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Effect of a Physical Training Season Applied on a U-19 Male Basketball Team

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Abstract This study aimed to analyze the effects of a specific physical training season, conducted concomitantly to the State championship, on muscle strength, speed and power in U-19 basketball players (n = 14; 18 ± 1 years old; 86.2 ± 10.2 kg of body weight; 1.92 ± 0.1 m of height). A double periodization model was used in the physical development program that was divided into the following periods: general preparatory, specific preparatory and competitive. The periodization was planned without any interference of the researchers. At five moments of the season (weeks 1, 8, 25, 39 and 49) the following parameters were assessed: maximal strength (1RM), sprints over 30 m (number of[NS]; mean speed over 30 meters (V_{30}). maximal speed[Vmax]; time to attain maximal speed[AT]) and jumps (Squat Jump[SJ], counter-movement jump without arms[CMJ] and counter-movement jump with[CMJA]). The results showed that at the finals of the championship significant increases ($p<0,05$) in V_{30} and AT were observed. The other parameters (1RM, SJ, CMJ, CMJA, Vmax and NS) did not change throughout the season ($p>0,05$). Thus, it can be concluded that only the time to attain it (acceleration) and V_{30} were sensitive to the training periodization proposed by the technical commission during the 49-week competitive season.

Keywords Basketball, Periodization, Power

1. Introduction

Basketball is a sport in which athletes switch between high (maximal or near maximal) and low intensity efforts, characterizing the intermittent nature of this modality[1,2]

Previous studies have shown that athletes perform about 997 changes of direction during a 48-min game, with an average time at each position of about 3 seconds. Taking into account the total duration of the game, it was observed that 25% of this time was spent in high intensity actions and movements and 75% of this time was spent in activities considered more intense than walking. Thus, the athletes' performance is directly related to their capacity to stand several stop-and-go efforts, as well as to their power and speed capacities during the game[1].

However, a common challenge among coaches regards to how to determine the appropriate training workloads during the competitive period when the annual championship schedule does not allow the teams to perform a defined and planned pre-competitive season[3]. On scientific periodics, there are few studies analysing periodization along a whole season, for comparison between training programs. Therefore, this study aimed to analyze the effects of a 49-week physical training program performed concomitantly to a state championship on muscle strength, speed and power in U-19 basketball players.

2. Materials and Methods

Sample

Fourteen U-19 male basketball players (18 ± 1 years old; 86.2 ± 10.2 kg of body weight; 1.92 ± 0.1 m of height; 5 ± 1.4 years of practice) who competed in the state championship participated in the study. They were previously informed about the protocols and aims of the study, which where in conformity with international ethical standards, and given a written consent prior to participation.

Inclusion and exclusion criteria

The inclusion criteria for participating were: (a) aged

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between 16 and 18 yrs; (b) have at least 3 yrs of experience in basketball; (c) engaged in basketball State championship; (d) no intake of nutritional supplements or potential ergogenic aids of any kind (exogenous anabolic androgenic steroids); (e) non-smoker; (f) normal blood pressure; and non-diabetic; and (g) they trained 12 hr per week (5 days per week).

Training periodization

The technical commission was formed by people with experience in basketball and planned the training periodization. The researches had no interference on the training organization, just evaluating the team. This commission also indicated the moments when measurements of the variables would occur. The whole season lasted 49 weeks and included the state championship (average of 2 games per week) planning a performance peak at the playoff moment, looking for won the championship. A double periodization model was planned (two performance peaks), comprising the first and second rounds as well as the finals of the championship. The volume of on-court training (technical-tactical) was 3 hours daily, with 90 minutes for physical training and 90 minutes for technical and tactical training. The physical exercises performed during the strength training were: knee extensor, horizontal leg press, squat, horizontal knee flexion, extension, ankle flexion, bench press, seated dumbbell press, elbow extension, lat pull-down and pulley triceps pushdown. Power training was performed twice a week, with volumes and intensities varying according to the focus of each period (Table 1).

Table 2 presents the test schedule throughout the periodization.

Table 1. Training distribution throughout the season

Weeks/ Microcycles	Periods		Intensity (%1RM)	No. of series *vs.* Repetitions	Rest (min)
1-3	1° Performance Peak	General Preparatory Period	50%	4 x 12-15	1 - 2
4-6			80%	3-4 x 6	1 - 2
7-8		Specific Preparatory Period	50%	3 x 15	1 - 2
9-13			80%	3x 6	3 - 5
14-20			50%*	4-5 x 8	2 - 8
21-24		Competitive Transition	85%	4 x 8	3 - 5
25-26		Resting	-	-	-
27	2° Performance Peak	General Preparatory Period	50%	4 x 10	1 - 2
28			70%	1 x5	3 –5
29-30			60%	3 x15	1 -2
31-35		Specific Preparatory Period	70-80%	3-4 x6	3 - 5
36-39			50%*	4-5 x 8	2- 8
40-42			85%	4 x 8	3 - 5
43-46		Competitive	65%	4 x 10	1 - 2
47-49			50%*	6 x 8	3 - 5

*Power Training comprised jumping sets

Table 2. Physical tests schedule and number of games performed at each period

Test 1	Test 2	Test 3	Test 4	Test 5
Week 1 Beginning of the competitive period	Week 8 After 7 games	Week 25 After 15 games (End of the first round)	Week 39 After 29 games	Week 49 After 39 games (*Play-Offs*)

Table 3. Parameters assessed throughout the season

Parameter	Test 1	Test 2	Test 3	Test 4	Test 5
1RM Bench Press (Kg)	81.6 ± 2.1	81.6 ± 15.2	82.7 ± 11.5	85 ± 11.5	82.8 ± 7.5
1RM Leg Press (Kg)	234 ± 34.7	237 ± 35	234 ± 34.7	240.3 ± 24.3	248.4 ± 22.9
SJ (cm)	38.7 ± 7.6	33.2 ± 3.4	38 ± 3.6	36.0± 3.1	36.0± 3.6
CMJ (cm)	39.3 ± 4.8	37.1 ± 4.1	42.4 ± 4.1	39.3± 4.2	39.0± 4.3
CMJA (cm)	47.9 ± 4.9	46.8 ± 4.7	48.8 ± 5.5	47.8± 5.2	47.6± 5.4
NS	9.6 ± 4	11.8± 5.1	9.9± 5.3	10.8 ± 6.7	9.00 ± 6.6
Vmax (m/s)	7.7 ± 1.2	7.4 ± 1.3	7.5 ± 1.4	7.4 ± 1.6	7.3 ± 1.8*
AT (s)	2.8 ± 0.3	3.0 ± 0.4	3.6 ± 0.21	2.7 ± 0.3*	2.5 ± 0.0*
V_{30} (m/s)	6.3 ± 0.2	6.3 ± 0.1	6.3 ± 0.1	6.6 ± 0.2*	6.8 ± 0.1*

(The values are mean ± standard deviation)

*$p < 0.05$ compared to Test 1; 1RM (maximal strength); SJ (squat jump); CMJ (counter-movement jump without arms; CMJA (counter-movement jump with arms), NS (number of sprints); Vmax (maximal speed during the sprints); Vmax (maximal speed during the sprints); AT (acceleration); V_{30} (mean speed over 30 meters)

Assessment of Physical Capacities

Maximal Strength

The one-repetition maximal test (1RM) was performed for bench press and leg press tests, following the protocol described by[4].

Vertical Jump

The height of the vertical jump was recorded using a jump platform (Ergo Jump System®). The following jumps were performed: squat jump (SJ), counter-movement jump without arms (CMJ) and counter-movement jump with arms (CMJA), according to the protocol proposed by Bosco[5]. Three maximal trials of each type of jump were performed and the average result was considered.

Consecutive sprints over 30 m

This test was performed to determine the number of sprints (NS), the maximal speed during the sprints (Vmax) and the mean speed over 30 meters (V_{30}). Sprints were separated by 20 s of active recovery periods[6, 7]. Five pairs of photocell barriers coupled to the software Velocity 2.0 were placed at each 7.5 m to determine the time to attain maximal speed, i.e. acceleration (AT). The test was stopped when the individual's performance was 10% worse than the higher speed attained in the first three sprints.

Statistical analysis

To test the data for normality, a Kolmogorov-Smirnov test was used. For comparisons of the means a repeated-measur es ANOVA was used. Significance was accepted at $p<0.05$ (GraphPad Instat®).

3. Results

No differences were observed for NS, 1RM, SJ, CMJ and CMJA between any of the testing moments. However, there were significant improvements ($p<0.05$) AT and V_{30} compared to the first test in Test 5 and also for AT and V_{30} at Test 4.

4. Discussion

The main finding of the present study was that the only variables that were improved throughout physical training season were acceleration (AT) and V_{30}. Also, the differences were observed only at the second specific preparatory period and the second competitive period. The other assessed variables showed no alterations during the season. These findings are important once acceleration and speed are essential components to a great performance in basketball. And the other capacities did not decrease over a long-term competitive season. Apart of that, to our knowledge this is the first study to follow-up a U-19 basketball team over a 49-week season and to consider the effects of several events that occurred during this period (games, training, travels) on motor components that are crucial to this sport modality.

In regards to the 1RM results, no significant changes were observed between the tests, although at the last analysis there was a trend of increasing for lower limbs muscle strength. We believe this result reflects the emphasis given to muscle strength maintenance all over the competitive period. Previous studies[8,9] have shown divergent results regarding muscle strength maintenance over a competitive season, likely because this capacity can be influenced by the amplitude of the strength training and the athletes' experience[8,9] observed a decrease in the average values for bench press and leg press 1RM test before the championship (81.6 kg and 234 kg). On the other hand, among athletes from the first division of Americam College Basketbal Tournament the values for bench press and leg press 1RM test were higher than the present ones[8,10].

Also, no significant differences were observed between the three types of vertical jump. The mean results recorded for CMJA are below those from other studies[10]. This fact could be expected, as at this moment of training periodization there were not enough stimuli to improve this capacity. This effect has also been previously described.[11,14]. Additionally, a better conditioning was observed for the lower limbs at the beginning of the season compared to the upper limbs, what is in accordance with[15], leading to an attenuated response of this physical capacity. Thus, it is important to use such information in future studies, in order to improve the power training to the lower limbs, exercising at higher intensities to allow gains in performance, and using lower volumes in order to avoid overtraining during the season.

In regards to the sprints test, there were no significant differences in NS during the season, although an increase in the group average was observed in May. By then, training was focusing strength, as referred to the general preparatory period. In October and November, reductions in NS were observed, with values close to those observed at the beginning of the season, probably as a result of the high number of games played from July to November.

We observed significant improvement in AT and V_{30} after the championship finals. This effect is likely a response to game stimuli, where stop-and-go actions require the performance of sprints. As the acceleration capacity is essential to power and speed actions in basketball, at that point the physical training was focusing power maintenance, a prerequisite to acceleration.

We recognize that a limitation of our study was the lack of a control group, but it is very difficult to set up it with competition athletes and even more for a long time (49 weeks), for obvious reasons.

5. Conclusions

The results suggest that V_{30} and the time to attain it (acceleration) were sensitive to the periodization proposed by the technical commission throughout the 49-week competitive season. Not less important, muscle strength and power did not decrease by the end of the championship compared to pre-training values.

The improvement of conditioning variables that are crucial to a good performance in basketball, as well as the maintenance of muscle strength and power over the season contributed, together with tactical and technical training, to make the present U-19 team finish the competitive season in the fourth position among sixteen teams, positioning it in the first division of state basketball.

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