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Short-term effects of combined training on the performance of the Brazilian women's basketball team

Efeitos de curto prazo do treinamento combinado da seleção brasileira de basquetebol feminino

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Abstract – Competitions are considered of paramount importance for high-performance sports because they determine the entire orientation of the training process. When analyzing the calendar of the International Basketball Federation, it can be observed that international competitions occur in short periods of time. In this sense, the aim of this study was to verify the effects of the application of combined training in the short-term preparation period on the speed of athletes of the Brazilian women's basketball team. Thirteen athletes participated in this study, who took part of the preparation for the 2015 Pan American Games. Athletes were submitted to anthropometric measures and biomotor capacity evaluation at cyclic speed - 20m run, and acyclic speed - T test at the beginning (M0) and end of a 27 - day preparation period (M1). Considering the period available for training, the total duration percentage was: technical / tactical 73.7%, strength and conditioning: 5.7%, preventive: 10.5% and general and special warm up: 10.1%. After data collection, the Shapiro-Wilk test was used to verify normality and then, the Student's T test was also applied. The main results indicate that the best time to evaluate cyclic speed (M0 and M1, respectively) was 3.34 ± 0.22s and 3.39 ± 0.21s and acyclic speed (M0 and M1, respectively), 9.30 ± 0.49s and 9.52 ± 0.57s. The results of the current study suggest that short-term intervention was not efficient to improve the cyclic and acyclic speed of female basketball athletes.

Key words: Athletic Performance, Sports, Exercise

Resumo – *As competições são consideradas o elemento central para o desporto de rendimento, pois determinam toda a orientação do processo de treinamento. Ao observar o calendário da Federação Internacional de Basquetebol, percebe-se que as competições internacionais acontecem em curtos períodos de tempo. Neste sentido, o objetivo deste trabalho foi verificar os efeitos da aplicação do treinamento combinado na preparação de curto prazo, sobre a capacidade biomotora velocidade, em atletas adultas da seleção brasileira de basquetebol feminino. Participaram deste estudo 13 atletas da seleção brasileira de basquetebol feminino da categoria adulta, que fizeram parte da preparação para a disputa dos Jogos Pan Americanos em 2015. As atletas foram submetidas a medidas antropométricas e avaliação da capacidade biomotora velocidade cíclica – corrida de 20m, e acíclica – teste T, no início (M0) e ao final de um período de preparação de 27 dias (M1). Considerando o período disponível para treinamento o % da duração total foi de: técnico/tático 73,7%, físico: 5,7%, preventivo: 10,5% e aquecimento geral e especial: 10,1%. Após a coleta dos dados utilizou-se o teste de Shapiro-Wilk para verificar a normalidade e, a seguir, o teste T de Student. Os principais resultados apontam que o melhor tempo para avaliar a velocidade cíclica (M0 e M1, respectivamente), foi de 3,34±0,22s e 3,39±0,21s e, na acíclica (M0 e M1, respectivamente), foi de 9,30±0,49s e 9,52±0,57s. Conclui-se que durante um curto período de intervenção, com grande concentração de estímulos, não foi eficiente para melhorar a capacidade biomotora velocidade cíclica e acíclica.*

Palavras-chave: *Desempenho Atlético, Esportes, Exercício*

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INTRODUCTION

Basketball is considered one of the most popular sport modalities in the world. Thus, the scientific community has shown great interest in conducting studies, including those related to performance factors and physiological load related to this sport modality[1].

Over the past few years, many authors have studied basketball with the aim of evaluating the aspects that characterize it as a game[2], identifying the physiological profile of athletes[3], analyzing responses from different training models[4-7], and comparing training methods[8]. Such surveys have contributed throughout the years to the characterization of the modality and offered support for the improvement of the training process. It was observed that studies in which findings are contextualized with the other components of the training process present results that come from a long preparation period[4,6].

The competitive demand of most modalities has increased considerably over the past decades. If in previous years, athletes had a long preparation time to reach their best performance condition during the main competition, today, the number of competitions and their density have increased throughout the training macrostructure, requiring new adjustments to existing training periodization models[9].

In this context, when observing the calendar of the International Basketball Federation (FIBA), it can be observed that international competitions in the modality occur in short periods of time. In a few days, athletes are submitted to a large number of games and mostly on consecutive days. The number of national competitions have also increased, which makes the time available for training aimed at the preparation of athletes for competitive demands increasingly restricted.

Given this scenario, characterized by limited training time and considering international competitions with increasingly demanding technical and physical requirements, there are few studies that point to the integration of means and methods of preparation, as well as to monitor the performance of athletes to achieve higher performance levels.

In this sense, the aim of this study was to verify the effects of the application of combined training in the short-term preparation on the biomotor capacity speed (cyclic and acyclic) of adult athletes of the Brazilian women's basketball team.

METHOD

Thirteen athletes from the Brazilian women's basketball team aged 25.3 ± 4.9 years and height of 178.0 ± 8.0 cm, participated in this study, who participated of the preparatory period for the 2015 Pan Games Americans.

To participate in this study, athletes were informed about all procedures and accepted all conditions, signing the informed consent form. The work was approved by the Research Ethics Committee of UNICAMP under protocol number 1.375.752, CAAE 50873515.5.0000.5404.

Training sessions occurred during 23 days distributed in three microcycles. The training components during the total period were distributed as follows: technical / tactical 73.7%, physical: 5.7%, preventive: 10.5% and general and special warm-up: 10.1%.

Box 1 presents the classic training components: physical, technical and tactical and their respective session contents based on the main objective and its use.

Box **1. Content of training sessions and activity description**

Content of training sessions	Activity description
Preventive Training (PT)	Sensory motor activation exercises, static and dynamic balance exercises, eccentric training.
General Warm-up (GW)	Displacements at low intensity with amplitude of movements, diversified stimuli of locomotion and motor coordination skills.
Special Warm-up (SW)	Use of the continuous variable method through cyclic and acyclic exercises with and without displacements performed with variations of speed, changes of directions and jumps.
Glycolic Interval Training (IT-AL)	Discontinuous interval method through linear run combined with changes of direction.
Mixed Interval Training (IT-M)	Discontinuous interval method through specific situations of game, with attack, defense and transitions
Tactical Technical Training (TT)	Content developed by the coach and his assistants - fundamentals of defense and attack, transitions, defensive and offensive systems and preparatory games.

Training load control was performed using the session PSE method proposed by Foster et al.[10]. This method consists in recording the total period in minutes of a training session and multiplying it by the average PSE reported by athletes 30 minutes after the end of the session, when athletes were asked to indicate the corresponding number on the CR-10 scale[11].

PSE was individually collected and without the proximity of another subject of the team to avoid any form of interference in their response. The information was obtained by pointing at the scale (without pronouncing the value verbally). In this investigation, training components were applied in the same environment and the transition from one to another occurred sequentially with minimum time interval. Thus, it was established that the time of all actions programmed for a training session would be summed and computed as the total time for the load calculation. The result of multiplying the total time of the training session by the average PSE of the team was considered the internal load of the training session, presented in arbitrary units (AU).

The daily internal training load was obtained by the sum of loads measured in each session performed on the day. From the daily internal training load values, three indexes are also obtained: weekly training load, monotony and strain. The weekly training load was calculated by summing all the daily values; monotony by dividing the value found in the average weekly training load by the standard deviation of the average and, finally, strain, calculated by multiplying the monotony value by the weekly training load.

To evaluate the displacement speed in 20 meters, the time for athletes to complete the trajectories was initially measured, as suggested by Eston and Reilly[12]. For this, two pairs of photocells (CEFISE, Speed Test Fit®) were used at the starting point (0m) and final point (20m). Athletes were instructed to stand with one foot at the starting point and run as fast as possible to the end of the course. After passing the endpoint, the evaluator informed the time in seconds to the recorder. Each athlete made two attempts with interval ranging from three to five minutes. The best result of both trials at each moment was used. Then, to calculate the speed, the distance of 20 meters was divided by the time elapsed.

In the acyclic speed, the protocol proposed by Pauole et al.[13] was followed, in which athlete standing behind the start-finish line, at command go, traveled a distance of 10 meters straight to a line marked with a cone; stepped on this line and changed direction to the left without crossing his legs (sudden stop, followed by a change of direction); they ran a distance of five meters to another line also demarcated with a cone; when the athlete stepped on that line, she returned in the previous direction, but went to the other end of the T, then ran another 10 meters (five meters to the center cone, another five meters to the left cone); when she stepped on the line (left), the athlete returned to the center cone, ran a distance of five meters, and then went to the start-finish line, totaling 40 meters. For this, two pairs of photocells (CEFISE, Speed Test Fit®) were used. The best result of the two attempts at each moment was used.

Statistical analysis

For the analysis of collected data, descriptive statistics were used through the mean and standard deviation and to verify the normality, the Shapiro-Wilk test was used. The speed test results were analyzed by the paired T-test. The effect size was calculated using Cohen's "d". To analyze the magnitude of the effect size for trained individuals, the Rhea[15] classification was used: trivial <0.25, 0.25 <small <0.50, 0.50 <moderate <1.0, large> 1.0. The significance level was set at 0.05. All analyses were performed in the GraphpadPrism 6.0 software.

RESULTS

The results found in the present study show that the preparatory period included a volume of 67 hours of training distributed in the different training components by time and percentage of the total time used (Table 1). It could be immediately verified that most of the training was aimed at the technical and tactical components of the modality.

Regarding internal load control, Figure 1 and Table 2 show the weekly training load distribution on the three training microcycles. Data of total daily internal load and weekly load indexes are presented.

In the first training microcycle, the daily internal load values oscillated, presenting a slight downward trajectory. Monotony and strain levels were high.

In the second training microcycle, two blocks of three days are presented, with high starting loads, which decreased on the subsequent two days. The session PSE values were more distinct, the same was observed for the daily internal load, explaining training differences, consequently a decrease in monotony and strain can be observed.

In the third training microcycle, both session PSE and daily internal load data remained distinct. The decrease in the total week value shows the decrease in strain, despite an increase in monotony.

Table 3 presents the time results in speed tests at the evaluated moment. It was verified that the results in both speed capacities (cyclic and acyclic) showed a decrease after the training session.

Table 1. Distribution of the training volume in the different training components in hours and time percentage (%)

Training components	Total Duration (h)	Total Duration (%)
Preventive	7:01	10.5%
General Warm-up	3:23	5.0%
Special Warm-up	3:25	5.1%
Mixed IT (IT-Mi)	1:45	2.6%
TI Anaerobic Lactic (IT-AL)	2:04	3.1%
Technical / Tactical	49:22	73.7%

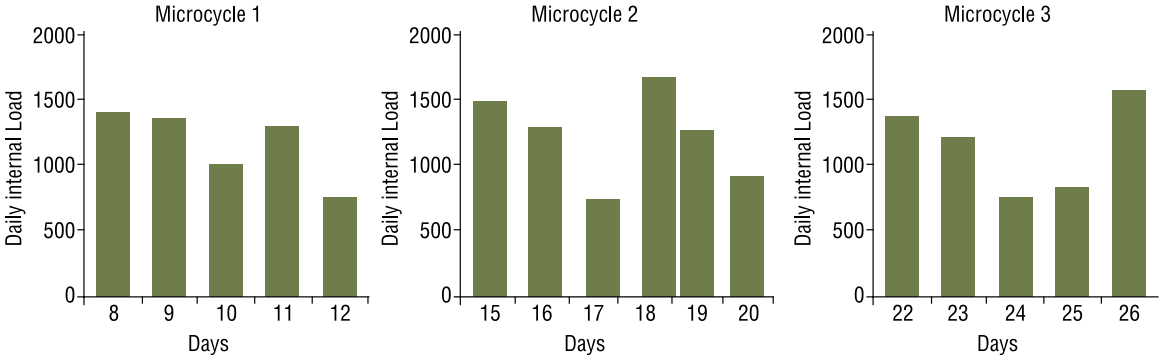

Figure 1. Total daily internal load of the three training microcycles.

Table 2. Weekly load indexes over three training microcycles.

	Total weekly load (AU)	Average weekly load (AU)	Standard Deviation	Monotony	Strain
Microcycle 1	6.004	1.001	226.8	4.41	26.488
Microcycle 2	6.564	1.094	382.2	2.86	18.786
Microcycle 3	5.314	1.063	351.8	3.02	16.053

Note. AU = Arbitrary Units

Table 3. Descriptive measures and result of the p value of speed tests at the evaluated moment.

Capacity	Evaluated Variable	Evaluated Moment		Δ%	P Value	Effect size
Biomotor		M0	M1			
Cyclic speed	Best time (s)	3.34 ± 0.22	3.39 ± 0.21	1.49	0.01*	0.23
Acyclic speed	Best time (s)	9.30 ± 0.49	9.52 ± 0.57	2.36	0.01*	0.41

Note. * Significant difference in relation to M0, $p < 0.05$

DISCUSSION

From the proposed objectives to verify the effects of a short-term training model on the speed capacity, the results show that the proposed training using two interval training variations distributed in a short period of time for cyclic and acyclic speed showed significant worsening.

In the last decade, researchers in the field of exercise physiology[16] have made great efforts to raise more evidences regarding the effects of interval training (IT), mainly in its variation characterized by high intensities.

Although short sprints represent a small portion of the total time of a match in collective games, the importance of these sprints is considered critical to the match outcome[17].

Buchheit et al.[18] investigated two different approaches to the discontinuous interval method in young handball players (15.8 ± 0.9 years), cited as having good training level in the modality. The experiment lasted four weeks, with two training sessions per week. Athletes were divided into two groups: G1 and G2. G1 athletes performed three to four sets of four replicates. Each replicate involved acceleration and change of direction exercises, with maximum duration of five seconds. The micro pause (between repetitions) was 30 seconds and the macro pause (between sets) was three minutes. However, G2 participants performed three to five sets of one replicate consisting of acceleration and change of direction exercises, but with fixed duration of 30 seconds. The interval between each series was two minutes. At the end of the experiment, no significant change was found in the time to run 10m at Tm, Tmed and in the FI of the anaerobic resistance test in both groups. Buchheit et al.[18] found no significant differences regarding the maximum time in the 20 m run test. Conversely, in the present study, Tm presented worsening in the 20m test.

In another study with Lithuanian basketball players aged 15-16 years, Balciunas et al.[6] investigated how two different training models could influence speed, lower limb power and anaerobic endurance of athletes. These athletes had already completed a four-week pre-season (not detailed in the study) and the investigation began during the first 16 weeks of the competitive period (Lithuanian championship). Athletes were divided into three groups: PE (Power Endurance), GE (General Endurance) and CG (Control Group). Training sessions lasted 90 minutes and were held three times a week.

The PE group used HR monitors in their training sessions, with the target area stipulated between 78 and 83% of maximum HR. They performed periods of 15 minutes of activity with stimuli of 50 seconds and passive recovery intervals of 20 seconds. Each period focused on one of the following basketball fundamentals: passing, carrying and shooting. The last 15 minutes were aimed at tactical work using five against five (5x5) entire court. The periods had a two-minute break between them and a longer break (15 minutes) in the middle of the session for the coach to give directions and corrections. The authors classified the activity of this group as specific high-intensity intermittent exercises.

The GE group used six 10-minute periods, with 10 free throws for each player in the interval between them. The stimuli were of 15 seconds, with equal recovery value and the focus was what the authors called active defense, using exercises as one against one (1x1); two against two (2x2) and three against three (3x3). The remaining 30 minutes were directed to tactical work using five against five (5x5) entire court. Intensity had no specific control.

Finally, CG performed only what the authors called standard Lithuanian training: 20 minutes of warm-up, 40 minutes for individual technical aspects and 30 minutes for tactical aspects, also without intensity control.

At the end of 16 weeks, none of the groups studied by Balciunas et al.[6] presented statistically significant difference for the time spent to cover the 20-m distance, nor for the values found for vertical jumps.

Regarding the control of internal training load, the findings of Foster et al.[19] show that the session PSE method was presented as a reliable subjective measure to estimate the training load during exercises where a physiological stable state is not reached, such as training and competition in collective sports. Thus, the method can combine, in a single number, the combined actions of variables effort intensity and duration.

Manzi et al. [20] found value of 3,334 AU for the total weekly load for the week in which there was no game, 2,928 AU for the week with one game and 2,791 AU for the week with two games. The study was carried out with professional players of an Italian men's basketball team, who played the Euroleague (one of the main European championships).

When analyzing the total weekly load used in the present study (Table 2), it was observed that the values found for women were much higher in all three weeks (6,004, 6,564 and 5,314 AU for weeks one, two and three, respectively), which at first may seem exaggerated values. It is important to emphasize that this is the first study evaluating an adult national team preparing for an international competition where they would play five consecutive matches with few hours of recovery between games and with a training period of only 27 days.

Thus, the values presented can serve as a reference for daily internal loads in the training of female basketball athletes of international level.

Analyzing data (Figure 1 and Table 2), it is observed that the peak volume fell over week two, when the total training volume was 6,564 AU. However, the monotony value of this week (2.86) was the lowest. This indicates that the training sessions were quite different with respect to the volume / intensity relationship. Since no athlete was absent from any of the team's activities (there was no withdrawal due to injury or any other physical / clinical reasons), the high internal training load values alone do not seem to cause harm to athletes' health, considering that the training period was only a few days. However, it is necessary to consider that these results were obtained with adult athletes of international level and concentration environment, where rest and feeding, as well as training, were highly controlled.

CONCLUSIONS

The findings of this study demonstrated that the use of the discontinuous interval training method during a short intervention period with high concentration of stimuli demonstrated a decrease in the cyclic and acyclic speed biomotor capacities.

In reference to the distribution of the training volume within contents, the predominance of technical and tactical components in relation to the total training volume within the macrocycle was demonstrated. This seems to indicate that punctual and controlled interventions in the physical component of training could make a significant difference in the final training outcome.

It is noteworthy that the PSE-s method proved to be very efficient and reliable for the control of internal training loads, since it objectively presented the load variability for each training microcycle. Thus, the use of this method is an important tool for the control of loads in female adult basketball players.

Finally, taking into consideration the challenges that the training of a high-performance basketball team presents, with emphasis on the verified model, it becomes feasible that, in addition to the concentrated application of IT stimuli and control by PSE-s, both strength training and final preparation with stimuli more focused on the improvement of cyclic and acyclic speed can be added to the training planning. Nevertheless, it is very important that coaches carry out intense application of the technical and tactical works in a way closer to the demand of competitions so that the transfer and assimilation of all stimuli are effective.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

This study was approved by the Research Ethics Committee of the University of Campinas (CAAE: 50873515.5.0000.5404.).This research is in accordance with the standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed the experiments: JPB, PCM, CRRH, RJFGF. Performed the experiments: CRRH, RJFGF. Analyzed data: JPB, PCM, CRRH, RJFGF, JFD. Contributed with reagents/materials/analysis tools: AMP, LMB, JFD. Wrote the paper: JPB, PCM, CRRH, RJFGF.

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