


# Can we improve coaches' injury prevention views and implementation practices in the community female Gaelic sport of camogie?

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## ABSTRACT

**Objectives** To evaluate the effect of a nationwide coach education workshop on the attitudes towards, willingness and perceived ability of camogie coaches to implement a Camogie Injury Prevention Programme (CIPP) and their implementation of this programme 4 weeks after the workshop.

**Methods** Coaches (n=98) from all four provinces in Ireland were recruited and completed a questionnaire prior to and immediately following a developed workshop on the CIPP. Four weeks later 40 of the 98 coaches completed a follow-up questionnaire. Descriptive statistics were completed and a mixed between–within analysis of variance was conducted to examine the differences in willingness and perceived ability to conduct the CIPP over time and between genders. Non-parametric tests examined the differences in attitude scores. The implementation rate of the programme 4 weeks following the workshop was also assessed.

**Results** Just 13.4% of coaches had previously heard of the CIPP. Significant improvements in attitudes towards, willingness and perceived ability to conduct the CIPP was noted ( $p<0.001$ ) post-workshop. Ninety-one per cent of coaches reported that implementing the CIPP in a phased approach with their teams would be beneficial. The camogie coaches primarily viewed the CIPP content favourably, finding the exercises important, relevant and mostly enjoyable. However, some coaches reported that the Nordic hamstring curl is too challenging for players to complete (immediately following workshop: 28.7%; 4 weeks later: 53.3%). Four weeks after the workshop, 72.5% of coaches who responded were implementing the CIPP with their teams in the community.

**Conclusions** Due to the success of the education workshop, the Camogie Association should incorporate this injury prevention workshop into all mandatory camogie coaching education courses.

## INTRODUCTION

Camogie is a popular native Irish sport, similar to field hockey and lacrosse,<sup>1</sup> played exclusively by females. It is a stick handling, multi-directional sport that requires a dynamic skillset including sprinting, jumping,

## Key questions

### What are the new findings?

- Very few camogie coaches were aware of the Camogie Injury Prevention Programme and did not use the current online education resources.
- The workshop successfully improved coaches' attitudes, willingness and perceived ability to conduct the intervention.
- Four weeks after the workshop, 72.5% of a subset of coaches who responded were implementing the intervention.
- Camogie coaches mainly viewed the content of the Camogie Injury Prevention Programme favourably.

### How might it impact on clinical practice in the future?

- It is our recommendation that the coaches education workshop on the Camogie Injury Prevention Programme, should be formally incorporated into coaching education courses.
- A phased approach to incorporating an injury prevention programme in community sports may aid implementation.

changing direction, tackling, hand passing and striking the ball.<sup>2</sup> Injuries in camogie are common and mostly occur in the lower limb, particularly the ankle, hamstring and knee.<sup>1,3</sup> Up to 88% of all adult camogie players sustain an injury during the playing season,<sup>1</sup> with 26.4 injuries per 1000 game hours reported in elite camogie players.<sup>3</sup> Although it's male equivalent, hurling, has a higher rate of injury (61.8 injuries per 1000 game hours),<sup>4</sup> camogie has a similar injury rate to women's field hockey which is another female stick sport (23.4–44.2 injuries per 1000 game hours).<sup>5</sup> To combat this injury risk, the Camogie Association developed the Camogie Injury Prevention Programme (CIPP),<sup>6</sup> which is an injury prevention exercise programme (IPEP) completed in the warm-up and is based on the activate warm-up.<sup>7</sup> The CIPP consists of three phases made up of 27 exercises. Phase



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I focuses on running, landing and cutting mechanics, phase II strength, plyometric and balance and phase III incorporates agility and power exercises. Phases I and III are conducted prior to training and games, with phase II only implemented prior to training sessions.<sup>6</sup>

IPEPs are commonly used in many sports worldwide.<sup>8</sup> There is a growing body of evidence demonstrating the effectiveness of these programmes in reducing injuries across sports.<sup>9–12</sup> However, many of these IPEPs have been examined in a controlled research setting (eg, randomised controlled trials) and may not reflect their real-life implementation or true preventative effect. Adherence issues have been noted in a number of studies, with compliance falling to below 10% in some IPEP interventions which illustrates a key difference between research and real-world sports settings.<sup>8 13 14</sup> Adherence has also been shown to have a major impact on intervention outcomes, with non-adherent participants demonstrating similar outcomes to control groups.<sup>15</sup> The RE-AIM framework suggests that the reach, effectiveness, adoption, implementation and maintenance of an intervention should be considered and planned prior to the employment to the intervention.<sup>16</sup> The RE-AIM sports-specific matrix attempts to capture the real-world context in which an injury prevention strategy is employed by assessing each of these factors at various levels ranging from participants themselves to national sporting organisations. In camogie, just 34% of coaches and 12% of players reported currently completing an IPEP with their local camogie team, highlighting the need to encourage implementation of IPEPs in this population.<sup>17</sup>

A number of different measures have been used to try and increase the likelihood of implementing an IPEP but this has shown mixed results.<sup>18–20</sup> As coaches are often the main deliverer of IPEPs in a team setting, they have been the subjects of a number of implementation strategies.<sup>17 19</sup> In an elite youth soccer club, following educational workshops, coaches displayed significantly more favourable attitude, increased sense of competency and intent to implement an IPEP, but adoption was relatively low at 53%.<sup>19</sup> In camogie, while coaches were willing to conduct general IPEPs, few reported sufficient knowledge (30%), experience (23%) or skills (43%) to do so.<sup>17</sup> Over 90% of coaches wanted more education to address the barriers to implementation and O'Connor *et al*<sup>17</sup> recommended the Camogie Association to prioritise the development of practical educational workshops and resources based on the findings of this study. Therefore, this study aimed to evaluate the effect of a nationwide coach education workshop on the attitudes, willingness and perceived ability of camogie coaches to implement the CIPP and participants' implementation of this programme 4 weeks following the workshop.

## METHODS

### Participants and procedures

All current camogie coaches were eligible to participate. Ethical approval was granted by the university's

research ethics committee. Respondents provided individual informed consent before participating. A 2-hour workshop that consisted of two sections was implemented. The workshop was developed based on previous research on camogie injuries,<sup>1 3</sup> reported barriers and facilitators to IPEPs by camogie coaches and players,<sup>17</sup> and input from the Camogie Association. Section 1 included a theoretical presentation and explanation on the background of the CIPP and injuries in camogie. The second section was a practical session where coaches were advised on pitch setup and shown how to demonstrate, cue and give feedback on each of the exercises in the programme. Each coach practiced performing and coaching the CIPP. The workshops were supplemented with online resources including a printable guide of the exercises and its components and videos demonstrating all exercises in the CIPP. Nine workshops were held in all four provinces of the island of Ireland, with an average attendance of 14.9 coaches at a workshop (range: 6–26). Questionnaires were administered to those attending the workshops as a hardcopy in person immediately before and after each workshop. A follow-up email was then sent to participants 4 weeks after they attended a workshop with a link to the Camogie Injury Prevention Questionnaire via SurveyMonkey (SurveyMonkey, California, USA), open from September to December 2019. The intervention was conducted with the support of the national Camogie Association and participants were recruited through the Camogie Association and/or regional secretaries of the area where the workshop was held. Regional secretaries forwarded the recruitment email to all club secretaries, who distributed among their coaches. Social media was also used to advertise the workshops and regional camogie social media accounts were encouraged to distribute on their social media pages.

### Instrumentation

A pre-workshop, post-workshop and 4-week follow-up questionnaire was developed based on previously used validated instruments.<sup>19 21 22</sup> Face validity was conducted by a panel of four experts in the field of sport and exercise medicine research. Each questionnaire contained three sections. The breakdown of each questionnaire is displayed in [table 1](#). The pre-workshop questionnaire asked an additional question on willingness to complete the CIPP, that was not relevant for the follow-up questionnaires and so was omitted from analysis. The same Likert scale was utilised in the pre, post and 4-week follow-up questionnaire. Three questions examining the opinion of coaches on IPEPs and three questions examining their views on injury were also the same in the pre, post and 4-week follow-up questionnaires.

### Statistical analysis

Data were analysed in Excel V.15 (Microsoft Corporation, Washington, USA) and SPSS V.23 (IBM Corp, Armonk, New York, USA). Descriptive statistics were calculated in SPSS. For each 5-point Likert scale, a score of 1–5 was

**Table 1** Composition of questionnaires

	Number of questions	Question topic
<b>Pre-workshop Questionnaire</b>		
<b>Section 1</b>	12 Questions	4 Demographic
		5 Opinion of IPEPs and injury
		3 Previous Use of IPEPs
<b>Section 2</b>	15 Question Likert scale	6 Attitude towards CIPP
		4 Willingness to implement CIPP
		5 Perceived ability to implement CIPP
<b>Section 3</b>	8 Questions	3 Implementation of CIPP
		3 Motivation to implement CIPP
		1 Opinion of IPEPs
		1 Knowledge of injury prevention resources
<b>Post-workshop Questionnaire</b>		
<b>Section 1</b>	12 Questions	6 Workshop
		2 Attitude towards CIPP
		2 Opinion of IPEPs
		2 Self-confidence to implement CIPP
<b>Section 2</b>	14 Questions	6 Attitude towards CIPP
		3 Willingness to implement CIPP
		5 Perceived ability to implement CIPP
<b>Section 3</b>	1 Table	4 on each exercise
<b>4-Week follow-up Questionnaire</b>		
<b>Section 1</b>	11 Questions	4 Implementation of CIPP
		2 Attitude towards CIPP
		3 Opinion of IPEPs
		1 Barriers to implement CIPP
<b>Section 2</b>	14 Questions	6 Attitude towards CIPP
		3 Willingness to implement CIPP
		5 Perceived ability to implement CIPP
		1 Table

CIPP, Camogie Injury Prevention Programme; IPEPs, injury prevention exercise programmes.

provided based on how they rated each statement where 1 was low and 5 was high. The scores were coded to indicate that the higher the score, the more favourable the participants' attitude, willingness and perceived ability to implement the CIPP, with an overall total score calculated for each variable. A total of four questions in each survey were negative and so their scores were inverted on calculation of the overall score.

Normality was assessed and all data were normal except for attitude scores. A Mann-Whitney U-test examined the differences between gender and level of coaching education, and a Wilcoxon signed rank test examined attitude scores pre-workshop and post-workshop. Effect sizes were classified as small ( $r=0.1$ ), medium ( $r=0.3$ ) and large ( $r=0.5$ ).<sup>23</sup> A between-within analysis of variance (ANOVA) was used to examine willingness and perceived ability scores pre-workshop and post-workshop between genders. This was repeated to examine the differences between coaching levels. A subanalysis was conducted on those who completed the 4-week follow-up, to examine the differences over time (pre vs post vs 4 weeks) and gender (male vs female) on willingness and perceived ability scores. Partial eta-squared effect sizes ( $\eta_p^2$ ) were classified as small (0.01), moderate (0.06) and large (0.14).<sup>23</sup> A Wilcoxon signed rank test examined the differences in attitude scores pre, post and 4 weeks following the workshop. A priori alpha level of 0.05 was chosen. Coaching level was not conducted in the subanalysis as too few level 2 coaches completed the follow-up questionnaire. One hundred and thirty-four coaches completed the workshop, with 98 completing both the pre and post questionnaire, and 40 of these completing the 4-week follow-up questionnaire (41% response rate).

## RESULTS

### Pre-workshop and post-workshop findings

More female coaches took part in the workshop (56.1%, 55), with a participant mean age of  $40.7 \pm 12.1$  years. Counties from all four provinces were recruited including Dublin ( $n=22$ ), Carlow ( $n=21$ ), Kilkenny ( $n=18$ ), Antrim ( $n=7$ ), Galway ( $n=11$ ), Wexford ( $n=12$ ) and Cork ( $n=7$ ). Most coaches held a coaching qualification (71.0%, 70), of which 40.0% held a foundation qualification (28), 52.9% (37) a level 1 qualification and 7.1% (5) held a level 2 qualification. Coaches opinions towards IPEPs were assessed before and after the workshop and is displayed in [table 2](#). Only 21.9% of coaches were aware of any IPEP and 13.4% had heard of the CIPP. A minority (16.8%) of coaches were aware of the online resources that accompany the programme on the Camogie Association website, but 95.8% said they would use these resources to further educate themselves. Most (73.4%) coaches felt that one workshop was sufficient and 90.6% felt that implementing the programme in phases would be beneficial.

No significant differences in attitudes were noted between genders ( $p>0.05$ ); however, a significant improvement occurred following the workshop (median:

**Table 2** Coach awareness of injury prevention pre-workshop and post-workshop

Pre-workshop	Yes % (n)	No % (n)
Are camogie injuries preventable? (n=94)	83.0% (78)	17.0% (16)
Have you heard of any injury prevention programme? (n=96)	21.9% (21)	78.1% (75)
Have you heard of the CIPP? (n=97)	13.4% (13)	86.6% (84)
Does your team currently employ an injury prevention programme? (n=95)	14.7% (14)	85.3% (81)
Does an injury prevention programme need to be introduced in your team? (n=83)	91.6% (76)	8.4% (7)
Are you aware of the online resources for the CIPP? (n=95)	16.8% (16)	83.2% (79)
Would you use the online resources to further educate yourself? (n=95)	95.8% (91)	4.2% (4)
Post-workshop	Yes % (n)	No % (n)
Were you confident instructing the exercises following the workshop? (n=87)	88.5% (77)	11.5% (10)
Was one workshop enough? (n=94)	73.4% (69)	26.6% (25)
Would implementing the workshop in phases make it easier to implement the CIPP? (n=96)	90.6% (87)	9.4% (9)
Did the workshop increase your motivation to implement the CIPP? (n=96)	99.0% (95)	1.0% (1)

CIPP, Camogie Injury Prevention Programme.

28.0±32.41 vs 25.0±3.0,  $p<0.0001$ ) with a large effect size ( $r=0.63$ ). **Table 3** displays the ANOVA results for the effects of gender (male vs female), and time (pre-workshop vs post-workshop) on willingness and perceived ability scores. No significant interaction effect for perceived ability and willingness scores was noted ( $p>0.05$ ). Significant improvements in perceived ability ( $p<0.0001$ ) with a large effect size ( $\eta_p^2=0.27$ ) was found, however no main effect for gender was observed ( $p>0.05$ ). With regard to willingness, a main effect for time ( $p<0.0001$ ,  $\eta_p^2=0.19$ ) and gender ( $p=0.005$ ,  $\eta_p^2=0.08$ ) was found, with females more willing than males. No significant interaction effect ( $p>0.05$ ) and no main effect for coaching level ( $p>0.05$ ) was found for willingness scores (**table 3**). Significant improvements in willingness ( $p=0.004$ ) with a moderate effect size was shown ( $\eta_p^2=0.12$ ). No interaction effect was noted for perceived ability ( $p>0.05$ ) but scores did improve pre-workshop and post-workshop ( $p<0.0001$ ) with a large effect size ( $\eta_p^2=0.18$ ). Level 2 coaches felt significantly more able to implement an IPEP compared with foundation and level 1 coaches with a moderate effect size (**table 3**). No significant differences between foundation, level 1, level 2 coaches' attitudes was noted ( $p>0.05$ ).

#### 4-Week follow-up sub-analysis findings

A subanalysis of participants who responded to the 4-week follow-up questionnaire was conducted (n=40).

No significant interaction effect ( $p>0.05$ ) for willingness and perceived ability scores was noted (online supplementary material 1). A main effect for time ( $p=0.049$ ,  $\eta_p^2=0.18$ ) and gender was observed ( $p=0.005$ ,  $\eta_p^2=0.22$ ), indicating females displayed better willingness scores than males. With regard to perceived ability, a main effect for time across the three time points was noted ( $p=0.007$ ,  $\eta_p^2=0.28$ ). A significant improvement in attitudes was observed before the workshop to 4 weeks after ( $26.00\pm 2.43$  vs  $28.00\pm 2.19$ ,  $p=0.003$ ) with a large effect size ( $r=0.50$ ). No significant difference was observed post-workshop to 4 weeks later ( $p>0.05$ ). No significant differences in attitudes was reported between males and females ( $p>0.05$ ).

#### Implementation

The majority (72.5%, 29) of the respondents were implementing the CIPP. In total, 63% (25) had implemented phase I of the programme, 48% (19) phase II and 33% (13) phase III. Most (95%, 38) believed that the programme could be maintained over multiple seasons. Half (20) reported barriers to implementing the IPEP at this point, including repetitiveness of the programme/boredom in the players (15%, 6), buy-in from other coaches (15%, 6) and not enough time (10%, 4).

#### Coaches' views on the CIPP content

Coaches were asked to rate the importance, how enjoyable and the difficulty of the exercises in the CIPP (online supplementary material 2). The side plank (32.6%), Nordic curl (28.7%) and front plank (22.3%) were the exercises more frequently described as too challenging immediately following the workshop. Over 90% of participants ranked all exercises in the CIPP as important and over 70% ranked all exercises as fun or average. In the 4-week follow-up, 53.3% rated the Nordic curl as too difficult.

#### DISCUSSION

The education workshop successfully enhanced camogie coaches' views on injury prevention as was demonstrated by the significant improvement in coaches' attitudes towards and willingness and perceived ability to conduct an IPEP immediately following the workshop and 4 weeks following. Previous research has supported this finding, with improved attitudes towards conducting an IPEP, perceived ability to teach their team an IPEP and confidence in leading an IPEP found following a workshop in youth soccer coaches.<sup>19</sup> Prior to the workshop, just over 1 in 10 camogie coaches had heard of the CIPP, and 17% were aware that there were online resources available on the Camogie Association website to accompany the CIPP. Studies have shown that supplementary material such as guides and coaching resources can facilitate the implementation of an IPEP.<sup>19-24</sup> The adoption of these online photo and video resources by the national sporting organisation on their website is beneficial, as was demonstrated by the fact that the vast majority of coaches

**Table 3** Means and SDs for dependent measures and effect sizes of main and interaction effects pre-workshop and post-workshop

Gender													
	Gender	Pre				Post				Main effect		Interaction effect	
		Mean		SD		Mean		SD		Time		Group	
		Mean	SD	Mean	SD	p	$\eta_p^2$	p	$\eta_p^2$	p	$\eta_p^2$		
Willingness	Male	10.91	1.76	11.95	1.93	<0.0001	0.19	0.005	0.08	0.33	0.01		
	Female	11.96	1.73	12.65	1.55								
	Total	11.50	1.81	12.35	1.75								
Perceived ability	Male	17.33	3.38	18.72	3.52	<0.0001	0.27	0.26	0.01	0.08	0.03		
	Female	16.02	3.68	18.58	3.63								
	Total	16.59	3.59	18.64	3.56								
Coaching level													
	Level	Pre				Post				Main effect		Interaction effect	
		Mean		SD		Mean		SD		Time		Group	
		Mean	SD	Mean	SD	p	$\eta_p^2$	p	$\eta_p^2$	p	$\eta_p^2$		
Willingness	Foundation	11.36	1.83	12.50	1.62	0.004	0.12	0.40	0.03	0.82	0.01		
	Level 1	11.14	1.77	11.97	1.55								
	Level 2	10.60	2.07	11.60	2.79								
	Total	11.19	1.80	12.16	1.68								
Perceived ability	Foundation	15.96	3.10	18.68	3.85	<0.0001	0.18	0.02	0.11	0.76	0.01		
	Level 1	16.38	4.02	18.49	3.24								
	Level 2	20.60	4.28	22.60	1.67								
	Total	16.51	3.82	18.86	1.14								

reported that they would use these resources to further educate themselves. This study supports the theory proposed by the RE-AIM Sports Setting Matrix that multifactorial strategies at various levels are essential for the success of an injury prevention strategy.<sup>16</sup> Similar to what was conducted in the current study, formal training at the level of the club and participant for coaches, adequate support structures with easily accessible resources and materials that are regularly reviewed by coaches and formal endorsement of the programme at the national and/or regional sporting organisation level are all required.<sup>16</sup>

Female coaches' willingness to conduct the CIPP improved significantly compared with males in this study. Previous research in coaches found that while willingness did not differ between genders, perceived ability to conduct IPEPs was significantly lower in females ( $p < 0.05$ ).<sup>17</sup> The practical focus of this education workshop may have facilitated female coaches to improve their confidence in their abilities to conduct the CIPP and consequentially positively affected their willingness to incorporate the CIPP into future sessions. Thus, this finding highlights that education has the potential to sufficiently increase female coaches likelihood of conducting IPEPs in their community clubs. Level 2 coaches displayed significantly more perceived ability to conduct the CIPP than foundation or level 1 coaches immediately following the workshop. This indicates that coaches with more formal coaching education and potentially more

coaching experience feel better equipped to conduct the CIPP with their teams following the workshop. Welcomingly, a significant improvement in coaches' perceived ability to conduct the CIPP was observed from before the workshop to 4 weeks later. Previous research in camogie coaches reported that inadequate knowledge, experience and skills to implement IPEPs were the main barriers to implementation, and that coaches did not feel they were provided with sufficient educational resources to support them in conducting IPEPs with their teams.<sup>17</sup> The education workshop examined in this study was intentionally designed and implemented with the aim of better supporting coaches of all levels to enhance their confidence, motivation and skills to conduct the CIPP to directly address these barriers.

Implementation and maintenance of an injury prevention programme are key elements linked to its success.<sup>16</sup> Four weeks following the education workshop, which included both theoretical and practical elements, 72.5% of participants who completed the follow-up questionnaire were implementing the CIPP with their teams and 95% of them believed that the programme could be maintained over multiple seasons, indicating successful initial adoption of the IPEP. The implementation rate was higher than previously reported following an ACL injury prevention workshop, where just 53% of teams implemented the IPEP when site visits were conducted in the first 2 weeks of their season.<sup>19</sup> However, the findings from the current study solely examine the implementation

and maintenance from a small subset of camogie coaches and future research is required to evaluate these factors nationally and over time. Previous research in female youth football teams has found that adherence to an IPEP was higher following a coach education workshop that incorporated a practical element compared with a web-based delivery of the programme.<sup>20</sup> It is important to note that the response rate in the current study at 4 weeks was low and so selection bias may exist in the current study's findings and may account for the differences displayed above. Future research should consider the long-term implementation of the IPEP and whether it is maintained throughout the season. The complexity of long-term implementation and maintenance of IPEPs has been highlighted in recent research.<sup>25</sup> The success of the intervention is dependent on many intrapersonal or interpersonal, organisational, community and societal factors.<sup>25</sup> Thus evaluating the efficacy of any intervention implemented using the entirety of the RE-AIM framework as a guide should be considered.<sup>16</sup> Many coaches in the current study had implemented the CIPP in phases, by first incorporating the initial phase of the CIPP and then expanding to phase II and phase III, with 91% believing that this would be a beneficial approach. This phased approach to implementing an IPEP may be especially helpful in community sports where coaches regularly display lower confidence and perceived ability in conducting IPEPs. Thus to maximise implementation, sporting organisations should encourage coaches to at least try implement a phase of the IPEP to start off with, and gradually as their confidence improves expand to the full programme. It is important however that coaches do implement the entire CIPP once they feel confident to do so, and that any education workshop stresses the importance of the CIPP in full.

Understanding key stakeholders' (like coaches) views on an IPEP is important. If there are elements that coaches do not consider important or relevant, it may consequentially negatively affect implementation and adherence. In general, coaches viewed the content of the CIPP favourably and found most exercises important, relevant and enjoyable for their players. However, immediately following the workshop, coaches reported that they would consider the Nordic hamstring curls, front plank and side plank difficult for players to complete. In the 4-week follow-up, over half of coaches reported that the Nordic hamstring curl was too challenging for players, followed by split squats and the side plank. Hamstring strains frequently occur in camogie<sup>1</sup> and in a recent systematic review, programs that include Nordic hamstring curls have been found to half the amount of hamstring strains sustained.<sup>26</sup> However, four out of five elite European soccer teams did not complete the Nordic hamstring curl exercises, despite 88% of clubs being familiar with the Nordic hamstring curl exercise programme.<sup>27</sup> Some coaches reported that it was not easy to get players to complete the programme and that it causes muscle soreness in players. The authors

also suggested that other factors such as the influence medical staff have on coaching practices may reduce adherence to Nordic hamstring curl exercise programs.<sup>27</sup> For general IPEPs, previous research in elite soccer noted that the main barriers to adherence by players was a worry regarding experiencing sore muscles (50%), heavy or tired legs (44%) and a view that some exercises may not reduce injury risk (38%) or may even increase injury risk (22%).<sup>28</sup> Thus education of not only coaches but players is key to maximise adherence to a programme. Given the complex nature of encouraging widespread adoption of all exercises in an IPEP, qualitative research can be extremely useful in furthering our understanding of players and coaches reasoning behind these decisions.<sup>29</sup> Thus, future qualitative research in an Irish context in camogie players is required.

### Limitations

We engaged with all regional secretaries in the Camogie Association to maximise the reach of the study. The authors purposefully targeted all four provinces of Ireland when recruiting coaches and completed workshops in 7 out of 29 counties that play camogie in Ireland. However, the sample size was small and due to the method of sampling potentially coaches most interested in injury prevention may have volunteered to complete the workshop. Thus, there may have been response bias and the representativeness of the participants to all camogie coaches in Ireland may not be accurate. A low response rate of the questionnaire 4 weeks following the workshop was also noted which may have impacted the implementation rate findings. The authors did not include a question examining the level of teams coached in the current study and this should be queried in future studies. The study was designed within a larger longitudinal project that was based on the RE-AIM framework. However, within this study it was not possible to assess the effectiveness, national implementation or maintenance of the CIPP. Further research should evaluate the uptake, implementation and maintenance of the CIPP utilising the RE-AIM Sports Setting Matrix.

### CONCLUSIONS

Injuries are frequent in the leading Irish female sport of camogie, and injury prevention is a key priority for the Camogie Association. This is the first study to examine the effectiveness of a workshop on improving camogie coaches' injury prevention views and implementation of an IPEP. The workshop successfully improved coaches' willingness, attitudes and perceived ability to conduct the CIPP. Four weeks following the workshop, 73% of a subset of coaches that responded were implementing the CIPP. The coaches were satisfied with the CIPP content and introducing the CIPP in a phased approach may be recommended to ensure coaches can manage and maintain implementation of the programme. Future research is required to examine the effectiveness of the CIPP at reducing injuries in camogie players. If it does successfully

reduce injuries, the Camogie Association should adopt this workshop into their mandatory coaching education courses to ensure all camogie coaches receive sufficient training in the CIPP and maximise large-scale uptake and adherence to the CIPP across Ireland. Following this, evaluation of the CIPP and its national roll-out using the RE-AIM Sports Setting Matrix is required.

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#### REFERENCES

- O'Connor S, Leahy R, Whyte E, *et al.* Understanding injuries in the Gaelic sport of Camogie: the first national survey of self-reported worst injuries. *International Journal of Athletic Therapy and Training* 2019;24:243–8.
- Camogie Association. *Official guide Part 2 official playing rules 2018-2021*. Dublin, Ireland, 2018: 1–28. <http://www.camogie.ie/files/An%20Treoir%20Oifigi%C3%BAil%20-%20Part%202%20Playing%20Rules%20-%20May%202018.pdf>
- Buckley CS, Blake C. The incidence of injury in elite camogie, an in-season prospective study. *BMJ Open Sport Exerc Med* 2018;4:e000315.
- Blake C, O'Malley E, Gissane C, *et al.* Epidemiology of injuries in hurling: a prospective study 2007–2011. *BMJ Open* 2014;4:e005059–7.
- Theilen T-M, Mueller-Eising W, Wefers Bettink P, *et al.* Injury data of major international field hockey tournaments. *Br J Sports Med* 2016;50:657–60.
- Association C. Camogie injury prevention programme | GAA does, 2019. Available: <https://learning.gaa.ie/CamogieInjuryPrevention> [Accessed 17 Dec 2019].
- Ulster GAA, Sports Institute of Northern Ireland. Activate warm-up. Cumann Lúthchleas Gael Uladh Published 2019. Available: <https://ulster.gaa.ie/pals/resources/activate-warm-up/> [Accessed 17 Dec 2019].
- van Reijen M, Vriend I, van Mechelen W, *et al.* Compliance with sport injury prevention interventions in randomised controlled trials: a systematic review. *Sports Med* 2016;46:1125–39.
- Parkkari J, Kujala UM, Kannus P. Is it possible to prevent sports injuries? *Sports Medicine* 2001;31:985–95.
- Taylor JB, Waxman JP, Richter SJ, *et al.* Evaluation of the effectiveness of anterior cruciate ligament injury prevention programme training components: a systematic review and meta-analysis. *Br J Sports Med* 2015;49:79–87.
- Taylor JB, Ford KR, Nguyen A-D, *et al.* Prevention of lower extremity injuries in Basketball: a systematic review and meta-analysis. *Sports Health* 2015;7:392–8.
- Thorborg K, Krommes KK, Esteve E, *et al.* Effect of specific exercise-based football injury prevention programmes on the overall injury rate in football: a systematic review and meta-analysis of the FIFA 11 and 11+ programmes. *Br J Sports Med* 2017;51:562–71.
- Finch CF, Twomey DM, Fortington LV, *et al.* Preventing Australian football injuries with a targeted neuromuscular control exercise programme: comparative injury rates from a training intervention delivered in a clustered randomised controlled trial. *Inj Prev* 2016;22:123–8.
- Gabbe BJ, Branson R, Bennell KL. A pilot randomised controlled trial of eccentric exercise to prevent hamstring injuries in community-level Australian football. *J Sci Med Sport* 2006;9:103–9.
- Hägglund M, Atroshi I, Wagner P, *et al.* Superior compliance with a neuromuscular training programme is associated with fewer ACL injuries and fewer acute knee injuries in female adolescent football players: secondary analysis of an RCT. *Br J Sports Med* 2013;47:974–9.
- Finch CF, Donaldson A. A sports setting matrix for understanding the implementation context for community sport. *Br J Sports Med* 2010;44:973–8.
- O'Connor S, Whyte E, O'Hanlon S, *et al.* Coach and player views towards injury prevention exercise programs in camogie: a cross sectional survey. *Athl Train Sports Health Care*. In Press 2019.
- Bizzini M, Junge A, Dvorak J. Implementation of the FIFA 11+ football warm up program: how to approach and convince the football associations to invest in prevention. *Br J Sports Med* 2013;47:803–6.
- Frank BS, Register-Mihalik J, Padua DA. High levels of coach intent to integrate a ACL injury prevention program into training does not translate to effective implementation. *J Sci Med Sport* 2015;18:400–6.
- Steffen K, Meeuwisse WH, Romiti M, *et al.* Evaluation of how different implementation strategies of an injury prevention programme (FIFA 11+) impact team adherence and injury risk in Canadian female youth football players: a cluster-randomised trial. *Br J Sports Med* 2013;47:480–7.
- Soligard T, Nilstad A, Steffen K, *et al.* Compliance with a comprehensive warm-up programme to prevent injuries in youth football. *Br J Sports Med* 2010;44:787–93.
- Zech A, Wellmann K. Perceptions of football players regarding injury risk factors and prevention strategies. *PLoS One* 2017;12:e0176829.
- Cohen JW. *Statistical Power Analysis for the Behavioral Sciences, 2nd Edition*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.
- Saunders N, Otago L, Romiti M, *et al.* Coaches' perspectives on implementing an evidence-informed injury prevention programme in junior community netball. *Br J Sports Med* 2010;44:1128–32.
- Bekker S, Clark AM. Bringing complexity to sports injury prevention research: from simplification to explanation. *Br J Sports Med* 2016;50:1489–90.
- van Dyk N, Behan FP, Whiteley R. Including the Nordic hamstring exercise in injury prevention programmes halves the rate of hamstring injuries: a systematic review and meta-analysis of 8459 athletes. *Br J Sports Med* 2019;53:1362–70.
- Bahr R, Thorborg K, Ekstrand J. Evidence-Based hamstring injury prevention is not adopted by the majority of champions League or Norwegian premier League football teams: the Nordic hamstring survey. *Br J Sports Med* 2015;49:1466–71.
- McCall A, Dupont G, Ekstrand J. Injury prevention strategies, coach compliance and player adherence of 33 of the UEFA elite Club injury study teams: a survey of teams' head medical officers. *Br J Sports Med* 2016;50:725–30.
- Bolling C, van Mechelen W, Pasman HR, *et al.* Context Matters: Revisiting the First Step of the 'Sequence of Prevention' of Sports Injuries. *Sports Med* 2018;48:2227–34.