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Post the pandemic "off season"; time to push forward with what a "new season" could look like

CHRIS WHATMAN

The recent lockdown in New Zealand (NZ) has undoubtably created many challenges for all parts of the sporting community. One positive might be the enforced break that has meant the first "off season" some young athletes have had for years. This was certainly the case for a young boy I know who enjoyed his time in lockdown so much (as did his mum the "taxi driver") that he's subsequently dialled back his commitment to his main sport and started playing an additional sport. Several online forums have referred to this enforced "off season" and the benefits it has had for injury reduction and rehabilitation in youth sport.

A recently published editorial in BJSM highlights the opportunity provided by the lockdown to pause and consider what the new season could look like.[1] Where are the opportunities to improve the youth sport experience, grow sustained participation and maximise the positive physical, social, and psychological benefits we know sport can provide? The editorial highlights the recent New Zealand Rugby initiative to introduce flexible game structures designed to maximise participation and enjoyment while reducing injury risk. Great to see sport in NZ leading the way.

During lockdown anecdotal reports and media coverage suggested a return to more "free play" and kids playing in the backyard with siblings and parents (producing the entertaining video clips presented by One News). These unstructured play activities have been shown to have benefits in terms of movement development and injury reduction.[2] During a recent podcast from the US, well known researcher in youth sports injury, Dr Neeru Jayanthi mentioned his new initiative "Pickup Sports" (https://pickupsports.co/). This is a programme designed to get parents playing with their kids and allowing kids to sample a number of sports thereby reducing the cost and time commitment associated with signing up to an organised league. In NZ the restrictions on travel have reduced the geographical area over which some competitions are now being played. Maybe these changes represent a better new normal?

Another relatively new concept is that of bio-banding – placing children in groups to train and or compete based on biological rather than chronological age. This has been advocated to overcome the selection biases and negative effects of differences in physical capability caused by the large variability in the timing of physical growth in children and adolescents. Most of the work in this area to date has been in football/ soccer with evidence suggesting that bio-banding, as a compliment to current structures, has a positive impact on skill development, injury prevention and psychological factors such as confidence.[3] Our research group has recently collaborated with NZ Cricket and Auckland Cricket to experiment with bio-banding in youth cricket with favourable results suggesting it could be used to complement their existing structures. There seems obvious potential for bio-banding in other popular youth sports in NZ such as netball and basketball where different rates of physical growth have clear implications for player development/ experience and injury risk.

Among other considerations proposed in the BJSM editorial were the widespread implementation of injury prevention programmes. Thankfully in NZ we probably lead the world in this space given the excellent collaborative work of ACC and the many NSO's they work with. In this edition of the journal we have two articles reporting on the great work NZ Football have recently done with injury prevention in Futsal. With further positive collaboration across the sector, including with Sport NZ and Secondary School Sport, we have a great opportunity to develop a better "new season" in youth sport.

On a side note my last observation on the lockdown is that it obviously gave authors time to write and submit to journals – several editors noted an increase in submissions, and we were no exception. This is the biggest issue Brenda has pulled together for some time so thanks to her for all the hard work and to all the authors, keep the stories coming. Hope you enjoy this bumper edition!

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CHRIS MILNE

HIGHLIGHTS FROM THE BRITISH JOURNAL OF SPORTS MEDICINE

May to August 2019

Cam Morphology in Young Male Football Players – van Klij and colleagues.[1] They studied 49 Academy male footballers and concluded that cam morphology mostly develops before proximal femoral growth plate closure.

Kinesiophobia (fear of movement) seems to have an influence on pain.[2] Luque-Suarez and colleagues conducted a systematic literature review and included data on 10726 individuals from 63 articles. They found strong evidence for an association between kinesiophobia and greater levels of pain intensity and disability.

Later in the same issue was an infographic entitled 'Correlation Between Phases and Final Result in the Men's Triathlon Competition at the Olympic Games in Sydney 2000'.[3] The author, Prof Fernandez-Revelles, concluded that the run section was the phase that most strongly influenced the men's triathlon result at the Sydney 2000 Olympic Games. This has relevance for New Zealanders as at the subsequent Olympic Games in 2004, New Zealand athletes Hamish Carter and Bevan Docherty finished first and second respectively. They had put particular emphasis on improving performance on the run during the preceding few years.

Issue 10 included an article entitled, 'Case for the Specialised Sports Physical Therapist to be an Essential Part of Professional Athlete Care: Letter from America No. 1'.[4] Donald Strack and colleagues explained that in the USA, physiotherapists do not have the prominence in athlete care that they enjoy in New Zealand. They make a compelling case for this situation to be altered.

Physical activity is an integral part of health care in the 21st century. An article by Ann Gates and colleagues entitled 'Movement for Movement' explained how Lancaster University Medical School embedded physical activity in the medical curriculum.[5] Their resources have been offered to all UK medical schools. One hopes that this is adopted widely for the benefit of patients in the future.

The athlete complaining of breathlessness does not always have asthma. Steffan Griffin and colleagues produced a useful infographic describing exercise induced laryngeal obstruction.[6] In this condition the larynx closes inappropriately during vigorous exercise. The major differentiation from exercise induced asthma is that athletes with laryngeal obstruction will have inspiratory stridor rather than expiratory wheeze. Breathing control exercises and improved breathing techniques can help in management of the condition.

Mental health issues have received much attention in recent years. The IOC convened an expert group to develop a consensus statement. Claudia Reardon and colleagues produced a comprehensive document that runs to 32 pages and contains 741 references.[7] It is worth consulting for further background on this topic. The incidence of mental health symptoms and disorders in athletes is a subject of much conjecture.

Vincent Gouttebarge and colleagues conducted a meta-analysis of 22 relevant original studies and showed that the prevalence of mental health symptoms and disorders varied from 90% for alcohol misuse to 34% for anxiety and depression in current athletes and from 16% for distress to 26% for anxiety and depression for former elite athletes.[8] This shows the importance of being aware of these issues.

The following issue contained narrative reviews on mental health in elite athletes. There was a particularly useful one on attention deficit and hyperactivity disorder (ADHD) written by Doug Han and colleagues.[9] They found the prevalence of ADHD to be approximately 8% which is as high or higher than in the general population. The positive and negative effects of ADHD may play a role in choosing a particular sport. Importantly, if stimulants are prescribed for elite athletes, there needs to be appropriate justification for their use from a specialist psychiatrist and a therapeutic use exemption should be applied for.

The International Olympic Committee produced a consensus statement on pain management in athletes. Brian Hainline and colleagues produced a useful infographic emphasising non pharmacological strategies.[10] In essence, movement, strength and conditioning plus adequate restorative sleep have been shown to have benefit whereas the data for modalities in massage, psychosocial interventions and supplementation is mixed.

Psychosocial factors are important in the management of low back pain. Mary O'Keeffe and colleague explained that these are not just present in persistent pain presentations.[11] They argue in favour of use of validated assessment tools so that we better understand the beliefs, attitudes, fears and emotional responses of our patients. This is an essential quality that clinicians need to nurture.

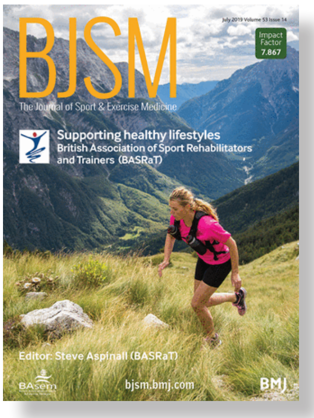
Nicol van Dyk has emphasised the importance of generative listening, i.e. being aware that there may be creative things that were not in your mind at the beginning of the consultation.[12] Preconceived notions are let go and the interaction becomes open to a new field of possibilities. Burns and associates analyzed the lifestyles and mindsets of Olympic, Paralympic and world champions. They found that championship performance requires a particular way of life that integrates mindset, performance, lifestyle and relationship factors. The performance support staff should work on strategies to strengthen and facilitate interpersonal relationships within the athletes support network.

Hypertension is very common in the community. Two articles in Issue 14 by James P. Sheppard and Linda Pescatello concluded that exercise measured up to medication as antihypertensive therapy and that its value had long been underestimated.[13,14]

Can you outrun a bad diet? Possibly. Stuart Phillips and Michael Joyner concluded that beyond weight loss there is clear evidence of the benefits of physical activity in improving health.[15]

Physical activity and aging was the focus of the Copenhagen Consensus Statement in 2019.[16] Jens Bangsbo and colleagues found that physical activity benefitted many organ systems and improved brain health and cognitive function. Lifelong physical activity, experiences and habits can have an influence on participation in later life. A supportive physical, social and cultural environment is important.

During New Zealand's lockdown in 2020 due to the COVID19 infection, many more people discovered the joys of cycling. Solveig Nordengen and colleagues found that cycling was associated with a 22% lower risk of combined cardiovascular disease risk compared with passive transport.[17] They found that cyclists had more favourable risk factor levels in body composition and blood lipid levels compared with non-cyclists.



Chronic musculoskeletal pain is a very common phenomenon. Benjamin Smith and colleague evaluated the existing findings and found that pain during therapeutic exercise for chronic musculoskeletal pain need not be a barrier to successful outcomes.[18] In essence, if the person is coping with the level of pain then it is reasonable for them to continue with the exercise.

Vastus medialis obliquus (VMO) retraining has been the standard for dealing with patellofemoral pain for the last few decades. Kay Crossley and Sallie Cowan have recommended that a progressive exercise regime whilst keeping pain levels below 3 out of 10 could lead to improved function.[19] There needs to be adequate time spent explaining patellofemoral pain and quashing beliefs about joint damage.

What about the effects of exercise on articular cartilage in people with knee osteoarthritis? Alessio Bricca and colleagues conducted a systematic review of nine randomised control trials.[20] They concluded that knee joint loading exercise does not seem to be harmful for articular cartilage in people at increased risk of or with OA of the knee. However the quality of evidence was relatively low.

Head injuries are a concern in multiple sports. Florian Beaudouin and colleagues investigated the prevalence of head injuries in professional male football over thirteen years in German football.[21] In 2006 a rule was introduced where players were given a red card for intentional elbow/head contact. Over the ensuing thirteen years, the incidence of head injuries dropped by 29% and lacerations or abrasions declined by 42%. Facial fractures were reduced by 16%. This shows the positive effect of rule changes in professional sport.

Concussion is relatively common in professional rugby. James Rafferty and colleagues studied the four professional Welsh rugby clubs over four years and found that players were more likely than not to sustain a concussion after 25 matches.[22] In addition, there was a 38% greater injury risk after concussion compared to following a non-concussive injury. These findings have relevance to our provisional rugby players in New Zealand also.

Physical activity is known to provide health benefits. However do all daily metabolic equivalent task units (METs) bring the same health benefits. Andreas Holtermann and Emmanuel Stamatakis evaluated this issue.[23] They concluded that we should acknowledge the possibility that not all daily METs are the same. For example, prolonged bouts of lack of movement are associated with all cause mortality risk independent of the daily METs. Exercise requiring dynamic use of large muscle mass is associated with low all cause and cardiovascular disease mortality risk compared with sports or similar METs that do not occupy the entire body.

Anterior cruciate ligament injury can be life changing for an individual. Patients may ask 'what is my risk of sustaining an ACL injury whilst playing sports?. Alicia Montalvo and colleagues conducted a systematic review of 58 studies and found that female athletes had approximately 1.5 times the risk of ACL injury compared with males.[24] One in 29 female athletes and 1 in 50 male athletes ruptured their ACL in a window that spanned from one season to 25 years. The reported sex disparity in ACL injury rates was independent of participation.

Does the volume of activity matter more than the pattern of accumulation in older men? Barbara Jefferis and colleague studied 1655 older men aged 71 to 92 years who had been recruited from UK general practices about 30 years earlier.[25] They found that all activities of light intensity upwards were beneficial and accumulation of activity in bouts of greater than ten minutes did not appear important beyond the total volume of activity.

Finally in Issue 16 there was a detailed analysis of sports related injuries in New Zealand. Doug King and colleagues analysed ACC claims for five sporting codes from to 2012 to 2016 inclusive.[26] They studied cricket, netball, rugby league, rugby union and football for moderate to serious and serious injury claims. Not surprisingly, rugby league and rugby union had the highest total number and costs associated with injury. Female athletes were at greater risks of moderate to serious injury in football compared with cricket. Moderate to serious concussion claims increased over the five year period for all five codes. Nearly a quarter of moderate to serious entitlement claims were to participants aged 35 years or older.

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ORIGINAL RESEARCH

Futsal: The nature of the game, injury epidemiology and injury prevention - a narrative review

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ABSTRACT

Aim

To summarise the available scientific evidence with respect to the game demands, injury epidemiology, and injury-prevention strategies in futsal.

Data Sources

Key electronic databases were searched for publications (PubMed, ScienceDirect, Scopus).

Study Selection

Peer-reviewed publications were considered eligible if they were focused on the game demands, injury epidemiology, or injury prevention in futsal.

Results

Futsal is a high-intensity game that requires substantial aerobic and anaerobic capacities of players. The injury incidence in futsal (2.03-5.90 injuries/1000 player hours) is comparable to football (2.22-5.52 injuries/1000 player hours). Injuries to the lower extremities are the most common (up to 88 % of all injuries). Most injuries are acute and caused by a contact situation, especially with another player (up to 46 % of all contact injuries). The 11+ has been shown to improve some performance measures in futsal players (jump, sprint, core strength, agility). In one study, the 11+ was found effective in reducing the number of futsal injuries (44% injury reduction).

Conclusions

Futsal is a high-intensity game with a comparable injury profile to football. Injury-prevention strategies have been poorly investigated in futsal. Future research should focus on the implementation of injury-prevention measures and the possible adaptation of the 11+ in the futsal environment.

Keywords

Futsal, injuries, 11+, injury prevention, warm-up

INTRODUCTION

Futsal is a fast-paced, dynamic sport derived from association football and played widely across the world.[1] Compared to 11-a-side football, the game is played on hard surfaces in a reduced space, usually indoors, but it can also be played outdoors. The nature of the game puts an emphasis on an individual's technique, creativity, footwork, agility, coordination, quick reflexes and fast decision-making.[2-4] High levels of physical and psychological preparation are also crucial.[5] From a biomechanical point of view, futsal is characterised by sudden changes of direction, quick accelerations and decelerations, and greater ground reaction forces compared to football.[6] Due to these demands placed on players, a comparable injury profile to football is seen.[7,8] With the growing popularity of futsal,[9] the issue of safety and injury prevention is becoming more important.[10,11] In 2016, it was estimated that over 60 million people play futsal globally, which corresponded to around 20% of people playing football worldwide.[9] This number increased from 11% reported in 2006 by FIFA.12 Injury-prevention programmes have been shown to significantly reduce the risk of injuries and to enhance the performance of athletes in several other sports (football, basketball, rugby).[13-18] One of these programmes, the 11+, was designed specifically to reduce the risk of injuries in football. It has since been validated, and shown to be effective, in both men's and women's football.[19-22]

Although there is one systematic review providing the summary of evidence-based research related to the sport of futsal, the main focus was on the development, coaching, physiological, psychological, technical and tactical elements of the sport.[23] The aim of this narrative review was to summarise the current knowledge and evidence relating to futsal in terms of the nature of the game, performance demands on players, and mainly on the injury epidemiology, and injury-prevention strategies. The purpose of the knowledge gained from this review was to determine if further research on the injury prevention in futsal was required and if current injury-prevention programmes, such as the 11+, were appropriate for the demands, injury rates and patterns in futsal.

METHODS

This review considered peer-reviewed journal publications from January 1990 (a year after the first FIFA Futsal World Cup) until May 2019. The search strategy was systematic in the design but did not follow a full systematic review methodology. The main author used several search strings and keyword searches that led to the relevant literature linked to futsal. The following keywords were chosen and used in various combinations with Boolean operators (AND and OR); futsal, performance, physiology, football, injury, epidemiology, the 11+, injury prevention. The review only included publications written in the English language, full-text or abstracts, and relevant to the review (futsal and established keywords).

The methodological quality of each paper focused on injury prevention and performance in futsal was assessed using the PEDro rating scale, a validated, 11-item scale to rate the quality of randomised controlled trials. The papers were assessed by two authors using the PEDro scale independently. Any discrepancies in the scores were discussed and a final score agreed by both authors.

The nature of the game and performance demands on players

Due to the speed, non-stop flow of the game and plenty of goalmouth action, futsal has become attractive for both spectators and players.[9] The nature of the game puts an emphasis on an individual's technique, improvisation, creativity, footwork, agility and coordination.[3,4] Reduced playing space forces players to make decisions that require speed and quick reflexes.[9] High levels of players' physical and psychological preparation are also crucial.[5] It has been reported that the fastest way to learn the fundamentals of football is in the futsal environment.[5,24] For all these reasons, futsal has been used more and more by traditional football players as a supplementary activity to improve their skills.[3,5,24] A number of world-famous players including Pele are reported to have developed their talents playing futsal.[25,26]

A number of studies have suggested that the nature of game taxes both the anaerobic and aerobic metabolic pathways.[27-29] The physiological characteristics have been analysed using laboratory testing methods and also by The Futsal Intermittent Endurance Test (FIET), a new field-testing method.[27,29] The FIET has been developed to imitate the movement demands of futsal and it is considered a valid field test to assess specific futsal aerobic endurance.[27,29] A summary of key physiological characteristics of futsal players is shown in Table 1.[30] Compared to football players, the results suggest that futsal players have higher values of the following variables; maximal heart rate (HR_{max}), the heart rate at the ventilatory threshold (HR_{VT}), the percentage of maximal heart rate (% HR_{max}), the maximum rate of oxygen consumption (VO_{2max}), oxygen consumption at the ventilatory threshold (VO_{2VT}), and the percentage of maximal oxygen consumption (% VO_{2max}).[30]

Besides the physiological demands of the game, previous studies have also focused on the physical demands and the profile of game activities based on the video analysis of movements (Table 2).[27,28] These studies have shown that futsal players cover 4-6 km on average per 1 game, with 26 % of this distance spent at high intensity and approximately 8.9 % of the total distance run at sprinting speed.[28,31,32] Futsal players also perform 9 exercise activities per 1 minute of play on average and a high-intensity effort every 23 s of play.[27,33] The work-to-rest ratio was reported to be 1:1, i.e. for every minute of "work" there is approximately 1 minute of "rest".[34]

A number of studies compared futsal and football in terms of physiological and physical demands, and these studies have found that both games require suitable aerobic power to maintain the high pace of play, especially due to the need for energy recovery between repeated sprints.[34-36] However, the intensity of game is much higher in futsal, which results in a consistent need for higher levels of anaerobic capacity, as most of the crucial moments of play last no longer than 5 seconds.[34,36] Futsal is, therefore, considered an intermittent high-intensity game that requires substantial aerobic and anaerobic capacities, along with substantial muscular power of the lower extremities to compete at a high level.[27,28,34,37,38] Despite some similarities with football, both games have significant differences that need to be considered when creating new training methods or developing injury prevention programmes.[34] The intensity and nature of futsal may also contribute to injury rates and the need for injury prevention strategies.

Injury epidemiology in futsal

With the growing population of futsal players there are several factors that contribute to increased injury risk, in particular the professionalisation of the sport, higher physical and physiological demands on players, the nature of the game, and the playing environment.[4,40,41] There have been several studies focusing on the injury occurrence in futsal (Table 3).[4,7,40-46] Referred to as a modality of football, the rate of futsal injuries has been found to be comparable to the rate in football.[7,8,40,45] Considering the total number of player hours (training and match hours together), the injury incidence in football has been reported to range from 2.03 to 5.90 injuries per 1000 player hours and the injury incidence in futsal has been showed to range from 2.22 to 5.30 injuries per 1000 player hours.[7,8,40,45] Several studies only reported the number of futsal injuries per 1000 player match hours, not including training hours.[42,44,46] In that case, the injury incidence has been reported to range from 91.5 to 208.6 injuries per 1000 player match hours.

The studies focusing on injury epidemiology in futsal have also focused on injury characteristics, such as the injured body part, type of injury, cause of injury, and severity of injury (Table 4).[4,40-44,46] The lower extremities (LE) have been shown to be the most frequently injured body part (86.5 % of all injuries), followed by the upper extremities (up to 23.7 % of all injuries), and head and trunk (up to 22.1 % of all injuries).[4,40-44,46]

Of all the injuries to the lower extremities, the ankle, knee and thigh (groin) were the sites most commonly injured.[4,40-44,46] Ankle injuries reached up to 50.6 % of all injuries, followed by thigh/groin injuries (up to 28.1 %) and knee injuries (up to 23.1 %).[4,40-44,46] The studies showed that ligament injuries (sprains and ruptures, up to 51.8 % of all injuries), skin injuries (contusions, up to 44.2 % of all injuries) and muscle injuries (strains and ruptures, up to 17.6 % of all injuries) were the most common types of injury in futsal.[4,40,42,44,46] Concerning types of injury, some studies have shown that the rate of concussion reaches a significant value in futsal (3.9 % of all injuries on average).[40,42,44] This is more than 4 times the rate of concussion in football (0.9 % of all injuries on average).[47,48] A harder ball, harder surface, and reduced space may be possible reasons for this difference.

With respect to the cause of injury, there are 2 main mechanisms, contact and non-contact.[4,40-44,46] An injury may occur during a contact (with another player, the ball, the equipment, etc.) or a non-contact situation (a fall/trip/slip, kicking the ball, a sudden change of speed or direction, planting and/or cutting, landing). Most

Table 1: Comparison of chosen physiological parameters between futsal and football players

Physiological Parameter	Futsal Players	Football Players
HR_{max} (BPM)	198 ± 8	189 ± 10.7
HR_{VT} (BPM)	177.2 ± 10.1	167.1 ± 10.8
% HR_{max} (%)	96.7 ± 2.3	88.4 ± 2.4
VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$)	62.5 ± 4.3	52.1 ± 4.6
VO_{2VT} ($ml \cdot kg^{-1} \cdot min^{-1}$)	58.7 ± 5.6	43.1 ± 4.6
% VO_{2max} (%)	93.9 ± 5.3	76 ± 8.4

Table 2: Futsal game activities classified by cut-off speed and values of physiological parameters based on laboratory treadmill testing

Game activity	Cut-off speed based on treadmill testing (km/h)	Cut-off speed based on treadmill testing (m/s)
Standing	0 – 0.4	0 – 0.1
Walking	0.5 – 6	0.1 – 1.7
Low-intensity running	6.1 – 12	1.7 – 3.3
Medium-intensity running	12.1 – 15.4	3.3 – 4.3
High-intensity running	> 15.5	> 4.3
Sprinting	> 18.3	> 5.1

Table 3: Summary of studies investigating injury rates in futsal

Study	Design	Injury Definition	Population	Follow-up	No. of injuries (Incidence per 1000 player hours)
Uluöz (2016)	Retrospective cohort study	Any tissue damage caused by futsal regardless of subsequent absence from games or training sessions (Junge & Dvorak, 2000)	66 Turkish female futsal players of university teams	1 competition season	93 injuries (-)
Serrano (2013)	Retrospective cohort study	Any physical complaint sustained by a player that results from a futsal match or futsal training, irrespective of the need for medical attention or time loss from futsal activities (Fuller et al., 2006)	411 Portuguese futsal players (284 males) of diverse competitive levels	Retrospective recall of 3 main injuries found during the sports career in futsal	512 injuries (-)
Gayardo (2012)	Retrospective cohort study	Injury with compromising which had presented at least one of the following consequences: decrease in the quantity or level of sports activity for at least 1 day, or which had needed medical evaluation or treatment	147 Brazilian female futsal players participating in the National League of Futsal	1 season (2010–2011)	104 injuries (-)
Angoorani (2014)	Prospective cohort study	Any physical complaint sustained by a player that results from a futsal match or futsal training, irrespective of the need for medical attention or time loss from futsal activities (Fuller et al., 2006)	55 Iranian national futsal players (23 males, 17 females, 15 U-23 males)	March 2011 to September 2012	54 injuries (2.22)
Van Hespen (2011)	Prospective cohort study	Any physical complaint associated with futsal (received during training or a match) that limits athletic participation for at least the day after the day of the onset (Faude, Junge, Kindermann, & Dvorak, 2005)	77 Dutch elite male futsal players	1 season of premier league male futsal (2009-2010)	58 injuries (3.1)
Hamid (2014)	Prospective cohort study	Any physical complaint sustained by a player that results from a futsal match, irrespective of the need for medical attention or time loss from futsal activities (Fuller et al., 2006)	468 Malaysian amateur futsal players (238 males)	1 season of the 2010 FELDA/FAM National Amateur Futsal League (141 matches)	86 injuries (91.5)
Junge (2010)	Prospective cohort study	Any physical complaint sustained by a player that results from a futsal match which received medical attention from the team physician, regardless of the consequences with respect to absence from match or training (Fuller et al., 2006)	Futsal players of 3 consecutive Futsal World Cups	3 consecutive Futsal World Cups (136 matches in total)	165 injuries (195.6)
Ribeiro (2006)	Prospective cohort study	any physical complaint arising during the match regardless of the consequences with respect to subsequent absence from matches or training (Junge, Dvorak, Graf-Baumann, & Peterson, 2004)	180 Brazilian futsal players (17-20 years old)	15th Brazilian Sub20 Team Selection Championship (23 matches)	32 injuries (208.6)

Table 4 - Summary of studies investigating injury characteristics in Futsal

Study	Injured Body Part (3 most common)	Anatomical Site (3 most common)	Type of injury (3 most common and concussion)	Cause of Injury	Severity of Injury
Uluöz (2016)	Lower extremity (57.0 %) Upper Extremity (23.7 %) Head and trunk (19.3 %)	Ankle (26.9 %) Knee (21.5 %) Low back (16.1 %)	-	Contact (58.1 %) Non-Contact (29.0 %)	1-3 days (10.8 %) 4-7 days (34.4 %) 8-28 days (25.8 %) >28 days (29.0 %)
Serrano (2013)	-	Ankle (50.6 %) Thigh (18.3 %) Knee (13.3 %)	Sprain (48.8 %) Muscular rupture (14.8 %) Fracture (8.4 %)	Non-Contact* (55.8 %) Contact* (44.2 %)	0-3 days (5.5 %) 4-7 days (10.5 %) 8-28 days (52.7 %) >28 days (31.3 %)
Gayardo (2012)	Lower extremity (86.5 %) Upper extremity (9.6 %) Head and trunk (3.8 %)	Ankle (28.9 %) Thigh (24.0 %) Knee (23.1 %)	-	Non-Contact (51.9 %) Contact (46.2 %)	0-6 days (4.8 %) 7-28 days (52.9 %) >28 days (33.7 %)
Angoorani (2014)	Lower extremity (85.2 %) Head and trunk (9.3 %) Upper extremity (5.6 %)	Ankle (40.7 %) Knee (22.2 %) Groin (13.0 %)	Sprain (51.8 %) Strain (13.0 %) Ligament rupture (7.4 %) Concussion (3.7 %)	Non-Contact* (70.4 %) Contact* (24.1 %)	1-3 days (33.3 %) 4-7 days (38.9 %) 8-28 days (14.8 %) >28 days (13.0 %)
Hamid (2014)	Lower extremity (65.1 %) Head and trunk (22.1 %) Upper extremity (12.8 %)	Knee (23.0 %) Ankle (21.0 %) Chest and back (14.0 %)	Contusion (36.0 %) Sprain (32.6 %) Strain(16.3 %) Concussion (3.5 %)	Contact (63.0 %) Non-Contact (37.0 %)	0 days (71.0 %) 1-7 days (8.0 %) 8-28 days (15.0 %) >28 days (6.0 %)
Junge (2010)	Lower extremity (69.7 %) Head and trunk (20.0 %) Upper extremity (10.3 %)	Knee (15.8 %) Thigh (13.9 %) Ankle (12.1 %)	Contusion (44.2 %) Sprain (19.4 %) Strain (17.6 %) Concussion (4.2 %)	Contact (60.6 %) Non-Contact (34.5 %)	0 days (43.0 %) 1-3 days (26.1 %) 4-7 days (4.2 %) 8-28 days (7.9 %) >28 days (1.2 %)
Ribeiro (2006)	Lower extremity (84.4 %) Head and trunk (12.5 %) Upper extremity (3.1 %)	Ankle (43.8 %) Thigh (28.1 %) Knee (12.5 %)	Contusion (31.3 %) Sprain (28.1 %) Strain (9.4 %)	Contact (65.6 %) Non-Contact (34.4 %)	0 days (65.6 %) 1-7 days (18.8 %) 8-28 days (12.5 %) >28 days (3.1 %)

* in a study by Serrano et al. (2013) and Angoorani et al. (2014), contact injuries refer to injuries caused by a contact with an opponent and non-contact injuries represent all other injuries.

of the injuries in futsal have been shown to be caused by contact situations (up to 65.6 % of all injuries), which is comparable to football (up to 73.0 % of all injuries).42-44,46,48 The most common contact injury was with another player (up to 46 % of all contact injuries).41,43 However, it was also demonstrated that non-contact injuries might reach a significant value in futsal (up to 51.9 % of all injuries).41 This might be an indication of an inadequate preparation of players before an exposure (training or a match).

Regarding the severity of injury, studies have shown that the results are influenced by the study design.[4,40-44,46] In retrospective studies, moderate (8-28 days lost) and severe injuries (>28 days lost) reached higher frequency than minor (0-3 days) or mild injuries (4-7 days lost).[4,41,43] A recall bias might be a possible reason for underestimating light/minimal and mild injuries, because more severe injuries are easier to remember.[42] In one study, the players were asked to refer to 3 main injuries in their futsal career.[4] This fact could also result in players remembering only the most severe injuries which had the highest impact in their career. Prospective studies have shown that most injuries in futsal are mild.[40,42,44,46] In football, higher rates of moderate and severe injuries have been reported.[47]

An injury can be further distinguished, whether it occurs during one specific, identifiable event (acute/trauma injury), or if it is caused by repeated micro-trauma without a single, identifiable event (overuse injury).[49] The reviewed studies show that most injuries were of an acute/traumatic nature with frequency up to 79 % of all injuries.[7,43] Overuse injuries were demonstrated to only contribute up to 26 % of all injuries. However, these injuries are very difficult to determine due to 2 objective reasons; firstly, due to the gradual onset of symptoms resulting in an overuse injury,[7,43] and secondly, because of the definition of injury, which is mostly time loss, and players might often play on with an overuse injury.[50] Significant differences were reported between the rates of overuse injuries based on the method of data collection.50

Injuries can also be classified whether they occurred during a match or training session.[49] Several studies have shown that the frequency of training injuries (up to 63.0 % of all injuries) in futsal is higher than in a match (up to 40.4 % of all injuries).[4,40,41] However,, the number of training hours is usually much higher than match hours.[40] Therefore, although the frequency of training injuries is higher, the incidence of these injuries (1.6 injuries per 1000 player hours) is much lower than the incidence of match injuries (6.3 injuries per 1000 player hours).[40] Similar results have been found in football when comparing the incidence of injuries in a match and training session.[47] Situations of higher competitiveness, commonly associated with the game, might result in a higher risk of injury, which could be a reason for the differences in the injury incidence between a match and training session.

Injury prevention and performance in futsal

Injury-prevention programmes have been shown to significantly reduce the risks of injuries and to enhance the performance of athletes in a range of sports.[13,14,16-18] The 11+ is one such programme that has been found effective and successful at preventing football-related injuries (up to 53.3 % injury reduction).[17,19,51,52] Despite its validated reduction of injury rates among football players, the 11+ was also shown to lose its effectiveness if not performed consistently and regularly.[19,20,22,51,53] Several studies have suggested that the 11+, developed by sport-related medical professionals and researchers, reduced the injury occurrence significantly only if the compliance level was high and the programme was performed more than once a week.[17,19,20,22,51-53]

Although there are several studies focusing on the injury characteristics and injury occurrence in futsal,[4,7,40-46] the implementation and evaluation of any preventive measures in futsal has been poorly investigated. As football and futsal are very similar in the game demands, this review has identified 5 studies that met the inclusion criteria for this review. These studies examined the effectiveness of the 11+ to reduce injury or improve performance in the futsal environment.[54-58] The characteristics of these studies are summarised in Table 5.

The methodological quality of each paper, except 1 study (not an RCT study design),[57]

Table 5: Summary of studies investigating injury-prevention measures in Futsal

Study	Design	Population	Follow-up	Outcome Variables
Lopes (2019)	RCT*	Amateur male futsal players IG[a]: 37 players (age: 27.0±5.1 years) CG[a]: 34 players (age: 26.0±5.1 years)	IG[a]: 10 weeks of the 11+ programme CG[a]: 10 weeks of regular futsal warm-ups	Agility test (T-test) Sprint test (30m sprint) Flexibility test (sit-and-reach test) Vertical jump test (squat jump)
Reis (2013)	RCT*	Adolescent male futsal players (age: 17.3±0.7 years) IG[a]: 18 players CG[a]: 18 players	IG[a]: 12 weeks of the 11+ programme CG[a]: 12 weeks of standard jogging and ball exercises	Isokinetic quadriceps and hamstring strength test (peak torque) Vertical jump test (squat jump) Countermovement jump test Sprint test (5m and 30m sprint) Agility test (T-test) Technical skill test (slalom-dribbling test) Balance test (single-legged flamingo balance test)
Soares (2019)	Prospective cohort study	Youth male futsal players (n = 14, age: 12.6±0.7 years)	18 weeks of the 11+ programme	Isokinetic strength test of knee flexor and extensor muscles (peak torque)
Zein (2014)	RCT*	Youth futsal players playing in high school teams (age: 16.2±0.9 years) IG[a]: 9 players CG[a]: 11 players	IG[a]: 4 weeks of the 11+ programme CG[a]: 4 weeks of routine futsal training	Core strength test (plank test) Vertical jump test (squat jump) Agility test (Illinois agility test)
Lopes (2018)	RCT*	Amateur male futsal players IG[a]: 31 players (age: 27.0±5.1 years) CG[a]: 34 players (age: 26.0±5.1 years)	IG[a]: 2 periods of 10 weeks of the 11+ programme separated by a 10-week period in-between CG[a]: 20 weeks of a combination of running, ball, and dynamic stretching exercises	Injury incidence (number of injuries per 1000 player hours) Warm-up compliance (number of sessions per week) Injury characteristics

* RCT – randomised controlled trial
a IG – intervention group; CG – control group

was assessed using the PEDro rating scale (Table 6), a validated tool to rate the quality of RCTs evaluating some specific intervention.[59] The mean quality score of the reviewed studies was 6.5 ±0.5 (out of 10). All studies satisfied the items of the PEDro scale related to random allocation of subjects, measures of at least 1 key outcome obtained from more than 85 % of the subjects initially allocated to groups, the treatment or control condition received by all subjects as allocated, the results of between-group comparisons being present for at least 1 key outcome, and both point measures and measures of variability for at least 1 key outcome. In addition, all the rated studies assured that groups were similar at baseline regarding important prognostic factors. In 2 studies the allocation of subjects was not concealed, which could result in a selection bias.[56,58] All studies failed to meet criteria for subject blinding, therapist blinding, and assessor blinding.

Four of the studies focused on the influence of the 11+ on players' performance measures,[54,56-58] and one study focused on the effectiveness of the 11+ to reduce the number of injuries in futsal.[55] In the case of the effect of the 11+ on players' performance, studies have found different results in several outcome measures. The study by Lopes et al. (2019) found no short or long-term performance enhancement in sprint (30-m sprint), flexibility (sit-and-reach test), agility (T-Test), and jump (squat jump) in the intervention group after 10 weeks of the 11+ performance (mean number of sessions per week was 1.9 ±0.1).[54] In contrast to this study, the study by Reis et al. (2013) found a significant improvement ($p < 0.05$) in squat jump (13.8%) and countermovement jump (9.9%), 5-m and 30-m sprint (8.9% and 3.3% respectively), agility (4.7%), slalom (4.8%), and balance (smaller number of falls by 30% in the non-dominant leg) performances after twelve weeks of executing the 11+ (mean number of sessions per week was 1.8 ±0.1).56 There were no changes in the control group. Significant improvement ($p < 0.05$) in agility (4.2%) was also found in the study by Zein et al. (2014) compared to the control group.[58] This study also showed an enhancement in core strength (40%) in the intervention group after 4 weeks of performing the 11+ (2 sessions per week). There was no significant improvement found in squat jump. The age of players might be one of the reasons for the differences in the results of studies. In the study by Lopes et al. (2019) the participants were adult male players up to 10 years older than the participants of other studies (Reis et al., 2013; Zein et al., 2014). There may be greater potential for improved movement patterns in younger players, because their basic patterns haven't been completely established, and they can be modified and developed more easily.[19] The duration of the intervention and warm-up routines in the control group might be other influencing factors that caused the differences in results. Unfortunately, studies didn't specify the warm-up routines in the control group in detail.

Table 6: PEDro scores

Study	Scores for PEDro Criteria											PEDro Overall Quality Score (/10)
	1	2	3	4	5	6	7	8	9	10	11	
Lopes (2019)	1	1	1	1	0	0	0	1	1	1	1	7
Reis (2013)	1	1	0	1	0	0	0	1	1	1	1	6
Zein (2014)	1	1	0	1	0	0	0	1	1	1	1	6
Lopes (2018)	1	1	1	1	0	0	0	1	1	1	1	7
Mean score ±SD												6.5 ±0.5

Two studies also analysed the influence of the 11+ on the isokinetic strength of knee flexor (hamstrings, H) and extensor muscles (quadriceps, Q) in the futsal environment.[56,57] Both studies showed a significant improvement in the isokinetic performance of flexors and extensors of the knee and a significant improvement in muscular asymmetries between the dominant and non-dominant limb of players. In a study by Reis et al. (2013), quadriceps concentric (14.7%-27.3%) and hamstrings concentric (9.3%-13.3%) and eccentric (12.7%) peak torque increased significantly ($p < 0.05$) compared to the control group.[56] This study also found an improvement of antagonist/agonist balance around the knee (functional H:Q ratio increased by 1.8%-8.5%). Similar results were shown in the other study.[57] After 18 weeks of the 11+, there was a significant improvement in the isokinetic performance of the knee's extensor and flexor muscles and decreased muscular asymmetries between the limbs of young futsal athletes. However, this study only analysed pre– to post-intervention changes without any control group.

Only one study focused on the effectiveness of the 11+ to reduce the number of injuries in the futsal environment.[55] After 20 weeks (5 months) of the 11+, with average exposure of 1.78 ±0.28 sessions per week, significant differences were found in total number of injuries (44% injury reduction, $p = 0.014$), acute injuries (47.7% injury reduction, $p = 0.007$), lower limb injuries (54% injury reduction, $p = 0.032$), and training injuries (62.1% injury reduction, $p = 0.028$) compared to the control group.[55] While the sample size used in this paper is very small, and thus caution is needed when interpreting the results, the findings suggest that futsal injuries can be reduced using a structured, neuromuscular warm-up programme.

CONCLUSION

Futsal, a five-a-side version of association football, has globally experienced significant growth. Despite some obvious similarities with football, the games have significant differences in physical and physiological demands. Due to the growing population of futsal players and the comparable injury profile to football, injury prevention has become a priority. Although the injury rates and injury characteristics have been shown to be similar to football, this review found significant differences in the rates of concussion and the severity of injuries. The frequency of concussion in futsal (3.9% of all injuries on average) has been shown to be more than 4 times higher than in football 0.9% of all injuries on average). Most injuries in futsal have been found to be mild (0-7 days), which is significantly different from football with most of the injuries being reported as moderate (8-28 days) or severe (>28 days). This review has highlighted a lack of evidence relating to the implementation and validation of injury preventive measures in futsal. There is some evidence the 11+ can improve physical performance in futsal players and one study has shown a benefit in terms of injury reduction. Further research is needed investigating the effectiveness of injury prevention measures implemented in futsal and in particular the possible use of the 11+ in the futsal environment.

ETHICAL APPROVAL

None declared.

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DECLARATION OF INTEREST

One of the authors (Mark Fulcher) is employed by New Zealand Football and is a member of the FIFA Medical Committee.

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ORIGINAL RESEARCH

Futsal FastStart: The development of a futsal-specific warm-up

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ABSTRACT

Aim

To develop a futsal-specific warm-up for recreational futsal players using a focus group approach.

Study Design

Two phases; i) two focus groups with sport medicine professionals, futsal coaches and players, ii) the development of a new, futsal-specific warm-up (Futsal FastStart).

Setting

New Zealand futsal environment.

Participants

Sport medicine professionals, futsal coaches and players.

Main Outcome Measures

The development of a new warm-up for recreational futsal via two focus groups. The concepts of warming up in the futsal environment were evaluated using a thematic analysis.

Results

Six futsal players and coaches, and four sport medicine professionals agreed that a warm-up was important to reduce injuries. The issues of time and space available to warm up were highlighted. Warming up as a team and incorporating a ball was suggested to improve compliance. The 11+, an injury-prevention warm-up used in football, was considered an adequate cornerstone from which to develop a new, futsal-specific warm-up (Futsal FastStart) to target futsal injuries.

Conclusions

Input from key stakeholders enabled the development of a new, futsal-specific warm-up for recreational players. Including futsal players and coaches in the design should enhance delivery and adherence to the warm-up. However, whether this warm-up has any impact on IP has yet to be determined.

Keywords

Futsal, warm-up, injury prevention, 11+

INTRODUCTION

Futsal is a fast-paced, dynamic sport derived from association football, played on hard surfaces in reduced space mostly indoors, and widely played across the world.[1] Due to the comparable injury profile to football and the growing population of futsal players (in 2016, it was estimated that over 60 million people play futsal globally), the issue of safety becomes more important.[2-4] The increased participation and relatively high rate of injury could result in greater morbidity and financial costs for both players and administrators. Although there are several studies focusing on the injury characteristics and injury occurrence in futsal,[2,5-10] the implementation and evaluation of any preventive measures in futsal has been poorly investigated.

Injury-prevention programmes have been shown to significantly reduce the risk of injuries and to enhance the performance of athletes.[11-15] The 11+, a warm-up routine developed by sport medicine professionals and researchers, is one such programme that was found effective in preventing football-related injuries.[16-19] Despite having been well-validated and shown to reduce injury rates among players, the effectiveness of the 11+ was shown to be strongly dependent on the level of compliance with the warm-up.[16,17,19,20,21] Unfortunately, the uptake of the 11+ by players has been shown to be poor outside of the research setting, mainly due to poor, evidence-based, injury-prevention knowledge dissemination among players and coaches, and due to delivery strategies.[22] The issue of compliance is, therefore, one of the key factors in successful injury prevention.

Despite its effectiveness, the use of the 11+ as a common warm-up in the community-based futsal environment may not be realistic. Firstly, the 11+ was developed by sport medicine professionals and sport researchers, rather than by players and coaches. As coaches are considered the most feasible method of reaching community-based athletes,[23] including them in the development of such programmes could lead to improved compliance.[24-26] Secondly, the 11+ was developed for football. It has been shown that if a warm-up did not include enough sport-related activities, the compliance was more likely to be lower.[19] Futsal-specific activities, therefore, must be considered when designing an injury-prevention intervention. Finally, the 11+ was developed to be performed on a football pitch. However, a warm-up needs to be implementable in the sport-related environment.[24] In the case of futsal, the reduced space, less time to perform a warm-up, as well as a harder surface, need to be considered. Thus, the aim of this study was to guide the development of a warm-up for recreational futsal players via two focus groups with coaches, players, as well as sport medicine professionals.

METHODS

This study utilised two focus groups to investigate the current warm-up habits in the New Zealand (NZ) futsal environment and common barriers to warm up in futsal, with a key aim to develop a new warm-up for recreational futsal players. The study was approved by the Auckland University of Technology Ethics Committee (# 18/215).

Participant recruitment

The recruitment of participants was facilitated by New Zealand Football and by Axis Sports Medicine (a FIFA Medical Centre of Excellence). Sport medicine professionals focused on the injury prevention and members of Auckland Football Federation (all futsal coaches and current or former players) were invited via email. Two focus groups were conducted, the first consisting of futsal players and coaches representing all levels of the futsal competitive environment (n = 6), and the second consisting of sport medicine professionals (two sport and exercise physiotherapists and two sport and exercise physicians). All participants were approached via email and those willing to participate were sent more-detailed information about the study and a consent form. Participants signed a consent form on the day of the focus group allowing for all discussions to be audio taped.

Focus group protocol

Both focus groups followed the same protocol (Table 1) with two sections. The first part was focused on a general perception of warm-up in futsal, and then specifically at a recreational level. The second part dealt with the use of 11+ in futsal and the issue of compliance

Table 1: The focus group protocol

Initial set of questions
Do you think a warm-up is a significant/important tool to reduce/prevent injuries? What thoughts and observations do you have about warm-ups in the futsal environment? What are the challenges to warm up at a recreational level?
Second set of questions
What thoughts do you have about the 11+? Is it feasible in the futsal environment? How would you change the 11+ to satisfy the demands of futsal? In your opinion, what could improve the uptake of a warm up in the recreational futsal environment?

Procedure

Both focus groups were conducted by the same moderator, one of co-authors, and lasted no longer than one hour. The primary researcher attended both focus groups and took comprehensive notes. The focus group with futsal players and coaches was conducted in a meeting room at a futsal centre. The focus group with sport medicine professionals was run in a meeting room at one of Axis Sports Medicine's clinics.

The discussion in each focus group commenced with a short introduction and a brief explanation of the session by the moderator. Each participant was given some time to ask any questions regarding the session and to introduce themselves. The first question of the focus group protocol then followed. The first question was designed to be an opening, easy-to-answer question to encourage all the participants to talk and feel comfortable.[27] The participants were always given enough time to discuss each question thoroughly until no more opinions were mentioned. Once there were no other questions to ask, and all opinions were expressed, the moderator thanked the participants and closed the session.

Data analysis

Data analysis was conducted by the primary researcher. Focus group discussions were voice recorded and transcribed verbatim by the researcher to reduce the possible loss of useful pieces of information. Thematic analysis was then used to deductively and inductively identify patterns or themes within the qualitative data.[28,29] In designing this research, there were three overarching areas of interest, which formed the initial deductive themes. These were the perceived importance of a warm-up and the challenges to warm up in futsal; the 11+ in the futsal environment; and the delivery strategies for a warm up. During the initial coding phase, these deductive themes served to guide the search for data of interest. The primary researcher then systematically worked through the data set, using inductive analysis. A 6-phase framework for doing a thematic analysis was used.[30] All data were read and re-read to become familiar with the data and early impressions were documented using notes. Each part of the data that was relevant to any of the questions was then coded into shorter, more meaningful sections. Open coding, i.e. developing and modifying the codes while working through the coding process, was preferred to pre-set codes.[29] The codes were examined to identify the preliminary themes.[28] A preliminary theme represented several codes that fitted together and provided some specific, significant information.[29] These themes were mostly descriptive. Preliminary themes were then associated with all the data that supported it.[28,29] The final themes were defined based on the review of preliminary themes. A new warm-up for recreational futsal (Futsal FastStart) was then developed using all the findings from focus groups.

RESULTS

Thematic analysis, using verbatim transcripts of discussions from both focus groups and comprehensive notes resulted in three key themes. The first theme, The use of a warm-up in the recreational futsal environment, was identified based on participants' perception of a warm-up importance and the barriers to warm up at a recreational level. The second theme, The structure of a futsal-specific warm-up, resulted from the discussion focused on the demands of the futsal game, use of the 11+ and exercises that could be included in a futsal-specific warm-up, and the challenges highlighted in the previous part. The last theme, The issue of compliance, was identified based on participants' ideas on how to improve players' and coaches' buy in to perform a warm-up. Each theme is supported with illustrative quotes to support their interpretation.

Theme 1: The use of a warm-up in the recreational futsal environment

In both focus groups, a warm-up was considered to be very important to prevent and/or reduce injuries by all participants. Evidence-based warm-up routines in particular were considered key to reducing the number of injuries occurring in a sport. However, the participants mentioned the influence of the level of performance. Based on the coaching and playing experience, the higher the level of competition was, the more emphasis was placed on a proper warm-up before a game or training. In the case of the recreational level, participants agreed that a warm-up was not considered important by players and various pre-game routines could be seen.

Sport medicine professional:" … This type of a warm-up [pointing at the 11+] is very important. I am talking about an evidence-based, neuromuscular warm-up…"

Futsal player and coach:" … The most people that perform futsal at a high level rank a warm-up as important, but if you are not at such competitive level, you might not see a warm-up as that important…Therefore, you can see a variety of teams with different warm-ups. A mix of kicking ball at a goal, a few strides there and back, not much more than that…"

Participants in both focus groups agreed that space and the lack of any authority (a manager, a coach) were common barriers to warm up at recreational level. The lack of knowledge about potential risk of injuries and the perception of a futsal game as a social event more than competition were considered to be further barriers to performing a warm-up properly by futsal players at a recreational level. Turning up five minutes before a game was said to be the result of this mind-set of players.

Futsal player:" … The space is an issue. Because of games running on courts, you might not have the whole court available, unless your game is scheduled to be the first that day… Most of the teams at this level *don't have a designated coach or a manager to coordinate a warm-up either..."*

Sport medicine professional:" ... If you asked me to play futsal at this level, I would turn up 5 minutes before a game and be ready to get on to the court... I also wonder if people approach a game of futsal with a low expectation of injury risk....So, definitely, educating them by saying there is the risk of injury you may not be aware of might be helpful..."

Theme 2: The structure of a futsal-specific warm-up

Both focus groups agreed that a futsal-specific warm-up should include some initial movement depending on space available. Initial jogging/running (if space allows) or jumping/skipping were mentioned to increase heart rate and "switch the muscles on". Dynamic stretches were the next elements to be included. Specifically, hip external/internal rotations and high knees/heel flicks were highlighted to activate the full range of motion of joints and to warm up the groin area. To improve functional performance and to satisfy the demands of a game, balance and changing-direction movements were stressed in both focus groups due to a high number of ankle injuries in futsal. Running forward/backward and single-leg movements were considered important by all participants. It was also mentioned that the pace of a warm-up should be gradually increased.

Sport medicine professional:" ... Give them a jog or run to bring the heart rate up. In reduced space, you can incorporate some jumping/skipping, on-spot movements... After that, there should be some dynamic movements, and some that are then replicated on the court... If you tell me, there are many ankle injuries, then single-leg balancing movements are very important..."

Futsal coach:" ... I would start with a few lengths of some running... Then some high knees and heel flicks, opening and closing gates... The balance is very important for futsal, so going side-to-side, I guess, exploding off one foot, all quite relevant to futsal as there are lots of checking, changing directions, and all in high intensities... All team squad also needs to be warm at kick-off, because within three or four minutes the whole team is off and subs need to be ready to sprint..."

All participants were asked about the 11+ and its use in the futsal environment. Regarding part 1 of the 11+ (running exercises), participants highlighted running straight ahead, quick forwards and backwards, and rotations of hips ("hip in/out"). Exercises for core and hamstrings strength (part 2 of the 11+) were mentioned to be often skipped due to time constraints and because they could be painful when performed on a hard surface. Participants also pointed out that jumping and landing was not common in futsal. However, the balance (part 2) and plant and cut movements (part 3) of the 11+ performed in a dynamic way were highlighted by all participants.

Futsal coach:" ... Running forwards/backwards, changing direction...That is game-related... Hamstring and core exercises are usually the ones we skip. They also hurt because of hard surface, so it seems a bit inappropriate for futsal... Jumping and landing is definitely less common in futsal than in football..."

Sport medicine professional:" ... You can use some lunging/squatting pattern to switch on the core... Jumping movements? Definitely less important for futsal...Plant and cut, very important..."

Theme 3: The issue of compliance

To encourage compliance with a warm-up, participants agreed that the programme needed to be shorter than the 11+, performed as a team, and incorporate a ball into a warm-up to engage players and to make it more fun. Five minutes were suggested as a realistic time for recreational futsal players to warm up. It was also suggested that giving players some structured routine to follow and to perform in a short period of time, could improve compliance with a warm-up.

Sport medicine professional:" ... I would probably keep it very short on this level. I think five minutes could be good...And I think people are more likely to do it as a team... Honestly, players might not really know what they could do in a short amount of time and that [a routine to follow] might help them. And that might be enough..."

Futsal player:" ... If we can incorporate a ball with some shots on a goal 30 seconds before kick-off, something like that might be useful..."

Overall, sport medicine professionals came up with an idea to make a warm-up compulsory and part of the game. According to them, this could improve not only the compliance with a warm-up, but also the issue of space available. A referee could be in charge of a warm-up to make sure players are properly prepared for a game and a ball could be incorporated more easily. One participant described it as follows:

Sport medicine professional:" ... You might do it as a part of a game so that if your game is scheduled for 7:30 pm, then at 7:30 pm you start a warm-up. A referee could lead that and you would make it rules of a game... And it would also reduce the challenge of space, because you could use a court..."

In summary the findings from the focus groups indicate several key items thought to be important and meet the requirements for a futsal-specific warm-up for recreational players. A new warm-up should be short (within five minutes), sharp (the pace gradually increased), performed as a team, and incorporate a ball if enough space is available. A futsal-specific warm-up should start with some initial running, followed by dynamic stretches, such as hip in/out, or high knees/heel flicks. Change of direction movements, such as running forward/backward and side to side, and balancing movements (propping and holding, planting and cutting) should be included to simulate game-related tasks. Based on these results, a new, futsal-specific, warm-up for recreational futsal was developed by the research team (Futsal FastStart, Figure 1).

Figure 1: Futsal FastStart warm-up programme developed based on the findings from focus groups.

DISCUSSIONS

The results of the current study indicate that all participants agreed a warm-up is important to reduce injuries. Evidence-based, neuromuscular warm-ups were mentioned to be key tools to prevent injuries. This opinion is in accordance with the results of other studies focusing on the evaluation of such programmes in real-world conditions.[11-15,16,17] The level of competition was identified as an important factor in the perception of warm-up importance and ultimately compliance. The lack of knowledge of the injury risks associated with playing futsal and the ability to prevent injury was found to be a possible reason why players didn't find a warm-up necessary at a recreational level. This is consistent with the results of other studies in a variety of sports.[23,30-32] Therefore, educating players about injury risks playing futsal might be a way to increase players' perception of warm-up importance in a community-based futsal environment.

The effectiveness of any structured, neuromuscular warm-up programme designed to reduce the risk of injuries is strongly dependent on coaches' and players' compliance.[19,21,23] Previous research has shown that the higher the compliance was, the greater the injury reduction.[19,21,33] Other studies have found that the coach, their education and positive attitude towards a warm-up, is a key factor to promote prevention and motivate players to perform a warm-up routine.[19,23,34] The use of the coach was also the most feasible method to deliver injury prevention measures in the community-based environment.[23] The lack of a coach or a manager was mentioned to be very common in the New Zealand futsal recreational environment. Participants also suggested that another reason for not performing a warm-up was the lack of any structured routine for use in futsal. It has been shown that the level of compliance with injury-prevention programmes in sport is strongly dependent on the types of exercises included in a warm-up.[19] If there was a perception of lack of sport-specific exercises, the compliance with a warm-up dropped significantly (by more than 80%).[19] Due to all these challenges, a different implementation strategy and a warm-up consisting of futsal-specific movements could improve players' compliance with a warm-up.[19,26]

Due to some similarities between football and futsal, the 11+ was suggested to be a useful source of exercises for a new, futsal-specific warm-up. However, factors such as the reduced space, less time to perform a warm-up and a harder playing surface, needed to be considered. A new, futsal-specific warm-up (Futsal FastStart) was, therefore, designed to be performed within five minutes, as a team, and using any space available. The warm-up is structured into seven steps starting with the initial running/jogging to increase heart rate. The second step consists of high knees/heel flick exercises, common and popular movements among players, followed by hip external/internal rotations (hip in/out), based on the 11+,35 to activate the full range of hip joint motion and warm up the groin area. The third and fourth step (quick forwards and backwards running, lateral jumps) represent change of direction tasks which are common in the futsal game.[36,37] These movements, adopted from the 11+, also teach proper landing mechanics with a correct leg alignment (knee over toe position) and improve balance and coordination. Participants also considered these exercises very important due to a high number of ankle injuries in futsal and due to the demands of game.[2,5,7-9] The fifth step involves squats with calf raises to activate core muscles and strengthen the lower extremity muscles. Participants reported that the 11+ exercises enhancing core (the static bench, sideways bench) and hamstrings strength (the Nordic hamstring exercise) were often skipped due to time constraints and the pain when done on a hard surface. It has also been shown that hamstring injuries are less common in futsal compared to football. The results of some studies showed that hamstring injuries constituted around 6% of all futsal injuries,[7] compared to about 12% of all injuries in football.[38] The sixth step consists of a planting and cutting movement adopted from the 11+, which was highlighted as a game-related task. The main goal is to prepare players for sudden changes of direction and increase the intensity. The last step should be performed on the court involving some sprints with a sudden change of direction, and some passing and shooting drills to replicate the following futsal activity.

The importance of undertaking a focus group approach when designing a programme was deemed important in this study so that a programme that engaged players and coaches from the start that they gained ownership of should improve future compliance.

Limitations and future directions

To our knowledge, this is the first study to draw upon the perspectives of players, coaches and sport medicine professionals to inform the development of a warm-up. There are limitations that should be considered when interpreting the results. Firstly, the number of participants was small. Secondly, the focus groups were conducted only once without any follow-up to discuss or review the programme that was developed. Future studies could, therefore, include a broader spectrum of participants to provide more generalisable findings and they could involve follow-up sessions to provide even deeper insight into the issue of a warm-up.

CONCLUSION

When designing a structured warm-up routine in recreational futsal, participants made three key suggestions. Firstly, the warm-up should be short, three to five minutes, and sharp to reproduce the intensity of game. Secondly, the warm-up should consist of futsal-specific movements and should ideally performed as a team rather than individually. And thirdly, a warm-up should incorporate a ball to engage players and to make it more fun. Based on these findings, a new, futsal-specific warm-up for futsal players at a recreational level has been developed (Futsal FastStart). Future research should be focused on the effectiveness of the programme to reduce the risk of injuries using a longitudinal study in the futsal community-based environment.

ETHICAL APPROVAL

Ethics approval was granted by the Auckland University of Technology Ethics Committee (reference number 18/215).

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DECLARATION OF INTEREST

One of the authors (Mark Fulcher) is employed by New Zealand Football and is a member of the FIFA Medical Committee.

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First Aid in Rugby (FAIR) Training: The Otago Experience

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ABSTRACT

Aim

This study examined the self-reported perceptions of physiotherapy students who completed the First Aid in Rugby (FAIR) course which included additional Physiotherapy content. The aim was to determine whether the students felt this course adequately prepared them for volunteer work as Rugby Medics with community rugby teams. The secondary purpose was to document the skills they utilised and scenarios they encountered.

Study Design

A cross-sectional web-based survey.

Setting

University of Otago and the Dunedin (New Zealand) community rugby environment.

Participants

Physiotherapy students who completed the Level 1 FAIR course prior to the 2019 rugby (winter) season.

Interventions

FAIR course delivered by New Zealand Rugby together with supplementary ethics, massage and strapping content taught by the University of Otago, School of Physiotherapy.

Results

Overall, 72 participants completed the survey, of these 36 volunteered a total of 1847 hours as Rugby Medics for community rugby teams in the Dunedin (New Zealand) region. The Rugby Medics reported they were mostly involved with; offering advice for self-management of injuries, communications and applying prophylactic strapping. The majority (27/36, 71%) of participants believed the FAIR course gave them an "Excellent" or "Good" preparation for their Rugby Medic duties.

Conclusion

This survey provides an initial insight into how the FAIR course prepared the participants to volunteer within the Dunedin rugby community. However, there were areas identified which should be considered for inclusion in the FAIR course to benefit future Rugby Medics.

Key Words

Rugby Union, First Aid in Rugby (FAIR), Player welfare, Sport/Rugby Medic, Physiotherapy.

INTRODUCTION

Rugby Union (typically referred to as Rugby) is a full contact collision team sport, played by over 8.5 million people in 121 countries worldwide.[28] Due to the relatively high risk of injury, World Rugby, the sport's international governing body, has developed policies and programmes that encompass a strong focus on player safety and welfare.[26] These cover both the professional and community (amateur) sectors of the game.

One such recent initiative developed by World Rugby is the First Aid in Rugby (FAIR) coursed designed to enhance immediate treatment of injuries in both professional and community rugby. At its introductory level the FAIR course provides community volunteers with the skills to manage injuries specific in grassroots Rugby and has been taught in 81 countries around the world.[27] The FAIR course has three levels. Level 1 includes principles of first aid tailored towards rugby associated musculoskeletal injuries, shock, circulation and concussion.[21] The course consists of approximately eight hours of online theory content prior to an eight hour practical skills workshop, thereafter, gaining a World Rugby FAIR qualification.[20] Levels 2 and 3 are directed towards allied health care professionals (e.g. Physiotherapists) providing them with advanced first aid training relevant to rugby.[8,27]

In Aotearoa/New Zealand (NZ), community rugby is played by over 177,000 persons.[12] New Zealand Rugby (NZR) has a long established commitment to reducing the risk of injury, improving player welfare and making the game safer at the community level via its pioneering and internationally recognised RugbySmart programme.[13,18] RugbySmart has its origins in the early 2000s when NZR combined with NZ's public injury insurance provider, the Accident Compensation Corporation (ACC) to develop an injury prevention and education programme directed at rugby coaches and referees.[18] This world leading initiative,[14] contributed to the development of injury prevention and education programmes elsewhere, such as the BokSmart programme in South Africa.[16,19] More recently the RugbySmart programme has expanded to include a range of initiatives aimed at enhancing the rugby playing experience and minimising injury. These include advice and training around; fair play, tackling techniques, strength and conditioning, nutrition and first aid.[13] With the development of the FAIR course by World Rugby, it was only logical that NZR would incorporate the delivery of this course within its RugbySmart portfolio of activities with the aspirational goal of having a FAIR trained Medic at each game.[22]

The university city of Dunedin (Otago, New Zealand) has a strong history of sports medicine activities and is considered by some as the birthplace of Sports Medicine in NZ, with the establishment of Sports Medicine New Zealand (SMNZ) in 1963.[23] One of the many initiatives was the development of a Sports Medic Course (SMC) in 1989, with input from Sports Medicine Australia, Sports Medicine Council of British Columbia and the United Kingdom National Coaching Federation.[2] Realignment of the SMC within the Accident Compensation Corporation (ACC) SportSmart programme in 2008,[1] and further restructure in 2014 lead to the SMC version as it is taught today.[2]

The SMC was made available to the general public in Dunedin and occasionally elsewhere in NZ. Previously, the course has been offered by SMNZ to Physiotherapy students at the University of Otago as an extracurricular activity at the beginning of their degree, facilitated and supplemented with content provided by the School of Physiotherapy (SOP). The qualification provided a unique opportunity for students to volunteer as Medics supporting community sports teams and events across sports codes in and around Dunedin. Typically they provided prophylactic strapping (also known as taping), massage, acute injury recognition and management, and referral to medical professionals when necessary.[24] Some Medics also volunteer at the Otago Sports Injury Clinic (OSIC), which is staffed by local doctors and physiotherapists and provides an important injury prevention and treatment service to the wider Dunedin sporting community.[15]

In 2019, the FAIR course taught by NZR trained facilitators with supplementary ethics, massage and strapping content provided by staff from the SOP was delivered to students enrolled in the Bachelor of Physiotherapy degree. Following the FAIR course, the graduates could choose to volunteer and contribute to the established Otago sports environment by working with community rugby teams and/or other sports codes. The inaugural offering of this course in collaboration with the SOP provided an ideal opportunity to gain an understanding of how the FAIR graduates use their skills, particularly when working with rugby teams. Despite its international delivery, searches of the published literature located no studies which have examined the FAIR course and how it prepares its graduates for real world scenarios. Thus, the purpose of this study was to:

1. Determine how well the FAIR course, together with supplementary content, prepared the Medics for their pitch-side requirements.
2. Document the role and explore the situations and activities the FAIR trained Medics encountered while working as volunteers with community rugby teams.

METHODS

Study Design

A cross-sectional web-based survey was used to gather quantitative and qualitative data. The study was designed with reference where appropriate to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).[9]

Ethics

Procedures for the study were approved by the University of Otago Human Ethics Committee (D19/228). A project information sheet was embedded at the beginning of the survey informing participants of the purpose of the research and their right to withdraw from the study at any stage. Acknowledging this and entering the survey represented their consent to participate anonymously.

Participants

The participants considered for inclusion in the study were second and third-year students from the University of Otago SOP who had completed the Level 1 FAIR course at the start (February/March) of the 2019 academic year. Physiotherapy students who completed the FAIR course at alternate times were excluded from the study. The sampling frame consisted of 108 participants.

Questionnaire design and development

The custom-designed questionnaire was developed specifically for the aims of this project and included sections on; demographic details, volunteer destinations (codes and teams), hours volunteered, the activities engaged in and experiences reported by the participants in their role as a sport medic, and how the FAIR course and supplementary content prepared them for real-life rugby situations they encountered.

Questions were sourced from; the NZ census, a previously conducted survey designed to profile the sports medics and their activities,[24] and input from experts with a background in rugby and survey design. The survey was comprised of closed (e.g. dichotomous responses required) and open-ended questions where participants provided information regarding a practice scenario, and Likert-like scales. Basic demographic information and the type of volunteer Medic work they had engaged in were collected in the first section of the survey, while the second section focused solely on participants who worked with rugby teams (Rugby Medics) in the wider Dunedin community.

To enhance the face validity of the questionnaire draft versions were circulated for comment by representatives from NZR and the Otago Rugby Football Union (ORFU). The survey was designed to be completed in approximately 15 minutes or less. This timeframe was confirmed during pilot testing by Physiotherapy students who have completed previous Medic training but were not eligible to participate in this study. These students also proofread and confirmed that the language used was appropriate for the age group and setting.

The data in this study were collected via Qualtrics, an online survey software package (Qualtrics, Provo, UT).

Recruitment of participants

Students were invited to participate via; email, announcements on Blackboard (an electronic teaching platform), an education related student-run social media forum and verbal invitations prior to lectures and laboratories. Reminders were sent at days seven and ten following the survey launch.[7] The survey remained open for a period of 12 days beginning on 5 August 2019.

All participants who completed the survey were eligible to go into the draw, conducted by a third party, to win one of a number of prizes donated by NZR.

Procedures

The information email to the participants contained a link to the Qualtrics survey website. Upon entering the site, participants were required to enter their student identification number and acknowledge their reading of the information sheet, thereby giving consent. Participants were given the opportunity to change their answers at any point prior to exiting the survey. They could skip questions and come back at a later time. For some questions, participants could provide more than one response.

All participants completed the first part of the survey, while only those working with rugby teams, hereafter designated as Rugby Medics, continued on to the second part which specifically addressed questions relating to their volunteer Medic activities with community rugby teams.

Data analysis

All data were downloaded, de-identified and screened for outliers by a research assistant. Descriptive statistics (e.g. mean, frequencies and percentages) appropriate to the data type were calculated using Statistical Package for Social Sciences (SPSS v.19.0; IBM SPSS Inc, Chicago, IL).

Data were grouped for analysis according to whether the participant worked with a rugby team, another sport and/or volunteered at the OSIC. Thematic analysis was conducted following the process outlined by Braun et al.[6] Participant responses were grouped into common themes and sub-themes based on their content by two members of the research team (SY, SO) both of whom are SMC trained Medics. The thematic coding process was reviewed and where necessary, moderated by an experienced FAIR trained Physiotherapy student (TH). In analysing the data, verbatim quotes were also extracted to illustrate the developed themes and presented by participant number (e.g., P01).

RESULTS

Of the 108 FAIR graduates who were eligible to participate in the study, 78 participants began the survey and 72 completed the survey by providing eligible data. This resulted in a sampling rate of 72.2% (78/108) and a retention rate of 92.3% (72/78). Of the 72 participants (Medics) who completed the survey, 44 volunteered as a Medic for a sports team. The majority (n=36) worked with rugby teams with the other 8 working as sports medics for other codes as follows; Basketball (1), Football (1), Hockey (1), Netball (1), or at the OSIC (5), during the 2019 winter sports season (one participant volunteered in two areas). Not all participants answered every question and for some questions participants could provide multiple responses. The demographic characteristics of the participants are presented in Table 1. Eleven participants had previous first aid training in addition to the prerequisite first aid course that is compulsory for students studying Physiotherapy. Six participants had previously completed the SMC, provided by SMNZ. The majority of participants were female and of NZ European ethnicity.

The 44 Medics who worked with sports teams and at the OSIC volunteered a total of 2193 hours to the Dunedin sporting community, with the Rugby Medics (n=36) volunteering 1847 of these hours during the 2019 rugby season (approximately 20 weeks, although many Medics worked considerably less). On average, the Rugby Medics volunteered 4.5 hours (range 2-8 hours) including travel time per week. In general, these Rugby Medics attended one game and up to two trainings per week. They worked with a range of men's and women's rugby teams from high school first XV to the premier club level (highest competition in community rugby). The majority, 86.1% of the Rugby Medics (n=31/36) worked alongside another Rugby Medic (n = 14) or similarly trained person (n = 17). Participants also reported working with a registered Physiotherapist at games (n = 8) and at training sessions (n = 18).

Table 1: Descriptive characteristics for all Medics

Variable	All Medics		Rugby Medics	
	(*n* = 72)		(*n* = 36)	
Sex (*n*, %)				
Male	17	23.6%	6	16.7%
Female	55	76.4%	30	83.3%
Age in years, mean (SD)	20.8 (2.4)		20.7 (2.0)	
Ethnicity (*n*, %)				
New Zealand European	59	81.9%	31	86.1%
Māori	5	6.9%	3	8.3%
Samoan	2	2.8%	1	2.8%
Chinese	2	2.8%		
Other*	4	5.6%	1	2.8%
Previous First Aid Experience (n, %) **				
Yes	11	15.3%	8	22.2%
No	61	84.7%	28	77.8%

** European (1), Hong Kongese (1), Indian (1), Nepalese (1).*

***Sports Medic Course (8), Lifeguard and Surf lifesaving (2), NZ Army first aid (1), Pre-hospital emergency care (1).*

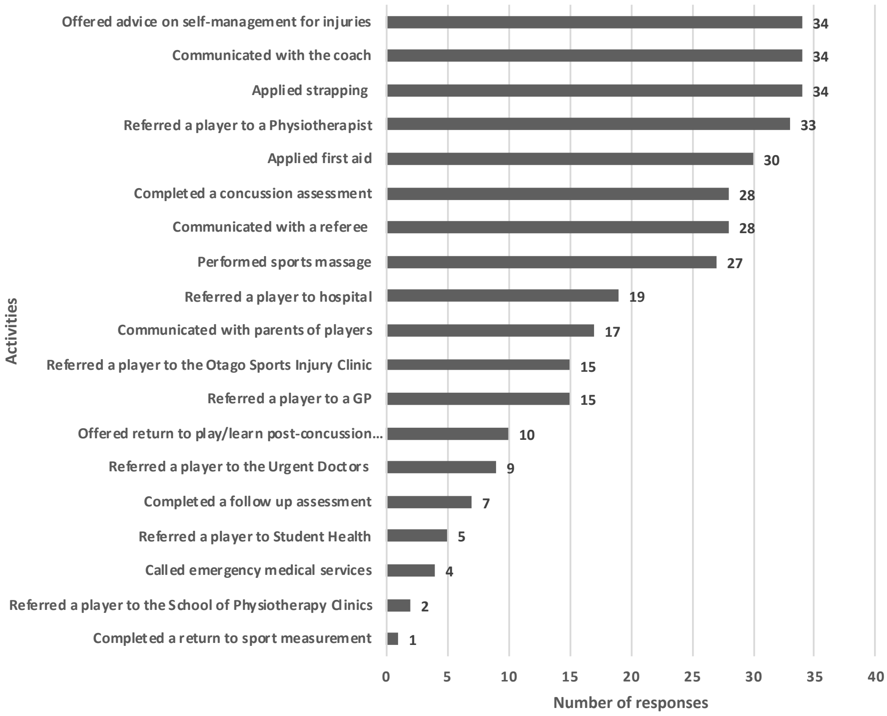

Figure 1: Activities reported by Medics (n=36) working with community rugby teams.

When asked "What activities did you perform in your role as a Medic?" The Medics provided 353 responses to the 19 listed activities and one Medic noted an additional activity. The three most reported activities (34/36, 94.4%) were; "offered advice for self-management of injuries", "communicated with the coach", and "applied strapping" (Fig.1). These were closely followed by the category "apply first aid" (30/36, 83.3%). There were 49 reports (49/353, 13.8%) of Medics referring players to a medical professional or service and 50 responses (50/353, 14.2%) of referring players to a Physiotherapist or Physiotherapy practice following injury. It should be noted that four medics called the emergency services.

The majority (27/36, 71%) of Rugby Medics believed the FAIR course gave them an "Excellent" or "Good" preparation for their medical duties work with rugby teams (Fig.2). This was somewhat higher than the level reported for participants working with other sports teams or at the OSIC. The reported

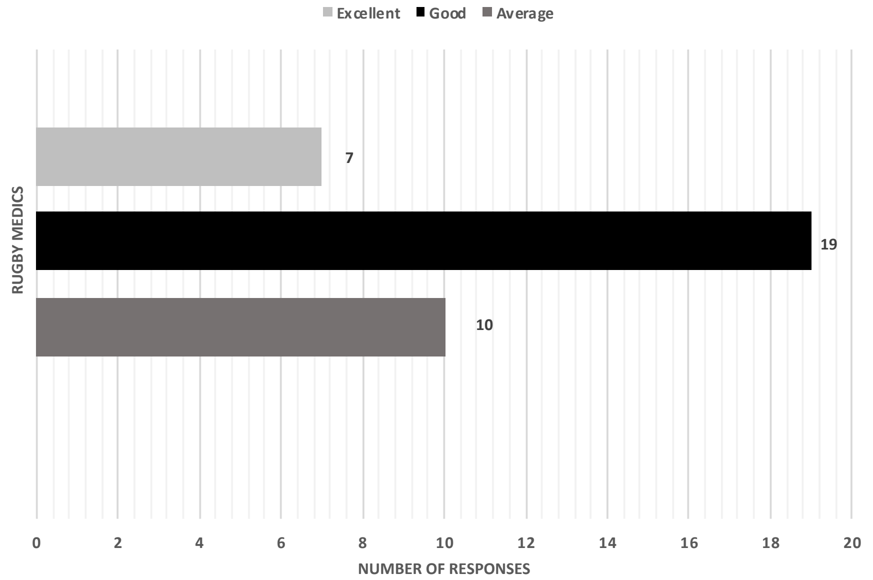

Figure 2: How the FAIR course prepared Rugby Medics for working with teams.

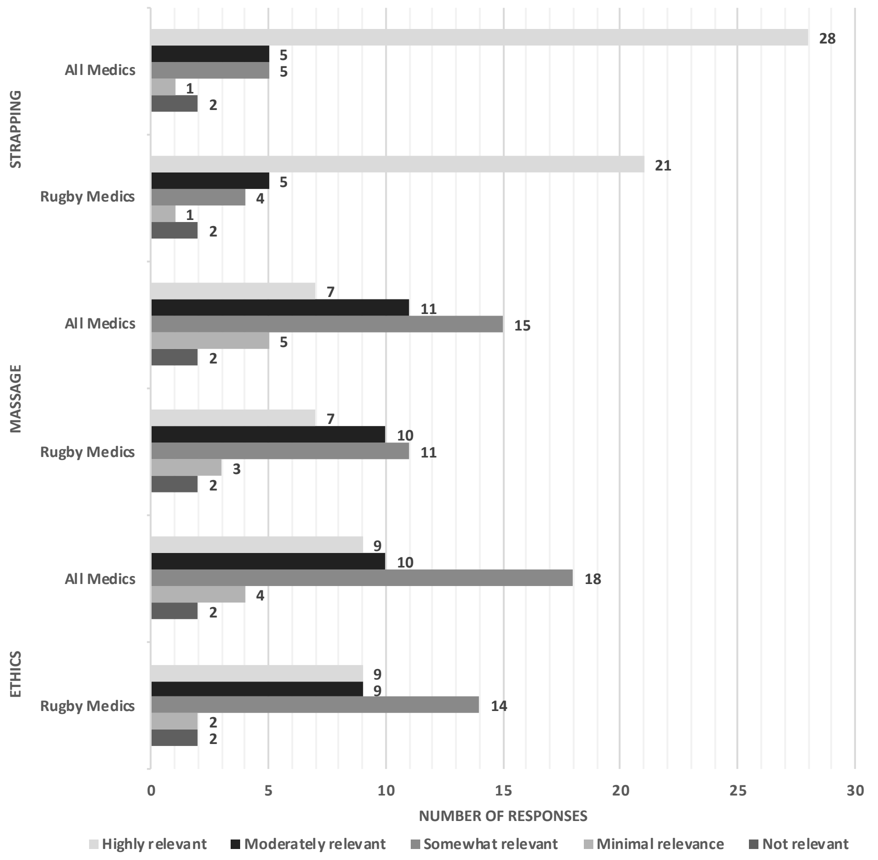

Figure 3: Relevance of supplementary content taught by the University of Otago, School of Physiotherapy.
*Note: Not all respondents answered every question.

relevance of supplementary content (ethics, massage and strapping) taught as part of their Physiotherapy curriculum is shown in Figure 3. Strapping was considered the most relevant topic that was taught outside of the FAIR course for all Medics.

Rugby Medics reported a range of challenging situations that they encountered during the course of their volunteer work with teams. Analysis of these responses identified two main themes; Personal Challenges and Practical Challenges (table 2). The most common Personal subthemes included; concussion management, decision making and lack of support systems for Rugby Medics. Physical Challenges included; dislocated joints, broken bones, and the diagnosis and management of soft tissue injuries. Most Rugby Medics (27/30, 90%) agreed that the FAIR course sufficiently prepared them for these situations. The remaining three believed that they were not prepared to apply strapping, make decisions about injuries and players and believed that they learnt most of their role on the field.

The majority of Rugby Medics (>88%) felt that they were "treated with respect" at all times by the various stakeholders (players, coaches, referees, parents, supporters and health professionals) and overall felt their work "was appreciated most of the time" (27/34, 79.4%) by these individuals. The Rugby Medics were unanimous (34/34, 100%) in their response that their experience volunteering contributed to their studies in Physiotherapy. Nearly all Rugby Medics (33/34, 97.1%), agreed with the statement that "wearing a bib or other form of uniform to identify them as a Rugby Medic would have enhanced their role or authority".

DISCUSSION

To the best of our knowledge this is the first study to document what FAIR trained Medics actually do when attending a game and/or training and how well the course prepared them for this engagement. The FAIR course (level 1) was designed to educate non-medically trained persons around the basic first aid skills needed to support injured rugby players, which was one of the most frequently reported activities in this survey, together with referrals to Doctors, medical clinics and Physiotherapists. These Rugby Medics performed an array of activities similar to those previously reported by Stevenson in her survey of Sports Medics working with a variety of sports in the same Otago community sport's environment.[24] The findings of Stevenson's unpublished study reported that strapping, massage and communication with coaches were the most frequently engaged in activities, aligning well with the findings of this study (Fig.1). Although prophylactic strapping is not a core element of the FAIR course, it is a fundamental expectation of many rugby players both for preventing injury and re-injury. Therefore, the SOP provided a strapping workshop to supplement the FAIR course so that the Rugby Medics could meet this expectation. While the evidence for the physiological benefits of prophylactic strapping are not compelling, the psychological effects are highly cited in literature,[3,4,10] as are player expectations. A similar case may be made for the reported

Table 2: Coded thematic analysis of experiences reported by Rugby Medics

Themes identified	*Subthemes
Personal Challenges	Decision Making
*"Working alone… making decisions based on limited knowledge, limited time and no consultant". P47***	Ill-equipped for Pitch Side Situations
	Concussion Management
	Responsibility of Player Welfare
	In-Experience
	Lack of Support Systems
Practical Challenges	Prophylactic Strapping Training
*"One game there were a few serious injuries, a guy dislocated his knee early on in training… (another player) fractured his tibia…and another guy had his teeth broken". P33***	Dislocations and Fracture Management
	Soft Tissue Injury Management
	Wound Care
	Spinal Injury Identification

**In order of most commonly provided experiences.*

*** Participant numbers i.e. participant number 33 or 47*

benefits of sports related massage with respect to recovery.[17]

All Rugby Medics felt that the FAIR course adequately prepared them for their duties as Medics working with community rugby teams. However, participants who volunteered at the OSIC and other sporting teams felt less prepared by the FAIR course. This was understandable due to the content of the course being tailored towards rugby. Although, basic first aid requirements would be consistent for Medics across other sports.

Narratives offered by participants to open-ended questions about situations they found challenging provide insight into activities they encountered. In many instances, they are related to "soft" skills as represented in the Personal Challenges theme, which are not the focus of the course but are addressed within the training. One area which was highlighted was the need to make important decisions, often while under stress. Such a situation can be challenging and sometimes overwhelming to a beginner Rugby Medic as illustrated below:

"A player received a serious neck injury in a tackle and was incapacitated. I was the only sports medic on the field (and was my 2nd game as a Medic) trying to deal with the casualty, as well as other players and supporters". P61

"Working alone… making decisions based on limited knowledge, limited time and no consultant". P47

"There was no Physiotherapist or Doctor present… the team, coach and manager expected us to know what was wrong with each injury…". P44

In addition to these personal accounts, four Rugby Medics indicated that they had called emergency services. This is an important decision to make and illustrates they are working within their scope of practice for the best interest of the player's welfare. This action illustrates the message given to Medics that "a charged cell phone is a Medic's best friend" (Gallagher, 2018, personal communication), with reference to dealing with challenging emergency situations beyond their training.

Rugby Medics are also required to communicate with an array of rugby related stakeholders (including coaches) which can sometimes be a difficult and daunting task to a young, (average age of 20.7 years) inexperienced Medic. Furthermore, most Rugby Medics were female which aligns with the SOP class roll and the majority volunteered with a men's rugby team. This was revealed to have created communication boundaries between the sexes:

"… being a girl working with a male rugby team meant that it was difficult to work with the team compared to my male friends…". P28

Scenarios were also shared about when communication with players and referees became difficult:

"…dealing with aggravated players who don't want to come off due to a concussion". P63

"…when you run on to an injured player and the referee doesn't stop the game". P65

" …(I) lacked support from the referee in disallowing the (concussed) players to return to the field of play…". P12

These aspects of their role are difficult to teach and are commonly developed with time and experience. Therefore, the presence of an experienced Rugby Medic or similarly trained person, as noted in a number of instances, would be beneficial through their provision of guidance and support. The need for supervision to enhance the clinical effectiveness of communication training programmes has been noted with respect to nursing students in England.[11] It may be appropriate for the developers of the FAIR course to formally incorporate instruction including tips and scenarios about how to address interactions and conflict surrounding players, coaches and officials. This is an area both our participants and undergraduate athletic trainers in the United States of America found difficult.[25] With the FAIR course being made available to the general public it is important that they are well equipped and confident in this aspect of their role. The wearing of an identifiable Rugby Medic uniform may also command greater authority and respect from these stakeholders, akin to a referee's uniform.[5]

Many interactions were noted as memorable and positive experiences by the Rugby Medics, shedding light on how they were appreciated and welcomed within the Otago rugby community:

"(I was) always being thanked at the end of each game by the coaches, manager, team captain and the players". P13

"… they were so grateful for what we do and couldn't thank us enough…". P41

"Our team manager thanked us at least three times a game… The players treated us with heaps of respect and were always polite". P27

Rugby Medics volunteered a considerable amount of time (approximately 56 hours each over the 2019 rugby season), to improve the game's safety and player welfare. These results are similar to those reported by Stevenson for Sports Medics working with teams and clinics in the same Otago environment.[24] This commitment is in addition to their full-time university studies as a future health professional. It is of note that many persons who completed the FAIR course did not go on to work with rugby (or other) teams. The reasons for this are diverse and speculative but may be due to; time constraints, demands of study, part-time work pressures or they simply decided it was not for them. However, some did indicate that they would volunteer in the future. Regardless of whether they volunteered as Medics, the course extended the first aid knowledge of the Physiotherapy students. Furthermore, skills developed as a result of taking the FAIR course and working as a volunteer Medic collectively contributed to their Physiotherapy studies.

Learnings and recommendations from the Otago experience

Based on the results of this study and taking into account; the expectations of the Dunedin community rugby environments, and the partnership with a tertiary education provider (University of Otago, SOP), there are a number of points which should be noted by the FAIR course developers and NZR. These learnings and recommendations are offered as a way of better equipping and growing the number of FAIR graduates attending community rugby games across the country and thus helping to make the game safer and enhance player welfare. It is suggested that the following points be considered to enhance the Rugby Medic experience and service:

- Adding training in prophylactic strapping to the Level 1 FAIR course.
- Enhancing the training in basic communication skills and conflict resolution.
- Providing additional education on professional boundaries and interactions with stakeholders.
- Look for ways to heighten the Rugby Medic's authority when they indicate the game should be stopped and/or a player removed.
- Work with tertiary education providers and Provincial Unions to offer the FAIR course to students and to support their placement with teams.
- Acknowledge and promote the volunteer role of Rugby Medics within the rugby community.

Strengths and limitations

This is the first study to document the self-reported Rugby Medic activities of graduates of the FAIR course and the scenarios they encountered when attending games and trainings. The survey questionnaire contained a mixture of question types and also allowed participants to share their stories, thus providing supporting insight to the structured questions. The questionnaire was reviewed by persons familiar with the rugby community and the FAIR course, thereby, improving its content validity.

Whilst there was a high response rate to the survey, the sample was from a single specific location and educational background. Responses were likely influenced by the historical role of Sports Medic and expectations of players within the community rugby environment. The training in prophylactic strapping and sport-related massage, which is external to the FAIR curriculum does not permit inferences to be directly made about the relevance of the FAIR training to pitch side scenarios. Thus, the data may not be representative of what FAIR graduates recruited from the wider rugby community do when attending rugby games or trainings elsewhere in New Zealand, or beyond.

CONCLUSION

This survey provided an initial insight into how the FAIR course prepared physiotherapy students within the Dunedin, Otago region. The FAIR course was effective in training Medics to volunteer with community rugby teams. However, there are areas identified which should be considered for inclusion in the FAIR course to benefit, equip and empower future Rugby Medics. The provision of a uniform item was deemed desirable to help identify Rugby Medics and support their role to ensure player welfare at the community level.

CONFLICT OF INTEREST

Two of the authors (Sophie Oldershaw and Steph Young) were trained as Sports Medics, and one author (Tobias Hoeta) has both Sports Medic Course and FAIR Level 1 qualifications. Dr. Salmon is employed by New Zealand Rugby. Dr. Sullivan is a member of the NZR Research Advisory Panel.

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ORIGINAL RESEARCH

Pasifika Rugby and Physiotherapy: An exploration of physiotherapy and sport and exercise across Moananui

CHARLEEN SILCOCK, S JOHN SULLIVAN

ABSTRACT

Aim

To investigate if national, elite and age-grade rugby teams in Pacific rugby playing nations (Oceania Rugby) are supported by Physiotherapists and/or other sports and exercise medicine (SEM) professionals.

Study Design

Cross-sectional systematic website search with content analysis aligned with the Otago University's Pacific research protocols.

Methods

Fourteen Pacific rugby unions, as identified by Oceania Rugby's governing body, were included. The study employed a web-based search of the grey literature. Sources of information included blogs, news articles, Oceania Rugby and World Rugby websites, Facebook pages and websites of Pacific rugby playing unions. Data was extracted using a systematic methodology exploring the websites and Facebook pages available for each union. Data was collected between 24 July 2019 and 11 August 2019, and periodically monitored up until 1 September 2019.

Results

Of the 14 Unions included in the study, only five had independent websites. Thirteen Unions had an active and current Facebook page. Only three websites had information regarding Physiotherapists or SEM professionals for teams; although this information was also found for nine countries across 27 teams via news articles and, predominantly, Facebook. No qualifications were reported for any Physiotherapists or SEM professionals attached to these teams.

Conclusions

There is a need for Physiotherapists and SEM professionals to advocate for inclusion of their profiles in the public arena, to illustrate the integral role they play in support of player welfare within Pacific rugby teams. The presence of active and current websites for Pacific rugby unions should be encouraged, allowing for easier information sharing and promotion of these professions.

Keywords

Rugby union, Sports Physiotherapy, Pacific Rugby, Sports and Exercise Medicine, Player welfare

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INTRODUCTION

From its beginnings, the sport of Rugby (Rugby Union) has experienced tremendous growth. Currently, more than eight million people (men and women) worldwide participate in various versions of the game including: 15 a-side, Sevens, and age grade competitions.[24] Rugby, like religion, was introduced to the Pacific Islands through British Colonisation in the late 1800s. From there it continued to develop from its local (e.g., village) roots to the first recorded international match between Fiji and Samoa being played in Apia in 1924.[5,6] Fiji subsequently went on to be undefeated in a 1939 tour of New Zealand.[12]

For administrative purposes, World Rugby (WR),[28] the governing body of international rugby, and responsible for growing the game globally, divides the world's playing nations into six regional associations. Oceania Rugby (OR)[13] represents the Pacific countries of: American Samoa, Australia, Cook Islands, Fiji, Nauru, New Caledonia, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Tahiti, Tonga, Tuvalu, Vanuatu and Wallis & Futuna. Today, more than 1.1 million players from the Oceania region are playing the game.[24] These playing numbers are dominated by Australia and New Zealand, which are designated as being Tier 1 nations for the purposes of international classification. Samoa, Fiji and Tonga are described as Tier 2 nations, while American Samoa, Niue, Cook Islands, Papua New Guinea, Solomon Islands, Tahiti and Vanuatu are within Tier 3. The remaining countries, collectively often known as the "Pacific Nations", encounter serious challenges to their success and ability to compete on the international stage. These challenges include player numbers, sponsorship, resources and facilities, travel costs and player drain.[6,21]

Eligibility rule changes state that players may only represent one country for men's 15 a-side rugby at international level, whereas previously a stand-down period allowed more than a single representation.[10,27] Therefore, Pacific countries are competing for the services of their Pacific players for their national teams against the likes of New Zealand and Australia, thereby decreasing the pool from which Pacific nations can select and produce national rugby representatives.[8,10,15]

It is not hard to see why Pacific players have been highly successful in Rugby, as it is considered an integral part of the culture and nationhood of many Pacific countries. Historically, games have been played between villages and outer islands, contributing to the sense of unity and pride,[20] and are still an important part of social activities within communities and schools, played when and wherever possible.[4] The natural talent, athleticism and physicality,[9] along with the rise of professionalism in rugby, has brought about new avenues and opportunities for Pacific players. With the ability to be able to provide for their families, who remain at "home" in the islands, professional rugby has become a pathway for both financial income and educational gains.[10] This has led to an increase in the number of Pacific players joining the professional game in Australia, Europe, Japan, New Zealand, and the United Kingdom.[11,12,14,15]

With the establishment of professional rugby in 1995, it is important that Pacific nations have the support structures in place to promote and enable player development and welfare, and team success both within Oceania and beyond. Such support includes training facilities, coaching expertise, and sport and exercise medicine (SEM) support. Rugby is an intensely physical sport with high incidence rate of match injuries in both the amateur and professional game.[16,29] This has also been shown to be higher in Pacific Island players at an amateur level.[3] Thus, the availability and accessibility of SEM professionals (including Physiotherapists) is an important aspect of both supporting players and in advancing the game.[18]

The importance of providing SEM support is well recognised by World Rugby, as the organisation is committed to promoting player welfare via its various programmes and strategies. A critical component of this involves specialised rugby-related education programmes/courses developed for health professionals (and community volunteers) who collectively work to provide a range of support services to players. These are aimed at: improving the side-line management of concussion, and reducing and managing injuries and trauma at all levels of the game.[25]

Physiotherapists play an important role in the management and prevention of injuries in rugby.[17] They are often the first port of call for players during trainings and on the side-line on game day, and play a key role in the performance and rehabilitation of the player. Despite the important role physiotherapists and other SEM professionals play in supporting the health and training needs of players, some nations in the Pacific may not have access to, or the funds to access, these key resources/services. Thus, it is challenging for them to compete and deliver the levels of support expected and provided in other countries. Furthermore, we do not know the extent to which Pacific teams are supported by Physiotherapists and other SEM professionals. Therefore, the primary purpose of this study was: to investigate if national, elite and age grade rugby teams in Pacific nations (Oceania rugby) are supported by physiotherapists. In addition, the study will collaterally explore the support offered by other SEM professionals. The study will adapt a methodology previously used to investigate the visible presence of SEM professionals in NZ rugby.[7] As the location of this information is expected to be diverse, based on pilot work, a systematic search of the grey literature[2] will form the basis of the search strategy.

METHODOLOGY

Study design

Cross-sectional systematic website search with content analysis framed within the Otago University's Pacific research protocols.[19]

A preliminary scoping exercise indicated that there was most probably rather limited and dispersed information available on this topic. Thus, in order to capture as much information as possible the study used a multi-faceted search methodology, based in part on methods previously used in studies which sought comparable information, but adapted to the specific need of this study.[2,7]

Ethics

This study sought and utilised information that was widely accessible in the public space and therefore formal ethics approval was not required.

Determination of sample

Pacific rugby playing countries were the focus of this study. In order to establish a sampling frame, the website of World Rugby,[28] the governing body for the sport, was visited (18 July 2019). Of the six regional administrative groupings identified, the Oceania administrative region encompassed the cluster of Pacific rugby playing countries (unions) of interest. Australia and New Zealand are included within this grouping but were excluded from the analysis in order to provide a focused snapshot of what is generally considered to be "Pacific Island" rugby.

Target information

The key information sought was whether there was a physiotherapist (sometimes designated as a Physical Therapist or Physio) associated with each of the identified Pacific Island national teams, and if so, information about their qualifications and nationality was of interest. The desired information could be sourced from any of the following: team lists, team photos (with identifiers), press releases, or news articles. The secondary purpose was to determine whether other sport and exercise medicine (SEM) professionals (e.g., Doctor, Massage Therapist, Strength and Conditioning coach, Trainer etc.,) were identified. For the purpose of this study, National Men's and Women's 15s, 7s teams, Under 18s and Under 20s National teams were considered eligible for inclusion. As the currency of information is important, and to present a comprehensive profile, only information posted in the five years leading up to the announcement of the 2019 Rugby World Cup (RWC) squads was considered.

Inclusion/exclusion criteria

Only information obtained from the official websites or Facebook pages of each nation was considered for inclusion and subsequent analysis. Information obtained from secondary sources such as newspaper stories and photos from a recognised publisher was also considered when formal search strategies failed to locate the target information. Eligible websites/Facebook pages created in languages other than English were included if the information could be translated on-line when accessing the site and/or was verified by a native speaker.

Information obtained from Wikipedia, unofficial websites and Facebook pages, and from general resources which could not be verified, was excluded. Community and "fan" type pages were not considered.

Search strategy and data extraction

Due to the expected elusiveness of the target information, a number of search strategies were utilised. An overview of these strategies is presented in Figure 1. All searches took place between 24 July and 11 August and monitored till 1 September 2019, and were conducted by the primary investigator (CS).

Strategy 1: Websites

Search: The World Rugby website[28] and the Oceania geographic region (via "Inside Rugby" and "Member Unions") tabs were located. The 12 listed member nations were explored. In addition, the Oceania Rugby website address[13] was sourced via "Regional Associations" which listed a further four nations (associate and full members of Oceania Rugby). After omitting Australia and New Zealand the websites of the remaining 14 nations were included in the analysis.

Data extraction: For each of nation's website, leader banners or tabs were initially searched via the "about us", "teams", or "staff" tabs if present, by CS, and discussed with SJS when information was not clear. If no information was located, the other header banners or tabs were then sequentially searched for any information regarding physiotherapists and/or SEM professionals named as support personnel for each nation's rugby team(s). This was followed by searches of any "news" tabs or feeds. Finally, the site's embedded search bar, if available, was used to search for the term "physiotherapist".

Strategy 2: Facebook

Search: The social media website Facebook was searched (by country name) for the pages associated with each member nation of Oceania Rugby as identified above. If located, they were checked to determine it was the official Facebook page for the rugby union in that country. If no official Facebook page was located, alternatives such as commonly branded team names (e.g., Manu Samoa for Samoa) were used. If Facebook pages could not be found the Google search engine was again used to search for Facebook links. These were then cross-checked against the hyperlink available under the "member unions" tab on the Oceania Rugby website. Community and "fan" pages were omitted.

Data extraction

Once the relevant rugby pages were identified and noted, they were systematically searched by CS, by scrolling through each individual post and link from the present day to 2014, where/as available. All posts with reference to a Physiotherapist, or SEM personnel were recorded, dated and categorised.

Strategy 3: Google Search

Search: If neither of these strategies located the desired websites and Facebook pages for analysis, the Google search engine was searched using the key terms "physiotherapist for/and (country) rugby union" with appropriate variations. This additional step was taken to provide an assurance that the search was as comprehensive as possible. Websites and Facebook pages were periodically explored up until 1st September to ensure all information associated with the squad announcements for the Rugby World Cup in Japan, September 2019, was captured.

Data analysis

Once all data were collected, each unit of information (Physiotherapist / SEM professional) was categorised according to its source: team list (TL), team photo (TP), narrative story (NS) or news article (NA), together with where the information was sourced from: Rugby Union website, Facebook page or from a Google search. Data were tabulated and descriptive statistics generated where appropriate.

RESULTS

Official websites were found for five of the 14 nations considered in this study: Cook Islands, Fiji, New Caledonia, Samoa and Tonga. While hyperlinks to three other nation's websites (Papua New Guinea, Solomon Islands and Tahiti rugby unions) were found, they were not active or the sites could not be accessed (in active). No websites could be located for the remaining six nations. However, 13 nations had official Facebook pages, two of which were in French (Tahiti and New Caledonia). No website or Facebook pages were located for Wallis & Futuna. A summary of these findings can be found in Table 1.

Of the five nations with active websites, three named their Physiotherapists and SEM team. For Fiji and Samoa, this information was found under the "teams" tab in the header banner of the home page. Due to a website that had not been recently updated, Physiotherapists for a Men's U20s team in 2015 and the Rugby World Cup 2015 "Ikale Tahi" team were found under the "news" tab for the Pacific nation of Tonga. This led to active links to the team announcements for each team in that year.

For the 13 official Facebook pages located, information regarding Physiotherapist or SEM involvement were noted for the following nine nations: American Samoa, Cook Islands, Fiji, Nauru, Papua New Guinea, Samoa, Solomon Islands, Tonga and Tuvalu. A news article regarding a Physiotherapist associated with American Samoa was also located through a search of the World Wide Web. These data are presented in Table 2.

In summary, information regarding SEM support was found on Facebook, websites or news articles for 9 nations for a total of 27 teams. Five of the 14 Oceania nations analysed (New Caledonia, Niue, Tahiti, Vanuatu and Wallis and Futuna) had no verified SEM support information accessible through a website, Facebook or other search. No qualifications (academic or professional) were noted for any Physiotherapist or SEM professional for any nation. The following SEM professionals were found in the search: Physiotherapist, Doctor, Strength and Conditioning Coach and a Trainer. Physiotherapists were most commonly listed, supporting a total of 24 teams, followed by Doctors (11 teams), Strength and Conditioning coaches (10 teams), and one team with a Trainer.

Table 1: Oceania Rugby Unions

Country	Membership status: World Rugby/ Oceania Rugby *	URL	Facebook Page	Date Visited
American Samoa	Affiliated/FULL	No website listed or found	https://www.facebook.com/AmSamoaRugbyUnion/	30/7/19
Australia	Affiliated/FULL	https://australia.rugby/	https://www.facebook.com/RugbyAU/	6/8/19
Cook Islands	Affiliated/FULL	www.rugby.co.ck	https://www.facebook.com/CookIslandsRugbyUnion/	24/7/19
Fiji	Affiliated/FULL	www.fijirugby.com	https://www.facebook.com/fijirugby/	24/7/19
Nauru	-/FULL	No website listed or found	http://www.facebook.com/NauruRugby/	1/8/19
New Caledonia	-/FULL	http://www.rugby.nc/ (in French) (in French)	https://www.facebook.com/rugbyNC/	1/8/19
New Zealand	Affiliated/FULL	http://www.nzrugby.co.nz/	https://www.facebook.com/AllBlacks	6/8/19
Niue	Affiliated/FULL	No website listed or found	https://www.facebook.com/Niue-Rugby-Union-Inc-153388455417336/	1/8/19
Papua New Guinea	Affiliated/-	www.rugbypng.com (link does not exist/inactive)	https://www.facebook.com/pngrugby/	1/8/19
Samoa	Affiliated/FULL	http://www.manusamoa.com	https://www.facebook.com/ManuSamoa	24/7/19
Solomon Islands	Affiliated/FULL	www.solomonislandsrugby.com (inactive)	https://www.facebook.com/siruf/	1/8/19
Tahiti	Affiliated/FULL	www.tahitirugbyunion.com (inactive)	www.facebook.com/Fédération-Tahitienne-de-Rugby-735313879877400/ (in French)	3/7/19
Tonga	Affiliated/FULL	www.tongarugbyunion.net	https://www.facebook.com/TongaRugbyOfficial	30/7/19
Tuvalu	-/FULL	No website listed or found	https://www.facebook.com/tuvrugbyunion/	1/8/19
Vanuatu	Affiliated/FULL	No website listed or found	https://www.facebook.com/VanuatuRugbyFootballUnion/	1/8/19
Wallis & Futuna	-/Associated	No website listed or found	No Facebook page listed or found	1/8/19

*Membership as per World Rugby website Affiliation: countries may be full members of Oceania Rugby but not yet affiliated with World Rugby (4-step process)

Table 2: Summary of Pacific Island teams supported by Physiotherapists and SEM professionals (2014-2019).

Country	Teams Supported	Physiotherapist Named	Other SEM Professionals Named	Source*	Platform	Date of Inception
American Samoa	Women's 7s SPG** 2019	√	-	NA	Google	21/6/19
	Men's 7s	√	-	TP	Facebook	19/7/19
	Men's 7s GC** (AU)2014	√	-	TP	Facebook	25/9/14
Cook Islands	Men's 7s	√	-	TL	Facebook	7/3/19
	Men's 7s	√	-	TL	Facebook	3/6/19
	Men's7s	√	-	NS	Facebook	11/6/18
	U18s Men's	√	-	NS	Facebook	17/12/17
	Women's 7s	√	-	NS	Facebook	5/3/17
	U20s Men's	√	-	TL	Facebook	22-24/11/16
	Cook Islands 7s	-	Doctor – World rugby	NS	Facebook	9/3/15
	Women's 7s	√	Assessment qualification	TL	Facebook	19/9/14
	Men's 7s CGames**	√	-	TL	Facebook	7/7/14
	Men's 15s	√	-	TL	Facebook	27/6/14
			-			
Fiji	Men's 15s	(2)	S&C (2); Doctor	TL	Website > Teams > Flying Fijians >	2019
	Women's 7s team	√	-	TL	Website > embedded search tab > newsroom	2016
	Men's 7s team	√	-	TL	Website > embedded search tab > newsroom	2016
	Women's 7s team	√	-	TL	Website > embedded search tab > newsroom	2014/2015
	Men's 15s	(2)	S&C (2); Doctor	TL	Facebook	10/6/19
Nauru	Men's 15s Oceania Cup	√	Team Doctor	TL/NS	Facebook	20&23/8/19
	Men's 7s	√	-	NS	Facebook	7/11/18
	Men's 7s SPG**	-	Team Doctor	NS	Facebook	9/7/15
New Caledonia	-	-	-	-	-	-
Niue	-	-	-	-	-	-
Papua New Guinea	Men's 15s	-	Trainer	TL	Facebook	11/8/19
	Women's 7s	-	S&C	NS	Facebook	15/1/19
	Women's 7s World Cup	√	-	TL	Facebook	9/7/18
	Men's 15s	√	-	TL	Facebook	11/11/16
Samoa	Samoa A	√	-	TL	Website > teams > link	unknown
	Men's U20s	-	Doctor; S&C	TL	Website > teams > link	2018
	Women's Oceania 7s	√	-	TL	Website > teams > link	2018
	Men's 15s RWC	(2)	Doctor	TL	Facebook	31/8/19
	Women's 15s	-	S&C	NS	Facebook	29/5/19
	Men's 7s	√	-	TL	Facebook	1&21/2/19
	Men's 7s	√	-	TL	Facebook	22/1/19
Solomon Islands	Men's 7s	-	Doctor	TL	Facebook	9/9/18
	U18s Men's 7s	-	Team Doctor	TL	Facebook	2/3/18
	Men's 7s	-	S&C trainer	NS/TP	Facebook	4/11/17
Tahiti	-	-		-	-	-
Tonga	Men's 15s 2015 RWC**	(2)	S&C; Doctor	TL	Website > news > Ikale Tahi	May-15
	Men's U20s	√	Doctor; S&C	TL	Website > news > U20s	May-15
	Men's 15s	(2)	Doctor; S&C	TP/NS	Facebook	9/11/18
	Men's 15s	(2)	Doctor	TP/NS	Facebook	31/10/18
	Tonga A	√	Doctor; S&C	TL	Facebook	6/3/17
	Men's U20s	-	S&C	NS	Facebook	2/12/16
	Men's 15s	√	Doctor; S&C (2)	TL	Facebook	6/10/16
	Men's 7s	√	-	TL	Facebook	29/3/16
	Tonga A	√	-	TL	Facebook	2/3/16
	Men's 15s	(2)	Doctor; S&C	TL	Facebook	3/10/15
Tuvalu	Men's 7s	√	S&C	NS	Facebook	25/5/19
	Men's 7s	-	S&C	FBp	Facebook	2/4/18
Vanuatu	-	-	-	-	-	-
Wallis & Futuna	-	-	-	-	-	-

Source*: TL: Team list; TP =Team photo; NS = Narrative story; FBp: Facebook post; NA: News article;
Key **: SPG: South Pacific Games, CGames: Commonwealth Games, GC: Gold Coast 7s, AU: Australia, RWC: Rugby World Cup, S&C: Strength and Conditioning Coach

DISCUSSION

This is the first study to provide some insight into the SEM personnel support systems in place within Pacific rugby playing nations. Underpinning the findings were the challenges in obtaining the information. Only five of the 14 nations in this study had an active official website. Hyperlinks to websites on the WR and OR sites were in some cases out of date (non-active), the Tonga Rugby Union website's latest information was from 2015 for example, or the uniform resource locator (URL) for that Union had changed. This could be due to poor internet access, associated costs or potentially the lack of resources to develop and manage the sites. Likewise, there was a discrepancy in the membership status between Nations identified on the WR and OR websites. Collectively, this highlights the need for Rugby's governing bodies to update and maintain these links as a way of communicating with their stakeholders and promoting their teams and the game of rugby.

Interestingly, when periodically checking websites leading up to the RWC, it was noted that the website for Ikale Tahi, the Tongan national team, was unable to be located, with "access denied". However it was noted that a new website, www.truoffical.com, was "coming soon" due to scheduled maintenance.

With the rising use of social media platforms, Facebook appeared to be a more accessible mode of information sharing for several unions. There were difficulties determining the "official" Facebooks pages, as some were displayed under their brand name such as "Manu Samoa" (Samoa Rugby Union). Furthermore, there were challenges in differentiating official Facebook pages and websites from community "fan" pages or unofficial sites.

The study was conducted in the lead up to the 2019 Rugby World Cup, therefore it could be assumed that information would be updated and readily available – at least for those teams involved in this global competition. Comprehensive information was found for Samoa, Tonga, Fiji (involved in the RWC) and the Cook Islands, with the latter acknowledging their medical personnel consistently for the previous five years via Facebook. Unions such as American Samoa, Vanuatu, Nauru and Tuvalu presented relatively recent information (last 12 months), but sporadically prior to this. In general, although a few team announcements included Physiotherapists and SEM staff, often it was limited to players, head coach and assistant coach, and occasionally included the manager.

In several cases, such as for Fiji, teams were supported by more than one SEM professional and involved an extensive support structure. The Fiji rugby website was easy to navigate and current, listing the 2019 squad and management. The larger SEM support team could be due to large playing numbers in Fiji, as well as the proximity to a University which houses the SEM professional programmes. It could also indicate the level of professionalism and well-established administrative structures, and the availability of funding.

It is acknowledged that some Pacific Nations have a limited number of health professionals domiciled in the Islands and thus need to source their SEM support team from elsewhere (e.g. Australia, New Zealand or further abroad) and may only do so for a particular game, competition or tournament. A likely limitation of this is the elite (and emerging) athletes may only have access to specialised and trained Physiotherapists within the rugby season or whilst on tour. This may be due to funding limitations for year-round support, or as some of these positions may be in a volunteer capacity, these professionals may not be available full time. As well as the obvious detriment to ongoing care of the player, this lack of support can impact the dynamics of the management and team as a whole, particularly in the professional era.

In some smaller nations the physiotherapy profession may not be well established, and it may be commonplace to have a team doctor to manage all medical needs, including strapping and massage. Likewise, other management personnel such as the coach or manager may take on these roles. In smaller Pacific nations, the same SEM professional may be the supporting physiotherapist for all the teams attached to that Union. Alternatively, a centralised model such as that in Papua New Guinea might be used where a team of physiotherapists or medical personnel working within a unit (Papua New Guinea High Performance Centre) supports the nation's various sports and athletes.

Of further note, only Papua New Guinea and Fiji, of the countries considered here, have Physiotherapy regulatory boards that are member organisations of the World Confederation for Physical Therapy.[1]

This paper extends the findings of a previous study which examined the visibility of SEM professionals in professional and semi-professional New Zealand rugby teams.[7] This study noted the variation between Pacific rugby nations and level of competitions in the reporting of SEM support staff and physiotherapists in particular. Like the previous study, the present investigation noted that unions did not generally present the qualifications or professional profiles of the SEM professionals on their websites. A cursory search of Rugby Australia and the NZ All Blacks websites noted that there was no acknowledgement of the SEM support team. However, this information is widely available to the general public via the various media.

Due to the variation in medical systems and access around the world, World Rugby encourages the use of best practice guidelines to establish the levels of team medical support.[26] Prior to becoming a member of tournament side-line medical staff, officials must have completed the relevant WR player welfare training courses encompassing medical protocols and head injury assessment, as well as completing a face to face course level 2 (immediate care in rugby).[22] The First Aid in Rugby (FAIR)[23] suite of courses are actively promoted in the Pacific countries, and are expected to lead to an increase in the number of appropriately qualified SEM professionals.

The findings from this study encourage the acknowledgement of the professionals that support rugby teams at a national, elite and age grade level. The important role these professionals play within the team unit is one that needs to be highlighted to the pacific rugby and wider community. This promotes player welfare and shows the professionalism under which these systems operate.

A common trend with the information collected is the lack of reporting of qualifications (academic and professional), of the SEM professionals. Highlighting the calibre and training of these professionals would foster increased confidence within players that they are surrounded by effective, professional, high quality clinicians, focused on player welfare and high performance. Further, it may encourage unions to celebrate the wealth of knowledge and skills these important people within their teams contribute to their rugby community and the Pacific. Physiotherapy as a profession needs to be more active in promoting its profile and advocating for inclusion of this information in the public space, such as union websites and social media.

For those teams without the benefit of these support systems, it is hoped that these findings promote the recruitment of SEM professions and motivate Pacifika physiotherapists to make themselves available for these Pacific Island teams, and to inspire Pacific youth to look into physiotherapy as a viable career option. Furthermore, the findings should encourage global rugby organisations/administrators to look at setting benchmarks for SEM involvement in rugby, and increasing visibility for these professionals within the rugby community. This may include a focus on making this information available via website and relevant social media outlets.

The strength of this original study was that it employed a systematic approach to searching for the target information of whether physiotherapists were recognised within their role with elite pacific rugby teams. The multifaceted approach provided a rigorous examination of both websites and Facebook pages. Despite this there are a number of limitations associated with the study. Firstly, it only captured information in the public space and did not proactively seek information from rugby administrators and unions, and as such may not represent the current situation. Secondly, monitoring dates that information was found and originally published was easier through Facebook, than on other websites; this may have led to under or over representation of data due to difficulty in ascertaining the currency of the information. Finally, all searching and coding was done by one researcher (CS) who has an interest in Pacific Island rugby. This may have introduced an element of bias.

To explore this topic further and gain a comprehensive picture of the involvement of physiotherapist and SEM professional in Pacific Island rugby, future research in this area might include conducting semi structured interviews with professions and administrators to more accurately ascertain the actual status of SEM professional involvement in Pacific Island rugby. This would serve to update information and fill this gap in the literature, encouraging the importance of player welfare and ongoing visibility of sports medicine in the Pacific Islands.

CONCLUSION

This research examined the presence of physiotherapists and other SEM professionals associated with Pacific rugby playing teams (and countries) as seen through subject specific websites and selected web-based social media sites. Currently, the visibility of these professions working with elite teams is lacking and needs to be encouraged and publicised through mediums such as current and active websites and social media platforms. Administrators and physiotherapists in particular should be active in promoting their involvement as key assets to the success and wellbeing of the teams they work with, and note the presence of support professionals when announcing and/or identifying teams.

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A comparison between foot, handle forces and lower back positions between ergometers and on-water rowing with High Performance rowers

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ABSTRACT

Low back pain (LBP) is the most prevalent injury in rowing. Greater frequency of fixed rowing ergometers use has been associated with increased LBP, and sliding ergometers are proposed to reduce the stress on the spine. The purpose of this study was to examine the lumbar flexion curvature in conjunction with the foot and handle forces, on fixed and sliding ergometers versus on water conditions. Four elite female adult rowers volunteered for this study and completed a 1,000 meter maximal test on the stationary and fixed ergometers and then on water. Forces at the handle, and foot block were measured over the three trials. Lumbar curvature (% flexion) was calculated for the first half of the drive phase of stroke from the catch position. Results indicate that fixed rowing ergometers induced the greatest amount of lumbar flexion, with some reduction for sliding ergometers compared to on water. Handle forces on the fixed ergometer were greater than on water but no different for the sliding ergometer. There was a trend for the foot forces to be greater on the fixed ergometer. Rowers moved differently in the three conditions and this is most evident when comparing between the fixed ergometer to on-water rowing. These results indicate that those clinicians and coaches managing low back pain in rowers should advise that when returning to rowing following an episode of back pain, on water is the least stressful activity on the spine, followed by sliding ergs and finally the fixed ergometer.

Key words: Injuries, lumbar flexion, feet

INTRODUCTION

Rowing requires extreme physical strength and endurance coupled with high training volumes.[1] Low back pain (LBP) is the most prevalent and significant injury that affects rowers.[2-7] There are a number of factors that have been identified as contributors to this specifically, high training volumes coupled with high loads on the spine and the flexed spinal position during the rowing stroke.[8] It is thought that the spinal loading at the catch and early drive phase are the most injurious.[2] Wilson, Gissane, Gormley and Simms[9] found that the risk of low back injury significantly increases with time spent ergometer rowing, whilst Teitz et al.[10] quantified a duration of over 30 minutes on the ergometer as a significant risk factor for lumbar spine injury. A recent study by Buckeridge, Bull and McGregor,[11] found high levels of lumbo-pelvic loading on rowers as the stroke rate increased on the ergometer. These findings suggest that the rower's technique appear to change with the increasing stroke rates.[11]

Changes in lumbar flexion curvature positions, particularly seen at increasing training intensities is understood to occur because greater spinal movement occurs.[12] McGregor, Patankar and Bull[13] found some evidence that less anterior pelvic rotation occurred with prolonged training. This typically results in an increase in lumbar flexion[2,14] and therefore increased exposure to injury as the passive structures of the spine are under greater stress the further a person moves into their range of flexion.[8,14] Additionally, the combination of shear and compressive loads that occur during the rowing stroke (especially at the start of the drive phase) also put the passive structures of the lumbar spine in an increased risk of injury.[3,15] It has been argued that more force is required on an ergometer to overcome the stationary fulcrum, as opposed to on-water rowing during the propulsion phase, where momentum is better maintained as the oars slide into the water.[16]

Rowing machines or ergometers (Figure 1) are commonly used for performance testing, technique coaching, crew selection, and bad weather training.[17] To varying levels, ergometers have been shown to simulate both physiological and biomechanical demands of on-water rowing[18-21] and also allow for control in testing situations, which is not always possible on the water, due to the variability in environmental conditions. While there are some similarities between the two conditions, a recent study assessed the agreement and relationship between a single-scull 2000m-water performance and a commonly used ergometer, the Concept II 2000m rowing ergometer, during time-trial performances. The results indicated that on its own, the Concept II rowing ergometer is a relatively poor predictor of water-based single-scull rowing performance.[22]

Research between ergometer and on water-rowing has traditionally focused on the forces applied during the early drive phase of the stroke, but this has been primarily limited to handle forces.[23] While handle forces are important, the need to look at foot forces are equally as important, given that most of the propulsion in rowing is generated via the lower limbs. These body parts (feet and hands) are of most interest, as they are two points of connection between the rower and the boat. Previous studies have analysed the handle/oar forces between the boat and the ergometer e.g.,[23,24] and more recently a study has compared foot and oar/handle forces.[25] However this latter study only considered those forces in varying ergometer conditions, and did not look at on-water performance.[25]

A variation of the commonly used Concept2 ergometer is placing it on sliders (Figure 2) in order to try and imitate on-water rowing more closely. Whilst these sliding ergometers have been shown to be more specific to rowers physiological on-water rowing demands,[26] there still remains the question about how similar the sliding and stationary ergometer is to on-water rowing in terms of forces applied at the handle and the feet. Some studies have investigated handle forces applied on stationary ergometers compared to on-water, or between stationary and floating or sliding ergometers.[27] However, there is limited research that compares the same high-performance rowers across three performance conditions; Stationary and sliding ergometers with on-water rowing.

There have been a number of studies that have quantified the loads and kinematic changes that occur on a stationary rowing machine, but few that have gathered information whilst rowing on water.[12,13] The reasons for this mostly sit around the technological challenges of recording data during on water rowing. Due to advances in modern technology, it is now possible to measure the forces generated during rowing at the foot stretcher and the oarlock. This would then allow researchers the ability and combine changes in handle and foot forces with the changes in lumbo-pelvic angle. To date there are no studies that have compared the differences in lumbar spine curvature on fixed vs sliding vs on water conditions. Therefore, this study will seek to examine changes in spinal kinematics and forces at the feet and oars/handle between on water and ergometer rowing in high-performance rowers. There are two hypotheses to be tested and presented in this study;

Part 1. That fixed ergometers would induce greater handle and foot forces at the beginning of the drive than sliding or on water conditions

Part 2. That fixed ergometers would induce greater increases in lumbar flexion than sliding or on water conditions.

METHODS

An observational cohort study was undertaken across three different rowing conditions. Participants: Four elite female adult rowers volunteered for this study (height: 1.78 ±5.6 cm; weight: 77.5 ±8.1 kg). All rowers had international representation experience with their personal best 2000-m ergometer times (m:ss.ms) of 7:04.5 ±3.7 s. The study was approved by AUT Ethics committee (number 15/247)

Tests

Each rower performed a single maximal 1000-m time-trial under three conditions (1) a fixed ergometer (Concept2), (2) a sliding ergometer (the same Concept2 ergometer placed on Concept2 slides), and (3) in an on-water double scull. The double scull was chosen as a stable boat with little or no possible lumbar rotation.

Part A: Handle and Foot force Measurement

Force data at the oarlock and footplate were collected with the PowerLineTM Instrumentation system (Peach Innovations Ltd., Cambridge, UK). This system was placed in the double scull and on the ergometer for the foot force measurement synchronized to a calibrated strain gauge attached to the handle on the rowing ergometer. A sample of three strokes at 15% (BEG), 50% (MID), and 85% (END) of the 1000-m trial was taken. The sample at 85% of the trial's time was used to assess the differences in conditions under a more fatigued state, where differences (if any) would likely be more pronounced.

Variables

The percentage of time (%) of the stroke from the catch when maximum handle force was reached.

The percentage of time (%) of the stroke from the catch when maximum foot force was reached.

Maximum foot force reached (N).

Maximum handle (oar) force reached (N).

Part B: Lumbo Pelvic Measurement

Two sets of two orange visible markers were attached over the spinous processes (See Figure 3) such that one set centred on either side of the first lumbar vertebrae (L1) and another set centred on either side of sacral level 1 (S1) as described by Caldwell, McNair, and Williams.[2] Prior to testing, a stationary erect standing position and a sit-and-reach position were recorded for reference values to normalise rowing lumbar curvature measures to a rower's % lumbar flexion to allow group comparisons. In the laboratory, a digital video camera sampling at 30 frames per second, was placed perpendicular to the sagittal plane to collect samples of strokes at 15% (BEG), 50% (MID), and 85% (END) of the 1000-m trial. On-water, video was taken by the same means, however, the camera was hand-held carefully in a chase boat perpendicular to the path of motion. Quality of video on-water was monitored via taped reference points placed on the boat that would align when the camera was perpendicular to the sagittal plane.

Data Analysis

For each variable In part A, the average of three strokes for each participant for each condition was used for statistical analysis. Data were treated with log-transformation before examining changes. Differences between conditions were assessed using Cohen's effect sizes (ES) and 95% confidence intervals presented to determine the likelihood of a real change. The scale used for effect size interpretations was: <0.2 = trivial; 0.2-0.5 = small; 0.6-1.1 = moderate; 1.2-1.9 = large; 2.0+ = very large 28. Confidence intervals including at least -0.2 to 0.2 were deemed unclear effects despite the observed effect size and these changes were discussed as "tendencies" based on the observed ES. The null-hypothesis was rejected and statistical significance achieved if $p<0.05$.

In part B, three strokes were selected for each section of the time-trial for each rower for analysis. Video data were digitized using Kinovea motion analysis software (Fig 4). Lumbar curvature (% flexion) was calculated as described by Caldwell, McNair, and Williams[2] for the first 60% of the drive phase of the stroke (not the whole stroke) or approximately the 1st ~0.45 s following

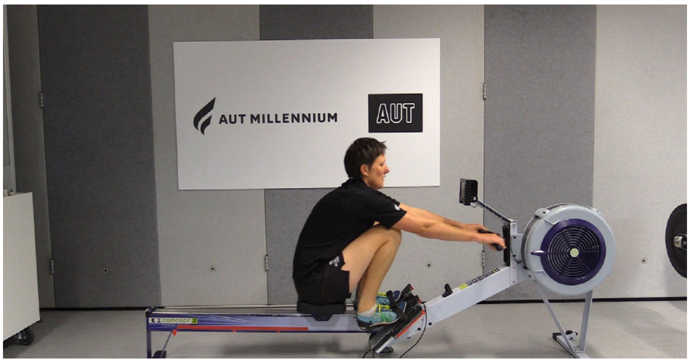


Figure 1: Fixed ergometer.

Figure 2: Sliding ergometer.

the catch position to ensure a peak lumbar curvature value was reached for each stroke for all rowers. Lumbar curvatures expressed as a % range of motion (%ROM) were graphed for visual assessment. Standardised mean differences (effect size) were calculated to examine differences in %ROM over time for each condition and between conditions. The scale used for effect size interpretations was: <0.2 = trivial; 0.2-0.5 = small; 0.6-1.1 = moderate; 1.2-1.9 = large. The null-hypothesis was rejected if p<0.05.

Figure 3: Markers on S1 & L1

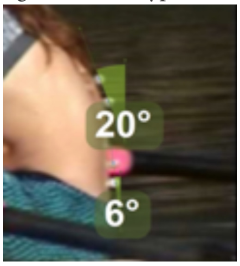


Figure 4: Lumbar and sacral angle measurements

Variables

% ROM between the catch and ~0.45sec (60% of the way through the drive phase of the stroke) at the BEG, MID and END of the test for all 3 conditions.

RESULTS

Part A: Overall, there were no statistically significant differences between the fixed and sliding ergometer compared to on water rowing in all the four variables recorded. However, when comparing one condition to another there were statistically significant differences in two of the four variables; in particular the timing of the foot forces and the maximal handle forces reached. Figure 5 shows that the timing of the maximum foot force occurred later in the stroke cycle, as the stability of the platform decreased (i.e. fixed to slides to on-water), with statistically significant effect size changes between foot forces achieved on the two ergometer conditions to that of the on-water condition (see Figure 5).

The timing of the maximum handle force tended to occur later in the stroke cycle on the water than either of the two ergometer conditions, but the significance of this difference was unclear due to the large confidence intervals observed.

When analysing what the maximal forces were reached in all 3 conditions, it can be seen (Figure 6) that the maximum force of the hands decreased as the stability of the platform decreased (i.e. fixed to slides to on-water), with a statistically significant difference between fixed and on-water, where rowing on-water reduced the hand force by a very large amount.

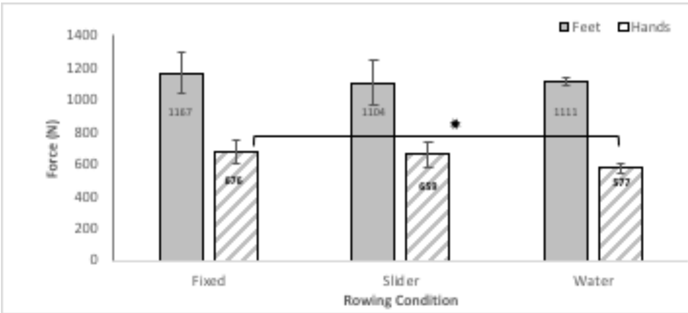


Figure 6: The maximal handle and foot forces achieved during the rowing stroke. * change is statistically significant, p<0.05.

The observed maximum foot force was similar between sliders and the on-water condition shown by a trivial ES (Table 1) and was observed to increase by a small amount between either of these conditions and the fixed ergometer. However, all findings regarding the observed timing of maximum foot force were unclear due to the large confidence intervals, and more data is needed to confirm the results of this variable. An example of the foot force profile throughout one stroke in all three conditions for one rower is shown in Figure 7. Here in figure 7 it can be seen that the timing of maximal foot force is earlier in the two ergometer conditions. In addition, it can be clearly observed that maximum foot forces achieved during the water conditions are significantly less than that during both ergometer conditions.

Part B: The Lumbar curvature as a %ROM for each BEG, MID, and END section of a 1000-m time-trial for each condition are shown below on Figure 8. There were no statistically significant differences between the %ROM for each condition. The only significant difference was in the sliding condition, when comparing between conditions from BED, MID to END; in particular BEG to MID and END. The difference in %ROM at the mid-point (~0.20-0.25 s) of the drive on the sliding erg had an effect size of 1.41. This result suggesting that on the slider erg there is a %ROM change as the rowers fatigue. This result is similar to the fixed erg, where the greatest %ROM was

Table 1. The statistical differences between the four variables in the three different rowing conditions

	Fixed to Sliders		Fixed to Water		Sliders to Water	
Variable	ES	95% CI	ES	95% CI	ES	95% CI
Max Force - feet	1.2	-0.6 to 3.0	-2.9*	-5.5 to -0.4	-1.5*	-2.4 to -0.6
Max Force - hands	<0.1	-0.4 to 0.5	-0.5	-2.0 to 1.0	-0.5	-1.7 to 0.8
Timing of Max Force - feet	-0.2	-0.7 to 0.2	0.2	-1.1 to 1.6	0.0	-1.3 to 1.3
Timing of Max Force - hands	-0.4	-1.1 to 0.3	2.2*	0.3 to 4.1	1.8	-0.3 to 3.9

ES = effect size, CI = confidence interval, * change is statistically significant, p<0.05.

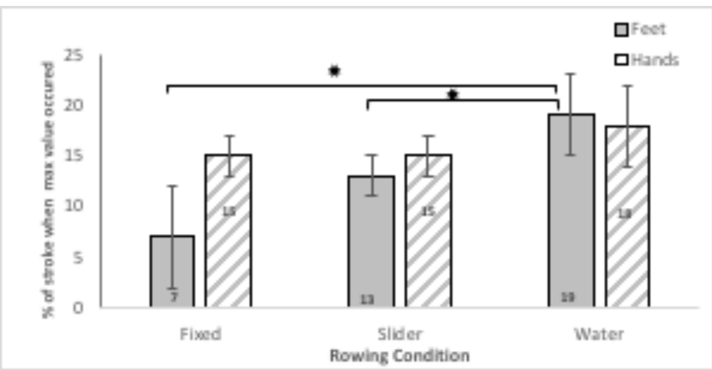


Figure 5: % of time during the rowing stroke when maximal foot and handle forces occurred. * change is statistically significant, p<0.05.

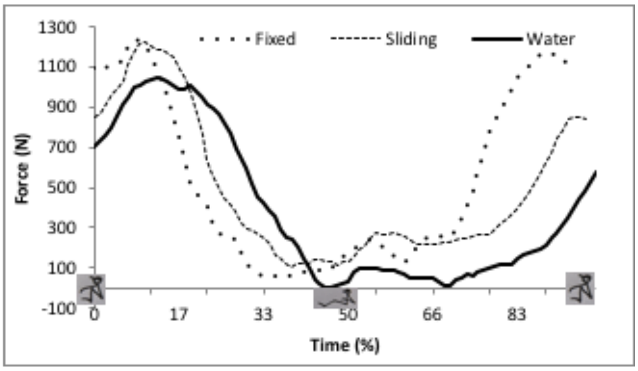
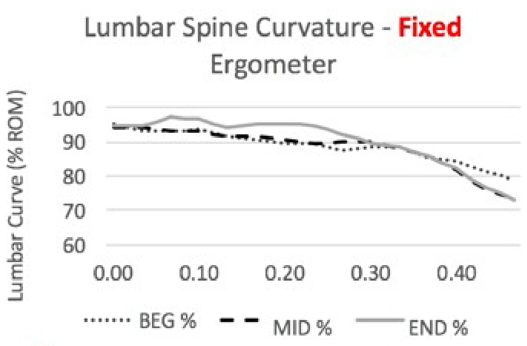
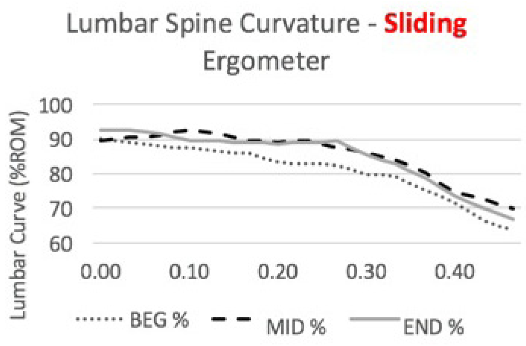


Figure 7: An example of an entire stroke from one rower showing the foot forces applied during the three conditions.





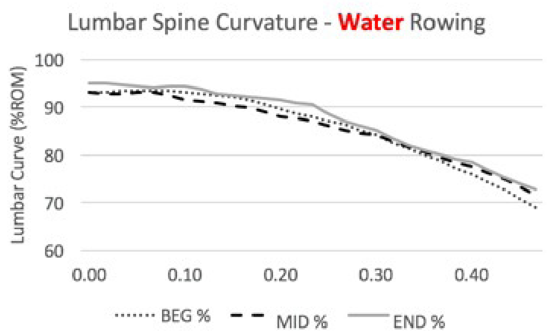


Figure 8: %ROM of the 1st half of the strike during the three conditions (Fixed, Sliding and water) and during the early, middle and end sections of the 1000m trial.

during the END section of the 1000m trial.

Combining Forces with ROM

Analysing the differences of either forces reached, the timing of these forces and/or the %ROM achieved during the three rowing conditions by themselves does not explain the true difference of these conditions, compared to looking at these results together. Since none of these four variables can be considered in isolation, it was decided to demonstrate the compounding influence of higher forces achieved, as well as these forces occurring early in the drive phase when compared to the on-water condition in relation to the %ROM at that time. Figure 9 illustrates the %ROM of the rowers when maximum foot and handle forces in the three conditions occurred. There were statistically significant differences between the fixed ergometer compared to the sliding ergometer, and the on-water condition for both the back angle at maximum handle and foot force.

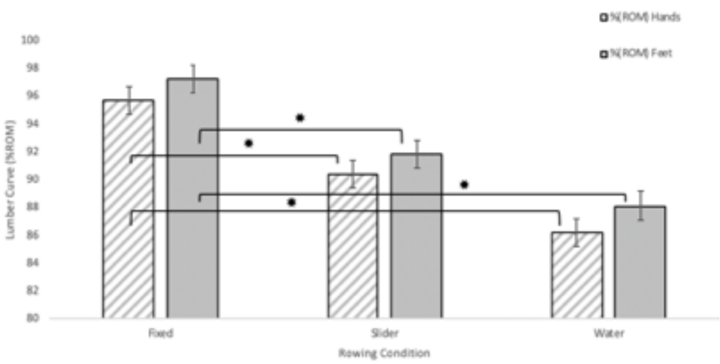


Figure 9: The %ROM at the maximum foot and handle force * change is statistically significant, p<0.05.

Figure 10, shows %ROM for one rower for a single stroke in each of the three conditions. On each %ROM curve is the time of when the maximal handle and foot force occurred for them during those strokes. It can be seen that the timing of maximal forces is at a significantly lower %ROM on the water condition compared to the fixed ergometer.

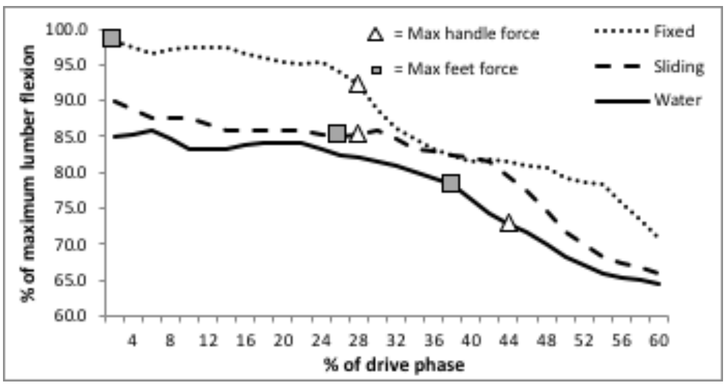


Figure 10: The %ROM for a single rower during the three conditions. The timing of maximal foot and handle forces is indicated by the a square and triangle respectably

DISCUSSION AND IMPLICATIONS

Part A: Temporal application of feet and handle forces in addition to the total forces produced by individual rowers differed between the ergometer conditions and the on-water condition. The maximal handle forces achieved were statistically different between the fixed ergometer and on water, but not statistically different between the water and sliders. There was a trend for the foot forces to be higher on the ergometer compared to on-water and in particular, maximum forces were achieved earlier on ergometers than on-water. The sliding ergometer appeared to have a more of a delay than the fixed ergometer to reaching the maximum force, which is more comparable to the on-water than fixed ergometer movement. The fixed ergometer had the situation where either the maximum foot force was already achieved by the start of the stroke (the catch) or just prior to it. Either way, this temporal coordination is significantly different to that of on-water performance. These changes imply differing demands of ergometer and on-water rowing as noted by the temporal and total force changes produced by rowers. These also imply that greater force is required to move the ergometer flywheel at the start of the stroke and hence also place greater stress on the lumbar spine. This is consistent with the findings of other research suggesting ergometer have the potential for greater low back injury.[9]

Part B: Rowers produced the highest lumbar curvature values relative to their full ROM during fixed ergometer rowing. Under a relatively more fatigued state at the END sample, water rowing, helped reduce %ROM by a small to moderate amount in the observed sample of rowers between 0.07-0.43 s of the stroke. This time comprised from just following the catch to about ¾ of the drive phase. In contrast, from sliding ergometer to water, lumbar curve values increased by a small amount in the observed sample from 0.00-0.23 s and also 0.37-0.47 s into the stroke cycle, which comprises the catch to early drive, then near the ¾ drive time. The findings support, that for competitive rowers who are concerned with water performance, rowers' lumbar spine mechanics are changed when rowing on the ergometer, and fixed-ergometer rowing may be more stressful to the spine as rowers near 100% of their lumbar spine range of motion in as short as a 1000-m time-trial. Duration effects on the lumbar spine were most pronounced in the sliding ergometer with small to large increases in lumbar curvature for the duration of the measurements across BEG to END.

Combining part A and B: When considering %ROM in conjunction to the timing of when the maximal handle and foot forces occurred, a significance difference can be established between the three conditions. With the fixed ergometer highlighting the difference of extremely high %ROM when the maximal forces at the feet and hand occurred, compared to the other two conditions. In particular the timing of when the maximal foot force occurred was close to the start of the rowing stoke, which is when a rower is in their greatest %ROM. What compounds this finding even further is twofold; firstly feet forces are the higher of the two forces produced by a rower and secondly, the %ROM tended to higher on a fixed ergometer to those reached in the sliding and on-water condition. In reality maximal foot forces are applied when the lumber spine is in its most flexed position of the rowing stroke.

The emergent coordination of rowers across conditions appears to have evolved from the task demands of the ergometer and is relatively consistent across rowers and both sliding and fixed ergometer conditions. Therefore, there are biomechanical implications for performing in one highly trained context (i.e. ergometer), which is different to what is required for performing in a dissimilar context (on-water). The impact of these changes on optimal performance requires further investigation.

Key outcomes from exploring the lumbar spine movements were: (1) fixed ergometer may induce greater lumbar spine flexion in some rowers from just after the catch to about ¾ drive phase. Those at risk of lumbar spine injury or those who have stiff lumbar spines should be cautious or reduce time spent on the fixed ergometer training. (2) Sliding ergometer or a more dynamic ergometer may be less stressful for the low back, however over time, rowers revert to lumbar curve profiles more similar to fixed ergometer rowing. It is worth nothing that while lumbar curve profiles changed under fatigue, the timing of maximal foot force occurring is still later to that of the fixed ergometer. (3) Water rowing induces the least variable lumbar curve profiles with peak lumbar curves occurring at the catch, then reducing lumbar curve % ROM as the rower progresses with an increased load. Water rowing, which is the natural environment for competitive rowers, elicits the least variability in lumbar curvature across a 1000-m time trial. In addition, peak handle forces are 20% less on water when compared to the fixed and sliding ergs. These results indicate that those clinicians and coaches managing low back pain in rowers should advise that when returning to rowing following an episode of back pain, on water is the least stressful activity, followed by sliding ergs and finally the fixed ergometer.

CONCLUSION

This study has investigated the differences between ergometers and on-water rowing in relation to forces applied at the hands and feet and lumber spine movements. The clear result established here, is that rowers moved differently in the three conditions and this is most evident between the fixed ergometer compared to on-water rowing. Handle and foot forces were different in fixed and sliding ergometers when compared to on-water. The current study demonstrated that on-water rowing has different temporal and maximal forces to fixed ergometer. In particular the need to generate large forces early in order to get the flywheel moving faster, and this differs to the movement tendencies than that required with on-water rowing.

A key injury implication for rowers is that those who have a back injury are probably best to start training on water when return to sport (in a single or double scull, or combining male and female rowers) and full return to sport probably should include the fixed erg last. When using a fixed erg (eventually), then initially look to reduce the drag factor as well as the training load. A strap or tape around the bar the seat slides on, to limit/stop the rower having a long stroke could also help to reduce the %ROM at the catch. This suggestion is in contrast with what is practiced, which is when injured to stay off the water and train on a fixed ergometer instead.

A positive outcome of this study was the ability to capture on water data. This has been a shortfall of other research in rowing and why most studies are conducted on fixed ergometers. [2,12,13] The ability to describe this methodology may encourage other researchers to replicate or extend this current study to gain more statistically significant results.

LIMITATIONS

The main limitation was the small sample size. Whilst we acknowledge this a large number of variables were captured and these are useful for further research.

The use of a handheld camera could have made it difficult to control for movement in the frontal plane and thus the possibility of a degree of parallax error.

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A short report: The epidemiology of CrossFit injuries in children and adolescents

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ABSTRACT

Aim

To determine the epidemiology of CrossFit injuries in children and adolescents in New Zealand.

Study Design

Descriptive Epidemiological Study.

Setting

Children and adolescents participating in CrossFit, New Zealand.

Participants

Children and adolescents aged five to 18 years, who sustained an injury while participating in CrossFit between the period 1 January 2017 to 24 August 2017 as per New Zealand Accident Compensation Corporation data.

Results

There were 72 CrossFit injuries in children and adolescents aged five to 18 years in New Zealand during the eight-month period. 54% of those injured were female compared to 46% male. The average age of injury was 14.8 years, with a clear peak between 14 and 16 years. 86% of injury events were sprains. The primary body sites for injury were the shoulder (including the clavicle and shoulder blade) and lower back/spine with 21% and 19% of injury cases respectively. 40% of injury cases occurred while lifting weights.

Conclusions

During the eight months of data analysed there were 72 injuries in children and adolescents participating in CrossFit in New Zealand. Shoulder and lower back sprains, are common in CrossFit, particularly when lifting weights.

Key Words

CrossFit, weight training, children, epidemiology, injury

INTRODUCTION

CrossFit is a strength and conditioning programme which focuses on varied, functional movements, performed repetitively, at high intensity. These functional movements are based on elements of multiple sports including but not limited to gymnastics, Strongman and Olympic weightlifting.[1] Since 2005, CrossFit's popularity has increased significantly.[1] In New Zealand (NZ), there are 120 official CrossFit affiliates, 31 of which offer CrossFit Kids – classes aimed at children as young as five to 18 years.[2] There is however limited epidemiology regarding CrossFit injury in children. The high intensity nature of CrossFit potentially puts participants at greater risk of injury, particularly of the shoulder than other lifting sports, with not just strength but control and appropriate technique needed to perform the exercises at pace.[3]

The literature suggests involvement of trainers in coaching participants through a workout and monitoring of technique is associated with decreased injury rate in adults.[4] Supervised strength training has been shown to be safe in children.[5] However, the high intensity nature of CrossFit in this cohort has not been studied and the additional risks associated with the rapid growth that occurs between the ages of 12-14 years, may put children at increased risk of injury.

The purpose of this study was to determine the number and type of injuries occurring in New Zealand children and adolescents participating in CrossFit.

METHOD

Retrospective analysis was conducted on New Zealand Accident Compensation Corporation (ACC) data on CrossFit injuries in children and adolescents aged five to 18 years, from a consecutive eight-month period (1 January 2017 – 24 August 2017). Data of interest included accident date, accident description, age, sex, ethnicity, read code description i.e. diagnosis code, primary injury site, scene of injury and treatment provider. Data received from ACC was obtained from their database. The data was refined by age to include those between five and 18 years of age inclusive. Injury events were then identified, using variations of the word CrossFit as the search criteria in the accident description input (See Appendix 1 for specific search terms). The raw data was further refined and categorised, before being statistically analysed according to gender, age, ethnicity, injury type, injury site, mechanism of injury, and health care provider type. The proportion of injuries for each subset of the above listed categories was calculated, along with the average age at which injuries occurred.

RESULTS

A total of 72 CrossFit injuries in children and adolescents aged five to 18 years in NZ during the period January 1st 2017 to August 24th 2017 were identified.

More injuries were reported in females; 39 (54%) compared to 33 in males (46%). The average age at the time of injury was 14.8 years. The age of participants injured ranged from nine to 18 years. The proportion of injuries according to age was calculated with 53% of injuries occurring between 14 and 16 years of age. The majority of those injured were of NZ European ethnicity at 46%, followed by Maori at 35%. The read code description was categorised according to injury type. Most injuries (86%) were sprains, with far fewer fractures (4%), abrasions (4%), open wounds (3%), contusions (1%) and dislocations (1%). The primary body site most commonly injured was the shoulder (including the clavicle and shoulder blade) with 15 out of 72 events recorded (21%). Primary injury sites are shown in Figure 1. In 40% of injury cases the lifting of weights was involved. 25% of cases were non-specific when describing how the injury occurred, only that they were participating in CrossFit when they were injured. The third largest category for mechanism of injury was body weight exercises at 17% e.g. pull ups, squats or lunges with no specific mention of the involvement of any weight.

The majority of patients sought healthcare advice from either a physiotherapist (56%) or their general practitioner (29%).

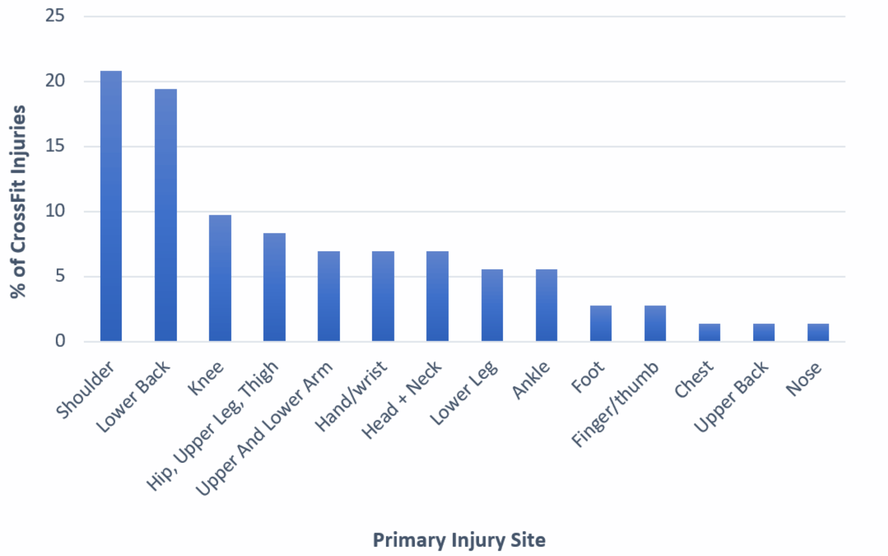

Figure 1: CrossFit injuries by primary injury site; demonstrating the shoulder and lower back were most commonly injured.

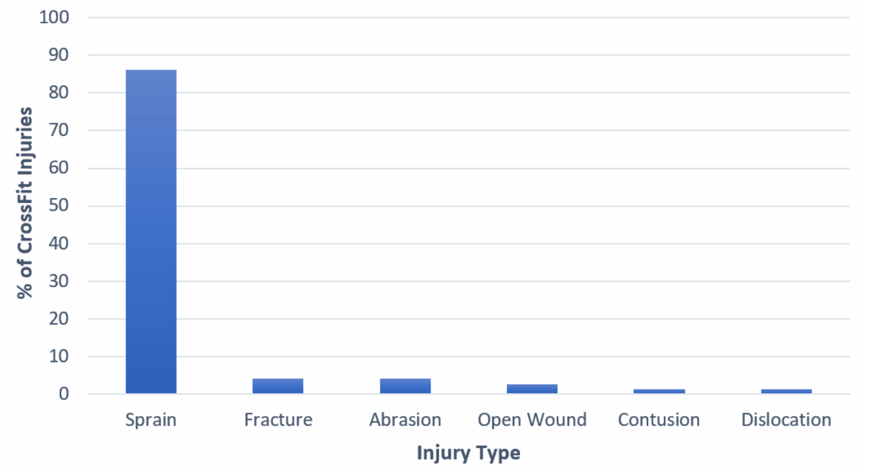

Figure 2: CrossFit injuries by injury type; sprains were the most commonly reported injury type.

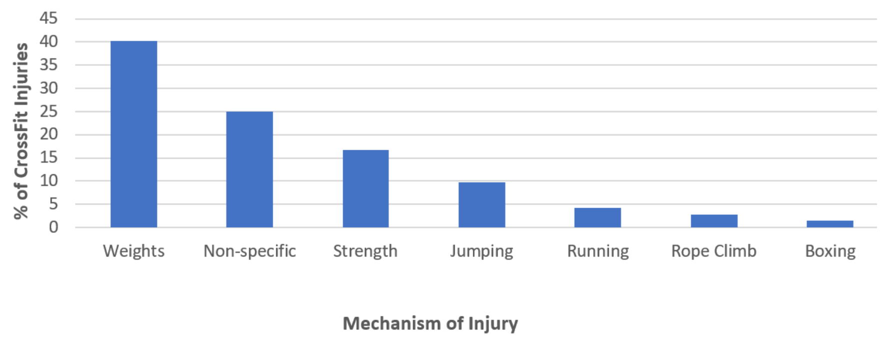

Figure 3: CrossFit injuries by mechanism of injury; the use of weights was involved in 40% of injuries.

DISCUSSION

An estimated four million people worldwide, participate in CrossFit and it continues to increase in popularity.[6] It is estimated that 18% of CrossFit participants are below the age of 18 and 86% report their ethnicity as Caucasian, with an almost equal gender ratio, which appears to be reflective of the general CrossFit population.[6] Without participation rates a true injury rate cannot be calculated. On average 2.1 injuries occurred per week in New Zealand during the time period of this study. Put another way, each of the 31 CrossFit Kids gymnasiums averaged 3.5 injuries per year.[2]

Māori account for approximately 17% of the New Zealand population.[7] The number of injuries reported in Māori appears to be overrepresented in our data. This could reflect high participation rates in CrossFit by Maori in New Zealand or less likely that Māori are more likely to suffer injury when participating in CrossFit.

Low back pain is a common complaint in adulthood with an estimated 84% of adults having experienced low back pain at some point in their lifetime.[8] The prevalence of back pain in children less than 10 years of age appears to be low, but increases in adolescence with an estimated lifetime prevalence of 40% and an annual incidence of 15%.[9] The lower back was the second highest primary injury site at 19%, all of which were sprains, and 64% of these events involved lifting weights. There is a paucity of research on the risk factors relating to back pain in children, however adult studies suggest a previous episode of back pain is the most consistent risk factor for a recurrent episode.[9] Hence further research is required to determine the incidence of back injuries per number of children participating in CrossFit, and their long-term outcomes.

Sprains were the most commonly reported injury type, accounting for 86% of injuries. Fractures only accounted for 4% of injuries. The one dislocation reported was a recurrent patellar dislocation. The high number of shoulder and lower back injuries is consistent with epidemiological studies in adult participants of CrossFit.[1,10,4] The long-term consequences of these childhood sprains progressing into adulthood, particularly of the shoulder and lower back are not well studied.

The cause for the peak age of injury in this cohort is unclear. Factors affecting this could be the adolescent growth, increased competitiveness, or increased participation rates in the 14 to 16-year group.

Insufficient supervision could also be a factor, reflected by 40% of the injuries being related to lifting weights. The second largest category, non-specific mechanism of injury at 25%, could also be technique error and both could be training load error from too much too soon, in the preceding weeks.[11] Non weight lifting strength training representing 17% of injuries shows that for some young athletes, their body weight alone is enough to cause injury. Again, poor technique, insufficient supervision and training load error could also contribute to these injuries. The athletes are expected to perform these movements under cardiovascular and muscular fatigue, the intensity of which is likely to compromise form/technique. This highlights the importance of adequate supervision by trainers and regular review of training load.

The major limitation of this study is the inability to determine the number of children training in CrossFit during the period the data was obtained, to determine an injury rate. The data itself is limited as there is no specific categorisation of injuries in the ACC data, so the database had to be searched manually. This relied solely on what patients had written in the accident description section of the ACC form. The search terms were case sensitive and thus any human error during the input stage of data processing would remove an event injury from the search.

It was not possible to ascertain whether those injured are the same person on different occasions or whether they had a pre-existing injury to the primary injury site unless specifically stated in the accident description. Patients who may have been performing specific movements while participating in CrossFit for example a clean and snatch, but who did not include any variation of the word CrossFit in the accident description, would have been missed in this study. The ACC system assumes the care providers have made the correct diagnosis and completed the ACC form appropriately. Finally, this study only includes those who sought healthcare advice following their injury. One would expect however, that severe injuries would be captured within this study.

CONCLUSION

Shoulder and lower back injuries, appear to be common in children and adolescents in CrossFit and require further research into their long-term impact. During childhood and adolescence, the use of weights has previously been shown to be largely safe and beneficial but it is clear that injuries still happen so it is important that those participating in CrossFit have technique and training load supervision with regular review.[12]

Further research is required to determine rates of injury and risk factors for these injuries so that injury prevention strategies can be instituted.

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Traumatic pneumothorax during a soccer match – implications for flying and return to sport

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INTRODUCTION

MB is a fit and well 42-year-old Australian man who presented to the Emergency Department of New Zealand's North Shore Hospital in September 2019, with a traumatic pneumothorax which occurred during a soccer match two days prior.

CASE REPORT

MB was on holiday in New Zealand and was playing a social soccer match. He jumped to head a contested ball, and was pushed in mid-air causing him to land on his right lateral chest wall directly onto the boot of the opposing player. After the incident, MB was winded but was able to complete the game with moderate pain in his right lateral chest. He did not seek medical attention until 2 days after the game and presented due to right sided chest pain worse on deep breathing. He was due to fly back to Australia the next day.

On examination, the patient was tender over his right 5th and 6th ribs laterally, however, no open wound was visible with no ecchymosis seen. No breath sounds were heard at the right lung apex, but lungs were otherwise clear. His vital signs were within normal range and remaining examination unremarkable. An erect chest x-ray demonstrated a large right sided apical pneumothorax with a 10cm rim of air, without evidence of tension and no underlying lung disease (Figure 1a).

A right sided 12Fr rocket chest drain was inserted without complication. A repeat chest x-ray showed the chest drain correctly placed with the tip projected inside the right apex, with approximately 20% resolution of the pneumothorax (Figure 1b).

Figure 1a: CXR showing large right sided apical pneumothorax with a 10cm rim of air

Figure 1b: CXR showing right sided chest drain correctly placed with the tip projected inside the right apex, with approximately 20% resolution of the pneumothorax

MB was admitted under general surgery. On the post-acute ward round MB was subjectively well with reduced pain and no shortness of breath. The chest drain was removed on the ward without complication.

A further chest x-ray following removal showed no remaining pneumothorax identified (Figure 1c). He was discharged the same day. Prior to discharge, respiratory medicine advised delaying flight back to Australia until the pneumothorax had been radiologically clear for 2 weeks, with resumption of contact sports from 4 weeks post injury.

DISCUSSION

This recommendation for flying delayed MB's return home, meaning accommodation and flight changes had to be sorted at his expense. Ability to fly post resolution of traumatic pneumothorax is also important for professional athletes who commonly travel long-haul between games, particularly in leagues spanning multiple countries such as Australia and New Zealand.

Traumatic pneumothorax is a rare injury from contact sport, however, has been previously described in basketball, baseball, ice hockey, soccer, rugby and American football.[1] It is an important condition for a practitioner not to miss at pitchside. A simple pneumothorax itself is rarely life-threatening, but it can develop into a tension pneumothorax, which can be fatal. Tension pneumothorax happens when air accumulates in the pleural space with each breath but cannot escape. This leads to increased intrathoracic pressure which can impede venous blood flow return to the heart and decrease cardiac output. Key signs to look for include distended neck veins and a deviated trachea away from the side of injury. Without intervention a tension pneumothorax is fatal and urgent thoracic decompression is required to reduce pressure.[2]

Airplane travel is not recommended in the setting of recent pneumothorax. This is

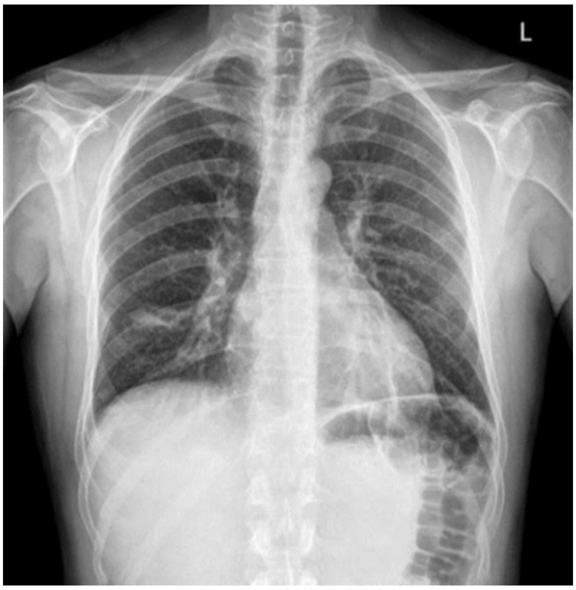

Figure 1c: CXR post chest drain removal. No remaining pneumothorax is identified

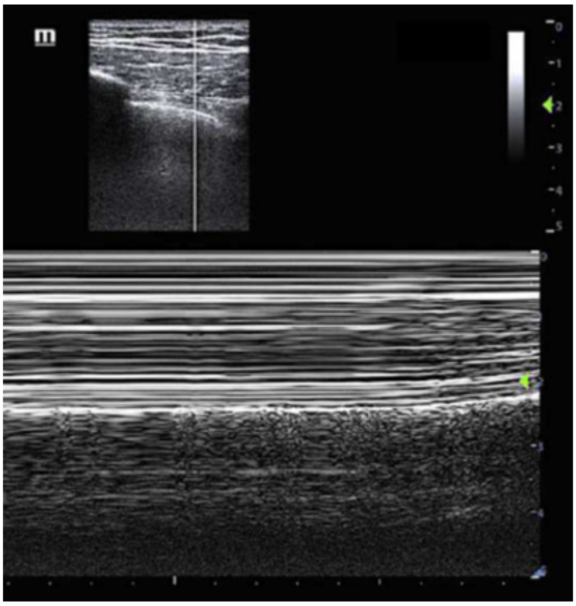

Figure 2a: Ultrasound image of normal lung in M mode displaying the 'sandy shore' sign below the pleural line (from (7))

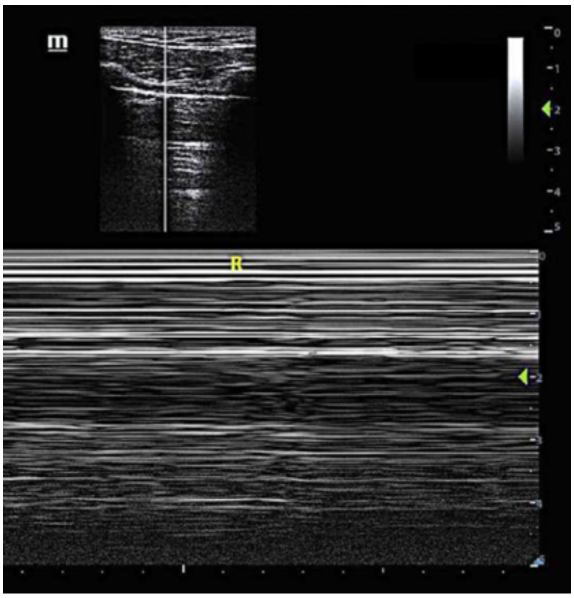

Figure 2b: Ultrasound image of a pneumothorax in M mode displaying the 'barcode' sign below the pleural line (from (7))

because the change in air pressure when travelling on an airplane can result in expansion of any gas remaining in the pleural space, and thus increase pneumothorax size and risk conversion to a tension pneumothorax.[3] A handful of guidelines exist for guidance on flying post pneumothorax. Both the Aerospace Medical Association and British Thoracic Society recommend that a current pneumothorax is an absolute contraindication to flying, and recommend delay of 2-3 weeks post radiological clearance to be deemed safe to travel.[4] This is in keeping with the recommendation the respiratory physician advised for MB in our case.

MB is part of an amateur soccer team in Australia with weekly competitive games. Recommendations for return to contact sport following pneumothorax is useful knowledge for the sports physician. There are no specific guidelines for returning to sports after traumatic pneumothorax, however, there is a consensus that activity should not be resumed until a player is asymptomatic and there is confirmed radiologic resolution of pneumothorax. A literature search for return to play suggests a wide range of timeframes for inactivity from 2-10 weeks.[3] However, more useful guidance is probably a sport specific, graduated return to activity guided by symptoms. Athletes can start with low to moderate aerobic exercise, and progress to more intense, higher forms and competitive games if they remain symptom free. This guidance is universal for all sizes of pneumothorax and is suitable for those both conservatively and procedurally managed.[5] Athletes may have some benefit from the use of a flack jacket or rib wrapping during their transition back to play, although there are no known trials to support their use and benefit may be solely psychological.[6] Other differentials for the sports physician to be aware of with pulmonary trauma include pulmonary contusion and rib fracture. Return to play recommendations for these are no contact activity for 1-2 weeks and 2-3 weeks respectively, following this a graduated return is again favoured.[7]

Ultrasound has recently become a useful way to diagnose pneumothorax, and offers the benefit of being done at pitchside compared to plain films. Due to its accuracy, ultrasound is now considered goldstandard for diagnosis in critical care settings, with superior specificity and sensitivity against X-ray.[8] Given the potential for a simple traumatic pneumothorax to become a tension pneumothorax with time, it is important for medics to be trained in the technique of pitchside ultrasound and can be used as a quick screening method to rule out serious diagnosis (Figure 2a). The medic should look for absence of lung sliding seen on normal breathing, also known as the 'barcode' sign which forms due to the lack of expanded lung tissue below the pleural line (Figure 2b).[8]

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Uncomplicated hip arthroscopy complicated by drug-induced acute interstitial nephritis

JUDIKJE SCHEFFER, BRUCE HAMILTON

INTRODUCTION

Non-steroidal Anti-Inflammatory Drugs (NSAIDs) are frequently prescribed as an analgesic and to reduce inflammation in acute and chronic injuries. Between 1-4% of the general population use NSAIDs on a daily basis, while in elite athletes NSAID use during Olympic Games and the World cup Football may be as high as 25-35%.[1] NSAIDs act by inhibiting cyclooxygenase (Cox), which blocks the formation of prostaglandin from arachidonic acid and consequently reduces the inflammatory response.[1,2] However, gastrointestinal, cardiovascular and renal adverse effects are well-recognised, including an increased risk of cardiovascular adverse-effects with Cox-2 inhibitors.[3]

This case report illustrates a delayed hypersensitivity reaction to post-operative drug use resulting in acute kidney injury.

CASE REPORT

Seven days following an uncomplicated arthroscopic repair of a right hip labral tear, Ms J, a 39-year old active female, presented to her General Practitioner (GP) with a five day history of abdominal pain. Apart from a previous history of ibuprofen induced abdominal pain, her medical history was unremarkable. Ms J had been discharged one day post-arthroscopy with naproxen 500mg BD to reduce surgical inflammation and omeprazole 20mg daily for gastric protection given her history of NSAID sensitivity. After approximately two days, Ms J developed significant abdominal pain and naproxen was immediately discontinued. Her dose of omeprazole was increased to 20mg twice daily and Gaviscon was added. At seven days post-operatively, the abdominal pain had improved, but Ms J experienced significant polydipsia and polyuria, at which point she presented to her GP.

On examination Ms J appeared well, and had a blood pressure of 130/60 mmHg (baseline blood pressure 120/80 mmHg). She had some abdominal tenderness. Urine dipstick recorded blood ++ and leukocytes +. Sequential blood results are illustrated in table 1.

Ms J was admitted to hospital for observation and further evaluation of her renal function. Comprehensive blood tests made auto-immune and infective causes for acute kidney injury unlikely. Renal ultrasound illustrated normal sized kidneys bilaterally, no hydronephrosis or hydroureter, and a presumptive diagnosis of drug induced acute interstitial nephritis (AIN) was made. Initial treatment consisted of immediate withdrawal of potential causative drugs and administration of IV fluids. NSAIDS had been discontinued 5 days earlier but omeprazole was immediately ceased.

A proposed kidney biopsy was cancelled due to the rapid improvement in creatinine levels from 285 mmol/L to 212 mmol/L over 24 hours (table 1). Given the potential gastritic symptoms and the rapid improvement of kidney function, immunosuppressives were not used.

Symptoms of polyuria, polydipsia (nephrogenic diabetes insipidus) and flank tenderness persisted for a further week, but as a result of the rapid improvement in creatinine levels Ms J was discharged home after 24 hours.

Post-operatively, the right hip has made uncomplicated progress, but rehabilitation has been impeded by significant fatigue due to the combination of gastrointestinal side-effects and acute kidney failure. After the initial rapid improvement in serum creatinine, improvement in renal function slowed and is expected to take weeks to months to fully return back to normal. (table 1)

DISCUSSION

AIN is a form of acute kidney injury, which is characterised by a rapid decrease in glomerular filtration rate (GFR) over hours to days. In Ms J case, the AIN was presumed to be caused by either a delayed-hypersensitivity reaction to naproxen and/or omeprazole.

AIN may be caused by medications, infection or auto-immune disease, but medication side effects account for 70% of cases.[5,8] The most frequent medication causing drug induced AIN include antibiotics, proton-pump-inhibitors, and NSAIDs, but potential causes continue to be identified.[4,5] The prevalence of drug induced AIN is uncertain, as diagnosis can only be confirmed by the clinical history and renal biopsy. It is likely underdiagnosed due to the lack of kidney biopsies performed when laboratory results are only minimally abnormal, and the tendency for symptoms and kidney function to improve rapidly after withdrawal of the causative medications.[5]

AIN is thought to be IgE (type 1 hypersensitivity) or T cell mediated (type IV hypersensitivity),[6] and it is a common cause for acute kidney injury after acute tubular

Table 1: Laboratory results, day 0 being day of diagnosis.

Serology (normal value)	Day 0	Day 1	Day 4	Day 7	Day 19	Day 26	Day 33	Day 40
Creatinine (45-90 umol/L)	285	212	175	144	123	115	114	111
Urea (3.2-7.7 mmol/L)	13.5		12.7	11.2	6.3	6.4	5.5	5.4
eGFR (>60)	17	25	31	39	48	52	52	54
Sodium (135-145 mmol/L)	141	142	141	140	143	141	142	139
Kalium (3.5-5.2 mmol/L)	4.6	4.1	3.9	3.9	4.4	3.9	4.4	3.8
Haemoglobin (115-155 g/L)	133	118	136	138	130	132	134	131
Haematocrit (L/L)	0.39	0.35	0.40	0.41	0.38	0.39	0.40	0.39
White cell count x10E9/L	6.51	5.10	6.0	7.4	6.1	7.4	5.8	5.6
C-Reactive Protein (mg/L)	65							

eGFR = estimated Glomerular Filtration Rate necrosis and pre-renal causes.[4] AIN should be differentiated from haemodynamically mediated renal damage, in which renal blood flow may be compromised by NSAIDs - especially in combination with hypovolaemia or the concurrent use of ACE-inhibitors/ Angiotensin II Receptor Blockers or diuretics.[7,8] Drug induced AIN is not dose-related and may begin days to months after exposure to the causative medication. In up to 10% of patients it can present with a triad of systemic inflammatory symptoms of arthralgia, fever or a rash. In 23% of patients there is eosinophilia and urine can show pyuria, mild proteinuria and haematuria.[5,8]

Acute and immediate withdrawal of the causative drug is essential in the treatment of drug induced AIN. A conservative, observation based approach is appropriate if renal function shows a progressive improvement, but immunosuppressive therapy such as corticosteroids may be considered in cases where initial improvement is insufficient. No randomised controlled trials have been performed on AIN due to its idiocratic nature, and it remains unclear whether immunosuppressives are more beneficial than a wait-and-watch approach.[5,8,9] Most patients (64%) experience complete recovery of their renal function after discontinuing the causative medication, but about 23% of the patients will only have partial recovery and a small number of patients will become dialysis-dependent.[8]

The prescription of NSAIDs is a well-accepted treatment in sports medicine, and is indicated where inflammation is present. However, their use is not without risks, which can vary from mild GI upset to thrombotic events and acute and chronic renal failure. When considering medication primarily for analgesia, paracetamol should be considered first line.[1]

When there is a clear indication to prescribe NSAIDS, they should be prescribed for a short period only and at the lowest appropriate dosage. Naproxen (max 1000g/ day) or ibuprofen (1200mg/day) in the lowest effective dose and short duration are considered the NSAIDs with the least risk of adverse effects and complications.[3] Long-term use of NSAIDs should be avoided, but when long-term use of NSAIDs is indicated, regular follow-up with the prescribing doctor is essential. Depending on the age, previous history of adverse effects and co-morbidities, the addition of a proton-pump-inhibitor should be considered.[1,2,3]

In this case, it is unclear whether the proton-pump-inhibitor and/or the NSAID was the causative agent. They are frequently prescribed together and are both known to be one of the more common offending agents causing AIN, as well as certain antibiotics, anticonvulsants and allopurinol.[5,8,10]

This case is a reminder of the potential consequences of routinely utilised medications, and the impact on rehabilitation from otherwise uncomplicated surgery.

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Future proofing female athletes: Need and opportunity

PAUL GAMBLE

Simply being born female is an acknowledged intrinsic risk factor for a variety of acute and overuse injuries involving the lower limb particularly. The disproportionate rates of first-time and recurrent injury among adolescent and adult female athletes have been documented for some time. The prevalence of sports injuries among females has been the subject of a great deal of investigation and a host of injury prevention interventions have been proposed in the decades since this originally came to light. Despite these efforts, the documented injury rates have remained remarkably consistent during this period.[1,2] Effecting any meaningful change at scale has thus proven to be a recalcitrant problem, and in certain cases the incidence of injury has actually risen over recent years.[2] Such observations and practical experience on the ground suggest that there remains a need for practitioners to more fully understand the root causes of the ongoing elevated risk. We must understand the origins of the problem in order to better inform interventions and countermeasures.

Girls have a tougher time than boys

Girls get nothing for free, and in the absence of intervention it all becomes harder when they hit their adolescent years. As boys hit puberty they benefit from spontaneous gains in lean mass, strength, power, and speed.[3] Beyond these performance improvements, young males also benefit from specific improvements in lower limb neuromuscular control and the ability to dissipate forces. Girls get no such luck. There is no neuromuscular spurt to look forward to if you are a young female athlete entering puberty.

To add injury to insult, upon reaching adolescence female athletes become more injury-prone. It is from this point onwards that the characteristic higher rates of lower limb injury in particular become apparent. If we consider non-contact injuries to the knee and ankle, whilst it varies according to the sport, post pubertal female athletes generally report more than twice the number of injuries compared to boys, and in some instances the relative injury rates are up to ten times higher than their male counterparts.[4] This disparity in relative risk of participating in sports such as soccer is particularly evident at sub-elite level.[5] Overuse injuries also become more prevalent among female athletes post puberty. A notable example is the incidence of anterior knee pain and patellar tendinopathy among athletes in jumping sports (hence the moniker jumper's knee), and patellofemoral pain is likewise prevalent among females in running sports following puberty.[6]

All in all, puberty sort of sucks if you're a female athlete. As limbs become longer and hips become wider, most muscle groups do not spontaneously catch up, which tends to create relative weakness as the muscles are now at more of a mechanical disadvantage from the longer levers and change in moment arm. To compound the issue, during the course of puberty there is a tendency to gain mass without corresponding increases in strength. Strength assessments of lower limb muscles largely tell the story: hip abductor strength (normalised to body mass) declines from the onset of puberty.[7] A related alarming finding is that hamstring strength scores are observed to peak at age 11 (in the absence of intervention), and either show no improvement or decline in the years post puberty.[8]

A widening gap thus develops in strength scores between boys and girls from the onset of puberty. In particular, females demonstrate specific deficits in hip eccentric torques (normalised to body mass) relative to age-matched males, affecting hip extensor, abductor, adductor, internal, and external rotators.[9] All of this makes it tougher to stabilise lower limb joints under dynamic conditions, and renders the female athlete less able to exert proximal control and resist the internal and external forces encountered during sport.

Compensatory changes in movement strategy

Naturally, girls make the best of the situation and find a way, despite these challenges. The one muscle group that does keep up with the changes that occur during puberty and becomes stronger is the knee extensors (quadriceps).[7] This leads girls to alter their movement strategy in a way that allows them to preferentially load the link where they are relatively stronger (i.e. knee extensors). Puberty thus marks the point where differences in movement mechanics become evident between boys and girls.[10] Essentially, adolescent boys are not only able to jump higher, but are also better able to dissipate the higher forces upon landing.[10]

In contrast, the compensatory changes in movement strategy adopted by females to work around strength limitations following puberty are manifested in how they generate propulsion, and also how and where they absorb energy through the lower limb kinetic chain upon landing.[11] In particular, the decline in knee flexor and hip eccentric torques observed in adolescent females is likely a causal factor in the altered mechanics employed during preparatory countermovement and take-off, and in turn the kinetics and kinematics adopted during landing.[12,13] Compensatory motor strategies and altered mechanics at touchdown similarly become evident in other athletic activities such as running with the onset of puberty.[14] There are other clearly observable changes in movement mechanics. For instance, deficits in lower limb and trunk strength lead to the tendency for adolescent females to remain more upright[15] and preferentially load the knee when landing, decelerating, and changing direction.[16]

Unfortunately, these quadriceps-reliant and knee-dominant movement strategies have a number of downsides, not least when it comes to risk of severe injury. The characteristic changes we see in biomechanics during jumping, landing, running, and changing direction are directly implicated in the non-contact and overuse injuries that are so prevalent among adolescent female athletes. In particular, young females tend to be a highly-represented group among the ACL injuries in sports injury clinics. Aside from deficits in force generating capacity in general, the inability to apply force rapidly is identified as a specific factor that contributes to injury during higher speed athletic tasks.[17]

Even for those who manage to dodge injury, the altered movement strategy is sadly also not stellar from a performance viewpoint.

Studies demonstrate that jump height, jump distance, speed, and change of direction scores all tend to plateau in female athletes during the years that follow puberty.[18] Clearly these are all rather unpromising developments even if viewed purely from a performance perspective.

Clues to inform effective countermeasures

Happily, female athletes are not doomed to this fate of being susceptible to injury and having their performance flat-line once they reach adolescence. With intervention we can give girls the boost in force-generating capacity that boys get for free. From here we can also address the problematic movement mechanics that females tend to adopt in the absence of this boost, and thereby reduce injury rates so that female athletes are no longer disadvantaged relative to their male counterparts.[19]

What is called for is a two-pronged strategy that involves both strength training and movement skills training. We do however need both elements. It is not sufficient to simply attempt to teach female adolescents how to move in a more mechanically efficient way. After all, they adopted the strategy we see for a reason, i.e. out of necessity. In essence we need to remove the deficit that created the necessity in order to overcome this barrier. In the absence of intervention to address the strength deficits responsible we cannot expect the new movement patters to stick under 'live' conditions. It is this critical point that is typically lost on practitioners – hence the ongoing need for education.

Remedial strength training should be considered the keystone for interventions. Recent data demonstrate that strength scores alone play an outsized role in guarding against risk of injury among females in comparison to males. This applies specifically to traumatic knee injury.[20]

Beyond the essential role of strength in general, targeted strength training serves as the gateway to enable female athletes to employ the movement strategy we are teaching them. Essentially, developing the requisite capacity helps to provide the necessary capability. For instance, improving hip strength in itself facilitates female athletes to adopt a more mechanically sound movement strategy.[21] The muscles of the hip are an important focus. Specifically, we should seek to develop the ability to generate propulsion from the hip, and provide stability to the lower limb in all directions.

Specific strength development for the hamstrings is also a key piece in the puzzle. The integral role of the hamstrings in running gait is generally recognised, but what is often overlooked is that hamstring strength is also a factor in facilitating landing technique.[22] Moreover, the hamstrings provide stability to the knee joint and actively resist shear forces thus protecting the ACL, meriting the description as an ACL agonist. Similarly, given the mechanistic connection of dynamic postural control for non-contact ACL injury, developing lateral trunk strength represents another important objective.[23]

Strength development should proceed in parallel with regular movement skills given the superiority of this combined approach in achieving the desired movement outcomes. Whilst increasing force generating capacity is a necessary step to provide the opportunity, employing neuromuscular training in combination with strength training increases the likelihood that female athletes will express the desired changes in movement mechanics.[24,25] The superiority of strength training in combination with movement skills development applies whether we are seeking to mitigate risk in uninjured athletes, manage overuse injury, or return athletes to performing following acute lower limb injury. Developing the requisite capacities at each link in the chain (hip, knee and ankle) will enable us to simultaneously work to develop the capability to utilise and express this capacity in more mechanically effective movement.

Eccentric torque development should be a particular focus, and eccentric-based strength training is also a highly potent stimulus. There will similarly be a need to progress the strength training program, to mirror the associated progression to more challenging athletic movement training and the attendant higher force demands. Specifically, this calls for more ballistic activities involving high rates of force development and the rapid coupling between eccentric and concentric phases.[17] To continue the theme from a previous commentary,[26] these elements generally constitute 'advanced' training modes, and so practitioners who might be adept with conventional strength training may nevertheless need to familiarise themselves with eccentric training modes, Olympic lifting, ballistic resistance training, and plyometrics or seek out the assistance of a coach who has the relevant expertise.

The critical need for timely intervention

In an ideal world, young female athletes would commence strength training prior to puberty. In many instances, this would mean girls engaging in regular strength training from around age 11. The blanket recommendation for early intervention with all young female athletes is not a new idea. Hewett and colleagues proposed this very solution in their 2012 study.[27] Clearly this is far from common practice currently, despite the consensus in the sports medicine and paediatric sports science literature on the need, the merits, and demonstrated safety when undertaken with qualified supervision.

All young female athletes would benefit from engaging in supervised strength training and receiving appropriate coaching direction for the injury protection this confers and to realise their athletic potential. Not only do girls who are stronger suffer less injuries, strength trained female athletes also demonstrate superior performance on a variety of measures in comparison to their untrained peers across an age span from 10-17 years.[28] Appropriate physical preparation should therefore be viewed as a non-negotiable for girls who participate in sport. To cater to this need, initiatives to deliver strength training under qualified supervision as part of the PE curriculum within a secondary school setting and offering similar provision for girls participating in youth sports are two avenues to be explored.

Whilst we have some way to go, we should be excited by the opportunities that exist, not least from a performance perspective. With a more proactive and systematic approach we can develop Amazonian athletes who are robust to injury and so participate in sport for longer, but who are also able to continue to redefine the limits of performance throughout their extended athletic career

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Basketball New Zealand Guidelines: Safe return to training for players in preparation for a condensed national basketball league season following covid19 restrictions

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INTRODUCTION

The outbreak of Coronavirus disease (COVID-19) around the world was declared a global pandemic by the World Health Organisation (WHO) on February 11, 2020.[34] COVID-19 is described as a viral illness that can that can affect not just your lungs and airways but most organs in the body, spreading from person to person with close physical contact, coming into contact with virus-contaminated surfaces, and from respiratory droplets when an infected person coughs, sneezes, or talks.[15,25,34] The viral illness can be asymptomatic, mild or result in hospitalisation, some requiring life support and in a small number of cases multiorgan failure and death. At the time of writing this document there are over 343,562 deaths worldwide.[34]

COVID-19 has resulted in youth, academic and professional sport in New Zealand,[26] and around the world, suspending play and competitive seasons, as well as structured in-season and off-season training for all sports. In particular, the National Basketball Association (NBA) suspended the season on March 11, 2020, after NBA player Rudy Gobert tested positive for COVID-19.[4] Initial reports from NBA Commissioner Adam Silver outlined that the season suspension would last at least 30 days. However, more recent reports suggest that a mid-to-late-June return is likely the best-case scenario.[28] On March 13, the International Basketball Federation (FIBA) announced that all FIBA competitions were suspended.[18] Collectively, these pivotal decisions set off a chain of events that led to the postponement of several high-profile team sport events, including the National Collegiate Athletic Association (NCAA) men's and women's tournaments, the National Hockey League (NHL) season, Major League Baseball (MLB) spring training, the English Premier League season, and the Union of European Football Associations (UEFA) European Championship, to name a few.

This has led to an uncertain future, with National Basketball Leagues (NBL) across the globe, including New Zealand and Australia, facing unprecedented times which require diligent analysis, evaluation, and preparation to cope with the altered schedule, and the potential deconditioning of players.[16,32]

New Zealand National Basketball League

The New Zealand National Basketball League (NZ NBL) has released plans for a new condensed 56-game competition commencing June 23, with a 1-week finals series to be played July 28 – Aug 1. The league will comprise seven teams (Auckland Huskies, Canterbury Rams, Franklin Bulls, Manawatu Jets, Nelson Giants, Otago Nuggets and Taranaki Mountainairs) that will play up to three games per week over five weeks, with all teams playing 14 regular season games based in Auckland.[1] The NZ NBL finals will feature all seven teams from the start of week six as they work their way through to the last two teams standing for the Grand Final on Saturday 1 August. From an athlete health and wellbeing perspective, two primary concerns have been raised in relation to the condensed schedule, these relate to:

1 Return to competition timeframe:
   - Length of preparation period: From the revised schedule release date, NBL teams will have a 33-day preparation period.
   - What is an acceptable pre-competition preparation timeframe to safely prepare professional players to return to the demands of National League competition after COVID-19 lockdown and training in isolation?

2 Condensed schedule: 14 games in 32 days:
   - Several teams will have intensified game blocks during the scheduled. For example, some teams will be required to play 5 games in 9-days, while others play 6 games in 12-days.
   - Back-to-back games: Five teams will play three back-to-back games, while two team will play two back-to-back games.
     - Taranaki Mountainairs: 5 games in 9-days, two back-to-backs
     - Franklin Bulls: 8 games in 14-days, two back-to-backs
     - Canterbury Rams: 9 games in 18-days, three back-to-backs
     - Manawatu Jets: 8 games in 16-days, three back-to-backs

In light of these concerns, Basketball New Zealand (BBNZ) sought collaboration from leading medical, academic and high-performance personnel in the development of guidelines to assist in the safe return to training for elite players, in response to the COVID-19 pandemic. The concepts of load, overload, and recovery are key considerations for coaches, performance staff and team physicians supporting athletes,[2] and are addressed throughout. Importantly, these guidelines support the Sport New Zealand, Balance is Better National Sport Season Transition Guidelines,[30] in providing training guidelines.

IMPLICATIONS OF COVID-19 ISOLATION ON PLAYER PHYSICAL READINESS

Effect of Detraining due to Covid-19 Isolation

The principle of training reversibility states that stopped or markedly reduced training induces a partial or complete reversal of the previous developed adaptations,[21] thus compromising athletic performance. The reversibility principle is also known as detraining.[20] When determining the effect of detraining from a variety of sports,[20,29] NBL executives, coaches and support staff must take into account the necessary (re)training time ('minimum effective dose') required for players to regain optimal physical conditions and maintain, or at least attenuate, the decay of endurance- and neuromuscular-related performance parameters upon return to training and competition.[8] Coaches and support staff should remain alert for potential risk of injury during the return to training stage for the following three key reasons:

1. Almost 60% of noncontact injuries have been reported during periods in which collegiate athletes transitioned back into training following a period of inactivity (e.g., after vacation).[8]
   a. *National Football League (NFL) lockout (2011):* Resulted in a significant increase in Achilles tendon ruptures in the following shortened preseason.[24] Twelve Achilles tendon ruptures occurred in 1-month, with 10 over the first 12-days of the preseason.
   b. *National Basketball Association (NBA) lockout (2011):* Experts warned of similar lockout injuries following the 149-day NBA lockout.[3] Games resumed Dec 25, 2011. By Jan 8, 2012, 19 key players across the league had already lost time to injury.
2. Cardiovascular fitness loss may occur as soon as 4 weeks of detraining;[27] with overall ~10% each week of total inactivity can be generally expected;[11] and
3. Loss of lean mass and muscle strength represents an important injury risk factor.[11]

As a simple rule an increase of training load of more than 10% per week more than doubles the injury risk over smaller increments in training load and represents 40% of the entire seasons injury risk.[12]

Moving forward through this immediate period of uncertainty, it is recommended that team administration, coaches, support staff, and athletes, anticipate various plausible scenarios, such as:

a. Team practice time constraints upon return to competition;
b. Limited accessibility to fitness and rehabilitation equipment,
c. Social and physical distancing restrictions.

Load Monitoring

In light of concerns surrounding the physiological and psychological demands associated with a condensed NZ NBL season, and the potential injury risk during retraining,[24] the concept of *'load monitoring'* is a primary consideration for game and training dose decisions.[32] Determining the prescribed *'external training load'* (i.e. physical 'work'), accompanied by measurement of *'internal training load'* (i.e. physiological or perceptual 'response'), assists coaches in quantifying the global acute training and competition stress placed on the athlete, and provides a means to determine the chronic load applied over time.[13] Reportedly, higher loads are associated with lower injury risk,[17] suggestive of a more robust athlete, so it would be fair to assume that best practice is to progressively build to higher chronic loads. Building to these loads makes it more likely that an athlete will cope with the demands of competition, and be potentially more resistant to injury. That is to say – while athletes may need greater load to potentially be more resistant to injury, this loading should be progressive. Progressive load is the gradual and systematic increases in training load to maintain and/or achieve continued positive training adaptation.[21] The rate of progression is an extremely important consideration, as progressing load too rapidly can result in injury while too little load will delay fitness gains. Finally, recovery strategies should be implemented as a means to promote adaptive responses to internal and external loads.[22] Figure 1 presents various methods to quantify training load, specifically from a basketball context.

50/30/20/10 Rule

The *"50/30/20/10 rule"* spanning a 4-week training period may serve as a useful baseline approach to individual and team load progression, as outlined in the Joint Consensus Paper by the National Strength and Conditioning Association (NSCA) and Collegiate Strength and Conditioning Coaches Association (CSCCa).[8] With the reintegration of players into the training environment, it is recommended to reduce the overall conditioning volume by 50% of the uppermost planned conditioning volume in the first week following return to training, with a 1:4 or greater work:rest ratio applied. This is followed by a 30% reduction in uppermost planned volume (week 2), 20% (week 3), and 10% (week 4), which would then see players completing the fully planned load in week 5. Theoretically, such an approach to progressive overload may assist with the lead management of players during reintegration into the training environment. Table 1 provides basketball-specific considerations outlined in an example 5-week return to training and competition plan. Key considerations include the number of sessions per day and per week; the session duration; the reintegration of physical contact and competitive training; and plyometric exercise progressions.[9,10]

Importance of Recovery

In the 2018 Recovery and Performance in Sport: Consensus Statement, Kellmann and colleagues[22] define recovery as a 'multifaceted (e.g., physiological and psychological) restorative process relative to time'. From the basketball-specific demands of training and competition, recovery should aim to minimise the impact associated with increased mechanical stress related to faster and shorter accelerations and decelerations, explosive changes of direction, repeated jumps and landings, and physical force contact among players.[7] Commonly used recovery strategies aim to hasten regenerative processes, whether through lifestyle (e.g., active recovery, sleep), physiological (e.g., post-exercise cooling, massage, compression), or nutritional and pharmacological interventions (e.g., supplements, anti-inflammatory medications).[14,23,33] Additionally, psychological well-being should not be overlooked in athletes, especially when returning to training and competition

Figure 1: Methods of quantifying training load for various training modalities applied to basketball. (Abbreviations: Rate of perceived exertion = RPE; Arbitrary units = AU).

Table 1: Example of a 5-week return to training and competition plan: Basketball specific considerations.

Week	Training Goal	% of Uppermost Planned Training Volume	Basketball-specific considerations
1	Reintegration to the training environment	Actual training volume to equal **50% reduction** uppermost planned training volume	1 2-3 training sessions per week 2 1x court-session per day 3 Session duration ≤ 60 minutes 4 Non-consecutive days on court 5 No contact work 6 No competitive work 7 Plyometric training 8 40-60 reps Level 1/2 jump landings
2	Returning to train	Actual training volume to equal **30% reduction** uppermost planned training volume	1 3-4 training sessions per week 2 1x court-session per day 3 Session duration 60-75 mins 4 Non-consecutive days on court 5 Introduce contact work ≤ 20% of session time 6 Introduce competitive work ≤ 20% of session time 7 Introduce deceleration drills ≤ 20% of session time 8 Plyometric training 60-70 reps Level 2/3 jump landings
3	Returning to train	Actual training volume to equal **20% reduction** uppermost planned training volume	1 4-6 training sessions per week 2 2 days on / 1 day off 3 2x court-sessions per day 4 Session duration ≤ 75 mins 5 Contact work ≤ 25% of session time 6 Competitive work ≤ 25% of session time 7 Deceleration drills ≤ 25% of session time 8 Plyometric training 70-80 reps Level 3/4 jump landings
4	Returning to play	Actual training volume to equal **10% reduction** uppermost planned training volume	1 4-6 training sessions per week 2 2 days on / 1 day off 3 2x court-sessions per day 4 Session duration ≤ 75 mins 5 Contact work ≤ 30% of session time 6 Competitive work ≤ 30% of session time 7 Live play situations ≤ 30% of session time 8 Deceleration drills ≤ 30% of session time 9 Plyometric training ≤ 100 reps Level 4/5 jump landings
5	Returning to play	Actual training volume **equal uppermost planned** training volume	1 Manipulate training components as required to meet player needs

Plyometric progression guide: Level 1/2 = Jumps in-place; Level 2 = Standing horizontal jumps; Level 3 = Multiple jumps (bilateral hopping/jumping); Level 4 = Box jumps; Level 5 = Bounding.[9, 10]

following

Table 2: Example of the 24 hour recovery points checklist.

Recovery Strategies	Description	Recovery Points
Compression therapy	Compression Garments / Socks • Worn during sleep • Worn during travel Intermittent pneumatic compression	2 points 1 point 2 points
Cold water immersion Hot water immersion Contrast therapy (hot/cold)	Ice bath (12-15°C): 8-12 mins Spa (~37°C): 8-12 mins Contrast 30 sec cold > 30 sec hot (8 rounds)	2 points 1 point 1 point
Hydrotherapy • Pool • Beach	Alternate swim strokes, running drills, mobility stretches: 20 mins	3 points
Sleep restoration	Achieved 8+ hours sleep last night Nap during day: 20-30 mins Used sleep aids (eye mask and ear plugs)	3 points 2 points 1 point
Psychological wellbeing	Listen to Smiling Mind App: 8-12 mins Visualisation: 8-12 mins Future-self Awareness: 8-12 mins	3 points 3 points 3 points
Substrate • Nutrition • Hydration	High protein snack within 30 mins of training (e.g., milk) Whole foods consumed within 90 mins after training Meet daily hydration target	1 point 1 point 1 point
Mobility Stretching	Yoga or Pilates: 20 mins Stretching with aids: 20 mins • Resistance bands • Mobility stick • Ankle incline board	3 points 2 points
Massage	Self-myofascial release (e.g., foam roller): 20 mins Calf massage (Effleurage): 8-12 mins Spiky ball planter release	2 points 1 point 1 point

Adapted from Bird,[6] and Vaile et al.[33]

COVID-19 restrictions. As alluded to by Minnett and Costello,[23] there is no 'one-size-fits-all' approach to recovery, therefore it is important to educate athletes about the importance of individualised, self-initiated, proactive recovery strategies.[14,33] Variations of the weekly recovery checklist6 have been used as successful education tools within the Australian NBL (Perth Wildcats, Illawarra Hawks), as well as internationally with the Indonesian Olympic Team (Beijing 2008 and Rio 2016) and Scotland Basketball at the 2018 Commonwealth Games. Table 2 provides an example of a 24-hour recovery points checklist. The goal is for the athlete to accrue a pre-determined number of recovery points within the 24-hour recovery period, which will be dependent on the sport-specific context.

RETURN TO TRAINING AND COMPETITION PLAN – RECOMMENDATIONS

It is recommended that teams competing in the NZ NBL address the steps outlined in the Reintegration, Planning, Returning process, which take into consideration the recommendations from leading governing bodies.[8,19,30]

1 **REINTEGRATION** to the training environment
- a COVID-19 Checklist
  - i COVID-19 Symptom checker
  - ii COVID-19 Hygiene protocols
- b Player musculoskeletal screening
  - i Performed by: Medical staff (Physiotherapist)
  - ii Aim: Determine if the athlete is currently injury free and ready to return to training
- c Player physical and sport-related testing
  - i Performed by: Performance staff (Strength and conditioning coach)
  - ii Aim: Determine athletes current physical performance capacity and readiness to return to training
- d Plan recovery modalities from recovery checklist
  - o Refer to Table 2
    - Neural
    - Muscular
    - Psychological
    - Nutrition
- e Player Health and Wellness Status Weekly Report
  - i Send to NBL
- f Basketball-specific training considerations
  - o Refer to Table 1

2 **PLANNING** to train/play/compete
  a Team training
    i Training load quantification
    ii Athlete monitoring and daily wellness reporting
  b Plan recovery modalities from recovery checklist
    o Refer to Table 2
      • Neural
      • Muscular
      • Psychological
      • Nutrition
  c Strength and conditioning
    i Individualised player approach
    ii Identified strength deficits
    iii Micro-dosing principle
      • Maximal strength
      • Change of direction
      • Jump training
      • Specific Endurance
      • Contact Training
  d Physiotherapy
    i Individualised player approach
    ii Identified athlete current injury status
    iii Injury prevention programming
      • International Olympic Committee 'Get Set – Train Smarter' app
      • Basketball prehab programme
  e Player Health and Wellness Status Weekly Report
    i Send to NBL
  f Basketball-specific training considerations
    o Refer to Table 1.

3 **RETURN** to training/play/competition
  a Team training
    i Introduce competitive elements
    ii Training load quantification
    iii Athlete monitoring and daily wellness reporting
  b Plan recovery modalities from recovery checklist
    o Refer to Table 2
      • Neural
      • Muscular
      • Psychological
      • Nutrition
  c Player Health and Wellness Status Weekly Report
    i Send to NBL
  d Basketball-specific training considerations
    o Refer to Table 1.

GENERAL CONSIDERATIONS FOR SAFE RETURN TO SPORT

The safe return to sport of elite athletes in a COVID-19 environment will be a complex process. General considerations outlined in the Australian Institute of Sport Framework5 and the Return to basketball FIBA COVID-19 restart guidelines[19] provide minimum baseline of standards for 'how' high performance/professional sport activities can be reintroduced based on the best available evidence to ensure the safety of athletes/other personnel and the wider community. Four key areas include, (1) Preparation for sports resumption; (2) Proposed criteria for resumption of sporting activities; (3) Athlete assessment conducted by performance and medical staff prior to the resumption of formal training; and (4) Ongoing monitoring and management of athletes and other personnel. Parliamentary and/or Local Public Health Authorities must be closely consulted in decisions regarding the resumption ('when') of high performance and/or professional sport activities. All individuals and sport organisations must follow directions of the appropriate Health Authorities. Additionally, it recommended that athletes and/or support staff must not join the training environment if in the last 14 days they have been unwell or had contact with a known or suspected case of COVID-19. Sport organisations must be proactive and ensure all athletes/staff have been medically cleared prior to return to the training environment.[5]

CONCLUSION

The primary focus of the Basketball New Zealand guidelines is the safe return to training for players in preparation for competition. At the forefront of these guidelines is player health and wellbeing. This deals with both the physical and psychological preparation of players to compete in a condensed National League, and prevention of viral spread through common COVID-19 hygiene measures. We acknowledge the logistical constraints, and the difficulty to implement sport-specific training strategies under previous New Zealand Alert Levels,[26] making it difficult to provide training solutions comparable to those adopted under normal circumstances.

Fundamental objective assessments and ongoing subjective athlete monitoring is likely the best avenue to determine players readiness following reintegration to the training environment and during the returning to training/play phase.[32] This provides an opportunity to individualise, recommend, implement, and modify daily training loads. Recovery strategies addressing muscular, neural, psychological, substrate recovery such as sleep hygiene, best nutrition practice, and psychological wellbeing have potential to improve athlete health and performance.[6,14,33] Training strategies such as micro-dose loading and prehabilitation focused on high risk areas may improve physical and psychological readiness of players.[32] While the proposed guidelines provide a framework for injury risk minimisation and safe return to training and competition, further to this, sports administrators and medical providers must remain aware of common COVID-19 symptoms and testing protocols as indicated by local resources, in the event of a positive case, to minimise spread among teams.[31]

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