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Abstract

Objectives: We aimed to determine the use of injury prevention exercises and injury prevention exercise programs in Danish youth handball and investigate coach and player experiences, beliefs and attitudes of injury and their prevention.

Design: A mixed-methods design consisting of cross-sectional quantitative surveys and qualitative interviews.

Methods: We surveyed 481 youth (14-18 years old) handball players and their 33 coaches about their use of injury prevention exercises, and attitudes towards injury and their prevention. Additionally, we interviewed five coaches and three players about barriers and motivational factors for implementing injury prevention programs.

Results: Players (71%) and almost all coaches reported performing injury prevention exercises for the shoulder, knee, and ankle. Yet few players (4%) and coaches (1%) reported performing the established full injury prevention programs systematically. Players were willing to implement programs to reduce injury risk (84% agreed) and enhance performance (88% agreed). Key factors influencing program uptake were lack of awareness of evidence-based injury prevention programs and lack of handball-specific exercises. Coaches and players identified continued education and training as vital facilitators in this setting, and all coaches agreed that injury prevention should be an essential part of coach education.

Conclusions: While Danish youth handball players and coaches seemed to recognize the importance of injury prevention, the use of established programs was marginal. Experiences, beliefs, and attitudes about injury and injury prevention influenced program uptake and should be addressed through continued education and training in this context in combination with making the programs more handball specific.

Keywords

Youth sports; athletic injuries; exercise; behavior; practice; knowledge

Introduction

Injury incidence and prevalence in both senior and youth handball are concerningly high.^{1, 2} In particular, shoulder and knee injuries have a substantial impact on youth handball players,^{3, 4} both in the short- and long-term⁵⁻⁷. There is, therefore, an urgent need to establish how these injury types can best be reduced in practice.

Studies have demonstrated that, in youth and senior handball, the risk of knee, ankle, and shoulder injuries can be reduced by up to 50%.⁸⁻¹⁰ Whilst efficacy on injury prevention exercise programs (IPEP) has been shown, there is limited evidence of implementation effectiveness.

Results from Norwegian senior handball illustrate that players and coaches stop using the IPEPs following study completion, but if nationwide preventive initiatives are initiated over time, anterior cruciate ligament (ACL) injury's risk remains low [7]. To the best of our knowledge, no previous studies in youth handball have investigated how IPEPs have been used after completing a randomized controlled trial or a national campaign.

In 2005, the Danish Handball Federation (DHF) initiated a nationwide one-year campaign to decrease the risk of knee and shoulder injuries in youth handball. The knee program ('Knokl for dit knæ' or KK) is an evidence-based IPEP, modeled on programs shown to be efficacious in Norwegian handball.¹⁰ The same group developed a shoulder program ('Skudklar Skulder' or SS) utilizing clinical and practical expertise as limited published evidence was available. Manuals and brochures describing the exercises with photos of

national team players were delivered to coaches. After the campaign, DHF undertook no further implementation initiatives other than placing the programs on the DHF webpage¹¹.

To better understand whether interventions are effective, it is essential to investigate whether interventions are being implemented in context, by whom, and to what degree.¹² End-user attitudes, beliefs, and experiences of injury and its prevention must also be understood.

Therefore, this study aimed to determine the use of knee and shoulder injury prevention exercises and training programs in Danish elite youth handball. Further, we aimed to investigate youth handball coach and player attitudes, beliefs, and experiences of injuries and injury prevention and if player differences in such attitudes, beliefs, and experiences exist between genders, age groups, and players with a previous injury.

Methods

We used a mixed-methods design consisting of quantitative surveys and qualitative interviews. The survey was embedded within a cohort study involving 679 youth elite handball players investigating risk factors for handball-related injuries, involving a clinical assessment procedure in their handball setting at preseason and midseason.¹³ Risk factor results, recruitment procedure, and demographic details of the cohort study players have previously been reported elsewhere.^{13, 14} The Ethics Committee of Central Denmark Region, according to the Danish Act on Research Ethics Review of Health Research Projects, deemed the study to be exempt from ethical review (request 89/2013) due to the study design. Participants provided written informed consent prior to study start. Permission for the study was granted by the Danish Data Protection Agency (File 2013-41-2137).

At the midseason of the 2013/2014 season, youth handball players playing in the highest division and their coaches were surveyed regarding the number of times a week and number of weekly hours spent on knee, ankle, and shoulder injury prevention during the previous three months, whether or not this training was

based on the KK or SS programs, and which injury prevention exercises they used, in which respondents could report as many responses as applied. These exercises represented exercises from the KK and SS programs and other available IPEPs at that time. Coaches were explicitly asked to detail their use of the KK and SS, and indicate three main reasons for not using the KK and SS program systematically. This part of the survey consisted of 10 or 11 questions as specified in Table 1 for players and Table A.1, Supplementary materials, for the coaches. Additionally, we surveyed the players and their coaches about their attitudes towards injury and injury prevention program uptake. The second part of the survey was derived from an existing questionnaire¹⁵ underpinned by the RE-AIM framework¹⁶ and the Health Belief Model.¹⁷ This part of the survey consisted of 17 or 29 closed-option questions with specified tick-box responses as detailed in Table 2 for the players and Table B.1 (supplementary material for the coaches). All statements were given as a five-point Likert scale going from "strongly disagree" to "strongly agree". We administered the survey in paper form to all participating players and coaches at the midseason testing procedure.

To gain a deeper and fuller understanding of the barriers and motivational factors towards knee injury prevention programs including the KK, a sub-group of five coaches and three athletes were interviewed about their experiences implementing injury prevention exercise programs in general. Using Robinson's¹⁸ approach to sampling in interview-based qualitative research, we made use of a convenience sampling technique to recruit "participants who are convenient in their proximity and willingness to participate". The number of participants we interviewed was informed by theoretical and practical considerations, allowing this group to be "sufficiently small for individual cases to have a locatable voice within the study, and for an intensive analysis of each case to be conducted"¹⁸.

Individual face-to-face semi-structured interviews were conducted by Bachelor physiotherapy students. The interview consisted of broad themes related to the research aim. These interviews were purposely wide-ranging in nature, and the interview guide consisted of 5 broad topic areas to explore: 1) background in handball and personal experience of injury, 2) awareness of injury prevention and IPEPS, and how this

knowledge was gained 3) delivery of/participation in injury prevention training, 4) delivery of/participation in other forms of off-court training (such as strength training), and 5) barriers and facilitators to the delivery of/participation in injury prevention training. Interviews were 30-60 minutes long, audio recorded, and transcribed. The transcripts were imported into NVivo qualitative data analysis software (QSR International Pty Ltd. V.10, 2012) as separate document sources for analysis.

All survey data were double entered using the Epidata software (www.epidata.dk) and analyzed in Stata version 13. Descriptive frequencies (n; %) were calculated to assess questionnaire responses relating to the coaches' and players' training practices, and attitudes and beliefs towards injury and their prevention. The 5-point Likert scale variables were collapsed to three levels (strongly agree/agree, uncertain, disagree/strongly disagree) for analyses.¹⁵ A chi-squared test was used to assess any differences in the use of injury prevention and strength training programs between gender with club as random effect. Multinomial logistic regression analysis with club as random effect was used to identify significant associations between attitudes responses and player characteristics controlling for other player characteristics.¹⁹ The estimated coefficients in this model were transformed into relative-risk ratios in Stata.

Thematic analysis of the interviews was conducted utilizing a Qualitative Description methodology.²⁰ Qualitative Description does not require extensive interpretation or theorizing of the data, and focuses analysis on revealing insights that might be of relevance to policymakers and practitioners. Author SB undertook data analysis of these interviews with review and input from author MM. This approach thus allowed the analysts to move easily into and out of the data, coding data to codes derived from the 5 topic areas that the interview schedule covered, without the need for further interpretation. This was completed for both the coaches and players data respectively. Overarching themes centered around the five RE-AIM¹⁶ acronym categories were then developed from the initially coded content, and organized into a tabular narrative thematic format to understand this context better and ease reporting. For a depiction of what the codes and themes were, please see Table D.1 and Table 3 respectively.

Results

The 254 boys and 227 girls (mean age 17.1 years, SD 1.1 years) from 23 clubs and 43 teams who attended the midseason testing procedure completed the survey. Reasons for not attending the midseason testing procedure are described elsewhere¹³. Forty-four percent of the players reported a previous or current knee or shoulder injury with no significant differences between gender ($p=0.20$). Three girl players from the U18 age group agreed to be interviewed; two reported a previous knee or shoulder injury.

Thirty-three of 43 coaches completed the survey, three of whom were women. These coaches had between 1 and 35 years of handball coach experience (mean 13.2 years, $SD=9.5$ years), and 18 of the coaches had received coach education within the DHF. The five interviewed coaches (four men and one woman) had between five and 29 years of handball coach experience (mean 16.2 years). Four had received coach education within the DHF. All had previously been a handball player at some level.

The use of injury prevention exercises for players and coaches are detailed in Table 1 and Table A.1, supplementary material for players and coaches, respectively. Fewer players and coaches reported performing weekly shoulder injury prevention exercises than knee injury prevention exercises. Players (71%) and almost all coaches reported performing weekly knee injury prevention exercises. A low proportion of these coaches and players said they used the established KK program systematically. We found no significant differences between gender in players who reported performing shoulder or knee injury prevention exercises (P values between 0.06 to 0.62). We did find significant differences between genders in the number of times per week ($P=0.01$) resistance training was performed, with boys participating more in this type of training.

<Please place Table 1 near here>

The survey results for attitudes and beliefs about injury and IPEP are reported in Table 2 for players and Supplementary material Table B.1 for coaches. Players recognized their high risk of injury and agreed that players who continued to play with injuries were likely to suffer from physical problems later in life. Most players reported that they would play with an injury if it meant that the team would get into the national finals. The players were willing to undertake extra training at home if these reduced injury risk and enhanced performance.

Players with an injury disagreed more than uninjured players that their club ensured necessary first aid, access to health service providers, and rehabilitation when injured. U16 players agreed more than U18 players that it was harmless to continue to play with an injury. Girls disagreed more than boys that, on their understanding: a) injury prevention was more relevant on the elite level, b) that it was more important to spend time on handball training than injury prevention training, and c) that preventing injuries were not any considerable concern to them. In contrast, they also disagreed more than boys that they would stop playing if they had an injury (Supplementary material, Table C.1).

<Please insert Table 2 near here>

Coaches agreed that IPEPs should be an essential part of coach education (100%) and that it was the coach's responsibility to implement them. There was high agreement amongst players and coaches that coach motivation had a key influence on player motivation to participate in IPEPs. All coaches thought injury prevention was important, however, when asked about why they thought injuries occurred, vast majority of the coaches responded that injuries were a result of 'bad luck'.

The interview data revealed that both coaches and players recognised the importance of injury prevention, but that awareness of established IPEPs was low. These coaches and players also felt that youth handball-specific IPEPs would enhance adoption and effectiveness, particularly if these were implemented

systematically and as part of regular training. Finally, organizational support for IPEPs, including via education and resources, was highlighted as an important facilitator. These narrative findings from the interviews organized thematically around the RE-AIM framework¹⁶ are presented in more detail in Table 3. The initial coding structure is provided as Table D.1 and participant quotes illustrating the findings are reported as Table E.1 in Supplementary material.

<Please insert Table 3 near here>

Discussion

This is the first study in youth handball investigating how IPEPs are used following a randomized controlled trial or national campaign. Although a large proportion of the coaches reported performing weekly injury prevention exercises for the shoulder, knee and, ankle, only few players (4%) and coaches (1%) reported performing the established full KK and SS injury prevention programs systematically. Instead, our results indicate that the players and coaches performed only some of the individual exercises from the programs.

The main reported barrier in this study was a lack of awareness of evidence-based IPEPs (such as the KK and SS) and their correct implementation amongst intended end-users. The lack of awareness is remarkable since the players recognized their high risk of injury. Both coaches and players agreed that injury prevention was a vital part of training, nevertheless, the low reach is mirrored across team ball sport contexts more widely²¹. The lack of awareness may be the result of IPEPs– at the time of this research – not being mandated by clubs or the federation for Danish handball youth levels. Instead, the coaches indicated that they had learned about injury prevention through their peer-networks or self-imposed continuous professional development. Injury prevention in youth Danish handball, for these coaches, was thus an informal, ad-hoc process, despite the availability of formally established IPEPs. As a result, as in other studies^{22,23}, the programs were modified to suit the context of the team. Specific injury prevention exercises thus became part of broader training programs, including resistance and conditioning training, at the

discretion of the coach, rather than via the systematic implementation of evidence-based IPEPs. Even though this may lead to broader adoption and maintenance of some of the exercises, it may have implications for intervention effectiveness.¹² Our findings demonstrated that boys participated in resistance training more often than girls, and thus may have benefited more from the injury prevention exercises that became part of their broader resistance and conditioning training. The gendered nature of this discretionary of resistance training is in line with contemporary understandings.²⁴ Given most of the players in our study did report performing resistance training, this provides a clear opportunity for formalising inclusion of injury prevention exercises into resistance training programs for the benefit of all.

A further reported barrier to IPEP uptake in this context was the experiences that current injury prevention programs were: 1) not handball-specific, and 2) not youth-handball specific. Interviewed players experienced the program as an 'add on' to the regular handball training and not as an integrated part of the handball training. Further, the players experienced injury prevention programs as "boring", and not congruent with their primary reason for participating in handball – which was fun and enjoyment. This affected their motivation to participate in them. While players and coaches considered injury prevention important, a disconnect existed in their motivation to implement and participate in injury prevention programs, respectively, as they experience these as not fit-for-purpose. Our findings are thus similar to the broader literature around implementation practices in sports injury prevention, including common barriers such as a lack of adherence,²⁵ the effect of coach and player injury knowledge, attitudes and beliefs,²⁶ and low fidelity to the intervention itself.²⁷

Our qualitative results indicate that end-user (including players) understanding of, and attitudes towards, what injury and its prevention entail is a vital facilitator to implementation that can and should be addressed through continued education and training in this context. It is thus concerning many of the coaches attributed injuries to 'bad luck', as this misconception is a known barrier to prevention²⁸.

In the Swedish community youth handball setting, reported facilitators for implementing injury prevention training similarly included ensuring that end-users know and understand the importance, benefits, and principles of such training.²⁹ In this way, enhancing knowledge and uptake of IPEPs clear policy statements and education development at the club and organizational level is vital.²⁹ Indeed, all coaches that participated in this research agreed that formal, mandated coach education about injury prevention were necessary and important, which is in line with suggestions from existing research.^{22, 30} Further, players and coaches agreed that coach knowledge and motivation for injury prevention were crucial drivers for player motivation. In this way, social modeling is a driver for behavior change³¹. This underlines the importance of involving end-users when developing injury prevention training to achieve high levels of knowledge, competence, and self-efficacy among end-users and program deliverers for more and better implementation.²⁹

The surveyed players and coaches felt that injury prevention was most important at the elite level. The vast majority of the players and coaches also reported that they would be motivated to perform the exercises if they knew the exercises had a preventive and performance enhancing effect. More boys than girls preferred to use their handball time to work on performance enhancement rather than injury prevention. This reflects similar findings in men's senior and elite junior boys Australian football.^{15, 32} This may reflect the fact that all of these players played at the highest youth level, but contrasted with the interviewed coaches' experiences, who highlighted that "selling" injury prevention as performance enhancement should not be emphasized in the youth context. According to the interviewed players and coaches, the exercises should be fun and handball specific. In this way, this research suggests a need for injury prevention programs to be more handball specific, and have age and level sensitivity, particularly in a youth team sports context. This is also in line with research in Swedish handball.²⁹

Finally, a concerning finding from this research is that players indicated that they would continue to play with an injury. While players recognized the long-term risk of continuing to play with an

injury, they felt injuries were a 'normal' part of the sport and expected to play through them. This attitude was more prevalent in the U16 age group and more widespread for girls than boys. Such behaviors during injury likely delays injury recovery and may lead to unnecessary consequences. This emphasizes the need for injury education and support from health service providers in this age group. Therefore, it is worrying that one-third of the players, more widespread in the injured players than non-injured players, disagreed that the club ensured they had access to health service providers when they were injured. Overall our results emphasize why both coach and player understanding of injury and its prevention is essential for implementation and why considerations for gender and age matter.

This survey was conducted eight years after the national campaign, which to some degree, may explain why many players and coaches were unsure if they used the KK and SS programs while performing injury prevention exercises and if the coaches and players did not use the full programs. Nevertheless, these programs were the programs referred to on the DHF webpage without any changes from the original programs. They were the only available evidence-based IPEPs in a Danish context at the time of this research. Our research demonstrates that placing programs on a webpage is not enough to ensure knowledge and adoption, and maintenance of these programs.

The survey was based on a survey from Australian Football and was not cross-culturally translated and validated for this context. Nevertheless, the findings were very similar to those reported in Australian Football.^{15, 32}

Our results are solely based on self-reports, which may affect the validity. Our results indicate, that youth handball players do not necessary have knowledge about the established programs, still a

large proportion of the players perform at least one exercise from the program. Therefore, we think player and coach reports in combination provides a more accurate picture of program uptake. Optimally, this should have been supported by on-field observation as undertaken in similar research in other sports^{33, 34}.

Only five coaches and three players were interviewed in this study. While this number of participants may be low to achieve meaning saturation, the qualitative component of this research focused on providing “a fuller picture and deeper understanding of a phenomenon” and enhancing description and understanding.³⁵ As the qualitative component of this study aimed to describe the attitudes, beliefs, and experiences of youth Danish handball coaches and players, it is essential to note that the findings are time and context-dependent. Both of the later issues influence the generalisability of our results. Still, our findings provide important insights into and considerations for future injury prevention interventions in this setting and injury prevention in youth athlete settings more generally.

Conclusion

While Danish youth handball players and coaches seemed to recognize the importance of injury prevention, the implementation of established programs was marginal. Key barriers influencing program uptake in the youth Danish handball setting were lack of awareness and lack of handball-specific exercises. Players reported willingness to implement programs if these reduce injury risk and enhance performance. Coaches and players identified continued education and training as vital facilitators in this setting. Coaches agreed that injury prevention was an essential part of coach education and was the coaches’ responsibility to implement. There was high agreement amongst players and coaches that coach motivation had a key influence on player motivation to participate in injury prevention.

This study showed that experiences, beliefs, and attitudes about injury prevention in this context may influence program uptake. Therefore, understanding more about these influences and their effect on implementation has important implications for future research and practice.

Practical implications

- Established injury prevention exercise programs appeared not to be systematically implemented in a Danish youth handball setting
- Coach education and training and organizational support may improve injury prevention exercise program uptake in sports settings
- Future injury prevention exercise programs should be fun, varied and include handball-specific exercises
- Players felt injuries were a ‘normal’ part of the sport and reported playing through them, even when they knew the long-term risks.
- Coach and player understanding of injury and its prevention is essential for successful programs.

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Table 1: Players' training and use of injury prevention programs at midseason

| Survey question | Boys (N=254) | | | | Girls (N=227) | | | |
|--|----------------------------------|------------------------------|--------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------|--------------------|
| | 0 h | >0-2 h | >2-4 h | >4 h | 0 h | >0-2 h | >2-4 h | >4 h |
| How many hours per week do you perform resistance training?, n (%) | 7 (3) | 47 (19) | 107 (42) | 93 (37) | 5 [†] (2) | 53 (23) | 111 (49) | 57 (25) |
| How many times per week do you perform resistance training?, n (%) * | 1 t 14 [†] (6) | 2 t 62 (25) | 3 t 121 (49) | >3 t 49 (20) | 1 t 11 [‡] (5) | 2 t 90 (41) | 3 t 90 (41) | >3 t 26 (12) |
| How many hours per week do you perform knee and ankle injury prevention training?, n (%) | 0 h 81 [§] (32) | >0-1 h 123 (49) | >1-2 h 38 (15) | >2 h 8 (3) | 0 h 55 [§] (25) | >0-1 129 (58) | >1-2 34 (15) | >2 5 (2) |
| How many times per week do you perform knee and ankle injury prevention?, n (%)* | 1 t 78 ⁺ (48) | 2 t 42 (26) | 3 t 33 (20) | >3 t 9 (6) | 1 t 90 ^{††} (55) | 2 t 38 (23) | 3 t 24 (15) | >3 t 13 (8) |
| Where do you perform your knee and ankle injury prevention?, n (%)* | On field 71(44) | Strength 102(63) | Not in training 31(19) | On field 75(46) | Strength 112(69) | Not in training 29(18) | | |
| Is the knee and ankle injury prevention training based on the KK program?,* n (%) | No 99 ^{‡‡} (63) | Yes 7 (4) | Unsure 52 (33) | No 107 ^{††} (65) | Yes 8 (5) | Unsure 50 (30) | | |
| How many hours per week do you perform shoulder injury prevention training? n (%) | 0 h 109 ^{§§} (45) | >0-1 h 98 (41) | >1-2 h 29 (6) | >2 h 6 (2) | 0 94 ⁺⁺ (43) | >0-1 h 98 (45) | >1-2 h 20 (9) | >2 h 8 (4) |
| How many times per week do you perform shoulder injury prevention training?, * n (%) | 1 t 33 ^{†††} (26) | 2 t 50 (39) | 3 t 31 (24) | >3 t 13 (10) | 1 t 48 [§] (39) | 2 t 34 (28) | 3 t 20 (16) | >3 t 20 (16) |
| Is the shoulder injury prevention training based on the SS program?,* n (%) | No 84 (63) | Yes 4 (3) | Unsure 45 (34) | No 87(69) | Yes 1 (1) | Unsure 38 (30) | | |
| What type of exercises do you apply in the injury prevention training you do with your team?, *n (%) | Balance board 95 (37) | Airex mat 48 (19) | Partner Balance 36 (14) | Balance board 69 (30) | Airex mat 63 (28) | Partner Balance 43 (20) | | |
| | Jumping 51 (20) | Hamstring floor 59 (23) | Hamstring kettlebell 5 (2) | Jumping 73 (32) | Hamstring floor 54 (24) | Hamstring kettlebell 5 (2) | | |
| | Elastic tubes legs 4 (2) | Other legs 53 (21) | Stretching shoulder 54 (21) | Elastic tubes legs 3 (1) | Other legs 53 (24) | Stretching shoulder 46 (20) | | |
| | Hand stand 55 (22) | Elastic tubes sh. 90 (35) | Other arms 28 (11) | Hand stand 70 (31) | Elastic tubes sh. 75 (227) | Other arms 34 (15) | | |
| If other (in either arm or leg), please elaborate, n (%)** | Resistance training 24 (9) | Gymnastic 21 (8) | Agility 3 (1) | Resistance training 25 (11) | Gymnastic 18 (8) | Agility 7 (3) | | |

n: Numbers; SD: Standard deviation; h: hours; t: times; *Respondees only those who have answered that they are doing strength training, or conditioning training, or injury prevention training; ** three main responses reported †Missing data from 1 player; ‡Missing data from 6 players; §Missing data from 4 players; †Missing data from 5 players; ††Missing data from 3 players, ††Missing data from 11 players, §§Missing data from 10 players, ††Missing data from 7 players; †††Missing data from 8 players; †††Missing data from 2 player

n: numbers; SD: Standard deviation; h: hours; t: times; *Respondees only those who have answered that they are doing strength training, or conditioning training, or injury prevention training; ** three main responses reported †Missing data from 1 player; ‡Missing data from 6 players; §Missing data from 4 players; †Missing data from 7 players; ††Missing data from 11 players, §§Missing data from 12 players.

+ correct +til 7 missing.

§§Missing data from 10 players rettes til 12.

Formatting and layout (page breaks, table layout, and placement of tables and figures) are for proofing purposes only and will be optimized for publication in the final version.

Table 2 Player attitudes towards injuries, training and injury prevention

| Survey questions | Players (n=481) | | |
|---|------------------------|-----------|----------|
| | Agree | Uncertain | Disagree |
| <i>How much do you agree with the following statements?</i> | | | |
| Impact of media and known profiles is of great importance to the players' motivation to carry out preventive training n (%) | 214 (45) [†] | 183 (38) | 79 (17) |
| It is first and foremost handball at elite level, it is important to focus on injury prevention n (%) | 247 (52) [‡] | 62 (13) | 165 (35) |
| It is more important to use the training time to play handball rather than implement programs that have an injurious purpose n (%) | 140 (30) [‡] | 188 (40) | 146 (30) |
| The motivation of the coaches has no influence on the player's motivation to perform injury prevention training n (%) | 70 (15) [§] | 62 (13) | 344 (72) |
| It is the coach responsibility that injury prevention training is performed n (%) | 162 (35) ⁺ | 190 (40) | 123 (26) |
| It is important that you as a player participate fully in training if you want to participate in a match n (%) | 400 (84) [‡] | 57 (12) | 17 (4) |
| It is important for coaches to have the latest knowledge of injury prevention training n (%) | 306 (65) [‡] | 138 (29) | 30 (6) |
| Training should focus more on improving game performance than on preventing injuries n (%) | 173 (37) [‡] | 209 (44) | 92 (19) |
| I would do extra training at home if I thought it would help me to play better n (%) | 414 (88) ^{††} | 44 (9) | 13 (3) |
| I would do extra training at home if I thought this would decrease my risk of injuries n (%) | 395 (84) ^{††} | 69 (15) | 8 (2) |
| Players who train more can play harder/perform better n (%) | 266 (56) [‡] | 142 (30) | 66 (14) |
| Players who do not attend training regularly are at greater risk of getting injured n (%) | 323 (69) ^{††} | 120 (26) | 28 (6) |
| My coach has taught me what I know about preventing injuries n (%) | 144 (30) [§] | 165 (35) | 164 (35) |
| My physiotherapist has taught me what I know about preventing injuries n (%) | 250 (53) [§] | 147 (31) | 77 (16) |
| Teammates have taught me what I know about preventing injuries n (%) | 29 (6) [§] | 149 (31) | 295 (62) |
| I think it is harmless to continue playing despite injury n (%) | 33 (7) ^{††} | 67 (14) | 372 (79) |
| I stop playing if I have an injury n (%) | 151 (32) ^{††} | 177 (37) | 144 (31) |
| I feel under pressure to play when I am injured n (%) | 63 (13) [§] | 87 (18) | 323 (68) |
| Players who continue to play with injuries are likely to suffer physical problems later in life n (%) | 375 (79) ^{††} | 80 (17) | 17 (4) |
| I would play with an injury if it meant we got into the national finals n (%) | 396 (84) ^{††} | 56 (12) | 20 (4) |
| Preventing injuries is not any large concern for me n (%) | 50 (11) ^{††} | 142 (30) | 279 (59) |
| Players do not have to be fully rehabilitated from injury before playing handball again n (%) | 74 (16) ^{††} | 125 (27) | 272 (57) |
| As a handball player you have a high risk of injury n (%) | 377 (80) ^{††} | 83 (18) | 12 (3) |
| My coach supports me when I'm injured n (%) | 341 (72) ^{††} | 101 (21) | 30 (7) |
| My teammates support me when I'm injured n (%) | 368 (78) ^{††} | 92 (19) | 12 (3) |
| My family supports me when I'm injured n (%) | 439 (93) ^{††} | 29 (6) | 3 (0.5) |
| My club ensures that I get the necessary first aid (ice, bandage, etc.) if I get an injury n (%) | 415 (88) ^{††} | 41(9) | 16 (3) |
| My club ensures that I have access to the necessary medical staff, as a physiotherapist, doctor, other healthcare professional when I am / is injured n (%) | 316 (67) ^{††} | 91 (19) | 64 (14) |
| My club helps me with my rehabilitation when I'm injured n (%) | 284 (60) ^{§§} | 109 (23) | 77 (16) |

n: Numbers; SD: Standard deviation

[†]Missing data from 5 players; [‡]Missing data from 7 players; [§]Missing data from 8 players; ⁺Missing data from 6 players;^{††}Missing data from 10 players; ^{†††}Missing data from 9 players, ^{§§}Missing data from 11 players

Table 3: Narrative findings of the qualitative interviews, organized thematically around the RE-AIM²⁸ framework

| Element of the RE-AIM framework ²⁸ | Narrative descriptions of the qualitative data findings | |
|---|--|--|
| | Coaches | Players |
| Reach | <p>These coaches have low awareness of established injury prevention exercise programs but have a high sense of personal responsibility towards injury prevention in their athletes, often due to their own personal injury experiences. The duty of care thus emerged as a strong motivator for enabling reach. As such, they all reported implementing some form of injury prevention training derived from self-education, peer-to-peer education, or via education from health professionals (e.g., physiotherapists).</p> <p>However, due to youth handball's volunteer-driven nature in Denmark, time and motivation to undertake such self-education about injury prevention programs were identified as barriers. Their preference would be for directive and support to be provided by the club or federation (top-down). Given these barriers, more locally-supported opportunities to learn about injury prevention would be welcome.</p> | <p>For the players, injury prevention is a recognized concept (player 3 passionately spoke about the importance thereof after a personal experience with injury); however, these players revealed low-to-no knowledge about established injury prevention exercise programs or what injury prevention entails.</p> |
| Efficacy/ Effectiveness | <p>These coaches expressed concern that the established injury prevention exercise programs were developed for the elite senior Danish handball setting instead of Danish youth handball. Thus, they identified that efficacy and effectiveness are unknown in this context. Further, these coaches found that the established injury prevention exercise programs were not handball-specific enough, and therefore they often modified them substantially to suit their contexts.</p> | <p>The players perceived injury prevention exercise program efficacy to be high if adoption, implementation, and maintenance were consistent.</p> |
| Adoption | <p>Injury prevention, according to these coaches, is not mandated by association or club policy. Therefore, they reported that it is mostly up to coaches to adopt and implement injury prevention programs. Role-modeling thus emerged as an essential facilitator for adopting established injury prevention exercise programs. All the coaches described how this would be good for both coach and player uptake.</p> <p>It is important to note that these coaches stressed that this is <i>youth</i> handball - where their athlete's prime drivers are fun and participation. These coaches recognised that injury prevention in its current form – considered ‘boring’ – does not fit</p> | <p>The player’s motivation to adopt injury prevention exercises and programs was low, hinging on a lack of knowledge and low perceived coach motivation. Adoption and motivation would be much higher, according to these players, if knowledge about the importance of injury prevention was higher, for both players and coaches alike. They also suggested that if injury prevention was a formalized aspect of regular training, such as part of the warm-up, then adoption may be higher and more consistent.</p> |

| | | |
|-----------------------|---|--|
| | <p>with their players' motivations and thus poses a significant barrier to uptake. In this way, these coaches expressed concern about club recruitment and economics- in that if recognized not having fun, they will either stop playing or move to another club. With the focus on fun and participation, these coaches also held that 'selling' injury prevention as performance enhancement might, therefore, not have as much an effect in this context as it does in the senior elite.</p> | <p>Similarly, the strongest point across these interviews was that established injury prevention exercises are not considered handball-specific enough. These players found injury prevention exercise programs 'boring' and said that if they could better understand and see the relevance to handball, their motivation may be improved.</p> |
| Implementation | <p>Both time and space appeared as significant barriers to implementation. In this context, space was a barrier as teams could not always access the training hall to implement injury prevention exercises (as other teams were using it), so they had to find other space to do so. Similarly, injury prevention exercise programs are regarded as an optional "add-on" to handball training, and as such, have to be performed outside of limited training time in youth settings.</p> <p>Finally, these coaches said that athlete motivation plays a major role in the implementation and is modulated by age and gender.</p> | <p>The players reported that established injury prevention exercise programs were not systematically implemented in the teams. Ad-hoc injury prevention exercises and strength training was encouraged, but mostly the responsibility to do so was left to the players themselves. As such, these players perceive that their coaches' knowledge of injury prevention is low. Finally, one player also spoke about time and space as a barrier to injury prevention training, mirroring the coaches' view above.</p> |
| Maintenance | <p>Maintenance of established injury prevention exercise programs was low to non-existent. These coaches recognize the importance of injury prevention training but lack the resources and organizational support for implementation.</p> | <p>The players reported maintenance (through perceived or actual personal responsibility of players) was low, with adherence to injury prevention training compromised by low motivation.</p> |

Supplementary materials

Table A.1 Coaches' use of injury prevention training and programs at midseason

| Survey questions | Coaches (n=33) | | | | |
|--|---|--|---------------------------------------|----------------------------|--|
| | 0 hours | >0-2 hours | 2-4 hours | >4 hours | |
| How many hours per week do you with your team perform knee and ankle injury prevention training?, n (%) | 1 (3) [†] | 16 (50) | 13 (41) | 2 (6) | |
| How many times a week do you on average perform knee and ankle injury prevention with your team?, times n (%)* | 1 times 9 (30) [†] | 2 times 15 (50) | 3 times 5 (17) | >3 times 1 (3) | |
| Is the knee and ankle injury prevention training based on the KK program?, n (%)* | Yes 9 (29) | No 22 (71) | I do not know | | |
| How do you include the KK exercises in the training?, n (%) of the 9 coaches using KK | Systematic use of KK every week 2 (22) [†] | Some exercises every week 4 (44) | Some exercises now and then 2 (22) | | |
| How many hours per week do you with your team perform shoulder injury prevention training?, n (%) | 0 hours 7 (23) [‡] | >0-2 hours 19 (61) | >2-4 hours 5 (16) | >4 hours 0 (0) | |
| How many times a week do you on average perform shoulder injury prevention with your team?, times n (%)* | 1 time 9 (41) [‡] | 2 times 8 (36) | 3 times 4 (18) | >3 times 1 (5) | |
| Is the knee and ankle injury prevention training based on the SS program?, n (%)* | Yes 3 (14) | No 17 (81) | I do not know 1 (5) | | |
| If you are not using the KK and the SS program systematically, what are the three main reasons for not doing so? , n (%) | No knowledge 13 (40) | Players not motivated 2 (6) | Too few exercises with ball 6 (18) | | |
| | The program is too difficult | Lack of progressions in the program | The program takes too much time | | |
| | 5 (15) | | | | |
| | The program is troublesome to organise 1 (3) | Program is not relevant as injury prevention | The program is not updated 2 (6) | | |
| | Other programs 15 (45) | Other 4 (12) | | | |
| | What type of exercises do you apply in the injury prevention training you do with your team? , n (%) ** | Balance board 7 (21) | Airex mat 9 (27) | Partner balance 20 (60) | |
| Jumping 17 (52) | | Hamstring floor 10 (30) | Hamstring kettlebell 2 (6) | | |
| Elastic tube legs 10 (30) | | Hand stand 19 (58) | Stretching shoulder 12 (36) | | |
| Landing techniche 6 (18) | | Elastic tubes arms 12 (36) | Other 7 (21) | | |
| If other, please elaborate, n (%) | | Agility ladder 2 (6) | Gymnastic 4 (12) | Tai boxing 1 (3) | |

KK: "Knokl for dit knæ" Injury prevention program for the knee and ankle; SS: "Skudklar Skulder" Injury prevention program for the shoulder; n: Numbers; SD: Standard deviation *Respondees only those who have answered that they are doing injury prevention training: ** Multiple answers allowed. [†]Missing data from 1 coach; [‡]Missing data from 2 coaches; [§]Missing data from 3 coaches

Table B.1. Coach attitudes towards injuries, training and injury prevention

| Survey questions | Coaches (N=33) | | |
|--|--------------------------------|-------------------|---------------|
| | Agree | Uncertain | Disagree |
| <i>How much do you agree with the following statements?</i> | | | |
| Impact of media and known profiles is of great importance to the players' motivation to carry out preventive training, n (%) | 18 (56) [‡] | 8 (25) | 6 (19) |
| It is first and foremost handball at elite level, it is important to focus on injury prevention, n (%) | 12 (38) [‡] | 1 (3) | 19 (60) |
| It is more important to use the training time to play handball rather than implement programs that have an injurious purpose, n (%) | 6 (20) [§] | 12 (40) | 12 (40) |
| The motivation of the coaches has no influence on the player's motivation to perform injury prevention training, n (%) | 4 (13) [‡] | | 27 (87) |
| It is the coach responsibility that injury prevention training is performed, n (%) | 26 (87) [§] | 3 (10) | 1 (3) |
| It is important that a player participate fully in training if he/she wants to participate in a match, n (%) | 24 (77) [‡] | 2 (6) | 5 (16) |
| Should be a part of coach education, n (%) | 31 (100) [‡] | | |
| It is important for coaches to have the latest knowledge of injury prevention training, n (%) | 27 (90) [‡] | 4 (13) | |
| It is up to DHF and DGI that I have the newest knowledge, n (%) | 4 (13) [‡] | 14 (45) | 13 (42) |
| I would implement injury prevention training if it had a performance effect, n (%) | 17 (54) [‡] | 9 (29) | 5 (16) |
| I would implement prevention training if I knew it prevented injuries, n (%) | 20 (67) [§] | 7 (23) | 3 (10) |
| Injuries have a negative influence on performance during match and the final season results, n (%) | 29 (94) [‡] | 2 (6) | |
| <i>If you think about the KK program as a whole, how much do you agree with the following statements</i> | | | |
| Coaches using KK (n=8)[‡] | | | |
| The program is exciting, n (%) | 6 (75) | 1 (12.5) | 1 (12.5) |
| The program is suited as a warm-up program for handball players, n (%) | 6 (75) | 1 (12.5) | 1 (12.5) |
| The players are motivated to use the program, n (%) | 3 (38) | 4 (50) | 1 (13) |
| The program has a good effect on the players fitness, n (%) | 5 (63) | 2 (25) | 1 (13) |
| The program will prevent injuries if used systematically, n (%) | 8 (100) | | |
| <i>What do you think is the main reason to injuries among players in your team? Pick up to three alternatives you find most important? n (%)</i> | | | |
| Coaches (N=33) | | | |
| Low fitness | Few training sessions on field | Too many matches | |
| 16 (48) | 3 (9) | 2 (6) | |
| Participating in more sports | Foul play | Shoes and surface | |
| 6 (18) | 8 (24) | 4 (12) | |
| Poor planning between school and clubs | Bad Luck | Other | |
| 5 (15) | 26 (78) | 9 (27) | |
| <i>How important do you think it is to spend time on injury prevention training? n(%)</i> | | | |
| Very important [‡] | Important | Less important | Not important |
| 15 (47) | 17 (53) | | |

KK: "Knokl for dit knæ" Injury prevention program for knee and ankle injuries; DHF: Danish handball federation, DGI: Danske Gymnastik- og Idrætsforeninger, A Danish association of sports clubs; n: Numbers; SD: Standard deviation. [†]Missing data from 2 coaches; [‡]Missing data from 1 coach; [§]Missing data from 3 coaches

Table C.1. Relationship between survey responses and player characteristics

| | Response | RR (95% CIs) | | |
|--|-----------|---------------------------|-----------------------------------|---------------------------|
| | | Gender (boys vs girls) | Previous injury (no vs yes) | Age group (U16 vs U18) |
| Attitudes towards training and injury prevention | | | | |
| Impact of media and known profiles is of great importance to the players' motivation to carry out preventive training | Agree | Reference | Reference | Reference |
| | Uncertain | 1.7 (1.1 to 2.6) | 0.9 (0.7 to 1.3) | 1.0 (0.6 to 1.5) |
| | Disagree | 1.3 (0.7 to 2.5) | 0.8 (0.5 to 1.3) | 1.3 (0.7 to 2.4) |
| It is first and foremost handball at senior elite level, it is important to focus on injury prevention | Agree | Reference | Reference | Reference |
| | Uncertain | 1.0 (0.5 to 2.0) | 0.8 (0.5 to 1.4) | 0.7 (0.4 to 1.5) |
| | Disagree | 2.1 (1.5 to 2.9) | 0.7 (0.5 to 1.1) | 1.1 (0.7 to 1.6) |
| It is more important to use the training time to play handball rather than implement programs with an injurious preventive purpose | Agree | Reference | Reference | Reference |
| | Uncertain | 1.7 (1.0 to 2.8) | 1.0 (0.6 to 1.5) | 1.0 (0.7 to 1.4) |
| | Disagree | 2.5 (1.4 to 4.4) | 1.2 (0.8 to 1.8) | 0.8 (0.4 to 1.6) |
| The motivation of the coaches has no influence on the player's motivation to perform injury prevention training | Agree | Reference | Reference | Reference |
| | Uncertain | 0.9 (0.3 to 2.4) | 1.0 (0.5 to 1.9) | 0.4 (0.2 to 1.0) |
| | Disagree | 1.9 (1.2 to 3.1) | 0.7 (0.4 to 1.3) | 0.8 (0.5 to 1.4) |
| It is the coach responsibility that injury prevention training is performed | Agree | Reference | Reference | Reference |
| | Uncertain | 1.2 (0.6 to 2.2) | 1.2 (0.8 to 1.7) | 1.1 (0.6 to 1.9) |
| | Disagree | 1.1 (0.5 to 2.1) | 1.2 (0.7 to 2.0) | 1.3 (0.7 to 2.4) |
| It is important that you as a player participate fully in training if you want to participate in a match | Agree | Reference | Reference | Reference |
| | Uncertain | 0.8 (0.3 to 1.8) | 1.1 (0.5 to 2.3) | 1.0 (0.5 to 2.1) |
| | Disagree | 0.7 (0.2 to 2.5) | 0.9 (0.4 to 2.0) | 0.9 (0.3 to 3.5) |
| It is important for coaches to have the latest knowledge of injury prevention training | Agree | Reference | Reference | Reference |
| | Uncertain | 1.0 (0.6 to 1.6) | 0.8 (0.5 to 1.2) | 1.2 (0.6 to 2.1) |
| | Disagree | 1.7 (0.7 to 3.8) | 1.4 (0.8 to 2.6) | 0.9 (0.4 to 1.9) |
| Training should focus more on improving game performance than on preventing injuries | Agree | Reference | Reference | Reference |
| | Uncertain | 2.3 (1.3 to 4.4) | 0.9 (0.6 to 1.4) | 0.5 (0.3 to 0.9) |
| | Disagree | 5.0 (2.7 to 9.2) | 1.2 (0.8 to 2.0) | 0.5 (0.3 to 1.0) |
| I would do extra training at home if I thought it would help me to play better | Agree | Reference | Reference | Reference |
| | Uncertain | 0.8 (0.4 to 1.9) | 1.0 (0.5 to 2.1) | 1.4 (0.7 to 2.9) |
| | Disagree | 0.7 (0.2 to 2.1) | 1.1 (0.5 to 2.7) | 1.5 (0.3 to 6.7) |
| I would do extra training at home if I thought this would decrease my risk of injuries | Agree | Reference | Reference | Reference |
| | Uncertain | 0.5 (0.3 to 1.0) | 0.7 (0.4 to 1.2) | 1.7 (1.1 to 2.7) |
| | Disagree | 1.8 (0.3 to 12.1) | 0.4 (0.1 to 2.1) | 1.4 (0.2 to 11.7) |
| Players who train more can play harder/perform better | Agree | Reference | Reference | Reference |
| | Uncertain | 1.4 (0.8 to 2.4) | 1.2 (0.7 to 1.7) | 1.3 (0.8 to 2.1) |
| | Disagree | 1.8 to 1.0 to 3.2) | 1.0 (0.5 to 1.7) | 1.0 (0.5 to 1.7) |
| Players who do not attend training regularly are at greater risk of getting injured | Agree | Reference | Reference | Reference |
| | Uncertain | 1.0 (0.6 to 1.7) | 1.0 (0.6 to 1.5) | 0.8 (0.5 to 1.4) |
| | Disagree | 0.6 (0.3 to 1.5) | 0.7 (0.4 to 1.4) | 0.9 (0.4 to 2.2) |
| My coach has taught me what I know about preventing injuries | Agree | Reference | Reference | Reference |
| | Uncertain | 1.1 (0.7 to 1.8) | 0.8 (0.4 to 1.4) | 0.9 (0.6 to 1.5) |
| | Disagree | 0.8 (0.4 to 1.4) | 1.4 (0.7 to 2.5) | 2.2 (1.4 to 3.6) |
| My physiotherapist has taught me what I know about preventing injuries | Agree | Reference | Reference | Reference |
| | Uncertain | 1.1 (0.7 to 1.6) | 0.8 (0.5 to 1.1) | 0.7 (0.4 to 1.2) |
| | Disagree | 1.4 (0.7 to 2.5) | 0.9 (0.5 to 1.6) | 0.9 (0.5 to 1.5) |
| Teammates have taught me what I know about preventing injuries | Agree | Reference | Reference | Reference |
| | Uncertain | 1.4 (0.5 to 3.7) | 0.8 (0.3 to 2.1) | 0.6 (0.2 to 1.8) |
| | Disagree | 1.2 (0.5 to 3.0) | 1.3 (0.5 to 3.6) | 0.7 (0.2 to 2.0) |
| Attitudes and beliefs towards injuries | | | | |
| I think it is harmless to continue playing despite injury | Agree | Reference | Reference | Reference |
| | Uncertain | 1.3 (0.6 to 2.9) | 0.6 (0.3 to 1.1) | 1.8 (0.8 to 3.9) |
| | Disagree | 1.2 (0.6 to 2.5) | 0.5 (0.3 to 0.9) | 2.9 (1.6 to 5.2) |
| I stop playing if I have an injury | Agree | Reference | Reference | Reference |
| | Uncertain | 1.4 (0.9 to 2.1) | 1.1 (0.7 to 1.6) | 0.8 (0.5 to 1.3) |
| | Disagree | 1.6 (1.0 to 2.5) | 1.1 (0.6 to 2.1) | 1.2 (0.7 to 1.9) |

| | | | | |
|--|-----------|-------------------|------------------|-------------------|
| I feel under pressure to play when I am injured | Agree | Reference | Reference | Reference |
| | Uncertain | 0.5 (0.3 to 0.8) | 1.3 (0.6 to 2.5) | 0.9 (0.4 to 2.0) |
| | Disagree | 0.6 (0.3 to 1.1) | 1.1 (0.6 to 1.8) | 1.7 (0.9 to 3.2) |
| Players who continue to play with injuries are likely to suffer physical problems later in life | Agree | Reference | Reference | Reference |
| | Uncertain | 1.0 (0.7 to 1.4) | 1.1 (0.6 to 2.1) | 0.5 (0.3 to 0.8) |
| | Disagree | 1.7 (0.6 to 5.0) | 1.1 (0.3 to 3.5) | 2.1 (0.7 to 6.1) |
| I would play with an injury if it meant we got into the national finals | Agree | Reference | Reference | Reference |
| | Uncertain | 1.1 (0.7 to 1.8) | 0.9 (0.6 to 1.2) | 1.2 (0.7 to 2.3) |
| | Disagree | 0.3 (0.1 to 1.2) | 0.9 (0.4 to 2.0) | 0.8 (0.3 to 1.8) |
| Preventing injuries is not any large concern for me | Agree | Reference | Reference | Reference |
| | Uncertain | 1.1 (0.5 to 2.3) | 1.0 (0.6 to 1.8) | 0.4 (0.2 to 1.0) |
| | Disagree | 1.7 (2.0 to 11.2) | 1.3 (0.7 to 2.7) | 0.5 (0.2 to 1.3) |
| Players do not have to be fully rehabilitated from injury before playing handball again | Agree | Reference | Reference | Reference |
| | Uncertain | 1.0 (0.6 to 1.6) | 0.7 (0.4 to 1.5) | 1.0 (0.6 to 1.6) |
| | Disagree | 1.4 (0.9 to 2.3) | 0.7 (0.4 to 1.1) | 1.0 (0.5 to 2.2) |
| As a handball player you have a high risk of injury | Agree | Reference | Reference | Reference |
| | Uncertain | 1.1 (0.6 to 1.8) | 0.8 (0.4 to 1.3) | 0.4 (0.3 to 0.6) |
| | Disagree | 1.1 (0.3 to 3.6) | 0.6 (0.1 to 2.8) | 0.6 (0.2 to 1.8) |
| My coach supports me when I'm injured | Agree | Reference | Reference | Reference |
| | Uncertain | 1.0 (0.6 to 1.6) | 0.9 (0.5 to 1.7) | 0.9 (0.5 to 1.6) |
| | Disagree | 3.0 (0.0 to 9.9) | 0.7 (0.4 to 1.4) | 2.2 (0.6 to 7.8) |
| My teammates support me when I'm injured | Agree | Reference | Reference | Reference |
| | Uncertain | 0.6 (0.3 to 1.1) | 1.4 (0.9 to 2.0) | 0.6 (0.3 to 1.1) |
| | Disagree | 0.01 (0.0 to 0.9) | 2.1 (0.6 to 7.9) | 2.6 (0.7 to 9.4) |
| My family supports me when I'm injured | Agree | Reference | Reference | Reference |
| | Uncertain | 0.6 (0.3 to 1.3) | 1.1 (0.5 to 2.7) | 0.6 (0.3 to 1.2) |
| | Disagree | 2.3 (0.2 to 27.4) | 0.6 (0.5 to 7.6) | 1.5 (0.2 to 13.0) |
| My club ensures that I get the necessary first aid (ice, bandage, etc.) if I get an injury | Agree | Reference | Reference | Reference |
| | Uncertain | 1.5 (0.7 to 3.3) | 0.9 (0.3 to 2.4) | 0.5 (0.3 to 1.0) |
| | Disagree | 1.1 (0.3 to 4.6) | 2.9 (1.1 to 7.8) | 1.0 (0.3 to 3.7) |
| My club ensures that I have access to a physiotherapist, doctor, other healthcare professional when I am injured | Agree | Reference | Reference | Reference |
| | Uncertain | 0.8 (0.4 to 1.6) | 1.0 (0.7 to 1.4) | 1.1 (0.7 to 1.8) |
| | Disagree | 0.9 (0.4 to 2.0) | 2.1 (1.4 to 3.2) | 0.9 (0.5 to 1.8) |
| My club helps me with my rehabilitation when I'm injured | Agree | Reference | Reference | Reference |
| | Uncertain | 1.4 (0.8 to 2.3) | 1.1 (0.7 to 1.8) | 1.1 (0.7 to 1.8) |
| | Disagree | 0.9 (0.5 to 1.9) | 1.4 (1.0 to 2.0) | 1.6 (0.7 to 3.5) |

Table D.1. Initial coding structure: Coaches' and players' experiences of implementing injury prevention exercises and programmes

| Coaches | Players |
|---|---|
| Background <ul style="list-style-type: none"> • Basic or regular player training/practice sessions | Background <ul style="list-style-type: none"> • Handball experience • Basic or regular training/practice sessions • Attitude towards handball |
| Coaching education and experience <ul style="list-style-type: none"> • Coaching education • Coaching experience • Playing experience | Injury prevention Injury <ul style="list-style-type: none"> • Attitudes towards injury • Experiences with injury • Player response to injury • Contact with medical professionals |
| Injury Prevention <ul style="list-style-type: none"> • Player attendance at injury prevention training • Club policy/practice • Coach attitudes towards injury prevention • Communication about injury prevention • Injury prevention training examples, exercises, or programmes • Motivation and culture • Player experiences or attitudes • Responsibility for injury prevention | Injury prevention training <ul style="list-style-type: none"> • Attitude towards injury prevention training • Experience of injury prevention training • Knowledge of injury prevention training • Motivation and culture • Responsibility for injury prevention |

Table E.1. Coach and player experience implementing injury prevention exercises and programs

| Element of the RE-AIM framework ²⁸ | Coach quotes | Player quotes |
|---|--|--|
| Reach | <p>“we must figure it [injury prevention] out on our own...for me, it’s not a problem because I do like to have an education that way” (Coach 2)</p> <p>“in the little club, I go all the material was sent with courses. If there were any new news, rules, or anything, we got it all at the time. Unfortunately, I do not get this here. I still think they are sending it, but it’s not always that we get it.” (Coach 1)</p> <p>“...the website...and also other coaches and other clubs where you talk to each other, looking at each other a little over the shoulder and comparing training” (Coach 3)</p> <p>“if you look at the right websites, you can find them, but then they are not [doing enough] in my opinion because it is posted on a website” (Coach 4)</p> <p>“It's me who seeks it. Do not know if they have some magazines or, but it's on [website] I'm looking for. But nothing comes from the club” (Coach 3)</p> <p>“Set requirements...It [IPEP implementation] should come directly from the top.” (Coach 5)</p> | <p>“I actually do not think I have so much knowledge about it. It's not something we'll get to know about. It is more the players who got an injury that can tell us about it” (Player 1)</p> <p>“I do not know Well, of course there is something with knees and ankles... But it's not because I think it has this great effect that we do it because it works. I just think it's something we do to do it. So, I do it with my shoulder, strength training and elastic exercises, all such a thing. But otherwise I do not have the great knowledge about it.” (Player 2)</p> <p>“before my injury, I will say, it was just something that should be done as fast as possible. I knew that it might not be the right attitude to have, but so on the team and something we were so quiet and calm about it, took it a bit like a half an hour where you could take it easy and talk... But after I've got the ACL injury, I've learned how important it is, that's with the new knee and all that.” (Player 3)</p> |
| Efficacy/ Effectiveness | <p>“I think the barriers are that when talking about injury and strength training, they think it's elite and on a higher level, so it's barriers to making it a part of handball in general and not just elite” (Coach 3)</p> <p>“It would be nice if a material could be specifically designed for this target group” (Coach 3)</p> | <p>“It's always good to have some more knowledge behind it, instead of just doing it and you do not know why you do it .. It could make more sense, so I'm more aware of what I'm doing” (Player 1)</p> |
| Adoption | <p>“I know that it [IPEPs] benefits the girls, but you also have to think about what the girls want” (Coach 2)</p> <p>“When it's [IPEPs] a part of the game and so it's a bit more fun compared to the dry exercises just on the floor” (Coach 3)</p> <p>“motivation must be that it's [IPEPs are] fun” (Coach 4)</p> | <p>“So the overall responsibility, I would say is the club. So they have a responsibility for the players to do the best that they train optimally. But overall, it could also be the individual player, so ... It's really everyone's responsibility on one level or another.” (Player 1)</p> |

| | | |
|----------------|--|--|
| | <p>“I’m making it [IPEP] fun. Handball must be fun and it is just the most important thing” (Coach 5)</p> | <p>“It [IPEPs] can be boring and yes, it has nothing to do with handball” (Player 2)</p> <p>“So, if it should increase my motivation, it [IPEP] would probably to make it more handball specifically, you are thinking, okay you cannot feel anything on the pitch and that's what you want will. to see results and something like that, maybe a little more handball specifically” (Player 3)</p> |
| Implementation | <p>“The challenge is also that in these clubs we are also fighting for our hall/field times. And when it's not elite it's hard to ask people to come an hour before we're going to work out. So it's again about changing the attitudes and culture. Time is a factor that means a lot.” (Coach 3)</p> <p>“there is both a space and a time problem... so you have to be creative with the space because we do not have enough space” (Coach 4)</p> <p>“You would be able to find a completely different motivation for 14-year-old girls and 16 year old girls” (Coach 2)</p> <p>“They are learning to train, they what we are doing with u14. u10 and u12 it is just got to be fun, you should achieve the feeling to be successful with the ball and u 14 it's where you start tightening in” (Coach 5)</p> | <p>“it's just something you do on your own...it's not like we have a definite workout where they say .. ‘now it's preventative’” (Player 1)</p> <p>“Perhaps it will not be a little more for a thing we must do. That means making more of it. So it may as well be from the club side, and from the physiotherapists and our physical coach. That they lay a little more emphasis on it.” (Player 2)</p> <p>“It's [injury prevention] actually just like something we do on our own” (Player 3)</p> |
| Maintenance | <p>“no-one comes to you and says you should do it [injury prevention]” (Coach 1)</p> <p>“This is something we implement a bit sporadically not systematically” (Coach 3)</p> | <p>“We always start saying that "Remember to get the whole body warmed up." But It's more like a "note to self” (Player 1)</p> <p>“Yes, so I do not think DHF can do a whole lot about it. It's probably out in the club, it's going to be somewhere, but I do not know if it should be player or at the coach. But at the end of the day it's our own responsibility so I think it might be the players responsibility.” (Player 3)</p> |