Co-creating an injury prevention implementation strategy for women's football

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Abstract

Introduction and aim: Injury prevention (IP) training can reduce anterior cruciate ligament injuries with up to 64%. Implementation of IP in real world settings is challenging. Co-creation with end-users helps overcome challenges with implementation. The aim of the study was to investigate how implementation of IP can be improved by exploring how coaches envision and experience a co-created implementation strategy.

Method: An implementation strategy was co-created with five youth girls' coaches from four teams in a local community-based football club. The process was evaluated through semi-structured focus group interviews with five coaches and eight youth players. Observations of football sessions were conducted before and five weeks after implementation. Interviews were guided by an interview guide, transcribed verbatim, and analysed by two researchers using reflexive thematic analysis. Observations followed a set protocol and were described.

Results: Five themes were generated from the coaches' interview; 1) use of IP during intervention period, 2) challenges during intervention period, 3) positive experiences during the intervention, 4) responsibility and other stakeholders and 5) visions for future implementation. Four themes were generated from interviewing the players; 1) experiences with IP during the intervention, 2) injuries and consequences, 3) motivation and 4) visions for implementation. Observations showed increased duration of IP, and increased number of IP exercises.

Conclusion: The co-created strategy increased the use of IP exercises. While coaches had mixed experiences with IP during the intervention, the players generally had positive experiences. The coaches' visions for the next step in the implementation process were to engage multiple stakeholders, change the culture of the club and gaining knowledge of IP.

Forord

Da dette kandidatspeciale afleveres i artikelformat, vil nogle af opgavens læringsmål besvares i appendix. Nedenfor er læringsmålene opdelt efter hvor i opgaven, det vurderes læringsmålene bliver besvaret.

Læringsmål besvaret i artiklen

- Kan forklare baggrunden for videnskabelige problemstillinger relateret til konkret fysioterapeutisk klinisk praksis inden for det muskuloskeletale område.
- Kan på baggrund af eksisterende evidens identificere, dokumentere og belyse kliniske, videnskabelige problemer relateret til muskuloskeletale smerte- eller funktionsproblemer.
- Kan tilrettelægge og gennemføre et projekt med fokus på: Relevante muskuloskeletale problemstillinger inden for enten undersøgelses-, behandlings- og/eller træningstiltag i forhold til etableret klinisk viden.
- Kan diskutere projektarbejdets resultater i forhold til de anvendte teorier og metoders rækkevidde og anvendelighed.
- Kan formidle og diskutere forskningsbaseret viden fra et konkret projekt inden for muskuloskeletal fysioterapi til andre sundhedspersoner og ikke-specialister.
- Kan ud fra eksisterende evidens identificere og vurdere kliniske muskuloskeletale problemstillinger og forholde sig til dem med inddragelse af ny viden fra aktuel videnskabelig litteratur på højeste niveau.

Læringsmål besvaret i appendix

- Kan dokumentere systematisk litteraturgennemgang og på et videnskabeligt grundlag opstille modeller, som kan forbedre klinisk praksis inden for det muskuloskeletale område (appendix 1,2).
- Kan tilrettelægge og gennemføre et projekt med fokus på: Relevante muskuloskeletale problemstillinger inden for enten undersøgelses-, behandlings- og/eller træningstiltag i forhold til etableret klinisk viden (appendix 3,4).
- Kan formidle og diskutere forskningsbaseret viden fra et konkret projekt inden for muskuloskeletal fysioterapi til andre sundhedspersoner og ikke-specialister (appendix 3).
- Kan udarbejde og kritisk evaluere en aktivitets- og tidsplan for et videnskabeligt projektarbejde (appendix 3,4).
- Kan identificere eget vidensbehov i forbindelse med problemstillinger og løsninger inden for muskuloskeletal fysioterapi (appendix 3).
- Kan kritisk reflektere over egen læreproces i relation til videnskabeligt arbejde og på det grundlag tage ansvar for egen udvikling og læring (appendix 3).

Artiklen er skrevet på engelsk og tilsigtes at publiceres i BMJ open, som er en gratis journal, der er dedikeret til at publicere sundhedsfagligt forskning fra alle discipliner og terapeutiske fagområder. Specialet er udført i samarbejde med Aalborg Universitetshospital.

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1. Introduction

While participating in sports offers numerous health benefits [1, 2], it´s not without risk, especially during youth [3]. In football an anterior cruciate ligament (ACL) injury stands out as one of the most severe knee injuries [4], with female adolescent athletes being particularly vulnerable [5]. An ACL injury has negative impact on the athletes' physical [6, 7] and psychosocial well-being [8, 9]. Furthermore, the potential health benefits of sports may be lost due to decreased physical activity [10] and sport participation [11] following an ACL injury.

Several injury prevention exercise programs (IPEP) have shown to reduce the risk of injuries, specifically non-contact ACL injuries by up to 64% [12]. However, the implementation of IPEPs in real-world settings remains a challenge [13, 14]. Coaches play a pivotal role in implementing IPEPs [15, 16]. However, coaches find that IPEPs lack sport specificity, challenge, and individual tailoring [17], emphasizing the importance of recognizing that 'one size doesn't fit all' in IP and that adaptable solutions are warranted [18].

To bridge the gap between theory and practice, involving end-users is essential [16, 18]. One method is co-creation, which has been used in health intervention [19], and injury prevention (IP) [20]. Co-creation aims to engage stakeholders to develop, tailor, or adapt implementation strategies, and improve the delivery of evidence-based practice, such as IPEPs [21]. While co-creating can be a time-consuming process [20], collaborating with stakeholders, such as coaches, helps identify and overcome implementation barriers [16].

To explore how IP implementation can be improved, it is interesting to explore how coaches envision and experience a co-created implementation strategy. Furthermore, it is worth investigating whether implementation can be simplified by prioritizing context and utilizing club resources and existing evidence-based tools (e.g., IPEPs, apps, and websites).

This study adopts a pragmatic approach to IP in a community-based football club, aiming to explore three key aspects: 1) football coaches' experiences with the first step in a co-created implementation process of IP and visions for next step of implementing IP training, 2) players' experiences with the implementation of IP and 3) to which extent the initial co-created implementation strategy changes the content of a football session.

2. Method

2.1 Study design and scientific standpoint

We used a mixed-method design consisting of focus group interviews and observations. Our research approach was action research, which is described as a "*pragmatic co-creation of knowing with, not on about, people*" [22]. This cyclic process involves problem identification, action, observation, and reflection, and is a continuous learning process where the researcher both learns and shares newly generated knowledge with others who may benefit from it [23]. Additionally, we took a pluralistic

pragmatic perspective, recognizing the validity of various human interests, perspectives, and forms of knowledge [24].

2.2 Context and participants

We recruited a local community-based football club in northern Denmark. Participants included two U13/14 girls' coaches, and three U15/17 girls' coaches, with each team having around 30 players. The teams were non-elite and practiced twice weekly with one match at the weekend. The project took place during the off-season where the teams played on either a shared artificial turf or indoors. All meetings with the participants were held within the football club premises, either on-field or in a designated meeting room.

The five coaches were all female, with an average age of 24 years and their coaching experience ranged from six months to five years. Two of the five coaches held coaching certifications. Additionally, all the coaches were active football players and had experienced injuries in the past. The longest injury-related absence from football among the coaches was four months.

The research team, CO and KS, were in their final semester of their master's degree program at Aalborg University. Both were authorized physiotherapists with clinical experience. KS was actively engaged in football, while CO had a current involvement in basketball. Additionally, they had experience with coaching in their respective sports.

2.3 Interview and interview guides

To investigate coaches' and players' perception of the implementation process, we conducted three separate semi-structured focus group interviews; one with the coaches, and one each with the U13/14 and U15/17 teams. Prior to the focus group interviews, interview guides were developed following the phases described by Kallio et al. [25] (appendix 5,6). The setup and execution of the interviews were based on the methods described by Kvale and Brinkmann [26], and the interview guides were pilot tested with two youth coaches. All participants, including the players' parents, were informed about the project and provided informed written consent (appendix 7,8,9). The interviews were recorded, and coaches and players were deidentified in the transcript. All interviews included a briefing and debriefing.

2.4 Observations and observation protocol

To explore content and potential changes in the football sessions we observed two sessions with the U13/14 and U15/17 teams; one before and one after the intervention period. An observation protocol was developed based on recommendations for IP training [27, 28] (appendix 10). This protocol was used to observe if coaches provided feedback, explained the purpose of exercises and which components of IP training was included. Additionally, the content of the football session, the time spent on each exercise/drill and the atmosphere within the teams was noted. Observations regarding

"components included", "purpose explained" and "feedback on technique given" were judged in a binary fashion (yes/no). The intervention was considered successful if a team met the minimum recommendations for components and duration during a football session. The observations were documented in paper form and a timer was set on a smartphone. The timer started when the players began the exercise and stopped when the coach instructed to change exercise or take a break. The timer was not stopped if the coach stopped the exercise to give instructions or feedback on technique.

3. The co-creation process

The co-creation process involved preparation phase, design phase, implementation phase and evaluation phase. Steps and timeline are illustrated in figure 1.

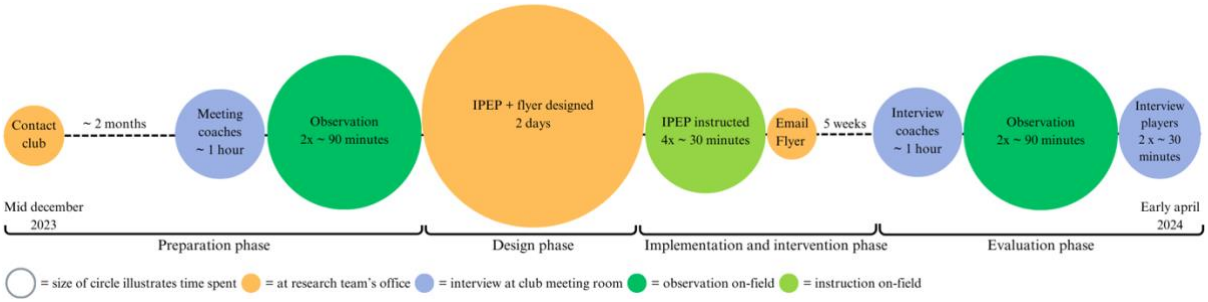

Figure 1: Timeline of the co-created implementation process.

3.1 Preparation

3.1.1 Establishing contact

Our preparation involved conducting literature searches on football IP, which included exploring program content and implementation factors (appendix 1,2).

For participant recruitment, convenience sampling was used to target a local football club. The head of youth at the club was contacted by phone and agreed to arrange a meeting with coaches from the girls' youth department. Due to challenges with communication (e.g. long response time) and finding a suitable date, two months passed from the initial contact to the meeting with the coaches.

3.1.2 Initial meeting

The meeting with the coaches took the form of a semi-structured focus group interview. The meeting began with a 15-minute Power Point presentation on injuries in girls' football (using injuries at 2023 FIFA Women's World Cup as example) and principles of IP. Specifically, recommendations about duration, frequency, exercise selection (IPEP components) and feedback on technique were highlighted [27, 28]. Subsequently, we explored the coaches' use of IP exercises, the barriers and facilitators encountered, and their visions for implementing IP within their teams (appendix 11). The coaches mentioned already using "FIFA 11", describing it as running and flexibility drills between

two cones, and noted the players performed it independently. They highlighted adductor pain, anterior knee pain and ankle distortions as the most frequent injuries. They noted several barriers (e.g. lack of skills and knowledge) and facilitators (e.g. football-specific exercises and easy overview). To implement the IP exercises, they envisioned the teams gathered on-field where the research team introduce the exercises. Potential adjustments could be made based on feedback from coaches and players. The coaches also envisioned having exercises accessible through either paper handouts or mobile application. The coaches collectively agreed to collaborate on implementing IP. Following the meeting, we observed football sessions with U13/14 and U15/U17 (appendix 10). These observations provided greater insight in the context.

3.2. Design of the intervention

Based on the coaches' visions, on-field observations and IP guidelines [27, 28] (appendix 11), we prepared a 20-minute long IPEP (appendix 12). We retained the running drills between cones that the team already performed, and added the Copenhagen adductor drill (strength), vertical jumping (plyometric), and one-legged ball throwing (balance). Additionally, we included competitive agility drills with a ball. These exercises collectively met all five components recommended by the National Athletic Trainers' Association [27]. Furthermore, we provided suggestions for incorporating plyometrics or agility exercises into their existing football drills. Most exercise explanations emphasized external cueing, such as "*imagine landing on eggs that must not break*" or "*land with as little sound as possible*." [16] Furthermore, the program included images to illustrate both good and bad landing technique. Each exercise was illustrated with an image, and included explanation of what to do, why to do it and feedback on technique. Images were adopted from FIFA 11+ [29] and google. We emphasized that incorporating variations and integrating exercises throughout the football session was a possibility. A flyer was designed at the coaches' request. Based on our observations, the flyer included feedback on how to meet the guidelines regarding the components in their football sessions. Additionally, it included examples of exercise variations and inspiration sources for IP exercises (apps, websites, and social media) (appendix 13). The design of the IPEP and the flyer were made in Canva Free.

3.3 Implementation

As envisioned by the coaches' the teams were merged for the first on-field introduction of the IPEP. The IPEP was instructed by the researchers while the coaches observed. The coaches were provided with a paper-handout of the program (appendix 12). We explained the overall purpose and the benefits of IP (e.g. reducing injuries, enhancing performance and team winnings) to the players on-field. Each new exercise was introduced with an explanation of its football specific purpose and benefits (e.g. "*Makes you better at sprinting*", "*protects your ankle*"). Players and coaches were encouraged to provide feedback on the content and implementation of the IPEP. For example, the

coaches believed that players followed instructions better in smaller groups, so we additionally held one separate on-field session for each team. We attended a final session for 30 minutes (with both teams on the same field) to address any questions about IP exercises. Overall, the research team used approximately six hours in-person with the coaches; one-hour meeting before the intervention, 2x90 minutes on-field for pre-implementation observations, and 4x30 min for instructions and guidance. The introduction to IP was concluded with the flyer being emailed to the coaches and the coaches were informed to contact us by phone in case of any questions. A date for evaluation was scheduled five weeks from the final on-field introduction.

3.4 Evaluation

To evaluate on the process, we interviewed the coaches and players, followed by the post-intervention observations of the football sessions. The domains explored in the coaches' interview were 1) has the implementation changed the coaches' approach to IP training, 2) what were the coaches' experience of the process, 3) how did the coaches find the content of the intervention and 4) coaches' visions for future implementation. The domains of the players' interview were 1) players' understanding of IP training, 2) players' experience with the intervention, and 3) players' visions for future implementation.

3.5 Data analysis

The focus group interviews were transcribed and analysed in accordance with Braun and Clarke reflexive thematic analysis [30]. The player interviews were analysed as one dataset. The analysis involves six phases: familiarisation, generating codes, identifying themes, reviewing themes, defining themes, and producing the article. As part of familiarisation, we read the transcript several times. Using NVivo 1.7.1, CO and KS conducted the initial coding and thematization independently of each other. Subsequently, the codes and themes were homogenized using excel version 16.84. The process is shown in appendix 14. Lastly, the findings from each interview were synthesized using matrix analysis to explore tensions, agreements, and divergences [31] (appendix 15). To highlight changes in the content of the football sessions, the first and the second observation for each team were compared.

4. Results

4.1 Focus group interview coaches

The data analysis of the focus group interview with the coaches resulted in five themes with 22 subthemes. Reflecting on the entire process, the coaches provide feedback on the intervention, as well as their visions for the next step in the implementations process. Coach 1-3 represents U13/14, and Coach 4-5 represents U15/17.

Theme 1: Coaches' use of injury prevention during the intervention period

The U13/14 coaches used IP exercises as a warm-up "*exactly as instructed*" by the research team. The U15/17 coaches reported some or limited use of IP exercises. Some coaches noted the flyer was a nice reminder and briefly looked at the inspiration sources, but none had downloaded the apps in the flyer. One coach distributed IP exercises throughout the football session by including strength or plyometric exercises as part of football drills. Others made variations to the specific exercises, e.g. time instead of repetitions, or kicking the ball instead of throwing.

"Yes, those (exercises) you showed first time. And then also added a little more on, like... So, instead of throwing the ball (standing) on one foot, well, then they should kick the ball, without touching the ground with the other leg. So added a little, so it was more football, so it's more fun for them." [coach 1]

Theme 2: The Coaches challenges during intervention period

Maintaining the overview of the players and making sure the quality of the exercises was optimal, especially when many players attended, was a challenge. One coach was at times alone with up to 30 players. Another coach noted the players didn't understand the purpose of IP. Furthermore, some coaches noted lack of focus as the reason for bad technique, to which one coach expressed concern as "*doing exercises with bad technique might do more harm than good*". A perceived lack of interest and focus from the players led to limited use of IP for some coaches, and they experienced getting players focused was harder than expected:

"Yeah, they just didn't show any interest and weren't motivated (for injury prevention). And the girls we have, many of them have that attitude 'they don't do it'. And yeah, I mean, I don't think they will get anything out of it when it (quality of exercises) is so bad. They didn't do it right... And they pushed each other to the ground and tied each other's shoelaces together. And, I mean, it was not what we were supposed to do at all." [coach 3]

Some coaches experienced their lack of knowledge about injuries to be a challenge, especially when the players already experienced pain. Furthermore, some experienced difficulties acquiring knowledge, such as variations of exercises or specific exercises for injured players. They reported challenges with finding a comprehensive source for exercises and described the search for IP exercises as time-consuming, especially when they also needed to find football-specific drills. In addition, one coach perceived IP exercises as "*boring*", while another noted that such exercises were time away from football-specific drills. Moreover, some coaches highlighted being a volunteer limit the time one can dedicate to learn about IP.

"Yes, and that's also where I think it (injury prevention training) becomes more of a primary focus at elite level. That's because when you're volunteering in a club, I think it's a bit much having a full-time study on the side. And part-time job. And 3 billion other things." [coach 5]

Theme 3: Coaches' positive experiences during the intervention

Overall, the coaches had a positive attitude towards the intervention. They felt they gained more tools for IP and some coaches expressed the intervention had "*sparked their interest*". Additionally, the coaches believed the players "*felt more important*" when external stakeholders introduced IP. All coaches were optimistic about early involvement and felt their visions and perspectives from the initial meeting were taken into account. Some noted being involved early laid the foundation for endorsing IP training to players and their parents.

"Yeah, but I already knew it (injury prevention) was important, but I found it nice to get some statistics on it. That there are this many who get injured and many (injuries) can be prevented because I think it is easier to pass on to our girls. And make it more specific. We can actually do this to reduce it (injures) for your sake. Otherwise, I think, sometimes they can be a bit like 'why should we do this. Isn't it irrelevant?' No, it actually matters." [coach 2]

One coach expressed predetermined exercises saved her time she would have spent planning beforehand. Furthermore, some coaches experienced the exercises were something the players could unite around, and IP exercises could be regulated to fit every level. Some coaches noted the warm-up was an opportunity for the players to chat and noted the setup facilitated overview of the players.

"I think the one where they stand on one leg, then they have a chance to chat. Especially, my girls – they talk a lot, and it is also nice, for example today, when you are alone with 26 girls... It is nice you can stand in the middle of the circle and see what they are doing." [coach 5]

Although a U13/14 coach experienced an increase in injuries on her team during the intervention period (e.g. twisted ankles), she noted it might be "*a pure coincidence because players got more physical."* A player had a potential ACL rupture on a team trip; however, the coaches attributed it to the quality of the field. Overall, the other coaches noted that their players had become more aware of their body.

"But I don't think there are more injuries. Some (players) have become more aware of their own body. Like, 'this hurts a bit' or 'this feels strange.'" [coach 1]

Theme 4: Responsibility and other stakeholders

The coaches believed they had a responsibility to implement IP exercises, though they expressed a desire for the club to take responsibility as well. They experienced lack of expectations and coherence throughout the youth department regarding the content and quality of the football sessions, including IP.

"There is no consistency across the youth teams. None at all. There is no one saying, 'This is good'. It's just like, 'you control your team. You can call if you need help'. I can't call and say I need help with injury prevention. I think (head of youth) knows as little as I do." [coach 1]

All the coaches believed involving the parents was vital, however, the support "*depends on which parents you ask*". Some coaches had positive experiences when collaborating with parents. Other coaches expressed difficulties with parents who held strong opinions about their children's football sessions and expected some parents would demand longer football sessions if IP took time away from football drills. Furthermore, coaches highlighted a situation where parents had directed criticism towards the coaches' young age and requested *"grown-up grown-ups"*.

Coaches suggested that if the club implements IP, parents should be informed that IP exercises is expected to be part of football practice. They also suggested informing parents on the importance of IP with relevant statistics. Some coaches suggested utilizing the parents' engagement by providing the parents with exercises they should encourage their children to do at home. A coach highlighted that by establishing common understanding, tensions can be avoided:

"(...) 10 minutes of your practice have to be injury prevention training. (...) Their parents know it, the girls know it. So, the first 10 minutes of the practice we do injury prevention. Period. Then they can't go home and complain to their parents that 'during a one and half hour practice, we used 10 minutes on injury prevention training', (because) we already made it clear." [Coach 3]

Coaches expressed a great number of injuries in the women senior department, and therefore suggested using the senior players who had suffered injuries as an example to highlight the importance of IP.

"So, at the end of a training session on a Monday, just line every injured senior player in a long row."

"Uhh, ACL, ACL..."

"There is actually crazy many of them (ACL injured senior players)" [coach 5, 1 and 3]

The coaches also expressed a desire for the Danish Football Association (DBU) to take responsibility for IP. Some coaches questioned the lack of expectations on IP, when the DBU had specific expectations

to the clubs in other contexts. Some coaches expressed licensed coaching courses lack IP content. One coach noting that by including IP in coaching courses, regardless of the age of players, it would automatically become part of football practice. However, other coaches expressed no intention of undertaking the licensed coaching courses as they felt the courses were time consuming with no economic benefits. One coach suggested top-down pressure from the DBU to the clubs to implement IP, which also would be a way to introduce IP to the coaches without a coaching license.

"Yeah, but it could also be, like, a general pressure from the DBU to the club where they say, 'This is actually something you must incorporate'. Just like concussions have received much more attention (...) I mean, it's just as important with knee (injuries) and so on. So, you push it down from the DBU to the clubs and say 'Okay, you might need to arrange workshops if that's what it takes for your coaches to gain knowledge.' Because it is also a lot to expect from volunteers to delve so deeply into injury prevention in that way." [coach 4]

Theme 5: Visions for future implementation

Looking one year ahead, the coaches didn't expect as much focus on IP as now. They emphasized the need to integrate IP throughout the club to maintain consistency as players transition between teams or get new coaches. The coaches believed involving the newly elected chairperson or the head of the youth department could facilitate culture change in the club. The coaches proposed integrating IP into both the youth and senior departments to avoid catching the youth players off guard when they transition to senior level and encounter IP exercises. One coach elaborated the importance of involving the chairperson:

"... also, get it (injury prevention) incorporated into the culture, like, from an early age because you can still get injured when you are 13 years old. I have a sister who got injured for the first time when she was 14 years old, and she hasn't played since. So, it is just super important that the coach get a focus on it (injury prevention) and I definitely think that comes from the chairperson, like that they say it is important." [coach 4]

Coaches proposed an IP workshop, with one suggesting it to take place at the season's outset and another proposing an expert be invited to a mandatory coaches meeting. They recommended a combination of theory, supported with statistics, and practical drills, emphasizing football-specific exercises with frequent ball incorporation. They envisioned the workshop content to demonstrate simple integration of IP into football sessions (e.g., distributing exercises throughout the session) and exercise variations (e.g. for specific injuries). Additionally, it should cover managing acute injuries. One coach suggested the workshop could include the following:

"I'm thinking maybe before the season begins. (...) have a workshop for the entire youth department coaches. (...) maybe get some food or something, so people actually want to come and work on it (injury prevention). Some small discussions about why. 'What does this exercise do?' 'I could imagine it does this and this', so you become a bit more reflective about the stuff instead of someone just saying 'this is good for this and this'. So, you actually also are able to put two and two together." [coach 5]

Some coaches highlighted the importance of making IP exercises easily accessible. They suggested a user-friendly platform where IP content is gathered, making it easy to search for specific exercises. They envisioned the DBU updating their exercise catalogue to include IP exercises and football drills. One coach highlighted using AI to make IP exercises more accessible.

"It (Chat GPT) can everything, you know that. The easier access to it (injury prevention) the more (people) will use it. If there is an app that says 'hip exercises' - bang, bang, bang, easy. The DBU just got to add something to their app." [coach 3]

4.2 Focus group interview players

The data analysis of the focus group interview with the players resulted in four themes and 13 sub themes. The data analysis presents the players' experience performing IP. Player 1-4 represents U15/17 and player 5-8 represents U13/14.

Theme 1: Players' experiences with injury prevention during intervention period

U13/14 players expressed using exercises exactly as instructed, while U15/17 players noted they used some of the exercises. Overall, the players described having a positive experience with IP. They described the exercises as *"fun"* and *"different"* and added that IP felt more serious when people from outside the club instructed the exercises.

"The fact that there are others than our own coaches who shows it (the exercises). I feel it helps a bit more... because then you know it is a bit more serious when other people come and say it is actually something. And I mean, you guys (CO and KS) have researched it." [player 7]

Some players described the warm-up as a "*cozy*" part of the football session and viewed it as an opportunity to "*chat with peers*" before football drills, which they believed helped them "*to be more focused*". Others saw it as a way to physically prepare for football drills:

"Yeah, I think it (exercises) is good. Because then you know that you are warmed up and then you are ready to train compared to if you just come straight to practice. I think you are more ready to train." [player 5]

The players described the exercises as easy to perform, and something they could do with peers of varying skill level. The exercises don't have to involve a football, as long as there is variation. Several players highlighted the exercises in pairs as most fun, where one player pointed out exercises where they had to *"battle for the ball"* and *"(physically) push each other"* as especially fun. Some players noted that exercises can be boring if too much time is spent on them. The players expressed a positive attitude towards physically demanding exercises and noted the exercises were more demanding than they were used to:

"I think it (physically demanding exercises) is quite good because we are maybe not used to having it so tough at practice... (laughs) So it might be quite good for us." [player 3]

Theme 2: Players' perception of injuries and its consequences

Some players defined an injury as either persistent pain or a limitation on certain movements. They emphasized the importance of warming up to prevent injuries, with one player specifically mentioning ACL ruptures. The players outlined injuries to have physical consequences such as inability to play or declining fitness levels, as well as social consequences such as missing team activities or teammates' absence on the field. Additionally, injuries were seen to impact the team dynamics due to player shortages, leading to feelings of guilt among injured players:

"It (injuries) also has big influence on the team, if just one player is injured. We can see that right now, for example, where one of our teammates is injured. It means a lot for the team that someone is missing, and you also carry a great burden yourself if you are injured. You feel bad about it because you want to be there and fight for the team. I also think it motivates one to do it (injury prevention)." [player 1]

Theme 3: Players' motivation

Some players described fewer discomforts during the intervention, leading them to believe in the effectiveness of IP training. Some players described that current pain or consecutive days of football games motivated them to engage in injury prevention exercises. Overall, players noted a growing emphasis on IP as they aged and encountered injuries themselves:

"Personally, I also believe that when you've had a few injuries before, you might as well take the time to warm up a bit extra and stretch a bit more, so you don't risk it happening again. Now you know what you've been through." [player 1]

The players expressed someone without prior injury may not recognize the importance of IP. Hence, knowledge about why it's important is necessary:

"I mean, I think it (injury prevention) is something you should know is important. Because I think someone maybe won't take it seriously if they haven't had (an injury)." [player 4]

Theme 4: Players' visions for implementation of injury prevention

The players think that the IP should be integrated in the football training rather than done independently before practice. While most players were "*fine*" with repeating the same program, they also emphasized the need of exercise variations. They saw an advantage in being able to do the exercises at home. Players perceived a shared responsibility between themselves and coaches in implementing IP on field. They suggested coaches or the club provide new exercises to fit different age groups. Given the players' existing responsibility for performing IP exercises, they felt comfortable performing IP exercises on their own during practice. However, they emphasized the need for coach guidance. A player expressed the players themselves have a responsibility to perform the exercises correctly.

"I mean, for one to do it (exercises) properly, it is us (who have responsibility) but our own coach could say "Now you have to do the one where you hold your leg (Copenhagen adductor)". But I mean... it is up to us doing it properly, so we won't get injured." [player 7]

Some of the players reported having used the same warm-up program (e.g. stretching and running) since they were kids, which now was routine. They suggested finding new exercises that could either replace or be added to their current exercise routine and highlighted fun exercises as easiest to remember (e.g. in pairs). Several players believed it is important to learn IP training at a young age to develop a habit:

"Yes, because the program we use right now before matches or just generally as warm-up. It's also something we've kind of learned in practice, where it's what we've done since we were kids, and now the exercises are integrated, so it would probably be the same thing to do there (to include other injury prevention exercises)" [player 1]

Players mentioned involving other stakeholders in implementing IP. While they didn't discuss IP with their parents, they believed their parents would support doing exercises to prevent injuries. Suggestions

included having the DBU focus on IP for youth clubs and providing instructional videos for players to use. Some players also proposed involving the head of youth to organize coach meetings where experts educate coaches on IP. Players felt they shouldn't attend these meetings, but they wanted to be informed about the plan, for example if external instructors would be present at practice. One player suggested coaches should try the exercises beforehand to experience them firsthand. When prompted a player explained how the DBU could assist:

"But, I mean, they (the DBU) could come up with suggestions, like they have that thing with 'DBU kids club', so something like 'DBU youth club' where they say it is important to have this injury prevention training included ehm.. To be a youth club." [player 4]

4.3 The results of the matrix analysis

The analysis highlighted several agreements and tensions sources between coaches and players, as well as potential tension sources between the coaches and higher organizational levels. The results from the matrix analysis can be possible targets for improving implementation of IP in the club. Tensions and agreements are presented in figure 2, and further explained in appendix 15.

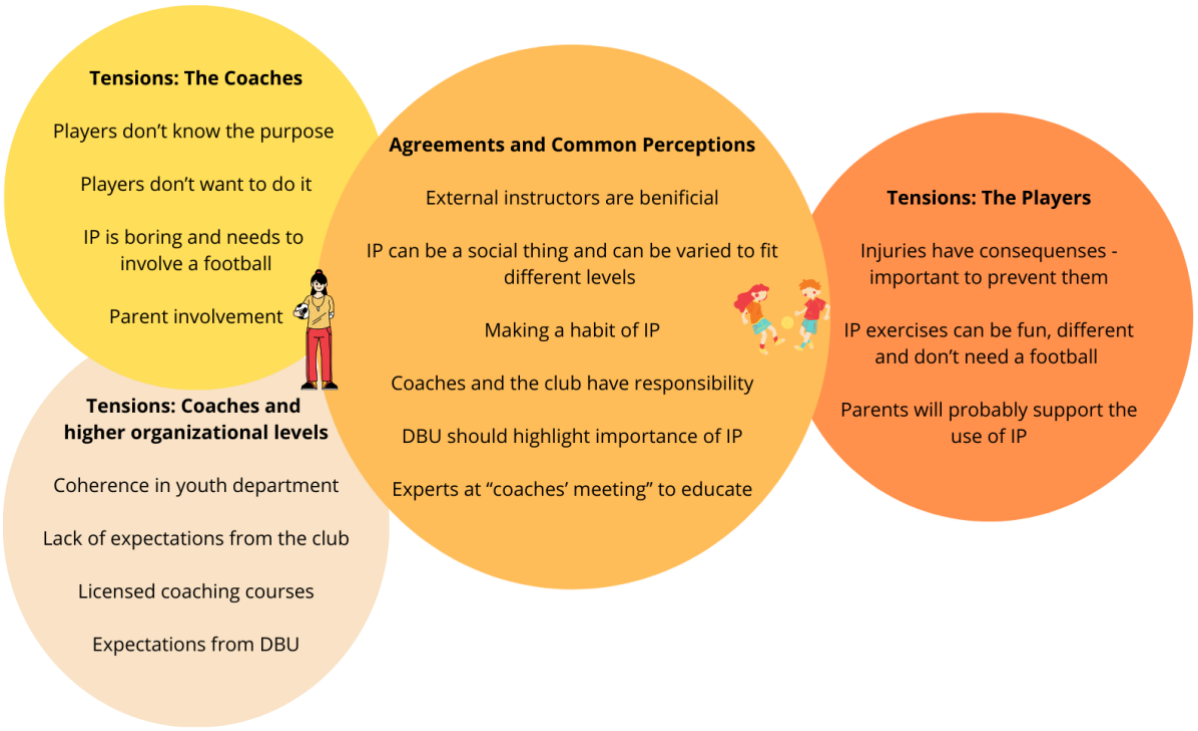

Figure 2: Results of matrix analysis illustrating agreements and tensions between coaches and players, and coaches and higher organizational levels.

4.4 Next step: Implementation Drivers Framework

Building on the coaches' experiences with the co-created implementation process and the players' feedback on the intervention, the next step in the implementation plan is applied within the 'Implementation Drivers Framework' in figure 3 [32-34]. This framework outlines the next steps for IP in the club. Implementation drivers are essential infrastructure elements for effective, high-fidelity, and sustainable programs. There are three types of implementation drivers: Competency drivers, Organization drivers, and Leadership drivers. The drivers compensate each other, meaning weakness in one driver can be overcome by strengths in other drivers. [32, 35]

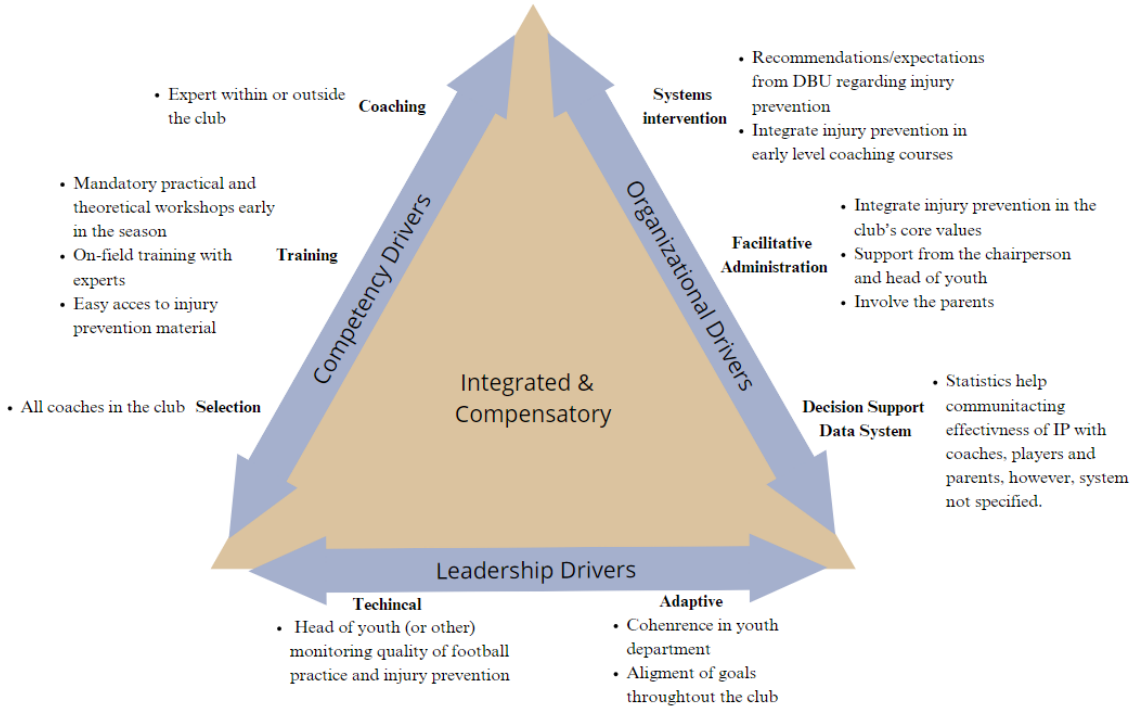

Figure 3: "Implementation Drivers Framework" based on coaches' and players' visions illustrating possible next steps in the implementation process.

4.5 On-field observations of football practice

The initial on-field observations contributed to understanding the context. The comparison of the initial observations and the subsequent observations was used to note changes in practice of each team (appendix 10).

4.5.1 Observations U13/14

In the initial observation, the U13/14 team incorporated agility and flexibility components into their warm-up. In the subsequent observation, they expanded their warm-up to include agility, flexibility, balance, strength, and plyometric components. They used IP as warm-up and duration of IP increased from 4:35 minutes to 22 minutes between the two observations. During the initial observation no

feedback was provided. In the second observation, feedback was given on plyometric, balance, and strength exercises. The purpose of the drills was not explained to the players in either session. There were no noticeable differences in atmosphere in the team between the two sessions. Throughout both sessions, the players followed the coaches' instructions, chatted and laughed with peers.

4.5.2 Observations U15/17

During the first observation, the U15/17 team included agility and flexibility components in their warm-up. At the second observation the U15/17 teams included agility, flexibility and balance components. They used IP as warm-up and duration of IP doubled from 5:20 to 10:40 minutes between the two sessions. No feedback was provided at either observation. The purpose of the balance exercises was clarified during the second observation. The atmosphere on the team didn't change between the two sessions. Throughout both sessions, the players followed the coaches' instructions, chatted and laughed with peers.

5. Discussion

5.1 Statement of principal findings

In this study researchers and coaches co-created the early steps in an implementation plan for IP in a female non-elite youth department in a community-based football club. Taking a pragmatic approach, the implementation process was led by the coaches' perspectives, utilizing existing evidence-based IP tools. The observations and interviews indicated increased use of IP exercises during football practice. While coaches had mixed experiences with IP during the intervention, the players generally had positive experiences. Furthermore, the coaches and players had several suggestions for improving the implementation of IP. The results from the interviews were applied in "Implementation Drivers Framework" which is used as foundation for the next steps in implementing IP at club level.

5.2 Comparison to other studies

Several barriers identified in our study are previously reported [36]. Despite our attempt to address these barriers, we did not succeed in overcoming the barriers experienced by every coach. The implementation resulted in both teams meeting the minimum recommendations for IP components and duration in a football session [27]. However, during the implementation the coaches had mixed experiences. The coaches who to a lesser extent implemented IP exercises found it boring, challenging, experienced challenges with parents and reported their players lacked focus and didn't understand its purpose. Interestingly, their players had a positive attitude and expressed willingness to participate. In contrast, the coaches and players who extensively used IP exercises described it positively. Additionally, during our observations we noted the players had fun and followed instructions, thus some coaches' barriers for implementing IP may be based on assumptions. Communication about injuries and prevention between players and coaches may therefore be

beneficial [37], and in youth sports, including the parents in the communication may help overcome some barriers. A study has found a general increase in parents' involvement in sports [38] highlighting parents as important stakeholders [39]. Since knowledge gaps regarding IP have been identified in coaches, players and parents [40], ensuring a common evidence-based understanding of IP and aligning expectations, as the coaches' envisioned, may support a successful implementation of IP.

To gain knowledge, the coaches suggested on-field IP instruction and envisioned mandatory workshops, mixed with theoretical and practical content, which is similar to findings in other studies [36]. Furthermore, the coaches and players in our study highlighted on-field instruction by experts to feel more serious, and it was a positive experience. A scoping review found that most IP train-the-trainer approaches in other studies have consisted of one-day workshops using both didactic and observational teaching methods. [41]. However, it is well known that knowledge alone will not change long-term behaviour [42]. A Cochrane review showed that mixed didactic and interactive formats may increase effectiveness of educational meetings [43]. Furthermore, on-field instruction may help overcome some challenges faced by coaches during program delivery to athletes [41], such as providing feedback on technique. The observations in our study showed that some coaches provided feedback on technique, while others did not. A systematic review found that some coaches are unaware of how to cue and facilitate correct performance [36]. This underpin a challenge as feedback have been found to be a critical component in IPEPs for significant injury reduction [44]. While practical instruction of IPEPs may improve delivery of alignment cues [45] it may not apply to every coach.

We provided a flyer with IP content to each coach upon their request at the initial meeting. At the evaluation coaches highlighted difficulties generally accessing IP content. While coaches described the flyer as a nice reminder, they didn't use any of the IP inspiration sources provided. Coaches reporting challenges with obtaining up-to-date information about IP have been reported in previous studies [36]. Furthermore, implementing IPEPs using passive dissemination strategies, such as apps and websites have previously faced challenges [33]. One explanation to the findings in our study could be the coaches' perceived lack of time to dedicate to IP when being a volunteer. Lack of time has been reported as a stressor among volunteer coaches [46], who typically are committed to full-time employment elsewhere. To overcome the time barrier, the coaches envisioned IP to be integrated in existing applications e.g. DBU's app. A study indicated that apps with broad functionality were more frequently utilized [47] which might call for integrating IP in apps already utilized by coaches.

The coaches envisioned administrative support, changing the club culture and coherence in youth department would improve implementation. These perceived facilitators are previously reported.

However, even when changing club policy or incorporate IP in coaching courses, challenges with adherence still remain [48, 49]. Thus, it's clear there is a need for improvement on several levels [33], which require the coaches' perspectives. The coaches' visions applied into "Implementation Drivers Framework" can be used as guide when planning the next step of implementation with the club, thereby ensuring the coaches' needs are met and improving the chances of successful implementation.

5.3 Implications for clinicians or policymakers

The coaches doubted their ability to maintain the same focus on IP in the future without support. However, they acknowledged the importance of IP, and recognized their responsibility for including IP in football sessions. While coaches are well-positioned to implement IP, the responsibility should not fall solely on volunteer coaches. Therefore, there is a need to involve policy makers and stakeholders at multiple levels (e.g. individual, organizational and community level) [50]. Implementing ACL IPEPs has societal benefits as it can lower rates of ACL injuries and subsequent knee osteoarthritis [51, 52]. A systematic review found that implementing IPEP is cost-effective [53], and a study conducted in a Danish context has reached the same conclusion [54]. Furthermore, a Danish unpublished master's thesis investigated the cost-effectiveness of implementing an IPEP compared to no IPEP in youth football. The thesis suggests that implementing IPEPs saves around 310 DKK per player annually, which allows for up to 16 hours of physiotherapy per team (with at least 15 players) annually for IPEP introduction and follow-up while still being cost-effective [55]. Hiring a consultant, such as a physiotherapist, to help the club and coaches implement and maintain IP measures could ensure volunteer coaches receive the support they need. Given that some clubs already employ a physiotherapist for injury treatment, allocating some of the physiotherapist's time to train the coaches in IP on-field could potentially reduce injury rates and the players' need for treatment. Future research could investigate whether having a physiotherapist affiliated with a club, specifically for IP, can improve implementation and long-term maintenance of IP.

5.3 Strengths and weaknesses of the study

One key strength of the study is its use of action research, where coaches and researchers collaborated to implement IP. By involving end-users in co-creating the implementation process, considering context, and utilizing research evidence, action research effectively bridges the gap between theory and practice [56, 57]. Another strength is the triangulation of data, combining players' and coaches' perspectives with observations to validate the findings [58]. To further strengthen the results, the study conducted a matrix analysis, enhancing the trustworthiness of the qualitative study [31].
A limitation in our study is the potential for desirability bias, as players may have given responses, they believed the researchers wanted to hear [59]. Furthermore, the observations might have been under influence of the Hawthorn effect, because the coaches and players knew the research team observed them which could have affected their behaviour [60]. Another limitation was that the results

of co-creating context-specific solutions are difficult to generalize. Furthermore, even though we attempted to be as pragmatic as possible, action research and co-creation was time-consuming.

6. Conclusion

The implementation of IPEPs in real-world settings remains a challenge. This study describes a pragmatic, co-created implementation process for IP training in a local community-based football club. The co-created implementation strategy successfully led to increased use of IP exercises, meeting the guidelines for multicomponent IP training. The coaches who used IP exercises the least expressed more challenges and barriers to using it, while the coaches who used IP exercises the most were mostly positive. The players expressed a positive attitude towards IP. The coaches' and players' visions for the next step in the implementation process were applied to the "Implementation Drivers Framework", emphasizing engaging multiple stakeholders, changing the culture of the club and gaining knowledge of IP.

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