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Quantifying positional movement patterns in Twenty20 cricket

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Abstract

The time-motion characteristics of five cricket positions (Batsmen, Fast bowlers, Fielders, Spin bowlers, Wicketkeepers) were quantified during four State Twenty20 (T20) cricket matches. A total of 18 different players were monitored over 30 innings. Several time motion characteristics were quantified using portable 5Hz global positioning system (GPS) units. Descriptive statistics (mean ± SD) were used to describe the data while the effect size statistic was used to determine the magnitude of difference in patterns of movement between positions. T20 cricketers covered between 6.4 - 8.5 km, with 0.1 – 0.7 km of this distance spent sprinting during an 80 min fielding innings. Fast Bowlers covered 8.5 ± 1.5 km; sprinted 42 ± 8 times, mean sprint distance was 17 ± 2m and total sprinting distance was 0.7 ± 0.2 km. Wicketkeepers covered 6.4 ± 0.7 km; sprinted 5 ± 2 times, mean sprint distance was 10 ± 3m and total sprinting distance was 62 ± 44m. While batting (30 min) players covered ~2.5 km; sprinted 12 ± 5 times, mean sprint distance was 14 ± 3m and total sprinting distance was 160 ± 80m. Fast bowlers and fielders have substantially greater physical demands than spin bowlers and wicketkeepers in T20 cricket.

Keywords: GPS, time-motion, bowling, wicketkeeping, fielding, batting.

1. Introduction

Twenty20 (T20), the shortest and fastest version of cricket, is proving to be a popular format in terms of drawing spectators and the most profitable for players, administrators, coaches and owners. With so much money invested in this version of the game, franchise owners, management teams and coaches would be wise to apply successful game tactics, and select players most capable of executing a proven game strategy (Petersen et al, 2008). Investigating the physical requirements of the game and how these vary by position is a key consideration for coaching and conditioning staff. Given this is presumably the most intensive game format; it is likely that T20 requires skill execution under a comparatively higher level of fatigue. Physical fitness potentially impacts on the ability to execute the skills required to implement a particular game strategy (Rampinini et al, 2008). Increased knowledge of the positional game requirements of T20 cricketers will enable conditioning coaches to design more effective individualised training programmes.

In T20 each team faces 20 six-ball overs, with fielding restrictions termed a powerplay (only 2 fielders are allowed outside the 30 yard circle, with another 2 players besides the wicketkeeper in catching positions a maximum of 15 yards from the bat) applying in the first six overs of each innings. The allocated time for each innings is 80 minutes, with specific rules implemented in T20 cricket to increase the speed of the game; dugouts have players closer to the pitch and the new batsman must be ready within 90 seconds (2 minutes in other forms of cricket) after a wicket falls or risk being 'timed out'. There are also financial penalties imposed upon team captains and players for time wasting and slow over rates. Anecdotally, the rules seem effective in speeding up the game as players jog between fielding positions and run to get into position between overs.

Recently, an analysis of team, batting and bowling indicators of performance showed that winning T20 sides captured more wickets in the first and last six overs of an innings (Petersen et al., 2008). In addition, data from the Hawk-Eye™ video-based ball tracking system has been used to compare the bowling styles (ball release speed, pitching line and length) between three different types of matches (Test, 50-over, and T20) and three different types of right arm bowler (fast, medium and off-spin). The authors found that the bowler's styles remained constant despite the batsmen's playing style becoming more aggressive in the shorter the game formats of cricket (Justham et al., 2008). Although these studies highlight actual strategies and tactics of game play they did not describe the player physical demands.

Time-motion studies employing Global Positioning System (GPS) units to automatically monitor player movement patterns are being increasingly used across many sports. Cricket conditioning coaches are increasingly using GPS technology to modify the training of individual players, and broadcasters are beginning to show actual distances covered during different formats of cricket. However there is no published data examining the movement patterns (inter-player total distance covered, number of sprints, and mean sprint distance) of different positions in T20 cricket. The purpose of this study was to quantify the positional movement demands of T20 cricketers. We also sought to quantify the magnitude of differences in movement patterns between fielders and specialist positions (wicketkeeper, fast and spin bowlers).

2. Methods

Time motion characteristics of Australian state-level T20 male cricketers (n=18) were monitored using portable 5Hz global positioning system (GPS) units (Catapult, Melbourne, Australia) during four domestic T20 games (total of 30 innings). The standard error of the estimate (validity) of distance for walking to striding for these GPS units ranged from 0.4 to 3.8%; whereas the estimate of reliability ranged from 0.3 to 2.9%. For sprinting, the typical errors of validity and reliability of estimating distances over 20-40 m ranged from 3 to 40% (Petersen et al, 2009a).

Each player was classified as either: a batsman, fast bowler, fielder, spin bowler or wicketkeeper. Each GPS unit was positioned via an elasticized shoulder harness to sit between the scapulae of the player at the base of the cervical spine. The GPS unit was activated and GPS satellite lock established for at least 15 min prior to the player taking the field as per the manufacturer's recommendations. After each session the unit was downloaded using Logan Plus 4.0 software (Catapult Innovations, Melbourne, Australia) for analysis. Total distance (km), distance travelled walking (movement speed 0 – 2 $m.s^{-1}$), jogging (2 – 3.5 $m.s^{-1}$), running (3.5 – 4 $m.s^{-1}$), striding (4 – 5 $m.s^{-1}$) and sprinting (5+ $m.s^{-1}$), number of sprints, maximum speed ($m.s^{-1}$), maximum sprint distance (m), number of efforts more intense than jogging, and the recovery time between high intensity efforts (running, striding, sprinting) were quantified. Descriptive statistics (mean ±SD) were used to characterize the central tendency of the data. To facilitate interpretation and application of the results, the data from different game lengths was scaled to 80 minutes (ICC sanctioned time allocated for a T20 innings) for each fielding innings, while batting files were scaled to a 30 min innings. Batting innings shorter than 15 min were excluded from analysis.

The approach of magnitude-based inferences to analyse the time-motion characteristics by position was adopted (Batterham and Hopkins, 2006). The effect size statistic was generated to assess the magnitude of difference between the generic fielder position and the three specialist positions (wicketkeeper, fast and spin bowler). The criteria for interpreting effect size were: <0.2 trivial, 0.2-0.6 small, 0.6-1.2 moderate, 1.2-2.0 large, and > 2.0 very large (Hopkins, 2004).

3. Results

The movement characteristics obtained from the five positions during four T20 games are detailed in Table 1. T20 cricketers during an 80 min fielding innings covered 6.4 – 8.5 km, with 0.1 – 0.7 km of this distance spent at sprinting velocities. Sprinting accounted for 9, 7, 7, 2 and 1 % of the total distance covered for fast bowling, batting, fielding, spin bowling and wicketkeeping respectively. In comparison, walking accounted for approximately 66% of the total distance covered by spin bowlers, wicketkeepers and the batsmen, but only ~50 % of the total distance covered by fielders and fast bowlers.

The magnitude of difference in movement patterns between fielders and specialist positions (fast bowlers, spin bowlers and wicketkeepers) is also displayed in Table 1. Fast bowlers had 11 more sprints (ES = 0.66), 33 more high intensity efforts (ES = 0.60) and 13 seconds less recovery time between high intensity efforts (ES = 0.60) than fielders. While magnitude comparisons for batting are not displayed in Table 1; compared to fielders batsmen had slightly longer recovery time between high intensity efforts (53 vs. 45 s: ES = 0.37). In contrast, compared to fast bowlers batsmen had moderately greater recovery time between high intensity efforts (53 vs. 32 s: ES = 1.05). Spin bowlers had only one-third of the number of sprints completed by fielders and half as many high intensity efforts. Consequently, spin bowlers only covered a third of the total distance running and sprinting covered by fielders. However, because spin bowlers covered ~45% more distance walking than fielders, they enjoyed twice as much recovery time between high intensity efforts (106 vs. 45 s: ES = 2.4).

Table 1. Time-motion variables (mean ± SD) of state T20 cricketers. The movement data in each position is scaled to a game duration of 80 min (except batting = 30min).

Workload characteristic	Batsmen (n=6)	Fast bowlers (n= 4)	Fielders (n= 14)	Spin bowlers (n= 3)	Wicketkeepers (n= 3)
Distance					
Walking (0 – 2.0 $m.s^{-1}$) (m)	1644 ± 507	4288 ± 884	4381 ± 968	6336 ± 938[d]	4670 ± 545[a]
Jogging (2.0 – 3.5 $m.s^{-1}$) (m)	395 ± 114	2195 ± 624[a]	2042 ± 481	1627 ± 543[b]	1301 ± 155[c]
Running (3.5 – 4 $m.s^{-1}$) (m)	80 ± 34	559 ± 184[a]	502 ± 208	215 ± 136[c]	222 ± 55[c]
Striding (4.0 – 5.0 $m.s^{-1}$) (m)	153 ± 91	725 ± 322	663 ± 421	240 ± 224[b]	178 ± 33[c]
Sprinting (5+ $m.s^{-1}$) (m)	161 ± 83	723 ± 168[a]	554 ± 353	154 ± 144[c]	62 ± 44[c]
Total distance (m)	2433 ± 450	8489 ± 1493[a]	8141 ± 1308	8537 ± 1568[a]	6433 ± 760[c]
Time					
Walking & Jogging (s)	1706 ± 47	4366 ± 122	4350 ± 249	4560 ± 281[b]	4686 ± 21[c]
Running, Striding & Sprinting (s)	81 ± 43	431 ± 123[a]	367 ± 195	134 ± 104[c]	111 ± 23[c]
Sprint					
Number (#)	12 ± 5	42 ± 8[b]	31 ± 18	10 ± 8[c]	5 ± 2[c]
Mean sprint distance (m)	14 ± 2	17 ± 2	17 ± 4	15 ± 5[a]	10 ± 3[c]
Maximum sprint distance (m)	34 ± 12	51 ± 20	54 ± 23	38 ± 18[b]	20 ± 11[c]
Maximum sprinting speed ($m.s^{-1}$)	7.5 ± 1.0	9.1 ± 0.6[a]	8.6 ± 1.1	8.9 ± 2.0[a]	6.5 ± 0.7[c]
High intensity efforts					
Number (#)	38 ± 17	163 ± 44[b]	130 ± 57	56 ± 35[c]	50 ± 12[c]
Mean effort duration (s)	2.2 ± 0.2	2.6 ± 0.1[a]	2.8 ± 0.5	2.2 ± 0.4[c]	2.2 ± 0.1[c]
Recovery between (s)	53 ± 24	32 ± 10[b]	45 ± 21	106 ± 49[d]	101 ± 28[d]

[a] Small, [b] moderate, [c] large and [d] very large magnitude of difference of time-motion variables of specialist fielding positions (Fast bowlers, spin bowlers and wicketkeeper) from the generic fielder position.

The wicketkeepers covered substantially less distance in jogging, running, striding and sprinting, than fielders. Notably, fielders covered ~8 times greater distance sprinting as wicketkeepers. Yet, wicketkeepers covered slightly more distance than fielders (290 m; 6% more) at walking intensity. Like the spin bowlers, wicketkeepers enjoyed twice the recovery time from high intensity efforts as fielders (101 vs. 45 s: ES = 3.0).

4. Discussion

Cricket conditioning coaches often work with players in their squad who are involved in all three formats of the game. This study provides descriptive data of T20 state level cricket and shows that fast bowlers have the highest, and wicketkeepers the lowest, workloads. T20 cricketers in the field (excluding wicketkeepers) typically covered between covered between 8.1 - 8.5 km during an 80 min fielding innings, with 0.2 – 0.7 km of this distance spent at sprinting velocities. In comparison wicketkeepers covered 6.4 km, with only 60 m spent at sprinting intensity. Players batting for 30 min covered 2.5 km with 160 m run at sprinting intensity. Coaches must reconcile differences in physical demands and movement patterns between game formats to formulate game and position-specific training plans.

Published data is starting to emerge defining the workload characteristics from different formats of cricket. Fielders in English county (first-class) cricket covered 15.5 km (2.6 $km.hr^{-1}$) in a day (Rudkin and O'Donoghue, 2008). In comparison T20 fielders covered almost 2.5 times more distance per hour (6.1 $km.hr^{-1}$). While a time-motion study (conducted via video recordings) of international batsmen scoring centuries did not estimate distance covered, 98.6% (Test) and 97.7% (One Day) of the batsmen's time was spent stationary, walking and jogging (Duffield and Drinkwater, 2008). In comparison, for the same movement patterns, T20 batsmen spent only 95.5% of their time at these lower intensities. Therefore, when compared to the longer formats of cricket, a greater proportion of time batting in T20 cricket is spent at higher intensities. Similarly, a case study conducted over 12 games reported an international One Day fast bowler covered ~16 km in 3.5 hours with 1.1 km (7%) at sprinting intensity (Petersen, et al., 2009b). In comparison, T20 fast bowlers covered 0.7 km (8.5%) of their total distance (8.5 km) at sprinting intensities. While a T20 innings is only 38% of the time taken for a One Day innings, fast bowlers covered 53% of the total distance and 63% of the sprinting distance reported for the international One Day fast bowler. Studies with larger sample sizes are required to confirm these preliminary estimates. It is also likely that the physical workload of international T20 matches would be greater than state T20 matches. Nevertheless, it appears that the physical demands of T20 cricket are likely to be more intensive than One Day and Test cricket.

When designing position-specific training programmes coaches should consider the positional differences identified in Table 1. Fast bowlers undertake the greatest workload at the highest intensity and have 13 s less recovery time between high intensity efforts as fielders. Therefore coaches should (where possible) seek fielding placements for their fast bowlers to the enhance recovery between high intensity efforts and limit the potential of fielding tasks impacting on their bowling performance. In comparison, spin bowlers are able to undertake their bowling with twice the recovery time from high intensity efforts as fielders. Future work classifying movement demands by actual fielding position should identify the most advantageous fielding placement for fast bowlers. However the specialist skills required for some positions (slips catching) needs to be taken into account when assigning positions in the field.

In cricket, players within the same team experience substantially different workloads, depending on among other factors their position, involvement and role within a game (Petersen et al., 2009b). Understanding both the positional and game format differences in workload will help conditioning coaches to determine the amount of physical preparation and recovery that players need. Coaches that don't have access to time-motion information on their players must rely on published or established values to estimate the physical loading on players. Managing the workload and recovery of players is becoming more important and increasingly complex with the increased opportunities for first-class players to play in a number of different professional leagues during the season. Future work should further quantify the positional workload in T20 with a greater sample size, and determine the magnitude of game-to-game variability in movement patterns for batsman, bowlers and fielders.

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