VELOCITIES AND ACTIVITY DEMANDS OF ELITE BRAZILIAN MEN´S BASKETBALL IN COMPETITION

Juliana Landolfi Maia, Ana Carolina Pahan, Lucas Antônio Monezi, Milton Shoiti Misuta and Luciano Allegretti Mercadante
Laboratory of Biomechanics and Instrumentation, School of Applied Sciences, University of Campinas, Brazil
email: lucianomerc@yahoo.com.br, web: www.fca.unicamp.br

INTRODUCTION

Kinematic analysis by videogrammetry has been used to describe the movement of basketball players, whether in the technical, tactical or physical aspect. Loads of physical training should be planned in terms of volume and intensity, so as close as possible to the demands required during games. In general, the amount of displacements performed can be characterized by the distance covered and the intensity by the velocities reached. The occurrence of successive alternating periods of efforts by rest intervals makes obtaining and manipulating variables such as the duration of effort, repetition number, time and type of recovery of great importance in the preparation of this physical shape, characterized by intermittent. Demands activities have been described by basketball players since 1995 by different methods [1,2,4,5]. This study [1] proposed classifying physical demands and shifts between them in terms of velocity comparing players of elite and sub-elite from Australian basketball, presenting the frequency of actions, number of hops and displacements performed as well as its duration and average distance in different conditions and velocity ranges.

The semi-automatic tracking system based on image processing techniques (Dvideo, Unicamp, Campinas, Brazil) [3] gives the player position versus time, bringing a good precision in time and space compared to visual estimation methods, for example. This system allows for kinematic analysis based tracking players in sequences of 2D images and reconstruction of their position on the court. The present study proposes an analysis of the players displacements during an official basketball match, classifying them by velocity range, describing, for each age, the frequency of these actions, the duration, the time intervals between them and distance, and verifying significant differences between positions guards, forwards and centers.

METHODS

A game of season 2011/2012 the main men's Brazilian championship, New Basket Brazil (NBB), was filmed by four digital cameras (JVC, model GZHD10), statically positioned at the corners of the gym, at the highest point possible from the ground (approximately 12 m) so that each camera would frame the entire court. The study was approved by the Research Ethics Committee of UNICAMP (CEP No. 1008/2010), and the footage was authorized by the National Basketball League (NBL), responsible for the championship.

The study included twelve players (29.9 $\pm$ 6.8 years, 93.0 $\pm$ 9.2 kg and 193.2 $\pm$ 6.0 cm) from the league leader, with different periods of stay on the court. Following the acquisition of image sequences, measurement of screen coordinates, calibration and synchronization of cameras and temporal reconstruction of 2D coordinates of the players on the court were held in DVideo System. The process of measurement of screen coordinates in image sequences was performed manually, and the player's position on the screen by the operator estimated in each frame, given the projection of its center of mass on the plan of the court. 2D coordinates of position versus time of the players have been smoothed separately, using a digital filter Butterworth type low pass 4th order with cutoff frequency of 0.45 Hz, determined by spectral analysis. From the curve of position versus time, velocities were obtained by numerical derivation. Distances were calculated by the cumulative sum of the displacements between two successive frames.

The actions of each player in each velocity range were defined by maximum velocity and duration (t), as proposed in [3], considering the beginning and end of each action as moments corresponding to minimum velocity immediately before and after the maximum velocity. Thus, each action performed corresponds to an effort that includes a phase of acceleration and deceleration. Other authors use the instantaneous velocity of the players to determine which range velocity actions occurred, not considering the continuity of action in relation to the efforts [1,2,5]. For every action it was calculated duration (t) the intervals between them (Δ t), considering the periods between consecutive actions in the same velocity range, and the distance covered. The actions were classified in four velocity ranges: $0.1 < v_1 \leq 1.0$ m/s (standing), $1.1 < v_2 \leq 3.0$ m/s (jogging), $3.0 < v_3 \leq 7.0$ m/s (running) and $v_4 > 7.0$ m/s

(sprinting), as proposed by [1]. In this analysis were discarded periods when the players were standing or walking, or in v_1. The statistical analyzes, data processing, obtaining derived variables and actions in each category were identified automatically by routine developed in Matlab. The variables not normally distributed according to the Kolmogorov-Smirnov test ($p < 0.05$), and the Wilcoxon test was used ($p < 0.05$) for statistical differences.

RESULTS AND DISCUSSION

Averages and standard deviations of the frequencies of the displacements performed (Fa), the time duration (t), the interval between them (Δt) and distance (d) for each player in each velocity range are presented in table 1.

In this study, players traveled 23.04% of the total distance in v_1, at 42.71 %, in v_2 at 34.30 % and 0.25 % in v_3 above 7.0 m/s. The average duration of each action (t) v_2 was 7.9 ± 3.4 s, in v_3 was 11.2 ± 4.8 s and in v_4 of 4.9 ± 5.1 s. The Fa averages were 278.8 ± 147.5 in v_2, 136.0 ± 50.0 in v_3 and 1.4 ± 1.7 in v_4. In v_2 (jogging) there have been found no significant differences between positions for any of the variables Fa, t, Δ t and d, suggesting that the actions in v_2 have the same characteristics for the different positions. Differences were found between point guards and power forwards positions in v_3 (running) and v_4 (sprinting). In v_3 to the frequency of actions ($p = 0.03$) and the interval between them ($p = 0.04$), in v_4 for frequency actions ($p = 0.02$), duration ($p = 0.03$) and distance covered ($p = 0.03$). The results indicate actions with similar characteristics between point guards and power forwards at all velocities. The main differences were found between guards and forwards sprinting and running, showing characteristics and frequency of actions significantly different, suggesting different efforts. Studies with Tunisians players [2] found differences between point guards and power forwards in tests of maximum velocity in 5, 10 and 30 m, and in agility tests. These results suggest that different schedules of volume and intensity of the efforts are made, since it is clear the different characteristics between point guards and power forwards to perform activities in different intensities in the game.

CONCLUSIONS

The application of two-dimensional reconstruction using the manual tracking and DVideo was possible in our experimental model, it is clear that guards often have different actions of power forwards and small forwards. Such information is useful in training prescription, considering a greater emphasis on interval training and, therefore, taking into account the specificities of each role on the court, since the variables Fa, t, Δ t and d, guide the training of these different functions. This is the first study to examine the frequency of actions in different velocity ranges considering the intervals between them in a Brazilian Basketball team.

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Table 1: Playing time, total distance covered, frequency of actions performed, duration, interval between actions and distances traveled in different velocities ranges for each player during a match.

	T (s)	D (m)	V2 F$_a$	t (s)	Δt (s)	d (m)	V3 F$_a$	t (s)	Δt (s)	d (m)	V4 F$_a$	t (s)	Δt (s)	d(m)
SF1	527	3967.5	387	11.52	3.8	1781.6	211	16.6	5.03	1496.6	2	4.9	124.7	5.9
SF2	850	2051.7	235	6.07	4.7	967.7	96	8.3	13.30	735.8	1	16.8	0	9.1
PF1	593	2473.5	266	8.67	7.6	1177.0	114	12.1	13.34	844.3	2	9.3	2435.0	19.0
PG1	876	4452.0	548	12.02	4.5	2224.4	303	15.3	10.05	1550.5	2	8.9	677.2	13.8
PG2	645	3776.0	370	11.15	4.1	1594.2	185	15.4	3.42	1574.9	6	8.6	1643.0	8.8
PG3	442	210.6	44	2.79	5.1	89.3	23	3.5	10.73	93.3	1	3.3	0	0.9
PF2	1030	3102.9	245	8.62	10.7	811.6	108	13.3	26.32	712.7	2	4.0	976.2	12.3
PG4	421	2210.8	217	5.36	7.0	983.4	136	6.9	11.96	884.9	1	3.9	0	8.0
PF3	850	3004.9	250	8.78	5.9	1052.6	102	12.1	17.14	804.2	0	0	0	0
PF4	364	700.3	28	2.16	2.7	112.8	16	3.1	77.22	123.4	0	0	0	0
SF3	570	2059.4	404	6.72	6.3	978.2	197	10.5	13.52	805.3	0	0	0	0
PF5	688	2932.6	352	11.23	9.2	1443.9	147	16.7	24.32	987.3	0	0	0	0
Average	655	2578.5	278.83	7.92	5.9	1101.4	136.50	11.2	18.86	884.4	1.42	4.9	488.0	6.4
DP	208	1253.5	147.53	3.36	2.3	619.7	80.31	4.78	19.55	483.9	1.68	5.1	808.9	6.4

Legend: T (s): playing time; D (m): total distance covered; PF; power-forward; PG: power-guards, SF: small-forwards, Fa; frequency of actions taken in the given category, t (s), time duration of each of the movements, Δ t (s); interval between each movement, d (m); distance covered in each velocity range.