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Factors influencing high school coaches' adoption of injury prevention programs

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Abstract

Objectives Despite documented efficacy of injury prevention programs (IPPs) to reduce sport-related lower extremity injury risk, there is evidence of a lack of widespread IPP adoption by high school coaches. This study identified factors related to non-adoption of IPPs by assessing coaches' knowledge, attitudes, and behaviors related to prevention programs and comparing attitudes between adopter and non-adopter coaches.

Design Cross-sectional

Methods Head soccer and basketball coaches (n=141) from 15 Oregon high schools were invited to complete a web-based survey assessing their IPP-related knowledge, attitudes, and behaviors.

Results Of the 66 coach respondents, 52% reported being aware of IPPs; 21% reported using an IPP with their team; and 9% reported having their student-athletes perform the IPP exactly as designed. No apparent differences in the attitudes towards the importance of injury prevention or the effectiveness of IPPs were identified between coaches that did and did not adopt an IPP. Perceptions that efficacious IPPs do not offer a *relative advantage* over coaches' existing practices, do not align with coaches' needs (*compatibility*), and are difficult to implement in their setting (*complexity*) emerged as key factors underlying coaches' decisions not to adopt a program. Of those that did report adopting an IPP, just 43% (6/14) reported implementing the program as designed.

Conclusions Improving preventative practices of high school coaches requires more than improved dissemination to increase coach awareness. To improve the rate of IPP adoption and implementation fidelity, coach education should directly address issues related to relative advantage, compatibility, and complexity.

Keywords: athletic injuries, prevention, knowledge, attitudes, lower extremity

1. Introduction

More than 1.7 million United States high school students compete in interscholastic soccer and basketball each year, realizing numerous benefits as a result of their participation.^{1,2} During the 2013-14 academic year, high school athletes suffered approximately 335,000 lower extremity injuries requiring medical attention and removal from sport for at least one day.³ Though many of these injuries are minor, athletes who suffer more serious lower extremity injuries, such as anterior cruciate ligament (ACL) ruptures, are less likely to return to pre-injury levels of physical activity and more likely to experience long-term disability.^{4,5}

While the efficacy of structured injury prevention programs (IPPs) to reduce lower extremity injury rates in soccer and basketball is well established,⁶⁻⁸ effective injury prevention can only occur if these programs are adopted.^{9,10} For the majority of high school teams, coaches determine the types of activities performed by team members and thus determine whether IPPs reach the student-athlete. Unfortunately, just 16% of high school girls' soccer coaches in Utah reported using "a training program specifically aimed at ACL injury prevention".¹¹ So despite their proven efficacy, IPPs may not be widely adopted by high school coaches – limiting any chance for population-level reductions in lower extremity injury rates.

The adoption of injury prevention behaviors is influenced by coaches' knowledge of and attitudes toward preventive practices.¹²⁻¹⁴ Like most other states, Oregon does not require coaches to complete education regarding the use of efficacious IPPs. As a result, one potential reason for a low level of IPP adoption may simply be a lack of awareness. However, coach awareness does not guarantee program adoption.^{15,16} Positive attitudes toward intervention programs, the perceived need for injury prevention behaviors, and the ease with which IPPs are able to be used in a real-world setting may influence whether or not a coach adopts an IPP.^{17,18} Further, once an IPP is adopted, the magnitude of protection is highly dependent upon implementing and performing the program as designed and intended.¹⁹ Given these challenges for translating efficacious IPPs to effective injury prevention practice, it is necessary to understand the contextual and behavioral factors surrounding the use of coach-led IPPs in order to reduce lower extremity injuries. The primary aim of this investigation was therefore to determine high school

soccer and basketball coaches' knowledge, attitudes, and behaviors related to lower extremity IPPs. In addition, we sought to: 1) explore whether attitudes toward IPPs and practice/training differed between coaches that did and did not choose to use IPPs with their teams; and 2) identify perceived barriers to IPP adoption of high school coaches who were aware of IPPs, but chose not to adopt one with their teams.

2. Methods

This study employed a cross-sectional design to determine the knowledge, attitudes, and behaviors of high school soccer and basketball coaches towards lower extremity IPPs. The sample was recruited from a population of 141 head coaches of a boys' or girls' soccer or basketball team during the 2013-2014 academic year at one of 15 Oregon high schools participating in a multi-year study of coaching practices and lower extremity injury risk (Supplementary Figure). All coaches provided informed consent prior to participation and the study was approved by the Institutional Review Board at XXX (#5749).

A web-based survey instrument (Qualtrics, Inc., Provo, Utah, USA) was developed to capture information about coaches' knowledge, attitudes, and behaviors regarding IPPs and training/practice sessions. Questions related to attitudes were adapted from a study assessing Australian football coaches' attitudes about lower extremity injury prevention.²⁰ The survey was developed and evaluated for face validity by the study's principal investigators (X.X.X. and X.X.X.), externally reviewed for content validity by two independent experts, and revised accordingly prior to use.

Coach awareness and adoption of efficacious IPPs were assessed by requesting coaches to provide "Yes/No" responses to questions asking whether they: 1) were aware of any IPPs that were scientifically shown to reduce the risk of lower extremity injury; 2) currently used a scientifically proven IPP with their team; and 3) had their student-athletes perform the IPP exactly as designed. All coaches were presented with the first question while the presentation of questions two and three, respectively, was triggered by coaches providing a "yes" response to the preceding question. Due to the lack of any large-scale dissemination and implementation programs for Oregon high school coaches, these questions were purposefully designed to assess the current level of awareness, adoption, and use of any IPP, rather than a

specific program. Coaches' attitudes towards lower extremity injury prevention, training/practice sessions, and potential barriers to IPP adoption were collected on a five-point Likert scale.

Survey results were analyzed using SPSS v 21.0 (IBM, Inc., Armonk, NY, USA). Coaches' attitudes responses were coded from 1 ("strongly disagree") to 5 ("strongly agree") and collapsed to 3 points for analysis due to the relatively low number of coach respondents.²⁰ Due to small cell frequencies, X^2 tests of association were only used to assess the relationships between coach awareness of IPPs and self-reported adoption of an IPP, respectively, and the combined totals for sport and gender coached. All other data were nominally scaled and are presented descriptively.

3. Results

The overall survey response rate was 47% with a range of 41-55% for each subset of sport and gender coached (Supplementary Figure). Of the 66 coach respondents, 52% reported being aware of IPPs scientifically shown to reduce the risk of lower extremity injury; 21% reported currently using a scientifically proven IPP with their team; and 9% reported having their student-athletes perform the IPP exactly as designed (Table 1). Coaches of girls' teams were more likely to be aware of IPPs than coaches of boys' teams. No association between sport coached and IPP awareness was identified. Among coaches aware of IPP efficacy, coaches of male teams were no more likely to adopt an IPP than coaches of female teams, but soccer coaches were more likely than basketball coaches to report using an IPP.

Among coaches that reported being aware of IPPs, attitudes toward injury prevention and training/practice sessions were generally consistent regardless of whether or not coaches reported adopting an IPP with their team (Table 2). All coaches agreed that lower extremity injury prevention is important in training sessions, and that it is important for coaches and players to have current knowledge of injury prevention strategies. All but a few coaches agreed that they would implement specific training if it were proven to prevent injuries, improve performance, or both, with no substantial differences in attitudes between IPP adopters and non-adopters. Nearly all coaches (94%) agreed that lower extremity

injuries negatively influence game performance and end of season results. However, less than half of coaches, regardless of IPP use, perceived lower extremity injuries to be a problem for their team.

Table 3 summarizes the attitudes towards potential barriers to IPP adoption among aware coaches who have not implemented an IPP. Sixty-five percent of coaches reported that they already have their student-athletes perform the same types of activities that are included in IPPs, 30% reported that their team's practices were not long enough to devote time to an IPP, and 25% reported that their players do not want to complete these types of IPPs. Relatively few coaches ($\leq 10\%$) reported high program cost; negative attitudes toward the relevancy and efficacy of IPPs; and a lack of available training or assistance in implementing a program as barriers to IPP adoption.

4. Discussion

Despite a growing body of evidence indicating that the use of structured IPPs by soccer and basketball athletes can reduce lower extremity injury rates,⁶⁻⁸ there is limited use of IPPs by high school coaches.¹¹ Our study confirms this previous finding and identifies several novel factors that likely contribute to the low rate of IPP adoption.

Finch and Donaldson's¹⁷ RE-AIM Sports Setting Matrix (SSM) extends the traditional RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework described by Glasgow^{21,22} to include relevant implementation factors for each dimension that should be considered at various levels of sporting organizations in order to maximize intervention effectiveness. Coach-specific *Reach*-related factors that are important to consider include the percent of coaches that attend program education and the percent aware of the program.¹⁷ Similar to most other states, Oregon does not require coaches to receive education specific to lower extremity injury, nor are such programs actively promoted. Consequently, only half of the coaches surveyed reported being aware of an efficacious IPP. In the absence of a formal dissemination program, the diffusion of knowledge about an innovation (IPP) to a potential user (coach) is primarily passive, relying heavily on mass media and interpersonal communications.²³ Interestingly, coaches of girls' teams were more likely to be aware of IPPs than

coaches of boys' teams. This could be due to the highly publicized fact that females are at greater risk for non-contact ACL injuries which prompted the development of many of the efficacious IPPs currently available. However, the overall IPP awareness rate was just 52%. While this level of awareness without a formal dissemination program indicates that there might be a significant degree of interest in injury prevention among high school coaches, it is evident from our results that relying entirely on passive mechanisms in order to spread awareness of efficacious IPPs is insufficient.

The RE-AIM SSM identifies the percent of coaches believing that an IPP program reduces participant injury risk as one *Effectiveness*-related implementation factor specific to coaches that affects their decision on adopting a prevention program.¹⁷ Of the surveyed coaches who reported being aware of an efficacious IPP, just 41% (14/34) indicated that they used one of these prevention programs with their athletes. While attitudes towards injury prevention have been associated with the adoption of preventive practices,^{14,18} we failed to identify any apparent differences in the attitudes towards lower extremity injury prevention of coaches who chose to adopt a program and those who did not (Table 2). Importantly, 90% of coaches who did not choose to implement an IPP reported believing that an IPP would reduce injury (Table 3). These results indicate that negative attitudes toward injury prevention in general, or doubt about the effectiveness of IPPs to prevent injury, were not the primary barriers to IPP adoption.

Rogers'¹⁸ Diffusion of Innovation Theory proposes several factors that influence an innovation's rate of adoption that may be relevant to coaches' adoption of IPPs. The most important predictor of the rate of adoption is the perceived *relative advantage* of the innovation (IPP), or the degree to which the new idea is better than what is currently being done.¹⁸ Of coaches that were aware of IPPs but did not adopt one with their team, only half indicated the activities included in IPPs are relevant or beneficial to their athletes. Yet, 65% reported they already had their athletes perform the same types of activities that are included in IPPs which indicates that these programs were likely not perceived as being a relative advantage over their existing practices. This finding may be especially encouraging provided that the activities being chosen by coaches mirror evidence-based injury prevention practice. It may be that coach

adoption of the activities common to efficacious IPPs (e.g., core strength, neuromuscular training, etc.) is more important than the adoption of any specific IPP. However, it is unknown whether the use of specific types of activities outside of an IPP are associated with lesser injury risk.

Additionally, *compatibility* - the degree to which an innovation aligns with the needs and values of a possible user - and *complexity* - the perceived difficulty in understanding and using an innovation - also influence an individual's decision to adopt an innovation.¹⁸ While coaches' unanimously agreed that injury prevention in general is important, less than half of the non-adopters perceived lower extremity injuries to be a problem for their team. Therefore, regardless of their positive attitudes toward injury prevention, these coaches may have not adopted an IPP because IPPs do not address an important issue for their athletes (i.e., compatibility). Moreover, non-adopters also identified lack of time during practices (30%) and a belief that their student-athletes do not want to use IPPs (25%) as barriers to program adoption (i.e., complexity). Most striking, there does not seem to be a common barrier to IPP use, but rather a wide range of barriers to IPP adoption. It is noteworthy that soccer coaches were significantly more likely to adopt an IPP than basketball coaches. While the reasons for this are unclear, it may be that some of the most well-known IPPs, such as the FIFA 11+²⁴ and PEP²⁵, are targeted to soccer athletes and may be more difficult for basketball coaches to adopt with their teams.

Finally, though the focus of this investigation was adoption of IPPs, we did assess one coach-specific factor related to *Implementation*.¹⁷ Of the 14 coaches who reported adopting an IPP, just 6 (43%) indicated that they implemented the efficacious IPP as it was intended. Given that program fidelity has been shown to impact the effectiveness of lower extremity injury prevention,¹⁹ the lack of fidelity with which high school coaches are delivering IPPs likely reduces any preventative effect.

Our results support previous calls for the need to focus on the dissemination and implementation of efficacious preventative practices in order to improve the effectiveness of large scale sport-related injury prevention efforts.^{22,26,27} Increasing awareness of efficacious IPPs is necessary given our observed 52% rate of IPP awareness among high school boys' and girls' coaches. While it is likely that coaches'

awareness of IPPs would be increased if state high school associations committed to requiring coach education on lower extremity injury prevention in much the same way that education about sport concussion is now routinely mandatory;^{14,28} this approach may not be feasible given that many states, in addition to concussion education, also require education on anabolic steroids, CPR and first aid, and heat and hydration. Further, policy initiatives driven by higher levels of sport administration have not been shown to necessarily lead to the use of preventative practices by coaches.¹⁶ It is possible that a multifaceted education approach, which includes efforts to reduce previously identified injury prevention knowledge gaps of parents and athletes,^{12,29} could indirectly increase coach awareness of IPPs if knowledgeable parents and athletes were to begin asking coaches why preventative practices are not being used with their team.

Regardless of the mechanisms used to increase coaches' awareness of IPPs, reducing lower extremity injury rates in high school athletes will require more than just increased awareness. It will also necessitate increasing the rate of IPP adoption. However, our results indicate that simply fostering positive coach attitudes and beliefs about the effectiveness of IPPs is insufficient for improving IPP adoption. Rather, coach adoption of injury prevention practices might be improved if coach education focused on: 1) highlighting the relative advantages of IPPs over a coach's current practice; and 2) cultivating a perceived need for injury prevention by providing coaches with detailed information about injury risk and the long-term ramifications for athletes who sustain more significant lower extremity injuries. In addition, it is essential to determine whether or not coaches' use of activities common to efficacious IPPs is associated with lesser lower extremity injury risk. Presently, there is no evidence to support or refute coaches' beliefs that having athletes perform activities similar to what is included in IPPs provides a comparable preventative effect. Without this information, it will remain challenging to convince some coaches that IPPs are better than their current practices. More research is also necessary to determine if efficacious IPPs can be effectively adapted to address coaches' perceived difficulties with their use and poor implementation fidelity- perhaps by more actively engaging coaches in IPP development.

Our study has several limitations. First, the 66 coaches surveyed were voluntary participants from a convenience sample of 141 head coaches at 15 high schools participating in a multi-year study assessing the influence of coach practices on lower extremity injury rates. We limited our survey to this population so that we could identify all potential survey respondents and calculate a response rate which would not have been possible if the survey was offered to all Oregon high school coaches. While this design introduces the potential for selection bias, the schools involved represent a broad cross-section of size and location. Second, as with previous work in this area,^{12,20,30} the survey instrument used in this study was only evaluated for face and content validity. However, a major strength of the survey instrument is that it was independently evaluated for content validity by two experts with significant experience in the assessment of knowledge, attitudes, and behaviors surrounding injury prevention. Third, the use of self-reported information means that coaches may have inaccurately reported their true knowledge, attitudes, and/or behaviors. Finally, while the RE-AIM SSM framework is recommended as a means to evaluate multiple dimensions of a single prevention program,¹⁷ we utilized this conceptual framework to describe the cumulative implementation of any IPP due the lack of any systematic lower extremity injury prevention programming in Oregon high schools.

5. Conclusion

There is limited awareness, and even more limited adoption, of efficacious lower extremity IPPs by Oregon high school basketball and soccer coaches. The low rate of adoption does not appear to be driven by negative attitudes regarding injury prevention or doubts about the effectiveness of IPPs. Rather, decisions may be driven by perceptions that IPPs present little relative advantage over current practices, that lower extremity injuries are not a substantial problem, and that environmental barriers preclude IPP adoption. Improving lower extremity injury prevention requires attention to these factors as well as efforts to improve the implementation fidelity of coaches who do choose to adopt IPPs.

Practical implications

- Only 52% of high school soccer and basketball coaches were aware of efficacious IPPs and just 21% adopted one with their team
- The low rate of adoption was not related to negative attitudes regarding injury prevention or doubts about the effectiveness of IPPs
- Primary barriers to IPP adoption were coaches' perceptions that IPPs present little relative advantage over current practices, lower extremity injuries are not a substantial problem, and IPPs are too difficult to use in their setting
- Increasing coach awareness of efficacious IPPs as well as education aimed at highlighting the need for injury prevention and the relative advantage of IPPs over current coaching practices are likely necessary to improve the effectiveness of high school lower extremity injury prevention

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Table 1. Self-reported knowledge and behaviors related to lower extremity injury prevention programs (IPPs) of high school coaches [*n* (% of Number of coaches)].

Sport Coached	Number of coaches	Number of coaches that reported...
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		Being aware of IPPs shown to reduce the risk of lower extremity injury	Using a lower extremity IPP with their team	Using a lower extremity IPP with their team exactly as designed
Boys Soccer	16	8 (50%)	5 (31%)	2 (13%)
Girls Soccer	17	12 (71%)	6 (35%)	3 (18%)
Boys Basketball	18	3 (17%)	- -	- -
Girls Basketball	15	11 (73%)	3 (20%)	1 (7%)
Soccer Combined	33	20 (61%)	11 (33%) ^b	5 (15%)
Basketball Combined	33	14 (42%)	3 (9%)	1 (3%)
Boys Combined	34	11 (32%)	5 (15%)	2 (6%)
Girls Combined	32	23 (72%) ^a	9 (28%)	4 (13%)
Overall	66	34 (52%)	14 (21%)	6 (9%)

^a Coaches of girls' teams more likely to be aware of IPPs than coaches of boys' teams ($p = 0.001$)

^b Soccer coaches more likely to use an IPP than basketball coaches ($p = 0.050$)

Table 2. Attitudes towards lower extremity injury prevention and training/practice sessions of aware coaches that reported adopting ($n = 14$) and not adopting ($n = 20$) a lower extremity injury prevention program (IPP) with their team.

Number of respondents (%)

		Number of respondents (%)			Median (Range)	
		Strongly Disagree/ Disagree	Neither Agree or Disagree	Agree/ Strongly Agree		
It is important for players to attend training/practice if they want to play in games.	IPP Use	-	-	14 (100%)	5	(4-5)
	No IPP Use	-	-	20 (100%)	5	(4-5)
It is important for coaches to have current knowledge of lower extremity injury prevention strategies.	IPP Use	-	-	14 (100%)	5	(4-5)
	No IPP Use	-	-	20 (100%)	5	(4-5)
Lower extremity injuries are not a problem for my team.	IPP Use	6 (43%)	4 (29%)	4 (29%)	3	(1-4)
	No IPP Use	9 (45%)	4 (20%)	7 (35%)	3	(1-5)
Training/practice sessions are important for improving performance.	IPP Use	-	-	14 (100%)	4	(4-5)
	No IPP Use	-	-	20 (100%)	5	(4-5)
It is important for players to have current knowledge of lower extremity injury prevention strategies.	IPP Use	-	-	14 (100%)	4	(4-5)
	No IPP Use	-	-	20 (100%)	4.5	(4-5)
Lower extremity injury prevention is important in training sessions.	IPP Use	-	-	14 (100%)	4	(4-5)
	No IPP Use	-	-	20 (100%)	5	(4-5)
I would implement specific training if it was proven to improve player performance and prevent lower extremity injuries.	IPP Use	-	-	14 (100%)	4.5	(4-5)
	No IPP Use	-	1 (5%)	19 (95%)	5	(3-5)
Lower extremity injuries negatively influence game performance and end of season results.	IPP Use	-	-	14 (100%)	4	(4-5)
	No IPP Use	-	2 (10%)	18 (90%)	5	(3-5)
I would implement specific training if it was proven to prevent lower extremity injuries.	IPP Use	-	1 (7%)	13 (93%)	4	(3-5)
	No IPP Use	-	1 (5%)	19 (95%)	5	(3-5)
I would implement specific training if it was proven to improve player performance.	IPP Use	-	-	14 (100%)	4.5	(4-5)
	No IPP Use	-	1 (5%)	19 (95%)	5	(3-5)

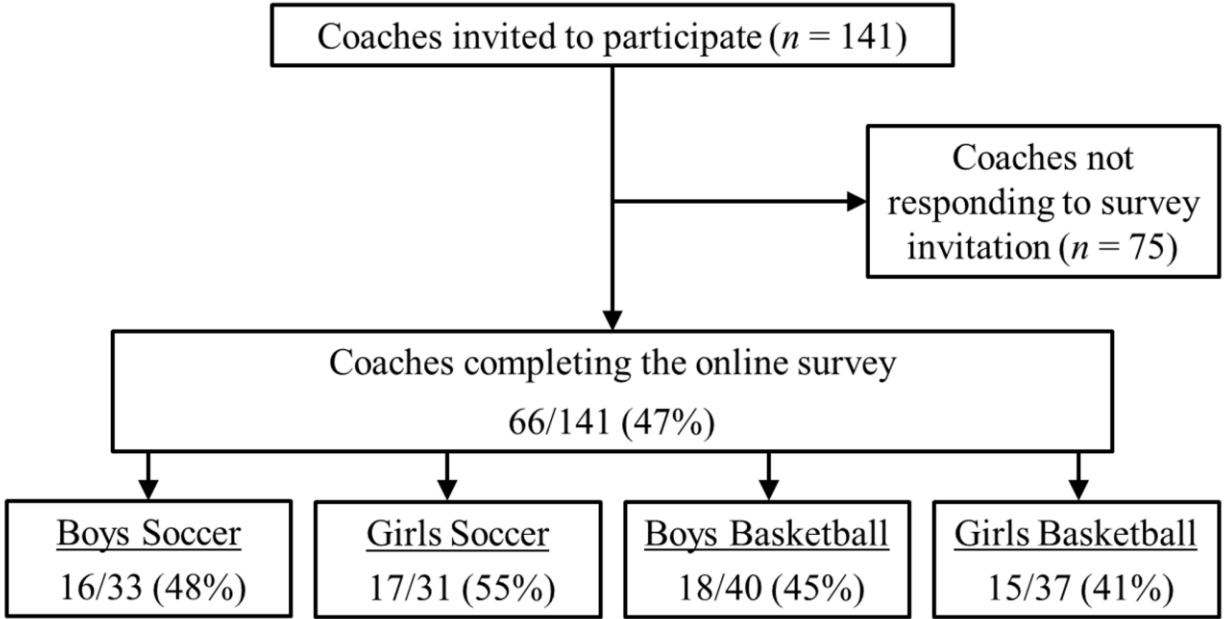
Table 3. Attitudes towards potential barriers to lower extremity injury prevention program (IPP) adoption by coaches that reported being aware of, but not choosing to adopt an IPP with their team ($n = 20$).

		Number of respondents (%)			Median (Range)	
		Strongly Disagree/ Disagree	Neither Agree or Disagree	Agree/ Strongly Agree		

The programs cost too much money	6 (30%)	13 (65%)	1 (5%)	3 (1-4)
My team's practices are not long enough to devote time to an injury prevention program.	7 (35%)	7 (35%)	6 (30%)	3 (1-5)
There is no training available to teach me how to implement a program.	10 (50%)	9 (45%)	1 (5%)	2.5 (1-4)
The activities included in these programs are not relevant or beneficial to my student-athletes.	10 (50%)	8 (40%)	2 (10%)	2.5 (1-4)
I already have my student-athletes perform the same types of activities that are included in these programs.	1 (5%)	6 (30%)	13 (65%)	4 (2-5)
I do not believe that using an injury prevention program will actually reduce the number of injuries on my team.	18 (90%)	2 (10%)	-	2 (1-3)
It is the responsibility of the sports medicine staff to implement lower extremity injury prevention programs.	14 (70%)	4 (20%)	2 (10%)	2 (1-4)
I do not want to change the warm-up and practice activities that I am currently using.	10 (50%)	7 (35%)	3 (15%)	2.5 (1-4)
My student-athletes do not want to complete these types of injury prevention programs.	11 (55%)	4 (20%)	5 (25%)	2 (1-4)
I do not have anyone with appropriate skills and knowledge to assist me to implement an injury prevention program.	15 (75%)	4 (20%)	1 (5%)	2 (1-4)

Supplementary Figure Legend

Figure. Flow chart of participant recruitment and study enrollment.



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