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Attitudes, beliefs, and behavior toward shoulder injury prevention in elite handball: Fertile ground for implementation

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We aimed to examine attitudes, beliefs, and current behavior toward risk factors and prevention of shoulder injuries, and to investigate the application of an exercise program during a cluster-randomized controlled trial aiming to prevent shoulder injuries in elite handball. All captains and coaches of 44 elite handball teams (22 male and 22 female) constituting the intervention (21 teams) and control arm ($n = 23$ teams) in the trial were invited to take part in a survey. A questionnaire, based on the Reach, Efficacy, Adoption, Implementation, and Maintenance framework, addressing the end user perspective on risk factors and prevention of shoulder injuries, as well as key issues related to the application of the Oslo Sports Trauma Research Center (OSTRC) Shoulder Injury Prevention Programme, was distributed using electronic survey software. The response rate was 100%. Overall, the majority of coaches (84%) and captains (89%) believed that handball players are at high risk for shoulder injuries. All delivery agents in the trial reported to be familiar with the exercise program and the majority believed in a preventative effect (coaches 90% and captains 81%). Only a minority reported full compliance with the recommended frequency (coaches 29%, captains 14%), with program being too time-consuming (coaches 67%, captains 81%) and lack of player motivation (coaches 76%, captains 62%) as the main barriers. Our results suggest that there is fertile ground for implementation of the OSTRC Shoulder Injury Prevention Programme in elite handball, with program length and lack of player motivation as the main barriers to overcome.

KEYWORDS

behavior, evaluation, implementation, injury prevention

1 | INTRODUCTION

Existing research on overuse shoulder injuries in elite handball has addressed all stages of the traditional van Mechelen four-stage approach to prevention of sports injuries.¹ Shoulder pain and problems are established as common burdens affecting participation and performance,²⁻⁶ as well as daily life (Stage 1).³ Reduced glenohumeral rotation, external rotation weakness, and scapular dyskinesis have been identified as internal modifiable risk factors in prospective studies (Stage 2),² although not confirmed in a recent study using similar

methods.⁶ Nevertheless, the four-stage approach was recently completed with a trial reporting preventative effect of the Oslo Sports Trauma Research Center (OSTRC) Shoulder Injury Prevention Programme on the prevalence and risk of shoulder problems in elite handball (Stage 3 and 4).⁷

Despite the widespread use of the van Mechelen model since its origin in the early 90s, several papers have highlighted the need for integration of implementation science in sports injury prevention research.⁸⁻¹² It is argued that randomized controlled trials evaluating the effect of injury prevention exercise programs in sports, such as the OSTRC

Shoulder Injury Prevention Programme, are performed in highly controlled settings and do not reflect the final implementation context.^{11,12} Consequently, dissemination and widespread use of evidence-based programs in the real-world sport setting may be inhibited,^{12,13} as the full potential will only be realized if the targeted end users adopt, implement, and maintain the programs as intended.¹² To meet these challenges, Finch outlined the Translating Research into Injury Prevention Practice (TRIPP) framework,¹² an extension to the traditional approach which includes two additional stages. Firstly, she recommended that researchers should seek to understand how evidence-based injury prevention exercise programs can be translated into actions that can be implemented in the real-world sport setting (Stage 5). Key elements at this stage are information regarding attitudes, beliefs, and current behavior toward injury causes, predisposing factors, and preventative measures, as well as identification of facilitators and barriers to implementation of programs.^{10,12} Finally, the effectiveness should be evaluated in a real-world sport setting by implementing the programs among the intended end users, while taking into account the elements identified in stage 5 (Stage 6).¹² In addition, to successfully understand the full complexities of the implementation context and enhance implementation efforts in sports injury prevention, integration of a five-dimensional framework from implementation science has been recommended: the Reach, Efficacy, Adoption, Implementation, Maintenance (RE-AIM) framework.^{9,11} However, despite these recommendations, studies expanding on the traditional four-stage approach and investigating the adoption and implementation of injury prevention exercise programs are scarce.^{9,14}

Thus, the main objectives of this study were to examine attitudes, beliefs and current behavior toward risk factors and prevention of shoulder injuries, and to investigate the application of the OSTRC Shoulder Injury Prevention Programme during a cluster-randomized controlled trial aiming to prevent overuse shoulder injuries in elite handball.

2 | METHODS

2.1 | Study design and participants

This was a cross-sectional and retrospective survey involving 44 elite handball teams (22 male and 22 female) constituting the intervention (21 teams) and control arms (23 teams) in a cluster-randomized controlled trial aiming to prevent overuse shoulder injuries.⁷ Toward the end of the intervention period (August 2014 to March 2015), we invited all team captains (n = 44) and a coaching staff representative (n = 44), nominated by the head coach as the individual responsible for the team's prevention and physical training, to take part in the survey. In most cases, the head coach (n = 23) and the fitness coach (n = 11) were nominated as the representative, followed

by individuals with a combined responsibility for fitness and medical follow-up (n = 6, eg, physical therapist) and assistant coaches (n = 3). All captains and coaches from both study arms consented to participate and represented four separate respondent groups in the survey (21 intervention coaches; 21 intervention captains, 23 control coaches; 23 control captains).

2.2 | The injury prevention exercise program

Full details of the development, content, and implementation of the injury prevention exercise program used in the trial have been published previously.⁷ Briefly, the OSTRC Shoulder Injury Prevention Programme consisted of five exercises with different variations and levels (15 in total) to be implemented three times per week as a part of the intervention team's regular warm-up to handball training. The exercises aimed at increasing glenohumeral internal range of motion,^{2,15} external rotation strength, and scapular muscle strength,^{2,16} as well as to improve kinetic chain and thoracic mobility.

The program was developed in collaboration between authors and an external expert panel consisting of four physiotherapists, clinically working with handball players, and a fitness coach employed by the Norwegian Handball Federation. As a part of the development process, a female team not included in the study, tested the program, and responded to a questionnaire to provide information regarding their beliefs and experiences of the content, duration, load, and applicability of the program.^{7,10,13}

The program targeted all players in the intervention teams and was delivered by team coaches and captains, which, together with the team medical staff, received specific training on the execution of the exercises in the program. Once players were familiar with the exercises, the program took about 10 minutes to complete. Team medical staff were asked to be present to supervise the quality of the exercises and ensure that players experiencing pain were performing the exercises as intended, at least one session per week during the first 4 weeks performing the program, and every second week for the rest of intervention period. In addition, follow-up visits by the research group were completed to all intervention teams to stimulate adherence and ensure quality of the exercises. To which degree the players in the intervention group completed the exercise program was monitored through self-reporting. Six times during the season, players reported how many times they had completed the exercise program during the past 7 days, both with the team and by themselves.⁷

2.3 | The survey

A questionnaire, with variations depending on group affiliation, was developed in collaboration between authors and pilot tested by two coaches and two players not involved in

TABLE 1 Attitudes, beliefs, and current behavior toward risk factors and prevention of shoulder injuries among coaches (n = 44) and captains (n = 21) and control teams (n = 23)

Question/statement	Intervention teams				Control teams				Intervention VS Control P = .092
	Coaches (n = 21)		Captains (n = 21)		Coaches (n = 23)		Captains (n = 23)		
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
To which degree do you think handball players are at risk for shoulder injuries?	High risk	20 (95.2)	19 (90.5)	17 (73.9)	20 (87.0)				
	Medium risk	1 (4.8)	2 (9.5)	6 (26.1)	3 (13.0)				
	Low risk	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)				
	No risk	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)				
What are the most important risk factors for shoulder injuries among handball players? (MR)	Poor fitness in general	19 (90.5)	17 (81.0)	18 (78.3)	20 (87.0)				P = .35
	Low training load	2 (9.5)	3 (14.3)	8 (34.8)	5 (21.7)				
	High ex-posure to match time	3 (14.3)	1 (4.8)	7 (30.4)	1 (4.3)				
	Tackles	7 (33.3)	10 (47.6)	11 (47.8)	12 (52.2)				
	Length of career	5 (23.8)	4 (19.1)	5 (21.7)	3 (13.0)				
	Throwing load	9 (42.9)	14 (66.7)	8 (34.8)	10 (43.5)				
	Other	5 (23.8)	2 (9.5)	5 (21.7)	4 (17.4)				
	Yes, definitely	12 (57.1)	11 (52.4)	14 (60.9)	17 (74.0)				P = .21
	Yes, to some degree	8 (38.1)	8 (38.0)	9 (39.1)	3 (13.0)				
	No, it won't make any difference	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)				
Do you think an injury prevention exercise program designed to improve strength, mobility and stability in the shoulder will reduce the risk for shoulder injuries?	No, it will increase the risk	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)				
	I don't know	1 (4.8)	2 (9.5)	0 (0.0)	3 (13.0)				

(Continues)

TABLE 1 (Continued)

Question/statement	Response	Intervention teams				Control teams				Intervention VS Control P = .013
		Coaches (n = 21)		Captains (n = 21)		Coaches (n = 23)		Captains (n = 23)		
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Have your team previously performed prevention training to reduce the risk for shoulder injuries?	Yes, to a large degree	5 (23.8)	1 (4.8)	12 (52.2)	2 (8.7)					
	Yes, to some degree	10 (47.6)	11 (52.4)	8 (34.8)	15 (65.0)					
	Rarely	4 (19.0)	8 (38.0)	0 (0.0)	5 (21.7)					
	No, never	1 (4.8)	1 (4.8)	0 (0.0)	1 (4.3)					
It is more important to spend time on specific handball training than prevention (LOA)	I'm new to the team and don't know	1 (4.8)	0 (0.0)	3 (13.0)	0 (0.0)					
	Strongly agree	0 (0.0)	4 (19.1)	1 (4.3)	5 (21.7)					P = .86
	Agree	7 (33.3)	5 (23.8)	4 (17.4)	8 (34.8)					
	Unsure	3 (14.3)	5 (23.8)	3 (13.0)	2 (8.7)					
Motivation among coaches has no influence on player motivation to perform prevention training (LOA)	Disagree	9 (42.9)	7 (33.3)	14 (61.0)	7 (30.5)					
	Strongly disagree	2 (9.5)	0 (0.0)	1 (4.3)	1 (4.3)					
	Strongly agree	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.3)					P = .17
	Agree	1 (4.8)	5 (23.8)	2 (8.7)	2 (8.7)					
	Unsure	2 (9.5)	2 (9.5)	0 (0.0)	3 (13.0)					
	Disagree	17 (80.9)	11 (52.4)	14 (60.9)	14 (61.0)					
	Strongly disagree	1 (4.8)	3 (14.3)	7 (30.4)	3 (13.0)					

Note: The shaded cells denote the most frequent response for each respondent group. Abbreviations: LOA, level of agreement; MR, multiple responses possible.

TABLE 2 Attitudes toward shoulder injury prevention among coaches, players, medical staff, and administration according to coaches (n = 44) and captains (n = 44) in intervention (n = 21) and control teams (n = 23)

How will you best describe attitudes toward shoulder injury prevention in the following groups?	Intervention teams		Control teams		Intervention vs Control
	Coaches (n = 21)	Captains (n = 21)	Coaches (n = 23)	Captains (n = 23)	
	n (%)	n (%)	n (%)	n (%)	
Coaching staff					
Strongly positive	12 (57.1)	4 (19.1)	13 (56.5)	3 (13.0)	<i>P</i> = .19
Positive	8 (38.1)	12 (57.1)	10 (43.5)	17 (74.0)	
Neutral	1 (4.8)	5 (23.8)	0 (0.0)	3 (13.0)	
Negative	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Strongly negative	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
I don't know	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Players					
Strongly positive	3 (14.3)	0 (0.0)	4 (17.4)	2 (8.7)	<i>P</i> = .29
Positive	15 (71.4)	11 (52.4)	13 (56.5)	15 (65.3)	
Neutral	2 (9.5)	7 (33.3)	6 (26.1)	3 (13.0)	
Negative	1 (4.8)	1 (4.8)	0 (0.0)	2 (8.7)	
Strongly negative	0 (0.0)	2 (9.5)	0 (0.0)	0 (0.0)	
I don't know	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.3)	
Medical staff					
Strongly positive	19 (90.5)	9 (42.8)	16 (69.6)	12 (52.2)	<i>P</i> = .70
Positive	2 (9.5)	8 (38.1)	6 (26.1)	10 (43.5)	
Neutral	0 (0.0)	3 (14.3)	0 (0.0)	1 (4.3)	
Negative	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Strongly negative	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
I don't know	0 (0.0)	1 (4.8)	1 (4.3)	0 (0.0)	
Administration					
Strongly positive	1 (4.8)	4 (19.1)	3 (13.0)	1 (4.3)	<i>P</i> = .55
Positive	6 (28.6)	5 (23.8)	5 (21.8)	5 (21.8)	
Neutral	6 (28.6)	2 (9.5)	7 (30.4)	3 (13.0)	
Negative	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Strongly negative	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
I don't know	8 (38.1)	10 (47.6)	8 (34.8)	14 (60.9)	

Note: The shaded cells denote the most frequent response for each respondent group.

the study to ensure readability and understanding. The questions, which were worded identically for coaches and captains within each study arm, were inspired by the RE-AIM framework and addressed adoption and implementation of the exercise program.

All questions were closed, with multiple response options. The questionnaire consisted of a section addressing attitudes, beliefs, and current behavior toward the risk for and prevention of shoulder injuries in both study arms. An intervention-specific section addressed views on and experiences with completion of the OSTRC Shoulder Injury Prevention Programme. In addition, a section specific for the control

teams investigated knowledge of the prevention program used by the intervention teams and included description of five randomly selected exercises from the program to examine completion of these or similar exercises during the season.

2.4 | Data collection

The coaches and captains received a link by e-mail, providing them access to the questionnaire using online survey software (Questback V. 9692, Questback AS). The questionnaires were distributed and completed during February 2015. Automatic reminders were sent to non-responders after

TABLE 3 Experiences with completion of the OSTRC Shoulder Injury Prevention Program among coaches and captains in intervention teams (n = 21)

Question/statement	Response	Coaches (n = 21)	Captains (n = 21)	Coaches VS Captains
		n (%)	n (%)	
Which players have mainly performed the program?	All players	20 (95.2)	17 (80.9)	<i>P</i> = .68
	Players with previous shoulder problem	0 (0.0)	1 (4.8)	
	Players with current shoulder problem	1 (4.8)	1 (4.8)	
	None of the players	0 (0.0)	0 (0.0)	
	I don't know	0 (0.0)	2 (9.5)	
Have your team performed the program three times per week as recommended?	Yes, three times per week or more	6 (28.6)	3 (14.3)	<i>P</i> = .11
	No, between one to three times per week	14 (66.6)	14 (66.7)	
	No, less than once per week	1 (4.8)	4 (19.0)	
	I don't know	0 (0.0)	0 (0.0)	
In which context has the program been performed? (MR)	Before organised handball training	12 (57.1)	14 (66.7)	<i>P</i> = .54
	As a part of the handball warm-up	10 (47.6)	7 (33.3)	
	During handball training	2 (9.5)	0 (0.0)	
	During other organised training	4 (19.1)	6 (28.6)	
	During individual training	5 (23.8)	5 (23.8)	
	Other	0 (0.0)	1 (4.8)	
Have you usually performed the program as a whole?	Yes, always	7 (33.3)	4 (19.0)	<i>P</i> = .26
	Yes, most of the time	10 (47.6)	11 (52.3)	
	Sometimes	4 (19.0)	5 (23.8)	
	No, never	0 (0.0)	1 (4.8)	
Have you followed the planned progression and variation of the exercises in the program?	Yes, absolutely	8 (38.1)	8 (38.1)	<i>P</i> = .86
	Yes, to some degree	11 (52.3)	10 (47.6)	
	No, we use a random selection	1 (4.8)	2 (9.5)	
	I don't know	1 (4.8)	1 (4.8)	
What do you think about the progression and variation of the exercises in the program?	Very good	2 (9.5)	1 (4.8)	<i>P</i> = .54
	Good	15 (71.4)	16 (76.1)	
	Not very good	1 (4.8)	3 (14.3)	
	Poor	1 (4.8)	0 (0.0)	
	I don't know	2 (9.5)	1 (4.8)	
Who has had the main responsibility for implementing the program?	The head coach	6 (28.6)	9 (42.8)	<i>P</i> = .78
	The physical trainer	2 (9.5)	3 (14.3)	
	The medical staff (eg, physiotherapist)	10 (47.6)	6 (28.6)	
	The team captain	2 (9.5)	1 (4.8)	
	Other player(s)	0 (0.0)	0 (0.0)	
	All players in general	1 (4.8)	2 (9.5)	
Who has had the main responsibility for the quality of the exercises?	Main coach	1 (4.8)	1 (4.8)	<i>P</i> = .91
	Physical trainer	1 (4.8)	1 (4.8)	
	Medical staff (eg, physiotherapist)	5 (23.8)	4 (19.0)	
	Team captain	2 (9.5)	1 (4.8)	
	Other player	0 (0.0)	1 (4.8)	
	All players in general	12 (57.1)	13 (61.8)	

(Continues)

TABLE 3 (Continued)

Question/statement	Response	Coaches (n = 21)	Captains (n = 21)	Coaches VS Captains
		n (%)	n (%)	
The education and follow-up we have received regarding the program has been sufficient (LOA)	Strongly agree	5 (23.8)	3 (14.3)	<i>P</i> = .69
	Agree	8 (38.1)	11 (52.3)	
	Unsure	6 (28.6)	3 (14.3)	
	Disagree	2 (9.5)	3 (14.3)	
	Strongly disagree	0 (0.0)	1 (4.8)	
The program is well suited as a part of the handball warm-up (LOA)	Strongly agree	5 (23.8)	3 (14.3)	<i>P</i> = .89
	Agree	8 (38.1)	13 (61.8)	
	Unsure	7 (33.3)	3 (14.3)	
	Disagree	1 (4.8)	1 (4.8)	
	Strongly disagree	0 (0.0)	1 (4.8)	

Note: The shaded cells denote the most frequent response for each respondent group. Abbreviations: LOA, level of agreement; MR, multiple responses possible.

3 and 7 days both per e-mail using the survey software and per SMS (Pling, Front Information DA), or per telephone. Responders were encouraged to take contact to clarify any questions regarding the content of the questionnaire, and two did. The data were analyzed using SPSS statistical software (SPSS V.24, IBM Corporation).

2.5 | Statistics

Categorical data were analyzed with the Fisher mid-P test (dichotomous outcomes), the Pearson chi-squared test (unordered outcomes), and the Wilcoxon-Mann-Whitney test (ordered outcomes).

3 | RESULTS

The overall response rate was 100%. Table 1 shows how coaches and captains in both study arms responded to questions addressing attitudes, beliefs, and behavior toward the risk for and prevention of shoulder injuries. Irrespective of group affiliation, the majority of coaches and captains reported that they believed that handball players are at high risk for shoulder injuries and that performance of a shoulder injury prevention exercise program definitely or to some degree would reduce the risk. Poor fitness in general, tackles, throwing load, and length of career were the most frequent risk factors reported. A significant greater proportion of coaches and captains in the control teams reported to previously have performed training to reduce the risk of shoulder injuries to a large or some degree compared to the intervention teams (*P* = .013). Irrespective of group affiliation, the coaches and captains disagreed that it is more important to spend time on specific handball training than prevention and disagreed that motivation among coaches has no influence on player motivation to perform prevention training.

Table 2 shows how the four respondent groups experienced attitudes toward shoulder injury prevention among different stakeholders in their team. The majority of respondents reported that their team medical staff was strongly positive, whereas players were positive. The majority of coaches in both study arms reported that the coaching staff was strongly positive, whereas the majority of captains reported that coaches were positive. The majority of all respondents had no knowledge of the attitudes of their administration.

All coaches (n = 21, 100%) and captains (n = 21, 100%) in the intervention teams reported that all players of their team were familiar with the OSTRC Shoulder Injury Prevention Programme. The majority of intervention coaches and captains (delivery agents) agreed that the education and follow-up they had received regarding the program had been sufficient and that the program was well suited as a part of the handball warm-up, with good variation and progression of the exercises (Table 3). Less than 30% of coaches and less than 15% of captains reported that their team had completed the program three times per week as recommended and less than half reported that they had performed it as a part of the handball warm-up. Only a minority of the surveyed coaches and captains agreed that they would continue to use the complete program the next season. Among both coaches and captains, belief that the program will prevent shoulder injuries was the most frequently reported facilitator to perform the program and the majority agreed that the program would prevent shoulder injuries when used systematically (Table 4). Lack of player motivation and too time-consuming program were most frequently reported by coaches and captains as the barriers to complying with the program as recommended (Table 4).

According to the majority of intervention coaches and captains, their medical staff was strongly positive to the OSTRC Shoulder Injury Prevention program (n = 22, 12 coaches, 10 captains, *P* = .59), whereas the coaching staff was positive (n = 21, 13 coaches, 8 captains, *P* = .31) and players were

TABLE 4 Views on and beliefs toward the OSTRC Shoulder Injury Prevention Program and factors affecting adoption and implementation according to coaches and captains in intervention teams (n = 21)

Question/statement	Response	Coaches (n = 21)		Captains (n = 21)		Coaches VS Captains <i>P</i> = .14
		n (%)	n (%)	n (%)	n (%)	
Which factors have influenced the motivation to perform the program? (MR)	Belief that the program will prevent shoulder injuries	21 (100.0)	13 (61.9)			
	Belief that the program will increase performance	12 (57.1)	7 (33.3)			
	Sense of duty	6 (28.6)	11 (52.4)			
	Influence from other players	6 (28.6)	2 (9.5)			
	Influence from the medical team	7 (33.3)	11 (52.4)			
	Other	1 (4.8)	0 (0.0)			
The program will prevent shoulder injuries when used systematically (LOA)	Strongly agree	8 (38.1)	6 (28.6)			<i>P</i> = .37
	Agree	11 (52.4)	11 (52.4)			
	Unsure	2 (9.5)	4 (19.0)			
	Disagree	0 (0.0)	0 (0.0)			
	Strongly disagree	0 (0.0)	0 (0.0)			
Have you experienced reduced amount of shoulder injuries?	Yes, we have less shoulder problems	4 (19.0)	2 (9.6)			<i>P</i> = .73
	No, the situation is unchanged	10 (47.6)	12 (57.1)			
	No, we have more shoulder problems	3 (14.3)	0 (0.0)			
	I don't know	4 (19.0)	7 (33.3)			
	Yes, player performance has improved	0 (0.0)	3 (14.3)			<i>P</i> = .33
Have you experienced any positive effect on handball performance?	No, the performance is unchanged	10 (47.6)	8 (38.0)			
	No, player performance is reduced	0 (0.0)	1 (4.8)			
	I don't know	11 (52.4)	9 (42.9)			
	Strongly agree	1 (4.8)	1 (4.8)			<i>P</i> = .33
	Agree	5 (23.8)	4 (19.0)			
I will continue to use the complete program next season (LOA)	Unsure	11 (52.4)	9 (42.9)			
	Disagree	4 (19.0)	4 (19.0)			
	Strongly disagree	0 (0.0)	3 (14.3)			
	Strongly agree	4 (19.0)	2 (9.5)			<i>P</i> = .27
I will continue to use parts of the program next season (LOA)	Agree	11 (52.4)	10 (47.6)			
	Unsure	4 (19.0)	6 (28.6)			
	Disagree	1 (4.8)	1 (4.8)			
	Strongly disagree	1 (4.8)	2 (9.5)			

(Continues)

TABLE 4 (Continued)

Question/statement	Coaches (n = 21)		Captains (n = 21)		Coaches VS Captains <i>P</i> = .13
	Response	n (%)	n (%)	n (%)	
What are the main reasons why your team did not comply with the program as recommended? (MR)	The players lack motivation	16 (76.2)	13 (61.9)		
	Too few exercises with handball	1 (4.8)	4 (19.0)		
	The exercises are too challenging	0 (0.0)	0 (0.0)		
	The program is too time consuming	14 (66.7)	17 (81.0)		
	The program is difficult to organise	0 (0.0)	0 (0.0)		
	The program is not relevant	3 (14.3)	0 (0.0)		
	Lack of equipment	0 (0.0)	2 (9.6)		
The head coach doesn't prioritise the program	3 (14.3)	8 (38.1)			

Note: The shaded cells denote the most frequent response for each respondent group. Abbreviations: LOA, level of agreement; MR, multiple responses possible.

neutral ($n = 21$, 11 coaches, 10 captains, $P = .59$, Figure 1). Regarding the team administration, the majority of coaches and captains had no knowledge of their attitudes ($n = 24$, 11 coaches, 13 captains, $P = .066$).

A significant greater proportion of coaches reported that they had performed prevention training to reduce shoulder injuries compared to captains ($P = .009$, Table 5). Compared to the coaches, a significant greater proportion of the captains reported that the coaching staff had detailed knowledge of the prevention programmed used by the intervention teams ($P = .035$). The majority of coaches and captains reported that the players and the medical staff of their team all were familiar with details of the prevention program. Only a few coaches and captains reported that this knowledge had affected their efforts toward shoulder injury prevention (Table 5).

Table 6 shows the control coaches and captains responses to questions regarding completion of five specific exercises from OSTRC Shoulder Injury Prevention Programme or similar. The majority of coaches and captains reported that they had completed two of the exercises on a sporadic to regular basis. None of the exercises were completely unknown to neither coaches nor captains.

4 | DISCUSSION

Our main findings were that the vast majority of coaches and captains in elite handball believed that players are at high risk for shoulder injuries, and that a shoulder injury prevention exercise program targeting risk factors would reduce the risk, suggesting that there is fertile ground for implementation. However, the minority of delivery agents reported to have implemented the OSTRC Shoulder Injury Prevention Programme as recommended in the trial, with lack of player motivation and too time-consuming program as the main barriers. This suggests that initiatives to reduce the program length and strategies to influence player motivation are needed to succeed with widespread dissemination.

The recently reported preventative effect of the OSTRC Shoulder Injury Prevention Programme suggests that dissemination and widespread use in the handball community would be beneficial.⁷ However, to succeed in a real-world sport setting, knowledge regarding attitudes, beliefs, and current behavior toward shoulder injury prevention among delivery agents and end users, as well as identification of facilitators and barriers to implementation of the program, is crucial.^{10,12} Overall, the coaches and captains surveyed had the impression that handball players are at high risk for shoulder injuries, suggesting that their perceived susceptibility for shoulder injuries is in line with the literature,²⁻⁶ an important premise to succeed with implementation.¹⁰ The vast majority of coaches and captains in both groups

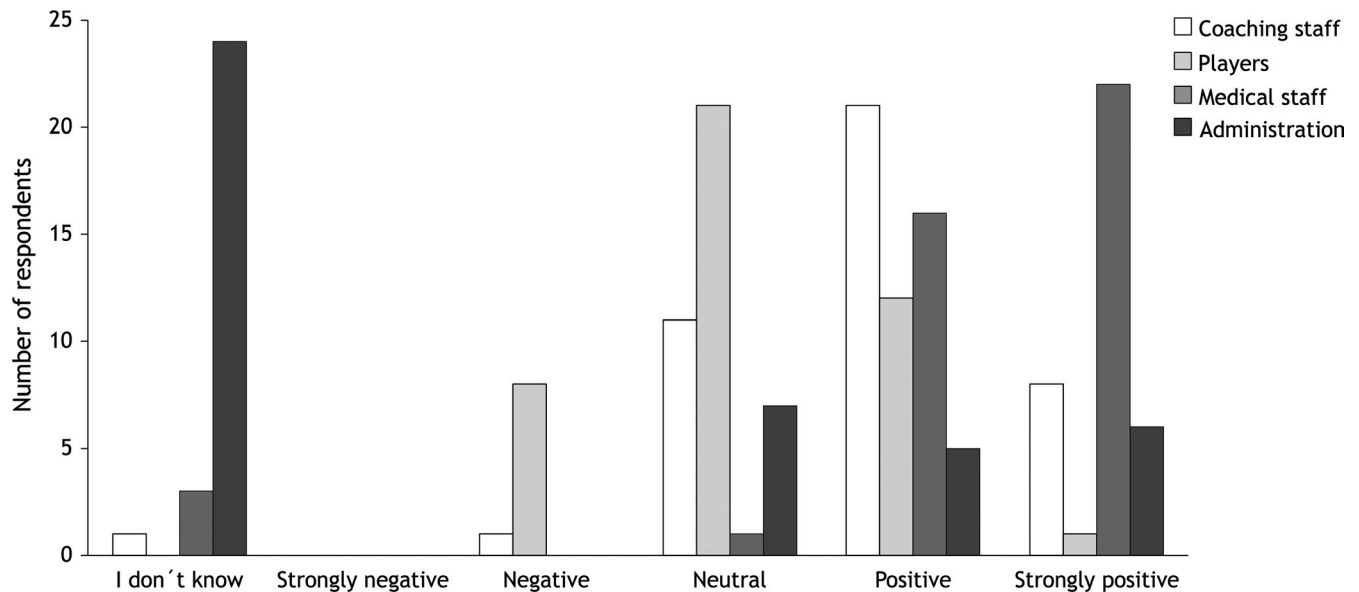


FIGURE 1 Attitudes toward the OSTRC Shoulder Injury Prevention Programme among coaches, players, medical staff, and administration according to all respondents in the intervention teams ($n = 42$, 21 coaches, 21 captains)

believed that a shoulder injury prevention program targeting risk factors would reduce the risk for shoulder injuries and the majority had previously employed preventative measures toward shoulder injuries. Only a minority reported that it is more important to spend time on specific handball training than injury preventative training. Hence, the elite handball community seems primed for adoption and implementation of the OSTRC Shoulder Injury Prevention Programme, as there seems to be a common beneficial belief.

All delivery agents in the trial reported to be familiar with the prevention program and the majority believed that the program would prevent shoulder injuries, which in fact was reported as the main facilitator to implementation among both coaches and captains. These findings support the importance of emphasizing the preventative effect of the program when aiming for a widespread dissemination. Additional common facilitators reported were satisfactory education and follow-up, program variation and progression, expected performance gains, and the practicability to implement the program as a part of the training session. These facilitators were in line with previous studies reporting on implementation of injury prevention exercise programs in team sports^{10,17-22} and should be emphasized in future dissemination. Influence from the team medical staff was further highlighted as a common facilitator in our data. However, as requirement of medical staff previously has been reported as a barrier to implementation and the fact that only a few handball teams will have access to one, even in the top divisions in Norway, this facilitator should receive less emphasis.²⁰

Despite these results suggesting that adoption of the prevention program was successful among the delivery agents, they still responded to deviate from the implementation recommendations, with the majority responding to perform the program between one to three times per week, which is in line with the self-reported player compliance in the trial.⁷ Similar to previous studies reporting on the uptake of injury prevention exercise programs in team ball sport,^{20,23-25} the time it takes to complete the program was emphasized as an important barrier and only a minority of the surveyed coaches and captains reported that they would continue to use the complete program the next season. Considering that the OSTRC Shoulder Injury Prevention Programme targets several risk factors associated with shoulder injury in handball, future research should investigate how these factors are altered among players performing the program in order to reduce the number of exercises. In addition, despite the majority agreeing that the program was well suited as a part of the warm-up, less than half reported to perform the program in this setting. This implies that alternative settings should be considered when planning future dissemination, for example, before the organized training, during other organized or individual training, as these were reported to be common delivery settings in the trial.

Future dissemination efforts should also include initiatives to motivate coaches and players to adopt the program, as lack of player motivation and lack of priority among the head coaches were reported as important barriers to implementation. In fact, both coaches and captains emphasized the motivation among coaches as highly relevant for the player's motivation to perform the program. These efforts should

TABLE 5 Prevention of shoulder injuries and knowledge with the OSTRC Shoulder Injury Prevention Program according to coaches and captains in control teams (n = 23)

Question	Response	Coaches (n = 23)	Captains (n = 23)	Coaches VS Captains
		n (%)	n (%)	
Do your team perform prevention training to reduce the risk for shoulder injuries?	Yes	20 (87.0)	8 (34.8)	<i>P</i> = 0.009
	No	3 (13.0)	9 (39.1)	
	I don't know	0 (0.0)	6 (26.1)	
Is the coaching staff familiar with the prevention program used by the intervention teams?	Yes, they're familiar with program details	12 (52.2)	17 (74.0)	<i>P</i> = 0.035
	Yes, they have heard about it	10 (43.5)	3 (13.0)	
	No, they're unaware of it	0 (0.0)	0 (0.0)	
	I don't know	1 (4.3)	3 (13.0)	
Are players familiar with the prevention program used by the intervention teams?	Yes, they're familiar with program details	14 (60.9)	15 (65.3)	<i>P</i> = 1.0
	Yes, they have heard about it	6 (26.1)	5 (21.7)	
	No, they're unaware of it	1 (4.3)	2 (8.7)	
	I don't know	2 (8.7)	1 (4.3)	
Is the medical team familiar with the prevention program used by the intervention teams?	Yes, they're familiar with program details	13 (56.5)	16 (69.6)	<i>P</i> = 0.21
	Yes, they have heard about it	8 (34.8)	4 (17.4)	
	No, they're unaware of it	0 (0.0)	0 (0.0)	
	I don't know	2 (8.7)	3 (13.0)	
Is the administration familiar with the prevention program used by the intervention teams?	Yes, they're familiar with program details	1 (4.3)	4 (17.4)	<i>P</i> = 0.052
	Yes, they have heard about it	11 (47.8)	6 (26.1)	
	No, they're unaware of it	1 (4.3)	0 (0.0)	
	I don't know	10 (43.6)	13 (56.5)	
Has knowledge of the program affected your team's efforts toward shoulder injury prevention?	Yes, our effort has increased	5 (21.7)	2 (8.7)	<i>P</i> = 0.25
	No, our effort is unchanged	18 (78.3)	21 (91.3)	

Note: The shaded cells denote the most frequent response for each respondent group.

seek to communicate the preventative effect of the program to end users and delivery agents, as this was reported as the most important motivator among both coaches and captains. Furthermore, the education and follow-up on how to perform the program should be prioritized, as a considerable proportion of both coaches and captains were unsure or disagreed that it had been sufficient.

Unfortunately, there is no guarantee that increased knowledge of the preventative effect automatically will translate into changed behavior, as the learning process and experiences of each individual will affect adoption and implementation of the program.²⁶ In order to succeed with behavioral modifications toward preventative measures, it is suggested that it should be included as a part of skill training from an early age to become

an accepted part of their routine and culture.²⁶ Thus, dissemination of the program should target players from a young age and instructions on how to perform the program should be a mandatory at all levels of coach education.

A common understanding among the stakeholders within a team is emphasized as an important premise to succeed with implementation of preventative measures.¹¹ According to our results, there were discrepancies in the attitudes toward the program in the trial, with the team medical staff reported to be strongly positive, the coaching staff to be positive, and the players to be neutral. In addition, the majority of coaches and captains reported to be unaware of their administration's attitudes toward the program, illustrating that communication between stakeholders can be improved. In order to succeed in

TABLE 6 Completion of specific exercises in the OSTRC Shoulder Injury Prevention Programme or similar according to coaches and captains in control teams (n = 23)

Question	Response	Coaches	Captains	Coaches VS Captains
		(n = 23)	(n = 23)	
		n (%)	n (%)	
Have you performed the <i>Push-up plus back slide</i> during the season?	Yes, this exercise has been performed	18 (78.3)	17 (73.9)	$P = 0.75$
	No, not this exercise specifically, but similar	4 (17.4)	5 (21.8)	
	No	1 (4.3)	1 (4.3)	
How often has this exercise or similar been performed per week?	Three times or more per week	2 (8.7)	1 (4.3)	$P = 0.15$
	Two times or more per week	6 (26.0)	2 (8.7)	
	One time per week	7 (30.4)	9 (39.1)	
	Only sporadically	7 (30.4)	10 (43.6)	
	Not relevant	1 (4.3)	1 (4.3)	
Have you performed the <i>Bow and arrow</i> during the season?	Yes, this exercise has been performed	4 (17.4)	4 (17.4)	$P = 0.069$
	No, not this exercise specifically, but similar	15 (65.2)	7 (30.4)	
	No	4 (17.4)	12 (52.2)	
How often has this exercise or similar been performed per week?	Three times or more per week	2 (8.7)	0 (0.0)	$P = 0.007$
	Two times or more per week	6 (26.1)	1 (4.3)	
	One time per week	7 (30.4)	2 (8.7)	
	Only sporadically	4 (17.4)	8 (34.8)	
	Not relevant	4 (17.4)	12 (52.2)	
Have you performed the <i>Dynamic W-stretch</i> during the season?	Yes, this exercise has been performed	6 (26.1)	6 (26.1)	$P = 0.54$
	No, not this exercise specifically, but similar	7 (30.4)	4 (17.4)	
	No	10 (43.5)	13 (56.5)	
How often has this exercise or similar been performed per week?	Three times or more per week	1 (4.3)	2 (8.7)	$P = 1.0$
	Two times or more per week	4 (17.4)	2 (8.7)	
	One time per week	4 (17.4)	2 (8.7)	
	Only sporadically	4 (17.4)	4 (17.4)	
	Not relevant	10 (43.5)	13 (56.5)	
Have you performed the <i>Sleeper stretch</i> during the season?	Yes, this exercise has been performed	9 (39.2)	14 (60.9)	$P = 0.43$
	No, not this exercise specifically, but similar	7 (30.4)	1 (4.3)	
	No	7 (30.4)	8 (34.8)	
How often has this exercise or similar been performed per week?	Three times or more per week	2 (8.8)	1 (4.3)	$P = 0.078$
	Two times or more per week	3 (13.0)	0 (0.0)	
	One time per week	3 (13.0)	2 (8.7)	
	Only sporadically	8 (34.8)	12 (52.2)	
	Not relevant	7 (30.5)	8 (34.8)	
Have you performed the <i>Backward throw</i> during the season?	Yes, this exercise has been performed	2 (8.7)	3 (13.0)	$P = 0.92$
	No, not this exercise specifically, but similar	6 (26.1)	5 (21.8)	
	No	15 (65.2)	15 (65.2)	
How often have this exercise or similar been performed per week?	Three times or more per week	1 (4.3)	0 (0.0)	$P = 0.094$
	Two times or more per week	0 (0.0)	1 (4.3)	
	One time per week	5 (21.8)	1 (4.3)	
	Only sporadically	2 (8.7)	6 (26.2)	
	Not relevant	15 (65.2)	15 (65.2)	

Note: The shaded cells denote the most frequent response for each respondent group.

future dissemination of the program, all stakeholders need to be addressed to reach a common understanding on the advantage of implementation.

Interestingly, the majority of coaches and captains in the control teams reported to have detailed knowledge of the prevention program used by the intervention teams in the trial, with the vast majority of coaches reporting to perform prevention training to reduce the risk of shoulder injuries. In fact, the majority of surveyed coaches and captains reported to perform two of the exercises in OSTRC Shoulder Injury Prevention Programme on a sporadic to regular basis. Thus, it seems that there is fertile ground for implementation of the program across the whole population surveyed. However, this suggests also that there was a considerable cross-over effect in the trial, indicating that the efficacy of the prevention program as reported in the trial may have been underestimated.

This study has limitations that need to be addressed. The survey included only team captains, and it is not known to what extent their attitudes, beliefs, and current behavior represent the views of their teammates. Considering the role of a team captain, it is possible that they are more devoted and conscious toward preventative measures. Further, as the person nominated to represent the coaching staff varied between teams, we cannot generalize our results to all head coaches at the elite level. In addition, as the surveyed coaches and captains all were at the elite level, it is possible that coaches and players at lower level of competition (eg, amateur level) have different views.

5 | PERSPECTIVES

Shoulder injuries are common in elite handball and affects participation and performance,²⁻⁶ as well as daily life.³ Recently, the OSTRC Shoulder Injury Prevention Programme was reported to reduce the risk of shoulder problems in elite handball,⁷ suggesting that dissemination and widespread use would be beneficial. However, to succeed in a real-world sport setting, knowledge regarding attitudes, beliefs, and current behavior among the targeted end users, as well as identification of facilitators and barriers to implementation, is crucial.^{10,12} According to our results, coaches and captains in elite handball believed that players are at high risk of shoulder injuries and that an exercise program targeting risk factors would be effective. This suggests that there is fertile ground for implementation of the exercise program. However, as program length and lack of player motivation were important barriers to implementation, shortening the program and developing strategies to enhance player motivation may be beneficial. Hence, we recommend that future research should evaluate the effect of the exercises in the program on the specific

risk factors targeted, as this may provide important knowledge to shorten the program. Furthermore, we suggest that future dissemination efforts should emphasize the preventative effect of the program, as this was reported as the main facilitator to implementation.

TRANSPARENCY

The study guarantors (SA and GM) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported and that no important aspects of the study have been omitted.

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CONFLICT OF INTEREST

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

All authors contributed to project planning and manuscript preparation. MJO and SA performed the data collection. SA drafted the manuscript and performed the data analysis. SA and the main supervisor, GM, are responsible for the overall content as guarantors.

ETHICAL APPROVAL

This study was nested within a cluster-randomized controlled trial reviewed by the Regional Committee for Medical and Health Research Ethics (REK 2014/653 A), which concluded that, according to the Act on Medical and Health Research (the Health Research Act 2008), the study did not require full review by REK. The trial was

approved by the Norwegian Social Science Data Service (NSD 2014/38187).

DATA AVAILABILITY STATEMENT

All data are available upon request.

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