Influences on the Physical Demands of International Women's Sevens Rugby

Jan Reyneke

A thesis submitted to the
Auckland University of Technology
In fulfilment of the requirements for the degree of
Master of Philosophy (MPhil)

2016
Faculty of Health and Environmental Sciences

Table of Contents

LIST OF TABLES

ATTESTATION OF AUTHORSHIP

I hereby declare that this submission is my own work and that to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the qualification of any degree or diploma of a university or other institution of higher learning, except where due acknowledgement is made.

Jan Reyneke

CO-AUTHORED WORKS

The following manuscripts are in the preparation for submission for peer reviewed journal publication as a result of the work presented in this thesis.

Reyneke, J., Hansen, K., Cronin, J., and Malcata, R. An investigation into the physical demands of international women's rugby sevens match play. (Targeted journal – International Journal of Sports Physiology and Performance)

Reyneke, J., Hansen, K., Cronin, J., and Allen, S. An investigation into the influence of score differential on the physical demands of international women's rugby sevens match play. (Targeted journal - International Journal of Sports Physiology and Performance)

INTELLECTUAL PROPERTY RIGHTS

ETHICAL APPROVAL

This study complied with the ethical standards for observational studies as required by Auckland University of Technology. Ethical approval was not required for the purpose of this investigation as the athletes signed agreements with the New Zealand Rugby to allow collected data to be released for research/performance purposes.

NOTE TO READER

Excluding chapters one, two and five, this thesis is presented in a series of chapters in publication format, which in some instances may lead to some unavoidable repetition. This thesis fulfils the AUT University Master of Philosophy guidelines by conducting an applied research investigation in a relevant area. These pieces of research critique previous literature relevant to the topic and provide experimental application to the growing body of knowledge.

ACKNOWLEDGEMENTS

I would like to thank the following people for their individual contributions of this thesis.

Dr Keir Hansen, my primary supervisor. One of the busiest men I know. I have immensely valued your constructive and thorough feedback on all aspects of this thesis.

Professor John Cronin, my secondary supervisor. I cannot thank you enough for all you have done. Your energy and passion for the field of strength and conditioning has had a huge influence on me both academically and professionally.

Dr Matt Kritz, for your support through the data collection period and continual support throughout my career. Your knowledge and support has been a big source of inspiration.

Dr Rita Malcata, and Dr Sian Allen additional co-authors of the two studies. Thank you for always being willing to give up your time to help where you could with my analysis and statistics. I have appreciated your help in an area where I most definitely needed it.

My parents and in-laws, for your continual support. I will forever be grateful.

Amber, my loving and beautiful wife, for your unconditional support through this process.

ABSTRACT

The use of time motion analysis and match analysis to gain a better insight into the demands of match play has been well documented across various sports. The information gathered from these techniques has enabled coaches and conditioning coaches to better prescribe trainings and conditioning to suit the specific demands of match play. The World Rugby (WR) Women's Seven's Series was only established in 2012. As a consequence, research specific to the demands of match play is sparse in the women's game [1-6]. It was therefore the initial aim of this thesis to systematically review all the relevant literature pertaining to the physical demands of both men's and women's rugby sevens match play. The review highlighted some key findings in the male game that were unknown in the female game. Firstly, it was identified that there may be a difference in the match play demands between positional groups in the male game. Secondly, it would appear that a much larger gap in the physical demands of match play exists between international and domestic players in the female game when compared to the male game. Finally, the review highlighted the lack of literature pertaining to the influence of match significance and match outcomes on the physical demands of match play, specific to the female game.

Following the review, Chapter 3 consisted of a longitudinal study exploring whether a difference exists in the physical demands of match play between positional groups and pool and cup games (play off). Fifteen members from a highly ranked international team (age, 24.3±3.87 years; body mass, 67.5 ± 6.31 kg; height, 168 ± 7.15 cm; mean ± SD) participated in this investigation. Global Positional System (GPS) running data, along with match play activities, were analysed to identify whether differences exist between these groups. The main findings from this study highlighted the lack of clear difference in the physical demands between positional groups. The second finding displayed an increase in the physical demands between pool and cup games. These increases however, where mainly through match activities and not the running demands. It was concluded that as the match importance increases, the demand on greater skill execution, rather than the running demands, becomes of greater significance.

Following Chapter 3, another longitudinal study was conducted exploring whether the score differential in winning games influenced the physical demands of match play. The same team participated in this investigation. Winning score differentials were classified

as either small (<21 points) or large (>21 points) and GPS running data along with match play activities were analysed to identify whether differences exist. Total distances covered were moderately greater in high score differential games (3.8, ±5.2 m/min; mean difference, ±99% confidence limits). Small differences (high-low) were also observed for distance covered at the following speeds: 2-3.5m.s^{-1} (1.3, ±3.4 m/min), 5-6m.s^{-1} (0.8, ±1.5 m/min) and ≥6m.s^{-1} (1.4, ±1.6 m/min). There were moderately greater numbers of missed tackles (0.2; mean count) and lineouts (0.5) in low score differential versus high score differential games. Coaches and conditioning coaches should consider the total running and match activity demands when matches are won by large or small margins. Specific recovery protocols should be considered for matches that have either higher running demands or higher match activity demands.

CHAPTER 1

INTRODUCTION

Thesis Rationale

Since its inclusion into the Olympic games program, the popularity of rugby seven's has attracted increased global attention, converting it into one of the world's fastest growing sports [7]. This is no more evident in the women's game with World Rugby (WR), formally known as the international rugby board (IRB), reporting women's rugby to be one of the fastest growing forms of the game with 200,000 registered women actively competing in fifteens and sevens and 800,000 women and girls participating in leisure rugby around the world [8]. Despite this, research into the game demands in the women's game is sparse, with studies of match analysis [2, 5, 9, 10], effects of match play on neuromuscular fatigue and muscle damage [11] and the validity of a fitness test [5] the totality of research. The body of literature pertaining to the male version of the game is larger, however it is unclear whether the games share similar physical demands. Therefore, drawing conclusions based on research from the male game could be misleading.

Studies into female rugby sevens have been predominantly centred around the physiological demands of match play [2, 9, 10], which have had a strong focus on the running and heart rate demands. Comparisons of the physical match demands between international and domestic [9, 11] match play and fatigue profiles across halves of play [2] have been made. Authors have reported international match play to carry a higher overall physical demand [9] when compared to domestic match play and that there is no significant decrease in performance across halves of play [2]. Although of value, these investigations have had small sample sizes and data has only been collected across one tournament. Factors such as tournament location, environmental conditions, quality of opposition, and injuries are also likely to influence a team's performance during competition [12]. Therefore, collecting data from only one tournament may not provide an accurate description of the demands across various situations.

As with fifteen-a-side rugby, players are required to perform specialist activities during gameplay specific to their playing positions. These specialist activities include

scrummaging and lineouts. It has been shown that the demands of fifteen-a-side rugby is very position specific, with distinct differences in the running and match activity demands [13]. The differences in the demands between positional groups in rugby sevens have been explored in the male game [14-18]. It would appear some differences do exist between positional groups in the male version of the game that may have important implications to specific preparation practices. To date no such research exists in the female game.

One unique aspect of rugby sevens is that it is played in a tournament format over one to two consecutive days. A typical tournament consists of two to three pool matches on the first day of play, followed by two-three play off matches (cup matches) on day two. Little is known of whether there is any change in the physical demands as the significance of the matches' changes from pool to cup games. A better understanding of the specific demands of matches would aid coaches and conditioning coaches in the prescription of specific recovery protocols. A recent investigation in the male game [15] showed no significant differences between the demands of pool and cup games. With a more established world series, it would seem the male game has a relatively stable competition. No research to date has explored the influence of match significance in the female game.

Only one study to date has investigated the influence of the score line on the activity profiles in the male version of the game [19]. The authors reported that players are likely to perform more running against higher ranked opponents when the score line is close. Previous research into football [20-22], rugby league [23, 24] and Australian rules football [25] have investigated the influence of the quality of opposition and the effect of match outcome score differential on the physical demands with contrasting results. Investigations into football and Australian football rules have reported less successful teams perform a greater amount of physical activity during match play. Researchers investigating rugby league however, have reported the opposite with more successful teams completing a greater amount of physical activity during match play. The authors suggested that the ability of more successful teams to maintain a higher physical intensity to be a competitive advantage. A better understanding into the influence of match outcomes on the physical demands will provide coaches and strength and conditioners with a more accurate description of the demands from game to game

which in turn, should aid in the prescription of appropriate trainings, rest and recovery protocols. No such research exists to date in women's rugby sevens.

It is clear that further research into the influences on match physical demands is warranted in women's rugby sevens. To date, no research on the match demands exists that has collected data from multiple tournaments or from WR World Series tournaments. It is not known if differences exist between positional groups or if the significance of the match has an influence on the game demands. Likewise, no literature exists exploring the influence of the score differential on the physical demands of match play.

Structure of the Thesis

This thesis is presented as a series of chapters including original research and a review of the current relevant literature. Chapter 2 is a review of the current literature pertaining to both male and female rugby sevens match play demands. As literature specific to female rugby sevens is limited, the majority of literature particular to rugby sevens in the review was conducted on the male game. Likewise, literature pertaining to the influence of the quality of opposition and match outcomes is limited in rugby sevens and therefore will highlight findings from football, rugby league and Australian rules football. Chapter 3 will present the results from a prospective longitudinal study exploring the running demands and match activity demands of international women's rugby sevens. Comparisons will be drawn between positional groups and pool games versus cup games. Chapter 4 will present the findings from another prospective longitudinal study investigating the influence on the score differential of the match outcome on the physical demands of match play. Finally, Chapter 5 will provide a summary, practical applications and directions for future research.

Significance of Research

It is well accepted that a sound understanding of the physical demands of match play is necessary in order to ensure physical training is prescribed in a manner that will aid in the improvement of performance. Identification of the potential differences in factors such as playing position, aids in the development of more specific physical conditioning programming that meet the unique individual demands of match play. Yet to date, very little such research has been conducted in women's rugby sevens.

The influences of different conditions such as weather and match location have been shown to affect match performance [12]. Therefore, a better understanding of how certain situations or conditions influence the physical demands of match play will aid in the development of specific programming that meet these differing demands. Likewise, a better understanding of these unique situational demands aids coaches to better prescribe subsequent trainings specifically, for example, to allow for appropriate work to recovery ratios. This thesis aims to address some of these issues in order to provide a more accurate description of the physical demands of international women's rugby sevens match play across multiple situations or conditions.

Research Questions

It is clear that the influences on the physical demands of rugby sevens match play are multi-factorial. This thesis therefore aims to answer the following questions:

- Is there a difference in the physical demands of match play between the positional groups of forwards and backs in women's rugby sevens?
- Is there a difference in the physical demands of match play between pool matches and cup matches in women's rugby sevens?
- Does the score differential influence the physical demands of match play in women's rugby sevens?

Originality of Research

To date there have been very few investigations into international women's rugby sevens match play. No studies to date have performed any form of match performance investigation from the WR Women's Sevens World Series, which is the highest level of competition in the sport. The team who participated in this investigation were the current World Series champions at the time of investigation. No research to date has been conducted on this team. This research will provide a better understanding of some of the influences on the physical demands of women's sevens match play, which in turn, should provide coaches and strength and conditioning coaches with a better framework to prescribe trainings and recovery from competition.

Limitations of Research

- The participants from this study were all elite international female seven's players from the same team. Therefore, results may not be generalized to other teams.
- Data was only collected from the WR Women's Sevens Series tournaments. Therefore results may not be generalized to other levels of the game.
- Due to the success of the team, this study only analysed results from winning performances.
- General speed threshold bands, commonly used for the purpose of research, were applied rather than individually set thresholds.

Delimitations of Research

- Only results of participants who completed >70% of game time was analysed.
- Data was collected from matches during official WR Women's Sevens Series tournaments.
- Data from finals games were excluded due to the extended game times (ten minute halves versus seven minute halves).

CHAPTER 2

LITERATURE REVIEW

Influences on the Physical Demands of Female Rugby Sevens Match Play

Introduction

Rugby sevens is a 14-20 minute (min) game, divided into two seven to ten minute halves of repeated high intensity activities including running and body collisions. The game is usually played in a tournament format over two to three days, with teams contesting five to six matches over the course of the tournament. Rugby sevens is essentially played under the same rules and field dimensions as rugby fifteens, however, it is played with fewer players (seven) and played for a shorter duration (14-20 min versus 80 min). In addition to the seven players on the field, teams may carry five substitutes and are permitted to make five interchanges throughout the game. Half time intervals are also shorter, with sevens matches consisting of a two minute interval versus 15 minutes in rugby fifteens. Both men and women compete in the World Rugby (WR) World Series consisting of nine and five tournaments each season respectively. 15-24 teams compete in the men's series and 12-16 teams compete in the women's series.

Since its inclusion into the Olympic games program, the popularity of rugby sevens has attracted increased global attention, converting it into one of the fastest growing sports [7]. As a consequence, governing bodies have increased the resources placed into sevens programs. This increase in resources has led to a demand for greater clarity around the specific demands of sevens match play. As a result, there has been some recent research into rugby sevens, mostly focused around men's sevens [14-19, 26-39]. Investigations into rugby sevens performance have focused on physical profiling [18, 29, 32], training load monitoring [26], effect of fatigue on neuromuscular function [37], influence on time of day on lower body power output [36] and match analysis [14-19, 27, 28, 31, 34, 35, 38, 39].

Investigation into performance in women's sevens is sparse, with studies of match analysis [1-3, 5, 10], physical profiling [4, 40] and the effect of match play on neuromuscular fatigue and muscle damage [11] the totality of research. The purpose of this review is to report the literature pertaining to the physical demands of rugby sevens match play to date in both the men and women's games. Firstly, literature investigating performance analysis, through the use of time motion analysis and notational analysis, will be reviewed. Thereafter, literature detailing the differences in the physical demands between positional groups, match significance and match outcomes will be summarized and key findings highlighted. The review will attempt to highlight the influences of different aspects on the physical demands of sevens match play.

Performance Analysis of Male and Female Rugby Sevens Match Play

It is well accepted and documented that males possess superior absolute muscle strength and produce greater power output than their female counterparts in a number of movement patterns and activities [41-43]. Investigations into the direct comparison between the demands of male and female team sports are sparse. Investigation into the highest level of football has revealed some significant differences ($P<0.01$) in the physical demands of match play between males and females [44]. The authors reported males to cover more distances at high-speed running >18km.h^{-1} (34%), fatigue less in the second half at speeds <15 km.h^{-1} (89%) and display more accuracy in skill execution during match play. However, as stated above, with the distinct differences in absolute physical output, relative speed thresholds may well provide a more accurate description of the individual physiological demands. A recent article by Bradley et al. [45] has suggested that the disparity in high speed running and sprinting distances is likely a reflection of sex differences in locomotor ability. The authors continued to suggest setting speed thresholds specific to female football players would provide a more accurate description of the physical demands placed on females during match play.

Furthermore, a recent investigation by Clarke et al. [10] exploring physiologically based GPS speed zones in female rugby sevens, reported that the currently used 5 m.s^{-1} , to describe high intensity running, may well underestimate high intensity running in female team sports by as much as 30%. Given this information, caution should be applied when comparisons are made between male and female data when relative or sex specific speed threshold metrics are not reported. It has also been shown in rugby league

that repeat high intensity effort (in the form of sprinting and tackling) has a greater physiological stress than repeated sprinting in isolation [46]. Therefore, drawing conclusions from non-collision based sports may well be misleading. To date no direct comparisons have been made between male and female rugby sevens match play, thus an aim of this review.

Interest in the match performance characteristics of sevens has grown rapidly since its inclusion in the Olympic Games. An understanding of match activities enables strength and conditioners to identify the demands placed on players in competition and apply the information to training, testing and recovery protocols. It has been established in the men's game, that although played on the same sized field and under essentially the same rules as the fifteen-a-side game, the movement patterns and subsequent physical demands vary greatly between the two codes [31]. This would suggest preparation should differ between the two forms of rugby, sevens and fifteens. Consequently, numerous studies have been conducted investigating the demands in the male game [14-19, 27, 28, 31, 33-35]. However, little is known whether differences exist between the movement demands of male and female sevens match play. A better understanding of whether differences exist, would aid in future research direction and may also provide a reference point for coaches to compare information from studies conducted on the male version of the game and its application to the female game.

Time Motion Analysis in Rugby Sevens

Influences on Total Distances in Rugby Sevens

Time motion analysis is a common method used in intermittent team sports to analyse and track player movements [2, 5, 13, 16, 17, 28, 33, 34, 47, 48]. An accurate description of specific match demands such as distances covered at different speeds, average speeds and number and distance of sprints are all important in assessing performance and tracking individual players [49-51]. Time-motion analysis of men's rugby sevens match play has used video analysis [18] and Global Positioning Systems (GPS) [14-17, 19, 28, 31, 33, 34, 52]. Time-motion analysis of women's sevens has used GPS only [2, 3, 5, 9-11]. The studies pertaining to match demands in both male and female sevens can be observed in Tables 1 and 2. There are several factors where caution should be applied when comparing the running demands from these studies. Firstly, the inconsistency in the inclusion criteria for analysis, displayed in Table 1, makes comparisons between studies problematic. It has been shown that substitute

players cover substantially greater high speed running in the second half when compared to players who contest the entire game [28]. The inclusion of this data may well have an influence on the relative total distances covered, which are reported in many studies. Secondly, the number of tournaments from which data was analysed varies, as does the level of competition.

Table 1. Summary of GPS data inclusion criteria in sevens research

Study	Subjects	Tournaments Analysed	Inclusion criteria	Analysed files
Ross et al. (2014)	27 Male Int	9	>70% game time	136
Ross et al. (2014)	11 Male Int	3	>70% game time	92
	12 Provincial	1		37
Suarez et al. (2014)	10 Male Club	1	Entire Game	23
Granatelli et al. (2014)	9 Male Club	2	Time on Field	NS
Higham et al. (2014)	42 Male Int	4	>1min game time	306
Suarez et al. (2012)	7 Male Club	1	Entire game	17
Higham et al. (2011)	19 Male Int	2 Int	NS	75
		3 Dom	NS	99
Suarez et al. (2012)	12 Female Int	1	Entire game	17
Clarke et al. (2013)	22 Female Int	1	Not involved in substitutions	24
Yabar et al. (2014)	10 Female Int	1	NS	29
	10 Female Club	1	NS	21
Clarke et al. (2015)	12 Female Int	1	NS	64
	10 Female state	1	NS	51
Vescovi et al. (2015)	16 Female Int	1	>6min per half	NS
	13 Female Dev	1		NS

NS= Not Stated
Int = International
Dev= Developmental
Dom= Domestic

Factors such as tournament location, environmental conditions, quality of opposition, and injuries have been shown to influence a team's performance during competition

[12]. Therefore, studies that have only collected data from few tournaments may not present an accurate description of the mean physical demands of match play across various situations. The reader needs to be cognisant of these factors when comparisons and conclusions are being made.

Table 2. Summary of total distances covered during matches using GPS

Study	Subjects	Position	Comp	TD (Absolute)	TD ($m \cdot min^{-1}$)	TD Sprinting ($m/m \cdot min^{-1}$)	Number of sprints
Ross et al.	27 Male Int	Forwards	Int	1452m	NS	$117m^{***}$	7.2^{***}
(2014)		Backs		1420m	NS	$134m^{***}$	7.8^{***}
Ross et al.	11 Male Int	NS	Int	NS	105 $m \cdot min^{-1}$	$9.8m \cdot min^{-1***}$	8.4^{***}
(2014)	12 Provincial	NS	Dom	NS	105 $m \cdot min^{-1}$	$8.35m \cdot min^{-1***}$	6.3^{***}
Suarez et al.	10 Male Club	All	Dom	NS	102 $m \cdot min^{-1}$	$9.7m \cdot min^{-1**}$	7.5^{**}
(2014)		Forwards		NS	98 $m \cdot min^{-1}$	$8.3m \cdot min^{-1**}$	6.5^{**}
		Backs		NS	107 $m \cdot min^{-1}$	$11.2m \cdot min^{-1**}$	8.5^{**}
Granatelli et.	9 Male Club	All	Int*	1221m	NS	NS	NS
al (2014)		Forwards		1139m	NS	NS	NS
		Backs		1292m	NS	NS	NS
Higham et al.	42 Male Int	Forwards	Int	NS	96 $m \cdot min^{-1}$	$6.4\ m \cdot min^{-1***}$	8.4^{***}
(2014)		Backs		NS	103 $m \cdot min^{-1}$	$9.8m \cdot min^{-1***}$	11.2^{***}
Suarez et al.	7 Male Club	NS	Dom	1580m	NS	$138\ m^{**}$	3.7^{**}
(2012)							
Higham et al.	19 Male Int	NS	Int	NS	120 $m \cdot min^{-1}$	$12.7\ m \cdot min^{-1***}$	NS
(2011)			Dom	NS	121 $m \cdot min^{-1}$	$11.1\ m \cdot min^{-1***}$	NS
Suarez et al.	12 Female Int	NS	Int	1556m	NS	$181m^{**}$	2.7^{**}
(2012)							
Clarke et al.	22 Female Int	NS	Dom	NS	86 $m \cdot min^{-1}$	NS	NS
(2013)							
Yabar et al.	10 Female Int	NS	Int	1642m	NS	$119m^{**}$	6.5^{**}
(2014)	10 Female Club	NS	Dom	1363m	NS	$47m^{**}$	1.6^{**}

Table 2 continued

Clarke et al. (2015)	12 Female Int	NS	Dom	NS	97m·min^{-1}	NS	NS
	10 Female State	NS	Dom	NS	94 m·min^{-1}	NS	NS
Vescovi et al. (2015)	16 Female Int	NS	Dom	1468m	95 m·min^{-1}	8 m·min^{-1}**	NS
	13 Female Dev	NS	Dom	1252	91 m·min^{-1}	4 m·min^{-1}**	NS

*International Tournament with domestic teams
** >20hm·h^{-1}
*** ≥6m·min^{-1}
NS= Not Stated
TD = Total Distance
Int= International
Dom= Domestic
Dev= Developmental
#= Number

A summary of data from studies which have investigated total distance covered during sevens match play can be observed from Table 1. Through the use of GPS, researchers have reported male and female players to travel a mean relative distance of 98-121 $m \cdot min^{-1}$ and 86-97 $m \cdot min^{-1}$ respectively, during match play. Absolute distances have been reported from 1221-1580 m and 1252-1642 m for males and females respectively. Of the total relative distance, it has been reported international men spend ~9% sprinting and perform on average ~8.6 sprints per match. International women seem to spend a similar percentage of their relative total distance sprinting (~9%) however, perform 50% fewer sprints (above 20 $km.h^{-1}$ or 6 $m.min^{-1}$) during games. Domestic men spend 9% of the total distance sprinting and complete six sprints per match, whereas domestic women only spend 3% sprinting and complete two sprints per match.

It would seem a clear difference exists between international and domestic match play in the female game with authors reporting a 16% difference in the total distances covered [1, 2, 9, 53]. This difference does not seem to exist in the male game however, with no difference in total distances covered by international players observed when compared to domestic players during match play [28, 52]. This large difference between domestic and international match play in women's sevens could well be attributed to the relatively young age of competitive women's sevens, with the first WR Women's World Sevens Series only being played in 2012. The WR Men's Sevens World Series on the other hand, has been in place since 1999. It is possible that the more established male game may have more mature domestic programs that may have consequently lead to the reduction in the gap between international and domestic match play. With dedicated coaches and conditioning coaches more prevalent at the international level in the female game, international players are more likely to have superior physical capacities, which could account for the large difference in match performance. However, there is little research to back this contention.

The difference between the reported relative total distances covered by male and female international players appears to be moderate (~16% greater in males). It should be noted however, that none of the international match play research carried out in the female game was conducted during the WR Women's Sevens Series, which involves the top 12-16 female teams in the world. The quality of opposition may well have an influence on the running demands. Suarez et al [33], noted that during their study on the male game, the analysed players won most of their games quite convincingly, with most

games being "decided" by half time. This is likely to have reduced the overall running demands during the second half. One could suggest that score differentials or the quality of opposition may well influence the running demands during match play. Additionally, all studies conducted on the female game have only collected data from one tournament. As highlighted, there are several factors which may influence a team's performance during competition [12]. Therefore, collecting data from only one tournament may not be a true reflection of the mean physical demands. No researchers to date have reported the running demands during WR Women's World Series tournament match play across multiple tournaments and therefore further investigation is warranted to arrive at normative data that is representative of the female game.

The Influence of Playing Position on the Physical Demands in Rugby Sevens

A sevens team consists of two distinct positional categories of which there are three forwards and four backs. Forwards are required to perform two position specific tasks of scrums and lineouts which both have unique energy demands. It is unknown whether these tasks may influence the match play and running demands during match play. To date, five studies in the male game have compared the movement pattern differences between positional groups [15-18, 33]. Reinzi et al [18], through the use of video based time motion analysis using subjective speed zones, reported forwards had a 17% higher frequency of jogs and a 30% higher frequency in static poses compared to backs. However, with the use of subjective speed zones, the analysis of only one tournament and the intra observer reliability for analysis not reported, comparisons to other such studies using GPS is problematic. It should also be noted the tournament analysed was played in 1995. One would suggest the game has developed significantly since then.

Granatelli et al. [17] reported positional differences between halves for the total distance covered with backs covering 12% greater total distance than forwards in the first and second halves. It should be noted however, that parameters around GPS analysis were unclear, simply using "time spent playing" for analysis. With Higham et al. [28] reporting substitute players to perform significantly greater high intensity running volume in the second half (123%), one could expect substitute players would influence the average distances covered and it would suggest setting parameters around GPS analysis is of importance. Higham et al. [16] reported that international backs compared to forwards achieved 6% higher maximal velocity, performed 12% more accelerations,

9% more decelerations and covered 7% greater distances ≥ 3.5 $m.s^{-1}$ and overall total distance.

Table 3. Summary of differences in positional running demands in men's rugby sevens

Study	Subjects	Measure		Difference
Reinzi et al. (1999)	30 male International	Jogging*		+ Forwards (61.4±13.5 compared to 51.2±10.3)***
		Static poses*		+ Forwards (62.1±12.6 compared to 43.6±10.3)***
Granatelli et al. (2014)	9 male club	TD between halves	1st half	+ Backs (677±60 m compared to 599±60m)****
			2nd half	+ Backs (615±87 m compared to 540±51 m)****
Higham et al. (2014)	42 male International	Max velocity		+ Backs (8±1.1 $m \cdot s^{-1}$ compared to 7.5±0.9 $m \cdot s^{-1}$)
		Accelerations		+ Backs (4.1±1.1 min^{-1} compared to 3.6±0.9 min^{-1})
		Decelerations		+ Backs (3.2±0.9 min^{-1} compared to 2.9±0.7 min^{-1})
		TD		+ Backs (103±14 $m \cdot min^{-1}$ compared to 96 ± 12 $m \cdot min^{-1}$)
Suarez et al. (2013)	10 male club	TD		+ Backs (+10±0.96%; moderate ES)**
		Distance >14 $km \cdot h^{-1}$		+ Backs (+26.4±6.2%; moderate ES)**
		Distance >20 $km \cdot h^{-1}$		+ Backs (+35±10.8%; moderate ES)**
		Maximum sprint distances		+ Backs (+15.8±4.2%; small ES)**
Ross et al. (2014)	27 male international	Maximal velocity		+ Backs (+5.9%; moderate ES)**

***Subjective measure**
****Cohen ES statistics trivial (0.0–0.19); small (0.2–0.59); moderate (0.6–1.1); large (1.2–1.9); and very large (>2.0)**
*****Frequency**
******Factorial ANOVA; p = 0.03**
TD= Total Distance
+=Greater

The authors reported that although the differences were small to moderate, they were deemed to be of practical importance. Suarez et al. [33] reported that domestic backs covered 9% more total distance, 21% higher distances at speeds >14.0 $km \cdot h^{-1}$ and 26%

greater distances at speeds >20.0 km·h^{-1} than forwards. Ross et al. [15] reported the absence of substantial difference in the overall physical demands between international forwards and backs. Match demand differences were small for all running variables and match activities.

Some clear trends seem to exist in the literature pertaining to the male game. It would seem for the most part that backs cover greater distances, distances at high-speed thresholds and achieve higher velocities compared to forwards. To date no studies have reported the differences in the positional running demands in female rugby sevens. Furthermore, little is known in the female game of the non-running demands. A better understanding of the total match demands between positional groups will provide coaches and conditioners with a better framework to prescribe trainings.

The Influence of Game Significance on the Physical Demands of Match Play

The influence of the level of competition has received some attention in rugby sevens in both the male [28, 52] and female games [3]. Higham et al. [28] reported mostly trivial and small differences in running demands between international and provincial male seven's players. However, the same players, who were international players, were analysed for both international and provincial games. As it is likely international players will possess greater physical capacities than provincial players, collecting data from an international player, playing in a provincial tournament, may not provide an accurate description of the match demands at a provincial level. Ross et al. [52] reported significant differences in high speed running (15%, ES=0.3) and rucks attended (ES=0.54) for international players compared to provincial. The authors also reported that international matches involved substantially greater active ball in play cycles (12%, ES=1.32) than provincial matches. In the only study to date performed on the female game exploring the differences in competition level, Portillo et al. [3] reported international players to cover 17% greater total distances and perform 2.3 times greater high speed running meters.

Indeed it seems that the physical demands of match play may increase as the level of competition increases, however, little is known of whether the quality of the opposition within the same level of competition may influence the physical demands of match play. Higham et al. [28] reported some small differences (4-18%) in movement patterns between tournament rounds for both international and provincial tournaments, however

the authors did not state whether the teams were competing in the cup (top half of teams from pool play) or the bowl (bottom half of teams from pool play). Competing in the bowl would likely result in a lower level of competition. Considering this, Ross et al. [15] compared the physical demands of pool play and cup matches and although the running demands and match activities did not differ significantly, a large (ES = 1.5) difference in the average ball-in-play time and a large increase (proportion ratio = 0.46) in the number of ball-in-play sequences > 60s was observed from the cup as compared to the pool round. However, the increase in the average activity sequence in cup rounds was coupled with an increase in recovery time between efforts resulting in a similar work to rest ratio between rounds. The authors concluded that the lack of clear differences in activities performed between pool and cup rounds may suggest a relatively stable overall competition level. To date, no studies have investigated whether a difference exists in the physical demands between pool matches and cup matches in female rugby seven's tournaments, consequently further investigation is warranted.

The Influence of Match Outcomes and Score Differentials on the Physical Demands of Match Play

There are a number of influences that may play a role in a player's activity profile during match play. To date, the influence of match outcomes (i.e. winning/losing and score differential) on the physical demands of rugby sevens match play has received little attention. Only one study to date has been conducted in the male game [19]. Some research has been conducted in rugby league [24], football [21, 22] and Australian football (AFL) [25], with conflicting results.

A study by Murray et al [19], characterized the activity profiles of international male sevens players during peak periods of play. The authors reported players performed more high speed running in the second half when the score was close and concluded that players are likely to perform more running when playing against higher ranked opponents. Researchers in football have assessed the within league influence of success, reporting that less successful teams covered greater distances in both high speed running and sprinting [22]. Furthermore, it has been shown that players from less successful teams have greater activity profiles than those from successful teams [20, 22, 54]. Investigation into AFL [25] has shown a similar trend, with authors reporting less successful teams are likely to have an increased physical activity profile and decreased

skill involvement and proficiency when compared with successful teams. Investigations into rugby league however, have provided contrasting results with Gabbett et al. [24] reporting the physical demands (e.g. distance covered, maximal accelerations and repeated high-intensity effort performance) of winning teams to be significantly greater than losing teams. The authors also reported that larger winning margins were associated with greater physical running demands when compared to moderate and small winning margins. It was suggested that the competitive advantage of a successful team in rugby league is linked to the ability to maintain higher playing intensity than that of less successful teams [24]. This study was however, only conducted on one team. In a similar study by Hulin et al. [55], the authors compared the match physical demands of two separate teams which were categorized as successful and un-successful based on winning percentages throughout the season. Interestingly, the findings from this study were in contrast to the study by Gabbet et al. [20]. The authors reported that the less successful team covered greater total distances and performed more high intensity running. The authors concluded that caution should be applied when interpreting time motion analysis in isolation as technical and tactical differences may well be the distinguishing factors between successful and less successful teams. Therefore, success may be the result of a multifactorial relationship between technical, tactical abilities and activity profiles.

Further investigation into the influence of match outcomes on the physical demands will provide coaches and conditioners with an accurate description of the demands from game to game, which in turn, will aid in the prescription of appropriate rest and recovery protocols. Likewise, further investigation will add to the body of literature to provide a better understanding of these influences on the physical demands of sevens match play. To date no such studies have been performed in women's rugby sevens.

Notational Analysis in Sevens Rugby

The study of sport through the observation of players' and teams' match activity is vitally important for the organization, design, teaching and training of team sports [56]. The information collected is critical in the identification of success factors and individual player assessments that can be used to track player performance over a period of time. These statistics provide a valuable description of the nature of the sport and may assist coaches in the development of team match preparation. Match

statistics collected in rugby sevens, as with other sports, provides coaches with useful, objective and critical information on the strategies, tactics and patterns of play employed by opposition teams, technical proficiency of teams and key performance indicators which may indicate successful and unsuccessful teams.

Notational analysis has been extensively used in men's 15-a-side rugby union to determine positional differences in match demands [13, 57, 58], performance analysis [59, 60] and to determine team and individual skills that may lead to success [58-61].

Table 4. Summary of notational analysis studies perform on men's rugby sevens

Study	Subjects	Tournament	Measure of Success	Success Factors
Van Rooyen et al. (2008)	9 International teams	2005 Seven World Cup	Reaching semi-final or final	Teams had to maintain possession for 30-60sec and converted 30% into points
Hughes and Jones (2005)	6 International teams	2001 IRB World Sevens Series	Winning percentage ≥70%	33% Fewer rucks Missed 50% fewer tackles 21% more clean line breaks
Higham et al. (2014)	All International teams competing in 2011 IRB World Sevens Series	2011 IRB World Sevens Series	Mean team ranking	Entries into the opposition's 22-m zone per match Tries per entry into the opposition's 22-m zone Tackles per match Passes per match Rucks per match Higher percentage of tackle completion

To date there has been no research on notational analysis in women's rugby sevens match play, with only five studies performed in the men's game [15, 27, 35, 52], which are summarized in Table´s 4 and 5. Van Rooyen et al. [35] investigated the frequency and duration of different phases of play and compared these statistics between successful and unsuccessful teams. It was reported that time in possession of the ball did not differentiate between successful and unsuccessful teams, however teams that reached the semi-finals held the ball for 30 to 60 seconds at a time and converted 30% of those possessions to score.

Hughes and Jones [62] compared the playing patterns of successful (winning percentage ≥70 %) and unsuccessful (winning percentage <70 %) teams from 16

games from the 2001 IRB Sevens World Series. The authors reported successful teams on average formed 33% fewer rucks, missed 50% fewer tackles and had 21% more clean line breaks than unsuccessful teams. It is possible however, that the game has evolved significantly since 2001, and it is therefore possible the above findings are somewhat out-dated. Higham et al. [27] reported more entries into the opposition's 22-m zone per match, tries per entry into the opposition's 22-m zone, tackles per match, passes per match, rucks per match and a higher percentage of tackle completion were associated with a better mean ranking. However, this study was limited to official match statistics routinely collected during the WR Sevens World Series.

There is still little known about the individual match activities of rugby sevens match play as the above studies have all focused on tactical aspects of the game. Although useful, they do not aid in the understanding of total physical match demands. To date only two studies have extensively reported the match activities during male sevens match play (Table 5). Ross et al.[15] explored the differences between positional groups and pool versus cup games for an international team. The authors reported mostly trivial to small differences, across a multitude of match activities (see Table 5), for both positions and pool versus cup matches. It was concluded that due to the lack of clear difference between positional groups for both running demands and match activities, position specific preparation was not required. Similarly Ross et al. [52] explored the differences between international and domestic match play across the same match activities. Substantial differences were reported in the frequency and execution quality between many activities, with international players performing more effective tackles and less handling errors.

A better understanding of the individual demands may help to aid in the specificity of training prescription particularly around skill development. The paucity of research on notational analysis of individual match activities in rugby sevens, in particular to the women's game, warrants further investigation.

Table 5. Summary of match activities performed during sevens match play

	Ross et al. (2015)				Ross et al. (2015)	
Activities	**Forwards**	**Backs**	**Pool**	**Cup**	**Dom (n.min^{-1})**	**Int (n.min^{-1})**
Ball carries	3.2 ± 2.4	4.1 ± 3.2*	3.5 ± 2.5	3.8 ± 2.6	0.26±0.16	0.30±0.16*
Ball taken into contact	1.6 ± 2.2	1.8 ± 2.3	1.6 ± 2.3	1.8 ± 2.5	NS	NS
Passes	2.2 ± 3.3	2.8 ± 5*	2.4 ± 3.8	2.5 ± 3.8	0.25±0.19	0.34±0.28*
Pass from ground	0.38 ± .98	0.47 ± 1.4	0.5 ± .98	0.42 ± 1.0	NS	NS
Own ruck attended	1.0 ± 1.9	1.0 ± 2.2	1.0 ± 1.83	1.1 ± 1.8	0.07±0.09	0.12±0.11*
Tackles	2.7 ± 2.6	2.4 ± 2.5	2.4 ± 2.3	2.7 ± 2.5	0.19±0.13	0.20±0.15
Missed tackles	0.78 ± 1.0	0.69 ± .95	0.74 ± .99	0.73 ± 0.1	NS	NS
Opposition ruck attended	1.51 ± 1.87*	0.89 ± 2.11	1.25 ± 2.1	0.83 ± 1.7	0.05±0.07	0.08±0.10*
Line break	0.36 ± .87	0.55 ± 1.3*	0.48 ± .99	0.43 ± 0.86	NS	NS
Try scored	0.58 ± .75	0.74 ± 0.79*	0.55 ± .76	0.70 ± 0.9	NS	NS
Restart take	0.41 ± 1.4*	0.19 ± 0.78	0.30 ± .99	0.27 ± 1.01	NS	NS
Handling errors	0.62 ± 0.8	0.61 ± 078	0.31 ± .95	0.45 ± 0.83	0.03±0.05*	0.02±0.04
Scrums	1.77 ± 1.86	NA	1.78 ± 1.89	1.83 ± 2.41	NS	NS
Lineouts	0.93 ± 1.22	NA	0.93 ± .85	0.98 ± 0.89	NS	NS

***Small effect size ±90% Confidence limit**
Dom= Domestic
Int= International
NA= Not Applicable
NS= Not Stated

Conclusion

It is readily apparent from this review that further investigation into women's rugby sevens match play is warranted. Although played under the same rules and pitch dimensions as the male version of the game, there appears to be some distinct differences in the demands. Therefore, the studies performed on the men's game may have less application to the women's game. Although the movement demands have previously been reported, no studies to date have reported the movement demands during WR Women's World Series tournaments across multiple tournaments. Likewise, little is known about the individual match activity demands. Further investigation should seek to understand the influence of playing position, the match significance and score differential on the match activities and movement demands. Although not within the scope of this thesis, it should be noted that the variables explored in this thesis only provide an understanding of the external load experienced during match play. To gain a more global understanding of the physical demands, internal loads through the use of heart rate monitoring should be explored. A better understanding of the influences of these variables on the physical demands of match play would provide conditioners and coaches with a better framework to guide training prescription. An understanding of these demands would provide coaches the opportunity to adjust volume and intensities of training sessions based on the demands experienced as a result of these different variables. Specific recovery strategies could be prescribed based on the knowledge of the specific running and match play demands.

CHAPTER 3

THE PHYSICAL DEMANDS OF INTERNATIONAL WOMEN'S RUGBY SEVENS MATCH PLAY

Preface

It is clear from the review of the literature that the influences on the physical demands of sevens match play are multi-factorial. Some key differences in the physical demands between positional groups in the male game seem to exist. However, little is known if these differences exist in the female game. Likewise, it has been shown in the review that the level of competition from pool to cup games does not seem to influence the physical demands during games in the male game. Once again there is no evidence to suggest the same pattern exists in the female game. Therefore, this chapter will firstly address whether differences exist in the physical demands between positional groups in the female game. Additionally, this chapter will address whether any differences in the physical demands exist between pool and cup games.

Introduction

Although played under essentially the same rules and on the same pitch dimensions as 15-a-side rugby, rugby sevens is played with fewer players (seven compared to 15) and matches are 14 minutes (20 minutes for cup finals) as opposed to 80 minutes. Both the women and men compete for the WR World Series that consists of 12-15 teams competing in five tournaments in the women's series, and 16-24 teams competing in nine tournaments in the men's series. Tournaments consist of six games played over two days as compared to one 80 minute game played per day in 15-a-side, usually separated by five to seven days. The popularity of the women's game has grown exponentially, with WR reporting the women's game to be one the fastest growing sports [8].

Time motion analysis is commonly used within intermittent team sports to track player or team movements [2, 5, 13, 16, 17, 28, 33, 34, 47, 48]. Investigations have been conducted in both female and male sevens with authors reporting that male players cover 87-121 $m \cdot min^{-1}$ [15-17, 28, 33, 34, 63] and female players cover 86-111 $m \cdot min^{-1}$

[2, 3, 5, 9] during match play. The running demands have been well documented in the male game, however investigations into the female game are scarce, with only five investigations of match play performance completed to date [1, 2, 5, 10, 64]. No studies to date have analysed the non-running demands in the female game with only three studies performed in the men's game [33, 65, 66] reporting non-running physical demands. Furthermore, no study to date has reported positional differences for match activities and running demands in the female game. A recent study by Higham et al. [16] on the men's game reported that backs compared to forwards achieved 6% higher maximal velocity, covered greater distances $\geq 3.5 m.s^{-1}$ and overall total distance (7%). Ross et al. [15] however, reported an absence of any substantial difference in the overall physical demands between international forwards and backs.

Additionally, little is known whether the quality of opposition or match significance may influence the demands of match play. Although Higham et al. [28] reported some small differences in movement patterns between rounds at low speeds (<3.5 $m.s^{-1}$), the authors did not state whether teams were competing in the cup (top eight of pool play) or the bowl (bottom eight of pool play). Ross et al. [15] compared the running demands and match activity differences between pool and cup rounds in their study on the male game. The authors found no significant differences in both running demands and match activities, concluding that a relatively stable competition level exists in the male game. With a relatively immature competition compared to the male game, the quality of opposition may well have an influence on the overall demands in the female game. However, no such research has been conducted in the female game.

Given the limitations cited previously, the purpose of this study was to investigate the running demands and match activities of international women's sevens rugby players during WR Women's World Series match play. Additionally, the study aimed to investigate whether differences exist in the demands between positional groups and to develop a better understanding of whether the match demands differ between pool games and cup games (play-off games).

Methods

Experimental Approach to the Problem

A prospective, longitudinal, observational study design was used for the purpose of this investigation, to characterize the running demands and match activities of international women's sevens rugby match play during the WR Women's World Series. Fifteen elite female players from a highly ranked international team were investigated across three tournaments during the 2013/2014 WR Women's Sevens World Series. The tournaments were held in the United States of America, Brazil and the Netherlands. 15 games were included for analysis. Team members had their movement patterns and match activities recorded during international match play and comparisons were made between the positional groups of backs and forwards. Additionally, comparisons were made between pool and cup games.

Subjects

Fifteen members from a highly ranked international team (age, 24.3±3.87 years; body mass, 67.5 ± 6.31 kg; height, 168 ± 7.15 cm; mean ± SD) participated in this investigation. Subjects had previously signed athlete agreements to release all data collected on three tournaments for the research purposes. Squad members were classified into two positional groups of forwards (N=5, age, 26.0 ± 3.11 years; body mass, 70.7 ± 5.99 kg; height, 171.6 ± 6.90 cm; mean ± SD) and backs (N=10, age, 22.9 ± 4.01 years; body mass, 64.9 ± 5.62 kg; height, 165.2 ± 6.34 cm; mean ± SD) based on their primary playing position. GPS data, along with match activity data, was analysed from players who completed a minimum of 70% (≥9:48 min) of the total game time (14min). Data collected from tournament finals was excluded from analysis due to the extended game time (20min). The study complied with the ethical standards for observational studies as required by AUT University, New Zealand.

Procedure

Movement pattern data was collected through the use of GPS devices (VX Sport 220, Visuallex Sport International, Wellington, New Zealand), sampling at 4 Hz, worn by a highly ranked international women's rugby sevens team during WR Women's Seven's Series matches. The validity and reliability of these devices has been reviewed previously [67]. When comparing the distance recorded during different running speeds at a set distance of 200 m, Buchheit et al [67] reported a small range of

variation at 14.4 km^{h-1} (+37m) with a slight underestimation and overestimation at 7.2 km^{h-1} and 19.8 km^{h-1}, respectively. When examining high speed running (18 $km.^{h-1}$), the units displayed a coefficient of variation of 3.3%. Devices were inserted into a custom fitted vest and worn under playing jerseys. After each tournament data was analysed using the manufactures software (VX View, Sport International, Wellington, New Zealand). The same firmware and software was used to analyse all data across the entire study. Data was analysed to investigate differences in movement patterns between playing positions, pool and cup matches. The following GPS speed metrics were used based on previous research [16]: (walking 0–2 $m \cdot s^{-1}$, jogging 2–3.5 $m \cdot s^{-1}$, running 3.5–5 $m \cdot s^{-1}$, striding 5–6 $m \cdot s^{-1}$ and sprinting $\geq$ 6 $m \cdot s^{-1}$). The validity and reliability of GPS micro technology for monitoring sports performance has been reviewed previously [68].

Table 6. Operational definitions of match activities of international women's rugby sevens

Ball carry	Count of times the player advances a minimum of three steps toward the defence while in possession of the ball
Ball taken into contact	Count of times the player carries the ball into a tackle contest
Pass	Count of times the player passes the ball
Own ruck attended	Count of times the player is involved in support in an attacking ruck
Opposition ruck attended	Count of times the player is involved in in an opposition ruck
Tackles	Count of times when the player is involved in a tackle in defence
Missed tackle	Count of times a player attempts to make a tackle unsuccessfully
Scrum	Count of times the player is involved in a scrum
Lineout	Count of times a player is involved in a lineout

Match activity data was collected through the use of video analysis software (Sportscode V8.9, Sportstec, Australia). Match activities, ball in play and rest durations were quantified with operational definitions for match activities, described in Table 6, as per previous research [15].

Ball in play was defined as the time when the ball was put into play under the conditions detailed in Table 2 [15].

Table 7. Operational definitions of ball in play scenarios of international women's rugby

Restarts	From the time the ball was kicked
Scrums	From the time the forwards engaged
Lineouts	From the time the ball leaves the throwers hands
Tap penalty or free kicks	From the time the ball is tapped

Play was deemed continuous when tap penalties or free kicks were taken quickly (<10 sec from time the penalty or free kick was awarded). Rest duration was defined as the time between periods of play, excluding the half time period [15].

Statistical Analysis

Differences in match demands and performance indicators between the two playing positions, back and forward, and between tournament rounds pool and cup, were determined using a mixed modelling approach in Statistical Analysis System (SAS, version 9.4). Performance indicators were modelled using an over-dispersed Poisson to allow the variance of the counts to be different from the mean count. The generalized mixed model included a fixed effect for playing position/ tournament round (two levels: *back* and *forward* or, *cup* and *pool*), with a random effect for athlete accounting for repeated measurements for athlete/s over the tournament, different residuals for playing position/tournament round, and an offset for each athlete's playing time. A similar mixed model predicted the differences in match demands for each of the groups: back, forward, cup and pool. The observed standard deviation for the back position and cup games was used as reference to calculate standardized differences (or effect size). Magnitude based inferences of the standardize differences between playing positions and tournament rounds were assessed according to the thresholds 0.2 small, 0.6 moderate, 1.2 large, 2 very large and >=4 extremely large. An effect was deemed unclear if the 90% confidence interval spanned the threshold for both positive (+0.2) and negative (-0.2) effects.

Differences in team's playing times and proportions between tournament rounds were investigated using a similar generalized linear model, with fixed effect for tournament round and using log-transformed time. Inferences for proportion ratios between tournament rounds were assessed according to the thresholds 1.11 small, 1.43 moderate. An effect was deemed unclear if the 90% confidence interval spanned the threshold for both positive (+1.1) and negative (0.9) effects.

Results

Differences Between Positional Groups

The individual per match running demands and match activities are shown in Table 8. Unclear differences between backs and forwards were observed for total distances covered between 0-2m.s^{-1}, 2-3.5m.s^{-1} and 3.5-5m.s^{-1}. Backs covered moderately greater distances above 6 m.s^{-1} (ES = 0.80), covered slightly greater total distances (ES= 0.35) and distances between 5-6m.s^{-1} (ES= 0.39). Backs completed slightly more ball carries (ES= 0.44) and forwards attended slightly more of their own rucks (ES= -0.18). Differences in opposition rucks attended, ball into contact, missed tackles, tackles and passes were either trivial or unclear.

Table 8. Individual running demands and match activities

	Forwards	Backs	Back-Forward	
Variable	**Mean ± SD**	**Mean ± SD**	**Standardize difference (mean, ± 90%)**	**Inference**
Running demands	(n=43, g=15)	(n=51, g=15)		
Total Distance (m)	1280 ± 200	1380 ± 270	0.35; ± 0.47	Small +
0-2m.s^{-1} (m)	469 ± 90	490 ± 90	0.23; ± 0.50	Unclear
2-3.5m.s^{-1} (m)	430 ± 110	450 ± 120	0.18; ± 0.59	Unclear
3.5-5m.s^{-1} (m)	290 ± 92	290 ± 110	-0.04; ± 0.58	Unclear
5-6m.s^{-1} (m)	77 ± 42	95 ± 46	0.39; ± 0.51	Small +
≥6m.s^{-1} (m)	29 ± 34	69 ± 48	0.80; ± 0.50	Moderate +
Match Activities				
Ball Carry	3.9 ± 3.7	5.5 ± 3.5	0.44; ± 0.33	Small +
Ball into contact	2.5 ± 2.7	2.8 ± 3.1	0.09; ± 0.23	Trivial
Tackles	3.4 ± 3.1	2.9 ± 2.7	-0.16; ± 0.35	Unclear
Missed tackles	0.3 ± 2.3	0.6 ± 2.6	0.11; ± 0.09	Trivial
Opposition ruck attended	1.1 ± 3.9	1.1 ± 3.1	0.0; ± 0.16	Trivial
Own ruck attended	2.0 ± 2.8	1.4 ± 3.1	-0.18; ± 0.20	Potential small+
Pass	4.3 ± 3.9	5.3 ±4.7	0.21; ± 0.50	Unclear
Scrum	3.1 ± 2.2			
Line out	1.7 ± 2.6			

+ or – indicates an increase or decrease from forwards to backs, m = Meters, n = Number of data files, g=Number of games analysed, SD = Standard deviation

Differences Between Pool and Cup Matches

The match demands differences between pool and cup games are displayed in Table 9 and 10. Data is presented as the entire team rather than backs and forwards. Match demands between pool and cup games were mostly trivial or unclear. A small decrease was observed in distances covered >6 $m.s^{-1}$ (ES= -0.31) and 5-6$m.s^{-1}$ (ES= -0.22) from pool games to cup games. A potential small increase was also observed in distances covered 0-2$m.s^{-1}$ (ES= 0.19) between pool and cup games. All other differences between running variables were deemed unclear. There was a potential small increase in the number of ball carries (ES=0.19) and a small increase in ball into contact (ES=0.23) and passes (ES=0.35) from pool games to cup games. All other match activities differences were deemed trivial.

Differences in playing time from pool to cup games were deemed trivial with ball in play (FD= 1.16) and recovery cycles (FD= 1.30) displaying small increases from pool to cup games. Proportional efforts of ball in play and recovery cycles were mostly unclear with a moderate increase (FD=1.62) in efforts 45-60s from pool to cup games. Ball in play cycles (FD=1.16) and recovery cycles (FD=1.30) showed a small increase from pool to cup games.

Table 9. Running demands and match activities for pool and cup matches

	Pool	Cup	Pool-Cup	
Variable	**Mean ± SD**	**Mean ± SD**	**Standardize difference (mean, ± 90%)**	**Inference**
Running demands	(n=57, g=15)	(n=37, g=15)		
Total Distance (m)	1350 ± 230	1330 ± 250	-0.08; ± 0.32	Unclear
0-2m.s^{-1} (m)	480 ± 90	490 ± 90	0.19; ± 0.33	Potential Small +
2-3.5m.s^{-1} (m)	440 ± 110	430 ± 120	-0.08; ± 0.29	Unclear
3.5-5m.s^{-1} (m)	290 ± 100	290 ± 110	-0.01; ± 0.27	Unclear
5-6m.s^{-1} (m)	92 ± 42	82 ± 47	-0.22; ± 0.31	Small -
≥6m.s^{-1} (m)	57 ± 50	46 ± 37	-0.31; ± 0.32	Small -
Match Activities				
Ball Carry	4.5 ± 3.2	5.3 ± 4.0	0.19; ± 0.35	Potential Small +
Ball into contact	2.4 ± 2.6	3.1 ± 3.2	0.23; ± 0.24	Small +
Tackles	3.2 ± 2.7	3.0 ± 3.1	-0.07; ± 0.24	Trivial
Missed tackles	0.53 ± 2.9	0.3 ± 2.6	-0.11; ± 0.09	Trivial
Opposition ruck attended	1.0 ± 2.9	1.3 ± 3.8	0.09; ± 0.13	Trivial
Own ruck attended	1.8 ± 3.1	1.4 ± 2.7	-0.14; ± 0.19	Trivial
Passes	4.5 ± 4.4	5.9 ± 3.9	0.35; ± 0.49	Small +
Scrum*	1.6 ± 2.2	1.4 ± 1.8	-0.11; ± 0.34	Trivial
Line out*	3.2 ± 2.7	3.0 ± 3.1	-0.07; ± 0.24	Trivial

+ or – indicates an increase or decrease from pool to cup matches, m = meters, n = number of data files, g=Number of games analysed, SD = standard deviation, *Forwards only

Table 10. Total time, ball in play time, ball in play and recovery cycles for pool and cup games

	Cup (n=10)	Pool (n=15)		
	(mean ± SD)	(mean ± SD)	Factor difference (mean ± 90% CL)	Inference
Total time (min:s)	16:27 ± 1:10	16:12 ± 0:49	1.01; ×/÷ 1.04	Trivial
Ball in play time (min:s)	7:28 ± 0:49	6:57 ± 0:48	1.09; ×/÷ 1.08	Trivial
Average ball in play cycles (min:s)	0:41 ± 0:23	0:22 ± 0:23	1.16; ×/÷ 1.17	Small
Average recovery cycles (min:s)	0:44 ± 0:22	0:32 ± 0:21	1.30; ×/÷ 1.13	Small
Proportion of efforts in ball in play and recovery cycles				
Ball in play cycles (s)	**%**	**%**	**Proportion ratio (mean, ×/÷ 90%)**	**Inference**
0-15	24	29	0.86; ×/÷ 1.37	Unclear
15-30	22	30	0.74; ×/÷ 1.38	Unclear
30-45	27	23	1.20; ×/÷ 1.37	Unclear
45-60	13	8	1.62; ×/÷ 1.74	Moderate +
>60s	13	11	1.20; ×/÷ 1.64	Unclear
Recovery cycles (s)				
0-15	8	10	0.76; ×/÷ 1.92	Unclear
15-30	34	31	1.11; ×/÷ 1.33	Unclear
30-45	15	13	1.19; ×/÷ 1.63	Unclear
45-60	17	20	0.85; ×/÷ 1.52	Unclear
>60s	26	26	0.99; ×/÷ 1.40	Unclear

+ or – indicates an increase or decrease from pool to cup matches, m = Meters, n = Number of matches, SD = Standard deviation
* Excluding cup finals matches

Discussion

To our knowledge, this is the first study to present the total match demands and positional differences of international women's sevens rugby. The results from this investigation expanded on the body of knowledge on match demands in women's sevens by including non-running match activities, activity cycles and recovery cycles. The main findings from this study was the lack of a clear difference in the match demands between the positional groups and a small increase in the match activity demands from pool to cup games.

The total distances covered during match play (± 1330 m) in this study was somewhat lower than reported in previous studies (1556 -1642 m) on international women's sevens match play [2, 64]. As previously reported by Ross et al. [15], running demands may well be team specific and it is likely factors such as technical, tactical and physical profiles of teams will influence the physical match demands. Furthermore, as the above

referenced studies on the female game have only been conducted over one tournament and were not conducted during the WR World Series, factors such as tournament location, climatic conditions, quality of opposition and injuries have been shown to influence performance during competition [12]. Therefore, these studies may not reflect an accurate description of the average running demands of match play.

Likewise, total distances from this study were slightly lower than that performed by a similar study by Ross et al. [15] (±1436 m) on the male game. Interestingly though, the percentage of distance covered >5 $m.s^{-1}$, which has been considered 'high intensity' running, was only slightly higher in males versus females, ±17% and ±10% respectively. A recent study by Clarke et al [10], which investigated physiologically based GPS speed zones, concluded that the currently used >5 $m.s^{-1}$ standard for reporting high intensity running, may underestimate high intensity running in females by as much as 30%. The authors suggested distances covered >3.5 $m.s^{-1}$ may provide a more accurate description of high intensity running in female team sports. This would substantially increase the percentage of time spent in high intensity to 32% in this study compared to 17% in the study by Ross et al. [15] on the male game. There are a multitude of factors that may contribute to this substantial difference. The number of individual passes thrown in this study was 52% greater than that of the study by Ross et al. [15]. This may suggest that this female team played a more expansive style of play resulting in more high intensity running. Likewise, the number of ball carries was 22% greater in this study. With defensive structures likely to be better in the male game due to the fact the male game is more established, the opportunity to carry the ball may be less. This may result in more low intensity running as teams search for a breakdown in the defensive structure to exploit. However, there is no evidence to back this contention. More research is required using individual, physiologically based, GPS thresholds, as suggested by Clarke et al. [10], to accurately depict the true high intensity running demands on both the male and female forms of the game.

Positional differences in running demands, excluding total distances covered, striding 5-6 $m.s^{-1}$ and sprinting ≥6 $m.s^{-1}$, were unclear. The moderate difference in distances covered above 6 $m.s^{-1}$ between positional groups may well be attributed to the greater velocity capacities of the backs, when compared to the forwards, rather than greater high intensity running performed. In a recent study by Clarke et al. [10], the authors reported a strong correlation between distances covered >5 $m.s^{-1}$ and maximum running

speed but not with players aerobic fitness. The authors reported that physiologically based individual thresholds correlated strongly with both players' aerobic fitness and high speed running capacity. The findings from this study support the contention that the greater distances covered above 6 $m.s^{-1}$ are more than likely attributed to the greater maximum running speed capacities of the backs when compared to the forwards. The lack of clear differences in positional play in this study is similar to that in the study by Ross et al. [15] in the male game. One can therefore suggest, as in the male game, the lack of clear difference in positional play would support a more uniform approach in the physical, technical and tactical preparation of rugby seven players.

Differences in the running demands between pool and cup games were mostly small to unclear. There were some small decreases in distances covered sprinting (ES= -0.31) and striding (ES= -0.22) from pool to cup games and a small increase in the amount of walking (ES= 0.19). However, these differences are of little practical relevance. Most match activity differences between pool and cup games were trivial with a small increase in the total number of ball carries, ball into contact and passes thrown observed. Interestingly, the mean total ball in play cycles increase by 46% from pool games to cup games. Although the corresponding mean recovery cycles also increased, the mean work:rest ratio's from pool to cup games still increased from 1:1.45 to 1:1.07. This is in contrast to Ross et al. [15] who reported that although ball in play cycles increased between pool and cup games, recovery cycles increased similarly resulting in similar work:rest ratios. This increase in work:rest ratio however, was not met with an increase in running demands but rather a small decrease. With the slight increase in match activities, it would seem this is where the demand lies. One could suggest therefore, there seems to be a slight increase in the demands between pool and cup games in the female game. It is possible that this could be attributed to the relatively young age of the female game resulting in greater disparity between the top and bottom ranked teams. It would appear that as the match importance increases, the demand on greater skill execution rather than the running demands becomes of greater significance.

Conclusion

This is the first study to present the total match demands of international women's sevens rugby match play. Similar to the male version of the game, there seems to be no clear difference between the physical demands of match play between backs and forwards. Further investigation, through the use of individual physiological based GPS

speed thresholds, is required in order to gain a better understanding of the true high intensity running demands of match play in the female game. In contrast to the male version of the game, there seems to be a slight increase in the physical demands between pool and cup games. These increases however, seem to be more related to match activities rather than the running demands. Finally, as this investigation was conducted on only one international female sevens team, the results may not be applicable to all international female teams. Further study across multiple teams is warranted.

Practical Applications

- The lack of clear difference in the physical and match activity demands between positional groups would suggest a more uniformed approach to both assessment and preparation is appropriate.
- Skill development may need to be prioritised considering that there is no significant increase in the running demands, yet there is an increase in match activities as match importance increases. Practitioners and coaches may need to consider the implementation of drills that require skill execution under pressure situations.
- Ball in play and recovery cycle lengths need to be considered when implementing match specific trainings. The length of ball in play cycles should be used as a guide to set appropriate drill times. Likewise, recovery times between drills could be set based off the average recovery cycles.
- With less high-speed running and an increase of ball into contact situations from pool games to cup games, appropriate recovery strategies need to be considered. The increase in ball into contact situations may suggest a greater contact stress across the entire body leading to greater potential inflammation of joints and musculature. Strategies such as total body ice bath submersion may be more appropriate in these situations.

CHAPTER 4

THE INFLUENCE OF SCORE DIFFERENTIAL ON THE PHYSICAL DEMANDS OF INTERNATIONAL WOMEN'S SEVENS MATCH PLAY

Preface

In the review of the literature, the influences of match outcomes and winning/losing margins were shown to be contrasting between different sports codes. It would seem however, that match outcomes and winning/losing margins do have an influence on the demands of match play. Additionally, in Chapter 3, we have identified a significant difference in the demands of match play as the level of significance increases from pool games to cup games. This chapter therefore addresses whether the score differential of winning games may influence the physical demands of match play.

Introduction

The decision in 2009 to include rugby sevens into the Olympic Games, starting in Rio 2016, has arguably provided the biggest improvement in profile and popularity of the game. Consequently, many countries have increased their financial and administrative support. Accordingly, the men's game has received some recent investigation [14, 16-18, 26-28, 34-37, 63]. Research into the women's game however, is scarce, with only five studies into women's sevens match performance published to date [2, 3, 5, 10, 11]. The World Rugby (WR) Women's Sevens World Series is played in a tournament format over two days with three games per day. Games are played on the same pitch size as conventional 15-a-side rugby union with similar rules however, with fewer players (seven as apposed to 15) and for less time (14-20 min as opposed to 80 min).

Studies into women's rugby sevens match play demands have largely focused on the physiological demands [2, 3] and the running demands [2, 3, 5, 10, 11]. Authors have reported players cover relative distances of 86-117 $m \cdot min^{-1}$ per match, with work:rest ratios of 1:03-1:0.4. What is less clear, however, is what factors may influence increased or decreased physical demands during match play. Some recent studies into both the male [28, 65] and female game [3] have investigated whether a difference

exists in the physical demands as the level of competition and/or match significance increases.

It seems that in the male game, the physical demands of match play may increase as the level of competition increases from provincial to international match play. A recent investigation by Ross et al. [52] reported that international match play was typified with greater high speed running demands with greater frequency and execution of certain match activities. Portillo et al. [3] reported greater running demands during international match play when compared to domestic match play in the female game. In another study, Ross et al. [15] investigated the influence of the match significance on the physical demands. The authors compared pool games and cup games (play off games) and found no significant differences with level of play. The authors concluded that the lack of clear difference between pool and cup games probably was due to a stable overall competition level. To date little is known whether the match significance, specifically whether pool and cup match play, may influence the physical demands in the female game.

The influence of match outcomes (i.e. winning/losing and score differential) on the physical demands of rugby sevens match play has also received little attention. A recent study by Murray et al [19], characterized the activity profiles of international male seven's players during peak periods of play. The authors reported players performed more high speed running (% or ES) in the second half, when the score was close and concluded that players are likely to perform more running when playing against higher ranked opponents.

Some research into the influence of match outcomes and score differentials has been conducted in rugby league [24], football [21, 22] and Australian rules football (AFL) [25] with some contrasting results. Researchers have assessed the within league influence of success in football, reporting that less successful teams covered greater distances in both high speed running and sprinting [22]. Furthermore, it has been shown that players from less successful teams have greater activity profiles of those from successful teams [20, 22, 54]. Investigation into AFL competition [25] has shown a similar trend with authors reporting less successful teams are likely to have an increased physical activity profile and decreased skill involvement and proficiency when compared with successful teams. In rugby league however, Gabbet et al. [24] reported

that the physical demands (e.g. distance covered, maximal accelerations, and repeated high-intensity effort performance) of winning teams to be significantly greater than losing teams. The authors also reported that larger winning margins were associated with greater physical demands when compared to moderate and small winning margins. It has been suggested by Gabbet et al. [24] that the competitive advantage of successful teams in rugby league is linked to the ability to maintain higher playing intensity than that of less successful teams. However, this investigation only analysed data from one team. A similar study by Hulin et al. [55] analysing data from two teams however, provided contrasting result's to Gabbet et al. The author's reported that compared with more successful teams, a less-successful team covers greater total distance and performs more high intensity running. Similar to the bulk of other research, the authors concluded that greater amounts of high intensity activity and total distance are not related to success in elite rugby league. To date no such research exists in the female game.

Given this treatise of the literature, the purpose of this study was to therefore determine whether the score differential of a match outcome influences the physical demands of match play in women's rugby sevens. Further investigation into the influence of match outcomes on the physical demands will provide coaches and conditioners with an accurate description of the demands from game to game, which in turn will aid in the prescription of appropriate rest and recovery protocols.

Methods

Experimental Approach to the Problem

This study followed a prospective, longitudinal study design where the activity profiles of international women's sevens rugby athletes were collected from match play during the 2013/2014 WR Women's World Series. Fifteen elite female players from a highly ranked international team were investigated across three tournaments during the 2013/2014 WR Women's Sevens World Series. The tournaments were held in the United States of America, Brazil and the Netherlands and 15 games were included for analysis. Team members had their movement patterns and match activities recorded during international match play and activity profiles were compared across two different score differential categories.

Subjects

Fifteen members from a highly ranked international team (age, 24.3±3.9 years; body mass, 67.5 ± 6.3 kg; height, 168 ± 7.1 cm; mean ± SD) volunteered as subjects for the purpose of this investigation. Subjects had previously signed athlete agreements to release all data collected on athletes for the purposes of research. GPS data, along with match activity data, was only analysed from players who completed a minimum of 70% (≥9:48 min) of the total game (14 min). Data collected from tournament finals was excluded from analysis due to the extended game time (20 min). The study complied with the ethical standards for observational studies as required by AUT University, New Zealand.

Procedure

Movement pattern data was collected through the use of GPS devices (VX sport 220, Visuallex Sport International, Wellington, New Zealand) sampling at 4 Hz, worn by a highly ranked women's rugby sevens team during WR Women's Seven's Series matches. The validity and reliability of these devices has been reviewed previously [67]. When comparing the distance recorded during different running speeds at a set distance of 200 m, Buchheit et al [67] reported a small range of variation at 14.4 km^{h-1} (+37m) with a slight underestimation and overestimation at 7.2 km^{h-1} and 19.8 km^{h-1}, respectively. When examining high speed running (18 $km.^{h-1}$), the units displayed a coefficient of variation of 3.3%. Devices were fitted within a custom made pouch worn under the playing jerseys of each player. Data was analysed post tournament using the manufactures software (VX View, Sport International, Wellington, New Zealand). The same firmware and software was used to analyse all data across the entire study. GPS speed metrics, which were analysed, were based on previous research [16]: (walking 0–2 $m \cdot s^{-1}$, jogging 2–3.5 $m \cdot s^{-1}$, running 3.5–5 $m \cdot s^{-1}$, striding 5–6 $m \cdot s^{-1}$ and sprinting ≥ 6 $m \cdot s^{-1}$). Metrics were expressed as meters per minute to account for varying playing times. The validity and reliability of GPS micro technology for monitoring sports performance has been reviewed previously [68].

Match activity data was collected through the use of video analysis software (Sportscode V8.9, Sportstec, Australia). Match activities, ball in play and rest durations were quantified with operational definitions displayed in Table 11 as

detailed in previous research [15]. Ball in play was defined as the time when the ball was put into play under the conditions displayed in Table 12 [15]. Play was deemed continuous when tap penalties or free kicks were taken quickly (≤10 sec from time the penalty or free kick was awarded). Rest duration was defined as the time between periods of play, excluding the half time period. As no previous research has investigated score differentials in women's rugby sevens, match score differential was divided into the following categorical groups; Small: ≤ 21 (≤3 converted tries) and Large: >21 (>3 converted tries).

Table 11. Operational definitions of match activities of international women's rugby sevens

Ball carry	Count of times the player advances a minimum of three steps toward the defence while in possession of the ball
Ball taken into contact	Count of times the player carries the ball into a tackle contest
Pass	Count of times the player passes the ball
Own ruck attended	Count of times the player is involved in support in an attacking ruck
Opposition ruck attended	Count of times the player is involved in in an opposition ruck
Tackles	Count of times when the player is involved in a tackle in defence
Missed tackle	Count of times a player attempts to make a tackle unsuccessfully
Scrum	Count of times the player is involved in a scrum
Lineout	Count of times a player is involved in a lineout

Table 12. Operational definitions of ball in play scenarios of international women's rugby sevens

Restarts	From the time the ball was kicked
Scrums	From the time the forwards engaged
Lineouts	From the time the ball leaves the throwers hands
Tap penalty or free kicks	From the time the ball is tapped

Statistical Analysis

Differences in running demands and match activities between games with low and high score differentials and their associated uncertainties (99% confidence limits) were assessed using non-clinical magnitude-based inferences [69]. Thresholds for assessing mean differences in running demands were set separately for each variable, with the

smallest important differences being 0.2 of the average between-game standard deviation for each variable [69]. Thresholds for moderate and large differences were 0.6 and 1.2 times this standard deviation, respectively.

Differences in the number of match activities between games with low and high score differentials were expressed as count ratios (high÷low score differential). These ratios were evaluated using a scale with thresholds of 1.11, 1.43, 2.0, 3.3, and 10 for small to extremely large differences [69]. The corresponding inverses of these thresholds were used to evaluate differences when the number of match activities was higher in low score versus high score differential games.

To account for inflation of error owing to the multiple match demands and activities investigated in this study, all effects have been assessed at the 99% confidence level. Effects were therefore deemed unclear if the 99% confidence interval overlapped the thresholds for both substantial positive and negative differences.

Results

Differences in Running Demands and Match Activities Between Low Score Differential and High Score Differential Matches

The individual per match running demands between high and low score differential match outcomes are displayed in Table 13. Clear, small to moderate differences were observed between most running thresholds. Total distances covered were moderately greater in high score differential games (3.8, ±5.2 m/min; mean difference, ±99% confidence limits). Small differences (high-low) were also observed for distance covered at the following speeds: 2-3.5m.s^{-1} (1.3, ±3.4 m/min), 5-6m.s^{-1} (0.8, ±1.5 m/min) and ≥6m.s^{-1} (1.4, ±1.6 m/min). All other differences in running demands were deemed unclear.

Differences in the individual per match activities are displayed in Table 14. There were moderately greater numbers of missed tackles (0.2; mean count) and lineouts (0.5) in low score differential versus high score differential games. All other differences in match activities between the two match outcome groups were deemed unclear.

Table 13. Differences in running demands (m/min) for games with low (<21) and high (≥21) score differentials

Running demands	Low (n=40, g=15)	High (n=54 g=15)	High-Low		
	Mean ± SD	Mean ± SD	Mean between-game SD	Standardised mean difference; ±99% CL	Inference
Total Distance	87.8 ± 8.9	91.6 ± 9.7	5.1	3.8; ± 5.2	Moderate +
0-2 m.s^{-1}	32.5 ± 4.2	33.1 ± 4.0	3.2	0.6; ± 2.3	Unclear
2-3.5 m.s^{-1}	28.5 ± 6.5	29.8 ± 5.8	4.3	1.3; ± 3.4	Small +
3.5-5 m.s^{-1}	18.5 ± 6.0	18.3 ± 4.5	4.4	-0.2; ± 2.9	Unclear
5-6 m.s^{-1}	5.5 ± 2.9	6.3 ± 2.6	2.4	0.8; ± 1.5	Small +
≥6 m.s^{-1}	2.9 ± 3.6	4.2 ± 2.4	2.5	1.4; ± 1.6	Small +

+ indicates substantially greater running demands for games with high vs low score differentials
m = meters, n = number of data files, g=Number of games analysed ,SD = standard deviation, CL = confidence limits

Table 14. Differences in number of match activities for games with low (<21) and high (≥21) score differentials

Match activities	Low (n=40, g=15)	High (n=54, g=15)	High÷Low	
	Mean ± SD	Mean ± SD	Count Ratio; $^{x}/_{\div}$ 99% CL	Inference
Ball carry	4.4 ± 2.9	4.9 ± 2.5	1.13; $^{x}/_{\div}$ 5.25	Unclear
Ball into contact	2.8 ± 1.8	2.4 ± 1.6	0.88; $^{x}/_{\div}$ 2.78	Unclear
Tackles	3.4 ± 1.8	3.0 ± 2.0	0.88; $^{x}/_{\div}$ 3.31	Unclear
Missed tackles	0.5 ± 0.6	0.4 ± 0.7	0.70; $^{x}/_{\div}$ 1.44	Moderate -
Opposition ruck attended	1.0 ± 1.3	1.3 ± 1.4	1.22; $^{x}/_{\div}$ 1.86	Unclear
Own ruck attended	1.9 ± 1.3	1.3 ± 1.4	0.70; $^{x}/_{\div}$ 2.14	Unclear
Passes	5.0 ± 4.2	5.1 ± 2.9	1.02; $^{x}/_{\div}$ 6.34	Unclear
Scrum*	1.6 ± 1.3	1.2 ± 1.8	0.74; $^{x}/_{\div}$ 2.00	Unclear
Line out*	1.1 ± 0.9	0.6 ± 1.3	0.54; $^{x}/_{\div}$ 1.68	Moderate -

- indicates a substantially greater number of match activities for games with low vs high score differentials
n = Number of data files, g=Number of games analysed, SD = Standard deviation, CL = Confidence limits, *Forwards only
Note: Per minute counts of match activities were multiplied by 14 (length of game) to give a per game count of match activities

Discussion

This study investigated the influence of score differential on the running and match activity demands of international women's sevens match play. Match outcomes were categorised as either a high winning points differential (>21 points) or low winning points differential (<21 points). To our knowledge, this is the first study to investigate these influences on match demands on international women's sevens match play. The main findings from this study were that greater winning margins are associated with greater total running distances and greater high speed running distances for the winning team. Likewise, greater winning margins were associated with fewer missed tackles and lineouts for the winning team. These findings suggest that greater winning margins may be associated with greater running demands and fewer match activity demands.

The results of this study showing greater total running distances when winning by larger margins, are in accordance with one study in rugby league [24]. However, another similar study showed conflicting results [55], as does the bulk of research in other football codes including men's sevens [19]. In Australian football, total distances were higher for players in losing quarters [25]. These findings in Australian football are in accordance to those found in men's rugby sevens. Murray et al. [70] reported that players covered greater peak high speed running in the first and second half when the score differential was close. The authors concluded players are likely to perform more running when playing against higher ranked opposition and when the score line is close. The players in this study completed more high speed running in matches that were won with larger winning margins. It is unclear as to the exact causes of this increase in high speed running. One possible explanation for these results could be explained through recent studies that demonstrated that the inclusion of collisions into small-sided games challenged player's ability to maintain running performance [71-73]. Although not statistically significant, there may be reason to suggest that the collision activities of ball into contact situations, tackles made, own rucks attended and scrums could be lower during higher winning margins. This increase in collision-based activities could be the contributing factor in the decrease in running demands in lower winning margins. However, more research is required with a greater sample size to back this contention.

Although results from this study only showed increases in two match activities when the score differential was close, there is possible non-statistically significant evidence to suggest there may be an increase in match activity profile, across more match activities, of players in matches where the winning margin is small. It is possible that the increase in match activities is due to better defensive abilities of the opposition resulting in teams having to utilise more skill related components to break the defence. This is in contrast to research in Australian football where Sullivan et al. [25] reported an increase in skill related activities when winning margins were large. The decrease in skill involvements in larger winning margins could be attributed to the relatively large disparity between the higher and lower ranked teams in women's sevens. Again, it is possible that this large disparity would lead to less skill utilisation required to break down opposition defensive structures, leading to this decrease in skilled activities with larger winning margins. However, more research is required with a larger sample size to back this contention.

It should be noted that caution should be applied when interpreting the findings from this study. Firstly, due to the success of this international female team, only winning results were analysed and the impact on the physical demands from losing results is unknown. Secondly, the current study only analysed the activity profiles of one team. A recent study by Hulin et al. [55] displayed contrasting results to similar studies in rugby league. The authors noted that their study investigated the activity profiles of two separate teams with differing success rates (i.e. high-success team versus low-success team), whereas Gabbett et al. [24] investigated the results of one team (i.e. one team when winning versus the same team when losing). Therefore, the conflicting results may reflect technical and tactical differences representing a greater distinguishing factor between successful and less-successful teams. Success therefore, may be the result of a multifactorial relationship between technical and tactical efficacy and activity profiles more than merely activity profiles in isolation.

Conclusion

The results from this study demonstrate that there is an increase in both total distance and high intensity running demands for the winning team when matches are won with a large points' differential versus matches won with small points' differentials. Although not statistically significant (possibly due to insufficient sample size) there may be

reason to suggest that a small winning margin may result in more ball into contact situations, tackles made, own rucks attended and scrums. However, further research is required with multiple teams and greater sample sizes to determine the influence of match outcomes and score differential on the physical demands of match play.

Practical Applications

- Coaches and conditioning coaches should consider the total running and match activity demands when matches are won by large or small margins.
- Specific recovery protocols should be considered for matches that have either higher running demands or match activity demands. Matches that have been won by higher winning margins, which result in greater running demands should place a greater emphasis on the recovery of the lower body musculature. Likewise matches that are won by smaller margins, which may lead to greater contact situations, which consequently may lead to greater inflammation of the joints and musculature of the entire body, may require more recovery strategies that address the entire body such as total body ice bath submersions.

CHAPTER 5

SUMMARY, PRACTICAL APPLICATIONS AND FUTURE RESEARCH DIRECTION

Summary

It is evident through the literature and findings of this thesis that the influences on the physical demands of rugby sevens match play are multi-factorial. With the relative recent emergence of women's rugby sevens as a competitive international sport, literature pertaining specifically to the women's game is scarce, with the vast majority of research being conducted in the men's game. No research to date has been conducted on the match play demands during WR Women's World Series match play. Therefore, the objective of this thesis was to increase the scientific body of knowledge in women's rugby sevens during WR Women's World Series match play. More specifically, the purpose was to investigate factors that may influence the physical demands of match play.

The first objective of the thesis was to review the literature pertaining to women's rugby sevens match play. As the literature specific to women's sevens is sparse, an attempt was made to compare the research performed in the women's game to the men's game and other relevant football codes. There were several key findings from this review. Firstly, the methodology used for analysis between studies was inconsistent. Inclusion criteria for data analysis varied greatly between studies, making any comparison problematic. Additionally, all studies in the female game only analysed data from one tournament. It was found that substitute players covered greater relative distances [28] and that factors such as tournament location, environmental conditions and injuries can influence a team's performance during competition [12]. These findings highlighted the difficulty in comparing studies and suggest that the reader must be mindful of these factors when comparing findings between studies.

The second main finding from the review of literature was the larger gap in the physical demands between international and national level match play when females were compared to the men's game. It is likely that this may be due to the relatively young age of women's rugby sevens. It is also possible that the more established male game

may have more mature domestic programs which may have consequently led to the reduction in the gap between international and domestic match play. With dedicated technical coaches and conditioning coaches more prevalent at the international level in the female game when compared to the domestic game, international players are more likely to have superior physical capacities, which could account for the large difference in physical profiles during game play. The third main finding from the review was that there may be differences in the match play demands between positional groups in the male game. Studies were contrasting with some studies displaying no differences between positional groups [15] and others displaying significant differences [16]. For the most part, it seems that backs cover greater distances, distances at high-speed thresholds and achieve higher velocities compared to forwards. No research to date had compared positional differences in the female game.

The next finding was the lack of research pertaining to the effect of match outcomes, or score differential, on the physical profile of match play. Only one study in the male game had attempted to explore this topic. The final finding from this review was the lack of literature pertaining to the match skill activities performed during match play i.e. tackles made, passes made and rucks attended. A better understanding of the areas highlighted in the literature review would add to the limited literature pertaining specifically to women's rugby sevens match play. These findings therefore highlighted the need to answer the following questions specific to the female game of sevens:

- Do the physical demands of match play differ between the positional groups of backs and forwards?
- Do the physical demands of match play differ between pool games and cup games?
- Is there a difference in the physical demands when games are won or lost by large or small point's differentials?

Following the review of the literature and to answer these questions, two studies were conducted to explore the influences of several factors on the physical demands of international women's sevens players during match play. Chapter 3 explored the influence of playing positions and pool versus cup games on the physical demands of match play. The key finding from this study was the lack of difference in the physical demands between positional groups. These findings suggest a uniformed approach across the team can be applied when conditioning women's rugby sevens athletes. The

study also highlighted an increase in match activities from pool games to cup games. With no similar increase in running demands, one could suggest that as the competition progresses from pool games to cup games, a greater demand is placed on skill execution rather than running outputs.

Chapter 4 investigated the influence of the score differential on the match demands in international women's sevens match play. The main finding was that greater total running distances and high-speed running distances were associated with matches won by large margins. A decrease in the number of lineouts and missed tackles with greater winning margins was also observed. There was some evidence to suggest that a bigger winning margin could lead to a decrease in more match activities, however this finding was not significant and research with a larger sample size is needed to further investigate this contention. From these findings, it may be suggested that smaller winning margins are associated with greater skill demands and larger winning margins with greater running demands. However, there were some limitations to the study. Firstly, the participating subjects were in a team that won all their matches during the study so only winning results were analysed. Therefore, little is known about the influence of losing margins on the physical demands. Secondly, the current study only analysed the activity profiles of one team. Two similar studies with contrasting results in rugby league may highlight some potential limitations to our study. The authors noted that one study investigated the activity profiles of two separate teams with differing success rates [55] (i.e. high-success team versus low-success team), whereas the other investigated the results of one team [24] (i.e. one team when winning versus the same team when losing). It was suggested that the conflicting results could reflect technical and tactical differences representing a greater distinguishing factor between successful and less-successful teams. Success therefore, may be the result of a multifactorial relationship between technical and tactical effectiveness and activity profiles more than merely activity profiles in isolation.

Practical Applications

There were several practical applications that evolved from this thesis. Firstly, the lack of clear difference in the running and match activity demands between positional groups would suggest a uniformed approach to both assessment and preparation appropriate for women's sevens athletes. Secondly, skill development needs to be prioritised,

considering there is no significant increase in the running demands yet there is an increase in match activities, as the match significance increases from pool games to cup games. Thirdly, as work to rest ratios increase from pool games to cup games, ball in play and recovery cycle lengths need to be considered when implementing match specific trainings. Finally, with an increase in the running demands with greater winning margins, specific recovery protocols should be considered post games when winning margins are either large or small.

Future Research Directions

In order to effectively condition an athlete for their chosen sport, it is essential that a thorough understanding of the movement patterns and physical demands of the sport be known. The review of the current literature pertaining specifically to women's rugby sevens and findings from our studies, highlight the need for further research within women's sevens.

Chapter 3 highlighted the potential limitation with the current commonly used GPS speed thresholds to determine high speed running. Clarke et al. [6] demonstrated a potential 30% underestimation in high speed running when using the traditional measure of >5 $m.s^{-1}$ versus individual based speed thresholds. The findings from Chapter 3 demonstrated that females performed 7% less high intensity running than males when using the uniform > 5$m.s^{-1}$ as a measure of high intensity running. However, when using the suggested > 3.5$m.s^{-1}$, as recommended by the findings of Clarke et al [6], this difference changed to 15% greater high intensity running. Further research should be directed towards the use of individually adjusted speed thresholds to help determine the true running demands during women's sevens match play.

In Chapter 4 it was found that greater running demands were associated with larger winning margins. Only matches that were won were analysed due to the success of the particular team that was analysed in this thesis. The influence that losing and losing margins has on the physical demands is unknown. Further research should seek to determine whether winning versus losing displays any significant differences in the physical profiles of match play. Likewise, only one team was analysed. It has been suggested that technical and tactical differences may play a more significant role in distinguishing differences in physical profiles between teams than activity profiles in

isolation [55]. Therefore, further research should endeavour to determine whether differences exist in the physical demands of match play between successful and less successful teams.

Finally, while the findings from this thesis provide further insight into some of the influences on the physical demands of women's sevens match play, they may only be specific to the participating team. Further research with multiple teams across an entire WR women's World Series campaign would provide a better description of the true demands of women's rugby sevens match play.

REFERENCES

1. Vescovi, J.D. and T. Goodale, *Physical Demands of Women's Rugby Sevens Matches: Female Athletes in Motion (FAiM) Study.* Int J Sports Med, 2015.

2. Suarez-Arrones, L., et al., *Match running performance and exercise intensity in elite female Rugby Sevens.* J Strength Cond Res, 2012. **26**(7): p. 1858-62.

3. Portillo, J., et al., *Comparison of running characteristics and heart rate response of international and national female rugby sevens players during competitive matches.* J Strength Cond Res, 2014. **28**(8): p. 2281-9.

4. Goodale, T.L., et al., *Relationship Between Physical Qualities and Minutes Played in International Women's Rugby Sevens.* Int J Sports Physiol Perform, 2015.

5. Clarke, A.C., et al., *Critical velocity as a measure of aerobic fitness in women's rugby sevens.* J Sci Med Sport, 2014. **17**(1): p. 144-8.

6. Clarke, A.C., J. Anson, and D. Pyne, *Physiologically based GPS speed zones for evaluating running demands in Women's Rugby Sevens.* J Sports Sci, 2015. **33**(11): p. 1101-8.

7. Engebretsen, L. and K. Steffen, *Rugby in Rio in 2016!* Br J Sports Med, 2010. **44**(3): p. 157.

8. *IRB Womens`s Rugby Plan*. Available from: http://wsws.irb.com/seriesinfo/strategicplan.html.

9. Yabar, J.P., et al., *Comparison of Running Characteristics and Heart Rate Response of International and National Female Rugby Sevens Players during Competitive Matches.* J Strength Cond Res, 2014.

10. Clarke, A.C., J. Anson, and D. Pyne, *Physiologically based GPS speed zones for evaluating running demands in Women's Rugby Sevens.* J Sports Sci, 2014: p. 1-8.

11. Clarke, A.C., J.M. Anson, and D.B. Pyne, *Neuromuscular Fatigue and Muscle Damage Following a Women's Rugby Sevens Tournament.* Int J Sports Physiol Perform, 2015.

12. Taylor, J.B., et al., *The influence of match location, quality of opposition, and match status on technical performance in professional association football.* J Sports Sci, 2008. **26**(9): p. 885-95.

13. Quarrie, K.L., et al., *Positional demands of international rugby union: evaluation of player actions and movements.* J Sci Med Sport, 2013. **16**(4): p. 353-9.

14. Suarez-Arrones, L., et al., *Positional differences in match running performance and physical collisions in men rugby sevens.* Int J Sports Physiol Perform, 2014. **9**(2): p. 316-23.

15. Ross, A., N. Gill, and J. Cronin, *The match demands of international rugby sevens.* J Sports Sci, 2015: p. 1-7.

16. Higham, D.G., et al., *Comparison of activity profiles and physiological demands between international rugby sevens matches and training.* J Strength Cond Res, 2013.

17. Granatelli, G., et al., *Match analysis and temporal patterns of fatigue in rugby sevens.* J Strength Cond Res, 2014. **28**(3): p. 728-34.

18. Rienzi, E., T. Reilly, and C. Malkin, *Investigation of anthropometric and work-rate profiles of Rugby Sevens players.* J Sports Med Phys Fitness, 1999. **39**(2): p. 160-4.

19. Murray, A.M. and M.C. Varley, *Activity Profile of International Rugby Sevens: Effect of Scoreline, Opponent and Substitutes.* Int J Sports Physiol Perform, 2014.

20. Rampinini, E., et al., *Technical performance during soccer matches of the Italian Serie A league: effect of fatigue and competitive level.* J Sci Med Sport, 2009. **12**(1): p. 227-33.

21. Rampinini, E., et al., *Variation in top level soccer match performance.* Int J Sports Med, 2007. **28**(12): p. 1018-24.

22. Di Salvo, V., et al., *Analysis of high intensity activity in Premier League soccer.* Int J Sports Med, 2009. **30**(3): p. 205-12.

23. Gabbett, T.J., *Activity and recovery cycles of National Rugby League matches involving higher and lower ranked teams.* J Strength Cond Res, 2013. **27**(6): p. 1623-8.

24. Gabbett, T.J., *Influence of the opposing team on the physical demands of elite rugby league match play.* J Strength Cond Res, 2013. **27**(6): p. 1629-35.

25. Sullivan, C., et al., *Match score affects activity profile and skill performance in professional Australian Football players.* J Sci Med Sport, 2014. **17**(3): p. 326-31.

26. Elloumi, M., et al., *Monitoring training load and fatigue in rugby sevens players.* Asian J Sports Med, 2012. **3**(3): p. 175-84.

27. Higham, D.G., Hopkins, W., Pyne, D., , *Relationships between rugby sevens performance indicators and international tournament outcomes.* Journal of Quantitative Analysis in Sports, 2014. **10**(1): p. 1-87.

28. Higham, D.G., et al., *Movement patterns in rugby sevens: effects of tournament level, fatigue and substitute players.* J Sci Med Sport, 2012. **15**(3): p. 277-82.

29. Higham, D.G., et al., *Physiological, anthropometric, and performance characteristics of rugby sevens players.* Int J Sports Physiol Perform, 2013. **8**(1): p. 19-27.

30. Lopez, V., Jr., et al., *Profile of an American amateur rugby union sevens series.* Am J Sports Med, 2012. **40**(1): p. 179-84.

31. Ross, A., N. Gill, and J. Cronin, *Match analysis and player characteristics in rugby sevens.* Sports Med, 2014. **44**(3): p. 357-67.

32. Ross, A., N.D. Gill, and J.B. Cronin, *Comparison of the Anthropometric and Physical Characteristics of International and Provincial Rugby Sevens Players.* Int J Sports Physiol Perform, 2014.

33. Suarez-Arrones, L., et al., *Positional Differences in Match Running Performance and Physical Collisions in Men Rugby Sevens.* Int J Sports Physiol Perform, 2013.

34. Suarez-Arrones, L.J., et al., *Running demands and heart rate responses in men Rugby Sevens.* J Strength Cond Res, 2012. **26**(11): p. 3155-9.

35. van Rooyen, M.K., Carl Lombard, and Timothy D. Noakes, *Playing demands of sevens rugby during the 2005 Rugby World Cup Sevens Tournament.* International Journal of Performance Analysis in Sport, 2008. **8.2**: p. 114-123.

36. West, D.J., et al., *The influence of the time of day on core temperature and lower body power output in elite rugby union sevens players.* J Strength Cond Res, 2013.

37. West, D.J., et al., *Profiling the time-course changes in neuromuscular function and muscle damage over two consecutive tournament stages in elite rugby sevens players.* J Sci Med Sport, 2013.

38. Suarez-Arrones, L., et al., *Repeated-High Intensity Running Activity and Internal Training Load of Elite Rugby Sevens Players During International Matches: A Comparison Between Halves.* Int J Sports Physiol Perform, 2015.

39. Furlan, N., et al., *Running-Intensity Fluctuations in Elite Rugby Sevens Performance.* Int J Sports Physiol Perform, 2015. **10**(6): p. 802-7.

40. Agar-Newman, D.J., T. Goodale, and M. Klimstra, *Anthropometric and Physical Qualities of International Level Female Rugby Sevens Athletes Based on Playing Position.* J Strength Cond Res, 2015.

41. Batterham, A.M. and K.M. Birch, *Allometry of anaerobic performance: a gender comparison.* Can J Appl Physiol, 1996. **21**(1): p. 48-62.

42. Cramer, J.T., et al., *Power output, mechanomyographic, and electromyographic responses to maximal, concentric, isokinetic muscle actions in men and women.* J Strength Cond Res, 2002. **16**(3): p. 399-408.

43. Falgairette, G., et al., *Effect of inertia on performance and fatigue pattern during repeated cycle sprints in males and females.* Int J Sports Med, 2004. **25**(3): p. 235-40.

44. Bradley, P., et al., *Gender differences in match performance characteristics of soccer players competing in the UEFA Champions League.* Human Movement Science, 2014. **33**: p. 159-171.

45. Bradley, P.S. and J.D. Vescovi, *Velocity Thresholds for Women's Soccer Matches: Sex Specificity Dictates High-Speed Running and Sprinting Thresholds - Female Athletes in Motion (FAiM).* Int J Sports Physiol Perform, 2014.

46. Johnston, R.D. and T.J. Gabbett, *Repeated-sprint and effort ability in rugby league players.* J Strength Cond Res, 2011. **25**(10): p. 2789-95.

47. Aughey, R.J., *Australian football player work rate: evidence of fatigue and pacing?* Int J Sports Physiol Perform, 2010. **5**(3): p. 394-405.

48. Coughlan, G.F., et al., *Physical game demands in elite rugby union: a global positioning system analysis and possible implications for rehabilitation.* J Orthop Sports Phys Ther, 2011. **41**(8): p. 600-5.

49. Deutsch, M.U., G.A. Kearney, and N.J. Rehrer, *Time - motion analysis of professional rugby union players during match-play.* J Sports Sci, 2007. **25**(4): p. 461-72.

50. Duthie, G.M., et al., *Sprint patterns in rugby union players during competition.* J Strength Cond Res, 2006. **20**(1): p. 208-14.

51. Gabbett, T.J., *Sprinting patterns of National Rugby League competition.* J Strength Cond Res, 2012. **26**(1): p. 121-30.

52. Ross, A., N.D. Gill, and J.B. Cronin, *A Comparison of the Match Demands of International and Provincial Rugby Sevens.* Int J Sports Physiol Perform, 2014.

53. Clarke, A.C., J.M. Anson, and D.B. Pyne, *Neuromuscular Fatigue and Muscle Damage After a Women's Rugby Sevens Tournament.* Int J Sports Physiol Perform, 2015. **10**(6): p. 808-14.

54. Castellano, J., A. Blanco-Villasenor, and D. Alvarez, *Contextual variables and time-motion analysis in soccer.* Int J Sports Med, 2011. **32**(6): p. 415-21.

55. Hulin, B.T., et al., *Physical Demands of Match Play in Successful and Less-Successful Elite Rugby League Teams.* Int J Sports Physiol Perform, 2015. **10**(6): p. 703-10.

56. Hughes MD, B.R., *The use of performance indicators in performance analysis.* J Sports Sci, 2001. **20**(10): p. 739-754.

57. Roberts, S.P., et al., *The physical demands of elite English rugby union.* J Sports Sci, 2008. **26**(8): p. 825-33.

58. James, N., S.D. Mellalieu, and N.M. Jones, *The development of position-specific performance indicators in professional rugby union.* J Sports Sci, 2005. **23**(1): p. 63-72.

59. Jones, N.M., N. James, and S.D. Mellalieu, *An objective method for depicting team performance in elite professional rugby union.* J Sports Sci, 2008. **26**(7): p. 691-700.

60. Lim, E., et al., *Predicting try scoring in super 14 rugby union the development of a superior attacking team scoring system.* Int J Perform Anal Sport., 2011. **11**(3): p. 464-75.

61. Lim, E., et al., *Development of a player impact ranking matrix in Super 14 rugby union.* Int J Perform Anal Sport. , 2009. **9**(3): p. 354-67.

62. Hughes M, J.R. *Patterns of play of successful and unsuc- cessful teams in men's 7-a-side rugby union.* . in *Science and football V: the proceedings of the Fifth World Congress on Science and Footbal*. 2005.

63. Ross, A., N. Gill, and J. Cronin, *Match Analysis and Player Characteristics in Rugby Sevens.* Sports Med, 2013.

64. Portillo, J., et al., *Comparison of Running Characteristics and Heart Rate Response of International and National Female Rugby Sevens Players During Competitive Matches.* J Strength Cond Res, 2014. **28**(8): p. 2281-2289.

65. Ross, A., N. Gill, and J. Cronin, *The match demands of international rugby sevens.* J Sports Sci, 2015. **33**(10): p. 1035-41.

66. Ross, A., N.D. Gill, and J.B. Cronin, *A Comparison of the Match Demands of International and Provincial Rugby Sevens.* Int J Sports Physiol Perform, 2015. **10**(6): p. 786-90.

67. Buchheit, M., et al., *Integrating different tracking systems in football: multiple camera semi-automatic system, local position measurement and GPS technologies.* J Sports Sci, 2014. **32**(20): p. 1844-1857.

68. Cummins, C., et al., *Global positioning systems (GPS) and microtechnology sensors in team sports: a systematic review.* Sports Med, 2013. **43**(10): p. 1025-42.

69. Hopkins, W.G., et al., *Progressive statistics for studies in sports medicine and exercise science.* Med Sci Sports Exerc, 2009. **41**(1): p. 3-13.

70. Murray, A.M. and M.C. Varley, *Activity Profile of International Rugby Sevens: Effect of Score Line, Opponent, and Substitutes.* Int J Sports Physiol Perform, 2015. **10**(6): p. 791-801.

71. Johnston, R.D., et al., *Influence of physical contact on pacing strategies during game-based activities.* Int J Sports Physiol Perform, 2014. **9**(5): p. 811-6.

72. Gabbett, T.J., D.G. Jenkins, and B. Abernethy, *Influence of wrestling on the physiological and skill demands of small-sided games.* J Strength Cond Res, 2012. **26**(1): p. 113-20.

73. Johnston, R.D., et al., *Influence of physical contact on neuromuscular fatigue and markers of muscle damage following small-sided games.* J Sci Med Sport, 2014. **17**(5): p. 535-40.

APPENDICES

Appendix 1: HIGH PERFORMANCE SPORT NEW ZEALAND (HPSNZ) CONSENT TO THE COLLECTION, USE AND STORAGE OF PERSONAL INFORMATION (ATHLETE)

Prior to completing this form athletes should read the HPSNZ Collection and Use of Athlete Information Brief.

Athlete consent for the collection, use and storage of information

I understand and agree that the organisations and people that constitute HPSNZ (as outlined in the HPSNZ Collection and Use of Athlete Information Brief) will collect, store, use, discuss and/or disclose my personal information for any of the purposes associated with the services provided to me as a Carded athlete. I also authorise the use and retention by HPSNZ of any personal information currently held or previously collected.

I understand that in collecting, using, storing and/or disclosing my personal information HPSNZ and all contracted service providers and other authorised individuals will at all times comply with the Privacy Act 1993.

I understand that I have the right of access to, and the right to correct any of my personal information that HPSNZ retains in its possession.

I understand that in signing this consent I am authorising the disclosure of my personal information to my National Sport Organisation (NSO) and any third party user identified by me from time to time. Any such disclosures will be advised to me and I will have the opportunity to refuse to give my consent to any such disclosure.

I understand that I have the right to seek advice and treatment from any medical or other service provider not provided to me through HPSNZ. Any information, treatment or medication that may be relevant to or affect my athletic performance, my reputation, or any of my obligations as a Carded athlete must be disclosed to HPSNZ or any of its authorised persons.

In particular, I acknowledge that I have been advised and I understand that a failure to disclose any such information, treatment or medication may result in the termination of the performance services provided to me as a Carded athlete if such failure causes me to be disqualified from any competition, or causes my NSO or HPSNZ, to suffer any embarrassment or adverse comment.

I also confirm that:

a) I have been provided with a copy of the HPSNZ Collection and Use of Athlete Information Brief, and
b) I have had the opportunity to seek independent advice about my right to privacy and my right to refuse to give consent to the disclosure of any information collected by or on behalf of HPSNZ, and
c) I may withdraw this consent at any time, and
d) Any such withdrawal may result in the termination of the performance services provided to me as a Carded athlete.

Athlete Authorisation

SIGNATURE: _____ DATE: _____

NAME: _____
(Please Print)

Witnessed by

SIGNATURE: _____ DATE: _____

NAME: _____
(Please Print)