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## **Title**

Evidence-based hamstring injury prevention is not adopted by the majority of Champions League or Norwegian Premier League football teams: the Nordic Hamstring survey

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## **ABSTRACT**

**Background:** The Nordic hamstring (NH) exercise program was introduced in 2001 and has been shown to reduce the risk of acute hamstring injuries in football by at least 50%. Despite this, the rate of hamstring injuries has not decreased over the last decade in male elite football.

**Aim:** To examine the implementation of the NH exercise program at the highest level of male football in Europe, the UEFA Champions League (UCL), and to compare this to the Norwegian Premier League, Tippeligaen, where the pioneer research on the NH program was conducted.

**Design:** Retrospective survey.

**Setting/Participants:** 50 professional football teams, 32 from the UCL and 18 from Tippeligaen.

**Methods:** A questionnaire, based on the RE-AIM framework, addressing key issues related to the implementation of the NH program during three seasons from 2012 through 2014 was distributed to team medical staff using electronic survey software.

**Results:** The response rate was 100%. Of the 150 club-seasons covered by the study, the NH program was completed in full in 16 (10.7%) and in part in an additional 9 (6.0%). Consequently, 125 (83.3%) of club-seasons were classified as non-compliant. There was no difference in compliance between the UCL and Tippeligaen in any season ( $X^2$ : .41 to .52).

**Conclusions:** Adoption and implementation of the NH exercise program at the highest levels of male football in Europe is low, too low to expect any overall effect on acute hamstring injury rates.

## BACKGROUND

Hamstring injuries represent a significant concern in many sports. In fact, recent studies from the professional level show that acute hamstring injuries rank as the first or second most common injury in male association football,<sup>1-4</sup> Australian Rules football,<sup>5, 6</sup> rugby<sup>7, 8</sup> and American football,<sup>9, 10</sup> in most studies accounting for one in every five to six injuries. In male association football, the proportion of hamstring injuries seems to have increased gradually compared to other injury types such as ankle sprains over two decades from 7% around 1980<sup>11, 12</sup> to 12–17% after 2000.<sup>11, 13-15</sup> Given the financial and competitive concerns in professional sports, another significant feature of hamstring injuries is that they often result in a prolonged absence from competition<sup>16-18</sup> and have a high recurrence rate.<sup>19-21</sup>

In football, acute hamstring injuries mainly involve the biceps femoris muscle, more often than the semimembranosus or semitendinosus,<sup>19</sup> and typically occur during high-speed running.<sup>4, 19, 22</sup> Since the net moment developed by the hamstrings is thought to be maximal in the late swing phase, right before heel strike, this is thought to be the vulnerable position.<sup>23-25</sup> In this instance, the hamstring muscles work eccentrically.

Based on the assumption that hamstring injuries occur as a result of strength deficits,<sup>26</sup> particularly insufficient eccentric muscle strength, in 2001 Mjøl̄snes et al.<sup>27</sup> developed an eccentric hamstring strength training program. The program is based on the Nordic Hamstring (NH) exercise, as this is a partner exercise that can easily be performed on the pitch without special equipment.

In a randomized training study on well-trained male football players, about half of them from the Norwegian Premier League (Tippeligaen), NH training for 10 weeks was shown to be much more effective in developing maximal eccentric hamstring strength than a comparable program based on regular concentric hamstring curls.<sup>27</sup> The same group then introduced the NH exercise in Tippeligaen in 2002, demonstrating that the incidence of hamstring injuries was 57% lower in teams that chose to use the NH training program compared to teams that did not use the program and 58% lower than baseline data from the previous seasons for the same teams.<sup>1</sup> Finally, in 2008 Petersen et al.<sup>28</sup> completed a randomized intervention trial on 50 Danish male elite, sub-elite and amateur football teams (942 players), documenting that the rate of new acute hamstring injuries was 59% lower in the intervention group, who were prescribed the complete 10-week NH program (Fig 1). Notably, the effect on recurrent hamstring injuries was even more pronounced; reinjury rate was 86% lower in the intervention group.

Thus, ample evidence has been available since the last report was published in 2011<sup>28</sup> documenting that the rate of acute hamstring injuries can be reduced by at least 50%. Despite this, the UEFA Champions League (UCL) injury study shows that the acute hamstring injury rate has not decreased over the last decade in elite football.<sup>29</sup> In the Norwegian Premier League, match injury incidence increased by 6% each year from 2002 through 2007, with a trend towards an increase in acute thigh injuries.<sup>30</sup> Therefore, based on the assumption that elite teams have implemented the NH program based on the consistent evidence available, authors have questioned the effect of the program.<sup>29</sup>

However, the gap from research to implementation is well known, and the full potential of prevention programs will only be realized if they are adopted, correctly executed and sustained by their intended end users. The RE-AIM framework has been developed to describe five key components to successfully close the gap: Reach, Efficacy, Adoption, Implementation and Maintenance.<sup>31; 32</sup> A recent review concludes that information on the RE-AIM components in published trials on injury-prevention exercise programmes in team ball sport is scarce, especially regarding the adoption and maintenance of programmes.<sup>31</sup>

Our objective was to use the RE-AIM framework to examine the application of the NH exercise program at the highest level of male football in Europe, the UCL, and to compare this to Tippeligaen, where the pioneer research on the NH program was conducted. We therefore expected reach, adoption and implementation to be higher in Tippeligaen than in the UCL.

## **MATERIALS & METHODS**

### *Study participants*

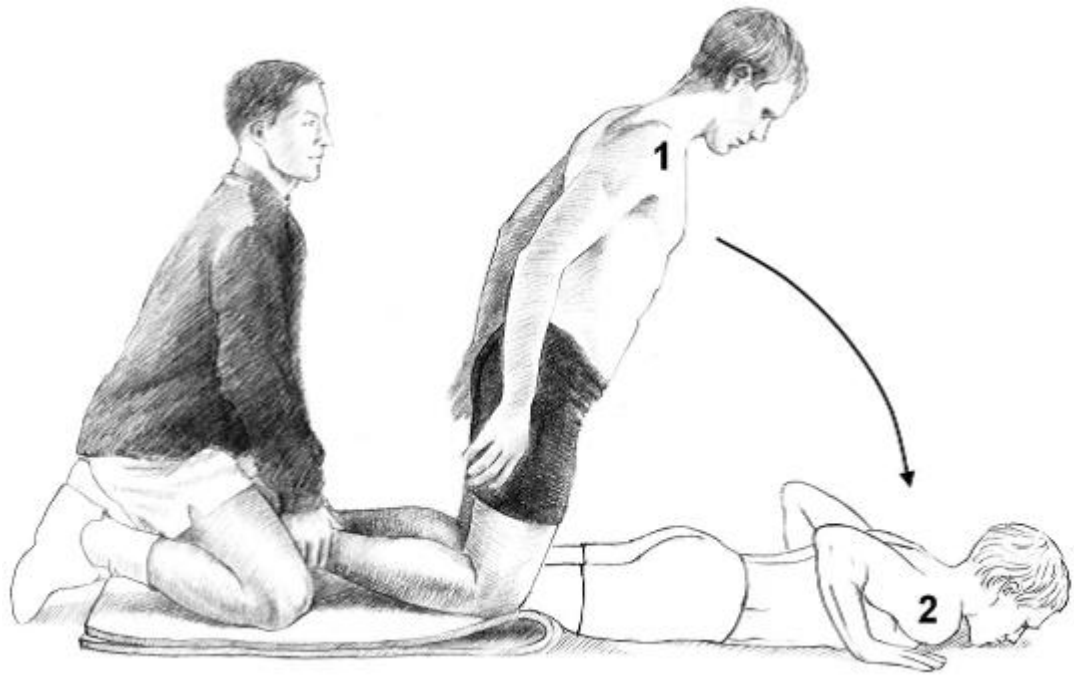
We invited 32 UCL teams and 18 teams from Tippeligaen to take part in the study. The UEFA Champions League (UCL) teams were selected by UEFA as either being qualified among the 32 teams in the UCL ground play stage for the season 2014-15 or had participated in the play-off stage or were ranked as one of the 50 best teams in Europe during the period 2001-2014. The Tippeligaen teams were qualified for the Norwegian Premier League during the 2014 season or had been relegated to the second division after the 2013 season. All teams invited participated in the UCL or Tippeligaen injury surveillance programs, which have been in place since 2001-02<sup>2; 33</sup> and 2000,<sup>14</sup> respectively.

### *The Nordic Hamstring Survey*

A questionnaire addressing key issues related to the reach, effectiveness, adoption, implementation and maintenance of the NH program was developed in collaboration between the authors, was reviewed by colleagues with expertise on the RE-AIM framework and then pilot tested in local elite teams not involved in the study until readability and understanding was ensured (Table 1). The questionnaire included a description of the exercise, as well as the complete, initial Nordic hamstring exercise program (the 10-week progression model) and the weekly maintenance program with the Nordic hamstring exercise (one session each week) (Fig 1).

*Fig 1.* The Nordic Hamstring Survey (questionnaire) description of the Nordic hamstring exercise program. When responding to the questions, they were asked to keep the following definitions in mind:

- *Nordic hamstring exercise:* An eccentric strength training exercise targeting the hamstring muscles:



- *Nordic hamstring exercise program*: The complete initial program includes a 10-week exercise progression, advancing from 1 to 3 weekly training sessions, and with increasing number of sets and repetitions. After the 10-week exercise progression, the maintenance program of 1 weekly maintenance session follows throughout the rest of the season. Reproduced with permission.<sup>27</sup>

*Table 1.* The Nordic hamstring survey included the following questions (response options and RE-AIM framework domain are shown in parenthesis):

- Were you familiar with the Nordic hamstring exercise program aimed at reducing hamstring injuries? (Yes; No) (Reach)
- Have you used the complete, initial Nordic hamstring exercise program (the 10-week progression) in your first team squad at the start of each of the following seasons: 2012, 2013 and 2014? Choose one option for each season: (Yes, the complete 10-week program; Yes, but only for 7-9 weeks; Yes, for only 5-6 weeks; Yes, but only for 4 weeks or less; No, not at all) (Adoption)
- On which players in your first team squad did you use the initial Nordic hamstring exercise program in each of these seasons? (All players from the first team squad; Players with a history of hamstring injury only; No players; Other selection criteria (if yes, please describe your selection criteria)) (Adoption)
- How many players in your first team squad completed the initial Nordic hamstring exercise program (the complete 10-week program) in each of these seasons? (>75% of players; 50 to 74%; 25 to 49%; Less than 25%) (Implementation)
- Have you used a weekly maintenance program with the Nordic hamstring exercise (one session each week) in your first team squad during each of the following seasons: 2012, 2013

and 2014? Choose one option for each season: (Yes, every week; Yes, most weeks; Yes, but sporadically; No, not at all) (Adoption)

- On which players in your first team squad did you use the weekly maintenance program in each of these seasons? Choose one option for each season: (All players from the first team squad; Players with a history of hamstring injury only; No players; Other selection criteria (if yes, please describe your selection criteria)) (Adoption)
- How many players in your first team squad completed the weekly maintenance program in each of these seasons? Choose one option for each season: (>75% of players; 50-74%; 25-49%; Less than 25%) (Implementation)
- Have you experienced any complaints about the Nordic hamstring exercises from players in your first team squad during the season? Choose one option: (Many; More than a few; A few; No complaints) (Effectiveness)
- How satisfied are you with the Nordic hamstring exercises in your first team squad? (Very dissatisfied; Dissatisfied; Indifferent; Satisfied; Very satisfied) (Effectiveness)
- On what basis did you make this assessment? Please let us know how you agree or disagree with each of the following statements: 1) It really reduces injuries, 2) It makes more players available for team selection, 3) Players can return to play sooner after injury, 4) Players perform better, 5) It's really easy to get players to do the program, 6) The players really like the program and see its value, 7) It causes muscle soreness in players, 8) It increases sprint speed and acceleration. (Fully agree; Partly agree; Indifferent; Partly disagree; Fully disagree) (Effectiveness)
- Is there a formal policy at your club concerning hamstring injury prevention concerning your first squad? (Yes; No)
- In the 2014 season, do you deliver any education on the Nordic hamstring injury prevention in the club, for your first team medical and/or coaching staff? (Yes; No, education is not delivered; No, education is not delivered at the moment, but planning to implement education on this in the future; No, education is not delivered, and not planning to implement any in the future) (Maintenance)
- Do you deliver any education concerning the use of any other strategies than the Nordic hamstring injury prevention program for your first team medical and/or coaching staff? (same options as previous question) (Maintenance)
- In the 2014 season, is your first team squad using any specific exercises/exercise programs other than the Nordic hamstring program to prevent hamstring injuries? (Yes; No) If yes, please describe. (Adoption)
- Do you intend to use the Nordic hamstring injury prevention program for your first team squad in the future? (Yes; No; We have not thought about it yet) (Maintenance)
- Which hamstring injury prevention strategy for your first team squad do you intend to use in the future? (Nordic hamstring exercise program is the only strategy we will use in the future; Nordic hamstring exercise program is part of, but not the only strategy we will use in the future; We will have a hamstring injury prevention strategy, but the Nordic hamstring exercise



program is NOT part of this; We will not have a hamstring injury prevention strategy in the future; We have not thought about it yet) (Maintenance)

### *Data collection*

We contacted each club via e-mail to the club representative nominated as the responsible for the club's participation in the injury surveillance program. In most cases, the club representative was the first team physician or physical therapist. They were informed that the aim of the questionnaire was to evaluate if the Nordic hamstring exercise is used, how it is used and if other preventive measures are used in conjunction with the Nordic hamstring exercise or instead. After consenting to participate in the study they were provided access to the questionnaire using online survey software (Questback V. 9692, Questback AS, Oslo, Norway). The questionnaires were distributed in November 2014 to the Norwegian teams (at the end of the 2014 Tippeligaen season, which lasted from April through October) and in January 2015 to the UCL teams (whose 2014-15 season started in August-September 2014). The survey software distributed automatic reminders after 3, 7 and 10 days, after which four clubs were contacted by telephone with an additional reminder.

### *Data analyses*

Based on their questionnaire responses, teams were classified as fully compliant with the NH hamstring program if they reported having used the complete initial NH program (10 weeks) and the maintenance program every or most weeks on >75% of players. Teams were classified as partly compliant if they reported having used the initial NH program for at least 5 weeks and the maintenance program every or most weeks on >50% of players. Teams using the program less than this were classified as non-compliant.  $X^2$  tests were used to compare Tippeligaen to the UCL clubs. P-values  $\leq 0.05$  were regarded as significant.

## **RESULTS**

The response rate was 100%. Of the 50 clubs included, 6 (12%) reported that they were not familiar with the Nordic hamstring exercise program, 3 of 32 UCL teams and 3 of 18 Tippeligaen teams ( $X^2$ : 0.58).

Table 2 shows how clubs reported using the initial progressive NH program and the weekly maintenance program in the 2012, 2013 and 2014 seasons. There was no difference between the UCL and Tippeligaen in the distribution of initial program ( $X^2$ : .98 to .99) or maintenance program use ( $X^2$ : 0.76 to .98) in any of the three seasons.

Table 2. Number of clubs reporting to have completed the initial 10-week progressive NH program and the weekly maintenance program among UCL and Tippeligaen clubs during the 2012, 2013 and 2014 seasons.

	UCL (n=32)			Tippeligaen (n=18)			Total (n=50)		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Initial NH program (10-week progression)									
Yes, the complete 10-week program	4	5	5	2	2	2	6	7	7
Only for 7-9 weeks	2	2	3	1	1	2	3	3	5
- Only 5-6 weeks	1	3	1	1	2	1	2	5	2
Only 4 weeks or less	6	4	5	3	3	3	9	7	8
Not at all	19	18	18	11	10	18	30	28	28
Weekly maintenance program									
Yes, every week	1	1	3	0	1	1	1	2	4
Most weeks	6	9	7	5	5	6	11	14	13
Sporadically	8	5	6	3	3	4	11	8	10
Not at all	17	17	16	10	9	7	27	26	23

Table 3 shows the relationship between how clubs reported having completed the initial 10-week progressive NH program and the weekly maintenance program. A total of 20 clubs reported having completed the initial 10-week progressive NH program and the weekly maintenance program at least most weeks. However, of the 6 clubs that used the complete, initial 10-week NH program in the 2012 season, 3 clubs included all players in the first team squad, 2 clubs included only players with a history of hamstring injuries, while 1 club used other selection criteria. In the 2013 and 2014 seasons, the corresponding figures were 4, 2 and 1 out of 7 clubs. Also, in the 2012 season, 4 of the 6 clubs who used the complete, initial 10-week NH program reported that >75% of players completed the program, 1 club reported 25-49% of players and 1 club <25% of players. In the 2013 and 2014 seasons, the corresponding numbers were 6 of 7 clubs reporting >75% of players and 1 club <25%.

In the 2012 season, 4 clubs were fully compliant with the program (i.e. >75% of players completed the initial 10-week progressive NH program and the weekly maintenance program at least most weeks), 3 were partly compliant and 43 were non-compliant. In the 2013 and 2014 seasons, the corresponding numbers were 6, 3 and 41 clubs, respectively. This means that of the 150 club-seasons during the 2012, 2013 and 2014 seasons, 16 (10.7%) were compliant, 9 (6.0%) partly compliant and 125 (83.3%) non-compliant. There was no difference in compliance between the UCL and Tippeligaen in any season ( $X^2$ : .41 to .52).

*Table 3.* Number of club-seasons where clubs reported having completed the initial 10-week progressive NH program and the weekly maintenance program. Numbers represent the sum of the reports from the 2012, 2013 and 2014 seasons from the 32 UCL and 18 Tippeligaen clubs (n=150).

	Weekly maintenance program										
	UCL					Tippeligaen					Combined
	Yes, every week	Most weeks	Sporadically	Not at all	Total UCL	Yes, every week	Most weeks	Sporadically	Not at all	Total Tippeligaen	Total
Initial NH program (10-week progression)											
Yes, the complete 10-week program	3	11	0	0	14	0	6	0	0	6	20
Only for 7-9 weeks	1	4	1	1	7	0	3	0	1	4	11
Only 5-6 weeks	0	0	4	1	5	0	3	0	1	4	9
Only 4 weeks or less	0	3	7	5	15	0	2	7	0	9	24
Not at all	1	4	7	43	55	2	2	3	24	31	86
Total	5	22	19	50	96	2	16	10	26	54	150

Complaints by coaches and players about the NH program were in most cases few (Table 4) and most teams ranged from being indifferent to very satisfied with the program (Table 5).

*Table 4.* Player and coach complaints reported in relation to their compliance with the NH program during the 2014 season (n=50).

	Player complaints				Coach complaints			
	Many	More than a few	A few	No complaints	Many	More than a few	A few	No complaints
Compliant	0	0	4	0	0	1	1	2
Partly compliant	0	1	1	1	0	0	1	2
Non-compliant	0	3	18	20	4	7	6	26
Total	2	4	23	21	4	8	8	30

*Table 5.* Program satisfaction reported in relation to their compliance with the NH program during the 2014 season (n=50).

	Very satisfied	Satisfied	Indifferent	Dissatisfied	Very dissatisfied
Compliant	1	3	0	0	0
Partly compliant	0	3	0	0	0
Non-compliant	1	11	23	7	1
Total	2	17	23	7	1

A large number of clubs reported being indifferent to various statements describing potential benefits and problems associated with the NH program (Table 6). Of those reporting a positive or negative opinion, the majority was on the positive side.

*Table 6.* Reasons reported for satisfaction-dissatisfaction with the NH program (n=50).

	Fully agree	Agree	Indifferent	Partly disagree	Fully disagree
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It really reduces injuries	11	22	13	4	0
It makes more players available for team selection	8	19	18	4	1
Players can return to play sooner after injury	8	14	19	7	2
Players perform better	4	12	26	5	3
It's really easy to get players to do the program	5	18	13	11	3
The players really like the program and see its value	0	17	22	9	2
It causes muscle soreness in players	9	13	20	8	0
It increases sprint speed and acceleration	2	9	31	5	3

Of the 50 clubs, 35 reported having a formal hamstring injury prevention policy for the first squad, 24 of 32 UCL teams and 11 of 18 Tippeligaen teams. Education on the NH program was delivered in the 2014 season by 19 of 50 clubs, 10 UCL clubs and 9 Tippeligaen clubs. In addition, 14 UCL and 14 Tippeligaen clubs reported delivering education on other hamstring injury prevention strategies.

The majority of clubs, 44 of 50, reported using specific exercises/exercise programs other than the NH program to prevent hamstring injuries, 27 UCL and 17 Tippeligaen clubs.

Two clubs reported that the NH program is the only hamstring injury prevention strategy they will use in the future (1 UCL and 1 Tippeligaen club), while 35 clubs (24 UCL and 11 Tippeligaen) report that the NH program is part of, but not the only strategy they will use in the future.

## DISCUSSION

Our main finding was that adoption and implementation of the NH exercise program at the highest level of male football in Europe, the UCL, was low and, perhaps surprisingly, that it was equally low in the Norwegian Premier League, Tippeligaen, where the program was pioneered. Of the 150 club-seasons covered by the study, the NH program was completed in full in 10.7% and in part in an additional 6.0% of cases. Consequently, 83.3% were classified as non-compliant. Therefore, as 4 out of 5 teams were non-compliant with the protocol, it comes as no surprise that hamstring injury rates remain high in both UCL and Norwegian elite football.<sup>29; 30</sup>

The compliance cut-off selected, i.e. using the initial NH program for at least 5 weeks and the maintenance program at least most weeks on >50% of players for the rest of the season, may be questioned. First, we do not know what the minimum effective dose is, only that efficacy has been demonstrated for the full, 10-week program in the trials by Arnason et al.<sup>1</sup> and Petersen et al.<sup>28</sup> As we do not know if lower doses can prevent injuries as well, we chose this threshold. Consequently, the majority of teams were classified as non-compliant, even if they did report using the NH exercise to some extent. An indication that the full 10-week program needs to be completed is that most of the injuries observed in the intervention group in the study by Petersen et al.<sup>28</sup> occurred within the initial, 10-week progression period. This suggests that completing this exercise progression may be critical for program efficacy. A recent systematic review on the efficacy of the NH program and other eccentric interventions also documents that program compliance is essential, showing a 65% reduction in hamstring injury risk among highly compliant participants, with no effect when including less compliant subjects.<sup>34</sup> In the current study, clubs reported doing no initial NH training or no maintenance training for 95 of the 150 seasons included (see Table 3); we therefore feel confident in concluding that the vast majority of teams did *not* use the NH program as prescribed. Second, classifying program use retrospectively over three seasons based on a simple questionnaire is difficult. Recall bias may be an issue, e.g. medical staff for some teams had changed during the period in question. Designing questions to capture compliance accurately is also difficult, and the questionnaire has not been validated against prospective reporting or direct observation, which would be the preferred method.<sup>35</sup>

Hamstring injury prevention does seem to be a priority among teams, as the majority of clubs reported using specific exercises/exercise programs other than the NH program to prevent injuries. In the same way, a recent study revealed that the NH program is only ranked 5th among preferred exercises to prevent non-contact injury in a survey of 44 premier league clubs.<sup>36</sup> As we anticipated team practices to range widely, we made no attempt at creating pre-determined categories to classify their use of other exercises in the same way as for the NH program. In response to an open question, clubs reported a plethora of exercises, as expected. These include isokinetic eccentric exercises, single leg balance exercises, lunges, trunk/core stabilization exercises, the Askling rehabilitation exercise protocol,<sup>37; 38</sup> gymball supine exercises, high speed running and sprint exercises, slider board exercises, pulley exercises, pilates-based exercises, yoga-based flexibility and strength exercises, eccentric leg curls in the yo-yo device,<sup>39</sup> and several more. Clubs also reported using pre-season isokinetic tests and functional movement screening, as well as fatigue monitoring in various forms. However, all these have one thing in common; there is currently no evidence to document their effectiveness in preventing hamstring injuries in football (or in any other sport, for that matter).

In contrast, the efficacy of the NH program on hamstring injury risk is well documented,<sup>1; 28</sup> and confirmed in a recent study on male Dutch amateur players documenting a 72% reduction in the risk for hamstring injuries.<sup>40</sup> The NH exercise addresses the mechanism of injury, believed to be excessive maximal eccentric loading,<sup>23-25</sup> as well as one key risk factor, eccentric strength. A number of candidate risk factors have been proposed for hamstring

injuries,<sup>41</sup> the most prominent internal factors being the following: previous injury, age, reduced hip range of motion, and poor hamstrings strength.<sup>26</sup> A history of previous hamstrings injury greatly increases injury risk, as documented in numerous studies.<sup>26; 41-43</sup> Older players are at increased risk for hamstring injury, and although older players will be more likely to have a previous injury because of a longer career, increased age is also an independent risk factor for injury.<sup>15; 41; 43</sup> However, studies on football players suggest that hamstring flexibility is not a significant risk factor for injuries,<sup>15; 44</sup> and a stretching program did not reduce hamstring injury risk in footballers.<sup>1</sup> In contrast, several studies suggest that players with low hamstring strength or low hamstrings:quadriceps strength ratio (or side-to-side strength imbalances) may be at increased risk of injury.<sup>26</sup> Inadequate hamstring strength would mean that the eccentric load necessary to resist knee flexion and start hip extension during maximal sprints could surpass the tolerance of the muscle-tendon unit. In particular, the relationship between the ability of the quadriceps to generate speed and the eccentric capacity of the hamstrings to resist the resulting forces, the hamstrings to quadriceps strength ratio, is thought to be important. The 10-week NH exercise program has been shown to increase the concentric hamstrings to eccentric quadriceps strength ratio by as much as 11%.<sup>27</sup> Notably, Opar et al. have recently used a novel field testing device to record hamstring strength, providing a reliable measure of eccentric knee flexor forces during the Nordic hamstring exercise.<sup>45</sup> They documented that low maximal eccentric strength in the Nordic hamstring exercise at the end of the preseason resulted in a four-fold increased risk of sustaining a hamstring injury during the season.<sup>45</sup>

The question is therefore: Why do teams not adopt and implement an exercise program with a well-documented effect on both injury and re-injury risk, but continue using exercises with no or limited evidence? This is very difficult to explain, based on the data from the current study. Reach was good; 88% of clubs reported being familiar with the NH exercise program. Also, the vast majority of the teams reported few complaints from coaches and players. Program satisfaction was good among teams using the program, and very few teams disagreed with pro-program statements like “It really reduces injuries”, “It makes more players available for team selection”, “Players can return to play sooner after injury”, “Players perform better”, etc. However, a significant minority felt that it is not easy to get players to do the program and that it causes muscle soreness in players, despite the fact that the Mjølsnes protocol has been shown to cause no or minimal delayed onset muscle soreness.<sup>27</sup> Nevertheless, it appears that we have to look for reasons for non-compliance among other factors, such as limited influence by the medical team on coaching practices. This needs to be explored in future studies.

We were somewhat surprised to see that compliance was no better in Tippeligaen than in the UCL. The initial NH studies were done in Tippeligaen, as early as 2001<sup>27</sup> and 2002,<sup>1</sup> and since then the NH program has received ample attention in basic and continued education, books and Norwegian websites aimed at medical personnel. However, there has not been a similar focus on education programs targeting coaching staff.



In conclusion, adoption and implementation of the NH exercise program at the highest levels of male football in Europe is low, too low to expect any overall effect on acute hamstring injury rates.

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### **WHAT ARE THE NEW FINDINGS**

- Adoption and implementation of the NH exercise program at the highest levels of male football in Europe is low, even in the Norwegian premier league, where the pioneer research was conducted.

### **HOW MIGHT IT IMPACT ON CLINICAL PRACTICE IN THE NEAR FUTURE?**

- More attention is needed on the implementation of the NH exercise program, focusing on all components of the RE-AIM framework.

## **ACKNOWLEDGMENTS**

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## **ETHICAL APPROVAL**

This study has been reviewed and approved by the UEFA Football Development Division and the UEFA Medical Committee.

## **CONTRIBUTORSHIP STATEMENT**

RB, KT and JE jointly designed the study and designed the questionnaire, RB and JE organized data collection and analyzed the data. RB, KT and JE jointly interpreted the data, wrote the paper and are responsible for the overall content as guarantors.

## **COMPETING INTERESTS**

None.

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