CREATE, CURATE, COOPERATE:
EXPLORING THE PROCESS OF SPORT SAFETY RESOURCE DEVELOPMENT

by

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A thesis in fulfilment of the requirements for the degree of:

Doctor of Philosophy

Australian Collaboration for Research into Injury in Sport and its Prevention,

and

Faculty of Health,

Federation University Australia

December 2017

ABSTRACT

Sports injuries are a significant public health burden both in Australia, and worldwide. Preventing injuries in sports settings is thus an important public health goal. It is now generally accepted that sports injuries are, like other unintentional injuries, largely preventable. Yet intractable problems remain. Complexity theory is harnessed in this research as a means of understanding such problems. To provide new insights into the complexity of sports safety promotion, this research consisted of a qualitative case study design underpinned by constructivist assumptions.

Study A documented sports injury prevention and safety promotion resources available from the websites of key sporting organisations. A thematic document analysis approach was used to identify and describe how many, and what types of, resources were available, as well as the sports injury prevention and safety promotion issues addressed. The findings of Study A suggest that sport settings have access to a proliferation of rival resources, which reflects a potentially inefficient and ineffective manner in which to influence policy/practice.

Study B determined the process that key intermediary organisations used to develop and disseminate the resources identified in Study A. Interviews with key participants about organisational processes of knowledge translation were undertaken, and a qualitative description approach was used to examine their accounts. The findings of Study B suggest that intermediary organisations can, and do, take on knowledge translation roles in order to make research knowledge more relevant (timely, salient, actionable), accessible (formatted and available), and legitimate (credible) for end-users.

A complexity approach was applied to this study to assist in recognising that open systems (stratification and fluidity), non-linearity (emergent properties and feedback loops), and improbability (demi-regularities and the ability to evolve, learn, and adapt) underscore sports safety. This study explicates and examines key insights and implications of adopting a complexity approach to the prevention of injury in sport settings.

STATEMENT OF AUTHORSHIP

Except where explicit reference is made in the text of this thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma. No other person's work has been relied upon or used without due acknowledgement in the main text and reference list of the thesis.

Signature of candidate: 

Date: 06/12/17

Signature of principal supervisor: 

Date: _ 08/12/2017

ACKNOWLEDGEMENTS

Any meaningful work is,

In the end,

Always

All ways

A collaboration.

To the participants in this research: thank you for making the time to share your experiences and insights with me with so much generosity and support. *Cheers.*

To my principal supervisor, Professor Penny Paliadelis: thank you for your calm and calming nurturing of both me, and this work. You gave me a lifeline when I needed it most, and trusted me to swim to shore in my own time. I have truly enjoyed working with you, and learning the deep value of qualitative research from you. *Gratitude.*

To my associate supervisor, Professor Caroline Finch: thank you for responding to my initial connection (via twitter!) and facilitating the opportunity to come to Australia to complete this PhD. For mentoring me in both the art and science of sports injury prevention. For mentoring me as a researcher. I have learned so much from you about who I want to be in the future. *Indebted.*

To Professor Alex Clark for the incredibly generous gift of time and expertise through my own journey learning about, and applying, the complexities of complexity theory with clarity and connection. *Thank you.*

To Dr Peta White, Dr Alexander Donaldson, and Dr Rob Watson, each of whom played a role in this journey, thank you for your assistance along the way. *Appreciation.*

To the examiners and peer-reviewers of this work: I so appreciate your generous time in providing expert feedback. The often unpaid and unacknowledged backbone of academic rigour and trustworthiness does not go unnoticed. *Recognition.*

To my colleagues here at ACRISP and Federation University Australia, who have been nothing but supportive along the way. A special mention to Dr Lauren Fortington for friendship during this journey. *Collaboration > competition.*

To colleagues who have become friends all around the world. When I started this I could not have fathomed how connected the worlds of sports medicine and injury prevention are, and that I would become part of the conversation. Thank you for becoming this net of insights and learning. I look forward to the meaningful work that we have yet to do. *It is always an exchange*.

To my network of humans on social media, and on Twitter particularly: you have opened my world up to so much more than I could have ever known. The work that you do in sharing yourselves and your journeys so openly and vulnerably *is* the real work. I learn so much more from you than I could ever add. *HT.*

To DSM, for their connection. Thank you for the gift of journey together. *Trust in the timing.*

To my sister Megan: your generosity astounds me. Thank you for always being there for me, in all of the ways. *I love you.*

To my dad, Johan: your unwavering belief in me is unparalleled. *Lovies.*

To my mom, Giorgette: I am who I am because of you. Your patience and kindness in supporting me every step of this journey called life is a gift. Thank you for being my source of comfort and courage. *Lief vir jou!*

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DEDICATION

Giorgette, *my mamma,* this one is for you.

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LIST OF KEY ABBREVIATIONS

1. NoGAPS: National Guidance for Australian Football Partnerships and Safety
2. AFL: Australian Football League
3. VicHealth: Victorian Health Promotion Foundation
4. NSWSIC: New South Wales Sporting Injuries Committee
5. JLT Sport: JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd
6. SRV: Sport and Recreation Victoria
7. SMA: Sports Medicine Australia

CHAPTER 1: INTRODUCTION

Introduction

Promoting safety to improve health and wellbeing by controlling the hazards and conditions leading to physical, psychological, or material harm is a complex and challenging endeavour (World Health Organisation 1998). To improve understanding about injury prevention and safety promotion in the sporting context, arguments presented in this thesis pivot on the understanding that both sport settings and safety promotion are inherently *complex*.

Given this challenging lens, and the ubiquitous question of whether a complexity approach is possibly *too* complex, this chapter presents the background, setting, context, and significance of the research described in this thesis. The research topic and problem are defined, and the theoretical framework and research approach introduced. In turn, two distinct but connected research aims are established, each with its own corresponding purpose, rationale, research questions, and methods. These form the basis of the two linked original research studies reported in this thesis. Finally, the structure of this thesis-incorporating-publications[1] is set out through a brief overview of each chapter.

1. A note on the format of thesis-incorporating-publications:

Consistent with contemporary academic practice and Federation University Australia guidelines, this PhD thesis is presented as a *hybrid* style of thesis that sits between a traditional thesis and a thesis-by-publication. It comprises a combination of traditional chapters and three peer-reviewed publications.

The rationale for including publications in a thesis is to show clearly that the research presented in the thesis is of internationally recognised publishable quality having undergone peer-review, and that it contributes significantly to knowledge in the field.

The three publications have been embedded within this thesis in their journal published form, and therefore their tables, images, and references have not been duplicated in the main text. It must be noted here that this thesis-incorporating-publications in its entirety is, therefore, shorter than a traditional thesis as the chapters that may normally be longer were written to journal specifications and word limits. However, all necessary and relevant information has been included, and/or expanded upon in the main text.

Background to the study

The word ‘accident’ was banned from the British Medical Journal in 2001 as it is often used inappropriately, as evoking ‘bad luck’, when describing incidents leading to injury or death (Davis & Pless 2001). Injury prevention researchers have long held the view that unintentional injuries are not unavoidable ‘accidents’, but rather the result of predictable and preventable events (Doege 1978; Evans 1993; Doege 1999). Adverse events occurring in sport settings should be understood in the same way.

Every fifth unintentional injury in industrialised countries occurs through sport or physical activity (Conn, Annest & Gilchrist 2003), and sports injuries remain a significant public health burden in Australia (Finch & Cassell 2006; Finch, Kemp & Clapperton 2015). This has led to the development of a wide range of efficacious physical sports injury prevention interventions (McBain *et al.* 2011a; McBain *et al.* 2011b), and calls for further research into their effectiveness (including dissemination and implementation) within sport settings (Finch 2006; Finch 2011a; Finch 2011b).

The past 20 years of research in the field of sports injury prevention has therefore provided clear evidence of ‘what works’ for sports injury prevention (efficacy), as well as provided the rationale and steps towards determining ‘what works in [a specific] context’ (effectiveness). However, limited research that adequately and comprehensively addresses effectiveness across complex contexts exists. In order to influence prevention outcomes in complex settings, the next step is to look at broader patterns in injury prevention and safety promotion, and how we study them, to start to uncover ‘what works, for whom, when, where, why, and how’ (Pawson & Tilley 1997). In this study, a complexity lens will be used to explore these questions.

Safety in sport settings can only be achieved if the whole is considered as more than the sum of its parts. A complexity approach views settings and safety promotion as ever-changing open systems that are fluid and in flux, with outcomes that are never entirely predictable (Boulton, Allen & Bowman 2015). It is this complexity approach that may provide valuable new insights for the prevention of injury and promotion of safety in sports settings.

Research significance

Sport is widely recognised, by researchers, clinicians, policy-makers, parents and participants as a means to achieve positive health outcomes and improved wellbeing. Yet, participants do not always experience sport as a universally positive activity. This is because adverse outcomes such as injuries may also be encountered in sport settings (Conn, Annest & Gilchrist 2003; Finch & Cassell 2006; Finch, Kemp & Clapperton 2015).

In order to reduce injury risks, improve safety, and ultimately increase the positive impact of participation in sport, there is a clear need for efficacious and effective injury prevention interventions to be available and implemented in such a way that the general sporting public can benefit (Finch & Donaldson 2010). To date, however, research suggests that very few injury interventions to improve safety in community sport settings have produced meaningful, long-term outcomes (Finch & Hennessy 2000; Timpka, Ekstrand & Svanström 2006). There has been limited critical evaluation, or indeed consolidation, of the steady accumulation and focus of interventions that this field of research produces, how sports injury prevention is researched theoretically, and how this corresponds with the inherent complexity of injury prevention and safety promotion in sports settings.

In Australia, the limited number of studies that have investigated sports *safety* specifically have predominantly focused on improving understanding by describing the injury prevention and/or risk management practices of specific sporting organisations (Casey *et al.* 2004; Donaldson *et al.* 2004; Swan *et al.* 2009; Abbott *et al.* 2008; Finch *et al.* 2009), rather than addressing the pressing need to inform and overhaul the systemic safety practices of community sports clubs over a range of settings. This is, further, a recognised gap in both national (Finch *et al.* 2011) and international (Timpka *et al.* 2008) approaches to comprehensive systemic sport safety promotion. Nationally, this gap has been explicated and explored in one sport via the National Guidance for Australian Football Partnerships and Safety (NoGAPS) project, which identified a number of research to practice gaps in safety promotion in this sport (Finch *et al.* 2011). Internationally, Timpka *et al.* (2008) reviewed the global research to policy gap and found glaring inconsistencies in the systemic promotion of safety.

The significance of this research, ultimately, lies in the reduction of cost to the healthcare system (Finch & Cassell 2006; Finch, Kemp & Clapperton 2015) as well as the reduction of physical, psychological, and material cost to sports participants themselves (Kerr *et al.* 2013). Sports participants who can avoid injuries and other forms of harm spend more

time participating, thus gaining more from the inherent health benefits of physical activity (Manini 2015). The research, policy and practice of sports injury prevention and safety promotion is, therefore, essential to helping people live healthier lives. Sports injury prevention and safety promotion is, in this way, important for individuals, and for society as a whole.

Setting and context for the study

This study was designed under the banner, and informed by the assumptions and partnerships of, a much larger study, which was the National Health and Medical Research Council funded (for which the associate supervisor for this research, CF Finch, was a chief investigator) NoGAPS project (Finch *et al.* 2011). The protocol, findings, and analysis of the core NoGAPS partnership project have been published elsewhere (Finch *et al.* 2011; Donaldson *et al.* 2015; Fortington *et al.* 2015; Donaldson *et al.* 2016; Finch *et al.* 2016).

The NoGAPS project intended to identify factors that influence the translation of safety promotion interventions into practice in community sport. The partnership aimed to reduce knowledge gaps between: 1) policy and practice, 2) efficacy to effectiveness, 3) research knowledge to translation, and 4) elite sport and community sport (Finch *et al.* 2011). The NoGAPS study brought together six organisations for a research partnership: the Australian Football League (AFL), Victorian Health Promotion Foundation (VicHealth), New South Wales Sporting Injuries Committee (NSWSIC), JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd (JLT Sport), Sport and Recreation Victoria (SRV), and Sports Medicine Australia (SMA). These organisations were chosen for the original NoGAPS project because they are recognised as key stakeholders in safety promotion in Australia, especially as it applies to the sport of Australian football (Finch *et al.* 2011). This group is representative of organisations at both national and state level concerned with sports safety promotion in Australia. The larger NoGAPS project provided the opportunity for a convenience sample of the types of organisations that this research aimed to investigate. This study, therefore, was conceptualised as a case study of the NoGAPS organisations.

Whilst the larger NoGAPS project focused on Australian football (i.e. Australian rules football), the work undertaken at the majority of the organisations included in this partnership is not limited to Australian football alone. This study aimed to investigate the wider systemic nature of sports injury prevention and safety promotion across Australian community sports settings by these organisations, so as to create a fuller picture of the complexity of promoting safety within a diverse range of sport settings. Therefore, while the outcomes arising from this research will be weighted towards the Australian football setting, they may resonate with a wider range of Australian community sport settings.

Introduction to the theoretical framework and research approach

In Australia there is currently no national sports safety policy, as the National Injury Prevention and Safety Promotion Plan 2004-2014 (National Public Health Partnership 2005), and its preceding National Sports Safety Framework (Australian Sports Commission 1997) and the Sports Safety Update (Australian Government Department of Health and Ageing 2003), have lapsed and been rescinded. This means that sporting organisations in Australia lack overarching guidance about how best to approach injury prevention and safety promotion systemically. Outside of legislative requirements such as 'Working with Children Checks', safety promotion in community Australian sport settings appears to currently be an ad-hoc undertaking (Casey *et al.* 2004; Donaldson *et al.* 2004; Swan *et al.* 2009; Finch *et al.* 2009).

The original research studies reported in this thesis were conceptualized to contextualise the current complexity of promoting safety in Australian community sports settings. This research is thus comprised of two distinct, but connected, studies that were designed: 1) to elicit information about the resources available for safety promotion in community sport settings in Australia, and 2) the processes key organisations undergo to create and distribute these resources.

Complexity theory was chosen as the theoretical framework for this study, as this lens may provide an understanding of the nature and implications of social reality as it pertains to the systemic promotion of safety in sport settings. A complexity approach recognises that open systems (stratification and fluidity), non-linearity (emergent properties and feedback loops), and improbability (demi-regularities and the ability to evolve, learn, and adapt) underscore social interventions. These key tenets will be explained in detail in Chapter 3.

The methodology for this study is underpinned by a constructivist epistemology, consistent with a descriptive qualitative research paradigm. The strategy of inquiry is a case study approach, consisting of studies A and B.

Research topic and problem

The research topic for this study is to investigate the complexity of safety promotion in sports settings. The research problem explored through this research is:

> Can a complexity approach help to better understand systemic safety promotion within Australian community sport settings?

This will be explored through two linked studies, the aims, purpose, rationale, research questions, and methods of which are described below.

Study A

Aim

The aim of study A is to determine the number of, and thematically describe the type and scope of, injury prevention and safety promotion resources available online from a set of key organisations (the NoGAPS partners).

Purpose

The purpose of study A is to contextualise the overarching research problem by collecting information about the scope of sports injury prevention and safety promotion resources available online from key organisations.

Rationale

The rationale for study A is to understand the nature and scope of sports injury prevention and safety promotion resources available online from the NoGAPS partnership organisations. Little is known about the nature of safety promotion and injury prevention resources available online for community Australian sport audiences. The complexity inherent in the number, type and variety of resources, as well as type and variety of injury and safety issues they may address, is foregrounded in this study, with a view to understanding more about the 'research-to-policy/practice' gap.

Research questions

A1 How many sport safety resources are available online from the NoGAPS partnership organisations?

A2 What types of sport safety resources are available online from the NoGAPS partnership organisations?

A3 What sport safety issues are addressed in the resources available online from the NoGAPS partnership organisations?

A4 Is there duplication of resources for the same sport safety issue either within or across the resources available online from the NoGAPS partnership organisations?

Methods

Two approaches were used in collecting data for this study: 1) an online search of each NoGAPS website, and 2) a direct email request to each NoGAPS representative.

Document analysis (Bowen 2009), a systematic, qualitative research method, was chosen to review documents thematically as a means of describing both the nature and content of the safety promotion resources available online from the NoGAPS organisations.

Study A has already been reported on in more detail in a peer-reviewed published paper, presented in Chapter 4.

Study B

Aim

The aim of study B is to determine, and describe, the processes of knowledge translation undertaken by a set of key organisations (the NoGAPS partners) in developing and distributing the injury prevention and safety promotion resources identified in study A.

Purpose

The purpose of study B is to determine the process that the NoGAPS organisations use to develop and distribute injury prevention and safety promotion resources.

Rationale

The rationale for study B is to explore the process by which the NoGAPS organisations produce and distribute sports safety resources for community sporting organisations. It is unknown what the development and distribution processes for such resources are, and whether they are underpinned by research and/or proven methods of knowledge translation. The complexity of 'bridging the gap' between research and practice is foregrounded in this study, with a view to better understanding the implications for policy and practice.

Research questions

B1 How do the NoGAPS partnership organisations identify and prioritise injury prevention and safety promotion issues for the development of new resources?

B2 What processes do the NoGAPS partnership organisations use to develop new injury prevention and safety promotion resources?

B3 What distribution pathways do the NoGAPS partnership organisations use to circulate injury prevention and safety promotion resources to the general sporting public?

Methods

Individual semi-structured interviews with key representatives of each of the NoGAPS partnership organisations were conducted to collect data for this study.

The data, collected as audio files, were analysed thematically, consistent with a descriptive qualitative methodology. This methodology does not necessitate a highly theoretical or abstract rendering of the data, but rather presents the themes in 'everyday language' in such a way that they are potentially useful for policymakers and practitioners (Sandelowski 2000).

Study B has already been reported on in more detail in a peer-reviewed published paper, presented in Chapter 4.

Organisation of thesis

As this thesis is presented in the form of *thesis-incorporating-publications*, it consists of a combination of traditional chapters and peer-reviewed publications:

Chapter 1: Introduction

This introductory chapter has presented the background, significance, context, and setting of this research. The research problem has been defined, and the theoretical framework and research approach introduced. The aim, purpose, rationale, research questions, and methods have been set out for study A and study B respectively. Finally, this chapter presents this overview of the organisation of this thesis.

Chapter 2: State-of-the-art review

This chapter presents a state-of-the-art review of the models and frameworks underpinning sports injury prevention research. The purpose of this chapter is to provide a narrative overview of the theoretical development of the field of sports injury prevention, so as to show how research underpinning the resources used to inform policy and practice is produced, and to explicate where knowledge translation gaps emerge. This field is traced from its origins in efficacy 'what works' approaches, through to effectiveness 'what works in context' approaches. The influence of these theoretical models and frameworks are, in turn, demonstrated through a discussion of key meta-analyses, systematic and other reviews, as well as examples, so as to show how these conventional approaches have shaped the field. Finally, this chapter highlights two key limitations to conventional approaches to sports injury prevention research, and makes the case for considering this topic through a complexity lens.

Chapter 3: Theoretical framework

Complexity theory is introduced in this chapter by comparing and contrasting it to the conventional approaches to sports injury prevention and safety promotion discussed in Chapter 2, through an embedded peer-reviewed publication. Next, the emergence of a complexity approach is discussed, before moving to detail the key tenets of complexity theory relevant to this research topic. Applications of complexity theory in other research fields are presented to demonstrate why this framework was chosen for this study

Chapter 4: Methodology and findings (Study A and Study B)

This chapter is written to both present and augment the two peer-reviewed original research publications arising from this work and embedded within this thesis: that of study A and study B.

First, this chapter explains the research approach taken, in more detail than was appropriate in the embedded peer-reviewed publications. The research paradigm (qualitative research), epistemology (constructivism), strategy of inquiry (case study), ethical issues, as well as rigour and trustworthiness are discussed.

Secondly, this chapter presents the methods of data collection (study A: document collation, and study B: interviews), data analysis (study A: document analysis, and study B: qualitative description), findings, and conclusions of study A and B in the form of peer-reviewed publications respectively:

Study A:

> Bekker S & Finch CF. 2016. Too much information? A document analysis of sport safety resources from key organisations. *BMJ Open* 6(5):E010877.

Study B:

> Bekker S, Paliadelis P & Finch CF. 2017. The translation of sports injury prevention and safety promotion knowledge: Insights from key organisations. *BMC Health Research Policy and Systems* 15(25): DOI: 10.1186/s12961-017-0189-5

Chapter 5: Discussion and conclusion

Chapter 5 presents and discusses the key conclusions from this study that consolidate and discuss the findings of study A and study B (Chapter 4) in relation to the research problem (Chapter 1), existing literature (Chapter 2), and theoretical framework (Chapter 3). Next, implications and recommendations for future research, policy and practice are made. Limitations are discussed. Finally, this chapter concludes the research presented in this thesis.

Conclusion

This introductory chapter has introduced the research presented in this thesis by presenting the background, major questions and approaches that guide this work. This chapter closes with a guiding overview of the structure of this thesis-with-publications. Following, Chapter 2 presents a state-of-the-art review of the relevant literature, providing context to the rationale for this research.

CHAPTER 2: LITERATURE REVIEW

Introduction

To establish an understanding of current knowledge in this area, and, more pertinently, how it is produced, this chapter presents a state-of-the-art review of the key published frameworks and models that inform and underpin sports injury prevention research. State-of-the-art reviews are typically narrative in nature (Grant & Booth 2009), important for tracing and tracking the development of a principle, concept, or field of research (Ferrari 2015). The purpose of this state-of-the-art review chapter is to provide an overview of how sports injury prevention is typically researched theoretically, in order to illustrate how current knowledge has been produced, and to show where gaps emerge. The aim of this chapter is, therefore, to review the key models and frameworks underpinning conventional sports injury prevention research, to highlight where limitations exist, and, in turn, to make the case for a complexity approach.

The sports injury prevention literature relevant to this study exists largely in the form of theoretical papers generally published as editorials, commentaries, and opinion pieces. Therefore, this chapter will focus on these types of publications. Further, as this is a state-of-the-art review of frameworks and models rather than a critical review of empirical literature, this chapter will largely draw on systematic reviews, meta-analyses and key examples to illustrate how key models and frameworks have shaped knowledge in this field, and led to gaps in the translation of knowledge to policy/practice.

This chapter begins with a short overview of key theoretical models and frameworks that have been critical to better understanding and researching injury prevention in general. A move is thereafter made to discuss the models and frameworks underpinning sports injury prevention research more specifically, which will be the focus of this chapter given the context and setting for this study. The state-of-the-art of conventional efficacy and effectiveness models and frameworks for sports injury prevention intervention development will therefore be discussed in more detail, using examples and reviews from the sports injury prevention exercise programs literature. Finally, limitations to the conventional models and frameworks underpinning sports injury prevention research are discussed, and the need for a complexity approach is introduced.

What this chapter is not, and does not address:

What this chapter is not, and does not address, is a comprehensive and critical review of the empirical sports injury prevention efficacy and effectiveness literature. The justification for this is that the aim of this study, as articulated in Chapter 1, is to determine whether a complexity approach can help to better understand systemic safety promotion within Australian community sports settings. Therefore, the purpose of this chapter is to explore narratively the *ways in which sports injury prevention is researched, and where gaps in knowledge translation into policy/practice emerge,* rather than the individual sports injury prevention strategies themselves.

In other words, the purpose of this chapter is to consider and review the key theoretical models and frameworks underpinning sports injury prevention research, so as to present the strengths and limitations, and ultimately provide an overview of the state-of-the-art of how research is undertaken, underpinned, and translated in this area.

The considerations that this chapter provides will feed into Chapter 3, the theoretical framework, where a complexity approach to sports injury prevention is introduced by comparing and contrasting it to the conventional research approaches discussed in this chapter, and then explained more fully.

Injury prevention

Early understandings of injury focused on the assumed fault of the injured person, and thus assigned personal responsibility (Chapman v. Hearse 1961). Yet, personal responsibility is only one of a variety of factors contributing to injury. Therefore, understandings of injury prevention quickly developed to better account for systemic influences such as mechanistic causes (De Haven 1944), host-agent-environment models (Gordon 1949), and energy interchange (Gibson 1961). Today, injury is generally defined operationally as those diagnoses and codes (or their combinations) present under "Injury, poisoning and certain other consequences of external causes" in the *International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)* (World Health Organisation 2016). By way of explanation, Langley and Brenner (2004 pp70) write that this includes "all those pathologies most scientists and members of the public would describe as injury (for example, fracture, dislocation, open wound)" and "all those mechanisms or events which "cause" injury (for example, motor vehicle traffic crash, fall, sharp objects)."

The epidemiologist Haddon (1980a) has been recognised as a world-leader in the area of injury prevention since the 1960s. His work derives from the earlier work of De Haven (1944), who was the first to formally focus on a model for the prevention of injury in the early 1940s. Haddon's (1980b pp41-42) '*The 10 Strategies'* remains a relevant hierarchy to understanding injury prevention:

1. To prevent the creation of the hazard in the first place
2. To reduce the amount of hazard brought into being
3. To prevent the release of the hazard that already exists
4. To modify the rate or spatial distribution of release of the hazard from its source
5. To separate, in time or space, the hazard and that which is to be protected
6. To separate the hazard and that which is protected by interposition of a material barrier
7. To modify relevant basic qualities of the hazard
8. To make what is to be protected more resistant to damage from the hazard
9. To begin to counter the damage already done by the environmental hazard
10. To stabilise, repair, and rehabilitate the object of the damage

Haddon further developed the *Haddon Matrix* (Haddon 1980a), which includes two dimensions as precursors to all injury events (Table 2.1; example Table 2.2). The first dimension describes three stages of injury: pre-event, event, and post-event. The second dimension consists of three factors that contribute to injury risk: human, vector, and environment. In public health terms, this matrix then considers how the host-agent-environment intersects with primary, secondary, and tertiary prevention measures. Possibilities for the reduction of injury can thereby be considered through: 1) prior and possible future resource allocation and activities, 2) relevant research and other knowledge, and 3) priorities for countermeasures (Haddon 1980a).

Table 2.1: A framework for Haddon's Matrix (adapted from Haddon 1980a pp417)

	Factors		
Phases	**Human**	**Vector**	**Environment**
Pre-event			
Event			
Post-event			

Table 2.2: Haddon Matrix applied to the problem of school violence by firearms (adapted from Runyan 1998 pp303)

	Factors		
Phases	**Human (students at school)**	**Vector (firearm & bullets)**	**Environment (school)**
Pre-event (before teen uses weapon)	Educate teens about the dangers of carrying guns to school Educate parents about dangers of allowing teens access to guns. Teach students to recognise and report student behaviours indicative of possible violent behaviour	Modify guns so they are only operable by the owner	Install metal detectors at entrances to schools. Eliminate storage places in schools (for example lockers) where guns might be kept
Event (when gun is taken out to be fired)	Teach students to take cover when they see guns or hear gunfire	Reduce capacity of weapons to fire multiple rounds quickly Modify bullets to be less lethal	Install alarm systems to call law enforcement as soon as weapons are visible
Post-event (after students are shot at)	Teach students first aid skill	Reduce the capacity of the gun to continue firing	Make school grounds readily accessible to ambulances

The Haddon Matrix has been an appropriate, successful, and widely used framework for the development of many injury prevention interventions, including sports injury prevention interventions (Vriend *et al.* 2017). However, it was developed out of Haddon's research into, and understandings of, motor vehicle crashes (Haddon 1980a). Due to its underpinnings (and thus language) being drawn from mechanistic assumptions, its relevance to social interventions has been limited (Runyan 1998). Its applicability to the example problem of school violence by firearms in Table 2.2 above is evident, however contemporary understandings of firearm violence are closer to models of infectious disease, where violence is understood as transmitted via *social* interaction (Branas, Jacoby & Andreyeva 2017). Therefore, to account for the social element more fully, Runyan (1998) expanded the Haddon Matrix by introducing a *third dimension* that

proposes value criteria for injury prevention planning: effectiveness, cost, freedom, equity, stigmatization, preferences, feasibility, and other identified criteria that better acknowledge the social aspect of injury interventions (Figure 2.1) (Runyan 1998).

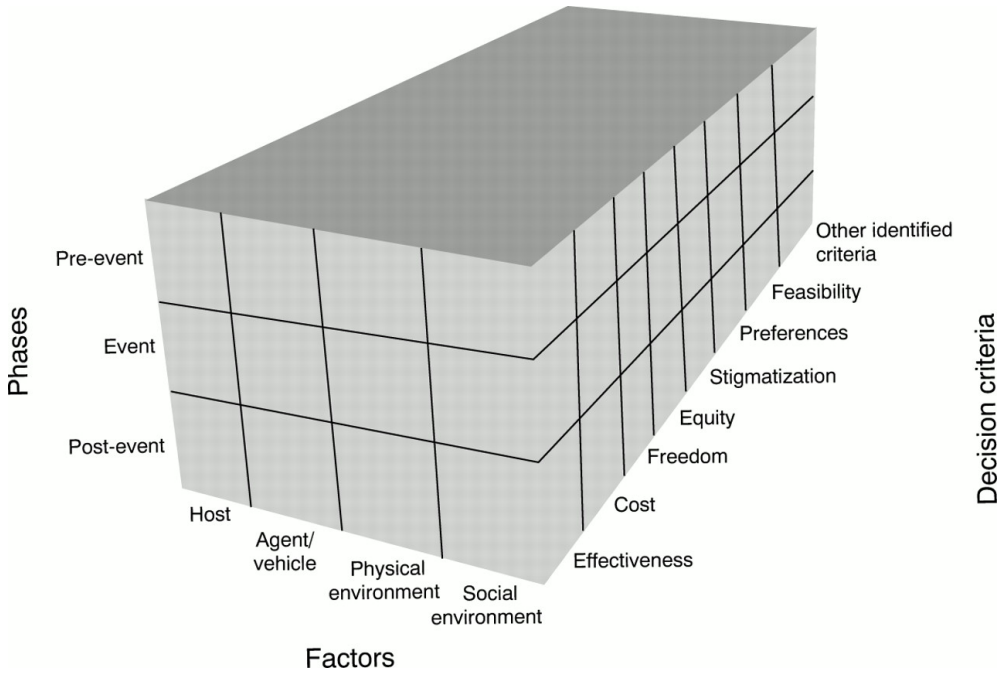

Figure 2.1: Three Dimensional Haddon Matrix (reproduced from Runyan 1998 pp304, used with permission from The BMJ through RightsLink / Copyright Clearance Center – Appendix 1a)

With regards to social interventions, then, arguably the most recognisable model by which to study and influence the prevention of injury is the *Public Health Model*, a scientific approach to prevention (Mercy *et al.* 1993). This model consists of four classic steps to intervention research as depicted in Figure 2.2.

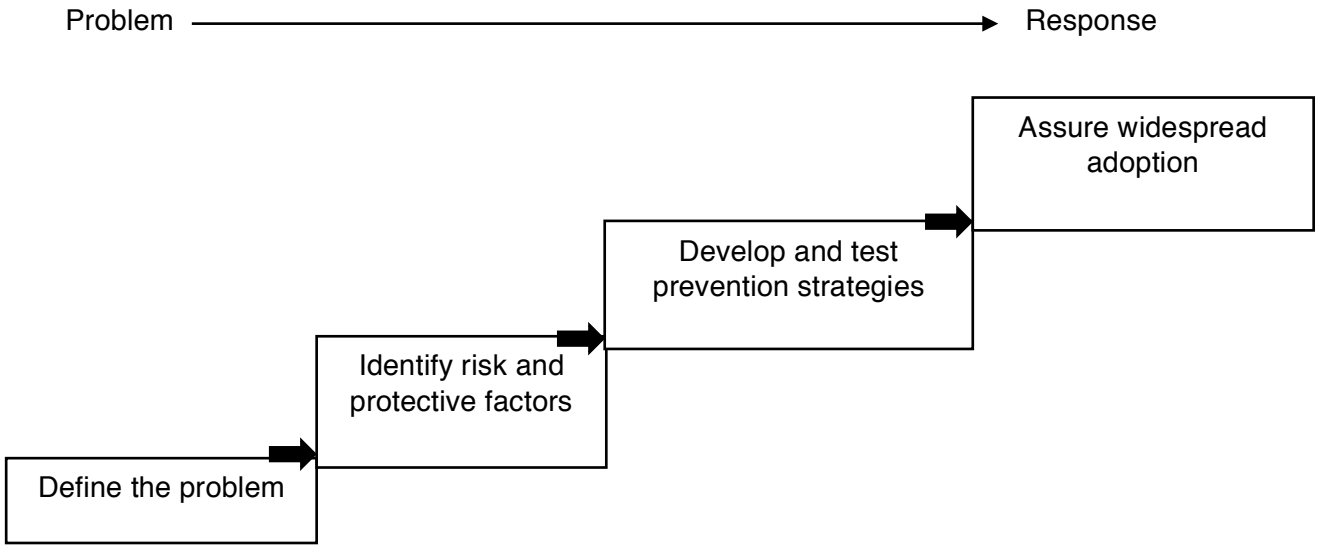

Figure 2.2: Public Health Model of a Scientific Approach to Prevention (reproduced from Mercy *et al.* 1993 with permission from HealthAffairs through RightsLink / Copyright Clearance Center – Appendix 1b)

The Public Health Model (Mercy *et al.* 1993) has informed a wide range of interventions across different fields of public health, including violence prevention (Foege, Rosenberg & Mercy 1995) and injury prevention (LaFlamme, Svanström & Schelp 1999; Stout 2008; Hanson *et al.* 2012). The theory behind this model in particular has had a great influence on sports injury prevention research, and this influence and resulting shaping of the field will be further discussed in the next section.

Sports injury prevention

In the sports injury prevention literature, sports injury is most often defined as time lost from participation/competition or time off from daily activities (such as work or training), often, but not always, coupled with attention from a medical professional (Finch 1997). This definition, and other similar time loss iterations, generally refers to *physical* sports injuries - such as muscle strains. However, injuries occurring in sports settings can further be understood through a biopsychosocial (Engel 1980) and/or sociocultural lens, in that the possibility for harm exists beyond physical (biomedical or biomechanical) injuries alone (Wiese-Bjornstal 2010; Brackenridge & Rhind 2014). This is reflected in the three main categories of harm identified in a 2015 review and framework for the International Olympic Committee youth athlete development model, categorised as individual (including disordered eating/eating disorders, self-harm, doping, and other substance abuse), relational (including harassment, abuse, bullying, and neglect), and organisational (including discrimination, hazing, and medical mismanagement) (Mountjoy *et al.* 2015). Similarly, a refined taxonomy in the 2016 IOC consensus statement on harassment and abuse (non-accidental violence) in sport (Mountjoy *et al.* 2016), classifies other forms of harm occurring in sports settings as: 1) psychological harassment and abuse, 2) sexual harassment and abuse, 3) physical abuse and forced physical exertion, and 4) neglect.

Models and frameworks informing sports injury prevention research developed out of theoretical understandings to the field of public health, as outlined in the previous section. More specifically, sports injury prevention research is largely theoretically informed by the Public Health Model (Mercy *et al.* 1993), an overview of which was provided in the previous section. Conventionally, research into sports injury prevention is undertaken as either *efficacy* or *effectiveness* studies (Finch 2010). This section will therefore provide a discussion of the conventional efficacy and effectiveness models/frameworks of sports injury prevention research respectively.

Efficacy: what 'works' to prevent sports injury

Efficacy research, where "the preventive effect of the intervention is assessed under ideal and tightly controlled conditions", describes the approach underpinning the vast majority of sports injury prevention studies (Finch 2010 pp213). Key to the efficacy approach in this field is the *Sequence of Prevention* (van Mechelen, Hlobil & Kemper 1987, 1992), a model that has as its main outcome a measure of intervention efficacy - whether or not an intervention 'works'.

The Sequence of Prevention (van Mechelen, Hlobil & Kemper 1987, 1992) was developed in the Netherlands specifically for injury prevention in the sporting context, in response to increasing calls in Europe for improving the understanding of sports injuries and their prevention. Theoretical underpinnings of injury prevention under the Public Health Model (Mercy *et al.* 1993), as introduced in the previous section, reflect in the Sequence of Prevention, which thus consists of four similar steps, as depicted in Figure 2.3.

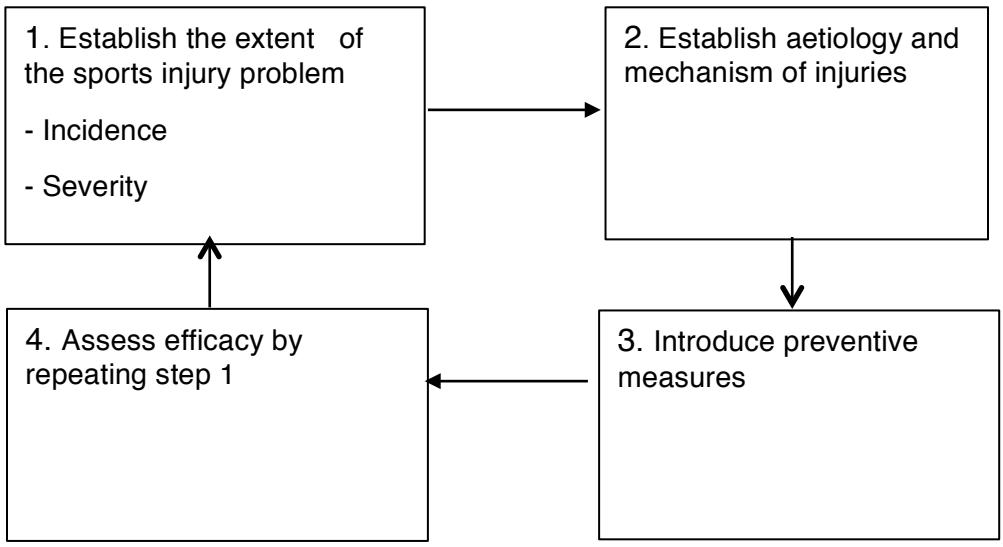

Figure 2.3: The Sequence of Prevention of Sports Injuries (reproduced from van Mechelen, Hlobil & Kemper 1987, 1992 pp84 with permission from Springer through RightsLink / Copyright Clearance Center – Appendix 1c)

The development of efficacious interventions theoretically informed by the Sequence of Prevention (van Mechelen, Hlobil & Kemper 1987, 1992) has been key to understanding how sports injuries, which are typically considered by the lay public to be inevitable and unavoidable 'accidents' (Davis & Pless 2001), can be prevented. A key example of an intervention developed under the efficacy approach is the Fédération Internationale de Football Association (FIFA) 11+ warm up programme (Bizzini, Junge & Dvorak 2013). The 11+ was developed by the Santa Monica Orthopaedic and Sports Medicine Research Foundation, and the Oslo Sports Trauma Research Centre in 2006 (http://f-marc.com/11plus/home/). The 11+ is the most widely evaluated sports injury prevention intervention, that, for example, has been empirically shown to 'work' through a 2008 trial of young female footballers in Norway, where players had 37% fewer training, 29% fewer match, and 50% fewer severe injuries (Soligard *et al.* 2008). When compliance was assessed in a further RCT of young female Norwegian football players, it was found that high compliance corresponded with significantly lower injury risk (Soligard *et al.* 2010). Other trials of the 11+ have also shown efficacy around various components associated with injury risk, such as functional balance (Steffen *et al.* 2013), neuromuscular control and knee flexor strength (Impellizeri *et al.* 2013; Bizzini *et al.* 2013), as well as static/dynamic balance and thigh muscle strength (Brito *et al.* 2010; Daneshjoo *et al.* 2012a; Daneshjoo *et al.* 2012b; Reis *et al.* 2013). Therefore, the 11+ is considered clearly efficacious under the Sequence of Prevention model for key measures of sports injury prevention outcomes. It 'works' to prevent certain sports injuries.

Similarly, the Nordic Hamstring exercise programme (Mjølsnes *et al.* 2004), also informed by the theoretical underpinnings of the efficacy approach, was developed with the aim of creating an efficacious intervention to prevent hamstring injuries. The Nordic Hamstring exercise intervention has been shown in efficacy trials to reduce the risk of hamstring injuries by at least 50% (Mjølsnes *et al.* 2004; Arnason *et al.* 2008; Petersen *et al.* 2011), and therefore is another example of a clearly efficacious intervention – it 'works' to prevent injury under the Sequence of Prevention.

The Sequence of Prevention (van Mechelen, Hlobil & Kemper 1992) has proven to be a key model of influence in the sports injury prevention literature, with the 1992 version having reached 1075 citations (Google Scholar March 2017). As its theoretical underpinnings are clearly compatible with efficacy approaches, the Sequence of Prevention has underpinned much of the popularity of studying sports injury prevention through the 'gold standard' of efficacy trials. The popularity of efficacy approaches to,

and the resulting proven empirical efficacy of, sports injury prevention interventions is reflected in several systematic reviews on the subject (McBain *et al.* 2012a; McBain *et al.* 2012b; Lauersen, Bertelsen & Andersen 2014; Leppänen *et al.* 2014; Rössler *et al.* 2014; Soomro *et al.* 2016). Most tellingly, this influence reflects in a 2012 systematic review of sports injury prevention research that showed that, since the early 1980s, RCT studies increased by over 650% (McBain *et al.* 2012a).

It would appear, therefore, that the existence of efficacious interventions developed under efficacy approaches theoretically informed by the Sequence of Prevention (van Mechelen, Hlobil & Kemper 1992) means that the future of injury prevention in sports settings is clear and secure. Yet, problems in preventing injury in the 'real-world' outside of controlled efficacy trials have emerged (Hanson *et al.* 2014; Bahr, Thorborg & Ekstrand 2015; Twomey *et al.* 2015; O'Brien, Donaldson & Finch 2016). Indeed, numerous issues have been encountered when transferring efficacious interventions to policy and practice in 'real-world' contexts, and therefore questions around intervention effectiveness, whether they 'work in context', have emerged (Kessler & Glasgow 2011; Finch 2011a).

For example, the efficacious interventions highlighted above have proven to be less than successful when transferred to other settings. The worldwide uptake of the 11+ was, and remains, low, despite financial and other support from FIFA (Bizzini, Junge & Dvorak 2013). The reasons for this are multi-faceted, but hinge on the underpinning assumption that what was proven to 'work' in a closed RCT in a high-income country, would work when translated to football clubs around the world. However, unforeseen implementation barriers were encountered in 'real-world' settings, including a lack of dedication and motivation to use the program (Bizzini, Dvorak & Junge 2013).

Similarly, the highly efficacious Nordic Hamstring exercise programme (Mjølsnes *et al.* 2004) previously discussed was recently found to not have been adopted or implemented by the majority of Champions League or Norwegian Premier League football teams (Bahr, Thorborg & Ekstrand 2015). This is despite: 1) hamstring injuries being one of the top injury concerns in this population, 2) the intervention itself being proven highly efficacious, 3) knowledge of the intervention being high, and 4) these being professional leagues which supposedly would have both the time and intrinsic motivation to implement such an intervention (Bahr, Thorborg & Ekstrand 2015). Returning to the 2014 systematic review and meta-analysis of sports injury exercise intervention RCTs referenced previously, which showed that the included interventions were generally

efficacious, it also showed that limitations exist around study design and context homogeneity and thus that results may be 'clinically useless' because they are not suited to context (Lauersen, Bertelsen & Andersen 2014).

Whilst efficacy studies theoretically informed by the Sequence of Prevention model (van Mechelen, Hlobil & Kemper 1992) are necessary to show whether interventions are efficacious, or 'work' in controlled settings, outcomes have not been as successful as expected when these are implemented across a variety of settings or locations (Finch 2011b; Hanson *et al.* 2014; Bahr, Thorborg & Ekstrand 2015; Twomey *et al.* 2015; O'Brien, Donaldson & Finch 2016). These issues appear to have emerged across the board in transferring efficacious interventions developed under efficacy approaches to the 'real-world'. A reason for this, as O'Brien and Finch (2014a) showed through a systematic review of the implementation of injury prevention exercise programmes in team ball sports, is that interventions which are shown to be efficacious inevitably fail to systematically examine the influence that key contextual components have on outcomes of effectiveness. Further, there is often inadequate reporting of any 'implementation' components in the published results of efficacy trials, if indeed they were utilised (O'Brien & Finch 2014b). Efficacy studies are thus useful for injuries where the aetiology and mechanisms of injury and prevention remain unknown, and where the efficacy of interventions are unproven, however tend to fall short when interventions are implemented in 'real-world' settings due to a number of socio-ecological factors (Kessler & Glasgow 2011; Finch 2011a). This will be further discussed in the following section.

Effectiveness: what 'works in context' to prevent sports injury

In response to the emergence of 'real-world' issues impeding the success of efficacious sports injury prevention interventions outside of controlled contexts, Finch (2006) has been a leader in formally identifying a number of limitations to efficacy approaches to sports injury prevention. A key issue being that research has shown 'what works' to prevent sports injuries in controlled settings, but that this information is not always relevant to, nor effective in, 'real-world' sports settings (Finch 2006). In this way, Finch (2006) was the first to facilitate a key shift to researching intervention *effectiveness* in the field of sports injury prevention, which is "where the preventive effect of the intervention is assessed under everyday circumstances" (Finch 2010 pp213).

Since 2006, a growing body of research, commentary, opinion pieces, and editorials on the importance of effectiveness approaches to sports injury prevention research, often framed as implementation and dissemination research, has emerged (van Tiggelen *et al.* 2008; Finch 2010; Verhagen & van Mechelen 2010; Finch 2011a; Finch 2011b; Verhagen & Finch 2011; Bizzini, Junge & Dvorak 2013; Steffen *et al.* 2013; Hanson *et al.* 2014; Donaldson & Finch 2013; O'Brien, Donaldson & Finch 2016). This reflects a similar move to effectiveness approaches in health research more broadly (Glasgow & Emmons 2007; Kessler & Glasgow 2011; Hanson *et al.* 2012; Peters *et al.* 2013; Green 2014; Neta *et al.* 2015), including a better accounting for context (Hanson *et al.* 2005).

Finch's work (2006) has, therefore, emerged as significant in the sports injury prevention field, with 391 citations to date (Google Scholar March 2017). Critically, in addition to formally recognising limitations to efficacy approaches, Finch (2006) also proposed the Translating Research into Injury Prevention Practice (TRIPP) framework as a new model to theoretically inform sports injury prevention in 'real-world' contexts (Figure 2.4). This is a six-stage framework aimed at providing the means to 'bridge the gap' between research and policy/practice. The TRIPP framework therefore aims to assess sports injury prevention intervention effectiveness – whether or not an intervention 'works in context'.

Model stage	TRIPP	Sequence of Prevention (van Mechelen, Hlobil & Kemper 1992)
1	Injury surveillance	Establish the extent of the sports injury problem
2	Establish aetiology and mechanisms of injury	Establish aetiology and mechanism of injury
3	Develop preventive measures	Introduce preventive measures
4	"Ideal conditions" / scientific evaluation	Assess efficacy by repeating step 1
5	Describe intervention context to inform implementation strategies	
6	Evaluate effectiveness of preventive measures to implementation context	

Figure 2.4: The Translating Research into Injury Prevention Practice (TRIPP) framework (reproduced from Finch 2006 pp4 with permission from the Journal of Science and Medicine in Sport through RightsLink / Copyright Clearance Center – Appendix 1d)

A relevant example of effectiveness research informed by the TRIPP framework is an Australian study, the Preventing Australian Football Injuries through eXercise (PAFIX) trial, designed to investigate an intervention aimed at preventing lower-limb injuries in community Australian football players (Finch, Lloyd & Elliott 2009; Finch, Twomey, Fortington *et al.* 2016). When assessed for efficacy in a clustered RCT, this intervention showed a clinically important knee injury rate reduction of 50% and a lower-limb injury

rate reduction of 22% (Finch, Twomey, Fortington *et al.* 2016). Findings around effectiveness showed that the intervention only reached 50% of targeted players, but for those who were exposed to the training adoption was high (Finch *et al.* 2014). However, a further case study on the implementation challenges encountered during the study explained why the latter stages of effectiveness research remain difficult to achieve, including 'real-world' issues such as player- and coach-related challenges, and environmental/equipment factors (Twomey *et al.* 2015). More specifically, these challenges, or 'real-world' 'unanticipated issues' (Twomey *et al.* 2015), mirror common implementation barriers that have emerged in other similar intervention effectiveness studies, including: a lack of compliance (Soligard *et al.* 2010; Steffen *et al.* 2013), the effect of coach and player injury knowledge, attitudes and beliefs (McKay *et al.* 2014), and insufficient fidelity to the intervention itself (Fortington *et al.* 2015).

A subsequent project, the National Guidance for Australian Football Partnerships and Safety (NoGAPS) study (of which this research is a case study), made use of a TRIPP-informed effectiveness approach to develop, disseminate and implement an efficacious injury prevention intervention, and to evaluate the resources needed for its effective uptake (Finch *et al.* 2011). Three primary phases were used to develop the resulting NoGAPS FootyFirst intervention: 1) compilation and quality assessment of research evidence, 2) incorporation of clinical expertise and practitioner knowledge and views, and 3) consideration of end-user preference, capacity, and values (Donaldson, Lloyd, Gabbe, Cook & Finch 2016). These phases were informed by prior understandings of the 'real-world' limitations of efficacy approaches (Hanson *et al.* 2014), the need for theory-informed implementation practices (Finch 2010; Kessler & Glasgow 2011; Finch 2011a; Finch 2011b; Verhagen & Finch 2011; Donaldson & Finch 2013), and, innovatively, better incorporating end-users' perspectives (Donaldson & Finch 2012). The process of development was underpinned by the assumption that "scientific evidence is just the starting point" (Donaldson, Lloyd, Gabbe, Cook, Young *et al.* 2016 pp334), and that "it will take more than an existing exercise programme to prevent injury" (O'Brien, Donaldson & Finch 2016 pp264). Key to this systematic process of developing the intervention was the hypothesis that much greater success with regards to the implementation of the developed intervention would be seen if it was developed and implemented under effectiveness assumptions (Finch *et al.* 2011). The resulting intervention, the FootyFirst lower-limb exercise programme, was thereby underpinned by scientific evidence (Donnely *et al.* 2012; Andrew *et al.* 2013), expert opinion (Donaldson *et al.* 2015), the knowledge gained in the PAFIX trial discussed in the previous paragraph

(Finch, Twomey, Fortington *et al.* 2016), and a systematic, iterative process to develop strategies for its implementation (Donaldson, Lloyd, Gabbe, Cook & Finch 2016; Donaldson, Lloyd, Gabbe, Cook, Young *et al.* 2016).

Effectiveness models and frameworks, as the PAFIX and NoGAPS FootyFirst examples above show, build on, and add to, the success of efficacy trials. However, effectiveness approaches, such as those informed by the TRIPP framework (Finch 2006), represent a relatively new area of sports injury prevention research, and therefore much less published research exists (Klügl *et al.* 2010). The most recently available critical appraisal of sports injury prevention research studies found that 33% were incidence and aetiology studies, efficacy studies made up 10%, while effectiveness studies comprised 1%, and the remaining majority of studies (56%) were reviews and editorials (Klügl *et al.* 2010). This trend is reflected in the findings of a 1999 review of prevention research more generally, that found that 63% of publications were descriptive, 11% covered intervention development, 16% intervention testing, only 5% were concerned with implementation, and less than 1% were concerned with dissemination (Oldenburg *et al.* 1999). Whilst these reviews are likely out-dated given their age, a 2014 systematic review of the reporting of implementation aspects of injury prevention exercise programmes in team ball sports, which used the RE-AIM framework (Glasgow, Vogt & Boles 1999) to assess reporting of implementation components, specifically: Reach, Efficacy, Adoption, Implementation, and Maintenance, paints a similar picture within interventions (O'Brien & Finch 2014a). This review showed that reporting of intervention components remains scarce. Reporting of efficacy measures was the highest with a mean of 58% of these papers mentioning this aspect, whilst reach (38%), implementation (36%), adoption (8%), maintenance (1%) reporting was lacking (O'Brien & Finch 2014a). Therefore, whilst it may be known whether an intervention 'works' or 'works in context' or not, the reasons why are not generally well articulated.

Effectiveness approaches to sports injury prevention, theoretically informed by models such as the TRIPP framework, have been essential to moving the field forwards. A better accounting for, and understanding of, components that assist in 'real-world' implementation and effectiveness of interventions continue to grow. However, limitations to both efficacy and effectiveness approaches, and their theoretical models and frameworks, have emerged. These will be discussed in the next section

Limitations to efficacy and effectiveness approaches

The 'puzzle' approach

An unintended consequence of both efficacy and effectiveness approaches, as evidenced by reviews of study types and the reporting thereof discussed above (Klügl *et al.* 2010; Oldenburg *et al.* 1999; O'Brien & Finch 2014a), is that studies using these approaches rarely follow or investigate all of the steps under a model/framework from start to finish in one study. Effectiveness approaches were developed to 'bridge' the gap between research and its use in practice (Finch 2006; Finch 2011a; Kessler & Glasgow 2011), however the tendency to reduce these research models and frameworks to a single stage study hinders more 'real-world' relevant research. Rather, studies tend to focus on 'a piece of the puzzle', justified as addressing one or two stages of the particular model or framework (Finch 2006). Rarely are research studies, such as the NoGAPS project (Finch *et al.* 2011), undertaken where all the steps of a model or framework are followed under one study. This may be because full efficacy or effectiveness studies following all the steps of a framework or model in one context are costly and lengthy to conduct, or that traditional single-disciplinary approaches preclude the multi- and inter-disciplinary research that these models and frameworks rely on (Glasgow & Emmons 2007; Craig *et al.* 2008; Hawe 2015b).

Glasgow & Emmons (2007) refer to this as the 'connectedness' necessary to increase translation of research into policy and practice. Currently, research studies are "happening in separate 'silos' of unrelated activities, as often happens in large systems" (Glasgow & Emmons 2007 pp426). The 'puzzle' approach may, in this way, be hampering progress in intervention research, and reflects in the less-than-ideal wider trend within health care research that findings take an average of 17 years to influence practice (Morris, Wooding & Grant 2011).

The 'pipeline' effect

As discussed, effectiveness approaches build on efficacy approaches to intervention research. However, as Greenhalgh & Wieringa (2011), Green (2014), and Hawe (2015a) theorize, both efficacy and effectiveness approaches tend to perpetuate the knowledge-to-practice gap, rather than solving it. A pipeline is created by the research approach itself in that efficacy approaches sanitize intervention contexts in seeking empirical evidence, and effectiveness approaches tend to work after the fact to find 'missing' implementation components or factors which must then be influenced (Glasgow, Lichtenstein & Marcus 2003; Kreindler 2014).

Accordingly, both efficacy and effectiveness models/frameworks reflect a 'pipeline' approach to research and practice (Green 2014; Hawe 2015a). The pipeline approach assumes that rigorous scientific research (efficacy research) is conducted at one end of the pipeline, and that the practice that must be influenced (through effectiveness research) exists at the other (Green 2014; Hawe 2015a). From this view, research must be translated into practice through more or different 'puzzle pieces' that aim to 'bridge the gap'.

The assumption that a 'research to practice gap' must necessarily exist because of the nature of scientific research under conventional models and frameworks, in which the pipeline is a temporal sequence in which certain steps must be conducted before the next, has been challenged by researchers theorizing about knowledge translation as being caused by underlying research assumptions, rather than an unavoidable and necessary delineation (Glasgow, Lichtenstein & Marcus 2003; Greenhalgh & Wieringa 2011; Green 2014; Hawe 2015a). Greenhalgh & Wieringa (2011), in particular, highlight the tensions in the knowledge translation literature, finding that the 'knowledge translation' metaphor places constraints on study design, and often has an outcome where "knowledge obstinately refuses to be driven unproblematically into practice" (pp 501). Further, these authors conclude that research needs to be conceptualised *differently* if better outcomes are to be achieved (Greenhalgh & Wieringa 2011). This is echoed by Kreindler (2014), Glasgow, Lichtenstein & Marcus (2003), Engebretsen, Sandset & Ødemark (2017), Greenhalgh (2010), Green & Seifert (2005) who have all problematized the knowledge translation metaphor, and the resulting 'pipeline' approach. As Hawe (2015a) concludes, such terminology under conventional approaches (efficacy to effectiveness, bridge the gap, knowledge translation) only perpetuates the illusion that intervention success is ultimately vested within the implementation process.

‘Knowledge translation’ is seeing a revival in the sports injury prevention literature, with tools such as the ‘Knowledge Transfer Scheme’ being developed to bridge the gap between science and practice (Verhagen *et al.* 2013). Similarly, a recent opinion piece stated that current sports medicine journals are outdated and ineffective in translating knowledge, and called for more and better knowledge dissemination (Barton 2017). However, these still tend to look at the problem through an efficacy-to-effectiveness lens, or a research-to-practice pipeline, and place the solution within these lenses.

Rather than vesting the problem within the pipeline and through a puzzle approach, the arguments presented in this thesis will call for a move to considering and working with ontological complexity, as will be argued in the next chapter. Complexity must be better accounted for in designing and conducting research if it is to have an impact on policy and practice (Glouberman & Zimmerman 2002; Craig *et al.* 2008; Boulton, Allen & Bowman 2015; Hawe 2015a), including within the sporting context (Bittencourt *et al.* 2016).

In summary: making the case for considering complexity

Despite the growth and theoretical development of the field of sports injury prevention and safety promotion research, intractable problems remain. It appears that current approaches to, and understandings of, sports injury prevention and safety promotion could benefit from novel approaches that account for the *complexity* of social interventions.

As shown in this chapter, it appears that closing the gap between efficacy and effectiveness remains a challenging, and perhaps flawed, endeavour. Effectiveness approaches have proven useful in starting to 'bridge the gap' between content and context, or efficacy and effectiveness, through implementation and dissemination research. However, even when interventions are designed with included implementation plans, the complexity of the 'real-world' often impairs their effectiveness. A consideration for the complexity of processes both of the intervention itself, and the processes that occur between knowledge and action, may be necessary to account for the complex ontology of social interventions, and systemic safety promotion.

Research has provided a wealth of evidence regarding 'what works' for sports injury prevention (efficacy), as well as provided the rationale and steps towards determining 'what works in context' (effectiveness). A clear next step is to start to uncover more about 'what works, for whom, when, where, why, and how' (Pawson 2006). The gap that this study will address is in better understanding the complexity in the gap between how knowledge is created, and its use in policy and practice. This includes better understanding about what the puzzle approach and pipeline effect look like in context.

To influence complex problems, an understanding of the nature and implications of ontology is required. Therefore, there is a pressing need to take a different approach to build on the successes of the past to better understand the complexity of sports injury prevention. This will be discussed in Chapter 3.

Conclusion

This chapter has provided an overview of key theoretical models and frameworks of injury prevention, and sports injury prevention more particularly. The theoretical development of the field of sports injury prevention was traced from its origins in efficacy 'what works' approaches, through to effectiveness 'what works in context' approaches. This is clearly a young science and the volume of theoretical literature is still relatively small. This chapter focused on relevant models and frameworks that underpin these approaches, and the current understandings of this field were shown through key examples and reviews. Finally, this chapter highlighted two key limitations to conventional approaches to sports injury prevention research, and made the case for considering a complexity lens. This will now be presented and discussed in Chapter 3.

CHAPTER 3: THEORETICAL FRAMEWORK

Introduction

The past 20 years of sports injury prevention research reflects a period of what Kuhn (1970) deems 'normal science', characterised by relative stability and consistent successes. Yet, discrepancies, intractable problems that resist explanation by methods of conventional science, persist. Accordingly, Kuhn (1970) asserts that progress on such issues can only be made when the conventional paradigm is cast into crisis and a 'paradigm shift' occurs. Scientific revolutions are thus necessary to progress, particularly where complex problems exist.

How can a shift to a complexity approach help to understand and influence safety promotion within sports settings? This chapter focuses on the key aspects and applications, insight and implications of complexity theory as an emerging paradigm in health research, and introduces its potential value for the study of injury prevention and safety promotion in sport settings. In the vein of Boulton, Allen & Bowman (2015) this chapter focuses on complexity *ontology* (complexity as worldview), rather than the *epistemology* of complexity (the ways we study complexity in the world).

In the preceding chapter, the literature pertaining to the conventional paradigm of sports injury prevention research was reviewed, the intractable issues that persist were highlighted, and the need for a complexity approach was introduced. This chapter, accordingly, will further show, including through a published editorial, the compelling need to bring a complexity approach to sports injury prevention research. Thereafter, the theoretical frameworks of conventional and complexity approaches will be compared and contrasted. Next, the key tenets of a complexity approach will be defined and described. Finally, this chapter will show how complexity theory has been applied to intractable problems in other relevant research areas, to demonstrate how this approach could be harnessed to potentially benefit sports injury prevention and safety promotion research. Therefore, this chapter will show how a complexity approach, through foregrounding the ontological complexity of both sport settings and sports injury prevention and safety promotion, can potentially make a difference to some of the intractable problems that persist in this area of research, policy, and practice.

Bringing complexity to sports injury prevention research: from simplification to explanation

This section has been published in the British Journal of Sports Medicine (Impact Factor: 6.6) as:

> Bekker S & Clark AM. 2016. Bringing complexity to sports injury prevention research: from simplification to explanation. *British Journal of Sports Medicine* 50(24):1489-1490

Authorship declaration:

Sheree Bekker conceptualised and led this editorial, had the major role in paper writing, and is responsible for the overall content as guarantor. Alexander M Clark provided expertise in complexity theory and its application to health services research, and contributed to the writing of this editorial.

Bringing complexity to sports injury prevention research: from simplification to explanation

Sheree Bekker,[1] Alexander M Clark[2]

Sports injury prevention research takes being formulaic to the extreme. Countless papers begin by reminding that sports injuries remain a significant public health burden,[1] and we are reassured that the proven efficacy of numerous interventions shows that sports injuries can be prevented.[2] Despite this optimistic picture, and amidst the proliferation of consensus statements and guidelines, the effectiveness of sports injury prevention interventions remains disappointingly inconsistent. We trace these discrepancies to two approaches that have guided past work—simple and complicated—and then move to propose a potentially useful way forward, that of complexity.

THE SIMPLE APPROACH

The 'simple' perspective advocates that injury incidence can be reduced via a recipe-type approach. Simplicity casts sports injuries as straightforward occurrences for which an optimal intervention is sought, where interventions either 'work' or 'do not work'. The Sequence of Prevention model,[3] for example, consists of four steps: (1) establish the extent of the problem, (2) establish the aetiology and extent of the injury, (3) introduce preventative measures and (4) assess intervention effectiveness by repeating stage 1. Under this simplified approach, research is conducted solely into the efficacy of interventions.

Interventions thus remain remarkably poorly described, hampering exploration of reasons for variations in outcomes—researched as a 'whole' rather than as multifaceted entities. Moreover, it is debatable whether the simple approach can even accommodate variations in intervention effects because the focus of this view is on identifying 'what works' rather than seeking to understand such variations. This does little to further the understanding of the large volume of both positive and negative findings in this field.

THE COMPLICATED APPROACH

More recent approaches recognise the limitations of this simple view, and the need for more sophisticated 'complicated' approaches to intervention.[4] As in other disciplines, the complicated approach uses formulae, past experience and historical precedence to specify what to include or address in interventions aimed to maximise their likelihood of effectiveness.[5] In contrast to the simple approach, the complicated perspective acknowledges the multifaceted nature of interventions, seeking to understand the influence of context, evidence-based content, dissemination and implementation on effectiveness.[4] This approach is often deemed more 'ecological', more 'integrated' and more 'real-world' than the simple approach.

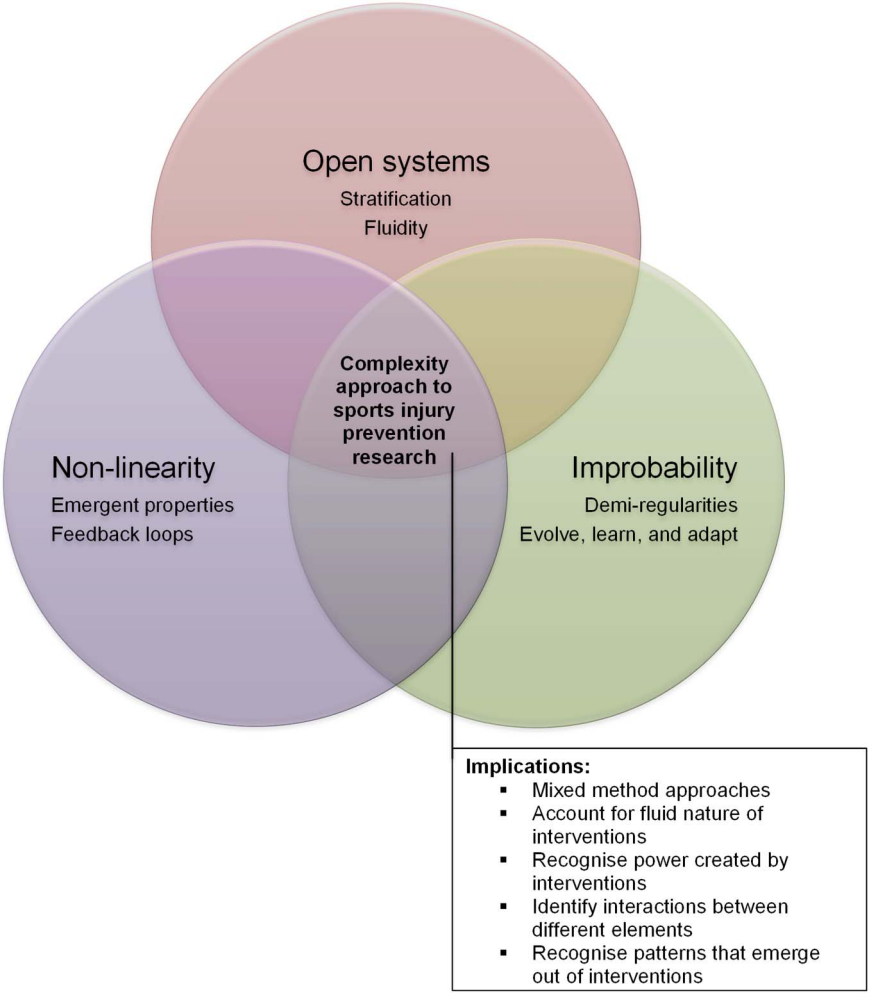

Figure 1 The implications of a complexity approach to sports injury prevention research.

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The attempt to more fully capture what influences intervention outcomes is welcome. Yet research continually shows that many other factors influence intervention effectiveness, including such components as compliance, attitudes and beliefs, and fidelity. Although such components are ubiquitous across sports settings, these factors remain vaguely described and unaccounted for. Consequently, there is no adequate means of explaining the inconsistent outcomes of supposedly promising interventions designed under the complicated approach. As such, variations in effects are dismissed, avoided or cast as an array of implementation issues. The assumption appears to be that interventions are 'proven' efficacious but unidentified and unanticipated barriers act to ameliorate or mask effectiveness.

This complicated view is widely understood and used as the means to 'bridge the gap' between efficacy and effectiveness. Accordingly, in practice, the complicated approach translates into a lengthy pipeline process which assumes that we can bridge this gap if only 'missing' implementation factors are better understood.[6]

THE COMPLEX ALTERNATIVE

In contrast to simple and complicated approaches, a complex approach recognises that formulae, experience and precedence have limited applicability across situations, times and settings.[5] Under this approach, interventions cannot be inherently effective because outcomes are influenced by interactions of people, places and programmes.[7] Single factors are unlikely to account for large variations in effect size because interventions have multiple components, which interact in unpredictable ways and may be moderated by context. The question as to whether a specific type of intervention works or not, or what its key 'magic bullet' components are cannot, therefore, be addressed.

This shift reflects the complexity of sport itself. In sport, both results and injuries are influenced by interactions between people, the physical environment and the social environment. Interactions across and/or between individual components (eg, the actions or changes made by a coach), subcomponents (eg, actions of particular players), context (eg, elite v community; competitive v friendly), as well as a range of other intervention-related factors (eg, fidelity), affect outcomes. Given sports injury prevention outcomes are influenced by intrapersonal, interpersonal, organisational, community, and societal factors, it is puzzling that research into sports injuries remains firmly anchored in approaches that view injury events as simple or complicated. Rather, interventions should be researched in terms of their complexity.[8]

Future interventions using a complexity lens should take account of the complex nature of interventions (figure 1). Research should focus on 'what works for whom, when, where and why'—taking account of not only whether interventions work, but also how they interact, influence and interplay within individuals as well as different populations.[7]

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Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

To cite Bekker S, Clark AM. *Br J Sports Med* 2016;**50**:1489–1490.

Accepted 11 July 2016
Published Online First 27 July 2016

Br J Sports Med 2016;**50**:1489–1490.
doi:10.1136/bjsports-2016-096457

REFERENCES

1 Finch CF, Cassell E. The public health impact of injury during sport and active recreation. *J Sci Med Sport* 2006;9:490–7.
2 Lauersen JB, Bertelsen DM, Andersen LB. The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials. *Br J Sports Med* 2014;48:871–7.
3 van Mechelen W, Hlobil H, Kemper HC. Incidence, severity, aetiology and prevention of sports injuries. A review of concepts. *Sports Med* 1992;14:82–99.
4 Finch C. A new framework for research leading to sports injury prevention. *J Sci Med Sport* 2006;9:3–9.
5 Glouberman S, Zimmerman B. *Complicated and complex systems: what would successful reform of Medicare look like?* Toronto: Commission on the Future of Healthcare in Canada, 2002. http://www.publications.gc.ca/site/eng/235920/publication.html (accessed 16 Mar 2016).
6 Hawe P. Lessons from complex interventions to improve health. *Public Health* 2015;36:307.
7 Pawson R, Tilley N. *Realistic evaluation*. Sage, 1997.
8 Clark AM. What are the components of complex interventions in healthcare? Theorizing approaches to parts, powers and the whole intervention. *Soc Sci Med* 2013;93:185–93.

Conventional (simple and complicated) approaches: the machine metaphor

The machine metaphor of Newtonian science underpins the conventional (simple and complicated) paradigm of research. The conventional perspective, therefore, takes the approach that all systems consist of parts, and that parts can be studied and used to explain the whole (Zimmerman, Plsek & Lindberg 1998). This approach is reductionist and considers all systems, whether mechanical or social, as machines.

The reductionist conventional approach has proven useful and successful in instances where simple (recipe-like) or complicated (composed of subsets of simple systems) problems are studied, however this is considered by some to be inadequate for understanding the nature of complex social systems (Glouberman & Zimmerman 2002). Potentially more successful sports injury prevention and safety promotion outcomes requires a better understanding of such complex social systems and how they can be influenced systematically. Therefore, a complexity lens has been chosen as the theoretical framework to underpin this research into sports injury prevention and safety promotion.

The complexity approach: social systems

Complexity theory assumes that the whole is always more than merely the sum of its parts (Byrne & Callaghan 2013). In relation to social interventions, complexity holds that the world is an ever-changing open system, fluid and in flux, and that outcomes are never entirely predictable or even patterned (Boulton, Allen & Bowman 2015). Complexity theory, thus, emerged as a science by which to explore what surfaced as the limitations of conventional reductionist science (Table 3.1).

Table 3.1: Comparing conventional paradigm with complexity paradigm (adapted from Mohammadi 2010 pp26)

Table 3.1 has been removed due to copyright restrictions

Emergence of complexity theory

The origins of complexity theory are traced in Castellani & Hafferty's (2009) 'Map of the Complexity Sciences'. This map shows the rich, varied, and continually emerging history and development of this ontological perspective (Figure 3.1).

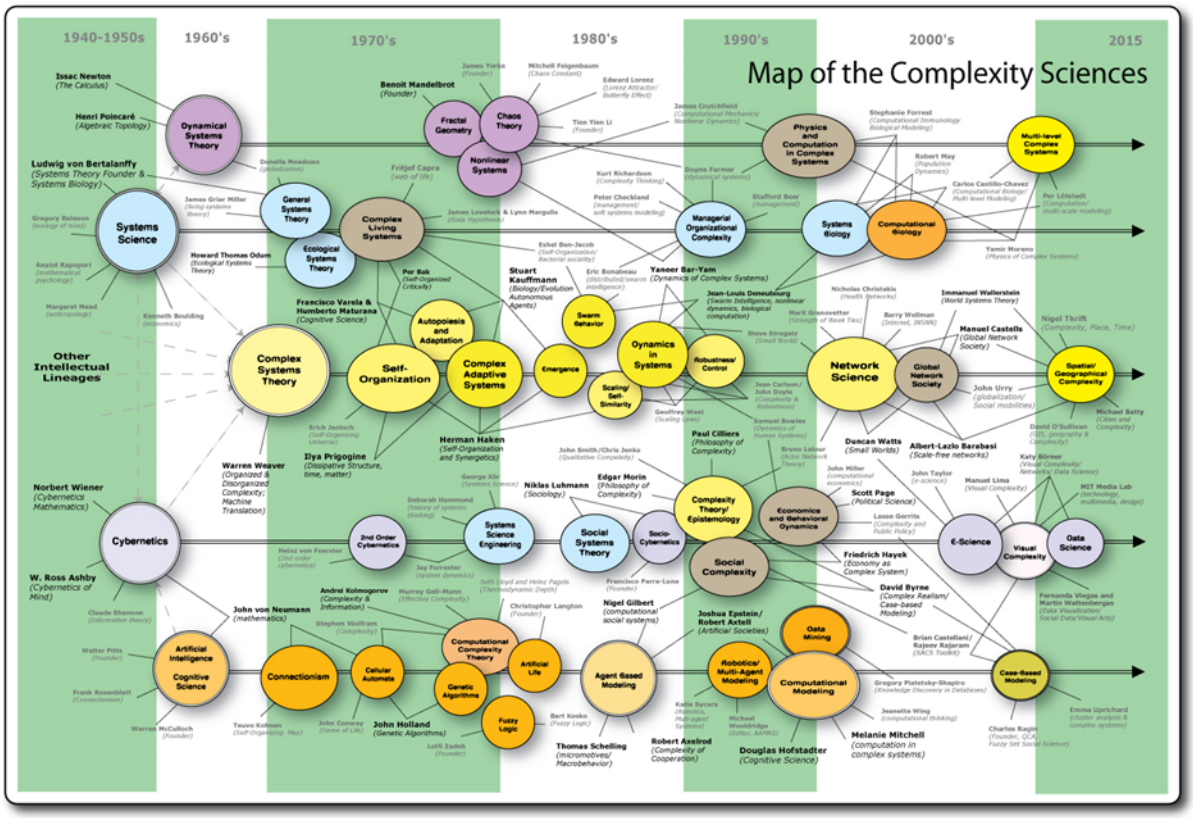

Figure 3.1: Map of the Complexity Sciences (Reproduced from Castellani & Hafferty 2009 with permission from Springer through RightsLink / Copyright Clearance Center – Appendix 1e)

In the health sciences, the most commonly applied area of the complexity sciences is that of systems science. I have chosen not to use systems science in this work as, aligning with Boulton, Allen & Bowman (2015), systems thinking tends to involve dividing problems up into parts, and then studying the causal relationships between those parts. Therefore, systems science is, through the Glouberman & Zimmerman (2002) lens, classed as *complicated* rather than *complex,* and has an *epistemological* focus rather than an *ontological* one.

Instead, this study will draw from the development of *social complexity* meta-theory in the social sciences, as led by authors: Prigogine (1978), Prigogine & Stengers (1997), Zimmerman, Plsek & Lindberg (1998), Holland (2000), McElroy (2000), Glouberman & Zimmerman (2002), Castellani & Hafferty (2009), Byrne & Callaghan (2013), Boulton, Allen & Bowman (2015), and Tsoukas (2016). Secondly, this work draws from complexity theorists working in health sciences, including: Plsek & Greenhalgh (2001), Clark (2013), and Hawe (2015a).

As a social complexity meta-theory in the health sciences emerged from a wide range of fields, including evolutionary biology, computer sciences, systems theory, and social sciences (Cohen 1999), it is not recognised as a pure theory as such, and would be better understood – for the purposes of this thesis - as a framework or lens (Mohammadi 2010) which is how it is applied in this study. As Boulton, Allen & Bowman (2015) argue in their book on embracing complexity science, complexity "is not a model or a method or a metaphor, it is a description of the way things are" (pp27). Similarly, Castellani & Hafferty (2009) explain it in this way:

> *"Social complexity theory is more a conceptual framework than a traditional theory. Traditional theories, particularly scientific ones, try to explain things. They provide concepts and causal connections (particularly when mathematicised) that offer insight into some social phenomenon...Scientific frameworks, in contrast, are less interested in explanation. They provide researchers effective ways to organise the world; logical structures to arrange their topics of study; scaffolds to assemble the models they construct. When using a scientific framework 'theoretical explanation' is something the researcher creates, not the other way around"* (pp34).

On the same premise, Pawson and Tilley (1997), on arguing for ontic depth in intervention research, state the "need to penetrate beneath the surface of observable inputs and outputs of a program" (pp215) of a simple or complicated lens to move toward a deeper explanation of outcomes that manifest in the interplay of complex social mechanisms. Complexity theory thus situates the nature of *being* as a state where formulae and prior experience are necessary but insufficient to understanding the inner workings of social interventions. Using this view, social interventions cannot be 'broken down' into singular components or pieces of the puzzle, as the intersection of components is understood to hold very real *synergies* in the fundamental relationships between components (Clark 2013) - the whole is more than the sum of its parts.

Complexity theory is, in essence then, an ontological frame of reference (Castellani & Hafferty 2009).

What is outside the scope of this thesis:

For the purposes of this work it is important to note firstly what is not being attempted. I will not attempt a comprehensive overview or comparison of complexity science, in any of its multiple forms. I have a more modest goal, which is to provide an overview of the fundamental tenets of complexity theory that bear relevance to the study at hand, so as to later apply the relevant insights to the findings and conclusions of this research. Although I recognise the existence, critiques, contributions, and potential of the different stances, my study takes its point of departure in seeking ontological relevance above all, through the lens of complexity theory.

The justification for this is that this research will not rely on specific complex intervention guidance or evaluation frameworks, but rather draws on the essence of complexity theory as a theoretical framework. The advantage of a complexity lens is that it provides the language by which a different manner of thinking about the ways in which the world works, and ways of *being* within the world can be explained. This allows implicit assumptions to be made explicit, which, in turn, allows for complexity ontology to be *embraced* rather than controlled for or written out.

Therefore, my goal is to draw on the ontic depth and tenets of complexity theory to uncover how this perspective can be applied to sports injury prevention and safety promotion research, so as to ultimately suggest ways in which old incorrigible problems can be confronted in new and exciting ways.

Key tenets of complexity theory

What are the relevant key tenets of a complexity theory framework? In this section, the three key tenets and respective sub-tenets introduced in the embedded editorial (Bekker & Clark 2016) will be further defined and discussed. These guiding assumptions will later inform the key conclusions drawn from this research.

To refresh, the key tenets of a complexity approach are:

1) Open systems (stratification and fluidity),

2) Non-linearity (emergent properties and feedback loops), and

3) Improbability (demi-regularities and the ability to evolve, learn, and adapt).

Tenet 1: Open systems

Unlike conventional Newtonian approaches, complexity theory embraces an understanding of contexts as open systems that are fluid and in flux - rather than controlling for contextual inference or writing complexity out. Under a complexity approach, interventions are considered open systems, implemented within other, wider open systems (Clark 2013).

Open systems are understood to be inherently *messy*, consisting of many dependent and interdependent components, ever changing, and constantly affecting one another (Clark, Lissel & Davis 2008). Interventions, under a complexity lens, must be theorised, designed, implemented, and evaluated in wholly different ways than conventional science allows so as to account for, rather than control for, the inherent messiness of open systems. Artificially controlling systems, as conventional simple and complicated research approaches do, is a limitation to gathering information about the real power and working of an intervention in the 'real-world'.

Stratification

The ontology of complexity, informed by critical realism, holds that “reality is divided or stratified into 3 domains: the actual (events and actions that are more likely to be observed), the real (underlying powers, tendencies, and structures whether exercised or not that cause events in the actual domain), and the empirical (fallible human perceptions and experiences, including science)” (Clark, Lissel & Davis 2008 ppE69). In order to understand and influence the way that interventions work more deeply and to understand the causal social mechanisms, an understanding must be brought in that accounts for the whole of reality. Research that accounts for the domain of the real, whilst investigating in the domains of the actual and empirical, holds to a better account of ontic depth. This stratification is congruent with, and holds insight for, a complexity approach to intervention within open systems.

Stratification, at the level of the actual, refers to the layers or levels of both the individual, and their environment. A human being is a collection of cells, which forms a collection of organs, which forms a human being, which exists within a community, within a society. This stratification of the environment, as it relates to injury causation, has been depicted in the ‘injury iceberg’ (Hanson *et al.* 2005) (Figure 3.2).

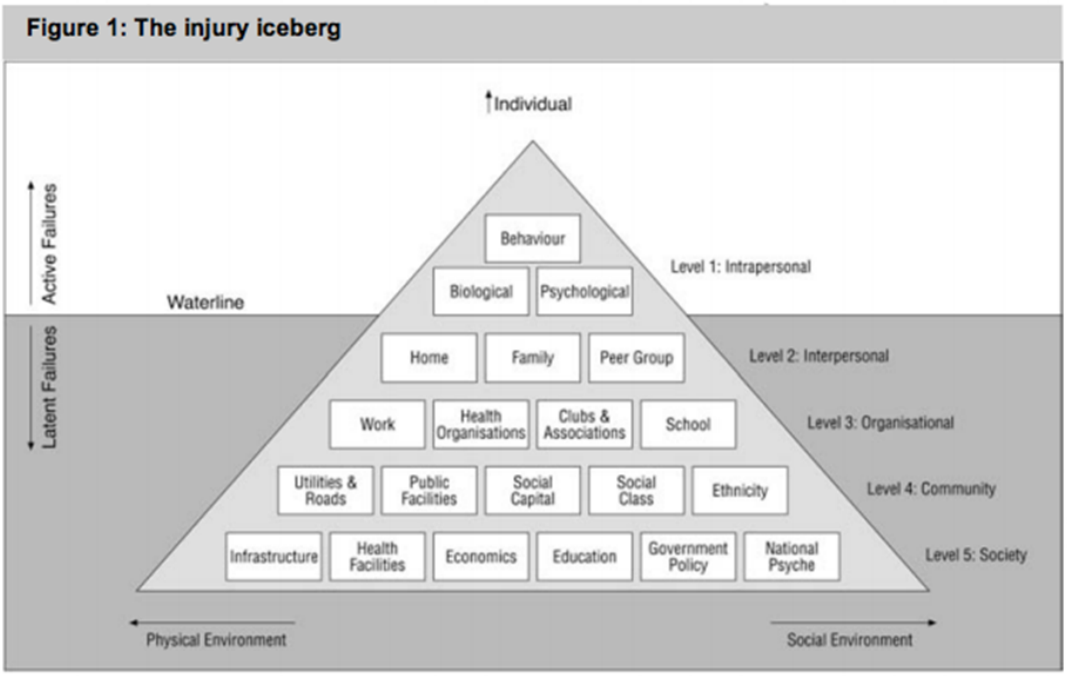

Figure 3.2: Injury Iceberg (Reproduced from Hanson *et al.* 2005 with permission from CSIRO Publishing © Australian Health Promotion Association 2016 - Appendix 1f)

Stratification is essential to understanding the world in that “instead of a purely conventional distinction between ‘micro’ and ‘macro’ it appeals to the real ontological distinctions between the various layers or ‘strata’ in the natural and social worlds” (Gorski 2013 pp659). Complexity ontology holds that reductionism is futile, as breaking wholes down into ever-smaller parts can become a never-ending exercise (Gorski 2013). It is recognised that science can learn, and *has* learned, from this reductionism, but complexity also holds that the strata higher up the ‘pyramid’ are irreducible to simpler parts or lower levels. The whole is more than the sum of its parts.

The tenet of stratification, therefore, explains why conventional approaches to interventions, developed under conventional simple and complicated lenses, are often not as successful as first deemed possible. Interventions that study and rely on parts of the whole (usually coaches) to adopt and implement sports injury prevention interventions are rendered inadequate when a complexity perspective holds that there are wider powers at work (e.g. managers, sporting culture, ‘winning at all costs’ mindset, patriarchal society) that need to be recognised, accounted for, and influenced. Furthermore, interventions are generally developed and evaluated through the lens of ‘parts of the whole’, whilst the powers inherent in those parts remain unrecognised, unseen, and therefore unstudied.

Fluidity

Stratified open systems are fluid and in flux. As Boulton, Allen & Bowman (2015) state: “the idea that the world is complex and interconnected – neither random nor chaotic, but not predictable either – is not a new idea” (pp6). Rather than focus on a false understanding of the social world as *static,* complexity theory holds that the world is constantly, and consistently, *becoming.* This allows for an understanding of interconnection and impermanence across stratification and within open systems.

Prigogine (1997) explained fluidity as a world that is “under perpetual construction” (pp1), and that there is a potential for “order through fluctuation” (1978 pp781). Therefore, accepting the fluctuating nature of the world, and embracing inherent diversity (heterogeneity) as a key feature of complexity (Mohammadi 2010), allows for a more nuanced understanding of social systems.

Tenet 2: Non-linearity

Non-linearity, or generative causation, holds that A plus B does not necessarily equal C. For example, as discussed in Chapter 2 the literature review, taking a sports team and adding an efficacious injury prevention intervention does not mean that it will be implemented consistently, or be effective. Outcomes are non-linear. Therefore, complexity theory tends to seek the deeper causal mechanism explanations of how interventions work, the generative causation, rather than the linear *cause and effect* relationships expected under the assumptions of conventional simple efficacy or complicated effectiveness research.

Rather than the successionist or linear view of empirical research, a complexity lens thus acknowledges the existence of generative causation or non-linearity (Clark 2013). Causation is not taken to be linear, where intervention X causes outcome Y, but rather that the intervention triggers underlying causal powers inherent in strata, and thus the action of the intervention emerges (Pawson & Tilley 1997). Therefore, interventions do not *'work'* as such, but it is the act of intervening that sets in motion a triggering of known and unknown social powers that act on the strata and thus generate outcomes. Indeed, Pawson (2014) asserts that it is a lazy linguistic habit to say that interventions 'work', rather it is 'people that make interventions work'.

Intervening in sports injury prevention and safety promotion is, then, not as simple as taking a population, adding an intervention, and expecting a hypothesised outcome. Rather, complexity ontology helps to theorize from the outset, and then explain why, the assumptions underpinning linear cause-and-effect type research are not holding to hypotheses as well as would be expected in the social world, even after controlling for barriers and enhancing facilitators. A complexity lens holds that interventions should be theorised in ways that account for deeper non-linear causation, with the ultimate aim of uncovering both positive and negative outcomes and learning from the patterns that emerge.

Emergence

Emergence is defined as “a relationship between two features or aspects such that one arises out of the other…[but] remains causally and taxonomically irreducible to it” (Clark, Lissel & Davis 2008 ppE70). Where stratification is the explication of parts and wholes, emergence refers specifically to the powers contained within the combinations of those parts and wholes. Unlike simple or complicated approaches, complexity holds space for parts, wholes, *and their powers* (Clark 2013). These powers are not always observable, and thus cannot always be measured, even when they exert a real influence. Boulton, Allen & Bowman (2015) suggest that such changes are usually “a qualitative change – a shift in characteristics, patterns and relationships, and dimensions” (pp41). This is non-linear emergence embodied.

The emergent tendencies and powers held within the combination of strata exert a very real force on this world, whether this is recognised or unrecognised, exerted or not (Clark 2013). Complexity holds that the ways that strata combine creates new inherent real underlying structures and powers at the level of the real, which cause events in the domains of the actual and empirical. Everything is therefore, understood to be connected, whether it can be seen, proven, recognised, or not. Further, emergence shows that components can come together across realms to create new components. For example, emergence holds that humans are more than just a collection of cells because if components in the stratified hierarchy are removed, the levels above cease to exist.

Sport is emergence embodied. Sport is irreducible to the players, the equipment, and the rules - but rather it is the combination of these with a whole host of other parts which may or may not be readily observable (such as the spirit of competition, fans, the reward, the sporting culture etc.) from which that what we know as *‘sport’* emerges. Sport injury prevention and safety promotion interventions should be reconsidered in light of the potential powers that emergence contains and exerts. Complexity approaches hold that interventions do not merely act within the strata of the individuals and their environment, as current reductionist research assumes. Implementing a complex intervention within a complex sport setting both has, and creates its very own, non-linear emergent properties, and it is these that need to be recognised and explained in order to understand and re-conceptualise interventions in such a way that potentially is more useful, more relevant, and more successful.

Feedback loops

Interventions affect themselves. Interventions often have long tails (where effects and outcomes are seen in the longer-term), where periods of lag have passed after the initial success, and where long-term outcomes may be different from those that were initially observed (Hawe 2015a). This is because, according to the tenet of feedback loops, interventions affect themselves and thus re-organise future actions. Complexity holds that interventions are not static, but that they evolve, and that this needs to be accounted for in research designs. It is no longer enough to rely on simple and complicated methods that measure observable outcomes on a one-off and usually short-term basis. Rather, multiple follow-up evaluations are necessary to understanding how interventions really work and evolve in context.

The presence of feedback loops can be observed in the sports injury prevention setting too. It has been shown that under-15 schoolboy rugby players believe that they can tackle harder when wearing protective headgear (colloquially known as the superman effect) (Finch, McIntosh & McCrory 2001), suggesting that behaviour is influenced by the intervention (headgear) itself. Therefore, feedback loops are at play as future actions by players are re-organised in light of the intervention. Similarly, it was recently reported in the New Zealand media that schoolboy rugby players were being starved/starving themselves to make the weight limit to participate in a tournament – the weight limit was introduced as a safety measure so that the risk of bigger boys injuring smaller boys would be reduced (Hurndell 2016). Such examples in injury prevention research are prolific, often framed as ‘unintended consequences’ of the intervention under simple and complicated lenses, rather than recognising the ontology of complex social structures.

Tenet 3: Improbability

Intervention outcomes are uncertain, and in some cases unintended, unpredictable, and unknown. However, even if outcomes are uncertain, they are not likely to be entirely random (Boulton, Allen & Bowman 2015). If non-linearity, emergence, and feedback loops are assumed, then improbability of effects can be the only expected outcome. Instead of controlling for improbability, a complexity lens provides contingencies for facilitating better understandings through studying demi-regularities, and the ability to evolve, learn, and adapt.

Demi-regularities

Complex outcomes from complex interventions in complex settings are better understood, and therefore studied, through the pattern of patterns, more formally termed demi-regularities. This allows for the crafting of deeper explanations behind the question 'what works, for whom, when, where, why, and how' (Pawson & Tilley 1997). Outcomes in the form of demi-regularities are understood as being somewhat patterned, rather than being relegated to the uniform (identical over time) or chaotic (random over time) (Clark 2013). Outcomes thus naturally self-organize (Boulton, Allen & Bowman 2015).

All interventions are variations of interventions that came before them, applied in different contexts and thus triggering different causal mechanisms and outcomes in an open environment that is fluid and in flux (Pawson 2014). Therefore, it is possible to study the demi-regularities of interventions and their outcomes to draw deeper inferences from the existence of recurring patterns, which could allow for better transfer of findings over different contexts.

Evolve, learn, and adapt

Finally, interventions are understood to evolve, learn and adapt under complexity assumptions. In other words, from the moment when an intervention is implemented, the context is already evolving, as a potential trigger for causal tendencies and powers has been introduced. This means that changes can be seen in the short-term, but also that medium-term and longer-term outcomes may be different from what was initially observed. A generative emergent ontology explains that interventions affect themselves, and that there is contextual learning, evolving and thus adaptation (Clark 2013). Further, there is a possibility that there may be a lag time, during which nothing of consequence happens, and effects and outcomes may only be seen in the longer-term (Hawe 2015a). This means that intervention evaluation cannot rely on once-off study, but that follow-up evaluations are needed once the intervention has had time to meld into its environment. Therefore, there is a need to understand that interventions work differently and have different effects over time.

An example of this can be found in Pawson and Tilley's (1994) research on crime prevention video cameras. Video cameras are often installed in so-called crime *'hot spots'* to deter potential criminals. This may be effective in the short-term, however, in the longer-term the hot spot with the video cameras transforms into a new context in and of itself. Instead of being deterred by the cameras, would-be criminals often learn how to be *'better criminals'* in those areas, and perpetrate their crimes in new innovative ways that cannot be detected by the video cameras. In this way, the intervention has been subject to a feedback loop, there is evolution of the context in that it affected the very mechanism that made it effective in the short-term. Hot spots with video cameras become a new context in the long-term, and would-be criminals learn and adapt.

For sports injury prevention interventions, once introduced into a sporting context, outcomes may change over time and different causal mechanisms may be triggered as the emergent context evolves and adapts. For example, coaches, support teams, managers, and the composition of the team itself change over time. This means that an intervention that was implemented and successfully triggered the desired causal mechanism last season, may be ineffective this season as the components change. Underlying powers and tendencies are not static, feedback loops come into play, and open environments are fluid and in flux.

Applications of complexity in research

The complexity tenets, open systems (stratification and fluidity), non-linearity (emergent properties and feedback loops), and improbability (demi-regularities and the ability to evolve, learn, and adapt), provide an understanding of sports injury prevention and safety promotion as being inherently complex. Unlike studying machines, and unlike laboratory research in closed systems, sports injury prevention and safety promotion research falls squarely into the domain of active social interventions in open systems. Thus, a theoretical framework grounded in complexity is appropriate for this study.

Complexity theory provides a lens with which to look at old intractable problems in new ways by advocating for the recognition of ontic depth. As introduced in the editorial at the start of this chapter (Bekker & Clark 2016), and previously explained in a commentary elsewhere by Clark *et al.* (2012), a complexity ontology must be brought in to the study of social systems as:

> *"outcomes can be influenced by individual components (a manager), subcomponents (a single player's attitude), context (a muddy pitch), and a range of uncontrollable factors (injury to key player). Deeper still, interactions between these elements may occur and generate new effects – for example, the gifted player who underperforms in the context of a 'big match' with a hostile crowd"* (ppe8316).

This analogy shows that a social intervention can never be simple or even complicated, but rather that interventions contain underlying mechanisms that both contain and exert powers, and that these are often messy, uncontrollable and inherently *complex*. Despite conventional research methods attempting to control for such elements in an attempt to uncover and influence causality, complexity holds that it is the underlying mechanisms of interventions that must be uncovered, examined, and influenced through research – rather than the overt focus on the outcomes of the intervention itself. Conventional simple and complicated approaches have a real danger of reducing everything to components and risk factors, and diminishing the complexity of the generative causation and non-linearity of intractable issues.

Researching only the observable inputs and outputs of an intervention most often translates into the flawed assumption that it is possible to determine whether an intervention *'works'* or not (Pawson & Tilley 1997). This is likened to asking *'does this football team win?'* – flawed because this cannot be a yes or no question; without

context, the answer must always be: *'it depends'*. Therefore, when questions are considered for their ontic depth, certain questions are rendered redundant (Clark *et al.* 2012). Intractable problems, according to Pawson & Tilley (1997), "are always embedded in a range of attitudinal, individual, institutional, and societal processes, and thus…outcomes are generated by a range of macro and micro social forces" (pp215).

Complexity theory has been applied as a theoretical framework in a similar manner to the lens taken in this research in a diverse range of fields such as criminology (Pawson & Tilley 1994), hospital and healthcare management (Plsek & Greenhalgh 2001), schools and health (Mohammadi 2010), and heart failure disease management programmes (Clark & Thompson 2012). Particularly pertinent to this study, Mohammadi (2010), in studying health promotion in school settings, concluded that there is a pressing need to achieve a deep understanding about the complexity of context, and that new strategies to intervene in the setting must be informed by a complexity ontology if changes are to be achieved. Similarly, the research around the complexity of heart failure disease management programmes relates particularly to the understanding of injury prevention and safety promotions programmes, as both focus on non-pharmacological interventions. Clark & Thompson (2012) made a similar call for a new complexity paradigm in heart failure research, and later published recommendations for future research in this area that included the need to examine demi-regularities, underlying causal mechanisms, context, and to address what works, for whom, when, and why (Clark *et al.* 2015). The strengths of a complexity paradigm are thus being recognised both in settings and health care research.

Limited published literature exists in which this lens has been applied to sports injury prevention and safety promotion. Some published commentaries have alluded to the possibility of viewing injury prevention in general with complexity in mind, however these have focused on an epistemological or methodological shift to systems science, rather than a paradigm shift to an ontological lens grounded in social complexity theory (Hanson *et al.* 2005; Hanson *et al.* 2012; Lich *et al.* 2013; McClure *et al.* 2015; Hulme & Finch 2015).

Recently, a conceptual paper utilizing complexity theory for sports injury *prediction* (the precursor to prevention) was published by Bittencourt *et al.* (2016). This paper included a narrative review of the paradigm shift from reductionism to complexity by utilising tenets such as open systems, non-linearity, recursive loops, and uncertainty, before introducing a new complex model for sports injury prediction. Accordingly, the authors present a

complex model for sports injury prediction, consisting of an emerging pattern of injury or adaptation determined by risk or protective regularities, a 'web of determinants', and recursive loops (Bittencourt *et al.* 2016). This new concept is a strong and positive move towards the inherent complexity of sports injury prevention, and can provide important new understandings for, and indeed dovetails with, the *prevention* of sports injury and promotion of safety as proposed in this thesis.

If the world is viewed as inherently complex, then there must be no choice but to grapple with its complexity (Wong 2013). Not doing so, and continuing to approach complex problems with conventional simple and complicated approaches, renders efforts essentially futile. As Boulton, Allen & Bowman (2015) state: "if the world is complex, then acting congruently with that complexity can be simpler than trying to control a machine that does not exist" (pp6).

Conclusion

Sport is a setting in which physical injury and harm may occur, and indeed sports injury prevention and safety promotion interventions themselves, can, and I argue should, be understood as complex. This view, seeing old issues in new light, could result in more effective and sustainable solutions to old incorrigible problems

To improve prevention outcomes, this chapter has presented a broader perspective of the world, as being more inherently complex than is usually acknowledged in this field of research. This brings a greater attention to, a deeper understanding of, and a fuller sense of the power of viewing sporting contexts and injury prevention interventions as being complex, providing a framework which conveys an alternative approach. This allows profoundly different insights to, and implications of, approaching intractable problems systemically in this context.

Following, Chapter 4 will present the methodology and findings of the research presented in this thesis.

CHAPTER 4: METHODOLOGY AND FINDINGS

Introduction

Seeking to prevent injuries and promote safety in sport settings is an important public health goal (Conn, Annest & Gilchrist 2003; Finch & Cassell 2006; Finch, Kemp & Clapperton 2015). This endeavour is not a straightforward one – rather, it demands a complex approach within complex sport settings that may yield complex outcomes (Bekker & Clark 2016). When seeking to reduce injury and promote safety, one size does not necessarily fit all.

In Chapter 2, the literature was reviewed to present background information about frameworks and models used in sports injury prevention and safety promotion research. Chapter 3 presented and discussed the theoretical framework for this study - complexity theory - as a new way to understand, explain, and influence intractable problems in injury prevention and safety promotion in sport settings.

This chapter describes the methodology for, and findings of, this study. As there is limited qualitative research in the field of sports injury prevention and safety promotion, and also a limited acknowledgement of the complexity of this field of research, this chapter will explain and then justify the use of this methodological perspective for this study.

The first part of this chapter discusses the research approach, philosophical underpinnings, strategy of inquiry, ethical considerations, as well as rigour and trustworthiness for this research. The second part of this chapter is comprised of the two embedded peer-reviewed publications that provide further details of the methods used in both parts of this study, and present the findings.

Research approach

In order to reduce risks, achieve safety, and increase participation in sport, there is a clear need for effective approaches to sports safety to be developed, distributed, and implemented. There has been limited development, or critical evaluation of understanding of the nature of social reality underpinning research into sports injury prevention and safety promotion, linked to the type of empirical research generally undertaken in this field.

The research problem for this study, as defined in Chapter 1, is to determine whether a complexity approach can help to better understand systemic safety promotion within Australian community sport settings. Whilst significant strides have been made in addressing the public health problem of sports injuries through prevention, there remains a paucity of knowledge as to how best to approach the intractable or complex problems that remain resistant to conventional research approaches. Complex problems are those issues that require a range of influences to counteract at different levels, including attitudinal, institutional, and societal considerations (Pawson & Tilley 1997), such as presents in the problem of sports injuries (Bekker & Clark 2016). The crux of the work presented in this study, therefore, lies in the use of an innovative theoretical framework as discussed in Chapter 3, which builds on conventional approaches to research (simple and complicated approaches), and moves to exploring safety in sport through a complexity lens (Bekker & Clark 2016).

A complexity approach, by its very nature, advocates the use of the strengths, and mitigation of the weaknesses, of different research approaches by highlighting the ontological relevance of the research design and conceptualisation to the research questions being explored (Byrne & Callaghan 2013). This means that a complexity approach is compatible with qualitative, quantitative, and mixed-methods study designs (Byrne & Callaghan 2013; Bekker & Clark 2016). In this study, a qualitative design was chosen as the most appropriate and the rationale for this is discussed next.

Paradigm: qualitative research

In deciding which approach was most relevant to this research study, it is useful to refer back to Chapter 2, the literature review, where the gaps in the existing literature are discussed. In this field of research, it is clear that the focus has largely been on quantitative approaches, as evidenced by the large body of research (Klügl *et al.* 2010; McBain *et al.* 2011a; McBain *et al.* 2011b) addressing the initial stages of sports injury prevention, underpinned by frameworks such as the Sequence of Prevention (van Mechelen, Hlobil & Kemper 1992) and the Translating Research into Injury Prevention Practice Framework (Finch 2006). Research into these initial stages focuses on issues such as injury surveillance and determining the efficacy of interventions, for which quantitative approaches are generally most appropriate. Indeed, a review by Klügl *et al.* (2010) showed that the vast majority of studies in this field investigate these initial stages. Therefore, sports injury prevention and safety promotion research is currently heavily weighted toward research that favours quantitative approaches, which does not readily address the issue of the complexity of safety in sports settings. Indeed, quantitative research does not adequately describe the processes of knowledge translation that occur between research outcomes and their implementation in policy/practice. The value of using a complexity approach, and its affinity with both qualitative and quantitative approaches, means that the approach chosen is led by the research question rather than methodological predilection. In this case, a qualitative approach was considered more suited to eliciting the kind of knowledge necessary to understanding sports safety through a complexity lens.

More recently, Finch (2011a) called for more research into the implementation and dissemination of interventions, which suggests the use of qualitative research approaches, which may provide greater understanding of interventions. However, there still remains a lack of focus on exploring this and the wider sports safety issues from a qualitative perspective. As shown through the preceding chapters, this qualitative gap stems from, and has resulted in, a poor understanding of the implementation of complex interventions in complex sport settings. This is where taking a complexity approach will provide a different ontological lens through which to consider the issues of sports safety. To this end, qualitative research is well suited to meeting the objective of this research as it can provide "…a focus on individual meaning, and the importance of rendering the complexity of a situation" (Creswell 2009 pp4).

Further, similar to the contrast between conventional and complexity paradigms discussed in the theoretical framework (Chapter 3), there are significant differences between qualitative and quantitative paradigms of research (Table 4.1) (Mohammadi 2010; Cresswell 2009). A qualitative approach will enable this study to explore the complex process of knowledge translation of sport safety information, and provides an alternative perspective from traditional quantitative outcomes to sports safety seen in many earlier studies.

Table 4.1: Comparison of underlying assumptions in quantitative and qualitative research (Adapted from Mohammadi 2010 pp67).

Table 4.1 has been removed due to copyright restrictions

The field of sports injury prevention research has, up until recently, largely made use of simple and complicated lenses, and thus quantitative approaches have been used to address pressing research problems (Klügl *et al.* 2010). To reiterate, this does not imply that quantitative approaches are inappropriate or simplistic, only that they are inadequate for researching complex problems in complex contexts *on their own* (Bekker & Clark 2016). If taken under an ontological lens grounded in complexity, then the qualitative research assumptions in Table 4.1 are clearly a good fit for complexity-consistent research relevant to this study. These assumptions mirror the tenets of complexity theory as discussed in Chapter 3.

Therefore, to understand complex problems in the area of sports safety, an understanding of the nature and implications of complex social reality was required. In order to provide new insights into the social complexity of sports injury prevention and safety promotion, a qualitative study design was thus chosen for this study as this *"is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem"* (Creswell 2009 pp4). In this study, a qualitative approach was considered to be the most appropriate for exploring the research problem and answering the research questions presented in Chapter 1.

Epistemology: constructivism

In working from a complexity approach to sports injury prevention and safety promotion, as discussed in Chapter 3, it has been recognised that open systems (stratification and fluidity), non-linearity (emergent properties and feedback loops), and improbability (demi-regularities and the ability to evolve, learn, and adapt) underscore intervention (Bekker & Clark 2016). The epistemological perspective must clearly fit with these ontological assumptions about social reality. As shown in Chapter 3, ontology is too often ignored or written out of interventions designed under simple and complicated lenses. Yet, epistemology is implicitly constructed out of ontological assumptions (Creswell 2009). Therefore, a coherent fit must be present for relevant and meaningful research to be undertaken.

Clark, Lissel & Davis (2008) suggest that, in stark contrast to the so-called 'paradigm wars' between positivist and constructivist approaches, a complexity lens reflects a deep consideration for the ontological lens rather than a focus on the epistemic basis of research – a focus led by the research question and context as opposed to the traditional disciplinary orientation. Therefore, a complexity approach was chosen for this study, led by an ontological perspective suggested by Fletcher (2016 pp2) in that "despite the seeming opposition between the constructivist and positivist perspectives, each reduces reality to human knowledge, whether that knowledge acts as a lens or container for reality".

Further to this, research under this lens is explained by Clark, Lissel & Davis (2008) to hinge on the explanation of social contexts in the ontological domain of the real (underlying powers, tendencies, structures), through the study of the actual (observable events and actions) and/or empirical (fallible human perceptions and experiences). Therefore, in this study, this approach allows for uncovering a problem in the domain of the actual, to validate it empirically, and then to further recognise that underlying social structures exist in the domain of the real (such as class, culture, or discrimination), which exert realised or unrealised power whether or not they are known or recognised (Clark, Lissel & Davis 2008). An example of how this perspective applies to research is provided by Clark, Lissel & Davis (2008): gender bias or discrimination may exist irrespective of whether or not it is recognised.

A key feature of this ontological approach, explained by Pawson & Tilley (1997) is to focus on questions of the explanation of the emergent reality of scientific fact, human experiences, as well as underlying social structures and systems, so as to show how these can cumulate into a progressive body of useful knowledge about so-called 'wicked' or complex problems. Research under this approach is, therefore, conceptualised to uncover the domain of the real to attempt to explain the deeper causal mechanisms, or those forces that produce events at the empirical and actual levels (Fletcher 2016). Complexity ontology allows a 'both-and' approach which holds positivism and constructivism as complementary rather than competing, and allows for the use of either, neither, or both epistemologically depending on the relation to the ontology of the phenomena being studied and the outcomes sought.

Since the majority of research into sports injury prevention and safety promotion has been underpinned by positivist quantitative approaches (Klügl *et al.* 2010), a constructivist qualitative approach was considered appropriate to providing new insights and understandings to this field of research via this study. In this way, valuable new information to supplement and indeed complement current knowledge, produced through a different kind of knowledge creation, is provided.

Qualitative research is typically associated with a social constructivist epistemology (Creswell 2009). As constructivism allows for understanding, multiple participant meanings, social and historical construction, and theory generation (Creswell 2009), these assumptions are clearly compatible both with complexity ontology and the aims of this study. This allows for researching the actual, whilst taking into account the real and the rich history of prior research into the empirical to construct and create a deeper reflection of the whole of social reality. Therefore, the original research studies reported in this thesis are underpinned by constructivist epistemological assumptions.

Strategy of inquiry: case study

The complexity of the social world is explicitly assumed to have an effect on the outcome of research under a complexity approach. Outcomes are always understood to be mediated by context, and conditioned by location - in what Sayer (2010) deems *"contingent necessity"*. In other words, *"activated differently, same causal power can have different outcomes"* (Parr 2015 pp373). This reflects back to the assumption, explained in Chapter 3, that research is needed to determine *'what works, for whom, when, where, and why?'* under complex assumptions (Pawson & Tilley 1997; Bekker & Clark 2016). More evocatively, paraphrasing Pawson (2013): *'what works in Wagga Wagga on a wet Wednesday will not work in Melbourne on a muggy Monday'*. Therefore, interventions and their outcomes are understood to be place, time, and context dependent (Pawson 2013).

Case studies allow for in-depth research of a pre-determined setting, location or context, such as a specific intervention, group, or individual, bound by time and activity (Creswell 2009). As this research aimed to contribute to a better understanding of the complexity of systemic safety promotion in sports settings, a case study strategy of inquiry is thus both relevant and ideal for this study.

Further, the opportunity to conceptualise this research as a case study nested within the larger core National Guidance for Australian Football Partnerships and Safety (NoGAPS) project (Finch *et al.* 2011) allowed for a clear and purposive context, setting, and location for this research. Accordingly, this study consisted of two parts, A and B, which together form the original case study research reported in this thesis.

The protocol of the larger NoGAPS partnership project has been published elsewhere (Finch *et al.* 2011). More detail on the location and setting for the case study reported in this thesis (the NoGAPS organisations, and the wider Australian sports setting) has been provided in Chapter 1, as well as within each of the following embedded publications.

Further information on each study setting, participants, recruitment processes, data collection and analyses, and methodological limitations are provided within the following two embedded publications respectively.

Ethical considerations

Proposed research with human participants must be granted approval from an independent human research ethics committee prior to its commencement (Creswell 2009). As this research was conceptualised as a sub-study of the larger NoGAPS study (Finch *et al.* 2011), all ethical issues in the NHMRC National Statement on Ethical Conduct in Human Research (2007) were considered and duly addressed. Ethical approval was gained from the Federation University Australia Human Research Ethics Committee as application E13-014 (Appendix 2a) and E13-015 (Appendix 2b) for parts A and B respectively.

As this research formed part of the larger NoGAPS project, the organisations and representative participants were informed of conduct of this research project at partnership research meetings in 2013. Prior to the commencement of data collection for each study, plain language statements and informed consent forms were emailed in advance to each participant, then confirmed and signed at data collection. Throughout this research, participants were assured that they were under no obligation to participate, that they would not be individually identified in any reporting or publication arising from this study, that confidentiality would be strictly maintained, and that data would be destroyed at their request or after the requisite retention period, which is currently five years. Each participant was further advised that they would be able to withdraw from participation at any stage, and that this would not affect their continued participation in the larger NoGAPS project.

The data are stored separately in a password-protected electronic format and/or locked filing cabinet at the Australian Centre for Research into Injury in Sport and its Prevention (ACRISP) office. The interview recordings and transcripts were given a code and only the researchers listed on the ethics approval have access to a list that matches participant name and the name of the organisation to the code. Further, the transcripts were de-identified prior to storage. The data will be destroyed by the chief investigator on the larger NoGAPS project (CF Finch) after 5 years, as per the ethics approvals. Final project reports for these studies have been submitted to the Federation University Australia Human Research Ethics committee.

Rigour and trustworthiness

Establishing the legitimacy of a research study is important for demonstrating the integrity of the study process, and ensuring the credibility of the reported findings (Noble & Smith 2015). This is important for maintaining academic research standards, and ensuring acceptability with intended audiences. Legitimacy is generally established through addressing rigour and trustworthiness. Rigour refers to a measure of study validity and reliability, often associated with quantitative research (Morse *et al.* 2002; Noble & Smith 2015). Trustworthiness, on the other hand, emerged as a parallel means of establishing study quality and credibility when using qualitative research approaches (Lincoln & Guba 1985).

In the reporting of qualitative studies, trustworthiness is most often addressed using Lincoln and Guba's (1985) evaluative criteria, a series of techniques for demonstrating: 1) credibility, 2) transferability, 3) dependability, and 4) confirmability. Techniques for addressing these aspects include, for example, triangulation, thick description, inquiry audit, and reflexivity (Lincoln & Guba 1985). Since the 1990s, various other iterations of the Lincoln & Guba (1985) criteria for evaluating the rigour of qualitative studies have emerged (Creswell 1997; Thorne 1997; Noble & Smith 2015).

Ongoing debates, however, about the credibility of determining rigour and trustworthiness in qualitative research, and the purpose thereof, abound. Most relevant to this study is the concern raised by Morse *et al.* (2002 pp15) about the popularized "shift from constructive (during the process) to evaluative (post-hoc) procedures" when reporting on trustworthiness utilizing Lincoln & Guba's (1985) and other (Creswell 1997; Thorne 1997; Noble & Smith 2015) criteria. Whilst ultimately Morse *et al.* (2002) make the case for process-driven verification strategies for establishing reliability and validity in qualitative research, they are in agreement with Wolcott (1990 pp121) in that considerations for paradigm must be taken into account when determining how best to "apparently 'have' or 'get' or 'satisfy' or 'demonstrate' or 'establish'" aspects related to validity. Similarly, the post-hoc approach to trustworthiness runs the risk of positioning qualitative studies as inherently less 'rigorous' or legitimate than quantitative research (Morse *et al.* 2002; Sandelowski 1993; Noble & Smith 2015). Thereby, the adaptation and application of quantitative concepts of validity and rigour into a measure of trustworthiness for qualitative studies is problematized as possibly inconsistent with epistemological assumptions (Morse 1999; Morse *et al.* 2002), and therefore it is

important that paradigmatic underpinnings be taken into account when establishing trustworthiness.

To this end, Porter (2007) makes the case for a realist ontology approach to rigour and trustworthiness. The complexity approach discussed in the theoretical framework used to inform the development, conduct, and reporting of this study is informed by my reading of critical realism, particularly the work of the philosopher Bhaskar as introduced in the text of Collier (1994). Therefore, it is appropriate to underpin this section with an ontological approach to rigour and trustworthiness that is grounded in realist principles. Most relevant to this study is Porter's (2007 pp85) agreement with realist complexity theorists Pawson and Tilley (1997) in stating that "interventions will be viewed differently from the different perspectives of the different stakeholders involved. Thus, if we consider a healthcare intervention, then intervention formulators, policy-makers, managers, clinicians and clients will all have their different 'take' on its effectiveness and the factors that promote or inhibit that effectiveness". These authors thus agree that complexity-consistent rigour and trustworthiness requires that multiple perspectives be taken into account, and the understanding that interventions are never implemented in isolation in a closed-environment. Rather, open systems, non-linearity, and improbability underpin social mechanisms (Bekker & Clark 2016), and thus understandings of rigour and trustworthiness. Therefore, Porter's (2007) case for a realist approach to validity is appropriate for this study.

Porter (2007) admits that there is no 'golden key' to judging rigour or trustworthiness from this perspective, but recommends the TAPUPAS criteria from Pawson *et al.* (2003) as being consistent with realist complexity approaches. As the theoretical realist complexity work of Pawson and Tilley (1997) and Pawson (2006; 2013) extensively influenced the theoretical framework underpinning this study, their TAPUPAS criteria are appropriate to address aspects associated with rigour and trustworthiness in this study. These are:

1. Transparency
2. Accuracy
3. Purposivity
4. Utility
5. Propriety
6. Accessibility
7. Specificity

Transparency

Transparency asks whether the process of knowledge generation is open to outside scrutiny (Pawson *et al.* 2003). In the reporting of this study, the research aims, objectives, questions, theoretical framework, methodology, and methods used by reporting decisions made along the way have been made clear through each subsequent chapter of this thesis. This is to show exactly how the research was conducted, who was involved, and how data collection and analysis was undertaken, and why. Further, more details on each of the two peer-reviewed published studies embedded in this chapter have been reported, so as to augment the information and findings provided in the articles themselves.

Accuracy

Accuracy asks whether the claims made are "supported by and faithful to the events, experiences, informants and sources" (Pawson *et al.* 2003 pp9). In the reporting of this research, fidelity has been maintained through ensuring that any assertions, conclusions and recommendations drawn are based upon relevant and appropriate information. For example, to achieve this, suitably anonymised quotes from participants themselves have been reported in study B. I have been clear in any reported conclusions that these are based on this case study or these participant experiences within the theoretical framework of this study, and that whilst they may resonate with other people, these may not be widely generalizable to other settings. This further resonates with the realist complexity understanding that what may work in one setting, may not be appropriate in another, but that wider patterns or demi-regularities may arise (Pawson & Tilley 1997).

Purposivity

Purposivity refers to the approaches and methods utilized, and whether they are appropriate or 'fit for purpose' (Pawson *et al.* 2003). In the reporting of this research, I have documented the decisions made with regards to the approach and methods chosen to answer the research questions, in order to clearly show my reasoning. This is most clearly shown in chapters 3 and 4. Whilst it is highly probable that other researchers may have taken a different approach or used different methods, I believe that my approach and methods are justified as appropriate to meet the objectives laid out in chapter 1.

Utility

Utility holds that “knowledge should be appropriate to the decision setting in which it is intended to be used, and to the information need expressed by the seeker after knowledge” (Pawson *et al.* 2003 pp10). In other words, are the knowledge claims appropriate and do they answer the research questions? Chapter 5 will more fully address utility, in drawing together studies A and B to present key conclusions and provide recommendations. The published findings of study A and B respectively, embedded in the next two sections of this chapter, have been evaluated by my peers as being of utility appropriate to publish in indexed peer-reviewed journals.

Propriety

Propriety asks whether the research has been conducted ethically, legally, and with due care to all relevant stakeholders (Pawson *et al.* 2003). Ethical considerations were addressed in the previous section of this chapter, including such aspects as informed consent, which inherently address and meet the legality and duty of care of this study.

Accessibility

Accessibility refers to the manner in which knowledge is presented, and holds that it should be presented in such a way that meets the needs of the knowledge seeker. For the purposes of this study, the knowledge produced has been presented in the form of this thesis, as well as two peer-reviewed publications. Other forms of knowledge have also been generated (and will be generated in future), such as conference and other presentations (Appendices 5-7), recognition from key organisations (Appendix 8), media (Appendix 9), as well as blog posts and plain language statements aimed both at researchers and policy-makers alike. These have also been shared with the research participants.

Specificity

Specificity refers to the knowledge generated reaching source-specific standards (Pawson *et al.* 2003). In other words, the knowledge generated must 'pass muster'. Both studies A and B have already been accepted as satisfactory through peer-reviewed publication in indexed scholarly journals as shown in the next two sections of this chapter. The full reporting of the research in this thesis has been guided and deemed appropriate by both my supervisors, however ultimately the judgement of specificity of this study for its purpose will lie with its examiners.

The TAPUPAS principles are a useful complexity-consistent set of principles that assist with 'thinking through' criteria for assessing the reporting of a research study when addressing rigour and trustworthiness. Pawson *et al.* (2003) have asserted that these are not intended to be a simple checklist, but rather a means to assist the researcher to apply professional judgement on a case-by-case basis. It is my intention, through signposting the aspects that the TAPUPAS principles have provided, to show my own due process for ensuring the rigour and trustworthiness of this research.

Study A

Too much information? A document analysis of sport safety resources from key organisations.

This study has been published in BMJ Open (Impact Factor 2.4) as:

> Bekker S & Finch CF. 2016. Too much information? A document analysis of sport safety resources from key organisations. *BMJ Open* 6(5):e010877

Supplemental material that was published alongside this paper as supplementary material 1, has been included in this thesis as Appendix 3.

Authorship declaration

Sheree Bekker led this work as part of her PhD studies – designed the study, led its conduct, took the major role in writing the paper and was responsible as guarantor for the overall content. Co-author Caroline F Finch was the lead investigator of the larger NoGAPS project and contributed to the design of the study and the writing of the paper.

BMJ Open

Too much information? A document analysis of sport safety resources from key organisations

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To cite: Bekker S, Finch CF. Too much information? A document analysis of sport safety resources from key organisations. *BMJ Open* 2016;**6**:e010877. doi:10.1136/bmjopen-2015-010877

► Prepublication history and additional material is available. To view please visit the journal (http://dx.doi.org/10.1136/bmjopen-2015-010877).

Received 16 December 2015
Revised 25 March 2016
Accepted 8 April 2016

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ABSTRACT

Objectives: The field of sport injury prevention has seen a marked increase in published research in recent years, with concomitant proliferation of lay sport safety resources, such as policies, fact sheets and posters. The aim of this study was to catalogue and categorise the number, type and topic focus of sport safety resources from a representative set of key organisations.

Design: Cataloguing and qualitative document analysis of resources available from the websites of six stakeholder organisations in Australia.

Setting: This study was part of a larger investigation, the National Guidance for Australian Football Partnerships and Safety (NoGAPS) project.

Participants: The NoGAPS study provided the context for a purposive sampling of six organisations involved in the promotion of safety in Australian football. These partners are recognised as being highly representative of organisations at national and state level that reflect similarly in their goals around sport safety promotion in Australia.

Results: The catalogue comprised 284 resources. More of the practical and less prescriptive types of resources, such as fact sheets, than formal policies were found. Resources for the prevention of physical injuries were the predominant sport safety issue addressed, with risk management, environmental issues and social behaviours comprising other categories. Duplication of resources for specific safety issues, within and across organisations, was found.

Conclusions: People working within sport settings have access to a proliferation of resources, which creates a potential rivalry for sourcing of injury prevention information. Important issues that are likely to influence the uptake of safety advice by the general sporting public include the sheer number of resources available, and the overlap and duplication of resources addressing the same issues. The existence of a large number of resources from reputable organisations does not mean that they are necessarily evidence based, fully up to date or even effective in supporting sport safety behaviour change.

Strengths and limitations of this study

- Document analysis is a systematic, qualitative research method for thematically reviewing documents.
- The websites from six organisations were included. These organisations have previously been recognised as key stakeholders in sport safety in Australia, and hence are considered broadly representative of similar organisations.
- This research did not analyse the quality of the content of the resources, and while the importance thereof is recognised, it was outside the scope of this particular study.

INTRODUCTION

We have become a society hallmarked by the aphorism 'too much information', or simply 'TMI', as the World Wide Web has ushered in an era in which information is at our fingertips. It has been suggested that, for up to 61% of American adults[1] and 78% of Australian adults,[2] their first port of call for healthcare information is searching the internet, or what is colloquially referred to as 'Dr Google'. Moreover, it has been shown that if a doctor working in primary care were to relay all of the recommended primary healthcare information to patients at every opportunity that presented itself, it would take an average of 7.4 h of their time each day.[3]

The field of sport injury prevention has seen a marked increase in information available through scientific and medical journals in recent years, as evidenced by a systematic review of over 12 000 published research articles.[4] Coinciding with this, there has been a concomitant proliferation of lay safety information, such as policies, fact sheets and posters, on injury prevention strategies intended for informing the general sporting public, ostensibly based on the aforementioned scientific evidence. This has been accompanied by a strong trend towards electronic dissemination of such information,[5] possibly because of the relative ease of access and cost-effectiveness of developing and disseminating resources in soft-copy rather than hard-copy form.

In light of this, this paper presents a first step in collating, and categorising, sport safety resources that key organisations distribute electronically via their websites. The aim of this research was to determine the number, and thematically categorise the type and topic focus, of resources disseminated by a set of key organisations which curate sport safety promotion information intended for the general sporting public.

METHODS

Describing the research context

This study was part of a larger investigation, the National Guidance for Australian Football Partnerships and Safety (NoGAPS) project.[6] A key aim of the broader NoGAPS study was to identify factors that influence the translation of safety promotion interventions into practice in community sport. The partnership aimed to reduce knowledge gaps between (1) policy and practice, (2) efficacy to effectiveness, (3) research knowledge to translation and (4) elite sport and community sport. The NoGAPS study provided the context for a clear and well-defined purposive sampling of six organisations for this research study: the Australian Football League (AFL), Victorian Health Promotion Foundation (VicHealth), New South Wales Sporting Injuries Committee (NSWSIC), JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd (JLT Sport), Sport and Recreation Victoria (SRV) and Sports Medicine Australia (SMA). These organisations were originally chosen for the NoGAPS project because they are recognised as key stakeholders in safety promotion in Australia, especially as it applies to the sport of Australian football.[6] This group is therefore representative of organisations at national and state level that reflect similarly in their goals around safety promotion in sport in Australia. Details of our engagement with these organisations, though regular consultation and meetings throughout the NoGAPS project, have been published elsewhere.[7]

Ethical approval

Ethical approval was granted by the Federation University Australia Human Research Ethics Committee (Ballarat, Australia).

Identifying sources of safety information

Currently, in Australia, there is no single source of information or set of comprehensive resources available for sport safety promotion, or to inform the general sporting public about the risks associated with sport participation. Sport settings, therefore, need to actively seek and use a range of safety promotion information from a variety of sources, often found online. The websites of the NoGAPS organisations provide key example sources of this type of information. This study collected, catalogued and thematically categorised the types and topic focus of all safety promotion resources applicable to sport settings available from the websites of the NoGAPS organisations between April and October 2013, inclusive.

Identifying types of resources

First, the types of resources available from the NoGAPS organisations that could be included in a catalogue of safety promotion resources for community sport clubs—rather than elite sport settings—in Australia were determined. Starting with formal document types, the World Health Organization definition for policy (8 p4) was the starting point to identify relevant formal resource types: 'A policy on…injury prevention is a document that sets out the main principles and defines goals, objectives, prioritized actions and coordination mechanisms, for preventing intentional and unintentional injuries and reducing their health consequences'. The words 'action plan', 'strategy' and 'programme' and their synonyms were added as also denoting types of resources.[8–10] Second, the practical end versions of resources (such as posters/fact sheets/guidelines) and all synonymous derivatives were included. The option to add to this list of types of resources as they emerged was maintained throughout the data collection process.

Search strategy

To ensure that no resources were missed, two approaches were used in collating resources for the catalogue: (1) an online search of each NoGAPS organisation website by the first author; and (2) a direct email request to each NoGAPS organisation representative.

Website search

The website search was conducted first. The home page of each NoGAPS organisation website was accessed in April 2013. This page was scanned for links to safety promotion resources relevant to sport settings, before a systematic search of the full website was conducted. Owing to the continually evolving nature of websites as information is updated, this search was repeated 6 months later. Repeating the search ensured that the final catalogue represented an accurate reflection of the resources available from these organisations over the course of 6 months in 2013—so as to ensure inclusion of new resources that were added to the websites over that time period. Full details of the systematic search are detailed in online supplementary material 1.

Direct request

A direct request for the website resources was also made to each NoGAPS organisation's nominated representative, by email, in May 2013, requesting the same types of resources as sourced in the online search. This was to ensure that no resources were missed. Full details of this approach are detailed in online supplementary material 1.

Collation of catalogue

Two catalogues (one for each search strategy) of collected resources were created using NVivo qualitative data analysis software (QSR International Pty Ltd. V.10, 2012). Each search strategy catalogue contained a list of

the resources identified and retrieved, organised by the NoGAPS organisation providing it.

The two catalogues were then merged, duplicate resources between catalogues removed and a final catalogue of safety promotion resources available from the NoGAPS organisations was collated. This process is shown in figure 1.

Document analysis

The topics of items included in the final catalogue were categorised for themes using document analysis, a systematic, qualitative research method for thematically reviewing documents.[11] The catalogue was coded first by resource type starting with policy and its identified derivatives, second by the less formal document types and finally by including new types of resources as codes as they emerged. The second theme coded for was the sport safety issue/s addressed by the resource, based on resource title alone, and adding codes to the sport safety issue theme as they emerged. Each of these two themes (type and issue) was then depicted using NVivo-generated data visualisation Word Clouds that encode word frequency information via font size and font colour/shade,[12] as shown in figures 2 and 3.

RESULTS

A total of 284 safety promotion resources were included in the final catalogue, demonstrating a large number of individual resources available for sport settings in Australia from these NoGAPS organisations alone. The types of resources in the catalogue are shown in table 1 and figure 2. As can be seen in table 1, the NoGAPS organisations disseminated more practical forms of

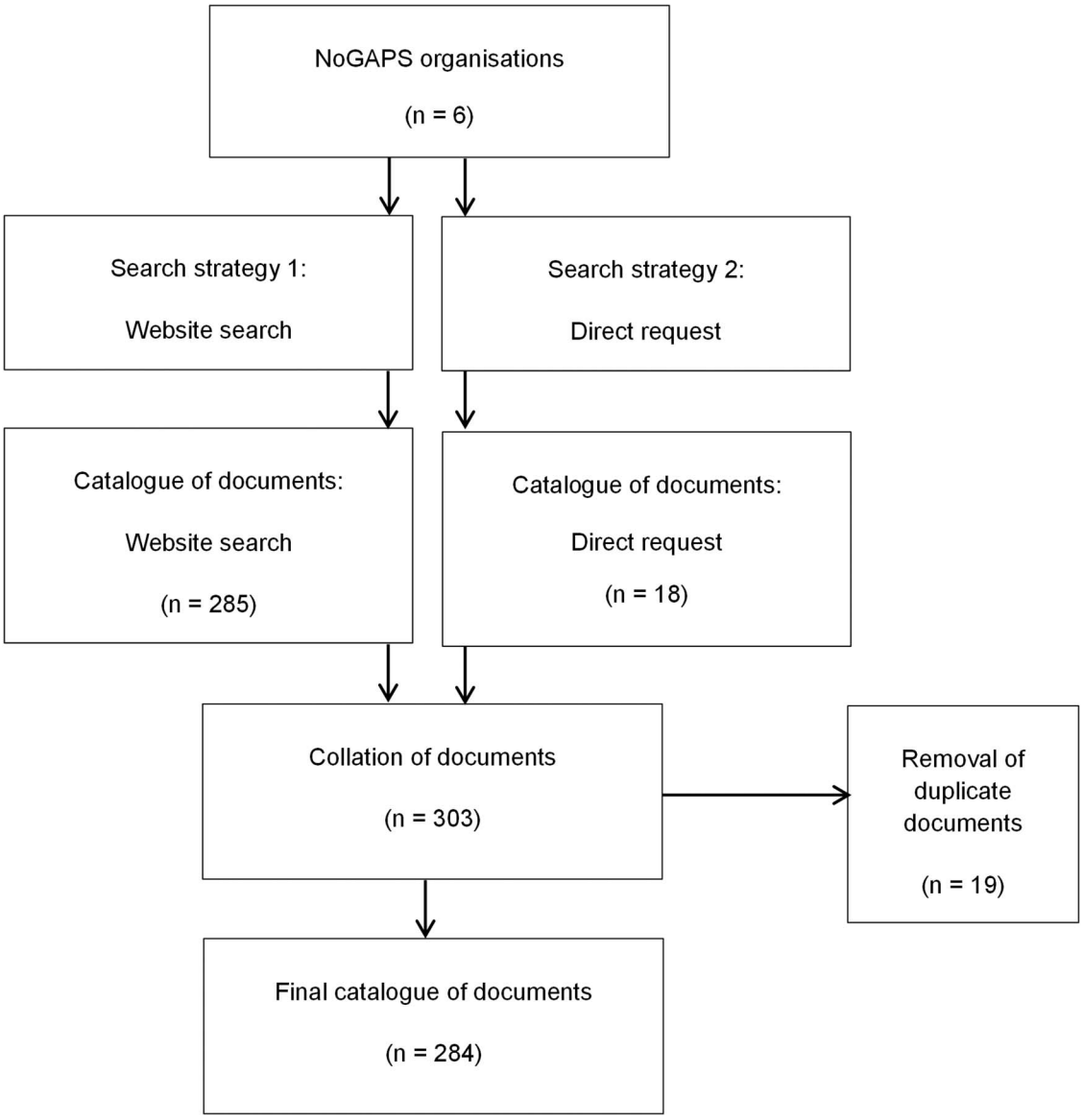

Figure 1 Search strategy used to identify the sport safety resources available from the NoGAPS organisations. NoGAPS: National Guidance for Australian Football Partnerships and Safety project.

Figure 2 Word Cloud of most common types of sport safety resources available from the NoGAPS organisations. NoGAPS: National Guidance for Australian Football Partnerships and Safety project.

resources, such as fact sheets and flyers, than they did formal policies or regulations. Resources aimed at knowledge translation through education and guidance, such as research reports and guidelines, were the second and third most common types of documents disseminated by these organisations. Figure 2 clearly depicts the numerous types of resources (such as fact sheets), with the frequency of their appearance in the catalogue indicated by font size.

The range of sport safety issues addressed by items within the catalogue is shown in table 2 and figure 3. Table 2 shows that resources for the prevention of physical injuries were the most frequent, which may be due to the focus of the sports injury prevention field being predominantly on biomechanical and musculoskeletal interventions. Resources for sport-specific injury prevention guidelines were the second most frequent issue addressed by the documents in this catalogue. This covered very popular sports such as running and cricket, but also included resources for less popular sports such as aerobics and in-line skating (rollerblading). Third, risk management and safety procedures, such as match day checklists, were well covered by all six organisations. In addition to injury prevention resources, four organisations also disseminated broader health promotion resources such as physical activity promotion for diabetes prevention. Figure 3 depicts the most common topic issues (such as concussion)—with frequency indicated by font size—as well as the target groups (such as women or children) and the sports they addressed (such as Australian football).

Figure 3 Word Cloud of most common sport safety issues, target groups and sports found in the sport safety resources available from the NoGAPS organisations. NoGAPS: National Guidance for Australian Football Partnerships and Safety project.

Table 3 depicts the considerable duplication of resources for single sport safety issues across and within organisations. For example, there were 15 identified resources for concussion, including three duplicate documents, from two organisations. Similarly, there were 11 resources for heat/ultraviolet light protection from four different organisations, with three duplicate documents.

DISCUSSION

This study is the first worldwide to analyse the number, type and topic focus of safety promotion resources available online for sport settings, across a set of key organisations. The resultant catalogue of resources addressing an overlapping array of issues is reflective of the rapid development and rise in the popularity of sport, and its associated safety problems, which has occurred without the concomitant development of comprehensive or targeted safety initiatives.[13] Moreover, it creates and perpetuates the very same 'too much information and too little time' issue in information dissemination and availability as described in the introduction to this paper.

Ideally, international, national and community sport organisations should collaborate to address elite-level and community-level safety by setting rules and norms of conduct.[14] Instead, the paucity of a national comprehensive sport safety policy in Australia has led to an environment focused on fragmented safety issues that often only cover single or limited concerns, which is often not mandated in a top-down manner.[15] The problem is exacerbated because community sport has a heavy reliance on volunteers adopting multiple roles, with very little health-related knowledge or experience.[16–18] This results in a smaller pool of sustained knowledge and expertise, particularly around the issue of safety practices,[15–17] compounded by smaller budgets and personnel time constraints.[18] Formal safety policies and practices, in the form of written or unwritten guidelines, are therefore often lacking or inconsistently implemented in these settings.[16 19 20] This lack of a comprehensive and coordinated approach to sport safety could result from sport clubs themselves being unaware of available information, or because of poor dissemination of formal policy and related information by overarching sporting organisations.[17] While most sporting organisations now recognise the importance of safety issues, few sport clubs currently have the resources, staffing, motivation or direct mandate to administer measures to counteract risk.[13]

Organisations such as those represented by the NoGAPS partners aim to bridge this gap by providing and disseminating safety promotion information in the form of a range of resources for a variety of sport settings, as evidenced by the catalogue in this study. The extent of this catalogue and the duplication within it, in turn, may be indicative of the current ad hoc process used in the development of sport safety resources. The development of new resources appears to be largely reactive to specific requests from sport clubs in reaction

Table 1 The type and number of sport safety promotion resources available from the six NoGAPS organisations

Resource type	Number of separate resources identified	Number of NoGAPS organisations providing resources of this type
Fact sheet/information sheet/booklet/pamphlet/brochure/letter/summary/flyer	116	6
Education/research/reports	46	6
Manual/guidelines/framework/guide	36	5
Checklist/form/template/tool/system/action plan/sample	30	6
Policy	23	5
Acts/rules/regulations	7	3
Position statement	7	3
Poster	6	2
Code/code of conduct/code of behaviour	5	2
Links to other online resources	5	2
Resource list/order form	3	3

NoGAPS: National Guidance for Australian Football Partnerships and Safety project.

to specific incidents or media coverage, or resulting from outputs of research projects, rather than through targeted broad proactive prevention efforts. This development process perpetuates replication of the types of resources available across organisations, and duplication of resources covering the same safety issues within and across organisations. Duplication of resources addressing the same issue suggests a piecemeal approach and lack of strategic accumulation of existing safety knowledge and initiatives. Further, consideration for the needs of the sport setting itself remains underexplored, and it is imperative that the end-user perspective is taken into account if safety promotion is to be effective,[21] as it is unknown as to whether or not these resources have been evaluated for effectiveness across different contexts. It is apparent from this study that people seeking sport safety information have to contend with the availability of a variety of overlapping resources, from different organisations, addressing the same sport injury prevention issue in either the same or different ways. An unintentional rivalry of resources for safety promotion activities is thus created, potentially rendering information dissemination efforts ineffective.

Not surprisingly, considering the comparatively vast base of scientific literature, the prevention of physical injury in sport (eg, concussion or anterior cruciate ligament injuries) was most commonly addressed in resources from the NoGAPS organisations. The websites of the NoGAPS organisations also typically provided more of the practical and less prescriptive end versions of policies, such as fact sheets, than formal policies themselves.

It was beyond the scope of this study to assess the quality of the content of resources or to explore how and why they were developed by the organisations. This should be the focus of future research because such factors are likely to influence the uptake and use of such resources by the public. Moreover, mere existence of online resources does not necessarily equate to evidence-based, useful or transferable information. A recent study of online concussion information found the quality to be varied with many key facts omitted from resources, even though the research knowledge base for safety practices to address concussion is sound.[22] A more recent qualitative review of sports concussion educational information[23] noted that simply making information available

Table 2 The sport safety issues addressed in the catalogue of safety resources available from the six NoGAPS organisations

Sport safety issue	Number of separate resources identified	Number of NoGAPS organisations providing resources addressing issue
Physical injury prevention (including concussion)	61	5
Sport specific	58	2
Risk management/safety procedures/first aid	48	6
Environmental issues (heat/ultraviolet/lightning/ground conditions/facilities/infectious diseases/blood)	33	6
Social behaviours (doping/alcohol/gambling/smoking/racial tolerance/religious tolerance/GLTBQIA* tolerance)	20	5
Health promotion	16	4

*Gay, lesbian, transgender, bisexual, queer, intersex, asexual.
NoGAPS: National Guidance for Australian Football Partnerships and Safety project.

Table 3 The duplication of resources for specific sport safety issues, across and within the six NoGAPS organisations

Sport safety issue	Total number of resources identified across all NoGAPS organisations	Number of NoGAPS organisations providing resources on this broad topic	Number of duplicate resources across NoGAPS organisations
Risk management/ safety procedures	26	5	2
Concussion	15	2	3
Heat/ultraviolet	11	4	3
Respect/tolerance	9	3	0
First aid	9	3	0
Facilities	8	2	0
Doping	4	2	0
Ground conditions	4	2	0
Alcohol	3	3	0
Smoking	2	2	0

NoGAPS: National Guidance for Australian Football Partnerships and Safety project.

increases knowledge, but does not produce long-term behaviour change. Similarly, editorials and opinion pieces[24–26] have stated that, despite the existence of scientific evidence, the effectiveness of sport injury prevention interventions remains decidedly ineffective because little attention has been given to information dissemination needs and processes.

It must be stressed here that it is not interventions per se that work, but rather it is people that make interventions work.[27] Interventions are always implemented within a wider socioecological context,[28] and attitudes, individuals, institutions and societal constraints all play a role.[29] Furthermore, resources are never embedded into contexts as a singular entity, rather they form part of a range of rival interventions/policies/resources,[29] as this study has shown. The perpetual development and dissemination of evermore resources, without recognising the potential interplay thereof, or subsequent evaluation as to effectiveness within context, only adds to this rivalry.

Study limitations

This study did not analyse the quality of the content of the resources, and, as discussed, while the importance thereof is recognised, it was outside the scope. The websites from only six organisations were included; however, these organisations have previously been recognised as key stakeholders in sport safety in Australia and hence are considered broadly representative of similar organisations.[6 7] While this study was conducted using a set of Australian organisations, we believe the issues raised are indicative of the nature of the development of sport and its concomitant safety issues in similar countries globally. This study did not collect information on how the need for the particular resources was first identified or how the specific resources were developed by the organisations. It will be an important next research step to evaluate organisational process and intentions behind resource development and dissemination strategies. The first author completed the document analysis and thematic coding, with review input from the coauthor. Notwithstanding these limitations, and as described elsewhere,[7] there was significant consultation with, and recognition of this research by, the NoGAPS organisations, each of which was invited to comment on the compiled catalogue and findings relevant to their organisation.

CONCLUSION

This study used a qualitative document analysis approach to identify and describe how many and what types of resources are available for sport settings from the websites of key organisations, as well as the sport safety issues they address. The findings highlight important issues that are likely to influence the uptake of safety advice and information by the general sporting public. First, the general sporting public has access to *at least* 284 resources for safety promotion from these six organisations alone. Second, the proliferation of resources on apparently the same safety issues only adds to the rivalry of limited time and ability of end users to identify and implement safety initiatives within their sport settings. This is exacerbated by the fact that those accessing the resources and needing to make safety decisions are likely to be volunteers without formal sport injury prevention training or health backgrounds. If sport bodies do not mandate safety actions through higher levels of administration, there is potential for confusion at community sport club level as to what action to take when there are many possible options available to them though different resources. Third, the mere existence of a large amount of resources from reputable organisations does not mean that they are necessarily evidence based, fully up to date or even effective in supporting sport safety behaviour change.

Over recent years, there has been a shift to online dissemination of sport safety promotion information,[22] but much of this has not drawn on well-established principles of social marketing to direct it.[30 31] Unfortunately, this ad hoc approach has led to a proliferation of resources that are neither regulated nor scrutinised for

quality. Sport settings, therefore, have access to a proliferation of rival resources, which reflects a potentially inefficient and ineffective manner in which to promote safety. Research can only have an impact on sport safety practice if evidence is consolidated and presented in such a way that effective practices are triggered, rather than creating a rivalry for implementation efforts without concomitant evaluation for effectiveness. Rather than merely calling for more research, or for more knowledge translation, we conclude that there is an immediate need to undertake research to better understand how to focus information accumulation, resource consolidation and better evaluation of the effectiveness of sport safety resources. Most importantly, future development and dissemination of sport safety resources will require full consideration of the needs of the end user from the outset.

Twitter Follow Sheree Bekker at @shereebekker and Caroline F Finch at @CarolineFinch

Acknowledgements The authors would like to thank the NoGAPS partnership organisation representatives for their assistance in the data collection phase, and their feedback on the findings of this research. The authors would also like to thank Dr PE White for earlier input to this research.

Contributors SB led this work as part of her PhD studies—designed the study, led its conduct, had the major role in paper writing and is responsible for the overall content as guarantor. CFF contributed to the design of the study and the writing of the paper.

Funding SB was supported by a Federation University Australia International Postgraduate Scholarship. This study is part of her PhD work, under the cosupervision of the coauthor. CFF was supported by a National Health and Medical Research Council (NHMRC) Principal Research Fellowship (ID 1058737). This study was partially funded by an NHMRC Partnership Project Grant (ID 565907) with additional support (cash and in kind) from the project partner agencies: the Australian Football League (AFL); Victorian Health Promotion Foundation (VicHealth); NSW Sporting Injuries Committee (NSWSIC); JLT Sport, a division of Jardine Lloyd Thompson Australia Pty Ltd, Sport and Recreation Victoria (SRV); and Sports Medicine Australia (SMA). The Australian Centre for Research into Injury in Sport and its Prevention (ACRISP) is one of the international research centres for the prevention of injury and protection of athlete health supported by the International Olympic Committee.

Competing interests None declared.

Ethics approval Federation University Australia Human Research Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

REFERENCES

1. Fox S, Jones S. The Social Life of Health Information 2011: Pew Internet & American Life Project. Washington DC; 2011. http://www.pewinternet.org/files/old-media/Files/Reports/2011/PIP_Social_Life_of_Health_Info.pdf (accessed 4 Dec 2015).
2. Research Australia. *Australia speaks! Research Australia opinion poll*. Research Australia Limited, 2015. http://www.researchaustralia.org/advocacy-publications/public-opinion-polls (accessed 4 Dec 2015).
3. Yarnall KS, Pollak KI, Østbye T, *et al*. Primary care: is there enough time for prevention? *Am J Public Health* 2003;93:635–41.
4. Klügl M, Shrier I, McBain K, *et al*. The prevention of sport injury: an analysis of 12,000 published manuscripts. *Clin J Sport Med* 2010;20:407–12.
5. Verhagen E, Bolling C. Protecting the health of the @hlete: how online technology may aid our common goal to prevent injury and illness in sport. *Br J Sports Med* 2015;49:1174–8.
6. Finch CF, Gabbe BJ, Lloyd DG, *et al*. Towards a national sports safety strategy: addressing facilitators and barriers towards safety guideline uptake. *Inj Prev* 2011;17:e4.
7. Finch CF, Donaldson A, Gabbe BG, *et al*. The evolution of multi-agency partnerships for safety over the course of research engagement: experiences from the NoGAPS project. *Inj Prev* 2016. doi:10.1136/injuryprev-2015-041922
8. Schopper D, Lormand J-D, Waxweiler R. Developing Policies to Prevent Injuries and Violence: Guidelines for Policy-Makers and Planners. 2006. http://www.who.int/violence_injury_prevention/publications/39919_oms_br_2.pdf (accessed 1 Apr 2015).
9. Sethi D, Waxweiler R, Racioppi F. Developing a national policy for injury and violence prevention. *Int J Inj Contr Saf Promot* 2008;15:53–5.
10. Sminkey L. Finding a common vision for injury prevention. *Inj Prev* 2006;12:171.
11. Bowen GA. Document analysis as a qualitative research method. *Qual Res J* 2009;9:27–40.
12. Viégas FB, Wattenberg M, Feinberg J. Participatory visualization with Wordle. *EEE Trans Vis Comput Graph* 2009;15:1137–44.
13. Timpka T, Finch CF, Goulet C, *et al*. Meeting the global demand of sports safety: the intersection of science and policy in sports safety. *Sports Med* 2008;38:795–805.
14. Timpka T, Ekstrand J, Svanström L. From sports injury prevention to safety promotion in sports. *Sports Med* 2006;36:733–45.
15. Poulos R, Donaldson A, Finch C. Towards evidence-informed sports safety policy for New South Wales, Australia: assessing the readiness of the sector. *Inj Prev* 2010;16:127–31.
16. Casey M, Finch CF, Mahoney M, *et al*. Sport safety policies and practices in two rural Victorian communities. *J Sci Med Sport* 2004;7:226–31.
17. Finch CF, Hennessy M. The safety practices of sporting clubs/centres in the city of Hume. *J Sci Med Sport* 2000;3:9–16.
18. Russell K. *Child safety and wellbeing in Australian sport. Safeguarding, child protection and abuse in sport: international perspectives in research, policy and practice*. Routledge, 2014;116–24.
19. Donaldson A, Hill T, Finch CF, *et al*. The development of a tool to audit the safety policies and practices of community sports clubs. *J Sci Med Sport* 2003;6:226–30.
20. Donaldson A, Forero R, Finch CF. The first aid policies and practices of community sports clubs in northern Sydney, Australia. *Health Promot J Austr* 2004;15:155–61.
21. Donaldson A, Finch CF. Planning for implementation and translation: seek first to understand the end-users' perspectives. *Br J Sports Med* 2012;46:306–7.
22. Ahmed OH, Sullivan SJ, Schneiders AG, *et al*. Concussion information online: evaluation of information quality, content and readability of concussion-related websites. *Br J Sports Med* 2012;46:675–83.
23. Mrazik M, Dennison CR, Brooks BL, *et al*. A qualitative review of sports concussion education: prime time for evidence-based knowledge translation. *Br J Sports Med* 2015;49:1548–53.
24. Finch CF. Implementation and dissemination research: the time has come! *Br J Sports Med* 2011;45:763–4.
25. Kessler RC, Glasgow RE. A proposal to speed translation of healthcare research into practice: dramatic change is needed. *Am J Prev Med* 2011;40:637–44.
26. Hanson D, Allegrante JP, Sleet DA, *et al*. Research alone is not sufficient to prevent sports injury. *Br J Sports Med* 2014;48:682–4.
27. Pawson R. *Evidence-based policy: a realist perspective*. Sage, 2006.
28. Hanson D, Hanson J, Vardon P, *et al*. The injury iceberg: an ecological approach to planning sustainable community safety interventions. *Health Promot J Austr* 2005;16:5–10.
29. Pawson R, Tilley N. *Realistic evaluation*. Sage, 1997.
30. Newton JD, Ewing MT, Finch CF. Social marketing: why injury prevention needs to adopt this behaviour change approach. *Br J Sports Med* 2013;47:665–7.
31. Smith WA. Social marketing: an overview of approach and effects. *Inj Prev* 2006;12(suppl 1):i38–43.

Study B

The translation of sports injury prevention and safety promotion knowledge: Insights from key intermediary organisations.

This study has been published in BMC Health Research Policy and Systems (Impact Factor: 2.3) as:

> Bekker S, Paliadelis P & Finch CF. 2017. The translation of sports injury prevention and safety promotion knowledge: Insights from key intermediary organisations. *BMC Health Research Policy and Systems* 15(25): DOI: 10.1186/s12961-017-0189-5

The interview schedule for this study that was published alongside this paper as Additional file 1: Appendix A has been included in this thesis as Appendix 4.

Authorship declaration

Sheree Bekker led this work as part of her PhD studies – designed the study, led its conduct, had the major role in paper writing and is responsible for the overall content as guarantor. Penny Paliadelis contributed to the writing of the paper. Caroline F Finch was the lead investigator of the larger NoGAPS project and contributed to the design of the study and the writing of the paper.

Bekker et al. Health Research Policy and Systems (2017) 15:25
DOI 10.1186/s12961-017-0189-5

Health Research Policy and Systems

RESEARCH Open Access

The translation of sports injury prevention and safety promotion knowledge: insights from key intermediary organisations

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Abstract

Background: A recognised research-to-practice gap exists in the health research field of sports injury prevention and safety promotion. There is a need for improved insight into increasing the relevancy, accessibility and legitimacy of injury prevention and safety promotion research knowledge for sport settings. The role of key organisations as intermediaries in the process of health knowledge translation for sports settings remains under-explored, and this paper aims to determine, and describe, the processes of knowledge translation undertaken by a set of key organisations in developing and distributing injury prevention and safety promotion resources.

Methods: The National Guidance for Australian Football Partnerships and Safety (NoGAPS) project provided the context for this study. Representatives from five key NoGAPS organisations participated in individual face-to-face interviews about organisational processes of knowledge translation. A qualitative descriptive methodology was used to analyse participants' descriptions of knowledge translation activities undertaken at their respective organisations.

Results: Several themes emerged around health knowledge translation processes and considerations, including (1) identifying a need for knowledge translation, (2) developing and disseminating resources, and (3) barriers and enablers to knowledge translation.

Conclusions: This study provides insight into the processes that key organisations employ when developing and disseminating injury prevention and safety promotion resources within sport settings. The relevancy, accessibility and legitimacy of health research knowledge is foregrounded, with a view to increasing the influence of research on the development of health-related resources suitable for community sport settings.

Keywords: Knowledge translation, Dissemination, Implementation, Injury prevention, Safety promotion, Sport

Background

In healthcare research, the time lag between evidence being produced and its use in practice is an average of 17 years [1]. Knowledge translation has emerged as an important research area concerned with reducing this lag by determining how research findings can best inform guidelines, policy and practice [2]. WHO ([3], p. 2) defines knowledge translation as "*the synthesis, exchange and application of knowledge by relevant stakeholders to accelerate the benefits of global and local innovation in strengthening health systems and advancing people's health*". Key functions of knowledge translation include addressing the relevancy (timeliness, salience, actionability), accessibility (formatting and availability) and legitimacy (credibility) of research for end-users [4].

The refrain – 'bridge the gap' – is often used in relation to knowledge translation in health services research; however, it applies equally to any research that hopes to influence health behaviours, including sports injury prevention and safety promotion. As the phrase suggests, there exists a recognised 'gap' between research and practice in the field of sports injury prevention and safety promotion [5], indicated by the lack of dissemination and implementation of evidence-based interventions [6]. Implementation and dissemination science has thus emerged as a means of 'bridging' the efficacy to

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effectiveness gap in this field [6, 7]. Frameworks for this purpose have been developed for the sports injury prevention context, including the Translating Research into Injury Prevention Practice framework [8] and the Knowledge Translation Scheme [9].

The field of sports injury prevention and safety promotion has thus started to embrace the importance of knowledge translation, via implementation and dissemination research [10], as a means of addressing the relevancy, accessibility and legitimacy of research knowledge for end-users. However, knowledge translation is still often – but not always – left as recommendations for future research activities. The researchers themselves rarely provide direct safety resources or guidance for the general public based on their research, and also do not share their lessons learned from the process of dissemination. This perpetuates the gap between research and practice. One reason for this could be because the translation of research findings into practice is time-consuming and complex, and requires an understanding of the process by which research findings might influence future behaviours [2].

Key organisations involved in sport settings (government and non-government alike, such as sports governing bodies) are therefore often required to take up an intermediary role to assist in 'bridging the gap' by providing research-based safety knowledge to the general public in accessible forms. In this capacity, such organisations perform a knowledge translation role to inform end-users of the findings of injury prevention and safety promotion research by developing and disseminating resources [11], to hopefully positively influence the practice of safety in sport. To date, no studies in the peer-reviewed literature have identified and explained the decisions and processes that facilitate this role in the sporting context.

The aim of this study was to determine, and describe, the processes of knowledge translation undertaken by a set of key organisations in developing and distributing injury prevention and safety promotion resources. This study thus sought to provide novel insight into the knowledge translation activities undertaken by intermediary organisations that work to 'bridge the gap' between research and practice in sport settings. Representatives from five key intermediary organisations participated in individual face-to-face interviews, and a qualitative descriptive methodology [12] was used to understand their perceptions and experiences of the sports injury prevention and safety promotion knowledge translation role undertaken by their respective organisation.

Methods

Context and setting

This study was designed under the banner of the National Guidance for Australian Football Partnerships and Safety (NoGAPS) project [13], and informed by its assumptions and evolution [14]. The NoGAPS partnership organisations were the (1) Australian Football League, (2) Victorian Health Promotion Foundation, (3) New South Wales Sporting Injuries Committee, (4) JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd., (5) Sport and Recreation Victoria, and (6) Sports Medicine Australia. The main aim of the overarching NoGAPS project was to identify the factors that influence the translation of safety promotion interventions into practice in community sport, particularly Australian football. The original partnership goals were therefore to reduce gaps between (1) policy and practice, (2) efficacy to effectiveness, (3) research knowledge to translation, and (4) elite and community sport settings [13].

These organisations were chosen for the original NoGAPS project because they are recognised as key stakeholders in safety promotion in Australia, especially as it applies to the sport of Australian football. This group is representative of organisations at both the national and state levels concerned with sports safety promotion in Australia. Whilst the larger NoGAPS project focused on Australian football, the work undertaken at the majority of the organisations included in this partnership is not limited to Australian football alone. Therefore, while the outcomes arising from this research will be weighted towards the Australian football setting, they should resonate with a wider range of Australian and similar international community sport settings.

Ethical approval

Ethical approval was obtained from the Federation University Australia Human Research Ethics Committee (approval number E13-015).

Recruitment of participants

The NoGAPS partnership project provided a clear and purposeful sampling of the types of organisations that this study aimed to include. The participants in this study were the self-nominated representatives of the NoGAPS partnership project organisations – as per the original NoGAPS project [14]. The representatives were initially informed of this particular study at a face-to-face NoGAPS whole-of-partnership management meeting in 2013, at which the lead researcher presented this proposed study. A formal invitation to participate was thereafter sent to each representative via email. Six representatives from five organisations agreed to participate (one organisation provided two representatives; participants denoted as 1a, 1b, 2, 3, 4 and 5 in the results section). The sixth organisation's representative declined to participate due to time constraints.

Data collection

Face-to-face semi-structured interviews were conducted between July and September 2014. The interview format ensured flexibility to explore processes at the level of each organisation, as it was assumed that there would be variation across NoGAPS organisations with regards to adopted processes, and between participants with regards to the information they had and were able to disclose.

A plain language statement, informed consent form and interview schedule were sent to the participants two days prior to the scheduled interview time. Interviews were conducted at the Melbourne, Australia, offices of each NoGAPS organisation, at a date and time mutually convenient to the participant (NoGAPS representative) and interviewer (lead author). At the interviews, participants were provided with hardcopies of the plain language statement, informed consent form and interview schedule. The informed consent form was signed prior to commencement of the interview. Each interview lasted between 30 and 45 minutes, was semi-structured, and comprised open-ended questions and prompts (Additional file 1: Appendix A). The interviews were recorded using a password-protected iPhone and iPad(™).

Organisation and preparation of data

The interviews were transcribed by a professional transcription company. Each participant was provided with the transcript of their interview for perusal, clarification and approval before the transcript was de-identified by removing participant and organisational names, and any identifying phrases. The transcripts were imported into NVivo qualitative data analysis software (QSR International Pty Ltd. V.10, 2012) as separate document sources for ease of analysis.

Data analysis

This study was underpinned by Qualitative Descriptive methodology [12] to conduct a thematic analysis of participant descriptions of the processes of knowledge translation undertaken at their respective organisations. This methodology allowed the researchers to move easily into and out of the data, and did not necessitate a highly abstract rendering or theorising of the data [12]. Rather, the analysis entailed "*the presentation of the facts of the case in everyday language*" ([12], p. 336). Qualitative description is considered particularly useful when exploring questions of relevance to policymakers and practitioners [12].

All data analysis was undertaken by the lead author, with review input from two further researchers (PW and RW) experienced in qualitative research, and particularly analysis of interview data, who assisted with developing the terminology around emerging themes. Analysis identified emergent themes and common considerations and processes between organisations. Participants provided accounts that ranged in depth, both within and across interviews. To ensure that the participants were given ample opportunity to provide the most accurate descriptions of process that they could, with the information that they had available at the time, each participant was sent the interview questions in advance. Further, participants were provided the opportunity after transcription to check and amend their accounts.

Results

This section describes the three themes that emerged from the data, namely (1) identifying a need for knowledge translation, (2) developing and disseminating resources, and (3) barriers and enablers to knowledge translation. The themes presented in Table 1 are an overview of the general practices discussed by the participants from the NoGAPS organisations, and summarises the types of knowledge translation decisions and activities discussed by participants.

Theme 1: Identifying a need for knowledge translation

Participants discussed procedures used to identify sports injury prevention and safety promotion issues as the focus of new resources, including monitoring of research, monitoring of sport itself or monitoring of the media for new issues arising:

> "*…one process is through our research and observation processes. The second thing is if we see a high incidence of things or a change of incidence of things we're always looking for that. Obviously things that are important topics in the community or the media*" [Representative 3]

> "*Certainly more recently, the issues were identified simply by keeping monitoring the research both in terms of the information that flows from our research partners as well as via various research newsletters and other sources, particularly sources on the web such as The Conversation, or even through various media articles and occasional searches through Google Scholar to see what is coming out*" [Representative 1b]

> "*The two basic premises are where* [organisation] *identifies a need because of some latest research or it's an area we've identified there is no information and that may just be because we've been proactive and had a look or it may be because we've had a number of enquiries about a particular topic*" [Representative 5]

Internal organisational goals or collaborative goals between and across NoGAPS organisations were also discussed as sources of initial development decisions:

Table 1 A general overview of the knowledge translation considerations and processes undertaken by the NoGAPS organisations (NoGAPS: National Guidance for Australian Football Partnerships and Safety)

Theme		Considerations	Processes
1	Identifying a need for knowledge translation	Identification of issues	(a) Monitoring of research, (b) Monitoring of sport, (c) Monitoring of media, (d) Government, (e) Collaboration, (f) Organisational goals
2	Developing and disseminating resources	Development of resources	(a) Commission of research to underpin resources, (b) Commission of the production of resources, (c) In-house development of resources, (d) Updating or review of existing resources
		Distribution pathways	(a) Direct, (b) Indirect
3	Barriers and enablers to knowledge translation	Barriers	(a) Format, (b) Framing: Injury prevention, health promotion and/or performance enhancement, (c) No clear strategy, (d) Reach/uptake/impact or justification of resources
		Enablers	(a) Framing: Injury prevention, health promotion and/or performance enhancement, (b) Awareness raising of injury prevention or safety issues

"*...it might be that an organisation like* [organisation] *comes to us and says, we want information on this made available for community sport, can you put something together?*" [Representative 5]

"*...what we do is consult broadly working with our key stakeholders and funded* [sic] *partners, as well as our specific program experts, campaigns and communications and marketing team across the organisation. Where we're talking about sport safety resources we would obviously consult with* [organisation] *to know if it is already in existence or was going to add value, as well as speaking with the sports sector that are actually the end-users...*" [Representative 2]

Government agendas were also mentioned as a starting point for development of new resources:

"*In the past there's been a cross-government committee... and more recently we had a – the government set up a* [committee] *– and the advice from those bodies are very important in getting approval for research and projects*" [Representative 1a]

Theme 2: Developing and disseminating resources

For all the participating NoGAPS organisations, the process of development of new injury prevention and safety promotion resources began with the commissioning of research. Alternatively, commission of resources could arise from different sources such as consultation with sporting bodies or scientific committees. The NoGAPS organisations typically responded as their organisational capabilities allowed:

"*So if there was a gap that wasn't being looked at, then it might be around some data that we need to actually get to, then we would actually source that out and then work with the appropriate partners, internal and external, to strategise to get that happening. So there's a bit of analysis first and research and program development as required to create practical resources*" [Representative 2]

All participants described how in-house development processes within organisations were determined in consultation with scientific committees, research boards or external researchers:

"*...largely just to work with* [organisation] *with our* [programme] *and commission something specific. If it doesn't require some research it can just be produced based on current information and expert advice and often the expert advice would come from the* [organisation] *members themselves. I think they tend to have a national alignment with communities or expert panels that can provide that input*" [Representative 1b]

"*At some points in the past there was a scientific committee that would write policies and documents. That stopped being used as much. It's now just coming back in. In the meantime, it's been a matter of identifying what it is that has to be written and then identifying the best writer, whether it's something that can be actually – its best practice doesn't mean lit review, doesn't need that in-depth research so it doesn't need a researcher to write it. It might be the national media manager can manage it. Then we get an expert to look at it*" [Representative 5]

"*What we do is because of our – the knowledge we have within our team of sport and the sport club environment at a local level and at other levels but particularly this is aimed at the local level this one. We come up with...we can populate the criteria on a program like that. We then – and we've had a lot of meetings with* [organisation] *and gone* [sic] *'is this*

criteria applicable', can we tweak it? And it's been tweaked along, between us and [organisation] *we've tweaked it to a point. Then from there we release it to say the* [organisation]*…and get feedback. So it has gone through a feedback process*" [Representative 4]

Another factor that the participants discussed was the dissemination of resources. The dissemination pathways that these organisations used were categorised as either direct or indirect. Direct pathways consisted of directly working with state sporting organisations, regional sporting assemblies, or local sporting bodies to provide them with the resources that were deemed necessary to their context and settings, or by reacting to requests from the sporting bodies themselves for resources on specific sport safety issues:

"*…we have direct communications which go through our state bodies to leagues and clubs or in some cases regions. So the states push out that information…In terms of within the states place orders for the* [injury] *resources for their community…*" [Representative 3]

"*The two channels that we use is one is direct or via the sport, there are some things that we go direct to clubs via email and there's 4500* [sport] *clubs that we have to communicate with, 2500* [sport] *clubs and so the communication is not easy. It's not always effective but going direct via email at least we know that it gets there*" [Representative 4]

"*…it's distribution via the sport network. So if it's a* [sport] *factsheet we'd be sending it to* [sport] *and asking them to promote it through their networks. If it fits with something that a sport was doing, we would send it to the organisation and ask them to promote it through their links*" [Representative 5]

"*Sports come into us identifying the need and that could be a state sporting association, regional sports assembly, association or a club. Organisations can make contact with us and may not even be a funded organisation, e.g. We need this. How do we use our defib* [sic]. *They need further guidance*" [Representative 2]

Indirect pathways to dissemination included events or promotions of new resources, via the media, social media and websites, newsletters or apps:

"*…the distribution of something like the app is pretty easy, you put it on the iStore or Google Play and done, it's effectively – well you can say that's been distributed*" [Representative 4]

"*We would do a media release that the national media manager does on behalf of us. So then that goes to media channels*" [Representative 5]

"*Social media, campaigns and innovation are new areas for* [organisation] *to work in, providing more opportunities for brand awareness and reaching target audiences*" [Representative 2]

"*There's a* [programme] *e-news that goes out monthly. So any new resource is highlighted with a link to the resource that's posted on to the* [programme] *website. It would be put as a news item on the* [organisation] *website*" [Representative 5]

Theme 3: Barriers and enablers to knowledge translation

A major barrier identified by all participants in the dissemination of resources to community sport was the format in which they received the knowledge from researchers:

"*I would just say there's a little bit of a gap between research in its purist form versus reviews of research and putting together resources. We have a gap, and by a gap I mean often when we commission research, the end reports and the products are written for researchers by researchers and they're not really translated well into a product that* [organisation] *can digest and use immediately. It takes on a lot of translation and then some further work before we get to a point where it's something that we can actually adopt quickly or implement or recommend that other groups pick up and implement*" [Representative 1b]

"*Well it depends on the audience that we want those resources to go to. They will sit with our branding strategy that we're working with in* [organisation]*, but it's important to make sure what they're called and who they're going to is clear. Is this for the sports sector? Who is it targeted at? That will then guide how we name it and how we work with it and what is its intended outcome*" [Representative 2]

A secondary barrier across these organisations was the confusion between injury prevention, health promotion and performance enhancement. Depending on the overarching aim of the organisation, the need to frame and target resources was different. Framing injury prevention resources as a means to health promotion or performance enhancement was generally considered by these participants to be an important enabler for this group of organisations:

"*So it's probably one of our priorities … how to get the information in a form that people will pick that up*

and want to pick it up and know how to use it, as opposed to messages about how risky particular activities are. It's more about well this is how to improve your performance and at the same time reduce your injury risk, but that's yet to really take place" [Representative 1b]

Another barrier discussed by participants was the need to raise awareness that sports injuries are not inevitable, and are thus preventable:

"*Our challenge is to make the most of that situation and keep that positive perception that something could be done around sports injuries alive…Because I think it's very easy for people just to go back to well nothing can be done about this. It's too hard. Let's just not do anything about it. So from my point of view that's our big challenge at the moment*" [Representative 1a]

This resonated with other participants' perceptions of the framing divide between sports injury prevention, health promotion and performance enhancement – but as an enabler:

"*Under that is the tackling barriers for participation and that includes the sports injury prevention. So it's within that area we are supporting…While it's not explicit in our action agenda (you don't read sports safety, sports injury prevention) the staff know it's part of our key work and it's certainly still a priority…*" [Representative 2]

One participant commented that a major barrier to the development process was the lack of a clear strategy:

"*I don't think we have a strong forward research strategy from managing the program point of view that would be easier, but then that needs to be tempered with the need to respond to issues as they arise*" [Representative 1a]

This linked with the overarching perceptions of the participants that there was a pressing need to address the assessment of reach or uptake of resources, and to determine their impact. The participants expressed that justification of their research translation role is an important step, and potential enabler, in future funding and allocation of more work in this area:

"*The difficulty on getting good data and all that sort of stuff means it's very difficult doing or showing that you've made an impact, apart from people's perceptions and so we're really stuck with – that's a very hard area to work with, but we've just got to work with that, that people at least perceive that doing something is going to have a positive outcome. That's enough to maintain impetus*" [Representative 1a]

"*…and that will help how we build that program in the future and this is something that's seen as a very good opportunity for capturing more accurate local sporting clubs evidence. So while we do not have specific stated sports injury goals in our strategic documents (except at project level) this* [type of] *evaluation will hopefully provide the clear justification for us to continue this work*" [Representative 2]

The major concern across all the participating organisations was this lack of a current means to readily measure reach or uptake of resources once they had been developed and disseminated:

"*…internally are unaware of the broader effect the resources are having, given we are not on the ground. So we might have put those resources together but found it difficult to do full follow up on effectiveness*" [Representative 2]

"*…while they're using it we may not get the feedback from them about uptake or comments regarding value*" [Representative 1b]

"*…maybe seek more formal feedback on that stuff ourselves. Because while I see lots of evidence of uptake I don't know how much it is* [or] *how strong it really is. So from the supply end I think we've done pretty much everything we can. From the users' end I am not sure exactly how much – what the level of uptake is, what percentage that's information that we need to get more of so that we know that – we're pretty satisfied with what the resources are and how they're presented and developed in terms of people's receipt of information. But we don't have really strong research-based information at this stage*" [Representative 3]

Discussion

The larger NoGAPS project sought to address several 'gaps', including policy to practice, efficacy to effectiveness and research knowledge to translation [13]. This discussion links the themes identified in this study with the role that intermediary organisations play in increasing the relevancy, accessibility and legitimacy of research knowledge for end-users. These aspects are highlighted and reflected upon, particularly in relation to the participating NoGAPS organisations and their role as intermediaries in translating research findings into useful resources that can support safe sport practices.

The (ir)relevancy of research knowledge

As theme 1 showed, research did not necessarily inform the identification of issues for which injury prevention and safety promotion resources were needed. The monitoring of research was only one aspect of this activity, along with monitoring other sources such as government priorities and media coverage. These organisations appear to give as much weight to media and the self-reported needs of sporting clubs as to robust research evidence.

The identification of safety issues to be addressed therefore did not appear to follow a formal process in any of the participating organisations. This ad-hoc approach to the identification of issues that warrant new or updated injury prevention and safety promotion resources suggests a reactive, rather than proactive approach. In the absence of researchers making research knowledge actionable, increasing the 'relevancy' of research knowledge by addressing the timeliness, salience and actionability of the format in which the knowledge produced is presented is an important intermediary function performed by organisations in general [4], and by these organisations for the sporting context. Future efforts should be directed towards the best ways for making research knowledge actionable by these organisations and others.

The (in)accessibility of research knowledge

Research findings written by, and for, researchers were generally not considered useful to these organisations when undertaking a knowledge translation role, as theme 2 showed. As a group, they commented on the pipeline lag between research and practice due to the time and effort needed to understand, translate and format findings into resources suitable for community settings. In their capacity as organisations providing a service to end-users, it remained imperative that resources were not provided to them in the form of 'pure research' but rather as easy-to-digest practical resources that could be readily used and easily understood by those developing the resources, and by end-users at community sport clubs. This is a step that researchers in the field of sports injury prevention and safety promotion traditionally do not undertake [6], and it is likely that they expect organisations such as the NoGAPS partners to assume this role. By addressing the formatting and availability –'accessibility' – aspect of knowledge translation, key organisations provide a vital intermediary service to end-users in general [4], and by these intermediary organisations for the sporting context. It is apparent from this study that there is a disconnect between how researchers present their research and the needs of organisations who need to act on it. Going forwards, both groups will need to work together to optimally remove this gap.

The NoGAPS organisations placed a distinct focus on understanding and determining the most effective framing of knowledge via resources for their audience. In other words, they struggled with how best to 'sell' these resources and the information contained in them to their audience of end-users. Re-framing or contextualising injury prevention or safety promotion information differently according to overarching organisational objectives – such as health promotion and/or performance enhancement – was thus seen as important. Therefore, whilst these organisations do not necessarily explicitly state safety promotion and injury prevention as overarching goals, they do recognise the need and importance thereof, and thus embed this within their general scope.

The (il)legitimacy of research knowledge

Theme 3 of this study suggests that the participating organisations generally did not evaluate the reach or ultimate uptake of the resources that they developed and disseminated because they generally did not have the time/resources, staff or skill set to do so. This was perceived as a major barrier to the development and updating of resources in the future, as these organisations have no means of showing the impact of their efforts. As with other intervention outcomes, when reach and impact are not routinely evaluated, a significant barrier to identifying the impact of the work is evident [15], and ultimately the credibility, or legitimacy, of research knowledge is thus undermined [4].

Limitations

Qualitative description is often characterised as 'basic', 'fundamental', or 'surface'; however, it can be, and is, useful and appropriate when exploring issues relevant to 'real-world' policy and practice [12].

Only six organisations were included in this research; however, these organisations have previously been recognised as key stakeholders in sports injury prevention and safety promotion in Australia [13, 14]. Therefore, the NoGAPS organisations are considered broadly representative of similar organisations that have briefs/action portfolios relating to sports injury prevention and safety promotion beyond that of the NoGAPS project focus. Participants' demographic data was not collected, as this study was conceptualised as a sub-study under the inclusion criteria and assumptions of the larger NoGAPS partnership project [14]. Whilst the findings of this qualitative study cannot be generalised to wider populations, it is suggested that the experiences of these participants will resonate with other organisations responsible for interpreting research and developing and disseminating resources to assist in the knowledge translation process. Notwithstanding these limitations, and as described elsewhere [14], there was significant consultation

with, and recognition of this research by, the NoGAPS organisations.

Conclusion

Given the ever-growing literature on the importance of implementation and dissemination science for injury prevention and safety promotion in sports settings [10], the development of frameworks to underpin these issues [8, 9], and the proliferation of resources [11], why do injury prevention and safety promotion outcomes remain challenging?

In this study, participants considered that research knowledge is all too often irrelevant, inaccessible and illegitimate for the purposes of resource development and, ultimately, for use by those at community sports clubs. When research is produced solely by researchers for researchers, the gap between research and practice is perpetuated [16]. Indeed, this has been theorised as contributing to the pipeline process in which research is produced at one end, and practice occurs at the other [16, 17]. These participants suggested that a knowledge translation 'gap' does exist, and is consistent with prior understandings in this field [5].

A large body of research on sports injury prevention and safety promotion intervention has focused on implementation strategies (and the implied embedded dissemination strategies); yet, this research is almost wholly focused on the efficacy to effectiveness gap [18]. Research evidence in this regard, as it currently stands, has shown support for the efficacy and clinical relevance of sports injury prevention and safety promotion interventions, namely that they 'work' [19]. More recently, support for these interventions has been bolstered by implementation plans, suggesting that effectiveness can too be achieved, and that they 'work in context' [20]. Research into sports injury prevention and safety promotion tends to stop short at recognising, and thus researching, the role of industry organisations in the translation of knowledge produced – the research-to-policy and practice gap. This study suggests that there is a need for guidance on measuring and demonstrating outcomes related to the impact of dissemination efforts. It must be noted that key examples where this gap has successfully been bridged do exist, including in the larger NoGAPS project and its successful FootyFirst programme [20]. Further, models such as the non-hierarchical organisational model [21], have been proposed as a means by which constant data and information exchange can be enhanced both across and within end-users.

This study found that key intermediary organisations can, and do, take on a knowledge translation role in order to make research knowledge more relevant (timely, salient, actionable), accessible (formatted and available), and legitimate (credible) for end-users. Indeed, this study echoes a previous finding that "*the greatest barrier to implementation had nothing to do with implementation*" ([22], pp. 223–4), but rather in understanding and influencing the complexity of processes that exist between knowledge and action, in which the participating organisations play an important intermediary role in the process. Recognising and capitalising on the potential intermediary role that these types of organisations play could enhance the influence of research on policy and practice. Thus, such organisations may have an important role to play as key contributors to broad teams tasked with generating injury prevention evidence and ensuring its uptake as an integral part of future research studies, and should be included in the process.

Additional file

Additional file 1: Appendix A. Interview schedule. (DOCX 16 kb)

Abbreviations

NoGAPS: National Guidance for Australian Football Partnerships and Safety

Acknowledgements

The authors would like to thank the NoGAPS partnership organisation representatives for their assistance in the data collection phase, and their feedback on the findings of this research. The authors would also like to thank Dr P White and Dr R Watson for earlier assistance with their review of data coding and analysis.

Funding

SB was supported by a Federation University Australia International Postgraduate Scholarship. This study is part of her PhD work, under the co-supervision of the co-authors. PP declares no funding for this work. CFF was supported by a National Health and Medical Research Council (NHMRC) Principal Research Fellowship (ID 1058737). This study was partially funded by an NHMRC Partnership Project Grant (ID 565907) with additional support (cash and in kind) from the project partner agencies: the Australian Football League (AFL); Victorian Health Promotion Foundation (VicHealth); NSW Sporting Injuries Committee (NSWSIC); JLT Sport, a division of Jardine Lloyd Thompson Australia Pty Ltd., Sport and Recreation Victoria (SRV); and Sports Medicine Australia (SMA). The Australian Collaboration for Research into Injury in Sport and its Prevention (ACRISP) is one of the international research centres for the prevention of injury and protection of athlete health supported by the International Olympic Committee.

Availability of data and materials

Not applicable.

Authors' contributions

SB led this work as part of her PhD studies, designed the study, led its conduct, had the major role in paper writing and is responsible for the overall content as guarantor. PP contributed to the writing of the paper. CFF was the lead investigator of the NoGAPS project and contributed to the design of the study and the writing of the paper. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate
Ethical approval was gained from the Federation University Australia Human Research Ethics Committee (approval number E13-015), and all participants signed an informed consent form prior to participation.

Publisher's Note

Received: 23 August 2016 Accepted: 12 March 2017
Published online: 28 March 2017

References

1. Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: Understanding time lags in translational research. J R Soc Med. 2011; 104(12):510–20.
2. Greenhalgh T, Wieringa S. Is it time to drop the 'knowledge translation' metaphor? A critical literature review. JRSM. 2011;104(12):501–9.
3. World Health Organization. Bridging the "Know–Do" Gap. In: Meeting on Knowledge Translation in Global Health. 2006. http://www.who.int/workforcealliance/knowledge/resources/knowdo_gap/en/. Accessed 22 Aug 2016.
4. Contandriopoulos D, Lemire M, Denis J-L, Tremblay É. Knowledge exchange processes in organizations and policy arenas: A narrative systematic review of the literature. Milbank Q. 2010;88(4):444–83.
5. Hanson D, Allegrante JP, Sleet DA, Finch CF. Research alone is not sufficient to prevent sports injury. Br J Sports Med. 2014;48(4):682–4.
6. Finch CF. No longer lost in translation – the art and science of sports injury prevention implementation research. Br J Sports Med. 2011;45:1253–7.
7. Finch CF. Implementing and evaluating interventions. In: Baker S, Li G, editors. Injury Research: Theories, Methods, and Approaches. New York: Springer; 2012. p. 619–39.
8. Finch C. A new framework for research leading to sports injury prevention. J Sci Med Sport. 2006;9(1–2):3–9.
9. Verhagen E, Voogt N, Bruinsma A, Finch CF. A knowledge transfer scheme to bridge the gap between science and practice: An integration of existing research frameworks into a tool for practice. Br J Sports Med. 2014;48(8):698–701.
10. Finch CF. Implementation and dissemination research: the time has come! Br J Sports Med. 2011;45(10):763–4.
11. Bekker S, Finch CF. Too much information? A document analysis of sport safety resources from key organisations. BMJ Open. 2016;6(5):e010877.
12. Sandelowski M. Focus on research methods-whatever happened to qualitative description? Res Nurse Health. 2000;23(4):334–40.
13. Finch CF, Gabbe BJ, Lloyd DG, Cook J, Young W, Nicholson M, Seward H, Donaldson A, Doyle TLA. Towards a national sports safety strategy: Addressing facilitators and barriers towards safety guideline uptake. Inj Prev. 2011;17(3):1–10.
14. Finch CF, Donaldson A, Gabbe BJ, Muhammad A, Shee AW, Lloyd DG, Cook J. The evolution of multiagency partnerships for safety over the course of research engagement: Experiences from the NoGAPS project. Inj Prev. 2016; 22(6):386–91. doi:10.1136/injuryprev-2015-041922.
15. Dzewaltowski DA, Glasgow RE, Klesges LM, Estabrooks PA, Brock E. RE-AIM: Evidence-based standards with a web resource to improve translation of research into practice. Ann Behav Med. 2004;28(2):75–80.
16. Hanson DW, Finch CF, Allegrante JP, Sleet D. Closing the gap between injury prevention research and community safety promotion practice: revisiting the public health model. Public Health Rep. 2012;127:147–55.
17. Hawe P. Lessons from complex interventions to improve health. Annu Rev Public Health. 2015;36:307–23.
18. O'Brien J, Finch CF. The implementation of muskuloskeletal injury-prevention exercise programmes in team ball sports: A systematic review employing the RE-AIM framework. Sports Med. 2014;44:1305–18.
19. Lauersen JB, Bertelsen DM, Andersen LB. The effectiveness of exercise interventions to prevent sports injuries: A systematic review and meta-analysis of randomised controlled trials. Br J Sports Med. 2014;48(11):871–7.
20. Donaldson A, Lloyd D, Gabbe B, Cook J, Finch C. We have the programme, what next? Planning the implementation of an injury prevention programme. Inj Prev. 2016. doi:10.1136/injuryprev-2015-041737.
21. Dahlström Ö, Jacobsson J, Timpka T. Overcoming the organization–practice barrier in sports injury prevention: A nonhierarchical organizational model. Scand J Med Sci Sports. 2015;25(4):e414–22.
22. Kreindler SA. What if implementation is not the problem? Exploring the missing links between knowledge and action. Int J Health Plann Manag. 2016;31(2):208–26.

Conclusion

This chapter has presented the methodology and findings of the original research reported in this thesis. The first section of this chapter expanded on the chosen methodology for the overall study, providing information on the research approach, paradigm, epistemology, strategy of inquiry, ethical considerations, as well as rigour and trustworthiness. The publications, in turn, detailed the methods and findings for both parts of the study.

Chapter 5 will next present the key conclusions from this study.

CHAPTER 5: DISCUSSION AND CONCLUSION

Introduction

Can a complexity approach help to better understand systemic safety promotion within Australian community sport settings? This research problem was presented and discussed in Chapter 1, and the research plan to explore this question through studying the nature and development of sport safety resources was developed. Chapter 2 showed that, despite significant progress in preventing injuries and promoting safety in sports settings, intractable problems and considerable gaps and barriers remain. Complexity theory was introduced in Chapter 3, as a lens through which to understand, explain, and potentially influence the complex problem of safety in sports settings. The methodology and results for this research were presented in Chapter 4, consisting of a case study approach reported via two embedded peer-reviewed publications.

This final chapter presents the conclusions arising from this research. As detailed findings and conclusions for Study A and Study B were presented in the publications included in Chapter 4 respectively, this chapter, in keeping with complexity theory, will present the overarching key conclusions and discussion. In turn, the implications and recommendations for future research, policy and practice that emerged from this research will be discussed. Limitations of this study will also be presented. Finally, this chapter concludes the research study presented in this thesis.

Key conclusions

In promoting injury prevention and sports safety, various resources exist, intended to inform policy and practice in this regard. Yet, little is known about what safety issues these resources actually inform, or the context that informs their development and distribution. This consideration is particularly relevant in the Australian context where currently no national sports safety policy exists. Therefore, this study aimed to investigate the development and distribution, as well as the type, scope, and amount of resources available to community Australian sports settings from the organisations partnered with the National Guidance for Australian Football Partnerships and Safety (NoGAPS) project (Finch *et al.* 2011).

Study A (Bekker & Finch 2016) aimed to investigate the number of, and thematically describe the type and scope of, injury prevention and safety promotion resources available online from the NoGAPS organisations. This original research showed that there were *at least* 284 different sports injury prevention and safety promotion resources available from these six organisations alone. Furthermore, that there was substantial overlap and duplication of content covering the same injury or safety issues via different resources. The findings of Study A suggest that, in the absence of a national sports safety policy, staff and/or volunteers at community sport settings have access to a proliferation of rival resources, which reflects a potentially inefficient and ineffective manner by which to systemically influence sports injury prevention and safety promotion policy and practice.

Study B (Bekker, Paliadelis & Finch 2017) aimed to determine, and describe, the processes of knowledge translation undertaken by a set of key organisations (the NoGAPS partners) in developing and distributing the injury prevention and safety promotion resources identified in Study A. The findings of Study B suggest that key intermediary organisations can, and do, take on knowledge translation roles in order to try to make research knowledge more relevant (timely, salient, actionable), accessible (formatted and available), and legitimate (credible) for end-users. Recognising and capitalising on the potential intermediary role that these organisations play could enhance the influence of research on policy and practice. However, the complexity of knowledge translation processes that must occur between research and its use in policy/practice is hampering progress in this regard.

Two major conclusions, based on the findings of these two case studies, are as follows:

1. There is potentially *too much complex injury prevention and safety promotion information* available for those working or volunteering at community sports clubs in Australia, which limits their ability to effectively synthesize, adopt, implement, and maintain relevant information.
2. The translation of injury prevention and safety promotion research findings into resources suitable for community sports settings is hampered by the *complexity of knowledge translation processes that must occur between research and its use in policy/practice*.

The two key conclusions are drawn from the findings of studies A and B, and are discussed in the next section in the context of prior literature and complexity theory.

Discussion

In Chapter 2, the literature review, it was discussed that evidence has shown 'what works' to prevent sports injuries and promote safety, but that challenges and barriers remain in how best to ensure 'what works in context' (Finch 2011a). In other words, a wealth of research exists on the efficacy of interventions, yet challenges remain in how best to influence effectiveness in context over time. This gap between efficacy and effectiveness, or more broadly between research and policy/practice, is multifactorial and complex (Glasgow, Lichtenstein & Marcus 2003; Finch 2011b; Greenhalgh & Wieringa 2011; Hanson *et al.* 2012; Kreindler 2014; Green 2014; Hawe 2015a; Bekker & Clark 2016).

The efficacy to effectiveness gap is most often theorized to be a knowledge translation issue. Green (2014 p25) states that "the usual answer to bridging the gap between research and practice or policy is to disseminate research findings more efficiently". On this premise, research knowledge must be made more accessible for those working or volunteering at community sports clubs to understand and use, achieved by distributing research knowledge in lay formats, rather than relying on knowledge from published research papers to diffuse into practice over time. Barton (2017 pp 59) concurs with this premise, and proposed a four-step process to improve knowledge translation in the field of sports injury prevention: 1) complete research, 2) journal publication, 3) multimedia creation, and 4) social media dissemination. In this opinion piece, Barton (2017) theorizes that most researchers stop at step 2, and that the barriers to knowledge translation for end-users are comprehension, unengaging content, and time restraints. Therefore, it is suggested that knowledge needs to be transformed into different multimedia formats (infographics, posters etc.), and shared via social media in order for it to be more engaging and accessible for end-users (Barton 2017). Thereby the solution to the gap in knowledge translation is cast as a need for different, more, or better knowledge *formatting and dissemination*. In other words, the crux of knowledge translation, from this view, is assumed to be a need for the design of plain language resources that make research knowledge more accessible for end-users, reaching them by disseminating these resources via social media platforms.

Barton's (2017) call for more effective formatting and dissemination appears to be based on the theoretical assumptions of the conventional simple approach, as discussed in Chapter 3. This is in line with the view of Engebretsen *et al.* (2017 pp2) who argue that current understandings of knowledge translation are "based on a simplistic view of

translation and knowledge dissemination". Further, this approach demonstrates an over-reliance on the 'fallacy of amelioration' (Watters 2014) in sports injury prevention and safety promotion research and policy/practice. The fallacy of amelioration suggests that the problem of knowledge translation is simply about an untapped wealth of research knowledge, which merely requires improved mechanisms for the distribution of that knowledge to increase reach, and, in turn, the implementation of research knowledge to solve complex problems (Watters 2014).

However, this assumption clearly demonstrates the pipeline fallacy in that a distinction is made between knowledge creation, its formatting and dissemination, and use in policy and practice (Green 2014; Hawe 2015a). The findings of this research have emphasised that locating the issue as a 'gap' in the research-to-practice pipeline, rather than interrogating and problematizing the relevancy, amount, and type of knowledge that is created in the first place, is a new perspective on sports injury prevention and safety promotion. Study A (Bekker & Finch 2016) has found that an intervention, provided in the form of a plain language resource, might be but one of possibly hundreds available to a community sports setting. So the question becomes: how do those involved in community sports settings make decisions about which resources are most valid, reliable, and evidence-based for their context? Further, Study B (Bekker, Paliadelis & Finch 2017) showed that plain language resources are already constantly and consistently being developed and distributed, and these often cover the same injury prevention and safety promotion concerns both across and between organisations. The issue, then, is that different organisations develop their own solutions based on a myriad of research and resources for each of the problems that they deem relevant (Bekker, Paliadelis & Finch 2017). Which is why, amongst the key participating organisations, an overlap of, for example, 15 different concussion resources and 11 different heat/ultraviolet resources were found to exist (Bekker & Finch 2016). This is clearly a concern that has not previously been identified in the existing literature.

The overarching issue seems to be that knowledge formatting and dissemination are still too often assumed to be the full extent of knowledge translation, and are placed within the 'pipeline' gap. In other words, the assumption that underpins most of the existing literature is that if knowledge is formatted differently and disseminated better, then knowledge translation will be achieved. Indeed, Greenhalgh and Wieringa (2011), Green (2014), Kreindler (2014) and Hawe (2015a) have all flagged that this simplistic use of the term 'knowledge translation' is responsible for perpetuating these flawed underpinning

assumptions and actions, as discussed in Chapter 2. Merely disseminating research findings to end users in more attractive or accessible formats is not enough, as many community sporting organisations are not equipped to, or adept at, effectively adopting, implementing, maintaining or monitoring the outcomes of research findings and guidelines into policy/practice (Hanson *et al.* 2012; O'Brien, Donaldson & Finch 2016).

Only some researchers in the field of sports injury prevention have identified the issues with this simple view of bridging the knowledge to practice gap (Finch 2006; 2011a; Hanson *et al.* 2012; Donaldson & Finch 2013; Verhagen *et al.* 2013). As discussed in the literature review, Finch (2006; 2011a) has called for more and better approaches to theory-informed knowledge translation through effectiveness approaches. This has been echoed by Hanson *et al.* (2012), Donaldson & Finch (2013), as well as Verhagen *et al.* (2013) as discussed in Chapter 2. All of these researchers posit knowledge translation as a much more complicated undertaking, in which context and other intervention components must be considered. By adopting a complexity lens, this study sought to build on work done by these researchers who represent the complicated approach to research and knowledge translation, as discussed in Chapter 3.

By adopting a complicated approach to this topic, however, both the 'puzzle' and 'pipeline' issues, as discussed in the literature review, still remain. This is because of the assumptions under which research is conventionally undertaken. The literature review, theoretical framework and embedded editorial (Bekker & Clark 2016) argued that the paradigm of conventional complicated sports injury prevention and safety promotion research still takes a parts-of-the-whole approach to solving problems in the sports setting. This conventional approach attempts to monitor, study, and influence each component part in turn. While this reductionist stratification is useful when breaking down the context, injury or safety issue, and its intervention into smaller, more manageable or more closed-system research appropriate parts, it does rely on the assumption of linear causation. In turn, single- and limited-issue sports safety resources are developed, as seen in Study A (Bekker & Finch 2016), on the understanding that if a 'magic bullet' component can be found and then influenced through an efficacious intervention, then the issue has essentially been resolved with best current evidence. That is, until a more complicated part of a part of that whole can be elicited, studied, and resolved in some way, or if the original part can be resolved in some new way. However, unexpected parts tend to emerge via such effectiveness approaches. For example, issues around reach, adoption, implementation, and maintenance (O'Brien & Finch 2014a) are still seen. From

this viewpoint, solutions to sports injury problems are seen as a set of complicated problems that must be solved, and re-solved. This approach fails to take into account the fluid nature of an open stratified ontology, such as community sports clubs, where the context is “under perpetual construction” (Prigogine & Stengers 1997 pp781).

The conclusions of this study therefore supports and builds on the work of Green (2014 pp25) who stated that “perhaps the question should not be how do we get more and better dissemination and implementation of the existing science to practitioners and policymakers, but instead, how do we ask the right questions in the first place and, in turn, how do we get better adaptation of the research practices into the real world”. Placing the onus on the ‘fallacy of amelioration’, ‘content delivery’, or simple and complicated views of ‘knowledge translation’ to solve complex social problems is hampering more meaningful change at a systemic and structural level. Using a complexity approach to sports injury prevention research enables a deeper understanding of ‘what works, for whom, when, where, why, and how’ in order to improve the relevance of research knowledge, and to better address the outcomes sought (Bekker & Clark 2016).

As discussed in Chapter 3, sports safety both is, and occurs within, an open system. When understood as an open system, intervening in sports settings to promote safety cannot be a linear task with a predefined outcome. Instead, open systems are considered stratified, with interacting components that are fluid and in flux, and thus outcomes vary (Clark, Lissel & Davis 2008). Sports safety, from this perspective, cannot be broken down into component parts of a whole, on the understanding that the whole is equal to the sum of its parts. Rather, as this study has identified, the consideration for sports safety as an open system, consisting of interacting parts from which sports safety continually *becomes,* is more ontologically sound. From this perspective, it is clear that sports safety is equal to *more* than the sum of its parts.

In considering sports settings as complex, open systems, everyday choices about injury prevention and safety promotion at community sports clubs are clearly varied and infinite. Therefore, a simple either-or choice between simply using, or *not* using, a single resource for a single problem (such as concussion guidelines downloaded from an app in a contact sport environment) represents a false dichotomy. Rather, the problem lies in how community sporting organisations make decisions about which resources to choose and use over a plethora of other, sometimes equally relevant resources, as identified in Study A (Bekker & Finch 2016). This is particularly seen when resources address the

same problem (such as concussion guidelines from different organisations in different formats such as apps and posters) and also the other problems that can arise in a complex sporting setting (forms of non-accidental violence such as harassment), as study A has shown (Bekker & Finch 2016). Furthermore, those implementing injury prevention and safety promotion interventions at community sporting clubs need to integrate these with what they *already know and do* in that setting for that particular problem, and take into account the myriad of other risks they seek to mitigate every day. This study has shown that the limitations of popular and current research approaches have contributed to the existence of *too much information* to be useful to those at community Australian sports clubs.

When viewed through a complexity lens, the focus should then not be on creating more and more resources to 'bridge the gap' and thereby promote safety in sports settings. This is because this research has shown existing resources are already numerous, ad-hoc and fragmented, which means that their usefulness and indeed power to effect change at a systemic or structural level within an open system is diluted. The current conventional mandate to effect change is too often couched as a myriad of individual suggestions conveyed via different types of resources developed by intermediary organisations, and left to the discretion and implementation efforts of those who are often volunteers at community sports clubs. As Hawe (2015a) and Hanson *et al.* (2012) suggest, this top-down approach in which each location handles the problem in its own way is ineffective, and as the current study shows, it is important to consider the process of how community sports organisations manage and implement a myriad of different and sometimes conflicting pieces of information. Individual behavior change strategies may be useful in effecting change for simple and complicated problems, however, this is sometimes at the expense of considerations of systemic contextual structural change. Therefore, individualising risk and its intervention is hampering more meaningful work at a larger systemic level. Parts of the whole are currently explicated and 'stop-gaps' are put in place, generally in a reactive manner in response to media coverage or other calls for action, rather than through a systemic and structural commitment to overall safety.

This study has, therefore, shown that the knowledge translation gap in community sports settings does not represent a simple knowledge formatting and dissemination issue, or even a complicated implementation issue, but rather represents a complex research *relevancy* issue. By using a complexity lens, it has become clear that both the lack of a comprehensive national sports safety policy, and the ad-hoc development of sports

safety resources, stems from an insufficient consideration for ontology. The Australian sport setting has, in the past, perhaps been considered as *too complex* to influence as a meaningful whole, as there are too many moving parts – or fluid components. Therefore, the system has been viewed from simple or complicated lenses to better 'control' for complexity. However this is the problem, as ignoring the complex nature of sports settings leads to a fragmented and sometimes siloed view of how best to prevent sports injury.

There is, therefore, a pressing need to move away from the simple or complicated focus on the interplay between the individual (or individual issues or sports settings) and their behaviour to prevent injury and approach safety. The focus needs to shift to an understanding of sports injury prevention as a larger and deeper structural matter, based on the complex nature of the stratified open system. A complexity approach accounts for, and aims to advance, understand, and influence the underlying causal mechanisms so as to achieve social change systematically. These include those structural factors, often deemed non-intervention components and written out of intervention research. For example, a complexity perspective holds that there are broader powers at work (such as managers' key performance indicators, sporting culture, 'winning at all costs' mindset, patriarchal society matters) that need to be recognised and accounted for if chances of success to improve sports safety are to be increased – as discussed in Chapter 3. Resources developed under fragmented and single- or limited-issue assumptions run the risk of missing, misunderstanding, or misrepresenting the structural changes necessary to make them work. The implications and recommendations for future research and policy/practice will be discussed in the respective sections later in this chapter.

This study is the first step in identifying that while there is a wealth of lay sports safety information available online, the proliferation of multiple, sometimes conflicting, resources may be doing more harm than good. The assumption that people will implement injury prevention or safety promotion interventions *merely because they* exist and *are presented in an eye-catching format* is naive. It is known that healthcare research, on average, takes 17 years to be translated into practice (Morris, Wooding & Grant 2011), and the problem remains that even if people do know about scientific evidence, they are often unsure of how to use it anyway (Mrazik *et al.* 2015). A new resource does not necessarily supersede or replace an old one, rather it just adds to the complex array of resources and requires greater responsibility and effort from those working at community

sports clubs to implement, despite the fact that these people often have limited time and capacity to do so.

A major barrier to sports safety knowledge translation is not knowledge formatting, but rather the complexity of the act of knowledge translation itself. As sports settings are an open system with moving parts, fidelity of, and institutional memory about, interventions may not be consistent over time. Each new season the composition of the team or club may change, and new participants may bring new understandings, resources, or decide to change policy or practice. Despite the fact that an intervention may be efficacious and effective in one season, does not mean that it will be in the next, or that previous successes in sports injury prevention can be replicated. As discussed in Chapter 3, sport safety is continually 'becoming'. In other words, safety within sports settings is a state that must be sought each new day, hour, and minute that sport is participated in, and therefore is never fully 'achieved' or 'not achieved'. Therefore, as the conclusions of this study have highlighted, safety within sports settings is a process, rather than an outcome. By moving to understand sports safety as a process, profound and novel insights can emerge that will influence the systemic structural change necessary to address complex incorrigible problems.

In summary, this study concludes that there is potentially *too much complex injury prevention and safety promotion information* available for those working or volunteering at community sports clubs in Australia, which limits their ability to effectively synthesize, adopt, implement, and maintain relevant information. Further, the translation of injury prevention and safety promotion research findings into resources suitable for community sports settings is hampered by the *complexity of knowledge translation processes that must occur between research and policy/practice*.

Implications and recommendations for future research

As discussed earlier, sports safety has, in the past, been studied from an approach characterized by a machine metaphor in which parts are considered equal to the whole (Zimmerman, Plsek & Lindberg 1998). This approach has been focused on developing and testing single- and limited-issue interventions in closed systems, which are then translated into resources for end-users in the complex real world by key intermediary organisations, in a 'piece of the puzzle', 'pipeline' approach informed by simple and complicated assumptions (Bekker & Clark 2016). This approach to understanding sports injury prevention has been based on the implicit assumption that individual interventions and their corresponding resources can, and do, effect safety outcomes within larger open systems.

The development of resources based on single and limited issue interventions places onus on the individual to act on individual issues when, in fact, complex problems exist at a wider systemic level. This study has identified that sports injury interventions and the resources disseminated generally lack consideration for ontology and an awareness of the complexity of the issues.

This study has concluded that simple and complicated approaches are inadequate for solving the 'wicked' problems that comprise safety issues in sports settings (Bekker & Clark 2016). Therefore, a complexity lens was applied to consider these complex problems in an attempt to better understand and influence injury prevention and safety promotion outcomes within community Australian sports settings.

In considering the nature of the world as inherently complex, there is a need for future research to accept this complexity. Theoretical perspectives, such as those presented in this study, pave the way to raising awareness of the ontology of social interventions. Further, qualitative approaches to research, which are absent in the vast majority of sports injury prevention studies, can improve understanding of context-specific considerations for successful social interventions. The following recommendations provide specific examples of how the findings of this study could inform future research.

Recommendation 1: A content analysis of the resources identified in Study A

First, it was beyond the scope of this unfunded, time-limited study to undertake an assessment of the actual content of the resources identified in Study A, which would help to better understand the quality of the knowledge provided to community sporting organisations, and whether this knowledge is potentially too complex. Of particular importance would be to determine whether or not these resources are evidence-based, and up to date with current evidence, and whether any are outdated and contain information that conflicts with new evidence.

A qualitative content analysis (Elo & Kyngäs 2008) of these resources may be appropriate to answer the research question ‘’are the sports safety resources available from the NoGAPS organisations evidence-based?” to fulfil the above aim. This is important because Study A determined how many and what kind of resources exist, but it is yet unknown as to whether the content that they contain is of a high quality or meaningful to end-users. A thematic analysis of the resources would assist in better understanding the focus of the information provided about a range of sports injury prevention strategies.

Recommendation 2: Monitor the reach and uptake, and evaluate the implementation and maintenance of sports injury prevention and safety promotion intervention resources

Monitoring the reach and uptake of these resources by community sporting organisations will provide useful information on the potential impact of such resources. An evaluation of the reach and uptake of the resources identified in Study A would help to better understand the dissemination needs, and potential adoption of, such resources by community sporting clubs in Australia. Evaluation of the implementation and maintenance of the interventions prescribed by these resources will help to provide an understanding of their use over time, and will assist intermediary organisations, such as the NoGAPS partners, in better tailoring future resources for use at community sporting organisations.

A realist (Wong *et al.* 2016) or complex (Craig *et al.* 2008) intervention evaluation, underscored by the RE-AIM framework (Glasgow, Vogt & Boles 1999), incorporating focus groups and observations to explore the knowledge and experiences of sports club administrators, coaching and other staff, parents, and athletes may be appropriate to answer the research question 'what works, for whom, when, where, why, and how' in terms of sports injury prevention resources in community sports settings in Australia. This is important to determine whether or not resources are actually used, how, by whom, and why in community sporting organisations in Australia. This will assist in better tailoring such resources in the future.

Recommendation 3: Undertaking similar research in different contexts and settings

This study has uncovered an oft-overlooked outcome of research under conventional approaches as discussed in Chapter 3: that too much information is produced without the input of key intermediary organisations, and that end-users are assumed to 'puzzle' this information together in a meaningful way. As this research is a case study that cannot be generalised across contexts and settings, undertaking similar studies in other places both nationally and internationally would be of benefit to better understanding how to ensure our work is more relevant. It is expected that differing legal, sporting cultures, and preventive policy and programs would produce different results, but that larger patterns across these contexts and settings would emerge, and have implications for injury prevention on both small and grand scales.

Implications and recommendations for policy and practice

The following implications and recommendations for policy and practice all reflect how the participating organisations could make use of the findings of this study to manage the increasing workload of translating and disseminating injury prevention messages to community sporting bodies more effectively. The three recommendations provide specific examples of how the findings of this study could guide the participating organisations, and potentially other sporting groups, to consider sports safety knowledge translation for future use in policy/practice.

Recommendation 1: Review current resources

As identified in this study, a large amount of resources currently exist, with duplication and overlap between and across organisations that develop and disseminate them (Bekker & Finch 2016). These organisations rarely reported reviewing their current resources as part of their development process (Bekker, Paliadelis & Finch 2017), and thus there is scope for taking stock of current resources. It is suggested that the participating organisations review their current resources to assess for duplication and inconsistency, and to develop a process to better inform a continuous review of resources available to community sporting organisations. This might include a process for document control, regular updating of resources when new information emerges or research is published, and a clear communication strategy to end-users of how and when updated or new information will be provided.

Recommendation 2: Update and curate, rather than create

As Study A (Bekker & Finch 2016) found, there are a large amount of resources available, and as Study B (Bekker, Paliadelis & Finch, 2017) showed, the updating and review of these resources is only a small component of the development process. Therefore it is recommended that intermediary organisations place a larger emphasis on updating and curating current resources, rather than focusing on creating new ones. This may include ensuring that popular resources are reviewed on an annual basis, and rescinding resources that no longer reflect current evidence.

Recommendation 3: Collaborate

In order to avoid duplication of work in the development of resources, intermediate organisations should consider collective work with each other, with relevant researchers, and with policy-makers and peak sporting bodies to create, curate, and collaborate on resource provision. The NoGAPS partners already show a keen interest in future collaboration (Finch, Donaldson, Gabbe *et al.* 2016), which would assist in sharing the responsibility for ensuring the currency of resources among members and enable the development of expertise across the organisations. This might include working with researchers and community sporting organisations to evaluate the uptake and implementation of current resources to better understand when, why, and by whom current resources are used so as to better understand their impact. Further, there is a need to work with these groups to create more relevant resources and avoid duplication and overlap.

Limitations

First, overarching limitations to this study relate, in part, to the constraints of conducting unfunded doctoral degree research, namely time and money.

Second, as this study was conceptualised as a nested case study within the NoGAPS project, it represents the experiences of the NoGAPS organisations and their work in the Australian Football context. Therefore, generalisations cannot be made across other Australian community sports settings, nor community sports settings internationally. However, in the original protocol for the core NoGAPS project (Finch *et al.* 2011), and in the embedded case study reporting publications (Bekker & Finch 2016; Bekker, Paliadelis & Finch 2017) these organisations are recognised as broadly representative of the Australian sporting context, and may be similar to other international organisations. Further, as the overarching key conclusions, and recommendations and implications for research, policy, and practice are drawn under complexity ontology, these may, therefore, resonate with sports safety in other contexts, settings, and locations.

Third, the sample size of six organisations may be considered too small for a meaningful research study of this topic. However, as this research was a qualitative study aiming to elicit rich, valuable data, the study of these six major Australian organisations was deemed appropriate. Further, the study of this select group of organisations has been recognised as delivering meaningful research through the core NoGAPS project (Finch *et al.* 2011), and paves the way for further research to adopt a complexity perspective.

Finally, the specific methodological limitations for each case study, A and B, have been reported in the respective publications embedded in Chapter 4.

Conclusion

Sport, and sports safety, has been identified as quintessentially complex. This research study intended to draw on an understanding of this complexity, and ultimately generate insights into how complexity plays a role in the promotion of safety in community Australian sports settings. Further, this research intended to contribute to understandings for future research, policy, and practice in this regard.

It is evident that there is a greater need for a better understanding and accounting for the consideration of complexity when developing and distributing future sports safety resources for this setting, and working towards systemic safety promotion policy and practice. The conclusions reflect the overall collective picture of the National Guidance for Australian Football Partnerships and Safety organisations that emerged via a case study approach, however may be broadly applicable to the wider Australian community sporting context.

This study looked at the complexity of injury prevention and safety promotion in community Australian sports settings by drawing on theoretical perspectives not previously applied in this topic area. This final chapter has presented the major conclusions of this research, which were: 1) that there is potentially too much complex injury prevention and safety promotion information for those working or volunteering at community sports clubs in Australia to effectively synthesize, adopt, implement, and maintain, and 2) that the translation of injury prevention and safety promotion research findings into resources suitable for community sports settings is hampered by the complexity of knowledge translation processes that must occur between research and its use in policy/practice.

If the world is regarded as complex, then it is only by recognising it as so, and grappling with that complexity, that we can begin to address the complex problems that persist. Paraphrasing Jones (2017) on obesity, sports injury prevention and safety promotion ‘is complex, but we shouldn’t let complexity get in the way of implementing promising policies’. Thereby, implications and recommendations for future research, policy, and practice were presented for consideration. The study limitations were also declared. Finally, I wish to wholeheartedly thank the participating organisations and individuals who contributed to this study, without whom the insights presented here would not have been possible.

REFERENCES

Abbott K, Klarenaar P, Donaldson A & Sherker S. 2008. Evaluating SafeClub: can risk management training improve the safety activities of community soccer clubs? *British Journal of Sports Medicine* 42(6)**:**460-465.

Andrew N, Gabbe BJ, Cook J, Lloyd DG, Donnelly CJ, Nash C & Finch CF. 2013. Could targeted exercise programmes prevent lower limb injury in community Australian football? *Sports Medicine* 43(8):751-763.

Arnason A, Andersen TE, Holme I, Engebretsen L & Bahr R. 2008. Prevention of hamstring strains in elite soccer: an intervention study. *Scandinavian Journal of Medicine & Science in Sports* 18(1):40-48.

Australian Government Department of Health and Ageing. 2003. *Sports Safety: An Update.* Canberra: Australian Government.

Australian Sports Commission. 1997. *SportSafe Australia: A National Sports Safety Framework*. Canberra: Belconnen.

Bahr R, Thorborg K & Ekstrand J. 2015. Evidence-based hamstring injury prevention is not adopted by the majority of Champions League or Norwegian Premier League football teams: the Nordic Hamstring survey. *British Journal of Sports Medicine* 49(22):1466-1471.

Barton C. 2017. The current sports medicine journal model is outdated and ineffective. Where to next to improve knowledge translation? *Aspetar Sports Medicine Journal* 6:58-63.

Bekker S & Clark AM. 2016. Bringing complexity to sports injury prevention research: from simplification to explanation. *British Journal of Sports Medicine* 50(24):1489-1490.

Bekker S & Finch CF. 2016. Too much information: a document analysis of sport safety resources from key organisations. *BMJ Open* 6(5):e010877.

Bekker S, Paliadelis P & Finch CF. 2017. The translation of sports injury prevention and safety promotion knowledge: Insights from key intermediary organisations. *BMC Health Research Policy and Systems* 15(25): DOI: 10.1186/s12961-017-0189-5.

Bittencourt NFN, Meeuwisse WH, Mendoca LD, Nettel-Aguire A, Ocarino JM & Fonseca ST. 2016. Complex systems approach for sports injuries: moving from risk factor identification to injury pattern recognition – narrative review and new concept. *British Journal of Sports Medicine* doi:10.1136/bjsports-2015-095850

Bizzini M, Impellizzeri FM, Dvorak J, Bortolan L, Schena F, Modena R & Junge A. 2013. Physiological and performance responses to the FIFA 11+ (part 1): is it an appropriate warm-up? *Journal of Sports Sciences* 31(13):1481-1490.

Bizzini M, Junge A, Dvorak J. 2013. Implementation of the FIFA 11+ football warm up program: how to approach and convince football associations to invest in prevention. *British Journal of Sports Medicine* 47(12):803-806.

Boulton JG, Allen PM & Bowman C. 2015. *Embracing Complexity: Strategic Perspectives for an Age of Turbulence.* Oxford: Oxford University Press.

Bowen GA. Document analysis as a qualitative research method. 2009. *Qualitative Research Journal* 9(2):27-40.

Brackenridge CH & Rhind D. 2014. Child protection in sport: reflections on thirty years of science and activism. *Social Sciences,* 3(3):326-340.

Branas CC, Jacoby S, & Andreyeva E. 2017. Firearm violence as a disease—"hot people" or "hot spots"? *JAMA Internal Medicine* 177(3):333-334.

Brito J, Figueiredo P, Fernandes L, Seabra A, Soares JM, Krustrup P & Rebelo A. 2010. Isokinetic strength effects of FIFA's The 11+ injury prevention training programme. *Isokinetics and Exercise Science* 18(4):211-215.

Byrne D & Callaghan G. 2013. *Complexity Theory and the Social Sciences: The State of the Art.* London: Routledge.

Casey M, Finch CF, Mahoney M & Townsend M. 2004. Sport safety policies and practices in two rural Victorian communities. *Journal of Science and Medicine in Sport* 7(2)**:**226-231.

Castellani B & Hafferty F. 2009. *Sociology and Complexity Science: A New Field of Science.* New York: Springer.

Chapman v. Hearse. 1961. High Court of Australia 461(106). Commonwealth Law Reports 112.

Clark AM & Thompson DR. 2012. Heart failure disease management programmes: A new paradigm for research. *Heart* 98(20):1476-1477.

Clark AM, Briffa TG, Thirsk L, Neubeck L & Redfern J. 2012. What football teaches us about researching complex health interventions. *The BMJ* 345:E8316.

Clark AM, Lissel SL & Davis C. 2008. Complex Critical Realism: Tenets and applications in nursing research. *Advances in Nursing Science* 31(4):E67-E69.

Clark AM, Thirsk SM, Wiens KS, Ski CF & Thompson DR. 2015. How to research the mechanisms of non-pharmacological cardiac interventions. *International Journal of Cardiology* 201:457-461.

Clark AM. 2013. What are the components of complex interventions in healthcare? Theorizing approaches to parts, powers and the whole intervention. *Social Science and Medicine* 93: 185-193.

Cohen M. 1999. Commentary on the organization science special issue on complexity. *Organization Science* 10(3):373-376.

Collier A. 1994. *Critical Realism: An Introduction to Roy Bhaskar's Philosophy*. London: Verso.

Conn JM, Annest JL & Gilchrist J. 2003. Sports and recreation related injury episodes in the US population, 1997-99. *Injury Prevention* 9(2)**:**117-123.

Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I & Petticrew M. 2008. Developing and evaluating complex interventions: the new Medical Research Council guidance. *The BMJ* 337:a1655.

Creswell JW. 1997. *Qualitative enquiry and research design: choosing among five approaches.* Thousand Oaks: Sage.

Creswell JW. 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* 3rd ed. Thousand Oaks: Sage.

Daneshjoo A, Mokhtar AH, Rahnama N & Yusof A. 2012a. The effects of comprehensive warm-up programs on proprioception, static and dynamic balance on male soccer players. *PloS One* 7(12):e51568.

Daneshjoo A, Mokhtar AH, Rahnama N & Yusof A. 2012b. The effects of injury preventive warm-up programs on knee strength ratio in young male professional soccer players. *PloS One* 7(12):e50979.

Davis RM & Pless B. 2001. BMJ bans "accidents". *The BMJ* 322(7298)**:**1320-1321.

De Haven H. 1944. Mechanics of injury under force conditions. *Mechanical Engineering* 66(4):264-268.

Doege TC. 1978. An injury is no accident. *New England Journal of Medicine* 298(9)**:**509-510.

Doege TC. 1999. Eschewing accidents. *Journal of the American Medical Association* 282(5)**:**427-427.

Donaldson A & Finch CF. 2012. Planning for implementation and translation: seek first to understand the end-users' perspectives. *British Journal of Sports Medicine* 46(5):306-307.

Donaldson A & Finch CF. 2013. Applying implementation science to sports injury prevention. *British Journal of Sports Medicine* 47(8):473-475.

Donaldson A, Cook J, Gabbe B, Lloyd DG, Young W & Finch CF. 2015. Bridging the gap between content and context: establishing expert consensus on the content of an exercise training program to prevent lower-limb injuries. *Clinical Journal of Sport Medicine* 25(3):221-229.

Donaldson A, Forero R, Finch CF & Hill T. 2004. A comparison of the sports safety policies and practices of community sports clubs during training and competition in northern Sydney, Australia. *British Journal of Sports Medicine* 38(1)**:**60-63.

Donaldson A, Lloyd DG, Gabbe BJ, Cook J, & Finch CF. 2016. We have the programme, what next? Planning the implementation of an injury prevention programme. *Injury Prevention* doi:10.1136/injuryprev-2015-041737.

Donaldson A, Lloyd DG, Gabbe BJ, Cook J, Young W, White P & Finch CF. 2016. Scientific evidence is just the starting point: A generalizable process for developing sports injury prevention interventions. *Journal of Sport and Health Science* 5(3):334-341.

Donnelly CJ, Elliott BC, Ackland TR, Doyle TLA, Beiser TF, Finch CF, Cochrane JL, Dempsey AR & Lloyd DG. 2012. An anterior cruciate ligament injury prevention framework: incorporating the recent evidence. *Research in Sports Medicine* 20(3-4):239-262.

Elo S & Kyngäs H. 2008. The qualitative content analysis process. *Journal of Advanced Nursing*, 62(1):107-115.

Engebretsen E, Snadset TJ & Ødemark J. 2017. Expanding the knowledge translation metaphor. *BMC Health Research Policy and Systems* 15(19): DOI: 10.1186/s12961-017-0184-x

Engel GL. 1980. The clinical application of the biopsychosocial model. *The American Journal of Psychiatry*, 137(5):535-544.

Evans L. 1993. Medical accidents: no such thing? *The BMJ* 307(6917)**:**1438-1439.

Ferrari R. 2015. Writing narrative style literature reviews. *Medical Writing* 24(4):230-235.

Finch CF. 1997. An overview of some definitional issues for sports injury surveillance. *Sports Medicine* 24(3):157–63.

Finch CF. 2006. A new framework for research leading to sports injury prevention. *Journal of Science and Medicine in Sport* 9(1-2):3-9.

Finch CF. 2010. Implementing studies into real life. In Verhagen E & van Mechelen W (eds) *Sports Injury Research* (pp619-639). Oxford: Oxford University Press.

Finch CF. 2011a. Implementation and dissemination research: the time has come! *British Journal of Sports Medicine* 45(10)**:**763-764.

Finch CF. 2011b. No longer lost in translation – the art and science of sports injury prevention implementation research. *British Journal of Sports Medicine* 45(16)**:**1253-1257.

Finch CF & Cassell E. 2006. The public health impact of injury during sport and active recreation. *Journal of Science and Medicine in Sport* 9(6)**:**490-497.

Finch CF, Diamantopoulou K, Twomey DM, Doyle TLA, Lloyd DG, Young W & Elliott BC. 2014. The reach and adoption of a coach-led exercise training programme in community football. *British Journal of Sports Medicine* 48(8):718-723.

Finch CF & Donaldson A. 2010. A sports setting matrix for understanding the implementation context for community sport. *British Journal of Sports Medicine* 44(13):973-978.

Finch CF, Donaldson A, Gabbe BJ, Muhammad A, Shee AW, Lloyd DG & Cook J. 2016. The evolution of multiagency partnerships for safety over the course of research engagement: experiences from the NoGAPS project. *Injury Prevention* 22(6):386-391.

Finch CF, Gabbe BJ, Lloyd DG, Cook J, Young W, Nicholson M, Seward H, Donaldson A & Doyle TLA. 2011. Towards a national sports safety strategy: addressing facilitators and barriers towards safety guideline uptake. *Injury Prevention* 17(3)**:**1-10.

Finch CF & Hennessy M. 2000. The safety practices of sporting clubs/centres in the City of Hume. *Journal of Science and Medicine in Sport* 3(1):9-16.

Finch CF, Kemp J & Clapperton A. 2015. The incidence and burden of hospital-treated sports-related injury in people aged 15+ years in Victoria, Australia, 2004-2010: a future epidemic of osteoarthritis? *Osteoarthritis and Cartilage* 23(7):1138-1143.

Finch CF, Lloyd D & Elliott B. 2009. The Preventing Australian Football Injuries with Exercise (PAFIX) Study: a group randomised controlled trial. *Injury Prevention* 15(3):e207.

Finch CF, Mahoney M, Donaldson A & Otago L. 2009. An exploration of the safety policies and practices of multi-purpose recreation facilities. *Safety Science* 47(10):1346-1350.

Finch CF, McIntosh AS & McCrory P. 2001. What do under 15 year old schoolboy rugby union players think about protective headgear? *British Journal of Sports Medicine* 35(2):89-94.

Finch CF, Twomey DM, Fortington LV, Doyle TL, Elliott BC, Akram M & Lloyd DG. 2016. 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. *Injury Prevention* 22(2):123-128.

Fletcher AJ. 2016. Applying critical realism in qualitative research: methodology meets method. *International Journal of Social Research Methodology*, 20(2):181-194.

Foege WH, Rosenberg ML & Mercy JA. 1995. Public health and violence prevention. *Current Issues in Public Health* 1:2-9.

Fortington LV, Donaldson A, Lathlean T, Young WB, Gabbe BJ, Lloyd D & Finch CF. 2015. When 'just doing it'is not enough: assessing the fidelity of player performance of an injury prevention exercise program. *Journal of Science and Medicine in Sport* 18(3):272-277.

Gibson JJ. 1961. The contribution of experimental psychology to the formulation of the problem of safety–a brief for basic research. *Behavioral Approaches to Accident Research* 1(61):77-89.

Glasgow RE & Emmons KM. 2007. How can we increase translation of research into practice? Types of evidence needed. *Annual Review of Public Health* 28:413-433.

Glasgow RE, Lichtenstein E & Marcus AC. 2003. Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *American Journal of Public Health* 93(8):1261-1267.

Glasgow RE, Vogt TM & Boles SM. 1999. Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *American Journal of Public Health* 89:1322–1327.

Glouberman S & Zimmerman B. 2002. *Complicated and Complex Systems: What would successful reform of Medicare look like?* Toronto: Commission on the Future of Health Care in Canada.

Gordon JE. 1949. The epidemiology of accidents. *American Journal of Public Health and the Nation's Health* 39(4):504-515.

Gorski PS. 2013. What is critical realism? And why should you care? *Contemporary Sociology: A Journal of Reviews* 42(5):658-670.

Grant MJ & Booth A. 2009. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal* 26(2):91-108.

Green LW. 2014. Closing the chasm between research and practice: evidence of and for change. *Health Promotion Journal of Australia* 25(1):25-29.

Green LA & Seifert CM. 2005. Translation of research into practice: why we can't "just do it". *The Journal of the American Board of Family Practice* 18(6):541-545.

Greenhalgh T. 2010. What is this knowledge that we seek to "exchange"? *Milbank Quarterly* 88(4):492-499.

Greenhalgh T & Wieringa S. 2011. Is it time to drop the "knowledge translation" metaphor? A critical literature review. *Journal of the Royal Society of Medicine* 104(12): 501-509.

Haddon W. 1980a. Advances in the epidemiology of injuries as a basis for public policy. *Public Health Reports* 95(5):411-421.

Haddon W. 1980b. The basic strategies for preventing damage from hazards of all kinds. *Hazard Prevention* 16(1):8-12.

Hanson D, Allegrante JP, Sleet DA & Finch CF. 2014. Research alone is not sufficient to prevent sports injury. *British Journal of Sports Medicine* 48(8):682-684.

Hanson DW, Finch CF, Allegrante JP, Sleet D. 2012. Closing the gap between injury prevention research and community safety promotion practice: reviewing the public health model. *Public Health Reports* 127(2):147-155.

Hanson DW, Hanson J, Vardon P, McFarlane K, Lloyd J, & Muller R. 2005. The injury iceberg: An ecological approach to planning sustainable community safety interventions. *Health Promotion Journal of Australia* 16(1):5-10.

Hawe P. 2015a. Lessons from complex interventions to improve health. *Public Health* 36(1):307-323.

Hawe P. 2015b. Minimal, negligible and negligent interventions. *Social Science and Medicine* 138:265–268.

Holland JH. 2000. *Emergence: From Chaos to Order.* Oxford: Oxford University Press.

Hulme A & Finch CF. 2015. From monocausality to systems thinking: A complementary and alternative conceptual approach for better understanding the development and prevention of sports injury. *Injury Epidemiology* 2(1):1-12.

Hurndell S. 2016. School rugby coach says boys' weight loss sparks safety fears. *NZ Herald* www.nzherald.co.nz/sport/news/article.cfm?c_id=4&objectid=11721836 [Accessed 28 November 2016].

Impellizzeri FM, Bizzini M, Dvorak J, Pellegrini B, Schena F & Junge A. 2013. Physiological and performance responses to the FIFA 11+ (part 2): a randomised controlled trial on the training effects. *Journal of Sports Sciences* 31(13):1491-1502.

Jones A (as quoted by Boys C). 2017. Putting an end to soft drink in Australian hospitals. *Good Food* www.goodfood.com.au/eat-out/news/putting-an-end-to-soft-drink-in-australian-hostpitals-20170419-gvnzad [accessed 25 April 2017].

Kerr ZY, Roos KG, Schmidt JD & Marshall SW. 2013. Prevention and management of physical and social environment risk factors for sports-related injuries. *American Journal of Lifestyle Medicine* 7(2):138-153.

Kessler R & Glasgow RE. 2011. A proposal to speed translation of healthcare research into practice: dramatic change is needed. *American Journal of Preventive Medicine* 40(6):637-644.

Klügl M, Shrier I, McBain K, Shultz R, Meeuwisse WH, Garza D & Matheson GO. 2010. The prevention of sport injury: an analysis of 12 000 published manuscripts. *Clinical Journal of Sport Medicine* 20(6)**:**407-412.

Kreindler SA. 2016. What if implementation is not the problem? Exploring the missing links between knowledge and action. *International Journal of Health Planning Management* 31(2):208-226.

Kuhn TS. 1970. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Laflamme L, Svanström L & Schelp L. 1999. *Safety Promotion Research*. Stockholm: Karolinska Institutet.

Langley J & Brenner R. 2004. What is an injury? *Injury Prevention* 10(2)**:**69-71.

Lauersen JB, Bertelsen DM & Andersen LB. 2014. The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials. *British Journal of Sports Medicine* 48(11):871-877.

Leppänen M, Aaltonen S, Parkkari, J, Heinonen A & Kujala UM. 2014. Interventions to prevent sports related injuries: a systematic review and meta-analysis of randomised controlled trials. *Sports Medicine* 44(4):473-486.

Lich KH, Ginexi EM, Osgood ND, Mabry PL. 2013. A call to address complexity in prevention science research. *Prevention Science* 14(3):279-289.

Lincoln Y & Guba E. 1985. *Naturalistic Inquiry.* Thousand Oaks: Sage.

Manini TM. 2015. Using physical activity to gain the most public health bang for the buck. *JAMA Internal Medicine* 175(6):968-969.

McBain K, Shrier I, Shultz R, Meeuwisse WH, Klügl M, Garza D & Matheson GO. 2011a. Prevention of sports injury I: a systematic review of applied biomechanics and physiology outcomes research. *British Journal of Sports Medicine* 46(3):169-173.

McBain K, Shrier I, Shultz R, Meeuwisse WH, Klügl M, Garza D & Matheson GO. 2011b. Prevention of sports injury II: a systematic review of clinical science research. *British Journal of Sports Medicine* 46(3):174-179.

McClure R, Mack K, Wilkins N & Davey T. 2015. Injury prevention as social change. *Injury Prevention* 22(3):226-229.

McElroy MW. 2000. Integrating complexity theory, knowledge management and organizational learning. *Journal of Knowledge Management* 4(3):195-203.

McKay CD, Steffen K, Romiti M, Finch CF & Emery CA. 2014. The effect of coach and player injury knowledge, attitudes and beliefs on adherence to the FIFA 11+ programme in female youth soccer. *British Journal of Sports Medicine* 48(17):1281-1286.

Mercy JA, Rosenberg ML, Powell KE & Broome CV. 1993. Public health policy for preventing violence. *Health Affairs* 12(4):7–29.

Mjølsnes R, Arnason A, Raastad T & Bahr R. 2004. A 10-week randomized trial comparing eccentric vs. concentric hamstring strength training in well-trained soccer players. *Scandinavian Journal of Medicine & Science in Sports* 14(5):311-317.

Mohammadi N. 2010. *Complexity Science, Schools and Health*. Saarbrucken: Lambert Academic Publishing.

Morris ZS, Wooding S & Grant J. 2011. The answer is 17 years, what is the question: understanding time lags in translational research. *Journal for the Royal Society of Medicine* 104(12):510-520.

Morse JM. 1999. Myth #93: reliability and validity are not relevant to qualitative inquiry. *Qualitative Health Research,* 9:717.

Morse JM, Barrett M, Mayan M, Olson K & Spiers J. 2002. Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods,* 1(2):13-22.

Mountjoy M, Brackenridge C, Arrington M, et al. 2016. International Olympic Committee consensus statement: harassment and abuse (non-accidental violence) in sport. *British Journal of Sports Medicine*, 50(17):1019-1029.

Mountjoy M, Rhind DJA, Tiivas A & Leglise M. 2015. Safeguarding the child athlete in sport: a review, a framework and recommendations for the IOC youth athlete development model. *British Journal of Sports Medicine*, 49(13):883-886.

Mrazik M, Dennison CR, Brooks BL, Yeates KO, Babul S & Naidu D. 2015. A qualitative review of sports concussion education: prime time for evidence-based knowledge translation. *British Journal of Sports Medicine* 49(24):1548-1553.

National Health and Medical Research Council. 2007. *National Statement on Ethical Conduct in Human Research.* Available at https://www.nhmrc.gov.au/guidelines-publications/e72 [Accessed 16 January 2017].

National Public Health Partnership. 2005. *National Injury Prevention and Safety Promotion Plan 2004-2014.* Canberra: Australian Health Ministers' Conference.

Neta G, Glasgow RE, Carpenter CR, Grimshaw JM, Rabin BA, Fernandez ME & Brownson RC. 2015. A framework for enhancing the value of research for dissemination and implementation. *American Journal of Public Health* 105(1):49-57.

Noble H & Smith J. 2015. Issues of validity and reliability in qualitative research. *Evidence Based Nursing,* 18(2):34-35.

O'Brien J & Finch CF. 2014a. The implementation of musculoskeletal injury-prevention exercise programmes in team ball sports: a systematic review employing the RE-AIM framework. *Sports Medicine* 44(9):1305-1318.

O'Brien J & Finch CF. 2014b. A systematic review of core implementation components in team ball sport injury prevention trials. *Injury Prevention* 20(5):357-362.

O'Brien J, Donaldson A & Finch CF. 2016. It will take more than an existing exercise programme to prevent injury*. British Journal of Sports Medicine* 50(5):264-265.

Oldenburg BF, Sallis JF, Ffrench ML & Owen N. 1999. Health promotion research and the diffusion and institutionalization of interventions. *Health Education Research* 14(1):121-130.

Parr S. 2015. Integrating critical realist and feminist methodologies: ethical and analytical dilemmas. *International Journal of Social Research Methodology,* 18(2):193-207.

Pawson R, Boaz A, Grayson L, Long A & Barnes C. 2003. *Types and quality of knowledge in social care.* London: Social Care Institute for Excellence.

Pawson R & Tilley N. 1994. What works in evaluation research? *The British Journal of Criminology* 34(3):291-306.

Pawson R & Tilley N. 1997. *Realistic Evaluation.* London: Sage.

Pawson R. 2006. *Evidence-based Policy: A Realist Perspective.* London: Sage.

Pawson R. 2013. *The Science of Evaluation: A Realist Manifesto*. London: Sage.

Pawson R. 2014. *Professor Ray Pawson introducing Realist Evaluation (webinar)/Interviewer: R Vincent* www.youtube.com/watch?v=YL39DAVNLBE [Accessed 28 November 2016].

Peters DH, Taghreed A, Olakunle A, Akua AI, Nhan T. 2013. Implementation research: what it is and how to do it? *The BMJ* 347:6753.

Petersen J, Thorborg K, Nielsen MB, Budtz-Jørgensen E & Hölmich P. 2011. Preventive effect of eccentric training on acute hamstring injuries in men's soccer a cluster-randomized controlled trial. *American Journal of Sports Medicine* 39(11):2296-2303.

Plsek PE & Greenhalgh T. 2001. Complexity Science: The challenge of complexity in health care. *The BMJ* 323(7313):625.

Porter S. 2007. Validity, trustworthiness and rigour: reasserting realism in qualitative research. *Journal of Advanced Nursing,* 60(1):79-86.

Prigogine I. 1978. Time, structure and fluctuations. *Science* 201(4358):777.

Prigogine I & Stengers I. 1997. *The End of Certainty*. Ney York: Simon and Schuster.

Reis I, Rebelo A, Krustrup P & Brito J. 2013. Performance enhancement effects of Federation Internationale de Football Association's "The 11+" injury prevention training program in youth futsal players. *Clinical Journal of Sport Medicine 23*(4):318-320.

Rössler R, Donath L, Verhagen E, Junge A, Schweizer T & Faude O. 2014. Exercise-based injury prevention in child and adolescent sport: a systematic review and meta-analysis. *Sports Medicine* 44(12):1733-1748.

Runyan CW. 1998. Using the Haddon matrix: introducing the third dimension. *Injury Prevention* 4(4):302-307.

Sandelowski M. 1993. Rigor or rigor mortis: the problem of rigor in qualitative research revisited. *Advances in Nursing Science,* 16(2):1-8.

Sandelowski M. 2000. Focus on research methods – whatever happened to qualitative description? *Research in Nursing and Health* 23(4):334-340.

Sayer A. 2010. *Method in Social Science: A Realist Approach.* Revised 2nd ed. London: Routledge.

Soligard T, Myklebust G, Steffen K, Holme I, Silvers H, Bizzini M, Junge A, Dvorak J, Bahr R & Andersen TE. 2008. Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial. *The BMJ* 337:a2469.

Soligard T, Nilstad A, Steffen K, Myklebust G, Holme I, Dvorak J, Bahr R & Andersen, TE. 2010. Compliance with a comprehensive warm-up programme to prevent injuries in youth football. *British Journal of Sports Medicine* 44(11):787-793.

Soomro N, Sanders R, Hackett D, Hubka T, Ebrahimi S, Freeston J & Cobley S. 2016. The efficacy of injury prevention programs in adolescent team sports: a meta-analysis. *The American Journal of Sports Medicine* 44(9):2415-2424.

Steffen K, Meeuwisse WH, Romiti M, Kang J, McKay C, Bizzini M, Dvorak J, Finch CF, Myklebust G & Emery CA. 2013. Evaluation of how different implementation strategies of an injury prevention programme (FIFA11+) impact team adherence and injury risk in Canadian female youth football players: a cluster-randomised trial. *British Journal of Sports Medicine* 47(8):480-487.

Stout NA. 2008. The public health approach to occupational injury research: From surveillance to prevention. *Safety Science* 46(2):230-233.

Swan P, Otago L, Finch CF & Payne WR. 2009. The policies and practices of sports governing bodies in relation to assessing the safety of sports grounds. *Journal of Science and Medicine in Sport* 12(1):171-176.

Timpka T, Ekstrand J & Svanström L. 2006. From sports injury prevention to safety promotion in sports. *Sports Medicine* 36(9):733-745.

Timpka T, Finch CF, Goulet C, Noakes T & Yammine K. 2008. Meeting the global demand of sports safety: The intersection of science and policy in sports safety. *Sports Medicine* 38(10):795-805.

Thorne S. 1997. The art (and science) of critiquing qualitative research. In Morse J (Ed) *Completing a qualitative project: details and dialogue* (pp117-132). Thousand Oaks: Sage.

Twomey DM, Doyle T, Lloyd DG, Elliott B & Finch CF. 2015. Challenges when implementing an evidence-based exercise injury prevention training program in community-level sport. *Journal of Applied Case Studies in Sport and Exercise Science* 1(1):29–39.

Van Mechelen W, Hlobil H & Kemper H. 1987. *How can sports injuries be prevented?* Papendal: National Instituut voor SportGezondheidsZorg publicatie nr 25E.

Van Mechelen W, Hlobil H & Kemper H. 1992. Incidence, severity, aetiology and prevention of sports injuries. *Sports Medicine* 14:82–99.

Van Tiggelen D, Wickes S, Stevens V, Roosen P & Witvrouw E. 2008. Effective prevention of sports injuries: a model integrating efficacy, efficiency, compliance and risk-taking behaviour. *British Journal of Sports Medicine* 42(8):648-652.

Verhagen EALM & Finch CF. 2011. Setting our minds to implementation. *British Journal of Sports Medicine* 45(13):1015-1016.

Verhagen EALM & van Mechelen W. 2010. Sport for all, injury prevention for all. *British Journal of Sports Medicine* 44(3):158.

Verhagen EALM, Voogt N, Bruinsma A & Finch CF. 2014. A knowledge transfer scheme to bridge the gap between science and practice: an integration of existing research frameworks into a tool for practice. *British Journal of Sports Medicine* 48(8):698-701.

Vriend I, Gouttebarge V, Finch CF, van Mechelen W & Verhagen EALM. 2017. Intervention strategies used in sport injury prevention studies: a systematic review identifying studies applying the Haddon Matrix*. Sports Medicine* Online First DOI: 10.1007/s40279-017-0718-y

Watters A. 2014. *The Monsters of Education Technology*. CreateSpace Independent Publishing Platform.

Wiese-Bjornstal DM. 2010. Psychology and socioculture affect injury risk, response, and recovery in high-intensity athletes: a consensus statement. *Scandinavian Journal of Medicine & Science in Sports*, 20(2):103-111.

Wolcott H. 1994. *Transforming qualitative data: description analysis and interpretation.* Thousand Oaks: Sage.

World Health Organisation. 1998. *Safety and Safety Promotion: Conceptual and Operational Aspects.* Quebec: World Health Organisation.

World Health Organisation. 2016. International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). Quebec: World Health Organisation.

Wong G. 2013. Is complexity just too complex? *Journal of Clinical Epidemiology* 66(11):1199.

Wong G, Westhorp G, Manzano A, Greenhalgh J, Jagosh J & Greenhalgh T. 2016. RAMESES II reporting standards for realist evaluations. BMC Medicine 14(1):96.

Zimmerman B, Plsek P & Lindberg C. 1998. *Edgeware: Lessons from Complexity Science for Health Care Leaders.* Dallas: VHA Inc.

APPENDICES

1. Reuse permissions for figures and papers
2. Ethical considerations
3. Supplementary material – Search strategy
4. Supplementary material – Interview schedule
5. Published conference abstracts
6. List of unpublished conference abstracts
7. List of other unpublished presentations (invited)
8. Recognition for this research
9. Media reports arising from this research
10. List of prizes/awards for this research

Appendix 1:

Reuse permissions for:

a. Figure 2.1
b. Figure 2.2
c. Figure 2.3
d. Figure 2.4
e. Figure 3.1
f. Figure 3.2
g. Bekker S & Clark AM. 2016. Bringing complexity to sports injury prevention research: from simplification to explanation. *British Journal of Sports Medicine* 50(24):1489-1490.

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Appendix 2:

Ethical considerations:

a. Study A (E13-014)
    i. Ethical approval
    ii. Final ethics report
b. Study B (E13-015)
    i. Ethical approval
    ii. Final ethics report

Approval

Human Research Ethics Committee

University of Ballarat
Learn to succeed

The UB HREC has noted the approval of the Monash University HREC

Principal Researcher:	Caroline Finch
Other/Student Researcher/s:	Alex Donaldson Peta White Sheree Bekker
School/Section:	CHASS
Project Number:	E13-014
Project Title:	Monitoring sports safety resource documents posted on the internet
For the period:	2/10/2013 **to** 2/8/2016

Please quote the Project No. in all correspondence regarding this application.

REPORTS TO HREC:

Annual reports for this project must be submitted to the Ethics Officer on:
2 October 2014
2 October 2015

A final report for this project must be submitted to the Ethics Officer on:
2 September 2016

This report can be found at:
http://www.ballarat.edu.au/research/research-services/forms/ethics-forms

Ethics Officer
2 October 2013

Please see attached 'Conditions of Approval'.

CONDITIONS OF APPROVAL

1. The project must be conducted in accordance with the approved application, including any conditions and amendments that have been approved. You must comply with all of the conditions imposed by the HREC, and any subsequent conditions that the HREC may require.

2. You must report immediately anything which might affect ethical acceptance of your project, including:

    - Adverse effects on participants;
    - Significant unforeseen events;
    - Other matters that might affect continued ethical acceptability of the project.

3. Where approval has been given subject to the submission of copies of documents such as letters of support or approvals from third parties, these must be provided to the Ethics Office before the research may commence at each relevant location.

4. Proposed changes or amendments to the research must be applied for, using a 'Request for Amendments' form, and approved by the HREC before these may be implemented.

5. If an extension is required beyond the approved end date of the project, a 'Request for Extension' should be submitted, allowing sufficient time for its consideration by the committee. Extensions cannot be granted retrospectively.

6. If changes are to be made to the project's personnel, a 'Changes to Personnel' form should be submitted for approval.

7. An 'Annual Report' must be provided by the due date specified each year for the project to have continuing approval.

8. A 'Final Report' must be provided at the conclusion of the project.

9. If, for any reason, the project does not proceed or is discontinued, you must advise the committee in writing, using a 'Final Report' form.

10. You must advise the HREC immediately, in writing, if any complaint is made about the conduct of the project.

11. You must notify the Ethics Office of any changes in contact details including address, phone number and email address.

12. The HREC may conduct random audits and / or require additional reports concerning the research project.

Failure to comply with the *National Statement on Ethical Conduct in Human Research* (2007) and with the conditions of approval will result in suspension or withdrawal of approval.

Final Project Report

Human Research Ethics Committee

Federation UNIVERSITY • AUSTRALIA

55

1) Project Details:

Project No:	E13-014
Project Name:	Monitoring sports safety resource documents posted on the internet

2) Principal Researcher Details:

Full Name:	Caroline Finch
School/Section:	ACRISP
Phone:	5327 6338
Fax:	5327 6338
Email:	c.finch@federation.edu.au

3) Project Status:

Please indicate the current status of the project:	
☒ Data collection complete **Completion date: 01/10/2015**	☐ Abandoned **Please give reason:**

4) Special Conditions:

If this project was originally approved subject to special conditions, were these met?		
☒ N/A	☐ Yes	☐ No *** NB: If 'no', please provide an explanation:**

5) Changes to project since original approval was granted:

Have amendments been made to the originally approved project?	
☐ No	☒ Yes Was HREC Approval granted for these changes? ☒ Yes ☐ No: **Please provide details :** **Amendment granted 16/04/2015:* Dr Rob Watson added to project Dr Alex Donaldson removed from the project

Final Project Report

Human Research Ethics Committee

Federation UNIVERSITY • AUSTRALIA

	Results of study will be published in Sheree Bekker's PhD Survey questions updated PLIS updated

6) Storage of Data:

Please indicate where the data collected during the course of this project will be stored, then when and how it will be destroyed:
As per university guidelines, and as outlined in the original application, the data is being stored as a password-protected electronic format. Data will be destroyed 5 years after completion of the project as per university guidelines (01/10/2025) by the project data manager permanently deleting the files.

7) Research Participants:

Were there any events that had an adverse effect on the research participants OR unforeseen events that might affect ethical acceptability of the project?	
☒ No	☐ Yes *** NB: Please provide details:**

8) Summary of Results:

8.1. Please provide a short summary of the results of the project (no attachments please):
A catalogue of sport safety promotion and injury prevention resources (n=284) available online from the NoGAPS organisations was developed. The document analysis determined that the type of resources catalogued were: factsheets/flyers (n=116), research reports (n=46), manuals/guidelines (n=36), checklists/forms (n=30), policies (n=23), acts/rules/regulations (n=7), position statements (n=7), posters (n=6), codes (n=5), links to online resources (n=5), resource lists/order forms (n=3). The scope of these resources was categorised by themes: injury prevention, risk management/safety procedures, environmental issues, social behaviours and health promotion. The second element of this study, the survey, was abandoned due to timeframe issues. The survey will therefore no longer be conducted.

8.2. Were the aims of the project (as stated in the application for approval) achieved? Please provide details.
The aims of this project were to determine what resources were available on the websites of the partnership organisations, as well as who accessed them and why. The first aim was achieved, the second was abandoned due to timeframe issues.

Final Project Report

Human Research Ethics Committee

Federation UNIVERSITY • AUSTRALIA

9) Feedback:

The HREC welcomes any feedback on: • **Difficulties experienced with carrying out the research project; or** • **Appropriate suggestions which might lead to improvements in ethical clearance and monitoring of research.**
None

10) Signature/s:

Principal Researcher:	C. Finch Print name: Caroline Finch	**Date:**	8/12/2015
Other/Student Researchers:	Peta E White Print name: Peta White	**Date:**	
	..... Print name: Rob Watson	**Date:**	
	SB Print name: Sheree Bekker	**Date:**	23/11/2015

Please return to the Ethics Officer, Gippsland or Mt. Helen campus, as soon as possible.

Final Project Report

Human Research Ethics Committee

Federation UNIVERSITY • AUSTRALIA

9) Feedback:

The HREC welcomes any feedback on: • **Difficulties experienced with carrying out the research project; or** • **Appropriate suggestions which might lead to improvements in ethical clearance and monitoring of research.**
None

10) Signature/s:

Principal Researcher:	C-Finch Print name: Caroline Finch	**Date:**	8/12/2015
Other/Student Researchers:	..... Print name: Peta White	**Date:**	
	..... Print name: Rob Watson	**Date:**	24/11/2015
	SB Print name: Sheree Bekker	**Date:**	23/11/2015

Please return to the Ethics Officer, Gippsland or Mt. Helen campus, as soon as possible.

Approval

Human Research Ethics Committee

University of Ballarat
Learn to succeed

The UB HREC has noted the approval of the Monash University HREC

Principal Researcher:	Caroline Finch
Other/Student Researcher/s:	Peta White Sheree Bekker
School/Section:	CHASS
Project Number:	E13-015
Project Title:	Measuring and monitoring research funding partner outcome expectations
For the period:	2/10/2013 **to** 15/12/2015

Please quote the Project No. in all correspondence regarding this application.

REPORTS TO HREC:

Annual reports for this project must be submitted to the Ethics Officer on:
2 October 2014
2 October 2015

A final report for this project must be submitted to the Ethics Officer on:
15 January 2016

This report can be found at:
http://www.ballarat.edu.au/research/research-services/forms/ethics-forms

Ethics Officer
2 October 2013

Please see attached 'Conditions of Approval'.

CONDITIONS OF APPROVAL

1. The project must be conducted in accordance with the approved application, including any conditions and amendments that have been approved. You must comply with all of the conditions imposed by the HREC, and any subsequent conditions that the HREC may require.

2. You must report immediately anything which might affect ethical acceptance of your project, including:

   - Adverse effects on participants;
   - Significant unforeseen events;
   - Other matters that might affect continued ethical acceptability of the project.

3. Where approval has been given subject to the submission of copies of documents such as letters of support or approvals from third parties, these must be provided to the Ethics Office before the research may commence at each relevant location.

4. Proposed changes or amendments to the research must be applied for, using a 'Request for Amendments' form, and approved by the HREC before these may be implemented.

5. If an extension is required beyond the approved end date of the project, a 'Request for Extension' should be submitted, allowing sufficient time for its consideration by the committee. Extensions cannot be granted retrospectively.

6. If changes are to be made to the project's personnel, a 'Changes to Personnel' form should be submitted for approval.

7. An 'Annual Report' must be provided by the due date specified each year for the project to have continuing approval.

8. A 'Final Report' must be provided at the conclusion of the project.

9. If, for any reason, the project does not proceed or is discontinued, you must advise the committee in writing, using a 'Final Report' form.

10. You must advise the HREC immediately, in writing, if any complaint is made about the conduct of the project.

11. You must notify the Ethics Office of any changes in contact details including address, phone number and email address.

12. The HREC may conduct random audits and / or require additional reports concerning the research project.

Failure to comply with the *National Statement on Ethical Conduct in Human Research* (2007) and with the conditions of approval will result in suspension or withdrawal of approval.

Final Project Report

Human Research Ethics Committee

Federation UNIVERSITY • AUSTRALIA

1) Project Details:

Project No:	E13-015
Project Name:	Measuring and monitoring research funding partner outcome expectations

2) Principal Researcher Details:

Full Name:	Caroline Finch
School/Section:	ACRISP
Phone:	5327 6338
Fax:	5327 6338
Email:	c.finch@federation.edu.au

3) Project Status:

Please indicate the current status of the project:	
☒ Data collection complete **Completion date: 01/10/2015**	☐ Abandoned **Please give reason:**

4) Special Conditions:

If this project was originally approved subject to special conditions, were these met?		
☒ N/A	☐ Yes	☐ No *** NB: If 'no', please provide an explanation:**

5) Changes to project since original approval was granted:

Have amendments been made to the originally approved project?	
☐ No	☒ Yes Was HREC Approval granted for these changes? ☒ Yes ☐ No: **Please provide details :** **Amendment granted 02/10/2013:* Ethical approval transferred from Monash University. Addition of researcher – Sheree Bekker who would collect and analyse the data **Amendment granted 13/06/2014:* Amendment to the interview questions - as hypothesized in the original application, these questions changed over the duration of the project, as the partners were exposed to the staged research outputs from the larger project. The interview questions are now being amended to suit the project as it has progressed to this end

Therefore the partnership outcome expectations were largely positive, focusing on the joint initiative of injury prevention. Barriers and facilitators were also identified, and these will be used to temper expectations on future projects so as to maximize partnership outcomes.

8.2. Were the aims of the project (as stated in the application for approval) achieved? Please provide details.

The broad aim of the larger NHMRC Partnerships Project is to use an evidence-informed approach to develop and deliver a sports safety program and evaluate the resources needed for effective uptake of a sports safety package for community Australian Football. In doing so, the project will identify and address the needs of state sporting bodies, government departments, and non-government organisations (NGOs).

The aim of this sub-study was to determine the expectations of partner organisations. While the partner organisations shared the common goal of developing practical guidelines to help sporting organisations to adopt a sustainable approach to safety and to implement specific interventions (as evidenced by their commitment to the funding application), it was hypothesised that the outcome expectations in terms of what each partnering organisation hoped to gain from the project would also be different and reflect the major operating focus of the organisation. It was also hypothesised that these expectations would change over the duration of the project, as the partners were exposed to the staged research outputs from the larger project.

These aims were achieved through this project, as it was our goal with our interview schedule to determine how, and to what extent, representatives of these organisations believed that the organisations were working together or could work together in future by asking them about current processes and future collaboration ideas or plans - to see how their expectations had been influenced by being involved in the partnership collaboration.

9) Feedback:

The HREC welcomes any feedback on:

- **Difficulties experienced with carrying out the research project; or**
- **Appropriate suggestions which might lead to improvements in ethical clearance and monitoring of research.**

None

10) Signature/s:

Principal Researcher:	C. Finch Print name: Caroline Finch	**Date:** 18/01/2016
Other/Student Researchers:	SB Print name: Sheree Bekker	**Date:** 18/01/2016

Please return to the Ethics Officer, Gippsland or Mt. Helen campus, as soon as possible.

Appendix 3:

Supplementary material 1 - Search strategy

Supplement 1: Search strategy

a) Website search

Australian Football League (AFL) www.afl.com.au

The link for the AFL community website (www.aflcommunityclub.com.au) was followed, as it included information on "everything on coaching, playing, umpiring, volunteering and managing your club". The landing page of the AFL community club section was scanned for relevant resources. Related resources were systematically accessed and downloaded using the menus at the top of the page headed: coaches, players, umpires, administrators, schools, health and fitness, courses. Finally, the search function of the website was used, and a query for "injury prevention" returned seven links that were systematically accessed, and any resources not yet included in the website search catalogue were downloaded.

Victorian Health Promotion Foundation (VicHealth) www.vichealth.vic.gov.au

The menus at the top of the home page were systematically accessed to search for any relevant links. The first menu "About" was accessed for the "policies" link (www.vichealth.gov.au/About-VicHealth/VicHealth-policies.aspx), and relevant resources were downloaded. The second menu "Programs and Projects" was accessed for the link to "Physical Activity". Finally, the search function of the website was used, and a query for "injury prevention" returned 289 links that were followed, and any resources not yet included in the website search catalogue were downloaded.

New South Wales Sporting Injuries Committee (NSWSIC)

www.sportinginjuries.nsw.gov.au

The menus at the top of the home page were systematically accessed to search for relevant links. The link to “Publications” {www.sportinginjuries.nsw.gov.au/publications.asp) was followed, and resources relating to safety promotion and injury prevention were downloaded. Secondly, under the menu “Schemes” (www.sportinginjuries.nsw.gov.au/4_howdo_i_apply.asp) the link to the “Research and Injury Prevention Scheme” was followed, after which the “Research Reports” (www.sportinginjuries.nsw.gov.au/4_research_reports.asp) were accessed and downloaded if relevant. This website had no search function.

JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd (JLT Sport)

http://www.jltsport.com.au/

As the capacity of the involvement of JLT Sport in the NoGAPS project is around Australian Football, only the “AFL” link (www.afl.jltsport.com.au/) was followed. This link contained two further sections. The first, “Community Football” (https://afl.jltsport.com.au/community.aspx), was accessed where the “downloads” (https://afl.jltsport.com.au/downloads_flyers.aspx) menu was selected and relevant resources downloaded. The second section, “18 Member Club Collective” (https://cir.jlta.com.au/login/afl), was also accessed as it listed information on “current policies including policy schedules, assets schedules, policy wordings, and transactions”, however this section of the website was blocked by a client register login. This website had no search function.

Sport and Recreation Victoria (SRV) www.dpcd.vic.gov.au/sport

At the time of data collection, SRV was under the Department of Planning and Community Development (this has since changed, under the new government, to the Department of Transport, Planning and Local Infrastructure, new website (www.dtpli.vic.gov.au/sport-and-recreation). The menu for publications was accessed, and relevant resources under the following sections were downloaded: community facilities, club resources, injury prevention, and inclusive sport. Finally, the search function of the website was used, and a query for “injury prevention” returned seven links that were followed, and any resources not yet included in the website search catalogue were downloaded.

Sports Medicine Australia (SMA) www.sma.org.au

The menus at the top of the home page were systematically accessed to search for relevant links. The “Resources and Advice” banner was accessed, and documents were downloaded under the topics: injury fact sheets, sport fact sheets, policies and guidelines, concussion, SMA programs, and sports injuries. The search function of the website was used, and a query for “injury prevention” returned 212 links that were scanned, and any relevant resources not yet included in the website search catalogue were downloaded.

As an SMA sport safety and injury prevention program, the SmartPlay website resources were also included in this search. The home page (www.smartplay.com.au/Pub/pStart.asp) was accessed and scanned for relevant resources. The menu was systematically accessed and, under the “Resources” section, documents were downloaded from the following pages: general sport safety,

sport factsheets, injury factsheets, policies/guidelines, recommended forms, women in sport, and resource order form. The search function of the website was used, and a query for “injury prevention” returned 14 links that were scanned, and any relevant resources not yet included were downloaded.

Each search was repeated six months later as an update, and to ensure that no resources were missed.

b) Direct request

Australian Football League (AFL)

The AFL referred the direct request to their AFL community club website for resources.

Victorian Health Promotion Foundation (VicHealth)

VicHealth provided two resources that they usually sent to Regional Sports Assemblies, being 1) List of Actions, and 2) Resource List. The List of Actions covered organisational priority areas for health promotion. The Resource List contained a column with hyperlinks to each of the resources on the appropriate website, and a brief summary of each resource and its applicability. VicHealth also provided softcopies of fourteen relevant resources that were identified in partnership with Sports Medicine Australia (Victoria) under the Healthy Sporting Environments programme and the SmartPlay banner.

New South Wales Sporting Injuries Committee (NSWSIC)

NSWSIC responded to the direct request that it does not provide resources, but that it supports other agencies in doing so, or funds research into safety promotion.

JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd (JLT Sport)

The only resource that JLT Sport provided to community clubs was a Match Day checklist, either in hard- or softcopy format.

Sport and Recreation Victoria (SRV)

SRV referred the direct request to their website, for all publicly available resource documents. Links to other SRV initiated and supported resources (e.g. the Vicsport Risk Management project, etc.) were provided. All other publications that SRV supports/funds are held and promoted through the SmartPlay Program under the auspices of Sports Medicine Australia.

Sports Medicine Australia (SMA)

SMA provided a Sport Safety Resources Order form that could be completed so that all their relevant resources could be ordered in hardcopy. It also referred to their website and the SmartPlay Program, where softcopies of all resources were available.

Appendix 4:

Additional file 1: Appendix A – Interview schedule

THE TRANSLATION OF SPORTS INJURY PREVENTION AND SAFETY PROMOTION KNOWLEDGE: INSIGHTS FROM KEY INTERMEDIARY ORGANISATIONS

Additional file 1: Appendix A

Interview Schedule

What process does [organisation] follow to develop new injury prevention and safety promotion resources?
How does [organisation] identify new issues for resource development?
How does [organisation] prioritise new issues for resource development?
How does [organisation] decide who is involved in the development process?
How does [organisation] generally develop new content? Is it evidence-based?
How does [organisation] decide on the description of title of the resource?
How do you feel the process works? What has worked well / not so well? (successes / failures)
What are the future plans for the development of new resources?
Would you do things differently if you could? What would you do differently?
How does [organisation] distribute injury prevention and safety promotion resources to community sport clubs?
How does [organisation] identify pathways for the distribution of resources to community sports clubs?
How does [organization] monitor the uptake of resources at community sports clubs?
Does [organisation] collect feedback about the use of resources at community sports clubs?
How well do you feel this distribution process works? What has worked well / not so well? (successes / failures)
What are the future plans for distribution of resources?
Would you do things differently if you could? What would you do differently?

Appendix 5:

Published conference abstracts:

a. **Bekker S**, White P, Donaldson A, Cook J, Gabbe B, Lloyd D & Finch CF. 2014. A catalogue of sport safety resources for community Australian Football clubs from the websites of key sport safety agencies. *Journal of Science and Medicine in Sport* 18:e139-140.

   Australian Conference of Science and Medicine in Sport & National Injury Prevention Conference, Canberra, October 2014

b. **Bekker S**, White P, Donaldson A, Cook J, Gabbe B, Lloyd D & Finch CF. What is the role of key sports safety agencies in the development and dissemination of sport safety policies for community sport settings? *British Journal of Sports Medicine* 48(7):565-566.

   IOC World Conference on Prevention of Injury and Illness in Sport, Monaco, April 2014

c. Bekker S, Paliadelis P & Finch CF. 2017. The translation of sports injury prevention and safety promotion knowledge: insights from key organisations. *British Journal of Sports Medicine* 51(4):294.

   IOC World Conference on Prevention of Injury and Illness in Sport, Monaco, March 2017

Methods: Seventy-eight clubs were targeted for implementation of an online injury surveillance system (approximately 4000 athletes) in five community Australian football leagues concurrently enrolled in a larger injury prevention project (National Guidance for Australian Football Partnerships and Safety (NoGAPS)). System implementation was evaluated quantitatively, using the RE-AIM framework, and qualitatively via semi-structured interviews with targeted-users (mainly sports trainers).

Results: Across the 78 clubs, there was 69% reach (informed about/trained in use of injury surveillance system), 44% adoption (set up an online account with intention of recording injuries), 23% implementation (used system to record injuries throughout season) and 9% maintenance (used system over two consecutive seasons). Reach and adoption were highest in those leagues receiving concurrent support for the delivery of the NoGAPS injury prevention training program (FootyFirst). Interviewees identified several barriers and facilitators to implementation including personal (e.g. belief in the importance of injury surveillance), sociocontextual (e.g. understaffing and athlete underreporting) and systems factors (e.g. the time taken to upload injury data into the online surveillance system).

Discussion: The injury surveillance system was implemented and maintained by only a small proportion of clubs. Outcomes were best in those leagues receiving concurrent support for the delivery of FootyFirst, suggesting that engagement with club personnel and organisations at all levels can enhance use of injury surveillance systems in community sport. Interview findings suggest that increased implementation could also be achieved by educating club personnel on the importance of recording injuries, asking leagues to create clearer injury surveillance guidelines, increasing club staffing, better remunerating those who conduct surveillance and offering flexible surveillance systems in a range of accessible formats. By increasing the use of surveillance systems, data will better reflect the target population and increase our understanding of the injury problem in community sport.

http://dx.doi.org/10.1016/j.jsams.2014.11.134

9

How do we know if they are doing what we want them to? Assessing exercise fidelity in an injury prevention exercise program

L. Fortington[1,*], A. Donaldson[1], T. Lathlean[1], B. Gabbe[2], D. Lloyd[3], W. Young[4], C. Finch[1]

[1] *Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), Federation University Australia, Australia*
[2] *Department of Epidemiology and Preventive Medicine, Monash University, Australia*
[3] *Centre for Musculoskeletal Research, Griffith University, Australia*
[4] *School of Health Sciences, Federation University Australia, Australia*

Background: It is assumed when exercise-based sports injury prevention programs are implemented, that coaches can provide appropriate instruction to enable players to perform the exercises correctly. This assumption has important ramifications for implementation strategies and, therefore, how effective the programs are in preventing injuries. However, the actual quality of exercise performance, or *exercise fidelity*, has rarely been evaluated. The aim of this research was to evaluate exercise fidelity in an injury prevention program using a purpose-designed observational tool.

Methods: The FootyFirst injury prevention program was specifically designed for community Australian Football. The program resources were designed for coaches to deliver the program to their players. In these, correct techniques were strongly emphasised with detailed images and descriptions of teaching points and common faults. The FootyFirst program contains 12 warm-up exercises and 5–6 exercises within 5 progressive levels. Performing each FootyFirst exercise with a high level of fidelity was considered essential to ensure the program injury prevention benefits. The FootyFirst Observational Tool (FOT) was developed to assess exercise fidelity by breaking the exercises down into 3–5 criteria describing correct technique, volume and intensity. Correct performance of each criteria was recorded as either 'yes' or 'no'. Two assessors independently used the FOT to assess exercise fidelity performed by players while participating in FootyFirst as part of their regular training. Attainment of exercise fidelity for each exercise was when all criteria were rated as 'yes' by both assessors. Results: The assessors agreed on 61 of 70 observations. The nine observations where the assessors disagreed could not be assessed for fidelity as it is not known which assessor was correct. Of the 61 agreed observations, exercise fidelity was achieved in 41 observations (67%), indicating that these players performed the observed exercise as intended. At least one essential criteria of an exercise was given a 'no' in 20 exercises (33%), indicating the exercise was performed incorrectly. Across all exercises, the most frequently incorrect exercise performance criteria was volume.

Discussion: Results from this study suggest that one third of players participating in FootyFirst may not have received the desired injury prevention benefits because they did not perform the exercises exactly as prescribed. Simply asking players/coaches if they are using a program is not enough; exercises should be observed to see how well they are performed. The insights from evaluating exercise fidelity will be used to modify the way the program is delivered.

http://dx.doi.org/10.1016/j.jsams.2014.11.135

10

A catalogue of the sport safety resources for community Australian Football clubs from the websites of key sport safety agencies

S. Bekker[1,*], P. White[1], A. Donaldson[1], J. Cook[2], B. Gabbe[3], D. Lloyd[4], C. Finch[1]

[1] *Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), Australia*
[2] *Department of Physiotherapy, Monash University, Australia*
[3] *Department of Epidemiology and Preventive Medicine, Monash University, Australia*
[4] *Musculoskeletal Research Program, Griffith Health Institute, Griffith University, Australia*

Introduction: Community Australian Football (AF) clubs have a responsibility to protect their players with a safe environment. Community AF clubs currently have access to, and use, numerous types of sport safety resources addressing various sport safety issues, obtained from a number of sources. This study describes a catalogue of the AF-relevant sport safety resources, available from the websites of key agencies in Australia which develop and disseminate such documents, so as to identify the gaps and duplications in the available resources.

Methods: Document analysis as a qualitative research method, using sport safety resources obtained from the websites of seven key agencies involved in the National Guidance for Australian Foot-

ball Partnerships and Safety (NoGAPS) project, was undertaken. These agencies include a peak sports body, an insurance company, as well as government and non-government agencies which develop and disseminate sport safety resources for community AF clubs.

Results: A catalogue of the AF-relevant sport safety resources developed by and disseminated on the websites of seven key sport safety agencies in Australia was developed. A total of 216 (187 after removal of duplicates) sport safety resources for community sports clubs were identified between May and September 2013. The types of resources catalogued were: research reports ($n = 40$), factsheets and brochures ($n = 39$), guidelines ($n = 26$), checklists and tools ($n = 25$), policies ($n = 22$), position statements ($n = 6$), rules and regulations ($n = 6$), posters ($n = 6$), codes of conduct/behaviour ($n = 5$), online resources ($n = 4$), and other ($n = 5$). Themes around sport safety issues were also identified through the cataloguing process, and these include types of sport safety issues (such as concussion and heat) as well as target groups (such as women and children). The cataloguing process revealed a duplication of resources for single issues both within and across agencies.

Conclusion: Sport safety resources are currently developed and disseminated in the form of different types of resources that cover single issues. This creates duplication of resources covering the same sport safety issue. The role of key sport safety stakeholder agencies in developing and disseminating sport safety resources is to effectively engage the end-user in sport safety interventions. Key sport safety agencies need to collaborate to develop a comprehensive sport safety resource that covers multiple issues and multiple solutions, which can easily be disseminated online, and effectively implemented and adopted by community AF clubs.

http://dx.doi.org/10.1016/j.jsams.2014.11.136

11

Cutting edge in rehabilitation: New frontiers in driving neuroplasticity

P. Hodges

A copy of this abstract may be made available at a later date (not available at time of printing).

http://dx.doi.org/10.1016/j.jsams.2014.11.137

12

'Tendon neuroplastic training': It's dynamite

E. Rio [1,*], D. Kidgell [2], C. Purdam [3], J. Cook [1]

[1] *Monash University, Australia*
[2] *Deakin University, Australia*
[3] *Australian Institute of Sport, Australia*

Tendon pain remains a clinical challenge. It is recalcitrant to treatment, frequently recurs and often becomes bilateral. Whilst the cornerstone for treating tendinopathy is exercise, we do not understand the mechanism behind its effectiveness. The success of intervention studies that aim to improve tendon pain and function appear to be unrelated to change in tendon structure on imaging. If we look outside the tendon, we have previously shown maladaption of motor control and large amounts of motor inhibition in people with patellar tendinopathy and that these changes may be positively altered with specific training. Maladaptive changes to motor control and motor inhibition may be potential contributors to recalcitrance if our interventions fail to address them. It is unlikely that our current exercise prescription in tendinopathy actually addresses these motor control changes. If we look to the strength training and motor control literature, our protocols may be lacking the specific features required to induce change. It is possible our approach to tendinopathy needs to include a better appreciation of motor control, the central nervous system (CNS) and changes that occur, termed neuroplasticity and most importantly, how to influence them. We present a new concept in tendon rehabilitation and explain the basis behind the specificity of training and instruction. Tendon neuroplastic training (TNT) combines the successful clinical protocols for treating tendinopathy, however with a strong focus on modulating the CNS and neuromuscular control with the goal of inducing neuroplasticity. The effect of different types of muscle contractions (isometric, isotonic – both concentric and eccentric phase) on the motor cortex activation is explained. The specific features of the TNT protocols will be discussed including simple methods of inducing neuroplasticity in exercise prescription for the clinician.

http://dx.doi.org/10.1016/j.jsams.2014.11.138

Award finalist

13

Nordic hamstring exercise weakness is a risk factor for hamstring strain injury in elite Australian football: A prospective cohort study

D. Opar [1,*], M. Williams [2], R. Timmins [1], J. Hickey [1], S. Duhig [3], A. Shield [3]

[1] *Australian Catholic University, Australia*
[2] *University of South Wales, Australia*
[3] *Queensland University of Technology, Australia*

Background: The Nordic hamstring exercise (NHE) reduces the risk of hamstring strain injury (HSI). It is unknown if measuring eccentric hamstring strength during the NHE can predict risk of future HSI in elite Australian footballers. The objective of this study was to determine if measures of eccentric hamstring strength during the NHE could identify athletes at risk of future HSI.

Methods: Elite Australian footballers ($n = 210$) from five teams in the Australian Football League participated in this prospective cohort study during the 2013 season. Eccentric strength during the NHE was measured at the start of preseason as was anthropometric and injury history details. Details of prospectively occurring HSIs were recorded by team medical staff.

Results: Low levels of eccentric hamstring strength at the start of preseason training increased the risk of future HSI by 2.7 fold ($p = 0.002$). Prior HSI increased the risk of future HSI by 3.1-fold ($p = 0.018$). No measure of between limb imbalance or any other prior injury data increased the risk of future HSI. Multivariate logistic regression revealed an interaction between increasing age, previous HSI and eccentric hamstring weakness leading to an increased risk of HSI.

Discussion: Low levels of eccentric hamstring strength during the NHE increases the risk of future HSI in elite Australian footballers and this effect is magnified in older athletes and in those with a previous HSI. This evidence suggests that a modifiable risk factor (eccentric strength) can modulate the risk conferred by non-modifiable factors such as age and previous injury.

http://dx.doi.org/10.1016/j.jsams.2014.11.139

17 **WHAT IS THE ROLE OF KEY SPORTS SAFETY AGENCIES IN THE DEVELOPMENT AND DISSEMINATION OF SPORT SAFETY POLICIES FOR COMMUNITY SPORT SETTINGS?**

S Bekker,[1] P White,[1] A Donaldson,[1] J Cook,[2] B Gabbe,[3] D Lloyd,[4] CF Finch[1].
[1]Australian Centre for Research into Injury in Sport and its Prevention (ACRISP), Federation University Australia, Ballarat, Australia; [2]Department of Physiotherapy, School of Primary Health Care, Monash University, Melbourne, Australia; [3]Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia; [4]Centre for Musculoskeletal Research, Griffith Health Institute, Griffith University, Gold Coast, Australia

10.1136/bjsports-2014-093494.17

Background Although sports clubs have a responsibility to protect their players with a safe training and playing environment, little is known about actual safety policies and procedures adopted by community sports clubs. Currently, there is no definitive macro-level sport safety policy available for clubs to implement in Australia. Community sports clubs use micro-policies around issues deemed relevant to their club, which are sourced from various agencies.

Objective This presentation will describe the full range of safety resources (policy documents, guidelines, action plans, research papers, fact sheets, posters, and procedures) as developed and disseminated online by key sports safety agencies in Australia. The gaps and duplications in the set of safety resources will also be identified. Finally, a recommendation around the safety needs of community sports clubs with regards to a macro sports safety policy that covers all relevant aspects which can easily be implemented and adopted will be made.

Design Document analysis as a qualitative research method.

Sources Online sport safety documents from key sport safety agencies in Australia.

Main outcome measurements To determine the relevant sport safety resources available online to community sport clubs through key sport safety agencies.

Results A collated list of recommended sport safety policies and procedures as developed and disseminated online by key sport safety agencies in Australia, for use by community sports clubs. An analysis of the gaps in current sports safety policy is also discussed.

Conclusions Sport safety policies and procedures are currently provided in the form of micro-polices that cover single issues (SunSmart, blood rule, concussion policy etc). It is recommended that key sport safety agencies collaborate to develop a macro-level policy around sport safety that comprehensively covers the full spectrum of safety under one plan that can be easily accessed, adapted and implemented in a variety of community sports club settings.

026 THE TRANSLATION OF SPORTS INJURY PREVENTION AND SAFETY PROMOTION KNOWLEDGE: INSIGHTS FROM KEY ORGANISATIONS

Sheree Bekker,[1] Penny Paliadelis,[2] Caroline Finch[1]. [1]*Australian Collaboration for Research into Injury in Sport and its Prevention, Federation University Australia, Ballarat, Australia;* [2]*Faculty of Health, Federation University Australia, Ballarat, Australia*

10.1136/bjsports-2016-097372.26

Background A recognised research-to-practice gap exists in the field of sports injury prevention and safety promotion. The role of key organisations in increasing the relevancy, accessibility, and legitimacy of injury prevention and safety promotion research knowledge for sport settings remains under-explored.
Objective This study sought to provide new insight into the knowledge translation activities undertaken by a set of key organisations that work to 'bridge the gap' between research and practice in sport settings.
Design Semi-structured face-to-face interviews about organisational processes of knowledge translation were undertaken with representatives from five key organisations.
Setting The National Guidance for Australian Football Partnerships and Safety (NoGAPS) project provided a clear and purposeful context for this study.
Participants The participants in this study were the self-nominated representatives from the following NoGAPS partnership organisations: 1) Australian Football League, 2) Victorian Health Promotion Foundation, 3) JLT Sport as a division of Jardine Lloyd Thompson Australia Pty Ltd, 4) Sport and Recreation Victoria, and 5) Sports Medicine Australia.
Main Outcome Measurements A qualitative descriptive methodology was used to analyse participants' descriptions of knowledge translation activities undertaken at their respective organisations.
Results Several knowledge translation processes and considerations emerged around three key themes: 1) identifying a need for knowledge translation, 2) developing and disseminating resources, and 3) barriers and enablers to knowledge translation.
Conclusions This study provides new insight into knowledge translation processes that key organisations undertake when developing and disseminating injury prevention and safety promotion resources for sport settings. The role these organisations play in increasing the relevancy, accessibility, and legitimacy of research knowledge through the development of useful injury prevention and safety promotion resources is key to influencing policy and practice in sport settings.

Appendix 6:

List of unpublished conference abstracts:

a. Bekker S & Clark AM.
Bringing complexity to sports injury prevention research: what is it and how to do it?
IOC World Conference on Prevention of Injury and Illness in Sport, Monaco, March 2017

b. **Bekker S**.
Complexity theory and 'wicked' problems.
Federation University Australia Higher Degree by Research Conference, Ballarat, July 2016

c. **Bekker S**, White P, Watson R, Finch CF.
An analysis of safety promotion and injury prevention resources for sport settings from stakeholder organisations in Australia: type, scope, development processes and dissemination practices
12th Australasian Injury Prevention and Safety Promotion Conference, Sydney, November 2015

d. **Bekker S**, White P, Watson R, Finch CF.
The process that informs the development and dissemination of sport safety resources within key sport safety agencies in Australia
Federation University Australia Higher Degree by Research Conference, Ballarat, November 2014

e. **Bekker S**.
An investigation into National Guidance for Australian Football Partnerships and Safety (NoGAPS) partner organisation's sport safety policies, and their dissemination and implementation in community Australian Football clubs
Federation University Australia Higher Degree by Research Conference, Ballarat, November 2013

Appendix 7:

List of other unpublished presentations (invited):

a. Bekker S & Clark AM.
   Bringing complexity theory to injury prevention research in sport settings.
   The George Institute lunchtime seminar, Sydney, August 2016

b. **Bekker S**
   The complexity of safety in sport.
   Australian Centre for Research into Injury in Sport and its Prevention retreat, Hepburn Springs, July 2015

c. **Bekker S**
   There is no such thing as an accident
   NerdNite, Wagga Wagga, July 2015

d. **Bekker S**
   Safety doesn't happen by accident
   3 Minute Thesis, Federation University Australia heats, Ballarat, September 2014

Appendix 8:

Letters of recognition from research participants

From: [redacted] **To:** "Caroline Finch"
Subject: RE: The translation of sports injury prevention and safety promotion knowledge

Thanks Caroline. Highlights the lack of an overall policy along with the fragmented approach of government and the respective codes many of which like AFL still work according to a federated union structure. Will definitely take on board going forward. Thanks

[redacted]

Sports Medicine Australia
Tel: 03 9674 8711
Mob: 0434 061 740
Sports House, 375 Albert Rd, Albert Park VIC 3206 sma.org.au

Subject: The translation of sports injury prevention and safety promotion knowledge

Dear [redacted]

This email is a follow-up to a discussion re had recently about the value of SMA resources, especially in the sports safety promotion area.

You may, or may not be aware, the SMA (though its then National and Victorian branches) participated in a large NHMRC Partnerships Project grant that I led, known as the NoGAPS project. As part of that project, which involved 5-7 partner agencies (including SMA, SRV, JLT, AFL), part of the research focussed on the overlap of focus of online sports safety resources across all agencies – this showed much duplication of resources and topics, potentially leading to confusion for the general public seeking information. We also conducted a follow-up to that explored how peak bodies identified sports safety knowledge and translated it into safety guidance for general circulation. This work was insightful and has highlighted major gaps that still exists between the needs of organisations such as yours and evidence generated by researchers based in universities or clinics. This gap is articulated well in the published papers and, I think, should provide some useful information to guide SMA's efforts for moving forward and planning its role in information dissemination.

Both items are in Open Access form at:
-Journal of Health Research Policy and Systems at: http://rdcu.be/qrKB (The translation of sports injury prevention and safety promotion knowledge: insights from key intermediary organisations)
-BMJ Open http://bmjopen.bmj.com/content/6/5/e010877 (Too much information? A document analysis of sport safety resources from key organisations)

I'd be happy to discuss this with you in the future, should you be interested in doing so.

From: [redacted]
To: Sheree Bekker
Subject: RE: Update: NoGAPS linked study
Date: Friday, 14 April 2017 3:52:36 PM
Attachments:

Hi Sheree,

Great!

Thank you for your email with the paper PDF attachment and link. Well done on the study and pulling the results together pointing to some important findings to build upon – that will hopefully influence how we work in the future.

[redacted]

You might be interested to know – soon we will have our welcoming and healthy framework of actions and resources for health promotion in sport up on the Vicsport website. It's a partner project with Vicsport to have a 'one stop' shop for the sporting sector, to compliment other existing resources/links in the sector. Our aim will not be to duplicate, but to provide an evidence based resource. I'll send you the links in the coming months once it's complete.

Thanks
[redacted]
Victorian
Health
Promotion
Foundation
(VicHealth)
15-31 Pelham Street Carlton Victoria 3053

[redacted]
www.vichealth.vic.gov.au

Appendix 9:

Media reports:

a. AFL, NRL and other codes must lead way to protect amateur and elite athletes

   Sydney Morning Herald (Fairfax syndicated), April 9 2014

b. Time for single sports safety plan to protect every player

   The Border Mail, April 10 2014

theage.com.au
THE AGE

AFL, NRL and other codes must lead way to protect amateur and elite athletes

Caroline Finch
Published: April 9, 2014 - 11:45PM

- **Join the debate at SMH Comment**

Last weekend, an Aussie rules player was severely injured at a match in Albury. Last month, rugby league player Alex McKinnon suffered an appalling spinal injury on the field. An estimated one in four Australians aged 15 years and over are involved in organised sport and physical activity. This includes 3.8 million people involved in the playing of sport and 1.6 million people involved in non-playing roles such as umpires, administrators or coaches.

That's a lot of people who front-up every weekend to kick a footy, hit a tennis ball or jog around Centennial Park.

The AFL, ARU, NRL and Football Federation Australia all have systems of checks and balances that work to ensure the safety of elite athletes. But what about the other 4.4 million people who play amateur sport? A 2006 report by Medibank Private found sports-related injuries in 2005 cost the community over $2 billion.

Many sports and physical recreation activities are organised by clubs or associations. This week at the International Olympic Committee conference on prevention of injury and illness in sport, in Monaco, researchers revealed new data showing the bulk of community sports groups have an ad-hoc approach to injury prevention. What is needed is a body that can provide and regulate uniform safety procedures outside of elite sports.

Although sports clubs have a responsibility to protect their players, little is known about the safety policies and procedures adopted by community sports clubs. There is no overarching sport safety policy available for clubs to implement in Australia. Community sports clubs use micro-policies around issues deemed relevant to their club, which are sourced from various agencies.

The Monash injury research institute's Sheree Bekker has looked at 289 safety resources (policy documents, guidelines, action plans, research papers, fact sheets, posters, and procedures) as developed and disseminated online by key sports safety agencies in Australia.

She has found sport safety policies and procedures are provided only in the form of micro-polices that cover single issues such as SunSmart, rules on bleeding on the field, and concussion. It confirms there is an urgent need for sport safety agencies, such as the AFL and NRL, to collaborate and develop a macro-policy around sport safety.

This would mean all Australian sports players would be covered by a single sports safety plan that can be easily accessed, adapted and implemented in a variety of community sports club settings. Sweden's Safe Communities program is an example of how to get this right.

But it's important not just to create a uniform safety policy; we've got to let people know about it too. It needs to be disseminated – to clubs, coaches, players, families and safety officers. In the age of social media, there is no excuse for sporting codes not to look after players – at all levels not just the elite level – and to tweet, text or post them the latest injury prevention facts as soon as they know them. Essentially, the same tools they use to recruit members and organise games can be honed to ensure safety measures are practised not just at the SCG but in Orange or Newcastle.

Of course, the latest AFL injury survey is something to be proud of and it is a model of what we could do elsewhere. Imagine if, in five years, we could say the majority of sporting clubs had signed to a program to keep

all their members safe. Not just their elite players. And that this program was actually implemented not just at the start of the season but throughout each season.

Professor Caroline Finch is Director of the Australian Centre for Sports Injury and its Prevention and will speak on Friday at the International Olympic Committee sports injury conference in Monaco.

This story was found at: ***http://www.theage.com.au/comment/afl-nrl-and-other-codes-must-lead-way-to-protect-amateur-and-elite-athletes-20140409-zqsnn.html***

The Border Mail (/)

Time for single sports safety plan to protect every player | OPINION

By PROF CAROLINE FINCH
April 10, 2014, midnight

Paramedics attend to injured Albury footballer James McQuillan last Saturday.

LAST weekend, Albury footballer James McQuillan was severely injured in an Ovens and Murray league match.

Last month, rugby league player Alex McKinnon suffered an appalling spinal injury on the field.

An estimated one in four Australians aged 15 years and over are involved in organised sport and physical activity.

That's a lot of people who front-up every weekend to kick a footy, hit a tennis ball or, in Sydney, jog around Centennial Park.

The AFL, ARU, NRL and Football Federation Australia all have systems of checks and balances to ensure the safety of elite athletes.

But what about the other 4.4 million people in amateur sport?

A 2006 report by Medibank Private found sports-related injuries in 2005 cost the community more than $2 billion.

Education

Many sports and physical recreation activities are organised by clubs or associations.

This week in Monaco, at the International Olympic Committee conference on prevention of injury and illness in sport, researchers revealed data showing most community sports groups have an ad hoc approach to injury prevention.

A body is needed that can provide and regulate uniform safety procedures outside of elite sports.

Although sports clubs have a responsibility to protect their players, little is known about the safety policies and procedures adopted by community sports clubs.

There is no over-arching sport safety policy available for clubs to implement in Australia.

Community sports clubs use micro-policies around issues deemed relevant to them, sourced from various agencies.

The Monash injury research institute's Sheree Bekker has looked at 289 safety resources (policy documents, guidelines, action plans, research papers, fact sheets, posters, and so on) as developed and disseminated online by key sports safety agencies.

She found sport safety policies and procedures are provided only in the form of micro-policies that cover single issues such as SunSmart, rules on bleeding on the field, and concussion.

It confirms there is an urgent need for sport safety agencies, such as the AFL and NRL, to collaborate and develop a macro-policy around sport safety.

This would mean all Australian sports players would be covered by a single sports safety plan that can be easily accessed.

It's important not just to create a uniform safety policy; we've got to let people know about it too.

It needs to be disseminated to clubs, coaches, players, families and safety officers.

With social media, there is no excuse for sporting codes not to look after players at all levels and to tweet, text or post them the latest injury prevention facts.

Appendix 10:

List of prizes/awards:

a. Best student paper

   Bekker S & Finch CF. 2016. Too much information? A document analysis of sport safety resources from key organisations. *BMJ Open* 6(5):e010877

   Australian Collaboration for Research into Injury in Sport and its Prevention, Ballarat 2016

b. Best student presentation
   12th Australasian Injury Prevention and Safety Promotion Conference, Sydney 2015

c. 2nd Place best student presentation
   Federation University Australia Research Conference, Ballarat 2013