Applied Physiology of Rugby Sevens: Performance Analysis and Elite Player Development

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Abstract

Rugby sevens is an abbreviated format of rugby union that will be contested at the Olympic Games from 2016. Despite a rise in the worldwide popularity and profile of rugby sevens, the technical, tactical, physical, and physiological demands of international competition are not well understood and only limited information exists on the characteristics of elite-level players. The purpose of this thesis was to quantify the requirements of international competition, identify the anthropometric, physiological, and performance characteristics of international-level players, and quantify the specificity of contemporary on-field training practices. Seven experimental studies were conducted to address these issues.

Linear mixed modelling of 392 international team performances identified several performance indicators either positively or negatively related to the number of points scored by a team. An increase of two standard deviations in a team’s possession time (4.0; ±2.0, change in points scored; ±90% confidence limits (CL)), passes (1.0; ±1.5), kicks (1.1; ±1.5), and relative ruck and maul retention (5.9; ±1.4) were related to scoring more points in a match. In contrast, opposition possession time (-5.8; ±1.8), penalties and free kicks conceded (-2.2; ±1.5), passes per min of possession (-1.7; ±1.5), rucks and mauls retained (-3.0; ±1.5), rucks and mauls per min of possession (-8.8; ±1.3), turnovers conceded (-7.0; ±1.4), and turnovers conceded per min of possession (-8.0; ±1.6) were negatively related to scoring points. Linear mixed modelling of performance indicators from nine tournaments of the 2011/2012 International Rugby Board (IRB) Sevens World Series confirmed the most successful teams maintained ball possession by minimising errors and turnovers, were efficient in converting possession into tries, and had effective defensive structures resulting in a high rate of tackle completion. Similarly, linear mixed modelling of performance indicators for 12 teams during four IRB Sevens World Series between 2008/2009 and 2011/2012 revealed the mean number of tries scored and conceded by a team best discriminated higher and lower World Series rankings within and between teams. Tactics associated with a better team ranking were based on increasing ball retention in line-outs and the breakdown, turning the ball over more frequently in opposition rucks, and pressuring the opposition in their territory by kicking fewer contestable restarts.

Activity profiling of 174 player observations during 27 matches demonstrated a higher physical intensity in international compared with domestic matches due to players covering
~27% greater distance at ≥6 m·s⁻¹ and performing 4 to 39% more changes in velocity. Total distance covered per min was ~45% greater in rugby sevens and relative high-velocity running volume more than double that of 15-player rugby union. Despite 1 to 16% reductions in the distance covered at >2 m·s⁻¹ and number of changes in velocity from the first to second half of matches, there was little indication of accumulated fatigue over a multi-day tournament.

Laboratory- and field-based testing of 18 international male rugby sevens players revealed they had highly-developed speed, power, and endurance qualities to meet the demands of competition. Rugby sevens players had anthropometric characteristics similar to those of backs in international 15-player rugby union. Acceleration and speed, lower-body muscular power, and relative maximal aerobic power were similar to, or exceeded, that of professional 15-a-side players. The small between-athlete variability of characteristics in rugby sevens players highlights the need for relatively uniform physical and performance standards in contrast with 15-a-side teams.

The body composition of 38 international male rugby union and 27 international male rugby sevens players was measured using dual-energy X-ray absorptiometry. The quantity and distribution of fat, non-osseous lean and bone mineral mass across anatomical regions were compared between backs and forwards in each squad. Forwards were heavier and had a greater quantity of fat (union 43 to 67%; ±~17%, range of % differences; ±~95% CL; sevens 20 to 26%; ±~29%), non-osseous lean (union 14 to 22%; ±~5.8%; sevens 6.9 to 8.4%; ±~6.6%), and bone mineral (union 12 to 26%; ±~7.2%; sevens 5.0 to 11%; ±~7.2%) mass than backs in both rugby union and rugby sevens. However, the magnitude of difference between the positional groups was greater in rugby union players. When anatomical regional tissue mass was expressed as a proportion of total regional mass, positional group differences were predominantly unclear in rugby sevens players, but persisted in rugby union players. The distribution of tissue varied between positional groups and rugby formats.

The movement patterns and physiological demands of 42 international male rugby sevens players were monitored during 22 international matches and 63 rugby-specific training drills. Differences between matches and training were quantified using magnitude-based inferential statistics. During 21 months of on-field training observation, technical and game-simulation drills typically failed to replicate the positional group-specific physical and physiological demands of competition.
In summary, rugby sevens imposes unique demands on players during competition. The disparity between rugby union and rugby sevens dictates different characteristics of players, priorities for player preparation, and tactical approaches to competition are required. Coaches and support staff can utilise the findings of this thesis to better prepare players for the requirements of this growing sport. The research outcomes can be applied to develop talent identification and transfer programmes, refine positional group-specific technical and physical development, and implement monitoring systems to ensure training adaptations are optimised leading into international competition in the newest Olympic team sport.
Statement of Contribution by Others

This thesis details original research conducted by the candidate at the Australian Institute of Sport while enrolled in the Faculty of Health at the University of Canberra. The thesis includes research articles of which I am the lead author and was primarily responsible for the conception and design of the research, ethical approval to conduct the research, data collection, analysis and interpretation, manuscript preparation, and correspondence with journals.

Where explicitly acknowledged in each experimental chapter, a number of individuals have contributed to the research presented in this thesis.

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Signature of candidate (Dean Higham)

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Signature of chair of the supervisory panel (Dr. Judith Anson)

Date: ..........................
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**Conference Presentations by the Candidate Relevant to the Thesis**


**Higham, D.G.** Current GPS use in rugby sevens. GPS and Elite Sport Workshop, 17-18 June, 2010, Canberra, Australia.


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