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Original research

Influence of playing standard on the physical demands of junior rugby league tournament match-play

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ABSTRACT

Objectives: To investigate the physical demands on junior rugby league players competing at three different standards of tournament match-play.
Design: Cross-sectional study.
Methods: Sixty junior rugby league players (mean ± SD age, 16.7 ± 0.7 years) participated in this study. Players were either competing in Division 1, Division 2, or Division 3 teams of the Confraternity carnival. Global positioning system (GPS) analysis was completed during 17 matches (totalling 139 appearances).
Results: Division 1 and 2 players covered significantly ($p = 0.001$) greater distance per minute of match play than Division 3 players (83.0 ± 12.3 m/min and 81.5 ± 6.9 m/min vs. 73.3 ± 9.8 m/min). The greater total distance at the higher competitive standard was achieved through greater ($p = 0.001$) distances at low speeds, with Division 1 players also covering more ($p = 0.038$) high speed running than Division 3 players. Expressed relative to playing time, the number of total collisions was lower ($p = 0.001$) in Division 3 players. Division 2 players engaged in more ($p = 0.034$) repeated high-intensity effort bouts than Division 3 players. Significant decrements in total ($p = 0.005$) and low speed distances ($p = 0.006$) were found, with Division 3 players showing the largest reductions in performance.
Conclusions: These findings demonstrate that both the average intensity and the repeated high-intensity effort demands of junior rugby league tournament match-play are greater at higher playing standards. Sport scientists and conditioning staff can use these data to plan appropriate training sessions to allow players to tolerate match-play demands, and recover from the demands of competition.

1. Introduction

Rugby league is a collision sport played throughout several countries worldwide.[1] The game is physically demanding, involving bouts of high-speed running, sprinting, and tackling, separated by periods of lower-intensity activity. During the course of a rugby league match, each team will perform an average of 300 tackles, with forwards exposed to more physical collisions (in the form of tackles and hit-ups) than backs.[2] As a result of these physical demands, players may experience neuromuscular and perceptual fatigue in the 24–48 h after competition, with significant muscle damage lasting up to several days.[3–5]

Most [6,7] but not all [8] studies that have investigated the influence of playing standard on physical performance in rugby league, have been limited to assessments of the physical qualities (e.g. speed, muscular power, strength, and maximal aerobic power) of players. In general, these studies have shown that at both junior[9,10] and senior[6,7,11] levels of competition, the physical qualities of players increase as the competitive standard increases, with differences also observed between starters and non-starters,[10,11] and selected and non-selected[11] players. Collectively, these findings suggest that well-developed physical qualities allow players to perform the wide range of skills required during competition, but also that physical qualities contribute, at least in part, to the higher playing standard of elite level rugby league match-play.

More recently, global positioning system (GPS) devices, coupled with integrated accelerometers have been used to quantify the training and match demands of elite rugby league.[12–14] Researchers have shown differences in intensity between training and competition,[14] winning and losing teams,[15] trial and fixture matches,[16] junior and senior competition,[16] and players interchanged during a match compared to those required to play the entire match.[13] In all of these studies, the physical demands have been greater at the higher playing level,[15,16] or when players played fewer minutes.[13] These studies complement the video-based time-motion analysis by Sirotic et al.[8] that demonstrated significant differences in match intensity between elite (108.9 ± 10.6 m/min) and semi-elite (102.3 ± 9.7 m/min) rugby league players. Differences in match intensities between the first and second halves

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have also been reported, with greater decrements in match intensity in elite than semi-elite players,[8] and greater reductions in repeated high-intensity effort performance in elite senior than elite junior players[16]. Reductions in physical match performance, as evidenced by decrements in total distance, low speed activity, high speed running distance, and frequency of collisions, have also been observed in elite senior fixture matches that were not observed in trial matches.[16] Collectively, these findings suggest that fatigue (or reductions in performance) from the first to the second half of matches may differentially impact players of different competitive standards.

While the majority of junior rugby league competitions are played under the unlimited interchange rule (allowing coaches to make an unrestricted number of interchanges during a match), from the age of 13, players compete under similar international laws to those applied in senior matches.[7] Despite the similarities in rules between junior and senior competition, junior matches are considerably shorter (i.e. 60 min) than those played at the senior level (i.e. 80 min). Furthermore, while regular fixture matches are played once every week in both junior and senior competition, tournament match-play is far more common for junior competitors. For example, the Queensland schoolboys rugby league, and Australian affiliated states carnivals are played over a five day period, with players required to compete in several matches over the course of the tournament. Moreover, the largest junior rugby league tournament in Australia, the Confraternity carnival, requires competitors to play six, 40-min matches in five days, with four of these matches played over the first two days of the competition. While the intensified competition schedule is likely to elicit different fatigue responses from regular fixture matches, it is also possible that the shorter duration of matches could differentially influence the activity profiles of players, including any first half to second half reductions in performance, in comparison to those typically described in 80 min matches at the senior level.

Although there is a growing body of evidence on the physical demands of elite senior rugby league match-play, the physical demands of junior competition are unknown. Understanding the match-play demands of junior rugby league could have important implications for talent identification, training prescription, and the quantification of player training loads.[17] Given the paucity of published data, studies investigating the influence of playing standard on the physical demands of junior rugby league match-play are clearly warranted. With this in mind, the purpose of this study was twofold: (1) to investigate the physical demands of junior rugby league players competing at three different standards of an intensified tournament competition, and (2) to determine if fatigue (or reductions in performance) were induced to a similar extent in these participants.

2. Methods

Sixty male junior rugby league players (mean ± SD age, 16.7 ± 0.7 years) participated in this study. The project was first discussed with the Executive Committee of the Queensland Independent Secondary Schools Rugby League (organising committee of the Confraternity Carnival). The committee provided their support for the project, and permission to contact individual schools competing in the carnival. After receiving permission from the individual schools, a letter was sent to players and their parents, advising them of the project, and inviting them to attend an information session about the project. During this session, participants received a clear explanation of the study, including information on the risks and benefits. Written parental or guardian consent was obtained prior to participation. All experimental procedures were approved by the Institutional Ethics Committee for Human Investigation.

Players were recruited from the 2012 Confraternity carnival. The Confraternity carnival involves 40 teams, competing in three different divisions. Divisions were based on the relative success of each team during the tournament in the previous year. Traditionally strong rugby league teams played in Division 1, while Division 3 was comprised of players who competed in rugby league, but not at representative level. Some teams may have been relegated from Division 1 to Division 2 or from Division 2 to Division 3, depending on performances in the previous year. Equally, some teams were promoted if they were highly successful in their respective division in the previous year.

The subjects in this study were participants in one of five teams competing in the carnival. The teams were either competing in Division 1 ($n = 2$ teams), Division 2 ($n = 1$ team), or Division 3 ($n = 2$ teams). The final ranking of the 5 teams was 9th, 14th (Division 1), 26th (Division 2), 33rd and 38th (Division 3). The Confraternity carnival consisted of 6 matches in 5 days. Players competed in two matches on both days 1 (Monday) and 2 (Tuesday) of the tournament, and a single match on days 4 (Thursday) and 5 (Friday). Matches on day 1 and 2 were separated by no more than 4 h. Due to the demanding playing schedule, each match was 40 min in duration (20 min halves, separated by a 5 min half-time break). Each team consisted of 20 players (13 on field with 7 replacements). Consistent with the majority of junior rugby league competitions, an unlimited interchange rule was applied.

Global positioning system (GPS) analysis was completed during 17 matches (totaling 139 appearances). The total number of player appearances for Divisions 1, 2, and 3 matches was 59, 30, and 51, respectively. The proportion of forwards (prop, hooker, second row, and lock), and backs (halfback, five-eighth, centre, wing, and fullback) who wore a GPS unit were comparable for Division 1 (54% and 46%, respectively), 2 (60% and 40%, respectively), and 3 (47% and 53%, respectively) teams. Up to 12 players wore a GPS unit during any given match.

Movement was recorded by a minimaxX GPS unit (Catapult Innovations, Melbourne, Australia) sampling at 5 Hz. The GPS signal provided information on speed, distance, position, and acceleration. The GPS unit also included tri-axial accelerometers and gyroscopes sampling at 100 Hz, to provide information on physical collisions and repeated high-intensity efforts. The unit was worn in a small vest, on the upper back of the players.

While recommendations for reporting GPS data have been presented,[18] there is generally a wide range of reporting methods employed in the scientific literature.[13,19] To date, there are no standardized methods for reporting velocity 'zones', and several definitions of what constitutes an 'effort'.[18] Due to the measurement error associated with GPS technology sampling at lower frequencies,[20] we analysed movements into broad velocity bands representing low and high speeds. To allow comparisons with other researchers,[15] in the present study, data were categorized into (i) movement speed bands, corresponding to low (0–5 m s^{-1}) and high (>5 m s^{-1}) speeds; (ii) collisions; and (iii) repeated high-intensity effort bouts. A repeated high-intensity effort bout was defined as 3 or more high acceleration (≥2.79 m s^{-1}), high speed, or contact efforts with less than 21 s recovery between efforts.[12] The minimaxX units have been shown to have acceptable validity and reliability for estimating longer distances at walking through to striding speeds,[20] although larger measurement errors and poorer validity have been reported for the measurement of individual sprints, accelerations, and change of direction efforts.[19] The minimaxX units have been shown to offer a valid measurement of tackles and repeated efforts commonly observed in collision sports.[14] Approximately 30 min after the completion of each match, players provided a rating of the perceived intensity of matches