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Original research

Between match variation in professional rugby league competition

Thomas Kempton[a], Anita C. Sirotic[b], Aaron J. Coutts[a,*]

[a] Sport & Exercise Discipline Group, Faculty of Health, University of Technology Sydney (UTS), Australia
[b] Melbourne Storm Rugby League Football Club, Australia

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ABSTRACT

Objectives: To assess between match variability of physical performance measures over both the total and sub sections of the match in professional rugby league competition.
Design: Longitudinal observational study.
Methods: Global positioning system (GPS) data were collected from 24 players from the same team competing in the National Rugby League (NRL) competition over 23 matches during 2011 season. The GPS data were categorised into total distance, high-speed running (>15 km h^{-1}) and very high-speed running (>21 km h^{-1}) distance for discrete reference periods (10 min, 20 min, 40 min and 80 min). The data was then log transformed to provide the coefficient of variation (CV) and the between subject standard deviation (both expressed as percentages).
Results: The data show that the between match variability is greater for high-speed (CV 14.6%) and very-high speed (CV 37.0%) running compared to total distance (CV 3.6%). Within each speed category, the variability of performance tended to increase as the duration of the reference period decreased.
Conclusions: The results show that while global measures of physical performance such as total distance are relatively stable, higher-speed activities exhibit a large degree of between match variability. In addition, when segmenting the match into short periods of time for analysis, all physical performance measures increased in variability. These findings have implications for determining sample size, identifying reliable performance measures and selecting appropriate time periods for future applied studies that involve observational match analysis.

1. Introduction

Time-motion analyses of competition matches are now common in rugby league and other team sports. Recent research has used time motion analyses to determine positional demands,[1,2] examine match-related fatigue[3,4] and develop tactical strategies[5] during rugby league match-play. In addition, many practitioners routinely collect physical performance data to assist in managing player workload[6] and this data is often viewed in real-time during competition matches to inform interchange and tactics.[7] The complex and intermittent nature of competition matches in team sports means that measures of physical performance are dynamic and vary between matches throughout the course of the season. Possible factors that influence match performance include the strength of opposition and match outcome,[8,9] physical fitness[10] and environmental conditions.[11]

Recent developments in semi-automated computerised video tracking technology means that many professional sports organisations – primarily large European based soccer clubs – are able to obtain detailed time motion analyses for all players on the pitch. This allows for comprehensive databases of physical performance information to be developed. Indeed, these types of databases have recently been analysed to examine typical match to match variation of certain performance measures in elite football competition.[8,12] These studies have reported that the typical between match variability for total distance is relatively low;[8] however, variability tended to increase for high speed running, very high speed running and sprint distance.[8,12] Collectively, these studies show that while global measures such as total distance are relatively stable, high-speed activities are a highly variable indicator of physical performance.

Global positioning system (GPS) provides an alternative method of time motion analysis that is commonly used by professional sporting teams involved in rugby league, rugby sevens and Australian football competition.[13–15] In contrast to semi-automated computerised technology, GPS systems only provide time motion data to the operator of the system for players that are fitted with a GPS unit. As a result, time motion profiles are not usually available for opposition players. This prevents clubs that use GPS technology from developing large, multi-team, physical performance

* Corresponding author.
E-mail address: aaron.coutts@uts.edu.au (A.J. Coutts).

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databases. Accordingly, the majority of research that relies on GPS time motion analyses is restricted to single club case studies with comparatively smaller sample sizes.[1,5,14]

While match to match variability has been reported for elite soccer competition using large samples derived from semi-automated computerised video tracking technology, there is currently no such information that is specific to rugby league. Furthermore, while time-motion profiles of competition matches are commonly divided into short segments[3,4] – such as 10, 20 or 40 min periods – the effect of shorter time periods on variability of performance measures is unclear. This information will be useful in determining appropriate sample size and selecting reliable performance measures for applied research studies, and assist in interpreting worthwhile changes in performance. Therefore, the aims of this study were to: (1) determine the typical between match variability of common physical performance measures; and, (2) examine variability during sub-sections of competition matches in professional rugby league.

2. Methods

GPS data was collected from 24 players (mean 12.7, range 4–20 games analysed per player) from the same team competing in the National Rugby League (NRL) competition during an entire season. The players comprised of 6 adjustables, 8 outside backs, 5 hit-up forwards, and 5 wide-running forwards.[14] A total of 345 individual match samples were collected from 23 competition matches. As multiple interchanges are permitted during NRL match-play, only data from players completing at least 90% of a given period were included for analysis. Informed consent and institutional ethics approval were obtained.

Player movements during the matches were measured using portable GPS units (SPI-Pro, 5 Hz, GPSports, Canberra, ACT Australia). The units were placed in customised harness and fitted to the players prior to the warm up, which allowed the units to begin collecting data for at least 20 min before the start of the match. All subjects had previously been familiarised with the GPS units during training sessions or non-competition matches. SPI-Pro GPS devices provide acceptable measures for longer distances at slower velocities (<18 km h^{-1}) of locomotion.[16] However, caution is required when interpreting short, higher speed activities as current GPS devices have been reported to underestimate sprinting distances.[16,17]

Following each match, the GPS data were downloaded to the TeamAMS proprietary software (V2.1 GPSports, Canberra, ACT, Australia). Each match file was then 'split' into eight discrete 10-min time periods of play (stoppages were included in addition), which were then used to construct performance profiles for each quarter, half and complete match. The data were categorised into total distance, high-speed running (>15 km h^{-1}) and very high-speed running (>21 km h^{-1}) distance, which are similar to those used in previous research.[8,18] The mean (±SD) satellite availability for the GPS data samples included in the present study was 8.1 ± 1.5.

Data were checked for normality prior to statistical analysis. Physical performance data was analysed using a customised Excel spreadsheet (Microsoft, Redmond, USA). The data was log transformed to provide the coefficient of variation (CV), which is the variation of performance expressed as a percentage of average performance. The between subject standard deviation was also calculated and expressed as a percentage. The between subject standard deviation was multiplied by 0.2 to determine the smallest worthwhile change (SWC) for each measure. The minimum criterion change required to produce a probable significant change in performance was investigated using a progressive statistical approach.[19,20]

3. Results

The variability (and 90% confidence interval) of common measures of physical performance between matches are reported in Table 1. The data show that variability is greater for high-speed (CV% 14.6) and very-high speed running (CV% 37.9) compared to total distance (CV% 3.6). Within each speed category, the variability of performance tended to increase as the duration of the reference period decreased.

Table 1 also shows the minimum percentage change required to produce a probable significant change in performance. This is a combination of the SWC and the CV and is determined using the statistical approach outlined previously.[19,20]

4. Discussion

This study investigated the typical between match variations for common physical performance measures in professional rugby league competition. The main findings were that physical performance varied between matches, particularly for higher speed activities. In addition, when the reference period was reduced in time (e.g. from 80 min to 40 min), variability increased for all performance measures. These findings have important implications for the design of applied observational studies and the interpretation of physical performance changes during matches.

The between match variability in this investigation are higher than those previously reported in professional soccer competition.[8,12] Specifically, the CV for total distance (3.6% vs. 2.4%) and high-speed running (14.6% vs. 6.8%) exceeded those reported by Rampinini et al.[8] Both studies used a similar sample size which was drawn from the same club over a single season. While acknowledging the dissimilarities in sample size, and the classification of speed zones, the CV observed in the present study for very high-speed running (37.9%) was much higher than those reported by Gregson et al.[12] for total high-speed running (17.7%) and total sprint distance (30.8%). Indeed, the comparatively smaller sample size used in the present study is likely to contribute to the high variability observed – as previous research has shown that larger samples tend to reduce the variability in physical performance parameters.[12] The observed differences, particularly in regards to high-speed activities, may also be related to differences in time motion technology. Specifically, the GPS units used in the present study have a higher technical error of measurement (CV% 0.3–9.317 and 1.84–2.318 for a range of different running speeds) compared to that of semi-automated computer based tracking (CV% 0.2–1.3%).[21] As such, differences in the technical error of measurement between the methods may contribute to the greater variability observed in the present study compared to previous research. Additionally, differences in the nature of rugby league and soccer may further explain these results. Indeed, it is likely that variability in match performance is a function of both technical (measurement) and biological (natural) error. Irrespective of methodological differences including choice of technology and classification of speed zones, both the present results and previous research report similar trends of between match variability increasing with running speed.

The increased variability in physical performance measures observed as the duration of reference period decreased is an expected outcome. As the size of the observation period increases, time motion parameters are likely to stabilise due to the addition of more points of measurement. While this finding in itself appears unremarkable, there are important associated practical implications. Specifically, recent research has used short (i.e. 10 min) periods to examine changes in movement patterns during rugby league competition.[3] In addition, it is now reasonably common for rugby league practitioners in the professional environment to use