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Barriers and facilitators to implementing the *Activate injury prevention exercise programme* – A qualitative study of schoolboy rugby coaches

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Abstract

The rugby-specific *Activate injury prevention exercise programme* was deemed efficacious in a randomised controlled trial and subsequently disseminated nationwide by the Rugby Football Union (English rugby union governing body) in 2017. However, no assessment has been made of the factors influencing *Activate* implementation in an applied setting. Consequently, this study sought to assess the barriers and facilitators to coaches implementing *Activate* in English schoolboy rugby. This qualitative study adopted a framework approach, using four a-priori themes influencing injury prevention implementation: awareness, motivational determinants, volitional determinants and socio-environmental factors. A purposive sample of schoolboy rugby coaches were recruited from schools nationwide, participating in semi-structured, one-on-one interviews (n = 10). Transcripts were thematically coded. Participants had positive perceptions towards *Activate*, although only six adopted the programme. Participants reported that players were generally unaware of the programme, with some suggesting this was not an issue as coaches made the decision to adopt *Activate*. Participants focused heavily upon the use of resources to develop coaches' awareness, knowledge and confidence. No participant implemented *Activate* as initially designed, influenced by time and engagement, instead incorporating it within training drills rather than as a block at the beginning of the session. Participants adapted the programme to make it suitable for multiple sports. Some participants reported asking players to deliver *Activate*, despite their lack of awareness, raising concerns around implementation. Participants heavily adapted *Activate* delivery to suit their contexts. How this affects the effectiveness of *Activate* to reduce injury risk is unknown and should be investigated. Player-specific dissemination strategies should be considered if these individuals act as delivery-agents.

Keywords

Motivation, neuromuscular training, Rugby Football Union, self-efficacy, strength and conditioning

Introduction

Neuromuscular training programmes have been found to lower injury risk by 36–42% across a multitude of youth sports.^{1,2} These programmes are predominantly assessed within scientific trials and once efficacy has been established, they are often disseminated for use in the 'real-world' with minimal consideration of the context they are intended for.³ Unfortunately, efficacy does not automatically result in effectiveness within applied settings, with numerous contextual barriers hindering the successful implementation of injury prevention programmes and exercises.^{4,5}

Youth rugby has come under intense scrutiny in the past decade due to high injury rates when compared to other

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youth sports.^{6,7} The rugby-specific *Activate injury prevention exercises programme* is a neuromuscular training programme which has gained attention as a means to mitigate injury risk. In 2015, a randomised controlled trial found that private independent school rugby teams with high *Activate* compliance (≥ 3 session per week) had 72% lower overall match injury incidence and contact injuries, as well as 59% lower concussion rates, than teams within the control group.⁸ *Activate* has since been disseminated by the Rugby Football Union (RFU; English governing body) and World Rugby (International governing body), although its implementation is largely unexplored, given the programme's relative infancy. A survey of English schoolboy rugby coaches ($n=106$) found that whilst coaches had moderate programme awareness (75%),⁹ the programme was not being implemented as intended. Only 48% of coaches reported previously using *Activate*, with those adopting the programme using it twice weekly instead of the recommended three sessions per week.⁹ Furthermore, coaches reported only spending 10–15 min completing *Activate*, which is less than the prescribed 15–20 min, suggesting either exercises were omitted or not completed in their entirety. A limitation of this study was that common barriers, such as a lack of time and inclusion of a ball, were identified through pre-determined survey responses. Whilst quantitatively derived data shed some light on end-user (programme deliverers and users) behaviour, qualitative methods are required to explore end-users' experiences of *Activate* implementation.

Behaviour change models have been used to explore the relationship between coaches' behavioural determinants and their teams' injury prevention behaviours.¹⁰ The Health Action Process Approach (HAPA) is one model used in the public health domain,¹¹ whilst starting to be utilised in sports injury prevention research.^{12,13} The model assesses the association between behavioural predictors, such as perceptions towards risk, and actual behaviour. The model is particularly appropriate for assessing neuromuscular training programmes given it requires long-term adherence, and end-users often do not maintain optimal implementation.⁹ The model is split into two distinct phases: a motivational phase where an individual's task self-efficacy, outcome expectancy and risk perception influence their intention to use the intervention. Once the individual develops this intention, a volitional phase occurs where plans are created alongside developing recovery and maintenance self-efficacy to deal with relapses and threats to the behaviour. Studies from youth football¹² and rugby¹³ have found coach task self-efficacy and outcome expectancy to be consistently associated with intention to use an injury prevention programme. For schoolboy rugby coaches, maintenance self-efficacy and action planning were key volitional constructs associated with greater *Activate* adherence.¹³ Moreover, an individual's behaviour will be influenced by the barriers and facilitators present in their immediate micro-setting (school or sports

team) and at a macro-level (regional or national).¹⁴ Within these levels, barriers can arise from various sources, including access to resources, finances, policies and socio-cultural factors, but will vary largely between settings.

In the English school system, there are predominantly two school types: independent, fee-paying independent schools and government funded, state schools, with the former generally having access to more resources and facilities. Therefore, barriers and facilitators to implementing *Activate* may be context specific; however, little is known about which barriers and facilitators are salient, how they vary between schools, what their source are and whether they occur at micro-setting or macro-levels. As such, the aim of this study was to qualitatively assess the barriers and facilitators to coaches implementing the *Activate injury prevention exercise programme* in English schoolboy rugby.

Methods

The Activate injury prevention exercise programme

Activate is a 15–20 min neuromuscular training programme containing balance, strengthening and plyometric exercises, which is designed to be completed as a warm-up prior to rugby training and matches.¹⁵ There are three age-specific youth programmes (under-15/16/18) and each programme contains four progressive phases, where exercises are advanced in complexity every 4–8 weeks throughout the season. The programme was disseminated by the RFU after publication of the efficacy study in 2017.⁸ Resources required for the programme were initially only accessible by signing up to the RFU website, with school coaches able to attend regional *Activate* coach workshops. In 2018, resources were updated to become open access and freely available online, with no registration required, whilst regional workshops needed to be requested by schools and coaches rather than places on workshops being bookable online.

Study design

This qualitative study used a framework approach¹⁶ (Supplementary File 1) to investigate the facilitators and barriers to implementing *Activate* by rugby coaches in English schools. A deductive approach was used, based on four a-priori themes, including the motivational and volitional phases of the HAPA model,¹¹ which are known to influence the implementation of sports injury prevention programmes.^{5,13,17}

Participants and recruitment

Schoolboy rugby coaches were purposively sampled to provide a range of perceptions from various settings.¹⁸ Participants were included if they were fluent in English,

had experience of coaching English schoolboy rugby teams (under-12 to under-19), and had awareness of *Activate* and the programme's content. Participants were not required to have previously used *Activate*, thereby ensuring a range of responses and perceptions from coaches with different experiences. Criterion sampling was used in the selection of participants,¹⁹ with participants selected from six different groups (Figure 1). Coaches who had been approached to participate in a previous study were targeted, inviting those who did (groups 1 and 2) and did not participate (groups 3 and 4). Additional coaches who had not been invited to participate previously were also sought, to mitigate selection bias, through a network of coaches known to the research team (groups 5 and 6). Finally, an array of coaches from private independent schools and government-funded state schools were sought to ensure a range of responses were obtained from various settings. All coaches were invited to join the study through a standardised recruitment email. If no response was received within two weeks, the next coach from that group was emailed on a rolling basis. No more than one coach was recruited from each school. Thematic saturation was deemed to have been achieved when less than 5% of new codes occurred in a run of two interviews.²⁰ Ethical approval for the study was granted by the Research Ethics Approval Committee for Health at the University of Bath (EP 17/18-167), with all participants providing informed consent prior to interviews.

Data collection

Ten interviews, lasting between 50 and 70 min, were conducted between March and September 2021 through Microsoft TEAMS (Microsoft, United States). Interviews were semi-structured and guided by the four themes (Figure 2). To ensure confidentiality, the lead researcher (CB) conducted all interviews, with only the interviewer and participant present. The lead researcher, who undertook qualitative research training prior to the study, assumed a neutral position, refraining from providing their beliefs and opinion on injury prevention and *Activate*. All participants were informed that the interview would revolve around their experiences and perceptions, and there were no correct or incorrect answers. They were encouraged to speak freely and their responses would be treated with confidentiality.

The interview guide (Supplementary File 2) was developed by the authorship group and contained five key questions, influenced by the HAPA model, investigating the participant's setting/context; injury prevention beliefs, *Activate* awareness, previous *Activate* use, facilitators to *Activate* implementation, and barriers to *Activate* implementation. Subsequent questioning was dependent on participant responses and previous or current *Activate* use. Questions were open-ended to facilitate conversation and to enable participants to provide in-depth responses. The interviewer recorded notes throughout each interview,

enabling further questioning of points raised by the interviewee, whilst aiding familiarisation post-interview (stage 1 of framework approach).¹⁶

Analysis

Interview audio was recorded via the Alon Dictaphone application (Alon Software) and transcribed verbatim. All data which may have made an individual identifiable were removed to ensure confidentiality. The lead researcher listened to each interview whilst reading the transcript to ensure precision whilst familiarising themselves with the data. Each transcript was subsequently coded and organised using NVivo (QSR International, Version 12). Once each interview had been coded, relevant codes from analysed interviews were merged to create a codebook. At this stage, codes were related to one of the four a-prior themes specified. An iterative approach was used where codes were continually amended until all interviews had been completed and data saturation was achieved. The final analysis stage of the analysis involved grouping codes within a theme into sub-themes (predominately barriers and facilitators relating to HAPA constructs). The lead researcher and a secondary researcher (RW) analysed the first interview independently, then compared codes to ensure consistency. Hereafter, the lead researcher completed the analysis phase independently, with the secondary researcher providing guidance. The study is reported in accordance with the Consolidated criteria for reporting qualitative studies (COREQ) checklist (Supplementary File 3).²¹

Results

In total, 10 interviews were conducted with six participants from government-funded state schools, and four from private sector independent schools (Table 1). The majority of participants ($n = 7$) were in head/lead coaching roles, and all coaches except one (ID: 002) maintained teaching roles as part of their employment. All participants had five or more years of coaching experience, with seven holding either an RFU Level 2 or 3 qualification.

All coaches, except one (ID: 008), had previously used *Activate*. Six coaches reported that they currently used *Activate*; however, four of these coaches acknowledged they had heavily adapted *Activate* to create a bespoke programme that was more generalised or applicable for multi-sports to suit their setting. The remaining two coaches reported using *Activate* exercises but neither completed set phases, often just selecting a few exercises for each session. Four coaches did not currently use *Activate*.

Theme 1. *Activate* awareness

I don't feel like Activate is shouted about enough. I don't think that many coaches that I've seen over the years know about it. (ID: 006)

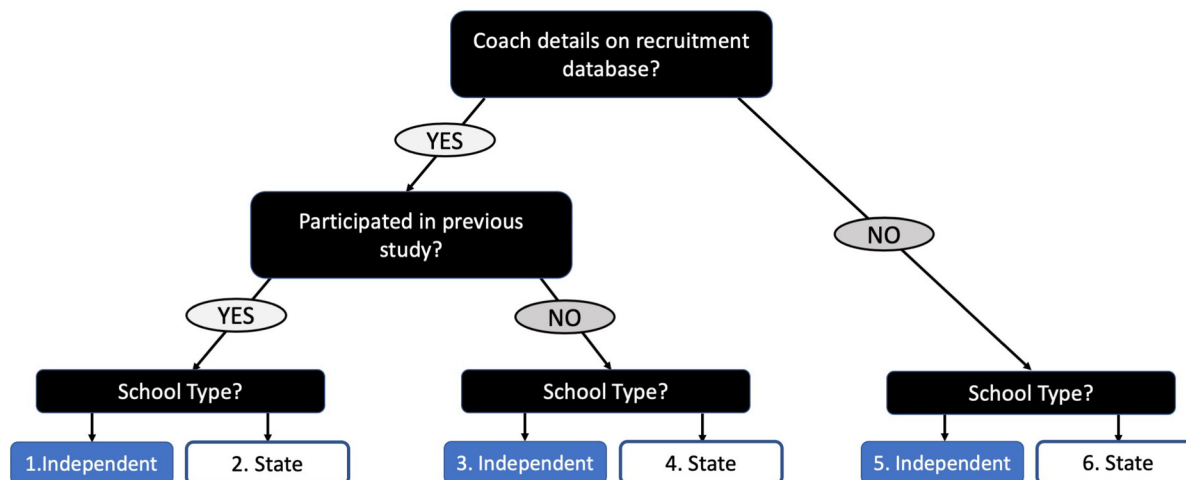


Figure 1. Participant recruitment process to highlight criterion sampling from groups 1–6.

There was unanimous agreement from the participants that injury prevention was a collective responsibility between coaches, teachers, support staff and players. Some participants felt that there was generally poor *Activate* awareness from their coaching peers, attributing this to a lack of publicity or poor programme dissemination from the RFU (Table 2). There was consensus that head coaches had the overall responsibility and decision whether their teams adopted *Activate*. Some head coaches reported that they mandated the use of *Activate*, although due to either coaching or teaching themselves, they were unable to check if assistant coaches were adhering to this mandate. All participants

reported awareness of RFU *Activate* resources, such as the dedicated website,²² cue cards, PDFs, and video demonstrations, with most previously using these resources. Some participants used these resources to raise awareness amongst their assistant coaches and their players, sending them videos through virtual platforms or printing out cue cards and placing them in changing rooms. Furthermore, participants reported that their schools had embedded *Activate* within in-house professional development training days. Some participants felt that the RFU endorsing *Activate* gave the programme credibility and subsequently created greater awareness and buy-in.

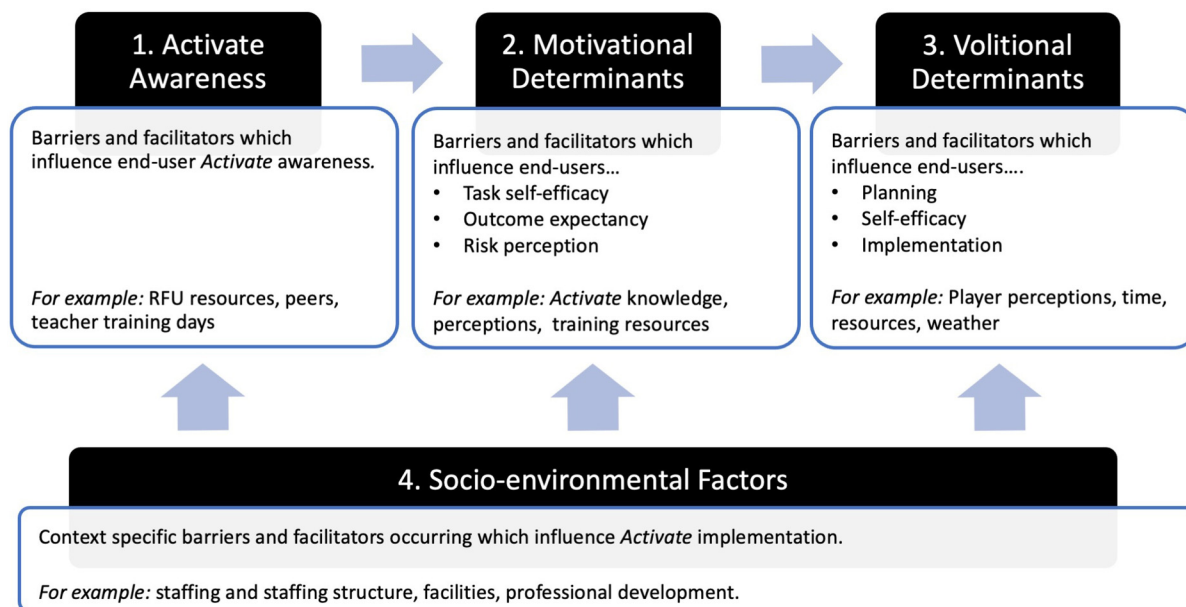


Figure 2. A-priori themes, influenced by Health Action Process Approach (HAPA) phases, and how they relate to each other and *Activate* implementation. Barriers and facilitators may occur at a micro-setting or at a greater macro level.

Table 1. Participant characteristics.

ID #	Figure Group	School type	Job title	Coaching ages	Rugby coaching structure	Teaching role?	Coaching experience	Coaching award	Previous workshop?	Current Activate use?
001	2	State - College	Sports Coaching Lecturer	16–18	FT HoR, FT Assistant, 2 × PT rugby coaches	Yes - Sport Lecturer	12 years	RFU Level 3	Yes	Yes - Modified
002	1	Independent - School	Director of Rugby	13–18	FT DoR, teachers coach age group with PT external coaches	No	9 years	RFU Level 4	No	Yes
003	3	Independent - School	Head of Rugby	14–18	FT HoR, teachers coach age group with PT external coaches	Yes - PE teacher	10 years	RFU Level 3	Yes	Yes - Modified
004	3	Independent - School	Director of Rugby	13–18	FT DoR, FT Assistant, teachers coach age group	Yes - PE teacher	20+ years	RFU Level 4	No	No
005	4	State - School	Director of Sport	12–18	FT DoS, 4 × PE teachers who coach, use volunteers	Yes - PE teacher	20+ years	RFU Level 2	Yes	No
006	6	State - College	Physical Wellbeing Manager	16–18	FT DoS, 6 × rugby coaches who also teach	Yes - Sport Lecturer	5 years	RFU Level 2	Yes	No
007	1	State - School	Director of Sport	11–18	FT DoS, FT Head of PE, 3 × FT PE staff	Yes - PE teacher	14 years	RFU Level 2	No	Yes - Modified
008	6	State - School	PE Teacher	11–18	FT Head of PE, teachers coach age groups	Yes - PE teacher	12 years	RFU Level 1	No	No
009	5	Independent - School	Head of Rugby	11–18	FT DoS, FT HoR, 2 × FT Assistants, 1 × FT S&C coach	Yes - PE teacher	6 years	RFU Level 2	No	Yes - Modified
010	2	State - Grammar	Head of Rugby	11–18	FT HoR, 4 × FT PE teachers, 12 other teachers who assist	Yes - PE teacher	20+ years	RFU Level 3	Yes	Yes

FT = Full-time, PT = Part-time, HoR = Head of Rugby, DoR = Director of Rugby, DoS = Director of Sport, PE = Physical Education, RFU = Rugby Football Union, S&C = Strength and Conditioning. A college is specifically for students aged 16–19 years old, whereas a secondary school is for students from 11–18 years old.

Table 2. Micro- and macro-level facilitators and barriers to Activate implementation as identified by participants.

Theme	Micro-setting	Macro-level
1. Activate awareness	<p>Facilitators</p> <ul style="list-style-type: none"> - Head coach mandating Activate use - In-house school Activate training 	<ul style="list-style-type: none"> - RFU endorsing Activate - RFU disseminating Activate resources to raise awareness
2. Motivational determinants	<p>Barriers</p> <ul style="list-style-type: none"> - Lack of coach Activate awareness <p>Facilitators</p> <ul style="list-style-type: none"> - Knowledge of Activate efficacy - Knowledge of injury risk and prevention - Small playing squad - Improvement in players' physical development - Player engagement through education - Providing players autonomy to run Activate themselves 	<ul style="list-style-type: none"> - Poor dissemination by RFU to raise Activate awareness - RFU disseminating after the season has started - RFU Activate resources to improve self-efficacy - Mandatory RFU Activate workshop attendance as part of coaching qualification
3. Volitional determinants	<p>Barriers</p> <ul style="list-style-type: none"> - Lack of Activate effectiveness research - Perceived lack of risk in some sessions (e.g. non-contact training) <p>Facilitators</p> <ul style="list-style-type: none"> - Exercise progressions – helped engagement and physical progression - Choosing a small number of exercises to master 	<ul style="list-style-type: none"> - Logistics of attending a face-to-face RFU Activate workshop - RFU resources enable coaches to plan and implement Activate over time - Activate phases fit within academic calendar
4. Socio-environmental factors	<p>Barriers</p> <ul style="list-style-type: none"> - Too many athletes to observe/coach at once - Exercise progressions – difficulty remembering and coaching changes - Number of exercises within a phase - Negative player engagement - Lack of inclusion of a ball - Poor weather <p>Facilitators</p> <ul style="list-style-type: none"> - Integrating Activate within games or skills /drills - Using a variety of prescription measures, e.g., time, games, engagement, to facilitate use 	<ul style="list-style-type: none"> - Activate exercises are too static

(continued)

Table 2. (continued).

Theme	Micro-setting	Macro-level
	<ul style="list-style-type: none"> - Adapting <i>Activate</i> to make it appropriate for multi-sports - Support staff (medical and S&C) help to encourage and deliver <i>Activate</i> 	
Barriers	<ul style="list-style-type: none"> - Time to deliver <i>Activate</i> within a session - Use of teaching staff, or volunteers, to coach who were not rugby oriented - Time to upskill dual-role coaches to use <i>Activate</i> 	<ul style="list-style-type: none"> - Rugby only being played for one school term, meaning coaches and players may have to learn multiple, sports-specific programmes.

RFU = Rugby Football Union, S&C = strength and conditioning.

One independent school participant felt that players were unaware of *Activate*, although this was not perceived as an issue because coaches, not players, made the decision to adopt the programme. This point was reinforced by participants from state schools who felt that players ultimately did what coaches told them to do. Another independent school coach felt there needed to be greater emphasis for *Activate* uptake in pre-season (July-August), rather than in September when coaches start their academic teaching and match-play commences. They felt earlier emphasis on *Activate* use would provide coaches time to engrain the programme in a pre-season period which is generally quieter than during the season.

Theme 2. Motivational determinants

... anything that would prevent injury and keep our players on the pitch and enjoying themselves. (ID: 005).

Task self-efficacy. Participants highlighted that self-confidence (task self-efficacy) was critically important to adopting *Activate*, focusing heavily on how the RFU resources had helped develop their own self-efficacy. Numerous coaches mentioned how a specific *Activate* workshop would facilitate programme use. Some coaches were speaking from experience, having previously attending a workshop, feeling that the practical component of the workshop was essential for building self-efficacy through observation, coaching and demonstration of the exercises. Other coaches were unaware an *Activate* workshop existed but felt that a training resource would be beneficial. One participant, who had not attended a workshop, felt that he was unqualified to use *Activate*, suggesting, along with another coach, that the RFU develop a training qualification to raise awareness and self-efficacy. Some participants supported mandating coach attendance at a training workshop. The idea of including *Activate* training in teacher training days was mentioned by some participants, with some schools already creating in-house training to upskill their coaches to facilitate its use.

Coaches nationwide were able to attend *Activate* workshops delivered by the RFU and specially trained workforce, known as community rugby coaches. Schools and coaches who wished to host a workshop were required to organise these events, in liaison with the regional community rugby coach. Participants who had undergone this process reported that it created numerous barriers, for instance, coaches could attend a workshop being hosted by another school, but there were challenges around travel time and the logistics of arranging attendance. The option of a virtual workshop was raised by the interviewer, with all participants in agreement that a face-to-face workshop would be better due to the practical component. However, there was acknowledgment that a virtual

workshop could be beneficial if coaches could not attend a face-to-face workshop.

The majority of participants reported giving players autonomy to run the warm-up, perceiving that this created player togetherness and responsibility. This also afforded the coach time to set up the session whilst the players were warming up. However, it was unclear whether players had self-efficacy to deliver the programme, or how this was assessed or developed. Some participants identified that players need self-efficacy to run the warm-up, with one suggesting that players would “rather not try and get it wrong than try and not get it wrong” (ID: 009), whereas the other participant denoted that online videos could be used as a learning resource to develop player self-efficacy.

Outcome expectancy. Participants had good knowledge that *Activate* could decrease injury risk in schoolboy rugby, stating that the publicised results from the efficacy study⁸ were one of the reasons for adopting the programme. Some participants reported that injury prevention was particularly important to them to maximise their players availabilities, as they had small playing squads. Participants also demonstrated knowledge that *Activate* could reduce the incidence of specific injuries, such as concussions. This led to some coaches using specific exercises to prevent injuries which might be more prevalent in facets of the game, such as the resistance exercises if they were including contact in training. Some participants acknowledged that they used *Activate* to improve the physical characteristics and athletic development of their players, rather than as a specific focus upon injury prevention.

Participants felt that educating players about the benefits of *Activate* was important for creating buy-in, hoping greater knowledge would facilitate engagement and greater exercise fidelity. Education was deemed particularly relevant for older players who could better grasp the statistics from the efficacy study and have a more in-depth understanding of technique and exercise physiology compared to younger players. Some participants felt further evidence confirming *Activate* could reduce injury risk would facilitate greater programme uptake. It is unclear if these perceptions were due to a lack of awareness of the published efficacy study⁸ or that more studies should be conducted before the programme can be deemed an effective strategy to reducing rugby injury risk.

Risk perception. Participants largely agreed that rugby players were at risk of injury, with some reporting this was a key reason for them to adopt *Activate*. Some participants were aware of the increased risk of injury through contact mechanisms, such as the tackle, and would use certain exercises to mitigate the risk of associated injuries like concussions, for example, the use of isometric cervical spine exercises prior to contact sessions. Some participants

questioned whether there was a need to complete *Activate* in sessions where perceived injury risk was lower, such as non-contact training or touch rugby: “If they are playing touch rugby, do they need that level of activation in the neck?” (ID: 001).

Theme 3. Volitional determinants

It (Activate) would be a very hard sell to the 13-year-old kid, who just wants to run around with his mates, but he's got to do his hamstring strengthening. (ID: 004)

Planning. Participants had short-term plans on how to implement *Activate*, largely revolving around using the RFU resources to upskill themselves and their fellow coaches. Some participants detailed plans of how their warm-up would differ between age-groups. There was general agreement that younger age-groups needed the warm-up to be gamified (creating competition through skills or training games) and delivered by a coach, with older age-groups taking responsibility for their own warm-up and implementing *Activate* in a block at the beginning of training. Coaches did not report specific plans for long-term *Activate* maintenance, with only a few coaches saying they would take players through the various age-specific programmes as they progressed through school years. Participants did not offer any definitive coping plans on how they would continue to use *Activate* if adherence waned or how they would overcome barriers to programme use.

Maintenance and recovery self-efficacy. Coaches reported that the *Activate* resources helped maintenance and recovery self-efficacy, providing guidance to deliver, progress or restart using the warm-up. However, there were numerous micro-settings, and contextual barriers which hindered programme maintenance. Participants did not feel it was possible to observe the technique of all students if they had large player numbers, and those who were not being watched would disengage or simply stand idly, awaiting instructions: “I'm working with this group over here and I'm working on some lunges and stuff, and I turn around and this group is on their phone” (ID: 001). A further barrier was that the exercises were deemed to be too static, and when the weather was poor students were reluctant to go outside and engage with the warm-up. This would be particularly pertinent for those teams where the warm-up was player-led.

Some participants felt the progressions between phases facilitated *Activate* maintenance, with each phase fitting nicely into the academic calendar. The remaining participants felt that the progressions made *Activate* implementation too complex and hindered them from using the programme. Participants raised concerns relating to

coaching multiple age-groups, as it was hard to remember all the different exercises and coaching cues. Adding in various phases compounded this, thus participants largely resorted to using a single phase for the whole season or did not use the programme at all.

No coach adopted whole *Activate* phases, instead choosing a small number of exercises to master the movements or to provide variety between sessions to stop the programme from becoming monotonous for the players. Coaches highlighted that the delivery-agent mastering one phase meant they often did not progress the programme past that initial phase. There was a sense that they would rather deliver the phase they were now comfortable with rather than challenge themselves, and the players, to learn the subsequent phase.

Participants reported that players themselves were a barrier to using *Activate*. Players were not reported to have negative perceptions towards *Activate per se*, but rather a natural desire to run around with the ball and play rugby as opposed to completing a warm-up.

Theme 4. Socio-environmental factors

when they're in year 7, they're only playing 20–25 min each way, if you're not careful your warmup can last longer than the game. (ID: 010)

Nearly every participant reported integrating their warm-up within games or rugby drills at the beginning of the session to disguise the warm-up as to improve engagement, particularly for younger age-groups. Engagement was perceived by many coaches as the primary aim of their rugby sessions, highlighting that without engagement, players would not complete *Activate* anyway. The inclusion of *Activate* within training drills or games meant coaches did not adhere to the prescribed sets and reps, instead adopting a variety of parameters, such as duration, distance travelled, perceived movement competency or player engagement, to dictate the transition between exercises.

Participants reported that they had adapted *Activate* to make it applicable for multi-sports, not just specific to rugby. English schoolboy sport, particularly in independent schools, revolves around playing rugby in the winter term (September–December), football in the spring term (January–April) and cricket in the summer term (May–July). Participants felt that developing a warm-up which could be used for all sports would negate the need to change the warm-up routine completely when transitioning from one sport to another. These tailored warm-ups were based upon programmes with a scientific basis, such as *Activate* and the *11+*,²³ although participants said that the programmes had been altered to the extent they would no longer resemble *Activate*.

The most commonly mentioned barrier relating to *Activate* implementation was lack of time to deliver the

programme within a session. Participants gave examples where they would only be able to dedicate five minutes to the warm-up in a 45–60 min session, or else they would not be able to cover their desired rugby content. One participant felt that they did not have enough time in a 90-min session to spend 20-min completing *Activate*. Time barriers resulted in many participants shortening the warm-up, or not using *Activate* at all. However, four coaches (two from state schools and two from independent schools) did not feel that session time was a barrier. This was mainly due to having longer sessions (90–180 min) so they felt they could dedicate time to complete the warm-up thoroughly.

Nearly all participants had teaching roles in addition to their coaching duties. When describing their staffing structures, this appeared to be a common practice, with schools relying on individuals who were primarily teachers, or even volunteers, to coach some of the rugby teams. This created various implementation barriers, with a lack of time to upskill these dual-role coaches. These individuals were perceived to be more teaching- than rugby-focused and reportedly had little interest in rugby and were only there to help. Subsequently, they were perceived as less inclined to spend their limited time upskilling themselves to learn *Activate*. Targeting teachers through more formal means, such as teacher training days or inhouse professional development, might be a strategy to improve their awareness and knowledge of sports injury risk and prevention. Some participants touched on the importance of support staff (medical and strength and conditioning coaches) in injury prevention. These individuals reportedly often challenged current practice or encouraged coaches to adopt evidence-based injury prevention strategies such as *Activate*. In some schools, coaches asked support staff to deliver the warm-up and targeting these individuals with *Activate* resources and training might be beneficial.

Discussion

The aim of this study was to explore the barriers and facilitators to coaches implementing *Activate* in their schoolboy rugby teams. Four a-priori themes were defined based on their known importance to implementing neuromuscular training programmes such as *Activate*. No coaches within the study implemented *Activate* as it was originally intended. Instead, coaches adapted *Activate* to suit their current context, primarily changing *Activate* to make it suitable for multiple sports or selecting exercises they perceived as necessary to match the demands of the rugby session. Interestingly, participants changed their implementation approach depending on the age group they were coaching, often providing older age-groups with autonomy to run their own warm-up. This highlights the complexity of successfully implementing *Activate* within applied settings, where many intrinsic and context-specific barriers and facilitators influence a coach's behaviour.

Barriers to implementing neuromuscular training programmes are well described in the literature, the most frequent being time,²⁴ specifically short session length,⁵ the duration of the programme²⁵ and the frequency of sessions per week.^{26,27} Participants in this current study identified further issues around lack of time to upskill coaches to use *Activate*, particularly impacting the use of exercise progressions. Issues pertaining to resources were not frequently mentioned by coaches. Indeed, participants demonstrated good awareness of *Activate* resources and were complimentary towards their quality and availability, contrasting with much of the sports injury prevention literature.^{5,17,28} Similarly, barriers around facilities and equipment were not commonly mentioned, though they have been for programmes such as the *11+*.^{17,24} *Activate* does not require any equipment but the context of school sport perhaps means that there aren't great challenges around access to the facilities, or maybe that *Activate* can be completed in a relatively small area regardless of surface type.

Motivation appears to be a facilitator in the implementation of sports injury prevention programmes,²⁹ with sport-specific exercises,³⁰ enjoyment²⁴ and improvements in confidence and ability⁵ all being cited as positives in youth populations. Knowledge of injury risk is also commonly cited as motivation for end-users to implement injury prevention programmes,^{31,32} with participants in this study adding to this body of evidence. However, risk perception does not appear to be a strong predictor of intention to using neuromuscular training programmes, such as the *11+*¹² or *Activate*,¹³ and focus may be better placed improving programme awareness and end-user self-efficacy.

Coaches are often the focus of behaviour change strategies in sport injury prevention research.³³ In community sport, these individuals often have the primary decision-making responsibility³³ and act as the delivery-agent.³⁴ However, the current study suggests that the players themselves are used as the delivery-agent in schoolboy rugby. This is interesting, as players have not been targeted with *Activate* dissemination. A recent study conducted over a two-year period found only 13% of English schoolboy rugby players were aware of *Activate*.⁹ It is unclear whether players have the knowledge, coaching skills and/or self-efficacy to deliver *Activate* proficiently. If they do not, it is possible that players may not provide the coaching cues for the exercises to fellow players, use incomplete phases, and not adhere to the prescribed sets and repetitions. If coaches are not observing the warm-up, it is possible that the players may not be using *Activate* at all, despite their coaches encouraging them to do so. To address this, stakeholders should consider whether player-specific training strategies are necessary to ensure they have the knowledge and self-efficacy to deliver and coach the programme to their peers. Many studies have sought to describe youth player perceptions towards injury risk and prevention

generally.^{32,35} However, player perceptions towards specific injury prevention programmes are less commonly investigated^{9,24} and a large knowledge gap around their knowledge and confidence to complete such programmes exists. These areas need to be investigated if players act as delivery-agents as reported in this current study.

Participants reported that *Activate* implementation depended on the demands of the session and the need to prevent specific injuries. This suggests that the coaches perceive these exercises to induce an acute physiological response, with limited need for long-term exposure to induce chronic physiological adaptations. At present, there is a scarcity of research on the physiological effects of *Activate*, with a single study investigating this area reporting that under-18 youth rugby players had a 24% increase in cervical spine strength after completing the isometric cervical spine exercises for 8 weeks.³⁶ A few coaches reported that they used *Activate* to improve their players' physical characteristics and movement control. There is a high level of evidence that neuromuscular training programmes, primarily football specific programmes such as the *11+*, can promote both acute and chronic physiological adaptations.³⁷ However, beyond the neck strength study,³⁶ it is not clear if *Activate* does induce acute and/or chronic physiological responses. Thus there is a need to investigate if *Activate* does improve the physical characteristics of youth rugby players given this may facilitate programme implementation (Table 3).

Exposure to the *11+* has been shown to induce positive physiological changes in an athlete, such as greater speed, power and stability.³⁸⁻⁴⁰ Establishing and promoting these benefits is important, as sports coaches are more likely to implement an injury prevention programme if it improves physical performance measures,^{41,42} reinforced by the coaches in this present study. *Activate* is currently labelled as an '*injury prevention programme*', which may be a barrier to programme uptake if injury prevention is not a primary focus for coaches. Therefore, it is necessary to investigate whether *Activate* does indeed improve physical performance measures. If so, consideration should be given to how the programme can be labelled to sound attractive to end-users and their goals, influencing greater uptake and implementation.

Nearly all adopting coaches reported interspersing *Activate* within rugby drills or in training based games rather than delivering the warm-up as a block at the beginning of the session as initially intended.¹⁵ The primary reason for this was to improve player engagement by merging the warm-up into rugby-specific activities. This is reflective of a shift in coaching practices over the last decade to improve player development through a constraints-led approach,⁴³ with the RFU having recently created resources on how to include *Activate* within skills and training games.²² However, through gamification, coaches did not stick to the specific dosages or parameters

Table 3. Additional participant quotation for the facilitators and barriers occurring for each theme.

Theme	HAPA Construct	Facilitators	Barriers
1. Activate awareness	-	“I went onto the actual Activate page and just had a quick look through it. And some of the stats I didn’t even know, like the 43% drop in injuries in male rugby. I thought, “Wow, why did I need to look on this to know that? That should just be like common knowledge.”” (ID: 009)	“if the head coach doesn’t believe in it or isn’t invested in it or doesn’t understand it, then they’re doing to go in a different direction” (ID: 001) “I look at Activate and I feel it just needs a bit of a push as in the communication side of things.” (ID: 009)
2. Motivational determinants	Outcome Expectancy	“anything that would prevent injury and keep our players on the pitch and enjoying themselves.” (ID: 005).	“if they don’t know the benefit then the standard of exercise drops” (ID: 009)
	Self-efficacy	“It’s learning (the workshop) by someone watching you do it and feeling the movement” (ID: 006).	“I don’t think Activate works well as an online CPD, in my opinion, because you have to get involved with it, have some fun with and try some stuff with like-minded people, and that was the best part of the workshop that I attended.” (ID: 001)
	Risk Perception	-	“You’re not going to prevent injuries in rugby” (ID: 010)
3. Volitional determinants	Planning	“I think as long as you’re creative with your warmup, not only do they (players) see the value, they know the value of it, but they also enjoy it” (ID: 010)	“it takes a hell of a lot of energy, a hell of a lot of effort, and to be honest with you, a hell of a lot of planning.” (ID: 008)
	Implementation	“the first half hour of our sessions are generally multi-direction invasion games, mixed with Activate” (ID: 002) “it is more about movements and time rather than reps and set which probably goes against the literature and the research.” (ID: 001)	“I think they’re (players) invested in rugby and do the warmup because Mr [Smith] tells them they’ve got to do the warmup.” (ID: 007)
	Self-efficacy	“The fact that it progresses is really good for me because it shows them where we want to go with things.” (ID: 009) “I tend to use phase one of Activate in the first half term, phase two of Activate in the second half term and phase three of Activate in the fourth half term.” (ID: 010)	“the changes of the exercises is the one that we found most prohibitive to be honest” (ID: 007) “by the time you got through it all and got your head around it, you were probably on to the next phase” (ID: 005)
4. Socio-environmental factors	-	“it might be they’d spend three months doing rugby and doing Activate or whatever, but then they might then spend the next three months doing football and doing the 11 + thing. So it makes sense from a school point of view, to try and tie it all together, to take the bits that cross over and keep them and take the bits that best worked for us and use them.” (ID: 005) “we’ve moved a lot of our injury prevention to the gym. The reason being we can get them excited to play rugby, we struggle to get them excited to do injury prep. Where in the gym where it might be a little bit slower, we can get them to do the work, and then their direct reward is they’re allowed to lift weights.” (ID: 009)	“for a coach who’s got limited time to deliver, having to spend a significant part of their training education on Activate or similar would be challenging” (ID: 004) “The maths teachers and the biology teachers who are working with a bit more of a participation environment rather than a performance environment, might be no less enthusiastic about it. I think they know the importance, but do they actually follow the Activate programme?” (ID: 010) “it was different for every age group and kept changing. And so, you know, and that meant that we had to keep changing and changing the pitch. It was just that it was a faff, which is why, ultimately, we sort of took the 11 + and made our own to a degree” (ID: 005)

HAPA = Health Action Process Approach.

for each *Activate* exercise, nor did they use whole phases. At present, it is unclear what effect sub-optimal implementation has on *Activate* effectiveness and there is a need to establish this. It may be that *Activate* does not need to be implemented as a block warm-up to be effective. For example, there is evidence that completing the strengthening exercises (part 2) from the *11+* post-training improved compliance but did not negatively impair the effectiveness of the programme.⁴⁴ If this finding was replicated for *Activate*, it may be that coaches can intersperse exercises through a session, complete them at the end or even away from the pitch. For this approach to be advocated, future research should focus on whether *Activate* remains effective if delivered through alternative approaches to the initially exercise prescribed.

Participants supported mandatory *Activate* training, much like coaches in England are required to complete a concussion awareness module⁴⁵ as part of their coaching qualifications. Mandatory coaching education workshops are not new to rugby injury prevention. In New Zealand, coaches are required to attend an annual *RugbySmart* workshop,⁴⁶ which has been used to successfully disseminate educational information regarding injury prevention and performance.^{46,47} Similarly, South African coaches are required to attend a *BokSmart* workshop bi-annually.⁴⁸ Running in a similar manner to *RugbySmart*, these workshops have been credited with improvements in player safety behaviour^{49,50} and a reduction in community rugby injuries.⁵¹ Relevant stakeholders should consider mandating *Activate* training as part of RFU coaching qualifications. At a minimum, this would raise *Activate* awareness, leading to a greater number of programme adoptees and potentially reducing the number of rugby injuries occurring nationwide.

The expected disparity in micro-setting barriers and facilitators to *Activate* implementation between school settings, independent and state schools, was not evident. Given independent schools generally have access to a greater number of resources, it was expected that they would have been able to overcome common barriers to implementing an injury prevention programme, such as time constraints and facilities. This did not appear to be the case. Participants from state schools did not report time as a barrier to delivering *Activate*, whilst some independent school some participants did. Despite increased staffing levels in independent schools, all participants, except one, had teaching responsibilities. The additional coaches these schools employed were not 'rugby coaches', which created further barriers, such as poor *Activate* awareness or knowledge of injury risk. This further amplifies the complexity of implementing a sports injury prevention programme in school sport, where different barriers may be presented between similar settings. In the results of the current study, it emerged that *Activate* implementation was impacted more by the age of players being coached, rather than the school setting.

Limitations

Despite six coaches reporting *Activate* use, none implemented it in its entirety. The recruitment strategy did not allow for the identification of coaches fully implementing *Activate* prior to the interview, with participants purposively sampled depending on their previous *Activate* awareness and use or non-use (a dichotomous indicator) to ensure a range of views and experiences. As such, it may be that some facilitators to successful implementation were not identified in this study. However, the results of this present study, supported by findings from a previous study in the same context,⁹ suggest that coaches seldom implement *Activate* fully. Data saturation was also reached, suggesting the sample may represent typical coaching practices throughout England.

Conclusion

This qualitative study highlights the complexity of implementing the *Activate injury prevention exercise programme* within schoolboy rugby union. Coaches generally held positive perceptions towards *Activate*, demonstrating good knowledge of the programme's efficacy; however, contextual barriers hindered all of them from adopting or implementing *Activate* fully. Adopting coaches often gamified the programme to improve player engagement, or they created an adapted version to make it suitable for their setting. It was reported that teachers are often asked to coach rugby teams, despite little interest or knowledge of rugby and injury risk. Targeting these individuals, who are unlikely to read any rugby-specific literature, through teacher training days, could promote awareness and self-efficacy to adopt and implement *Activate*. Mandating *Activate* training as part of coaching qualifications could be another strategy to improve awareness and self-efficacy, leading to greater *Activate* implementation and a lower injury risk in schoolboy rugby. Interestingly, players were often the programme delivery-agents, despite dissemination and training resources being directed towards coaches. Developing strategies to engage with players, alongside coaches, could provide a benefit to *Activate* implementation. However, it is evident end-users do not implement *Activate* as initially intended, and the impact this has on programme effectiveness needs to be explored.

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Supplemental material

Supplemental material for this article is available online.

References

- Emery CA, Roy TO, Whittaker JL, et al. Neuromuscular training injury prevention strategies in youth sport: a systematic review and meta-analysis. *Br J Sports Med* 2015; 49: 865–870.
- Steib S, Rahlf AL, Pfeifer K, et al. Dose-response relationship of neuromuscular training for injury prevention in youth athletes: a meta-analysis. *Front Physiol* 2017; 8: 920.
- Finch C. A new framework for research leading to sports injury prevention. *J Sci Med Sport* 2006; 9: 3–9. Discussion 10.
- Bahr R, Thorborg K and Ekstrand J. Evidence-based hamstring injury prevention is not adopted by the majority of Champions League or Norwegian Premier League football teams: the Nordic Hamstring survey. *Br J Sports Med* 2015; 49: 1466–1471.
- Richmond SA, Donaldson A, Macpherson A, et al. Facilitators and barriers to the implementation of iSPRINT: a sport injury prevention program in junior high schools. *Clin J Sport Med* 2020; 30: e231–e233.
- Barden C, Quarrie KL, McKay C, et al. Employing standardised methods to compare injury risk across seven youth team sports. *Int J Sports Med* 2021; 42: 1019–1026.
- Sport Collision Injury Collective. Open letter: preventing injuries in children playing school rugby, <http://www.sportcic.com/resources/Open%20Letter%20SportCIC%20March1st%202016.pdf> (2016, accessed 18 August 2019).
- Hislop MD, Stokes KA, Williams S, et al. Reducing musculoskeletal injury and concussion risk in schoolboy rugby players with a pre-activity movement control exercise programme: a cluster randomised controlled trial. *Br J Sports Med* 2017; 51: 1140–1146.
- Barden C, Stokes KA and McKay CD. Implementation of the Activate injury prevention exercise programme in English schoolboy rugby union. *BMJ Open Sport Exerc Med* 2021; 7: e001018.
- McGlashen AJ and Finch C. The extent to which behavioural and social sciences theories and models are used in sport injury prevention research. *Sports Med* 2010; 40: 841–858.
- Schwarzer R. Modeling health behaviour change - how to predict and modify the adoption and maintenance of health behaviours. *Appl Psychol* 2008; 57: 1–29.
- McKay CD, Merrett CK and Emery CA. Predictors of FIFA 11+ implementation intention in female adolescent soccer: an application of the health action process approach (HAPA) model. *Int J Environ Res Public Health* 2016; 13: 657.
- Barden C, Stokes KA and McKay CD. Utilising a behaviour change model to improve implementation of the Activate injury prevention exercise programme in schoolboy rugby union. *Int J Environ Res Public Health* 2021; 18: 5681.
- Swinburn B, Egger G and Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med* 1999; 29: 563–570.
- Hislop MD, Stokes KA, Williams S, et al. The efficacy of a movement control exercise programme to reduce injuries in youth rugby: a cluster randomised controlled trial. *BMJ Open Sport Exerc Med* 2016; 2: e000043.
- Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 2013; 13: 117.
- Donaldson A, Callaghan A, Bizzini M, et al. A concept mapping approach to identifying the barriers to implementing an evidence-based sports injury prevention programme. *Inj Prev* 2019; 25: 244–251.
- Cresswell JW and Plano-Clark VL. *Designing and conducting mixed methods research*. 3rd ed. CA, USA: Sage Publications, 2011.
- Palinkas LA, Horwitz SM, Green CA, et al. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health* 2015; 42: 533–544.
- Guest G, Namey E and Chen M. A simple method to assess and report thematic saturation in qualitative research. *PLoS One* 2020; 15: e0232076.
- Tong A, Sainsbury P and Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* 2007; 19: 349–357.
- England Rugby. Activate webpage, <https://www.englishrugby.com/participation/coaching/activate> (2021, accessed 22 November 2021).
- Bizzini M and Dvorak J. FIFA 11+: an effective programme to prevent football injuries in various player groups worldwide—a narrative review. *Br J Sports Med* 2015; 49: 577–579.
- O'Brien J and Finch CF. Injury prevention exercise programs for professional soccer: understanding the perceptions of the end-users. *Clin J Sport Med* 2017; 27: 1–9.
- Shamlaye J, Tomsofsky L and Fulcher ML. Attitudes, beliefs and factors influencing football coaches' adherence to the 11+ injury prevention programme. *BMJ Open Sport Exerc Med* 2020; 6: e000830.
- Soligard T, Nilstad A, Steffen K, et al. Compliance with a comprehensive warm-up programme to prevent injuries in youth football. *Br J Sports Med* 2010; 44: 787–793.
- Steffen K, Myklebust G, Olsen OE, et al. Preventing injuries in female youth football—a cluster-randomized controlled trial. *Scand J Med Sci Sports* 2008; 18: 605–614.
- Saunders N, Otago L, Romiti M, et al. Coaches' perspectives on implementing an evidence-informed injury prevention programme in junior community netball. *Br J Sports Med* 2010; 44: 1128–1132.
- O'Brien J and Finch CF. Injury prevention exercise programmes in professional youth soccer: understanding the perceptions of programme deliverers. *BMJ Open Sport Exerc Med* 2016; 2: e000075.
- Moesh K, Bunke S, Linnell J, et al. Yeah, I mean, you're going to handball, so you want to use balls as much as possible at training": end-users' perspectives of injury prevention

- training for youth handball players. *Int J Environ Res Public Health* 2022; 19: 3402.
31. Verhagen EA, van Stralen MM and van Mechelen W. Behaviour, the key factor for sports injury prevention. *Sports Med* 2010; 40: 899–906.
 32. Perera NKP, Akerlund I and Hagglund M. Motivation for sports participation, injury prevention expectations, injury risk perceptions and health problems in youth floorball players. *Knee Surg Sports Traumatol Arthrosc* 2019; 27: 3722–3732.
 33. Emery CA, Hagel B and Morronegiello BA. Injury prevention in child and adolescent sport: whose responsibility is it? *Clin J Sport Med* 2006; 16: 514–521.
 34. O'Brien J and Finch CF. A systematic review of core implementation components in team ball sport injury prevention trials. *Inj Prev* 2014; 20: 357–362.
 35. McKay CD, Steffen K, Romiti M, et al. The effect of coach and player injury knowledge, attitudes and beliefs on adherence to the FIFA 11+ programme in female youth soccer. *Br J Sports Med* 2014; 48: 1281–1286.
 36. Attwood MJ, Hudd LW, Roberts SP, et al. Eight weeks of self-resisted neck strength training improves neck strength in age-grade rugby union players: a pilot randomized controlled trial. *Sports Health* 2022; 14: 500–507.
 37. Faude O, Rossler R, Petushek EJ, et al. Neuromuscular adaptations to multimodal injury prevention programs in youth sports: a systematic review with meta-analysis of randomized controlled trials. *Front Physiol* 2017; 8: 791.
 38. Bizzini M, Impellizzeri FM, Dvorak J, et al. Physiological and performance responses to the "FIFA 11+" (part 1): is it an appropriate warm-up? *J Sports Sci* 2013; 31: 1481–1490.
 39. Daneshjoo A, Mokhtar AH, Rahnama N, et al. Effects of the 11+ and Harmoknee warm-up programs on physical performance measures in professional soccer players. *J Sports Sci Med* 2013; 12: 489–496.
 40. Steffen K, Emery CA, Romiti M, et al. High adherence to a neuromuscular injury prevention programme (FIFA 11+) improves functional balance and reduces injury risk in Canadian youth female football players: a cluster randomised trial. *Br J Sports Med* 2013; 47: 794–802.
 41. Joy EA, Taylor JR, Novak MA, et al. Factors influencing the implementation of anterior cruciate ligament injury prevention strategies by girls soccer coaches. *J Strength Cond Res* 2013; 27: 2263–2269.
 42. Norcross MF, Johnson ST, Bovbjerg VE, et al. Factors influencing high school coaches' adoption of injury prevention programs. *J Sci Med Sport* 2016; 19: 299–304.
 43. Renshaw I, Davids K, Newcombe D, et al. *The constraints-led approach*. London: Routledge, 2019.
 44. Whalan M, Lovell R, Steele JR, et al. Rescheduling part 2 of the 11+ reduces injury burden and increases compliance in semi-professional football. *Scand J Med Sci Sports* 2019; 29: 1941–1951.
 45. England Rugby. Headcase webpage, <https://www.englandrugby.com/participation/playing/headcase> (2021, accessed 14 November 2021).
 46. Gianotti SM, Quarrie KL and Hume PA. Evaluation of RugbySmart: a rugby union community injury prevention programme. *J Sci Med Sport* 2009; 12: 371–375.
 47. Quarrie KL, Gianotti SM, Hopkins WG, et al. Effect of nationwide injury prevention programme on serious spinal injuries in New Zealand rugby union: ecological study. *Br Med J* 2007; 334: 1150.
 48. Viljoen W and Patricios J. BokSmart - implementing a National Rugby Safety Programme. *Br J Sports Med* 2012; 46: 692–693.
 49. Brown JC, Gardner-Lubbe S, Lambert MI, et al. The BokSmart intervention programme is associated with improvements in injury prevention behaviours of rugby union players: an ecological cross-sectional study. *Inj Prev* 2015; 21: 173–178.
 50. Brown JC, Gardner-Lubbe S, Lambert MI, et al. Coach-directed education is associated with injury-prevention behaviour in players: an ecological cross-sectional study. *Br J Sports Med* 2018; 52: 989–993.
 51. Brown JC, Verhagen E, Knol D, et al. The effectiveness of the nationwide BokSmart rugby injury prevention program on catastrophic injury rates. *Scand J Med Sci Sports* 2016; 26: 221–225.