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Female soccer knee injury: Observed knowledge gaps in injury prevention among players/parents/coaches and current evidence (the KNOW study)

B. Orr[1], C. Brown[1], J. Hemsing[1], T. McCormick[1], S. Pound[1], D. Otto[2], C. A. Emery[3], L. A. Beaupre[4]

[1]Department of Physical Therapy, University of Alberta, Edmonton, Alberta, Canada, [2]Department of Surgery, University of Alberta, Edmonton, Alberta, Canada, [3]Sport Injury Prevention Research Centre, Faculty of Kinesiology, Departments of Community Health Sciences and Paediatrics, Faculty of Medicine, University of Calgary, Calgary, Alberta, Canada, [4]Departments of Physical Therapy and Surgery (Division of Orthopaedic Surgery), University of Alberta, Edmonton, Alberta, Canada
Corresponding author: Lauren Beaupre, PT, PhD, 2-50 Corbett Hall, University of Alberta, Edmonton, AB, Canada T6G 2R4.
Tel: +1 780 407 3945, Fax: +1 780 407 7534, E-mail: lauren.beaupre@ualberta.ca

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This study sought to determine if knowledge regarding the risk for knee injuries and the potential for their prevention is being translated to female adolescent soccer players (13–18 years), their parents, and coaches. Eligible participants in the 2007 indoor soccer season were surveyed to determine their knowledge of the risk for and the potential to prevent knee injuries, and their knowledge of effective prevention strategies, if they felt that injury prevention was possible. Team selection was stratified to be representative of both competitive and recreational level play and age group distributions within the selected soccer association. Of the study subjects, 773/1396 (55.4%) responded to the survey: 408 (53%) players, 292 (38%) parents, and 73 (9%) coaches. Most respondents (538 [71%]) were aware of the risk for knee injury. Coaches and parents were more likely than players to view knee injuries as preventable; however, appropriate prevention strategies were often not identified. Four hundred eighty-four (63.8%) respondents reported that they had never received information on knee injuries. Substantial knowledge gaps regarding knee injury prevention and effective preventative strategies were identified. Given the predominance of knee injuries in female adolescent soccer players, there is an urgent need for knowledge translation of prevention strategies to decrease both incidence and long-term consequences of knee injuries.

Introduction

Soccer is one of the most popular sports worldwide, with over 270 million players reported in 2006 (http://www.fifa.com/mm/document/fifafacts/bcoffsurv/bigcount.summaryreport_7022.pdf, FIFA's Big Count, 2007). In the USA, high school participation increased from 300 000 to almost 750 000 between 1990 and 2010 (http://www.nfhs.org, National Federation of State High School Associations, 2010). However, with increasing popularity is an accompanying increase in adolescent injuries (Wong and Hong, 2005; Adams & Schiff, 2006). Between 1990 and 2003, US emergency departments managed 1.6 million pediatric soccer-related injuries, many of which were lower extremity injuries (Leininger et al., 2007).

Knee injuries represent 10–50% of all soccer injuries (Dick et al., 2007; Fernandez et al., 2007; Schiff, 2007; Louw et al., 2008) with one of the most significant injuries being an anterior cruciate ligament (ACL) tear (Powell and Barber-Foss, 2000; Majewski et al., 2006; Emery et al., 2006b; Fernandez et al., 2007; Prodromos et al., 2007; Ingram et al., 2008; Louw et al., 2008). The National Collegiate Athletic Association Injury Surveillance System reported 0.32 female compared with 0.12 male ACL soccer injuries per 1000 player exposures (Mihata et al., 2006). In our health zone, 10% of all ACL reconstructions between 2000 and 2004 occurred in females younger than 18 years compared with only 6% in age-matched males. Further, 50% of female injuries occurred while playing soccer (L. A. Beaupre, personal communication).

Knee injuries, particularly those involving the menisci may lead to further knee damage, activity limitations, and early knee arthritis (Lohmander et al., 2004, 2007; Kostogiannis et al., 2007; Neuman et al., 2008, 2009), as well as increasing the risk of contralateral knee injury (Faude et al., 2006; Sward et al., 2010).

Several controlled trials with competitive athletes have examined whether either lower extremity (Hewett et al., 1999; Heidt et al., 2000; Soderman et al., 2000; Olsen et al., 2005; Soligard et al., 2008; Tegnander et al., 2008; Emery & Meeuwisse, 2010) or ACL (Caraffa et al., 1996; Mandelbaum et al., 2005; Hewett et al.,

2006; Mihata et al., 2006; Pfeiffer et al., 2006; Gilchrist et al., 2008) injuries can be prevented. For the most part, significant reductions in lower extremity injuries were reported with interventions that typically involved neuromuscular training (i.e., plyometrics and balance work), as well as education regarding landing and stance positions (Hewett et al., 1999; Heidt et al., 2000; Mandelbaum et al., 2005; Gilchrist et al., 2008; Emery & Meeuwisse, 2010). Although stretching was sometimes included, stretching alone does not appear effective in reducing injuries (Pope et al., 2000).

The Fédération Internationale de Football Association (FIFA) has developed one prevention program, the FIFA-11+ (Soligard et al., 2008), and has posted it on their website to encourage soccer coaches and trainers to adopt the intervention as part of their usual training regimens (FIFA, 2010). With this information available in the public domain, it is hoped that wider adoption of the program might occur with youth soccer coaches in addition to professional FIFA coaches.

However, to our knowledge, no study has examined how evidence regarding knee injury risk and the potential for prevention of such injuries is being translated to athletes, parents, and coaches within the soccer community, particularly at younger and less competitive levels where player participation is rapidly increasing. Two consensus conferences on ACL injuries (Ireland, 2002; Griffin et al., 2006) also concluded that public awareness of injury prevention should be a focus of health professionals. In addition, there was a need to engage appropriate users of prevention strategies, namely coaches, while educating those who would benefit from such strategies – players and, indirectly, their families.

Knowledge translation (KT), simply defined as turning research into practice, encompasses all steps between new knowledge creation and its application to yield societal benefits (Canadian Institutes of Health Research, 2004; Straus et al., 2009). A knowledge gap occurs when evidence and "end users" of evidence do not connect. To date, most KT has examined how researchers engage other clinicians to adopt and practice evidence-based medicine. In injury prevention, information must be moved to nonmedical stakeholders, so that knowledge can be adopted and implemented to potentially prevent medical system encounters.

Emery et al. (2006a) support the notion that there is a responsibility hierarchy related to injury prevention in sports including the child, parent, coach, sports organization, and the government (Emery et al., 2006a). Finch (2006) has also suggested that we need a new injury prevention framework (TRIPP – Translating Research into Injury Prevention Practice) to incorporate KT as a key component in evaluating the effectiveness of interventions to reduce injury. She suggested that in the iterative process of evaluating prevention strategies, there also needs to be formal assessment of the strategies in an "implementation context" (Finch, 2006).

Players, parents, and coaches represent stakeholders or end users who should understand the knee injury risk while playing soccer; in addition, coaches should be able to apply prevention strategies and educate players to potentially reduce knee injuries. Thus, our goal was to determine if the available evidence regarding knee injury risk and the potential for preventing such injuries was being communicated to the female adolescent soccer-playing population, including coaches, players, and their parents in our urban health region.

Knee injuries were defined as any injury occurring suddenly during an organized soccer practice/game that had at least one of the following: (1) required medical attention, (2) resulted in the inability to complete the activity session in which the injury occurred, and/or (c) required the participant to miss one or more days of sporting activity after the injury (Emery et al., 2005).

The primary objective was to determine if players, parents, and coaches (1) were aware of the risk for knee injuries, as defined above, while playing soccer, (2) were aware of the potential to prevent knee injuries, and (3) for those who indicated that knee injuries were preventable, could indicate effective prevention strategies.

Secondarily, we examined if the following were associated with the knowledge level reported: play level (recreational, competitive), years of soccer experience, coach's experience/training, or respondent type (player, parent, coach). We also examined whether respondents had received knee injury information, and if so, the source(s) of that information.

We hypothesized that knowledge about knee injury risk would be better than that for prevention and appropriate prevention strategies. We also hypothesized that knowledge gaps would be larger in younger, less experienced, and recreational players, as well as in less experienced and recreational-level coaches. Lastly, we hypothesized that coaches would have more knowledge about knee injuries than players or parents and would be more likely to have received information on knee injuries.

Materials and methods

Design

A descriptive survey was administered during the 2007 indoor soccer season to three stakeholder groups (coaches, players, parents) from the Edmonton Minor Soccer Association (EMSA) to determine their current knowledge level about knee injury risk and the potential for injury prevention. Ethical approval was received from the Research Ethics Board prior to data collection.

Survey development

We followed similar survey development steps as others have reported (King et al., 1998; Mummery et al., 1998; Emery et al., 2006b) starting with a literature review (Kitchenham & Pfleeger, 2002a) to determine current evidence regarding knee injury risk and prevention. In addition, we contacted three experts (an orthopedic surgeon with an ACL surgical practice, a sports physical

Table 1. Preventative strategies

Strategy	Descriptor
Longer warm-up	Warm-up longer than 10 min.
Balance activities	Any proprioceptive activity that challenges the base of support and reaction time targeting mechanoreceptors within the joint capsule or ligaments as well as the surrounding muscles and tendons.
Quad strengthening	Any strengthening activities designed to target the quadriceps muscle group, particularly the vastus medialis as it contributes to important function in knee biomechanics and stabilization.
Increased fitness	An improvement in cardiovascular conditioning and/or muscular strength. Describes a physiological change in aerobic capacity, and/or improved strength, endurance, power, or agility.
Stretching	General stretching program for global muscles; should be performed by three sets of 30- to 60-s hold per muscle.
Biking	Stationary and/or road bicycle cardiovascular fitness. Amount of time not specified.
Jump training	Any exercise drills or training that works on proper take off and landing techniques to improve biomechanics. May also include plyometric jumping exercises.

therapist, and a youth injury prevention researcher experienced in survey administration) (Kitchenham & Pfleeger, 2002b). We drafted a survey for content validity review by the experts; the survey was further revised based on their suggestions (Kitchenham & Pfleeger, 2002c). The next survey draft, which included the knee injury definition and basic participant information (player age, soccer experience, competitive level, amount of time spent playing soccer weekly, and coaching experience), had questions on the following: (1) if the participants had ever received any knee injury information and sources of that information, (2) risk of knee injury, (3) potential for injury prevention, and (4) potential preventative strategies (Table 1). All questions were close-ended (multiple choice, ranking, or "indicate all that apply" options) to standardize responses and improve survey completion rate (Kitchenham & Pfleeger, 2002b).

The second draft, approved by our expert panel, was distributed to an eligible under 14 years (U14) team, their parents, and coaches prior to formal data collection to test survey clarity and response time (Kitchenham & Pfleeger, 2002c). We selected a U14 team as our pilot evaluation team because they represented the youngest respondent group and were most likely to run into difficulty with question comprehension. Following the pilot evaluation, the survey was further revised for clarity. The final draft of knee injury risk/prevention survey had five questions (two questions on previous receipt and sources of knee injury information, one question on knee injury risk, and two questions on prevention in addition to items regarding respondent characteristics) (Appendix).

Participants

EMSA is a local organization that manages the indoor soccer season in a metro urban area of greater than 1 million residents. The indoor season starts in mid-October and runs until mid-March when soccer moves to the outdoor setting. Indoor soccer is played in an arena-like setting with five players in addition to the goalie on the field for each side; most teams have 14–16 players. The game is played in two 25-min periods.

Players compete for positions on the competitive teams with the recreational level open to all interested participants. Teams are tiered according to their ability with the number of teams in each category dependent on the number of registrants. Coaches for the competitive level are typically required to have some training and experience in coaching soccer while coaches for the recreational division are often parent volunteers, who are only required to take a basic coaching course.

Players, parents, or coaches of female indoor soccer teams of EMSA in 2007/2008 within the defined age groups of U14, under 16 years (U16), or under 18 years (U18) were eligible for participation. All data were anonymous, as per ethical requirements.

Sampling

We had limited time as the survey was performed close to the end of the indoor season; thus, we chose appropriate stakeholders who were available during the data collection period. We attempted to reduce selection bias (Kitchenham & Pfleeger, 2002c) by ensuring that chosen teams were representative of the EMSA population, which is grouped based on player age and skill level.

Approximately 70% of the target population played recreationally, while the remaining 30% played competitively; thus, teams were selected via cluster-based sampling (Kitchenham & Pfleeger, 2002d) based on these proportions. The number of teams selected within each age category was also reflective of the proportional age distributions within EMSA. However, although the overall group was cluster-sampled to be representative of EMSA's age and competitive distribution, individual teams were selected with a convenience approach (Kitchenham & Pfleeger, 2002d) to allow the researchers to target teams playing on the same evenings. As game scheduling was based on age distribution, there was no suggestion that our sampling strategy would result in a biased respondent group. All parents and coaches of participating players present at the time of survey distribution were also asked to participate. In addition, the survey was e-mailed to all coaches of the female teams in the specified age groups to increase coach representation.

Data collection

Teams chosen for study participation were notified via an e-mail sent to a coach with a study information letter. If coaches agreed to participate, players/parents were informed about the study. Participating teams were then informed when the data collection would occur. All data collection for players and parents was done at four local soccer centers.

When surveys were disseminated to players, parents, and coaches, a researcher gave a study overview and specifically discussed the knee injury definition to be used during survey completion. Participants were encouraged to answer all questions to the best of their ability, but that it was better to indicate that they did not know or were unsure rather than to guess.

We used group administration mode (i.e., researchers stayed with the respondent group) as a mechanism to increase survey participation (Kitchenham & Pfleeger, 2002c). The researchers made themselves available to clarify survey questions, not to provide information regarding appropriate responses.

Overall, 1396 surveys were distributed to 43 teams, of which 12 (28%) were U14, 21 (49%) were U16, and 10 (23%) were U18 teams. Of the distributed surveys, 773 (55.4%) were returned. While response rates were very similar among the age groups, they varied among the respondent types. Coaches had the highest response rate (68%) while parents had the lowest (49%); players had a 63% response rate. The U18 parents had the lowest response rate as they were not in attendance at the games in the same proportions as the younger age groups' parents.

Thirty-two (74%) participating teams completed the survey with researchers in attendance; 83.1% of available participants completed the survey under these circumstances. The remaining teams' coaches (11 [26%]) allowed survey distribution after instructions were given by the researchers, but participants completed surveys at home; only 12.8% completed surveys despite repeated e-mail and telephone contacts by researchers using this approach.

Analysis

We described the target population (player age, soccer experience, and play level). Then we examined the three respondent groups' (players, parents, and coaches) responses regarding knee injury risk, the potential for injury prevention, and appropriate prevention strategies to determine whether or not respondents agreed with published research evidence. Only those indicating that injuries were preventable responded to the question regarding preventative strategies.

Responses within respondent groups (players, parents, coaches) were compared to determine if level of play and years of soccer/coaching experience affected knowledge level. Most respondents (74%) had more than 5 years soccer exposure; thus, responses were dichotomized (<5 years experience/≥5 years). Knowledge levels among age divisions were also compared in the player analysis. Further analysis compared responses among groups (players, parents, coaches) to determine if respondent type influenced knowledge level.

Finally, we examined information about soccer knee injuries looking at both the rate of receiving information and information source(s). Respondent groups were compared to determine if respondent type affected the likelihood of receiving injury information.

Statistics

As sample sizes differed by respondent type, levels of significance were defined prior to analysis to reflect the different power levels. Levels of significance of $P \leq 0.01$ were chosen for the player and full group analysis ($n > 400$) while the level of significance $P < 0.05$ were selected for coach and parent analyses with fewer respondents. As the data were categorical, chi-square tests were used when more than two groups were compared while Fisher's exact test was used for 2×2 comparisons. The Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA) Version 17.0 was used for all analyses.

Results

Demographics

Of 773 respondents, 408 (53%) were players. Although the U16 group was largest, the average player age was 14.2 (standard deviation [SD] 1.5) years. Most players had played soccer for an average of 7 years and spent an average of 3–4 h practicing or playing weekly (Table 2). Parents reported similar responses about their children's soccer participation and exposure, suggesting that our parent sample was representative of the selected players (Table 2). Coaches reported more variation in soccer experience and exposure than the player/parent respondents (Table 2). Competitive coaches had coached an average of 15.1 (11) years compared with 8.9 (6.6) years for recreational coaches ($P = 0.01$). They also had more average hours of soccer exposure weekly (8.6 [13.3]) than recreational coaches (3.1 [1.4]; $P = 0.04$).

Table 2. Participant characteristics

	Players ($n = 408$)	Parents ($n = 292$)	Coaches ($n = 73$)
Distribution by age group			
Under 14	130 (32%)	92 (32%)	21 (29%)
Under 16	183 (45%)	153 (52%)	33 (45%)
Under 18	95 (23%)	47 (16%)	19 (26%)
Average age (SD)	14.19 (1.49)	NA	NA
Min, max	9, 18		
Level of play			
Recreational	249 (61%)	178 (61%)	42 (58%)
Competitive	141 (35%)	107 (37%)	28 (38%)
No response	18 (4%)	7 (2%)	3 (4%)
Years of play			
<5 years	114 (28%)	69 (23%)	19 (26%)
5 years or more	294 (72%)	223 (77%)	54 (74%)
Average years of play (SD)	7.3 (3.1)	7.3 (2.8)	11.3 (9.0)
Min, max	1, 16	0,13	0, 45
Average hours of play/week (SD)	3.6 (2.0)	3.4 (1.8)	5.3 (8.6)
Min, max	1, 16	1,12	1, 72

SD, standard deviation; Min, minimum; Max, maximum; NA, not applicable.

Table 3. Risk of knee injuries

How often do you think sudden-onset knee injuries occur in females while playing soccer?

	Players ($n = 408$)	Parents ($n = 292$)	Coaches ($n = 73$)
Never (0%)	1 (<1%)	0 (0%)	0 (0%)
Rarely (<10)	7 (2%)	20 (7%)	12 (16%)
Sometimes (10%–20%)	119 (29%)	119 (41%)	31 (42%)
Often (20%–50%)	154 (38%)	96 (33%)	19 (26%)
Very often (>50%)	40 (10%)	22 (8%)	8 (11%)
Don't know	74 (18%)	31 (11%)	1 (1%)
No response	13 (3%)	4 (1%)	2 (3%)

Knee injury risk

Overall, respondents appeared to be aware of the knee injury risk while playing soccer. Most respondents ($n = 538$ [71%]) chose responses in line with reported evidence (Table 3). The majority of player respondents chose responses that agreed with published evidence, although almost 20% indicated that they did not know the risk for knee injury (Table 3). There were no differences among the age divisions or between levels of play in knee risk knowledge ($P > 0.82$).

Parent respondents responded similarly to players although the "sometimes" response was selected more commonly than the "Often" response (Table 3). Only 11% of parent respondents did not know the risk for knee injury. No differences were noted among parents from different age divisions or competitive levels ($P > 0.62$).

Coach respondents also selected injury risk options that have been previously reported, although 12 (16%) coaches actually thought the risk for knee injury was

Table 4. Prevention of knee injuries

Can knee injuries be prevented?	Players ($n = 408$)	Parents ($n = 292$)	Coaches ($n = 73$)
Yes	170 (42%)	146 (50%)	45 (62%)
No	85 (21%)	76 (26%)	15 (21%)
Don't know	133 (33%)	64 (22%)	9 (12%)
No response	20 (5%)	6 (2%)	4 (6%)
Activities to prevent knee injuries: (select all that apply)*			
	Players ($n = 408$)	Parents ($n = 292$)	Coaches ($n = 73$)
Longer warm-up	101 (59%)	102 (70%)	33 (73%)
Balance activities	47 (28%)	71 (49%)	22 (49%)
Quad strengthening	47 (28%)	99 (69%)	28 (62%)
Increased fitness	60 (35%)	96 (66%)	34 (76%)
Stretching	135 (79%)	113 (77%)	37 (82%)
Biking	16 (9%)	40 (27%)	17 (38%)
Jump training	28 (17%)	49 (34%)	16 (40%)
Other	8 (5%)	13 (9%)	1 (2%)

*Only those who indicated that injuries could be prevented responded to this question.

Table 5. Source of knee injury information

Where did the knee injury information come from?* (Select all that apply)	Players ($n = 127$)	Parents ($n = 56$)	Coaches ($n = 43$)
Teacher	35	3	1
Coach	68	4	5
Parent	43	7	0
Family doctor	42	25	9
Specialist†	21	21	14
Physical therapist	31	22	13
Athletic therapist	20	8	7
Nurse	5	5	1
Chiropractor	6	6	5
Massage therapist	11	5	2
Friend	22	7	1
Neighbor	2	3	0
Information sheet/pamphlet	10	7	1
Television	9	1	1
The Internet	10	6	6

*Number of respondents who indicated that they had received information regarding knee injuries.
†Orthopedic surgeon, sports medicine physician.

lower than has been reported (Table 3). There were no differences in knee injury risk knowledge among coaches from different age divisions or competitive levels ($P > 0.93$).

Among the three respondent groups' responses, players were more likely to respond "don't know" while coaches were more likely to respond with the "rarely" option than other respondents ($P < 0.001$).

Knee injury prevention

Of players, 218 (54%) indicated that they were either unsure or thought that knee injuries could not be prevented (Table 4). Of those indicating that knee injuries were preventable, the most commonly selected activities were stretching and a longer warm-up (Table 4). No differences were noted among player age or play level groupings in determining whether knee injuries were preventable or not, or in selected prevention strategies ($P > 0.25$).

Half of the parent respondents thought that knee injuries were preventable, but again, the most commonly selected prevention activities were stretching and longer warm-ups, although parents also commonly indicated that increased fitness and quadriceps strengthening might prevent knee injuries (Table 4). No significant differences were seen between recreational and competitive-level parents or those with more or less soccer exposure ($P > 0.11$).

Forty-five (62%) coaches responded that knee injuries were preventable with no significant difference among competitive and recreational coaches ($P = 0.34$). Of those who thought injuries were preventable, the most commonly selected strategy was still stretching, as well as increased fitness and a longer warm-up (Table 4), with a smaller number indicating that quadriceps strengthening and balance activities might also prevent knee injuries. Significant differences were, however, noted between recreational and competitive coaches when looking at preventative strategies. Most (93%) recreational coaches thought that stretching would prevent knee injuries compared with 57% of competitive coaches ($P = 0.01$). Further, many recreational coaches (83%) thought that a longer warm-up would prevent knee injuries compared with 50% of competitive coaches ($P = 0.04$).

In comparing all respondents, players were more likely to respond with a "don't know" response whereas parents and coaches were more likely to indicate that knee injuries were preventable ($P < 0.001$). There was no significant difference between parents and coaches in their knowledge of whether or not knee injury prevention was possible ($P = 0.09$).

Information on knee injuries

Many respondents (484 [63.8%]) had not received information on knee injuries. Players (127 [32%]) and coaches (29 [40%]) were more likely to have received information while only 56 (19%) parents reported receiving knee injury information ($P < 0.001$). Most individuals who had received information had received it from multiple sources (Table 5), most commonly allied health or medical personnel (physical therapists, physicians, specialists). Players appeared more likely to have

received information from their coaches, teachers, and parents. Electronic media was not a common knowledge resource (Table 5).

Discussion

Although soccer knee injuries have frequently been studied, there is little evidence regarding how well health-care professionals and athletic trainers are sharing available evidence with the soccer-playing population. Our primary objective was to determine whether current research evidence regarding acute knee injury risk and the potential prevention of such injuries was being translated to an identified end user group, namely U14–U18 female adolescent indoor soccer players, their parents, and coaches. We used a large representative sample of the female soccer-playing population, including the recreational cohort, as well as the more commonly studied competitive group. Although it appears that there is awareness of knee injury risk, we were able to identify substantial and important knowledge gaps regarding knee injury prevention. Our findings clearly indicate a need for further education in this group about injury prevention.

Most respondents were able to identify the risk of knee injuries when playing soccer. However, there was much more heterogeneity among respondents regarding prevention of knee injuries. Less than half of player respondents thought that knee injuries were preventable while 50% of parents and 62% of coaches thought that knee injuries were preventable. This would suggest that more information regarding injury prevention is reaching the adult population.

Interestingly, for those who thought that knee injuries were preventable, most did not correctly identify prevention activities. The most commonly selected activity to reduce injury was stretching, one of the few activities with limited evidence to suggest it does not prevent knee injuries (Pope et al., 2000; Parkkari et al., 2001). Balance training activities, reported as effective in preventing knee injuries (Hewett et al., 2006), were more recognized among parents and coaches as preventative measures but were not commonly chosen by any respondent. Jump training was among the least commonly chosen responses, despite evidence that this activity appears useful in preventing ligamentous knee injuries (Hewett et al., 2006).

We hypothesized that competitive-level and more experienced respondents, particularly coaches, would be more likely to report that knee injuries were preventable and choose effective preventative strategies. This hypothesis only held true for coaches. No differences were seen among recreational or competitive players, or parents or younger vs older players. The majority of coaches, regardless of experience or coaching level, believed that knee injuries were preventable; however, competitive coaches were slightly better at identifying appropriate prevention measures than recreational coaches. Even among coaches, substantial numbers selected stretching, longer warm-up, and general fitness as being the best preventative strategies. This finding suggests that the knowledge gap on injury prevention exists at all levels of play and among respondent types, but most notably in the player group. Twomey et al. (2009) reported similar results when they investigated the uptake of lower extremity prevention strategies among premier football league coaches in Australia (Twomey et al., 2009). Even among these high-level coaches, warming up and cooling down exercises were deemed more important for injury prevention than sidestepping or changing direction training.

Our results point to the need for education regarding injury prevention to curb the rising tide of youth sports injury (Emery et al., 2006b; Fernandez et al., 2007; Leininger et al., 2007; Ingram et al., 2008). Although injury prevention has been the focus of much research to date, it is now recognized that similar attention needs to be paid to determine how to ensure the knowledge gleaned through research is disseminated to end users. Finch and Donaldson (2010) provide a novel extension to the RE-AIM (reach, effectiveness, adoption, implementation and maintenance) framework (Glasgow et al., 1999, 2003), used for encouraging uptake of health promotion activities in various populations (e.g., fall prevention). The RE-AIM sports setting matrix (RE-AIM SSM) is specific to the community sports setting implementation context and accounts for the fact that many sports injury interventions are in need to be targeted at these multiple levels of sports delivery (Finch & Donaldson, 2010).

Few parent and coach respondents reported having been given information regarding knee injuries. As coaches are the primary mode of delivering prevention strategies and parents are still primarily involved in most participants' chosen activities, it does not appear that those who need the information are receiving it. Electronic resources and videos are available to support effective neuromuscular training injury prevention programs in soccer (i.e., the 11+; Soccer Injury Prevention Program; Prevent Injury and Enhance Performance) and the availability of these resources should be communicated through soccer associations (http://www.fifa.com/aboutfifa/footballdevelopment/medical/playershealth/the11/index.html, FIFA, 2010; http://siprc.ca/research/news/SoccerInjuryPreventionBrochure.pdf, Sport Injury Prevention Research Centre, University of Calgary, 2010; http://smsmf.org/pep-program, Santa Monica Sports Medicine Foundation, 2010). Despite wide access to, and utilization of electronic media in formal education and daily life, it also does not appear that these media (the Internet, television) are currently being used to inform knee injury prevention knowledge.

Coaching clinics should be encouraged for all levels of play; these clinics should promote the adoption of effective injury prevention techniques, as well as

strategies for educating players and parents. In addition, some interaction with a physiotherapist through preseason evaluation would facilitate identification of individual risk factors, which may be addressed in addition to promoting the most appropriate recommendations for follow-up if an injury occurs (Maffey & Emery, 2006).

Emery et al. (2006a) suggest that solely depending on active strategies targeting children and/or their parents to evoke behavior change does not yield the level of compliance that can be reached with policy-based strategies. As such, government departments including departments of health and wellness, sports and recreation, increasingly need to promote injury prevention programs through mandating policies related to safety in sports (Emery et al., 2006a). Any reduction in significant knee injuries could have a substantial impact on health resource utilization in acute injury management (Leininger et al., 2007), reducing the future need for chronic knee pain management, and allowing more active lifestyles at older ages (Sothern et al., 1999).

Although this was a large, representative sample, there are still study limitations. Data collection occurred at the end of the soccer season; thus, we could not randomly select teams, but instead used a cluster-based convenience sample. However, age and competitive level distribution remained representative of the overall EMSA population, so results should likely generalize to the indoor soccer population; furthermore, no systematic response differences were seen. Although we only surveyed indoor soccer players, the injury rate of indoor soccer appears similar to that of outdoor soccer (Emery & Meeuwisse, 2006). In addition, we had only a 55% response rate to our survey distribution as we had a very dichotomous response from our selected teams. For those teams that allowed group administration mode, we had over 80% response rates while for teams where surveys were completed independently and returned, we had only a 13% response rate. This difference appeared to be related to the coaches' enthusiasm for the study rather than any systematic differences between respondents and nonrespondents, but it is possible that our sample does have some respondent bias.

Finally, we only examined whether knowledge was being translated and did not address whether those aware of effective prevention strategies were actually implementing them. More work is needed to examine implementation of injury prevention strategies.

In summary, a substantial knowledge gap was found regarding knee injury prevention, demonstrating a need for more education. Coaches should be aware of successful prevention strategies to incorporate into practices and games to reduce youth soccer knee injuries. Further work is required to determine the best way to educate the soccer-playing population to reduce knee injuries while promoting sports participation.

Perspectives

Soccer participation is rapidly increasing, particularly in the younger, community-based population. This increase in participation has been accompanied by an increase in soccer-related knee injuries. Although effective injury prevention programs have been developed for competitive-level soccer players, it does not appear that these programs are being adopted by the coaches of female adolescent soccer players. A substantial knowledge gap was found between research evidence for knee injury prevention in soccer and female adolescent soccer players, their parents, and their coaches. Those who thought injuries were preventable typically could not identify effective prevention strategies. These findings suggest that there is much work to do to translate research evidence into practice. Multiple methods of information delivery and education, including health policy changes are needed to improve the uptake and application of injury prevention. These strategies need to be directed at all levels of the soccer-playing population including younger and less competitive participants, one of the most rapidly growing segments of the soccer-playing population.

Key words: adolescent females, knowledge translation, athletic injuries.

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Appendix

Player Survey

Team Information
Team Name: _____
Age level: _____
Player Number: _____

Player Information
Age: ___ years

How many years have you played soccer?
a. ___ years b. < 1 year

How many hours per week total do you participate in soccer (including practices and games)?
_____ Specify number of Hours

What level do you play?
a. Competitive (**Circle one**): Division I I III
b. Recreational

Please complete the following questions using the knee injury definition below.

Sudden onset Knee Injury Definition: Any knee injury occurring suddenly **during** an organized soccer practice or game that requires **<u>one or more</u> of the following**: (a) requires medical attention and/or (b) results in the inability to complete the session of activity in which the injury occurred, and/or (c) requires the participant to miss one or more days of the sporting activity following the injury.

1. Have you ever been given information on knee injuries (as defined above)?
a. Yes b. No c. Don't know

2. If yes, where did you get this information from? (**Circle all that apply**)

a. Teacher
b. Coach

c. Parent
d. Family Doctor
e. Specialist (e.g. orthopedic surgeon, sports medicine physician)
f. Physiotherapist
g. Athletic Therapist (trainer)
h. Nurse
i. Chiropractor
j. Massage therapist
k. Friend
l. Neighbor
m. Information sheet/Pamphlet
n. TV
o. Internet
p. Other (specify)_____

3. How often do you think sudden onset knee injuries occur in females while playing soccer?

a. Never (0%)
b. Rarely (less than 10%)
c. Sometimes (10–20%)
d. Often (20–50%)
e. Very often (> 50%)
f. Don't know

4. Do you think sudden onset knee injuries can be prevented?
a. Yes b. No c. Don't know

5. **If you answered yes to the previous question**, which of the following do you think would prevent sudden onset knee injuries? (**Circle all that apply**)

a. Longer warm up
b. Balance activities
c. Quadriceps (thigh muscle) strengthening
d. Increasing fitness
e. Stretching
f. Biking
g. Jump technique training
h. Other: _____