



FROM RESEARCH TO PRACTICE

Challenges when implementing an evidence-based exercise injury prevention training program in community-level sport: A Case Study

Dara M. Twomey*^{a,b}, Tim L.A. Doyle^c, David G. Lloyd^{c,d}, Bruce C. Elliot^c, Caroline F. Finch^b

^a School of Health Sciences and Psychology, Federation University Australia, Victoria, Australia; ^b Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), Federation University Australia, Victoria, Australia; ^c School of Sport Science, Exercise and Health, University of Western Australia, Crawley, Western Australia, Australia; ^d Centre for Musculoskeletal Research, Griffith Health Institute, Griffith University, Gold Coast, Australia.

Abstract

This interdisciplinary case study describes the key challenges experienced in the delivery of a team-based lower limb injury prevention training program in community-level sport. Player factors such as punctuality, commitment to other sports, and absences from full training due to injuries presented difficulties. The support of coaches and senior leadership teams and their understanding of the important role of training programs and injury prevention were critical in addressing these challenges. Inclement weather impacted on the use of fundamental equipment and required unanticipated adaptations to the programs. All of these factors must be considered in the implementation design and delivery phases of any exercise-based training intervention for injury prevention. Given the many similarities in delivering exercise programs across sports, detailed reporting of the real world challenges experienced will help inform successful study designs in the future. This case study highlights the benefits of multidisciplinary collaborations between a variety of professionals, including researchers, coaches, club management and equipment manufacturers, not only in the design of the training interventions but also in the solution of issues as they arise during implementation.

Keywords: community-level sport; compliance; exercise prescription; exercise training intervention; program delivery.

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* = **Corresponding Author:** Dr Dara Twomey, School of Health Sciences, Federation University Australia, Ballarat, Victoria 3353, Australia. Ph: +61 3 5327 9062; Email: d.twomey@federation.edu.au

Background

The efficacy of exercise training programs for lower limb injury prevention has been well established (Emery & Meeuwisse, 2010; Mandelbaum et al., 2005; Myklebust et al., 2003). However, the effectiveness in community settings largely relies on the successful delivery of the intervention (Finch & Donaldson, 2010). Recent research has emphasised the importance of understanding the context in which the implementation takes place in order to inform the design of interventions (Donaldson & Finch, 2013; Finch, White, Twomey, & Ullah, 2011; Verhagen & Finch, 2011). The recent addition of two further stages to van Mechelen, Hlobil, and Kemper's (1992) model has resulted in a six-stage approach named: 'Translating Research into Injury Prevention Practice' (TRIPP - Finch, 2006). The new TRIPP Stages, five and six, relate specifically to the design of implementation strategies, incorporating knowledge of the context and the evaluation of the effectiveness of the intervention, respectively. Recent evidence suggests that understanding the barriers and challenges to the adoption and maintenance of sports injury prevention strategies contributes significantly to their success, particularly in community-level sport (Finch & Donaldson, 2010; Finch et al., 2011). The following case study contains reflections on the implementation of interventions in community sport, and the challenges faced by those delivering them.

Compliance, which can be defined as the degree to which players complete all aspects of an intervention, contributes significantly to the effectiveness of training programs, yet reporting of compliance is often unclear in research reports (cf. Finch & Donaldson, 2010; Soligard et al., 2010; Verhagen, Hupperets, Finch, & van Mechelen, 2011). Although compliance levels have been reported in some recent studies, these have generally been limited to reporting absolute numbers of training sessions attended (Soligard et al., 2010; Steffen et al., 2013). In many of these reports a level of important detail is missing, specifically whether or not players completed all components of the intervention at each session (Keats, Emery, & Finch, 2012). Knowledge of the specific factors that influence compliance levels is rarely reported but could provide valuable information to enhance design and delivery strategies, thereby increasing training compliance, in future interventions.

Intervention fidelity, which is different to compliance as it infers that the players not only complete the training exercises but perform them correctly, has been identified as a key contributor to success in sports injury prevention strategies but is rarely recorded or reported (Finch, 2011a, 2011b; Fortington et al., 2014; Verhagen & Finch, 2011). The ability to perform the components of a training intervention exactly as prescribed can be impeded by many factors, such as weather conditions or time constraints. For example, inclement weather was identified as placing logistical challenges on the completion of the FIFA 11+ program (Steffen et al., 2013) However, no specific details of its impact on the study results, nor any program modifications were reported (i.e., attempts to address the impact of these challenges). It has also been shown in an observational study of training program fidelity in community Australian football that the volume of exercises performed was the most frequent cause of incorrect performance (Fortington et al., 2014). Players completing too few exercises could be related to time constraints. Only one previous paper has published practical lessons learned delivering a sports injury prevention program, but these were mainly focused at the organisational level (Chalmers, Simpson, & Depree, 2004).

The purpose of this report is to present in-depth evaluation and reflections following an injury prevention training program, delivered within a large group-clustered randomised controlled trial in community sport. In doing so, we will share some of the challenges and unanticipated issues we experienced during the intervention implementation. In this

way, we hope to both illustrate the importance of compliance and fidelity issues, as well as offering guidance for those delivering similar injury prevention programs - particularly in community sport. The following report focuses on challenges associated with (i) players; (ii) coaches; and (iii) environmental/equipment factors. We then move on to consider: (iv) how the challenges were managed to ensure both compliance and fidelity; and (v) recommendations on how these challenges/issues could be avoided in future. In addition, we will highlight the necessity for multi- and interdisciplinary collaborations between a variety of professionals - including researchers, coaches, club management and equipment manufacturers - not only in the design of the training interventions but also in the resolution of issues as they arise during implementation.

Overview

The experiences presented in this paper are based on the implementation challenges recorded by research staff - i.e. the project managers and trained staff who delivered the programs - during the implementation of two exercise training programs that were delivered as part of a large randomised controlled trial (RCT). The research was investigating the effectiveness of interventions designed to prevent lower limb injuries in community-level Australian football (the Preventing Australian Football Injuries through eXercise (PAFIX) trial - Finch, Lloyd, & Elliott, 2009). The design of the overall project and the specific exercise training programs were developed by a multidisciplinary team comprising: epidemiologists; bio-mechanists; sports medical staff; and strength and conditioning experts. Specific details are available elsewhere regarding: (i) the project design (Finch, Lloyd, & Elliott, 2009); (ii) the accuracy of data collection (Twomey, Finch, Doyle, Elliott, & Lloyd, 2010); (iii) the evidence-base and rationale for the training programs in relation to Australian football (Donnelly et al., 2012); (iv) the actual training programs and player feedback (Finch et al., 2014a); and (v) the reach and adoption of the training programs (Finch et al., 2014b).

A total of 40 community-level Australian football teams (approximately 1564 players) were recruited during the 2007 and 2008 playing seasons and randomly assigned to one of the two periodised training programs. All players were male and over 18 years of age (mean age of 22.1 years). Players were recruited from two Australian states, Victoria and Western Australia, approximately 3,000 kilometres apart, which experience very different climatic conditions (Western Australia is generally warmer and drier). The 'control' training program simulated common training programs used in community-level Australian football, with exercises such as running, bounding and changing direction. The neuromuscular control training program (i.e., intervention) comprised balance, plyometric and technique activities aimed at altering biomechanical and neuromuscular knee injury risk factors. The two programs were conducted simultaneously so that the effectiveness of the neuromuscular control program could be compared to a regular warm-up program currently in use. The control program included the use of balls and cones only. The equipment supplied to each club for the neuromuscular control program included: six mini-hurdles; two mini trampolines; eight balance cushions; eight balance boards; eight Swiss balls; 10 Australian footballs; and a set of 30 cone-shaped markers. Both periodised programs were delivered by trained staff as a warm-up in two training sessions per week over 26 weeks, taking approximately 10-20 minutes to complete. The periodisation cycles of the programs are detailed in Table 1.

Table 1: Outline of the neuromuscular control program delivery plan.

Week	Mesocycle	Frequency per week
1-4 (pre-season)	General preparation – basic balance, bounding and planned change of direction exercises	Twice
5-8 (pre-season)	Basic aggressive – basic balance, bounding, planned and unplanned change of direction, jumping and landing exercises	Twice
1-5 (in-season)	Aggressive 1 – advanced balance, unplanned change of direction and jump/landing exercises	Twice
6-10 (in-season)	Aggressive 2 – advanced combined balance, unplanned change of direction and jump/landing exercises	Twice
11-14 (in-season)	Maintenance 1 – balance , bounding and unplanned change of direction exercises	Once
15-18 (in-season)	Maintenance 1 – balance , jump/landing and unplanned change of direction exercises	Once

Ethical Considerations

The study was conducted in full accordance with the Australian National Statement on Ethical Conduct in Human Research and approved by the University of Ballarat (currently Federation University Australia) and the University of Western Australia Human Research Ethics Committees. All players were provided with a Plain Language Statement that outlined the purpose of the PAFIX project, what they would be required to do and how their data would be managed. Players were given the opportunity to seek any further information from the research team and once satisfied provided their written, informed consent.

Critical reflections on the barriers and challenges to effective intervention delivery

Player-related challenges

The training programs were designed to start eight weeks before the start of the season, and continue for the 18-week season. Although the training programs were designed to start at a basic preparation level, as detailed above, this assumed that most players would attend football training during the pre-season. In reality, many community club players participated in other sports (e.g., cricket) during the Australian football off-season, and were still involved in those during the ‘General Preparation’ phase. This meant that they were not available to participate fully in the PAFIX program. Further, the continuous recruitment of new players during the pre-season also challenged the fidelity of the programs during this time. New players would likely have had different conditioning levels to those who had been compliant throughout. An issue like this is unavoidable in community club sport. We attempted to address the issue by ensuring the trained project staff members delivering the program were aware of the key elements essential for new players. Each club was provided with two staff from the PAFIX project, and together with the assistance of the club coach they were able to integrate the new players into the programs. This was achieved by one of the trained project staff running the scheduled program session, with assistance from the club coach, and the other project staff member worked with individual players to ensure that they had the foundational skills necessary to join the PAFIX program in the subsequent training session. We reflected that accommodating the competing demands on players in community level (i.e., non-professional sport) is critical in seeking good fidelity and compliance. It was necessary

for us to modify implementation dates, content, adaptability, and session-length, and we recommend that practitioners acknowledge these issues at the design phase of interventions.

The nature of a periodised training program, where the intensity and difficulty of the exercises increase and fluctuate throughout the season, presumes that players will progress through the cycles according to the program design. The PAFIX program comprised cycles of 4-5 weeks, as previously detailed in Table 1, with different exercises on each of the two training sessions per week. The players were given exercise progression options according to their ability. For example, the baseline balance board exercise was a double stance position with eyes open but players could progress to a single leg stance with eyes open or closed. In a team environment, however, it can be difficult to ensure that each player is progressing at his own pace and not influenced by the ability of other players to perform exercises beyond their capacity. We responded to this issue in the PAFIX study with the two additional trained personnel, as described above. Together with the club coaches, these additional staff were all able to monitor individual players' progression and adapt training programs accordingly.

In addition to individualising the level of training to each player, moving through the progressions correctly was also negatively affected by missed sessions. If too many sessions are missed, the regular program may be at a level too advanced for the player, because of technique or intensity, when they rejoin the squad. Consequently, they may not gain the full benefit from the training, or may even be at an increased risk of injury. Since the exercises in the PAFIX program were of a relatively low intensity, it was only necessary to make small variations to the intervention exercises - for example, varying the running speed of a drill. Furthermore, in cases where players were injured or experiencing slow progress, the staff sought to incorporate low impact and low intensity exercises from the earlier stages of the program.

Another important factor was the punctuality of the players, which can have a significant impact on the success of a program, given that it was delivered as a warm-up to subsequent coach-led training. During the implementation of the PAFIX injury prevention exercise training programs, there were many occasions where an incomplete program or no program was performed. Of the reasons recorded for partial or non-participation 21% was due to player lateness. There are two major considerations with the late arrival of players to training. Firstly, the players who join in after the start of the session may not be physically prepared to undertake the physical tasks of their training. Secondly, non-compliance with the PAFIX injury prevention program may have rendered players more likely to sustain an injury during the season, with consequences for both the player and the fidelity of the research. The solution we adopted was to have clubs/teams undertake the specialised exercises later in the training session. The times were negotiated at individual club level by the trained staff delivering the programs and did not affect the content of the program but achieved the desired outcome of ensuring that those players who arrived late did not miss out.

Coach-related challenges

Coaches can have a significant influence on player behaviour (Twomey, Finch, Roediger, & Lloyd, 2009). Therefore, their support is critical for the successful implementation of an injury prevention training program. While coaches support and recognise the value of injury prevention training programs, they often feel inadequately equipped to integrate them into their coaching practices (Saunders et al., 2010; Twomey et al., 2009). This was evident during the first few weeks of the PAFIX programs, where many coaches used the time to set-up other drills rather than engaging with the injury

prevention training. Upon noticing this behaviour, the research team reflected that the PAFIX project was an ideal opportunity for community-level coaches to learn how to deliver injury prevention strategies in their normal training sessions. The researchers believed it was important for coaches to learn this skill, so that the program could be maintained long after formal support was withdrawn. In response, the project staff based in the clubs were asked to discuss the benefits of the exercises with the coaches, whenever possible. Furthermore, the use of the coaching staff to assist with individual progressions or injured players gave them an additional opportunity to increase their injury prevention knowledge. Anecdotally, this appeared to be a successful strategy as coaches engagement with and assistance in the delivery of the program increased as the season progressed.

Environmental/Equipment Factors

Inclement weather can impact on the logistical implementation of training programs (Steffen et al., 2013). The PAFIX program was complicated by the fact that it was a dual-state project with very different weather patterns in each state. In Western Australia, the weather conditions remained relatively mild and dry (an average of 18 degrees): resulting in good playable conditions and very few disruptions to training. In contrast, Victorian teams experienced extreme drought conditions for the pre-season which continued for six weeks of the playing season in 2007, followed by very wet conditions in 2008. In 2007, many venues were closed and it was necessary for training to take place on synthetic turf hockey fields, tennis courts or indoors. Consequently, modifications had to be made in both years for the Victorians teams, to ensure both safety (i.e., on different surfaces and smaller playing areas) and fidelity (i.e., as close as possible to the planned content). In the case of two clubs, three - four sessions were cancelled. In response, staff made the decision to reduce the number of maintenance weeks to ensure the main in-season cycles were not affected.

An unanticipated issue that arose in Victoria was the use of inappropriate footwear. The exercises in the neuromuscular training program required the use of equipment such as mini trampolines, balance boards and Swiss balls. Due to the very wet and muddy grounds in 2008, the players did not want to wear running shoes during the PAFIX program and then change into football boots for the remainder of the training session. The use of studded football boots on mini trampolines and the balance equipment was not only damaging to the equipment but potentially increased the injury risk for the players. In response, wherever possible, some balance exercises were moved to a drier area of the facility and running shoes were worn. With the landing exercises involving the mini trampolines, the exercises were modified to accommodate studded footwear. For example, players were asked to perform the run-up, then, on a signal, jump as high as possible off the ground and land in a flexed position.

Another challenge with the use of the mini trampolines emerged in the wet conditions. The small surface area of the mini trampoline legs was not able to withstand the weight of many of the players and began sinking into the surface. Consequently, the rebound property of mini trampolines was lost, resulting in a potentially dangerous activity. This was only an issue in Victoria, so new wooden bases were machined to prevent sinking.

Discussion

This case study has discussed some of the specific on-the-field challenges experienced during the implementation of a sports injury prevention training program in community-level sport. The issues reported are based on 'real-world' experiences and focus on the

most pertinent issues when implementing a specialised injury prevention programs. Although this case study is based on the experiences in community-level Australian football, many of the challenges presented could easily affect other sports and levels.

Ideally, all players would attend and participate fully in every training session but the reality in community club sport is that this will rarely occur (Finch et al., 2014b). Our PAFIX trial experiences highlight the fact that variability in participation levels and adherence are inevitable. With issues of non-attendance, lateness, injury and ongoing recruitment, compliance is far from guaranteed and the fidelity of the intervention faces a serious threat. A lack of full participation may result in a player either failing to achieve the desired adaptations or advancing to an exercise that is too difficult before he is ready. In both cases, the risk of injury is increased, not reduced. Engaging the coaches, and other club management staff, to assist with monitoring individual player progressions is a valuable way to develop collaborations among different professions. If assistance from other coaches or club personnel is not available then slow advancement in the training drills needs to be accounted for, ideally in the design phase. Addressing such issues ad-hoc is arguably too unreliable given the burden of injuries - financial, time and emotional.

The timing of a training program, both across the playing season and within each training session, needs to be carefully considered. The continuous recruitment of players, particularly throughout the pre-season phase, was typical of what happens in this level of sport (Braham, Finch, & McCrory, 2004; Finch et al., 2014b). Tailoring programs to individual needs within a team setting can be challenging and requires a well-designed program and suitably trained staff. Therefore, careful budgeting for adequate staff will result in a greater likelihood of a successful intervention. It is acknowledged that this recommendation may not always be possible at community-level sport and therefore providing education that empowers the coaches and players to undertake specialised injury prevention programs would also be valuable.

Many specialised injury prevention training programs, including the PAFIX, have been implemented as warm-up programs delivered at the start of training sessions (Finch et al., 2009; Myklebust, Skjølberg, & Bahr, 2013; Soligard et al., 2008). In practice, the reach and adoption of the programs can be substantially compromised due to the lack of player punctuality (Finch et al., 2014b). It is recommended that future programs consider randomising the timing of the specialised program in the 'real-world' settings that will integrate with the coaching staff's current and planned training sessions.

Coaches play a major role in sport and can be important advocates for injury prevention (Saunders et al., 2010; Twomey et al., 2009). Surveying coaches to identify the barriers to training prevention programs has been recommended (Steffen et al., 2013) and undertaken (Twomey et al., 2009). However, what is self-reported doesn't always match what is observed (Eime, Finch, Owen & McCarty, 2005) so reporting what is happening in reality provides additional valuable information for the success of future programs. Similar to previous interventions (e.g., Chalmers et al., 2004), recognising the role of the coaches from the outset of the PAFIX project was essential to its success. A detailed written agreement signed by coaches during the recruitment phase was invaluable in engaging the coaches with the researchers and reminding them of their commitment to the program. Although all participating players receive information regarding what a project entails and the benefits to them, having something at the club management/coach level is important for success. The agreement outlined the benefits of participating and clearly stated what was required from the clubs and coaches and is highly recommended in similar future projects.

Although the weather is an uncontrollable and unpredictable factor, its influence on the program fidelity needs careful consideration. The ground conditions can significantly impact on the progress and logistics of an injury prevention program. From our PAFIX experience, assuming that every training session will be consistent in its delivery throughout the pre-season and playing season is not appropriate. As such, it is important to develop a program that can accommodate variations to location and training surface, as well as the cancellation of sessions. For example, in the PAFIX training programs the maintenance cycles at the end of the season were shortened in some Victorian clubs. Furthermore, the differences in weather experienced by the two different states (Western Australia and Victoria) may explain inconsistent findings, wherein interventions that seem effective in one setting may not work in another. As such, it becomes clear that programs need to be informed at the design stage by the consideration of local conditions, likely issues and suitable responses (Finch, 2011b). In addition to modifications to the specific exercises prescribed, the choice of equipment may also require modification or careful management. Within our own project, this included considerations of the safe use in all weather conditions, the footwear required and potential damage/repair. Based on our experience, the inclusion of equipment manufacturers and/or technical staff as part of the interdisciplinary team would appear a very valuable strategy.

Recommendations

After reflecting on the challenges in implementing an exercise training intervention in the 'real world', the following recommendations are made:

Recommendation 1: Factors such as player availability, coach support and support-staff availability are critical in the design and delivery of sports injury prevention exercise programs. To maximise fidelity and effectiveness, where possible staffing levels should reflect the (reasonably predictable) challenges reported here - and not be based on an idealised view of how the intervention will be delivered.

Recommendation 2: Player punctuality can affect a warm-up based injury prevention intervention. Therefore timing of delivery needs to be considered in future exercise training interventions.

Recommendation 3: The progression of an outdoor injury prevention training program can be significantly affected by environmental factors, particularly weather. Therefore contextual factors such as climate and venue must be considered in the design phase. The choices of training drills, equipment and rate of progression may all need to be adapted accordingly.

Recommendation 4: The inclusion of a wide variety of professions and disciplines, such as coaches, clinicians, researchers, equipment manufacturers, and technical staff, in the design phase of an intervention could significantly increase the likelihood of a successful implementation.

Conclusions

Given that community sport settings are 'predictably unpredictable', future injury-prevention programs should seek to recognise, incorporate and manage this variability at

the design stage. Programs should focus on the desired outcomes and adaptations and ensure that these can be delivered regardless of the challenges detailed in this report. Further still, practitioners and researchers should continue to record and report the real-world challenges experienced when implementing such programs, in order to inform the design of future interventions. By sharing our experiences of such challenges, and their resolutions, we may begin to overcome the apparently 'unpredictable' challenges to programs. This strategy would help to ensure that interventions which are both theoretically sound and evidence-based successfully manage the transition into the 'real-world'.

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