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# RUGBY UNION MOVEMENT PATTERNS: THE IMPACT OF FORWARD SUBSTITUTES

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## Abstract

**PURPOSE:** Forwards are regularly substituted within the sport of rugby union. There is currently limited information on how this effects movement patterns in rugby union match play. This study investigated how the movement patterns and pacing strategies of forwards that play the whole game in contrast with forwards inserted as substitutes in the second half.

**METHODS:** Global positioning system (GPS) data were collected during professional rugby union match play. Second half data for 19 whole game (WG) players and 17 substitute (sub) players were compared in terms of relative total and high-intensity (>4m.s<sup>-1</sup>) distance, maximum speed (m.sec<sup>-1</sup>), sprint (>6 m.s<sup>-1</sup>) and acceleration (>2.75 m.s<sup>-1</sup>) frequency. Given the practical nature of this study, likelihood of effects being true was assessed via magnitude-based inference and the size of effect was assessed using Cohen's effect size (ES) statistic. Effect sizes of 0.2, 0.6, 1.2 and 2.0 were considered *small*, *medium*, *large* and *very large* respectively. **RESULTS:** Substitute forwards displayed increased high intensity running distance (12 ± 6 vs. 9 ± 4 m.min<sup>-1</sup>, *likely medium*), sprint frequency (1 every 13 ± 25 min vs. 1 every 20 ± 25 min, *likely medium*), acceleration frequency (1 every 7 ± 9 min vs. 1 every 13 ± 7 min, *likely small*) vs. whole game players. Differences in movement variables were larger when substitutes were first introduced, but were not different in later quartiles. **CONCLUSIONS:** Whole game players adopted a "flat" pacing strategy in the second half, while substitutes adopted a "one bout, all out" approach. The impact if substitutes on game movement patterns is meaningful, but short-lived. Differences between whole game and substitute players were negligible in the latter phases of the game. **PRACTICAL APPLICATION:** The introduction of forward substitutes increases match intensity temporarily. This effect could be accentuated by introducing multiple substitutes at once, and may have tactical applications with coaches saving their substitutes for critical moments within the game.

## Introduction

Rugby union is a full contact sport defined by repetitive bouts of short duration maximal effort activity (sprinting, tackling and contesting rucks), interspersed with periods of low-intensity activity (standing, walking and jogging) (Austin, Gabbett & Jenkins, 2011).

Rugby union forwards are exposed to more contact activities more regularly than backs during match play (Deutsch et al., 2007) resulting in more rapid fatigue (Tee et al., 2017).

Substitution of starting players occurs regularly in rugby union, with teams allowed to substitute seven players during the course of the game for tactical reasons or injury.

Soccer, (Carling, Espié, Le Gall, Bloomfield, Jullien, 2010) Rugby League (Waldron et al., 2013) and Rugby Sevens (Higham et al., 2011) have all reported greater high intensity running distance covered by substitutes. To date no research has investigated the impact of substitutions on movement profiles in professional rugby players.

The aim of this research is to report the influence of the introduction of substitutes on physical performance in professional rugby union. This information will be useful for rugby union coaches attempting to manage fatigued players and/or optimize the impact of substitutes.

## Acknowledgements

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## Methods

**PARTICIPANTS:** Nineteen professional rugby union players (age 25.5 ± 2.4 years; body mass 101.5 ± 12.2kg, stature 1.86 ± 0.07m) volunteered to take part in the study and provided data 24 separate matches in the 2013 rugby season. All players signed informed consent and ethical approval was granted by the University of Johannesburg Ethical Review Board

**PROCEDURES:** Global positioning system (GPS) and accelerometer data (SPI Pro - GPSports, Canberra, Australia) were collected during professional rugby union match play. Second half data for 19 whole game (WG) players and 17 substitute (Sub) players were compared in terms of total and high-intensity (>4m.s<sup>-1</sup>) distance, maximum speed (m.sec<sup>-1</sup>), number of sprints (>6 m.s<sup>-1</sup>) and accelerations (>2.75 m.s<sup>-1</sup>), Data were normalized to distance per minute played (m.min<sup>-1</sup>) or sprint/acceleration frequency to account for differences in total playing time. Data were further divided into bout quartiles to compare the time-course of pacing strategies utilized by WG and Sub players.

**DATA ANALYSIS:** Given the practical nature of this study, effect sizes were assessed using Cohen's effect size (ES) statistic and likelihood of effects being meaningful was assessed via magnitude-based inference (MBI). ES's of 0.2, 0.6, 1.2 and 2.0 were considered *small*, *medium*, *large* and *very large* respectively. MBI's were assessed according to the following scale of likely hood that the true effect was meaningful - <1%, almost certainly not; 1% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possible; 75% to 95%, likely; 95% to 99%, very likely;>99%, almost certain.

## Results

**TABLE 1:** Movement variables of Whole Game or Substitute forwards in the second half of professional rugby match play.

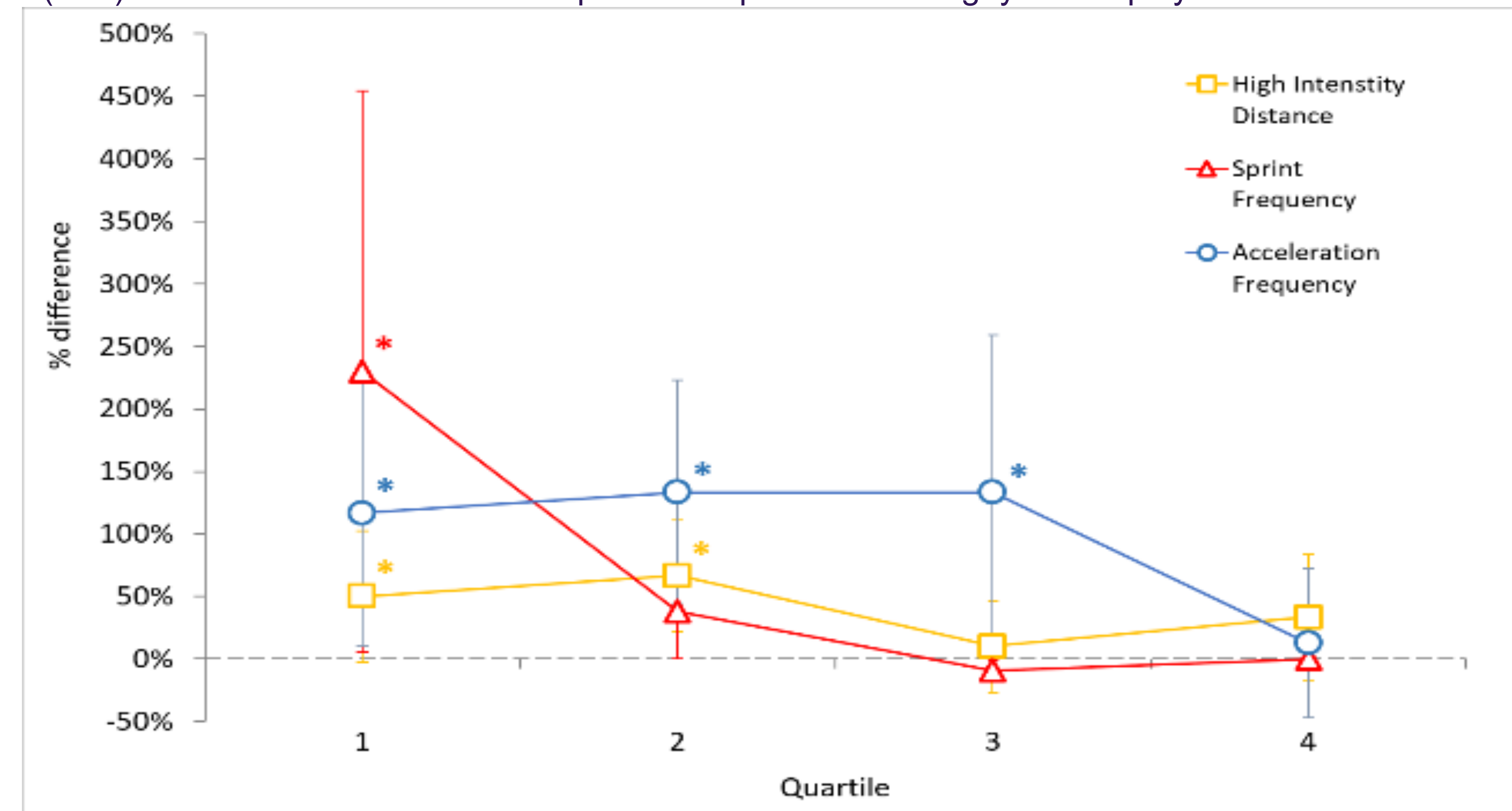
	Whole Game	Substitute	MBI	Effect Size
<b>Relative distance (m.min<sup>-1</sup>)</b>	65 ± 8	67 ± 10	Unclear (53/37/11)	Small (0.22)
<b>High intensity (&gt;4m.s<sup>-1</sup>) distance (m.min<sup>-1</sup>)</b>	9 ± 4	12 ± 6	Likely (88/11/1)	Medium (0.60)
<b>Maximum speed (m.s<sup>-1</sup>)</b>	7.3 ± 1.3	7.1 ± 1.4	Unclear (46/38/17)	Trivial (0.15)
<b>Sprint frequency (&gt;6 m.s<sup>-1</sup>)</b>	1 every 20 ± 25 min	1 every 13 ± 25 min	Likely (92/7/1)	Medium (0.67)
<b>Acceleration frequency (&gt;2.75 m.s<sup>-2</sup>)</b>	1 every 13 ± 7 min	1 every 7 ± 9 min	Likely (85/14/1)	Small (0.55)

Data presented as mean ± SD Brackets indicate the chances that the true value has a positive/negligible/negative effect. Effect size indicates magnitude of difference between groups. Frequencies indicate how regularly players exceeded the respective speed, acceleration and impact thresholds per minute.

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**FIGURE 1:** Percentage difference in key movement variables of Whole Game (WG) or Substitute (Sub) forwards across second half quartiles in professional rugby match play.



\* Indicate likely meaningful differences between whole game players and substitutes.

## Conclusions

Substitute players perform more high intensity running, and sprint and accelerate more frequently than whole game players in the second half of professional rugby union matches.

These higher-intensity exertions are not sustained throughout the playing bout, and by the end of the game there is no longer a difference in the physical output of whole game and substitute players. This indicates that substitutes adopt a "one-bout, all-out" pacing strategy.

## Practical Applications

The introduction of substitute forwards temporarily raises match intensity. This finding may have tactical applications if coaches time the use of their substitutions to correspond with critical moments within the game.

