercise. Most teams did the eccentric exercises before warming up and did not perform eccentric exercises during mid-season. These results are in line with the recent results of Bahr and colleagues, showing a percentage 83% non-compliancy of the Nordic Hamstring programme in UEFA Champions League and Norwegian Premier League teams *(4)*. A recent systematic review showed that compliance to eccentric interventions like the Nordic hamstring exercise is primordial, showing a 65% reduction in highly compliant teams and no reduction in less compliant teams *(15)*. Compliance is also an issue for other injuries, a meta-analysis investigating the effect of high, moderate and low compliance to neuromuscular training in regard to anterior cruciate ligament injuries *(35)* concluded that athletes with a moderate compliance rate had a 3.1 times greater risk and athletes with low compliance

had a 4.9 times greater relative risk of ACL-injury than athletes with high compliancy. Based on this study, incorporation of the exercises in a warm-up or as a part of regular practise is a good strategy to enhance compliance. Also strategies to maintain adherence to the exercises like supervision, exercise variation and education may be important to enhance compliance. A recent systematic review and meta-analysis on compliance to eccentric hamstring prevention exercises *(15)* concluded that decreased intervention compliance is the key reason for inconclusive evidence regarding eccentric hamstring strengthening. They also concluded that for compliant athletes, there is a 65% decreased risk of hamstring injuries. Reasons for non-compliance to these eccentric exercises are delayed onset muscle soreness, high volume of these exercises and poor supervision. Coaching workshops, policy enactment of the club and emphasising performance-enhancement are proposed as means to enhance compliance to these eccentric hamstring exercises.

Results for stretching showed that most teams performed stretching of the hamstrings and quadriceps. The timing, type and holding time of stretching varied widely across teams. We observed that the majority of the teams had a stretching time below 15 seconds or had no specific stretching time. There is conflicting evidence regarding the duration and effectiveness of stretching in hamstring injury prevention **(20,21)**. More research on this topic is needed to provide good stretching guidelines.

There are some limitations in our study. First, the response rate was moderate (15/36 teams). Second, we only presented data from the English and Belgian elite football teams. Therefore, the results of our study cannot be generalised to teams in other leagues and other countries. Last, to include as much teams and data as possible, all questions were marked as optional answer. As a result, not all questions were completed by the teams.

In conclusion, while most football teams have a hamstring injury prevention programme, the content of the prevention programmes and implementation is suboptimal in many Belgian and English elite football teams. We observed room for improvement in several areas including the screening for risk factors, timing of the hamstring muscle exercises (after warming-up) and the implementation of a prevention programme during mid-season when most hamstring injuries occur.

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