Dynamics of the power measures alterations and the posterior long-lasting training effect on basketball players submitted to the block training system

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ABSTRACT

The present study had as objective to investigate the alteration dynamics of the vertical jump explosive power (VJ), the horizontal jump explosive power (HJ) and the fast horizontal power to the right leg (STCD) and left leg (STCE) in the distinct preparation stages in adult basketball players submitted to the block training system. The group studied was composed of 12 athletes from the main league who participate in the São Paulo State Basketball Championship (A1). Eight athletes fully accomplished the program and were included in the analysis. The athletes were submitted to a preparation bicyclical structure (first macro-cycle with 23 weeks and the second with 19 weeks). In the structuring of the model, the macro-cycle was divided in basic stage (power concentrated loads), special stage and competition stage. The basic stage had duration of eight weeks in the first training macro-cycle and three weeks in the second macro-cycle. The athletes were evaluated in eight distinct moments of the annual cycle, characterizing a longitudinal investigation. The results demonstrated: 1) the efficiency of the block training system in basketball, evidenced by the punctual expression of the posterior long-lasting training effect (PLTE); 2) the competition loads presented different effects for VJ and HJ and 3) several occurrences verified between STCD and STCE, demonstrating the necessity of evaluating and analyzing in details the results of the different jump tests when used as control parameters of the training effects.

Key words: Basketball. Speed. Periodization.

INTRODUCTION

The development of methods to measure the ability to generate power during a maximal intensity effort has received notable attention in the last years(1). Field tests such as runnings and jumps have been widely used and recommended by the specialized literature(2). Being a necessary requirement for the success in most sports, the ability of performing a vertical jump almost always may distinguish some athletes from their pairs(3).

The field tests are more accessible and practical with regard to their utilization for most coaches, for whom, many times the laboratorial tests are unfeasible and inaccessible. Countless studies have demonstrated this wide utilization of field tests aimed at the evaluation of the athlete's performance(4-12).

The field tests most commonly used are the vertical jumps with or without the countermovement technique, the deep jumps (starting from a given height and performing the jump with reactivity) and simple-distance jumps (a single effort) or multiple-distance jumps(9,13-17).

These measures are many times performed in a longitudinal perspective in order to observe alterations as result of some training programs along a competition season or even alterations in a longer cycle of preparation(18-26).

The different power manifestations observed through distinct types of jumps demonstrate adaptation responses that many times are not coincident in time for the several training load orientations, in other words, there is an heterochronism of these measures and a differentiated sensibility between them for the same predominance of load orientation with regard to the chronology, association and relation between the distinct measures and to the possibility of predicting a dependent variable, for example the running performance(27-30).

The planning of the basketball training requires special attention in order to perform an effective season(31). Some authors have published their conceptions of training organization(20,24,32) as well as the fitness alterations during the season(19-21,26) or even in some specific moment of it(33). However, studies that demonstrate the motive profile of high-level basketball players are surprisingly scarce as well as results about the several effects of training in elite athletes also deserve further investigations(34).

The possible posterior long-lasting training effect [PLTE](24,35-38) as result of the use of concentrated loads have not been target of publications and elucidations concerning the Brazilian and the International basketball.

Thus, this study searched to observe: 1) the possible alterations and the dynamics of the distinct power manifestations measured by four different types of jumps (vertical jump with countermovement [VJ], horizontal jump [HJ], horizontal consecutive triple jump to the right leg [STCD] and horizontal consecutive triple jump to the left leg [STCE]) in distinct stages of the season (eight distinct moments) for a group of high-level basketball players submitted to the block training system (concentrated load) and 2) the possibility of obtaining punctually (competition stage) the PLTE for the measures studied.

METHODOLOGY

Sample characterization

Twelve athletes from a basketball team participating in the main league of the São Paulo State Basketball Championship (A1) were initially selected for the present study. However, only eight athletes fully accomplished the preparation program, therefore, were object of study. The ages of these eight athletes effectively studied ranged from 19 to 30 years, average of 23.5 years, body weight

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between 78 and 130 kg, average of 98.75 kg and height between 172 and 210 cm, average of 198.5 cm. All athletes filled the free consent form before participating in the study, which was a regular component of the preparation. All athletes were familiarized with tests, control procedures and with the training system (concentrated loads).

Tests – The following control exercises were used:

Horizontal explosive power

Horizontal jump with no running (HJ): athlete in standing position, feet slightly apart and parallel, feet tips behind line. The athlete performed a rocking arm movement as preparatory movement with knees semi-inflected. The jump was performed throwing arms forward, stretching hips, knees and ankles. The athlete performed three attempts, where the best one was considered.

Vertical explosive power

Vertical jump "countermovement" in the Ergo Jump® *contact rug (VJ):* the jump was performed using the "countermovement" technique. The movement of arms was not allowed. The athlete was oriented to set his hands on his hips, starting and ending exercise with feet on the contact rug (TC). The athlete kept his knees extended during the aerial part of the jump in order to avoid measurement errors. The athlete performed three attempts and the best one was considered.

Lower limbs fast power

Triple consecutive horizontal jump – left side (STCE) and triple consecutive horizontal jump – right side (STCD): athlete in anterior-posterior spacing position with knees slightly inflected behind the starting line. As preparation for the jump, the athlete performed weight transference to the back leg and then started the exercise. The arm movement was free and aided in the performance of the movement. After the firs impulse, the athlete touched the ground for the first time, where the first jump was considered; the athlete performed the repulsion with a fast and sudden passage from damping to overcoming. The athlete was oriented to perform jumps continually with no stops between one jump and another. The jump distance was measured from the front foot tip (initial position) up to the heel nearest to the starting line when the third jump was concluded. The athlete performed three attempts with each leg and the best score of STCD and STCE was considered.

All jump tests used in the present study presented relatively high reliability and reproducibility[1]. The tests were selected from widely known test "batteries"[39,40] and used in the most several studies related to the measurement of power in jumping[41,42].

The data collecting was performed by the same appraiser in all tests and for all collecting moments (eight) of the present study. The tests were always applied in the usual training schedule of the team studied and with standardized warming up. The application sequence of the control exercises was the following: VJ, HJ, STCD, STCE.

Control of the power measures (jump tests)

This study investigated the behavior of the power measures in the following moments:

1st micro-cycle with duration of 23 weeks

- Beginning of the power concentrated load blocks (T0)
- End of the power concentrated load blocks (T1)
- End of competition I (T2)

2nd micro-cycle with duration of 19 weeks

- Beginning of the power concentrated load blocks (T0)
- End of the power concentrated load blocks (T1)
- Beginning of the competition II (T2)
- End of the first inning of competition II (T3)
- End of the second inning of competition II (T4)

Experimental design

In the model structuring, the training macro-cycles were divided into BASIC STAGE (power concentrated loads), SPECIAL STAGE (the volume of utilization of speed exercises and the metabolic intensity are increased) and COMPETITION STAGE.

The *basic stage* (power concentrated load blocks) was characterized by the organism morphofunctional preparation for a specific speed regimen. Each task was accomplished predominantly through the special power preparation means (SPP) aiming at possible morphological restructuring of the organism. In this stage (basic) the power concentrated loads, according to the system's concepts[23,24,35-38] should be developed at the end of the macro-cycle and consolidated by means of extensive specific loads in subsequent stages.

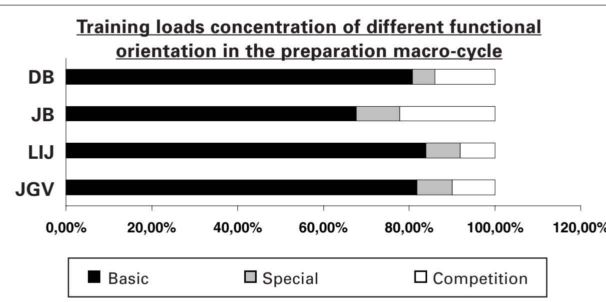
With regard to the *special stage*, the fundamental role of the connection link between basic and competition stages is emphasized.

The training loads in the special stage present a interconnection feature aimed at the adaptation of the organism for a progressive increase regimen of high-speed exercise performance, thus preparing for a condition of high competitive shape and this condition should be reached in the competition stage.

The *competition stage* was planned to become effectively the main stimulation mean of the increase on the special work capacity through the increase on the speed of the fundamental sportive exercise performance (specific).

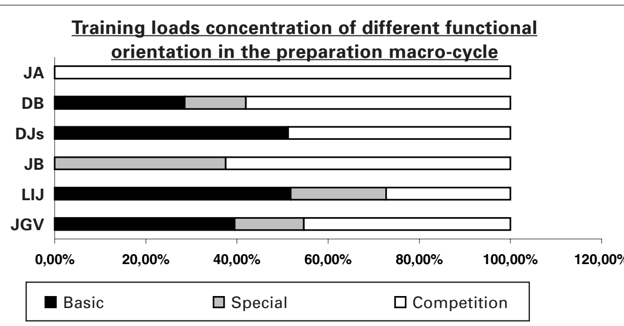
The annual cycle was composed of two training macro-cycles (bicyclical structuring) with duration of 43 weeks distributed as follows: 23 weeks in the 1st preparation macro-cycle, one week of recovery/transition and 19 weeks for the 2nd macro-cycle. The SPP was guided by the conjugate sequence system[24,43], where the objectives related to the previous preparation of the locomotor sys-

BOARD 1
Training loads concentration of different functional orientation – SPP means and percentile of the jumps global volume (JGV) – 1st macro-cycle



DB = ducking with bar, JB = jumps with bar, LIJ = low intensity jumps, JGV = jumps global volume.

BOARD 2
Training loads concentration of different functional orientation – SPP means and percentile of the jumps global volume (JGV) – 2nd macro-cycle



JA = jumps with acceleration, DB = ducking with bar, DJs = deep jumps, JB = jumps with bar, LIJ = low intensity jumps, JGV = jumps global volume.

tem to an ulterior intense work was respected and also the attainment of an adequate technique of performance for reactive-featured exercises used in the program.

The first macro-cycle presented the following temporal organization: basic stage = 8 weeks, special stage = 2 weeks, competition stage = 13 weeks; the 2nd macro-cycle: basic stage = 3 weeks, special stage = 3 weeks, competition stage = 13 weeks. The organization of the SPP means and the characteristic concentration of the block training system are demonstrated in boards 1 and 2.

Statistical analysis

For the descriptive analysis of data, the minimal and maximal values as well as the median, the interquartilic semirange and the percentiles 25 and 75 were employed. The Wilcoxon combined pairs signalized ordering was used in order to determine the significance level of differences between scores of athletes in different evaluation moments. The significance degree adopted was $p < 0.05$.

RESULTS

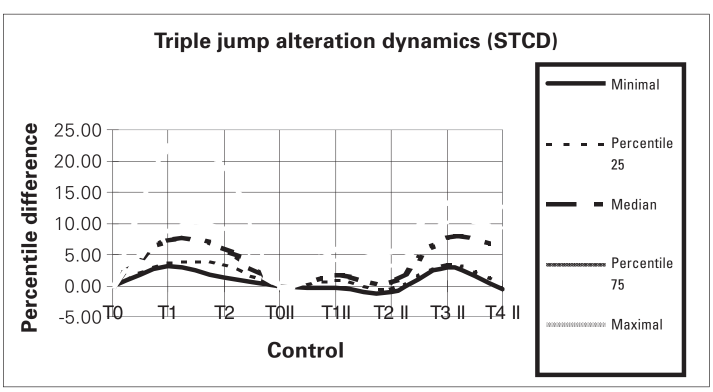
The positive and statistically significant alteration from T0 to T1 (after power concentrated loads) and from T0 to T2 (from the beginning of the macro-cycle until the end of competition) is demonstrated in table 1 for STCD, representing the fast power dynamics at the 1st training macro-cycle. However, no significant alterations on the results of STCD between T1 and T2 were observed. A decrease on the median value from T1 to T2 is observed.

TABLE 1
Median, interquartilic semirange and minimal and maximal values of the fast power alteration (STCD) – 1st training macro-cycle

	T0	T1	T2
STCD (m)	7.50 ± 0.51 (6.45~8.05)	7.88 ± 0.205 (7.66~8.75)	7.77 ± 0.32 (7.65~8.55)
T0		*	*
T1	*		
T2	*		

* significant ($p < 0.05$)

In graphic 1, the drop tendency from T1 to T2 in the 1st training macro-cycle is observed, in the 2nd training macro-cycle, a drop tendency in T4II in relation to T3II is also observed, in other words, from the end of the first competition inning (T3II) to the end of the second inning (T4II). Even presenting this drop tendency, improvements of about 20% with value of central tendency of the group (median) of about 6% for the first macro-cycle and of about 10-15% for the highest median value of about 8% in the second macro-cycle, are observed.



Graphic 1 – Fast power alteration dynamics (STCD) along the annual cycle (first and second macro-cycles; T0II, corresponding to the beginning of the second macro-cycle): lowest value, percentile 25, median, percentile 75 and highest value.

The positive and statistically significant alteration from T0 to T1 (after power concentrated loads) and from T0 to T3 (end of the first competition inning) and from T0 to T4 (from the beginning to the end of the second competition inning) is demonstrated in table 2 for STCD, representing the fast power dynamics in the 2nd training macro-cycle.

A significant alteration from T2 (end of the special stage – speed concentrated loads) to T3 and T4 (end of the first and second innings, respectively) was also observed.

TABLE 2
Median, interquartilic semirange and minimal and maximal values of the fast power alterations (STCD) – 2nd macro-cycle

	T0	T1	T2	T3	T4
STCD (m)	7.65 ± 0.23 (5.59~8.50)	8.03 ± 0.15 (5.71~8.47)	7.71 ± 0.38 (5.79~8.50)	8.63 ± 0.5 (6.00~8.78)	8.11 ± 0.61 (5.95~9.00)
T0		*		*	*
T1	*			*	
T2				*	*
T3	*	*	*		
T4	*		*		

* significant ($p < 0.05$)

The positive and statistically significant alteration from T0 to T1 (after power concentrated loads) and from T0 to T2 (from the beginning of the macro-cycle until the end of the competition) is demonstrated in table 3 for STCE, representing the fast power dynamics in the 1st training macro-cycle. Unlike STCD, in the 1st macro-cycle (table 1) a difference statistically significant from T1 (after power concentrated loads) to T2 (end of competition – first macro-cycle) was observed.

Unlike the first macro-cycle (table 3), it was observed in table 4 that the significant alteration of STCE in the second macro-cycle

TABLE 3
Median, interquartilic semirange and minimal and maximal values of the fast power alterations (STCE) – 1st macro-cycle

	T0	T1	T2
STCE (m)	7.65 ± 0.375 (7.25~8.28)	7.90 ± 0.29 (7.75~8.85)	7.96 ± 0.45 (7.40~8.75)
T0		*	*
T1	*		*
T2	*	*	

* significant ($p < 0.05$)

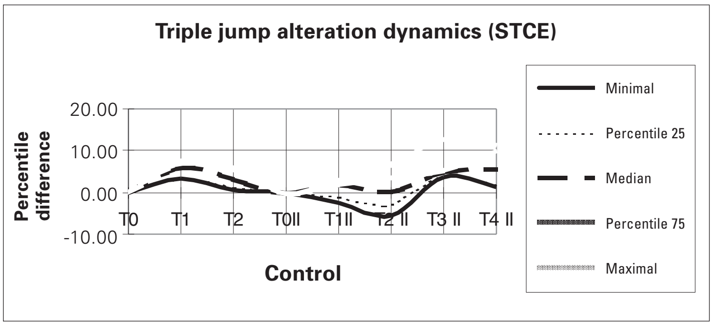
TABLE 4
Median, interquartilic semirange and minimal and maximal values of the fast power alterations (STCE) – 2nd macro-cycle

	T0	T1	T2	T3	T4
STCE (m)	7.82 ± 0.375 (5.81~8.58)	8.22 ± 0.544 (5.75~8.74)	7.87 ± 0.490 (5.64~8.81)	8.55 ± 0.525 (6.12~9.32)	8.70 ± 0.689 (6.14~9.10)
T0				*	*
T1				*	
T2				*	*
T3	*	*	*		
T4	*		*		

* significant ($p < 0.05$)

was only verified between T0 and T3 and T0 and T4; in other words, even when increases on the values of STCE from T0 to T1 occurred, the statistical analysis did not consider the alteration as significant.

In graphic 2, the drop tendency from T1 to T2 in the 1st macro-cycle and in the 2nd macro-cycle is observed, however, an increase tendency in T4II in relation to T3II is also observed, in other words, from the end of the first competition inning (T3II) to the end of the second inning (T4II). It was also verified in graphic 2 a change on the curve with drop tendency after the special stage (T2II) and, on the other hand, higher values of STCE during the competition stage were verified (T3 and T4).



Graphic 2 *– Fast power alteration dynamics (STCE) along annual cycle (first and second macro-cycles; T0II, corresponding to the beginning of the second micro-cycle): lowest value, percentile 25, median, percentile 75 and highest value.*

Table 5 demonstrates the absence of significant increments for VJ in the 1st macro-cycle, also pointing to a significant drop from T1 to T2.

TABLE 5
Median, interquartilic semirange and minimal and maximal values of the vertical explosive power alterations (VJ) – 1st macro-cycle

	T0	T1	T2
VJ (cm)	44.10 ± 1.5 (35.4 ~ 45.3)	47.30 ± 4.0 (34.0~50.8)	40.75 ± 5.0 (25.5~50.0)
T0			
T1			*
T2		*	

* significant ($p < 0.05$)

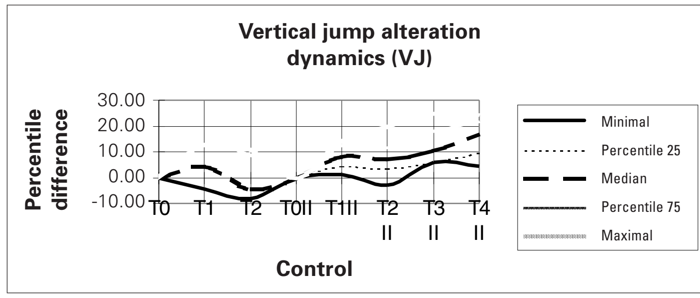
Unlike table 5 (first macro-cycle), significant alteration from T0 to T1, to T2, T3 and T4 was observed in table 6. Significant differences from T1 to T4 and from T2 to T3 were also observed.

TABLE 6
Median, interquartilic semirange and minimal and maximal values of the vertical explosive power alterations (VJ) – 2nd macro-cycle

	T0	T1	T2	T3	T4
VJ (cm)	40.75 ± 5.02 (25.6~50.0)	43.10 ± 3.92 (29.2~52.9)	42.25 ± 5.75 (30.7~54.7)	47.70 ± 6.40 (32.0~55.5)	47.70 ± 4.75 (31.9~58.5)
T0		*	*	*	*
T1	*			*	*
T2	*			*	
T3	*	*	*		
T4	*	*			

* significant ($p < 0.05$)

Graphic 3 demonstrates a drop tendency of VJ at the end of the 1st macro-cycle, as after the speed concentrated loads (T2II) in the 2nd macro-cycle. The significant increase of VJ at the end of the competition stage is relevant.



Graphic 3 *– Explosive power alteration dynamics (VJ) along annual cycle (first and second macro-cycles; T0II, corresponding to the beginning of the second micro-cycle): lowest value, percentile 25, median, percentile 75 and highest value.*

Table 7 demonstrates significant increments of HJ after power concentrated loads in the 1st macro-cycle (T0 to T1), however, it shows significant drop of HJ in T2.

TABLE 7
Median, interquartilic semirange and minimal and maximal values of the horizontal explosive power alterations (HJ) – 1st macro-cycle

	T0	T1	T2
HJ (m)	2.57 ± 0.085 (2.45~2.85)	2.68 ± 0.09 (2.60~2.85)	2.60 ± 0.13 (2.43~2.84)
T0		*	
T1	*		*
T2		*	

* significant ($p < 0.05$)

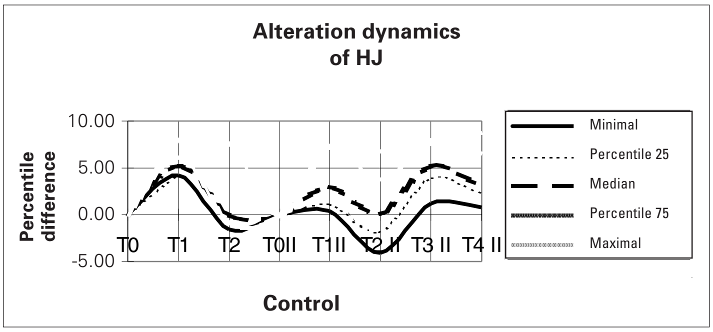
Table 8 demonstrates significant alterations of HJ after power concentrated loads in the first macro-cycle (T0 to T1) as from T0 to T3 and T4.

TABLE 8
Median, interquartilic semirange and minimal and maximal values of the horizontal explosive power alterations (HJ) – 2nd macro-cycle

	T0	T1	T2	T3	T4
HJ (m)	2.53 ± 0.11 (1.90~2.85)	2.51 ± 0.23 (2.01~3.06)	2.52 ± 0.14 (2.03~3.00)	2.58 ± 0.16 (2.01~3.08)	2.55 ± 0.22 (1.96~3.10)
T0		*		*	*
T1	*		*		
T2		*		*	*
T3	*		*		
T4	*		*		

* significant ($p < 0.05$)

Graphic 4 demonstrates the same tendency as the other power measures with regard to the end of the 1st macro-cycle, however, a drop tendency from T3II to T4II is observed, reaching the highest values at the end of the first competition inning of the 2nd macro-cycle.



***Graphic 4** – Explosive power alteration dynamics (HJ) along annual cycle (first and second macro-cycles; T0II, corresponding to the beginning of the second micro-cycle): lowest value, percentile 25, median, percentile 75 and highest value.*

DISCUSSION

Additional groups (control group or other group with load organization other from that used in the present study) were not used with the objective of contrasting with the concentrated load system, once the objective of this study was not to compare results to other systems of load organization, but rather, by means of a reasonable and important external validity, to observe the possibility of the utilization of a load organization methodology (concentrated) not yet exhaustedly discussed and elucidated with regard to the scientific knowledge especially for sportive games.

Thus, considering the results presented and analyzed table 1, it seems reasonable to assume an increase tendency of the possibilities of fast power manifestation in basketball after power concentrated loads unlike studies presented by Siff and Verkhoshansky[43], Tschiene[38] and Verkhoshansky[35-37] in which the deep and extended alterations are demonstrated and, as result, a decrease on the functional indexes due to the application of loads of remarkable concentrated volume.

Significant alterations from T1 to T2 were not observed and we may suppose that the competition loads, performed in this first macro-cycle of the annual cycle, do not contribute for the improvement and sustainability of the fast power with regard to the STCD. Still, significant positive alterations were observed for T2 in relation to T0.

In graphic 1, this drop tendency from T1 to T2 is observed in the 1st macro-cycle; in the 2nd macro-cycle, a drop tendency may be observed in T4II in relation to T3II, in other words, from the end of the 1st competition inning (T3II) to the end of the 2nd competition inning (T4II).

These findings clearly demonstrate that after an important percentile alteration in T3II, the fast power increment possibilities were impaired possibly due to the high load concentrations of competition and speed or even due to the ineffective power load organization in this phase. The power loads at the moment (T4II) has as main objective, together with loads of high metabolic intensity, to maintain the indexes already reached through the so-called neuromuscular strengthening.

After the power block in the first macro-cycle, improvements above 20% are observed. For the second power block of the annual cycle, the maximal value reached was near to 6%, indicating the exploration of the adaptation current supply (RAA) and corroborating with the own concept that suggests a functional increment even greater as the special work capacity is increased[35,43].

Considering that the block training system involves the creation of a residual effect in function of morphofunctional alterations originated from previous loads, maximizing subsequent ones, one may admit that the drop of STDC during the end of the competition stage not necessarily means a decrease on the special work capacity, but rather an adjustment to the predominant loads in this very moment; these loads then present other well-defined objective that is the performance of the fundamental competitive exercise with maximal speed and consequent approximation to the sportive success.

The statistical significance with regard to the alteration between T1 and T2 presented for STCE in the first macro-cycle (table 3) is not revealed for STCD during the same period. Despite presenting positive alterations with statistical significance between T0 and T1, STCE and STCD are different in relation to the comparison of the power block to the first competition stage of the annual cycle.

These alterations indicate a compensatory adaptation different from the called supporting leg, once all athletes evaluated in this study were dextral. Therefore, the left leg was more required especially during concentration stages of special and specific exercises (special stage and competition stage) in which a significant increase on the performance of game motive actions or similar actions occurred that, in turn, stimulated this higher requirement with regard to the own utilization of a limb in relation to the other.

Although significant increments are observed between T0 and T1 (1st macro-cycle), a drop tendency of STCE is still necessary to be emphasized when values of T1 and T2 are compared. Therefore, it seems reasonable to speculate that the competition loads did not represent the stimulus required for the increase on the capacity of manifesting fast power in its higher level of possibility during the competition stage in the 1st macro-cycle or yet, that the special power preparation exercises (SPP) used during the competition stage did not fulfill their role along with the competitive loads for the maintenance of the level acquired as result of the power concentrated load blocks.

Unlikely, the adaptation responses in the 2nd macro-cycle seem to emphasize more important and punctual alterations with regard to the STCE.

An increment of the median in the 2nd macro-cycle (T0II-T1II) is observed in graphic 2, however, increases not so relevant for the different points analyzed, and yet, if we observe carefully the table, it is clear that at this moment, the tendency approximates the tendency reported by the specialized literature[35-38,43], once no alterations statistically significant from T0 to T1 (2nd macro-cycle) are verified. In graphic 2, negative alterations for the lowest value and percentile 25 and alterations slightly positive for the median (near to 2%) and for a higher value around 3% in the 2nd macro-cycle are emphasized.

On the other hand, the attainment of the PLTE coinciding with the most important moment of the program is emphasized at the end of the macro-cycle (T4II). Table 4 supports these affirmations, once it demonstrates alteration statistically significant between T0 and T3, T0 and T4 and between T2 and T3 and T2 and T4, evidencing the punctual expression of PLTE to STCE.

The utilization of means and methods of higher power potential in this 2nd macro-cycle seems to have enabled more important morphological modifications that resulted in improvement and sustentation of the fast power in a higher level if compared to the 1st macro-cycle. This introduction of means with higher training potential may be exemplified analyzing board 2 when deep jumps were used in the 2nd macro-cycle, what did not occurred in the 1st macro-cycle (board 1). Such fact evidences the effective fulfillment of the succession and interconnection principle and could only have occurred by means of the possibility of performing a 2nd macro-cycle in the annual cycle.

The percentile alterations above 10% (T0II/T4II) and slightly above 6% for the median in the 2nd macro-cycle enable to guarantee the training safety and efficiency for STCE, once considering the percentile differences above 6% and around 3% for the lowest value in the 1st macro-cycle (graphic 2), the relevance of the alteration magnitude for the 2nd macro-cycle is evident.

Other consideration required at this moment is the strategy used during the competition stage that, from the results obtained comes to express the necessity of using the power special exercises during the competition stage as a stimulus to the neuromuscular strengthening and consequent maintenance of the power levels previously acquired. The introduction of jumps with acceleration (JA) in the competition stage is observed in board 2 as well as the introduction of other SPP means as the deep jumps (DJs), for example.

It is also observed that the basic stage of the 2nd macro-cycle had duration of only three weeks and the competition stage 13 weeks, thus, when the absolute percentile values are presented, one should take into consideration that the SPP means belong to the basic stage from the relative point of view, according to the concepts of the system. It is also worthy mentioning the drop dynamics of the functional possibilities at the end of the special stage in order to further express the PLTE punctually.

Analyzing table 5, a tendency distinct from those previously presented is emphasized, what seems to indicate the necessity of assuming the existence of different types of power-speed manifestations. The differences between isolated and repetitive efforts from the neuroregulatory point of view and possibly metabolic differences and other differences related to the types of muscular contraction suggest the adoption of distinct methods for the maximization of one or other power manifestation and, consequently, of different exercises for the evaluation of their possibilities.

In other words, it is likely that, for VJ the power loads concentration during the basic stage had not been sufficient to allow important morphological restructurings that could enable functional improvements in athletes in subsequent stages. The other hypothesis is that maybe, as for STCE, restructurings had been indeed obtained during the power block, reason why improvements in the functional capacity at this moment were not found; however, the difference would lie on the competition load intensity.

Suppose that the competition stage did not result in stimuli sufficiently strong to produce improvements on the vertical explosive power, the interaction fundamental concept between the training and competition systems was not established, in other words, loads that prepare the organism and loads that enable the maximal exploration of the physiological possibilities at the most important moment of the macro-cycle[24,35-38,43].

Another question previously approached that infers about the necessity of a more powerful stimulus of neuromuscular strengthening during the competition stage may be put, in order to aid on the power improvement (fast or explosive) and to support or even to create necessary conditions for the PLTE revealment.

Improvements statistically significant are presented in table 6 (VJ in the 2nd macro-cycle) both from T0 to T1 and from T1 to T3 and T4 and yet from T1 (power block) to T3 and T4, thus expressing the PLTE at the most important moment of the annual cycle. The widely positive compensatory adaptations during the 2nd macro-cycle are verified in graphic 3, corroborating with the previous considerations with regard to hypothesis emerged for the non-attainment of increments in the 1st macro-cycle; such increments have been partly corrected by the program and also by the own intensity of the competition stage. It is worthy mentioning the significant increment of VJ in the 2nd macro-cycle, verified in graphic 3. Percentile alterations that reached maximal value near to 25% and minimal value near to 5% with median line exceeding 15% are seldom reported in literature[20], especially with regard to high-qualification athletes.

With regard to the HJ, the same dynamics presented by VJ for T2 was also verified, in other words, a decrease tendency of the possibilities of performing explosive efforts. The justification, as reported for VJ, befalls on the question about low intensity of the competition loads or even of the non-optimized utilization of SPP means. On the other hand, even correcting the program, significant alterations from the end of the 1st inning to the end of the 2nd inning in the 2nd macro-cycle were not verified (table 8). These findings may be indicating the influence of the increment on the volume of specialized motive actions of high metabolic intensity developed during the competition stage, what would lead to an adaptation to exigencies imposed of distinct dynamics between vertical and horizontal explosive powers.

For SPH, the same alteration dynamics of VJ in T2 (negative) as result of the speed concentrated loads is emphasized, however, while VJ seems to be positively influenced due to the duration of the competition loads, the HJ levels tends to decrease. Thus, it is speculated that at this moment, only the components that determine decisively the effectiveness of the sportive success reflect the tendency of substantial increment, whereas the components that in previous stages allowed the development of the athlete's shape, at this moment seem to suffer stagnation or even slight drops.

Graphic 4 illustrates the previous considerations with regard to the alteration tendency of HJ along the annual cycle. It is very interesting the fact that, even not reflecting in magnitude the alterations observed in VJ, not only the increments of the horizontal explosive power are presented (HJ) after the power concentrated loads both in the 1st and in the 2nd macro-cycles, but also it should be mentioned that important improvements were verified in the 2nd macro-cycle when alterations are always more difficult to be reached.

It is important to emphasize in this discussion that the present study, despite being yet unpublished and the importance of findings here discussed with regard to both the nature (longitudinal) and the external validity, presents relative limitation with regard to the generalization of results and should be analyzed only within the basketball context and yet, within the reality of a high-performance and adult team.

This problematic is related to "sportive training" longitudinal studies that, on the one hand, are extremely necessary for a better understanding of factors related to the structuring of the training process, on the other, lose in external validity when compared to transversal and fragmented studies that many times seem not to elucidate the fundamental questions of the athletes preparation.

Despite the reduced *N*, an important homogeneity (high-level basketball players) of the sample for the population studied is verified and, therefore, with a relevant quality of data. The field studies with high-level athletes will always present difficulties with the "size of the sample", especially studies of longitudinal nature, once an adult basketball team, for example, seldom present a group with over that 12-15 athletes and, in addition, problems with lesions, absences, delays, changes on the schedule, departure of athletes, arrival of new ones and others may represent important threats for the study.

Stone *et al.*[44] observed that most studies on Sports Sciences, unlikely the Exercise Sciences are longitudinal and involve multiple test sessions and a relative reduced number of subjects, however, in the opinion of authors, are the most valuable for the training development and handling, given the inherent analysis of a specific population and due to the lack of publications in this topic.

Thus, it is reasonable to admit the relevance of the present study, once the possible threats above mentioned were not verified, what enabled the integral and reliable performance of the proposed experimental design as well as the control in the eight different moments of the annual cycle, enabling the presentation and the analysis of the dynamics of important indicatives in the basketball context.

CONCLUSION

The punctual reach of the PLTE verified from indicatives used in the present study allows guaranteeing the efficiency of the block training system in basketball.

It was observed that the competition concentrated loads performed different effects for the measures of both the vertical explosive power (VJ) and the horizontal explosive power (HJ) and the necessity of evaluating the fast power through consecutive jump exercises for both legs in a differentiated way concerning the several occurrences verified for STCD and STCE is emphasized.

These findings demonstrate that the result of tests usually used for the evaluation of the lower limbs muscular power (explosive and fast powers) should be carefully evaluated and interpreted, once it seems to represent distinct neuromuscular qualities and, as result, different adaptation responses along the sports season.

For the speed concentrated loads, it was verified that they tend to decrease temporarily the functional possibilities of basketball players, overcoming the initial level during the competition stage, what demonstrates the necessity of an adequate planning (from the temporal point of view [loads distribution along the preparation cycle]), which, a given training effect would not influence negatively the yield of basketball players and that the PLTE would be reached punctually at the moment of the most important interventions.

It was also emphasized that the utilization of a bicyclical structure enabled the correction on the program direction during the annual cycle and the increment of the training loads potential, indicating the importance of this annual cycle organization strategy in the context of the schedule reality of the Brazilian basketball.

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REFERENCES

1. Jurimae T, Saar M. Shuttle-run test: the role of jumping ability, flexibility, coordination and balance. J Hum Mov Studies 1998;35:201-17.
2. Mayhew JL, Bemben MG, Rohrs DM, Bemben, DA. Specificity among anaerobic power tests in college female athletes. J Strength Cond Res 1994;8:43-7.
3. Baker D. Improving vertical jump performance through general, special and specific strength training: a brief review. J Strength Cond Res 1996;10:131-6.
4. Hoffman JR, Kang J. Strength changes during an in-season resistance-training program for football. J Strength Cond Res 2003;17:109-14.
5. Hoffman JR, Epstein S, Einbinder M, Weinstein Y. A comparison between the wingate anaerobic power test to both vertical jump and line drill tests in basketball players. J Strength Cond Res 2000;14:261-4.
6. Hoffman JR, Tenenbaum G, Maresh CM, Kraemer WJ. Relationship between athletic performance tests and playing time in elite college basketball players. J Strength Cond Res 1996;10:67-71.
7. Kellis SE, Tsitskaris GK, Nikopoulou MD, Mousikou KC. The evaluation of jumping ability of male and female basketball players according to their chronological age and major leagues. J Strength Cond Res 1999;13:40-6.
8. Lacour R. Physiological analysis of qualities required in sprinting. N Stud Athletics 1996;11:59-62.
9. Locatelli E. The importance of anaerobic glycolysis and stiffness in the sprints (60, 100 and 200 meters). N Stud Athletics 1996;11:121-6.
10. Manning JM, Dooly-Manning C, Perrin DH. Factor analysis of various anaerobic power tests. J Sports Med 1988;28:138-44.
11. Moravec P, Ruzicka J, Susanka P, Dostal E, Kodejs M, Nosek M. The 1987 International Athletic Foundation/IAAF scientific project report: time analysis of the 100 meters events at the II World Championships in Athletics. N Stud Athletics 1988;3:61-96.
12. Vittori C. Monitoring the training of the sprinter. N Stud Athletics 1995;10:39-44.
13. Bosco C, Belli A, Astrua J, Tihanyi RP, Kellis S, Tsarpela O, et al. A dynamometer for evaluation of dynamic muscle work. Eur J Appl Physiol 1995;70:379-86.
14. Field RW. Control tests for explosive events. NSCA Journal 1989;11:63-4.
15. Newton RU, Dugan E. Application of strength diagnosis. Strength Cond Journal 2002;24:50-9.
16. Schmidtbleicher D. Training for power events. In: Komi PV, editor. Strength and power in sport. London: Blackwell Scientific, 1992;381-95.
17. Sinnett AM, Berg K, Latin RW, Noble JM. The relationship between field tests of anaerobic power and 10-km run performance. J Strength Cond Res 2001;15: 405-12.
18. Berg K, Latin RW. Comparison of physical and performance characteristics of NCAA division I basketball and football players. J Strength Cond Res 1995;9:22-6.
19. Groves BR, Gayle RC. Physiological changes in male basketball players in year-round strength training. J Strength Cond Res 1993;7:30-3.
20. Hoffman JR, Fry AC, Howard R, Maresh CM, Kraemer WJ. Strength, speed and endurance changes during the course of a division I basketball season. J Appl Sports Sci Res 1991;5:144-9.
21. Hunter GR, Hilyer J, Forster MA. Changes in fitness during 4 years of intercollegiate basketball. J Strength Cond Res 1993;7:26-9.
22. Latin RW, Berg K, Baechle T. Physical and performance characteristics of NCAA Division I Male Basketball Players. J Strength Cond Res 1994;8:214-8.
23. Moreira A, de Souza M, Oliveira PR. A velocidade de deslocamento no basquetebol. Revista Brasileira de Ciências do Esporte 2003;24:201-15.
24. Moreira A. Basquetebol: sistema de treinamento em bloco - organização e controle. Dissertação de Mestrado. Faculdade de Educação Física, Universidade Estadual de Campinas, 2002.
25. Hoffman JR, Kang J. Strength changes during an in-season resistance-training program for football. J Strength Cond Res 2003;17:109-14.
26. Petko M, Hunter GR. Four-year changes in strength, power, and aerobic fitness in women college basketball players. Strength Cond Journal 1997;19:6-49.
27. Baker D, Nance S. The relation between running speed and measures of strength and power in professional rugby league players. J Strength Cond Res 1999;13: 230-5.
28. Hennessy L, Kilty J. Relationship of the stretch-shortening cycle to sprint performance in trained female athletes. J Strength Cond Res 2001;15:326-31.
29. Kukolj M, Ropret R, Ugarkovic D, Jaric S. Anthropometric, strength, and power predictors of sprinting performance. J Sports Med Phys Fitness 1999;39:120-2.
30. Young W, Mc Lean B, Ardagna J. Relationship between strength qualities and sprinting performance. J Sports Med Phys Fitness 1995;35:3-19.
31. Hilyer J. A year-round strength development and conditioning program for men's basketball. NSCA Journal 1989;11:16-9.
32. Jaric S, Ugarkovic D, Kukoli M. Anthropometric, strength, power and flexibility variables in elite male athletes: basketball, handball, soccer and volleyball players. J Hum Mov Studies 2001;40:453-64.
33. Hakkinen K. Changes in physical fitness profiles in female basketball players during the competitive season including explosive type strength training. J Sports Med Phys Fitness 1993;33:19-26.
34. Matavulj D, Kukolj M, Ugrkovic D, Tihany J, Jaric S. Effects of plyometric training on jumping performance in junior basketball players. J Sports Med Phys Fitness 2001;41:159-64.
35. Verkhoshansky Y. The long-lasting training effect of strength exercises. Sov Sports Rev 1983;1-3.
36. Verkhoshansky Y. Principles of planning speed and strength/speed endurance training in sports. NSCA Journal 1989;11:58-61.
37. Verkhoshansky Y. Principles for a rational organization of the training process aimed at speed development. Rev Treinamento Desportivo 1999;4:3-7.
38. Tschiene P. El ciclo anual de entrenamiento. Rev Stadium 1987;125:10-20.
39. Eurofit, European Test of Physical Fitness. Council of Europe. Committee for development of Sport. Strasbourg, 1988.
40. Oja P, Tuxworth B, editors. Eurofit for Adults. Finland: Council of Europe and UKK Institute for Health Promotion Research, 1995.
41. Bosco C, Luhtanen P, Komi PV. A simple method for measurement of mechanical power in jumping. Eur J Appl Phys 1983;50:273-82.
42. Ugrinowitsch C, Barbanti VJ, Gonçalves A, Peres BA. Capacidade dos testes isocinéticos em predizer a performance no salto vertical em jogadores de voleibol. Rev Paul Educ Fís 2000;14:172-83.
43. Siff MC, Verkhoshansky Y. Superentrenamiento. Barcelona: Paidotribo, 2000.
44. Stone MH, Sands WA, Stone ME. The downfall of sports science in the United States. Strength Cond J 2004;26:72-5.