

# BMJ Open Adductor Strengthening Programme is successfully adopted but frequently modified in Norwegian male professional football teams: a cross-sectional study

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## ABSTRACT

**Objectives** Groin injuries represent a substantial problem in male football, with the Adductor Strengthening Programme (ASP) being the only exercise programme demonstrated to significantly reduce the risk of groin problems. We aimed first, to use the Reach Adoption Effectiveness Implementation Maintenance (RE-AIM) framework to investigate attitudes, beliefs and behaviour to the ASP among primary delivery agents of injury prevention exercises in Norwegian male professional football teams. Second, we aimed to identify a real-world application of the ASP protocol used in a professional team setting.

**Design** A descriptive cross-sectional survey, using a questionnaire designed to cover all five dimensions of the RE-AIM framework.

**Setting** The top two divisions of Norwegian male professional football.

**Participants** 32 primary injury prevention delivery agents.

**Primary and secondary outcome measures** Primarily, the proportion of respondents being aware of the ASP and its effect; having adopted it; having implemented it as intended; and considering maintaining using it. Secondary, the most often used ASP modifications.

**Results** Twenty-nine (91%) participants responded. All (100%) respondents were aware of the ASP and its injury preventive effect. The two most stated reasons for using the ASP were its injury preventive effect and that it does not require equipment. The ASP was adopted by all (100%) delivery agents, but only 10% used it in accordance with the original protocol. The main modifications were that the players in 72% of the teams were instructed to perform a non-progressive number of repetitions during pre-season, and in 86% of the teams instructed to perform more sets, but fewer repetitions per set, during in season. In total, 97% of the delivery agents planned to continue using the ASP.

**Conclusion** The delivery agents have positive attitudes and beliefs to the ASP, but they frequently modify it. We identified and reported a real-world application of the ASP protocol.

## INTRODUCTION

Groin problems represent a substantial problem in football. They account for 4%–19% and 2%–11% of all time-loss injuries in male and female football, respectively.<sup>1</sup>

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The questionnaire was pilot tested by delivery agents with relevant experience.
- ⇒ Thorough data collection process leading to a high response rate.
- ⇒ The internal validity of the questionnaire was not systematically explored.
- ⇒ Some of the questionnaire's questions are prone to recall bias as the survey was conducted towards the end of the competitive season.

Moreover, the average weekly proportion of male players with any groin problem causing pain and/or reduced performance is 21% in a full competitive season,<sup>2</sup> and 29% in periods with match congestion.<sup>3</sup>

In a clinical trial, the Adductor Strengthening Programme (ASP) showed a significant 41% reduction in risk of groin problems in male semi-professional players performing the programme during one full season.<sup>2</sup> Consequently, dissemination and widespread implementation of the ASP in football training seems beneficial.<sup>2,4</sup> The ASP is based on a single exercise, the Copenhagen Adduction (CA) exercise,<sup>4</sup> structured with three progression levels and a protocol with a pre-season and in-season exercise prescription. In the clinical trial, players completed on average about 70% of the recommended exercise prescription, demonstrating a considerably higher compliance than previous groin injury prevention programmes.<sup>5,6</sup> The high compliance is an important strength of the ASP, as only injury prevention programmes that are successfully implemented (ie, widely adopted, complied with and maintained over time) will reach effectiveness outside controlled clinical trials.<sup>7</sup>

Gaining knowledge on attitudes, beliefs and behaviour to injury prevention exercises are important when evaluating their implementation in the real-world setting.<sup>7</sup> For this purpose, integrating the Reach Effectiveness Adoption Implementation Maintenance



(RE-AIM) framework<sup>8,9</sup> is recommended, ideally evaluated across all levels of the sport setting hierarchy.<sup>9</sup> In brief, the framework evaluates the proportion of a targeted population that is aware of a given intervention (Reach), the interventions positive outcomes (Effectiveness), the proportions that has adopted the intervention (Adoption) and implemented it as intended (Implementation), and the extent to which it is sustained (Maintenance).<sup>8,9</sup> Note that the specific RE-AIM implementation dimension refers to the extent to which an exercise or a programme is used as intended in the real-world setting.<sup>9</sup> The general term implementation also used in this article, however, refers to all initiatives applied to put an exercise or a programme into practice.<sup>10</sup>

Attitudes and beliefs towards the ASP is previously investigated among players participating in the clinical ASP trial.<sup>11</sup> The study revealed that only 31% of the players anticipated to continue using the ASP in accordance with the original protocol.<sup>11</sup> Also, a recent study on the CA among coaches in international male professional teams reported that 72% were aware of the exercise, while 94% of those had adopted it.<sup>12</sup> These findings are consistent with previous research emphasising that evidence-based injury prevention exercises can be challenging to apply in the real-world settings.<sup>13</sup> To enhance knowledge, we believed it was important to conduct a survey among team staff, specifically among those having the main responsibility for implementing and conducting injury prevention exercises (hereafter referred to as 'delivery agents').

Therefore, the primary aim of this study was to use the RE-AIM framework to investigate attitudes, beliefs and behaviour to the ASP among delivery agents of injury prevention exercises in Norwegian male professional football teams. The secondary aim was to identify a real-world application of the ASP protocol used in a professional team setting, which to our knowledge, previously has not been conducted for any single-exercise injury prevention programme.

## METHODS

### Study design and participants

This was a cross-sectional study conducted in September and October 2020. Participants were the primary delivery agent in each team in the top two divisions of Norwegian male professional football (n=32): Eliteserien (n=16) and OBOS-ligaen (n=16). The study is described according to the Strengthening the Reporting of Observational Studies in Epidemiology statement checklist for cross-sectional studies.<sup>14</sup>

### Survey

A new questionnaire designed to cover all dimensions of the RE-AIM<sup>8</sup> framework was developed, based on previous questionnaires used in studies investigating implementation of preventative training in elite and subelite sport's settings.<sup>11,15</sup> The final version consisted of 38 questions, primarily closed ended. The questionnaire was developed

and delivered in Norwegian; however, a translated English version is provided as an appendix to this paper (online supplemental file 1).

### Data collection

We collected contact information to the delivery agents either through our network of contacts or by contacting the team's directly. All delivery agents received an email with detailed information about the study and a link with access to an online survey software (SurveyXact, Rambøll Management Consulting AS, Oslo). We distributed the questionnaire during an international break in September 2020. Weekly reminders were sent to non-responders by email for 4 weeks, and after 5 weeks, non-responders were contacted by telephone.

### Analysis

We performed statistical analysis using SPSS statistical software (SPSS V.24, IBM Corporation). Data consisted of categorical nominal variables, presented as proportions, including for the specific RE-AIM dimensions. Open-ended text responses were analysed with a quantitative content analysis,<sup>16</sup> using a structured code form counting frequencies of variables mentioned. The code form was also used to categorise whether the participants had a positive, negative or neutral attitude.

### Patient and public involvement

Three experienced delivery agents (two physiotherapists and one football coach) not involved as participants did pilot test the questionnaire and gave feedback on its understanding and readability. Patients and/or the public were not involved in any other part of the conduct, or reporting, or dissemination plans of this research.

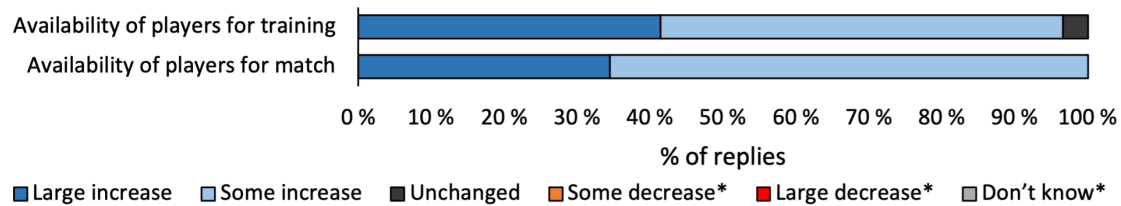
## RESULTS

### Participant characteristic

Twenty-nine (91%) of the 32 delivery agents participated in the survey (14 from Eliteserien and 15 from OBOS-ligaen). The non-responders gave no specific reasons for not participating. Twenty-three (79%) of the respondents were physiotherapists, five (17%) were strength and conditioning coaches and one (3%) was a naprapath. Respondents' experience as delivery agents in football is shown in table 1.

**Table 1** Years of experience as delivery agents of injury prevention exercises in football

Years of experience as delivery agent	n (%)
0–4 years	5 (17)
5–9 years	13 (45)
10–14 years	7 (24)
15–19 years	3 (10)
≥20 years	1 (3)



**Figure 1** Beliefs regarding whether Adductor Strengthening Programme can influence availability of players in training and match play. \*No respondent replied some decrease, large decrease or don't know.

### Attitudes to groin injury risk and importance of injury mitigation

Football players risk of getting a groin problem was assumed to be high or moderate by 19 (66%) and 9 (31%) delivery agents, respectively, while one respondent considered the risk to be low. All (100%) respondents thought prevention exercises to mitigate groin problems was important, replied by 27 (93%) as highly important and by 2 (7%) as moderately important.

### Reach and effectiveness of the ASP

All (100%) respondents were aware of either one or both of ASP and the CA. All (100%) delivery agents thought the ASP has potential to successfully mitigate the burden of groin problems, with 11 (38%) perceiving the groin problem mitigation as large and 18 (62%) perceiving it as moderate. Beliefs about the ASP's effect on player availability can be viewed in [figure 1](#).

### Adoption and implementation of the ASP

All (100%) delivery agents had adopted the ASP in their team the current season, of which three (10%) replied that their usage was in accordance with the original ASP

protocol. How the teams reported the usage of the ASP in terms of exercise frequency, sets and repetitions is shown in [tables 2 and 3](#) for pre-season and in-season, respectively.

The most often-used ASP modifications are summed up in [table 4](#), which is the identified real-world application of the ASP protocol used in a professional team setting.

### Maintenance of the ASP

Twenty-eight (97%) delivery agents planned to continue using the ASP in the subsequent season, of which 20 (71%) planned to use a modified protocol.

### Facilitators and barriers to implementation of the ASP

The most often stated reasons to use the ASP were first, the documented preventive effect of the ASP (100%, both in current and subsequent season) and second, that no additional equipment is needed (52% in current and 43% in subsequent season) ([figure 2](#)). On an open-ended non-mandatory question, four respondents (27%) defined an indirect performance enhancing effect as an additional positive effect of ASP. Five (31%) respondents described the ASP progression levels as being too demanding, while four (25%) thought it was likely to cause muscle soreness.

“How often were the players instructed to perform the ASP?”	n (%)
More than 3 times a week	2 (7)
3 times a week	4 (14)
Twice a week	16 (55)
Once a week	5 (17)
We carried out the programme, but less than once a week	2 (7)
“How many sets were the players instructed to perform per side?”	n (%)
More than 2 sets per side	8 (28)
2 sets per side	17 (59)
1 set per side	4 (14)
“How many repetitions were the players instructed to perform per set?”	n (%)
More than 15 repetitions each week	1 (3)
12–15 repetitions each week	3 (10)
7–10 repetitions each week	16 (55)
3–5 repetitions each week	1 (3)
3–15 repetitions, weekly progressive as in protocol	3 (10)
3–15 repetitions, weekly progressive as own modification	5 (17)

\*Specified as under normal circumstances, for example, not influenced by COVID-19.

**Table 3** Overview of reported training volume of the Adductor Strengthening Programme (ASP) during in-season\*

“How often were the players instructed to perform the ASP?”	n (%)
More than once a week	9 (31)
Once a week	16 (55)
Once every 2 weeks	2 (7)
We carried out the programme, but less than once every 2 weeks	2 (7)
“How many sets were the players instructed to perform per side?”	n (%)
More than 2 sets per side	7 (24)
2 sets per side	18 (62)
1 set per side	4 (14)
“How many repetitions were the players instructed to perform per set?”	n (%)
More than 15 repetitions	1 (3)
12–15 repetitions	6 (21)
8–11 repetitions	14 (48)
4–7 repetitions	8 (28)

\*Specified as under normal circumstances, for example, not influenced by COVID-19.

Two of these four respondents indicated soreness was the reason for modifying the original ASP protocol.

## DISCUSSION

The primary aim of the present study was to use the RE-AIM framework to investigate attitudes, beliefs and behaviour regarding the ASP among delivery agents of injury prevention exercises in Norwegian male professional football teams. A secondary aim was to identify a real-world application of the ASP used in a professional team setting. The main findings were that all delivery agents were aware of the ASP, all thought the programme can mitigate the burden of groin problems, all stated to use the ASP in their team the current season and, almost everyone planned to continue using it in the subsequent season. However, only 10% used the ASP in accordance with the original ASP protocol.

### Reach and effectiveness

Having a targeted population to recognise injury risk, to be aware of relevant injury prevention exercises or programmes and to acknowledge the exercise's or programme's ability to mitigate the injury risk are vital for successful real-world implementation of effective injury prevention exercise programmes.<sup>9 17–20</sup> The surveyed delivery agents' belief that players are at moderate to great risk of groin problems aligns well

with epidemiological data.<sup>1 3 21</sup> The reported awareness level of ASP on the other hand is higher than previously reported for the CA<sup>12</sup> and the injury prevention exercise programme, FIFA 11+.<sup>22</sup> Discrepancies in awareness levels between members of the team around the players may be due to, unlike the current study surveying mostly physiotherapists, comparable studies having primarily surveyed head coaches which clearly also have other responsibilities besides being updated on injury prevention exercises and measures.

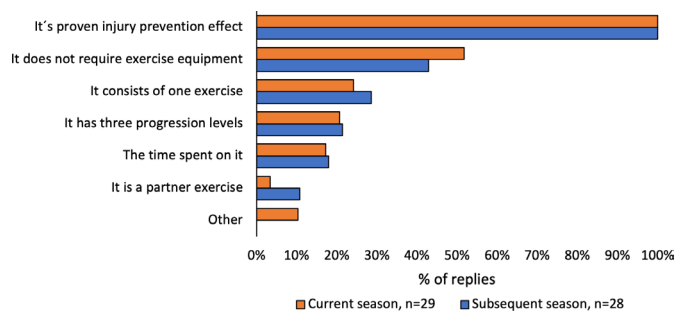
All delivery agents considering the ASP as capable of mitigating the burden of groin problems aligns with its evidence-based effect, and coincides with previously reported perceptions of the CA.<sup>12</sup> Moreover, the high ASP awareness level and the positive attitude towards its efficacy implies that the ASP dissemination strategies have been successful within this specific population of clinicians.

### Adoption

All respondents reported using the ASP throughout the season. This is a similar finding to the adoption rate seen for the CA<sup>12</sup> in male professional football, when only accounting for users being aware of the exercise. Compared with what has been reported for the Nordic Hamstring (NH) exercise<sup>23</sup> in male professional football however, the ASP adoption rate is substantially higher. Interestingly, all respondents stated

**Table 4** Adductor Strengthening Programme real-world application in Norwegian male professional football teams

Adductor Strengthening Programme – real-world application			
Week	Sessions per week	Sets per side	Repetitions per side
Pre-season – week 1–8	2	2	7–10
In-season – all weeks	1	2	8–11



**Figure 2** Reasons for choosing to use the Adductor Strengthening Programme this season and reasons for planning using the programme the following season.

that the evidence-based efficacy of the ASP was an important reason for choosing to adopt the programme. The discrepancy in ASP and NH adoption rates is interesting, as they share the same exercise characteristics, and both were originally studied in clinical trials including Norwegian male football teams.<sup>2,23</sup> One variation, however, that may explain some of the discrepancy in adoption rates is the 6-year's difference between our data collection and the data collection of the NH adoption.<sup>24</sup> This is likely due to evidence-based efforts to prevent injuries having improved among practitioners in elite teams in recent years.<sup>25</sup>

### Implementation

When implementing the programme, the current study shows that delivery agents in professional football usually modify the ASP to fit their team's training philosophy and schedule. Similar findings have been demonstrated for the NH<sup>24,26</sup> and the FIFA 11+.<sup>27,28</sup> So far, no other studies on specific modifications of single-exercise injury prevention programmes exist.

The original ASP protocol<sup>2</sup> prescribes a pre-season strengthening phase containing a detailed 8-week progression, and an in-season maintenance phase with a continuous number of repetitions. The intention is first, to provide hip adductor muscle strength gains, and second, to maintain the increased muscle strength, as reduced hip adductor muscle strength is the only consistently reported risk factor for groin injury in sports.<sup>29</sup>

Compared with the original programme, in total, the delivery agents usually prescribed slightly more repetitions per session, but divided into two sets, especially during in-season. Furthermore, they generally conducted fewer sessions per week during pre-season, and the vast majority did not adopt the 8-week progression recommended for pre-season.

We did not investigate why the delivery agents modified the ASP. However, a potential reason for non-progression during pre-season strengthening phase might be that the delivery agents consider most professional players to already have gained, and maintained, adequate hip adductor muscle strength. This would limit the delivery agent's perceived need for players to commence a progressive strengthening phase. Another reason for the modifications of the ASP could also be lack of support

and acceptance from players and/or coaches. Such support is considered a key facilitator in the implementation process,<sup>9,22</sup> and motivation to comply with the original ASP protocol has already been shown to be low among players.<sup>11</sup> A reason for modifying previous injury prevention strengthening exercises has been attributed to a possible fear of muscle soreness.<sup>13,30</sup> However, only two respondents reported to have modified the ASP partly due to such fear, and there is evidence that even the most strenuous level of the ASP barely caused any reported muscle soreness if the number of repetitions was progressed gradually.<sup>31,32</sup> Consequently, fear of muscle soreness seems to not be an important barrier to optimal ASP implementation in the real-world setting.

### Effectiveness of the real-world application of the ASP

An important aspect is that the delivery agents modify the ASP without knowing the impact. As mentioned, the ASP aims to mitigate groin problems by targeting hip adductor muscle strength. There is compelling evidence that muscle strength effects are dose dependent,<sup>33</sup> which also has been suggested for the CA.<sup>34</sup> The reported used pre-season ASP exercise volume is approximately 640 repetitions during 8 weeks, which, interestingly, is a higher volume than what the evidence-based original ASP protocol prescribes (470 repetitions).<sup>2</sup> Moreover, it accommodates a suggested minimum of 500–800 repetitions during 8 weeks, when aiming to facilitate meaningful hip adductor muscle strength gains.<sup>34</sup> Since the reported used weekly in-season ASP exercise volume is almost equal to pre-season, it is reasonable to assume that players somewhat maintain their hip adductor muscle strength during in-season.

Beyond volume considerations, progression seems required to elicit the greatest strength training gains.<sup>35</sup> As the ASP consists of a bodyweight exercise, weekly increase in the number of repetitions is the main progression variable. A critical assessment is therefore whether the reported lack of pre-season progression can reduce the ASP's effectiveness in groin problem mitigation. Additionally, muscle strength gains also depends on recruitment of high-threshold motor units, through accumulation of neuromuscular fatigue induced when performing sets to at least somewhat near neuromuscular failure.<sup>36</sup> Therefore, another critical assessment would be whether more sets but fewer repetitions per set, as respondents have reported, affect the ASP's effectiveness.

So far, changes in physiological characteristics when performing the ASP, such as effects on muscle cross-sectional area and architecture, musculotendinous stiffness, and motor unit recruitment and synchronisation,<sup>35</sup> have not been scientifically investigated. Similarly, the exact dose–response relationship between ASP exercise volume and hip adductor muscle strength gains, and between ASP exercise volume and groin injury mitigation rates also remains to be investigated. And lastly, the importance of a progression strengthening phase(s) when aiming to mitigate groin problems is unknown.



Discussions around the most often-used modification's impact on the ASP's effectiveness are therefore currently theoretical, only.

Consequently, we will argue that there is no convincing evidence claiming that the ASP modifications applied by the delivery agents affect the mitigation of groin problems in male professional players, compared with the original protocol. Additionally, considerations on ASP exercise volume and other modifications are subordinated to the fact that no injury prevention programme will reach its full potential unless it is implemented, adopted and maintained, by teams in the real-world setting.<sup>19</sup>

### Maintenance

To be successful, the final step of any injury prevention exercise implemented in the real-world setting is that the exercise or the programme is maintained over multiple seasons. In our study, nearly all respondents planned to continue using the ASP in the subsequent season, representing a considerably higher maintenance level than previously reported.<sup>11</sup> A particular challenge, however, is that team staff members, including medical staff, are frequently replaced when managers are replaced, increasing the risk of preventative measures not being persistently maintained over time.<sup>19</sup> It is yet to be confirmed whether ASP has been established as part of the teams' or clubs' sports plans or policies on injury prevention measures.

### Methodological considerations

The high response rate (91%) is a strength of this study. However, it is uncertain whether our results can be generalised to other delivery agents and professional football settings outside Norway. Especially, considering that the original ASP intervention study was conducted among Norwegian male football teams. This may have led to a 'word of mouth' effect in the Norwegian football community, which to some extent can explain the higher ASP awareness level and adoption rates in this study.

A further strength of the current study is the pilot testing of the questionnaire ensuring valuable input to the final questionnaire. A limitation is that the internal validity of the questionnaire was not systematically explored, which is a prerequisite to draw firm valid conclusions.<sup>37</sup> The pilot study ensured, however, some degree of internal validity, by providing adequate understanding and readability of the questionnaire dimensions. Furthermore, questions related to the 'implementation' dimensions, especially regarding the pre-season application of the ASP, are prone to some degree of recall bias as the survey was conducted towards the end of the competitive season.<sup>38</sup> Therefore, this study describes how the teams in overall perform the ASP, only, while it is likely that the programme was individualised depending on players previous injury record and experience with specific strength exercises. Moreover, this study did not include a question about delivery agents' perceived involvement

in and support from players and coaches, which is considered a key facilitator to successful implementation in the real-world football setting.<sup>9</sup>

Importantly, 79% of the respondents had a defined team staff role as a physiotherapist. This contrasts with previous studies, where surveyed delivery agents were either strength and conditioning coaches, head coaches or medical doctors.<sup>22 26 30 39 40</sup> In contrast to the other members of the medical and coaching staff, physiotherapists are educated and trained in health science with special emphasis on injury prevention and rehabilitation. Therefore, it is not unlikely that some of the variations in attitudes, beliefs and behaviour between the present and previous studies are due to differences in the participant's formal team staff role and educational background.

Regarding data collection methods, we chose to develop and conduct a survey for the following reasons. First, a survey is an appropriate tool to collect responses from individuals living in a widespread geographical area. Second, it is suitable when investigating several variables at the same time, such as all the RE-AIM dimensions, and third, a survey provides a cost-effective and relatively seamless data collection method. Therefore, a survey using a questionnaire was considered appropriate to accommodate the research questions in our study.

### Perspectives

The delivery agents are aware of the ASP, they have adopted it, and they anticipate maintaining the usage. The implementation of the programme, however, is slightly different in each team. Further studies are warranted to acquire knowledge about why the ASP is being modified, and the impact of the modifications on the ASP's effectiveness. As this in previous studies primarily has been conducted in male adult teams, future studies should include women's and youth football, too. Also, widespread dissemination of the ASP outside the Scandinavian countries is needed to achieve reach worldwide. Finally, as recommended,<sup>9</sup> similar investigations of attitudes, beliefs and behaviour to the ASP among other stakeholder, for example, coaches, club officials and relevant sporting organisations, are needed in order to further explore the complexity of introducing preventative measures in the real-world professional setting.

### CONCLUSION

The present study found that delivery agents of injury prevention exercises in Norwegian male professional football teams have positive attitudes and beliefs to the ASP, using it frequently and planning to maintain the usage of it in the subsequent season. Most delivery agents, however, instructed players to complete the ASP with modifications. Therefore, we have identified a real-world application of the ASP protocol used in a professional team setting.

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**Ethics approval** The study was approved by the ethics board at the Norwegian School of Sport Sciences (134-130820) and by the Norwegian Centre for Research Data (NSD 2020/837286). Participants gave informed consent to participate in the study before taking part.

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