STUDIES IN PHYSICAL CULTURE AND TOURISM
Vol. 15, No. 1, 2008

RYSZARD LITKOWYCZ, KAZIMIERZ MIKOŁAJEC, ADAM ZAJĄC, ROBERT GÓRALCZYK
Academy of Physical Education, Katowice, Poland

SPEED AND ANAEROBIC FITNESS IN ELITE JUNIOR BASKETBALL PLAYERS DURING A PRE-COMPETITIVE MESOCYCLE

Key words: basketball, speed, anaerobic fitness, training loads.

ABSTRACT

Starting speed training and anaerobic power are the main components of basketball fitness. While preparing for competition, especially tournaments such as European Championships it is very important to create an optimal balance between training loads directed at the development of speed, anaerobic power and capacity. The main objective of this work was to determine the influence of a six-week pre-competitive mesocycle on speed and anaerobic fitness variables. The research was conducted on 16 elite young players of Polish U-20 Men's Basketball National Team. The training loads were registered during all practice sessions with the use of heart rate monitors according to specific intensity zones (aerobic, aerobic/anaerobic, lactic anaerobic and alactic anaerobic). The level of speed abilities at distances of 5, 15, 20, 30 and 10×30 m were diagnosed with the use of a laser diode system LDM 300C-Sport. During the six-week pre-competitive mesocycle starting and absolute speed did not improve significantly (5, 15, 20, 30 m), while anaerobic endurance (10×30 m) showed statistically significant changes. A high volume of training loads in the aerobic zone and an inadequate volume of alactic anaerobic metabolism training seems to be the main reason for lack of improvement in the level speed abilities.

INTRODUCTION

One of the most important aspects of competitive sports includes the proper application and analyses of training loads. Appropriate training loads influence significantly game effectiveness of particular players and the whole team. Training loads are defined as a volume of work times workout intensity. Volume is a quantitative component of a training load, while intensity is a qualitative component [8, 16, 19]. Training loads maybe registered for a single player, or an average load maybe calculated for the entire team. Training loads are registered and analysed for single practice session as well as for macrocycles and annual training periods [18, 21]. The review of literature related to training loads patterns [5] indicates highly developed concepts in individual sport disciplines such as track and field, swimming, weight lifting, while few solutions for team sports are presented. This phenomenon is most likely related to the complexity of training loads in team sport games.

There have been many attempts to register training loads in particular drills and entire practice sessions in basketball [1, 12, 13, 23]. In basketball most often work volume is expressed as time (h, min., s), while work intensity is evaluated with the use of heart rate monitors. Based on heart rate frequency particular intensity zones are created (aerobic – 1, aerobic/anaerobic – 2, lactic anaerobic – 3, alactic anaerobic – 4). The main objective of

Correspondence should be addressed to: Ryszard Litkowycz, Department of Basketball, Academy of Physical Education in Katowice, Mikołowska 72a, 40-065 Katowice, tel.: 32 2075136, fax. 32 2075337, litkowycz@op.pl

this research was to analyse the training loads during a six-week pre-competitive mesocycle and determine their impact on speed abilities and anaerobic fitness.

METHODS

The research was conducted on 16 elite young players of Polish U-20 Men's Basketball National Team. Basic characteristics of subjects are presented in Table 1.

Table 1. Characteristics of the Polish U-20 Men's National Basketball Team players

Variable	X	min.	max	SD
Body height [cm]	198	183	218	9.2
Body mass [kg]	92.6	80	102	5.6
Age [years]	18.5	17	19	0.7
Training experience [years]	7.3	6	9	0.8

The U-20 team began preparation for the Division B European Championships in December 2004 (3 days). The main preparation period included 36 practice sessions and 6 scrimmage games (Tab. 2).

The basketball players were tested at the beginning and at the end of the mesocycle. The training loads were registered during the preparation and pre-competitive period on the basis of heart rate monitoring. During each training session players practiced with the use of heart rate monitors (Polar Team System, Finland) according to specific training intensity zones – aerobic, aerobic/anaerobic, lactic and alactic anaerobic. The level of speed abilities at distance 5, 15, 20, and 30 m were diagnosed with the laser diode system LDM 300C-Sport (Jenoptic, Jena, Germany). During the testing procedures the heart rate was recorded by Polar Monitor S610 (Polar, Finland). The restitution was monitored during the first five minutes of recovery. The intensity zones were set upon previous studies of [1, 12, 13, 25, 26]. All drills, performed during the 36 sessions were divided into four zones according to their intensity: aerobic (continuous runs, warm-up exercises, basic drills executed with low intensity), aerobic/anaerobic (fast break drills, fundamental drills carried out with moderate intensity), anaerobic lactic (specific drills with high intensity), anaerobic alactic (speed and strength exercises with maximum intensity and short duration).

Basic statistical measures were calculated. To evaluate the level of statistical significance between paired observations the t-Student's test for dependent variables was applied. The level of statistical significance was accepted at $p \leq 0.05$ (Tab. 4 and 5) [20].

Table 2. Preparation schedule of U-20 team

No.	Location of training camp	Number of players	Time	Number of days	Training camp profile
1.	Pruszków	18	20 – 22.12	3	team recruitment
2.	Spała	16	23.01 – 30.01	8	team recruitment
3.	Jaworzno *(testing)*	14	15.05 – 25.05	11	Tactics and conditioning
4.	Wrocław	14	3.06 – 12.06	10	Tactics and conditioning
5.	Spała *(testing)*	14	16.06 – 22.06	7	Tactics and conditioning
6.	Bydgoszcz	12	23.06 – 30.06	8	Scrimmage games
7.	Warna	12	6.07 – 17.06	12	Competition

RESULTS

The preparation period consisted of one mesocycle divided into three training microcycles. The work volume equaled 3306.5 minutes (36 training sessions) during three camps (Tab. 1 and 3).

The analysis of training loads revealed that microcycle 2 possessed the highest volume (1307 min) while microcycle 3 the lowest (846 min). The structure of training loads in particular microcycles showed that the main part of training efforts during the preparation period were lactic anaerobic (microcycle 1-33%, microcycle 2-36%, microcycle 3-42%). On the other hand, alactic anaerobic metabolism had the lowest volume (microcycle 1-9%, microcycle 2-8%, microcycle 3-7%). When the metabolic structure of the whole mesocycle is considered, the data is similar (lactic anaerobic metabolism – 37%, alactic anaerobic metabolism – 8%, 27-28% of workout was performed in the aerobic zone (Tab. 3).

The results of investigation connected with recovery showed that the heart rate after 1, 2 and 3 minutes of recovery, after the 10×30 meter test run, decreased; however after the 4th and the 5th minute of recovery a slight increase was recorded. A significant difference ($p \leq 0.05$) of the considered variables was recorded only after the first minute of recovery (Tab. 4).

The estimated level of speed at 5, 15, 20 and 30 m did not change in contradiction to anaerobic endurance (10×30 m) where statistically significant differences ($p \leq 0.05$) were observed (Tab. 5).

Table 3. Characteristics of total work in particular metabolic zones of intensity [min (%)]

Metabolism	Microcycle I	Microcycle II	Microcycle III	Mesocycle
Aerobic	355.5 (31)	355 (27)	196 (23)	906.5 (27)
Aerobic/anaerobic	314.5 (27)	385 (29)	235 (28)	934.5 (28)
Lactic anaerobic	382 (33)	470 (36)	360 (42)	1212 (37)
Alactic anaerobic	101.5 (9)	97 (8)	55 (7)	253.5 (8)
Total	1153.5 (100)	1307 (100)	846 (100)	3306.5 (100)

Table 4. Statistically significant differences between the level of restitution in test 1 and 2 [bps/min]

Variable	n	X_1	X_2	ΔX	SD	t	p
REC 1’	10	149.7	134.7	15	11.260	4.418	**0.00**
REC 2’	10	117.2	110.4	6.8	26.823	0.801	0.44
REC 3’	10	107.5	105.9	1.6	22.061	0.229	0.82
REC 4’	10	102.9	103	–0.1	21.70	–0.014	0.98
REC 5’	10	100	100.6	–0.6	18.081	–0.104	0.918

Table 5. Statistically significant differences between the levels of speed in test 1 and 2 [s]

Variable	n	X_1	X_2	ΔX	SD	t	p
5 m run	10	1.297	1.309	–0.012	0.074	–0.507	0.62
15 m run	10	2.758	2.773	–0.015	0.153	–0.308	0.76
20 m run	10	3.354	3.426	–0.072	0.276	–0.823	0.43
30 m run	10	4.662	4.728	–0.066	0.270	–0.770	0.46
10×30 m run	10	50.759	48.996	2.843	3.013	2.297	**0.04**

DISCUSSION

There is no doubt that an athlete must face extreme demands during practice and competition. That is the reason the coaches have to utilize the training methods leading to supercompensation. In this case the volume of work in particular metabolic zones is an important base for planning of short-term and long-term training [9, 10, 11, 14, 15, 16, 17, 18, 22].

The volume of workout in separate metabolic zones should be approximate to the structure of effort during the competition. The analysis of literature [1, 2, 3, 6, 7, 12, 23, 24] reveals that basketball is a sport where the main source of energy is achieved through aerobic/anaerobic and lactic anaerobic metabolism. For that reason the aerobic system should be activated only during the preparation phase and significantly restricted in the phase of competition when the athlete must concentrate on championship.

The obtained results show that lactic anaerobic metabolism was dominant during the analysed period in the preparation and pre-competitive phase (Tab. 3). The biggest difference was between lactic and alactic metabolism and slightly less significant between anaerobic and aerobic energy systems.

Effectiveness in basketball depends on the ability to undertake short, very intensive efforts, performed with high frequency, followed by longer periods of low intensity activity (standing, walking, jogging) [7]. For that reason lactic and alactic anaerobic metabolism should dominate in basketball training, especially during the pre-competitive and competitive phases. Some results achieved by other researches [4, 23] indicate that the structure of training loads during competition shows the following proportions: 61% anaerobic, 28% aerobic/anaerobic and 11% aerobic metabolism. The obtained results concerning the style of play with high intensity are based on transition basketball. In case of half court offense these variables amount to 25, 50 and 25% respectively. Comparing the results obtained during the pre-competitive mesocycle of the Polish U-20 National Team it turns out that the training loads were similar and equal respectively in 45% (lactic 37% and alactic 8%) and the remaining part of metabolism was divided into aerobic – 27% and aerobic/anaerobic 28%. The authors mentioned above did not separate lactic and alactic anerobic metabolism; however different studies [2, 3, 7, 12] show that a division of anaerobic zones makes the structure more accurate.

The data presented in Table 4 and 5 indicates significant differences related to these two variables: anaerobic endurance (10×30 m run) and heart rate recorded after the first minute of recovery. This means that significant improvement was observed in the level of anaerobic endurance and in the efficiency of restitution (aerobic capacity). A lack of significant differences in speed variables at distances of 5, 15, 20 and 30 meters may suggest errors in planning of the training process. It seems that the training loads directed at the development were insufficient (Tab. 3).

The other reason for a significant improvement in speed endurance and no improvement in speed variables could be attributed to insufficient recovery periods between repetitions and sets during speed training. Most of the training planned as speed and power loads turned into anaerobic capacity.

The following conclusions can be drawn:

1. Basketball game effort must be evaluated based on the heart rate and blood plasma lactate concentration.
2. Inadequate volume of work in the alactic anaerobic metabolism zone in the global training load structure leads to lack of significant changes in speed and power.
3. High volume of lactic anaerobic and aerobic/anaerobic training cause significant changes in the level of speed endurance.
4. Significant changes in recovery efficiency is attributed to a high volume of aerobic work.

REFERENCES

[1] Banaszczak A., Gabryś T., Bioenergetyczna koncepcja klasyfikacji obciążeń treningowych w koszykówce (Metabolic concepts of training loads classification in basketball). Diagnostika Pohyboveho Systemu. Metody vysetreni, primarni prevence,, prostredky pohybove terapie. Sbornik IV. Mezinarodni konference v oboru funkcni antropologie a zdrvotni telesne vychowy. Olomouc 2000.

[2] Blasković M., Matkowić B., Matkowić B.R., Relationship between morphological characteristics and performance in basketball players. *Biology of Sport*, 1989, 6.

[3] Błajet P., Energetyczne uwarunkowania wysiłku fizycznego w koszykówce (Metabolic determinants of physical effort in basketball). *Sport Wyczynowy*, 1989, 3-4.

[4] Brittenham G., Complete conditioning for basketball. *Human Kinetics Publishers*, 1996.

[5] Bułgakowa N.Ż., Otbor i podgotowka junych pływców (Selection and training of young swimmers). *Fizkultura i Sport*. Moskwa 1986.

[6] Buyukyazi G., Karamizrak S.O., Islegen C., Effects of continuous and interval running training on serum growth and cortisol hormones in junior male basketball players. Acta Physiologica Hungaria, 2003, 90, 69-79.

[7] Buśko K., Wit B., Brzeźnicki M., Wybrane wskaźniki fizjologiczne u młodych koszykarzy w dwuletnim cyklu szkolenia (Chosen physiological aspects of basketball players in a two-year training cycle). *Sport Wyczynowy*, 2000, 11-12, pp. 22-31.

[8] Chmura J., Bioenergetyka wysiłku piłkarza podczas meczu (Metabolic game characteristic in soccer). *Sport Wyczynowy*, 1997, 11, pp. 18-23.

[9] Kielak D., Bezpośrednie przygotowanie startowe – oczekiwanie i wątpliwości (Pre-competitive preparation – expectations and doubts). *Sport Wyczynowy*, 2004, 3-4, pp. 13-21.

[10] Kosmol A., Systemy informatyczne sterowania obciążeniem wysiłkowym w wybranych dyscyplinach sportu (IT systems in the process of optimal steering of training loads in selected sports). Studia i Monografie. AWF, Warszawa 1999.

[11] Krupecki K., Jaszczanin N., Jaszczanin J., Cięszczyk P., Optymalizacja obciążeń treningowych w przygotowaniach olimpijskich wioślarzy (Training loads optimization in Olympic rowers). Antropomotoryka, 2005, 32, pp. 31-40.

[12] Mikołajec K., Góralczyk R., Poprzęcki S., Zając A., Szyngiera W., Waśkiewicz Z., The effects of specific conditioning on speed abilities in young female basketball players. *Journal of Human Kinetics*, 2003, 10, pp. 39-48.

[13] Portnow J., Basketbol (Basketball). VIR Print, Moskwa 1997.

[14] Rakowski M., Zmiany obciążeń treningowych młodych pływaków w okresie bezpośredniego przygotowania startowego (Changes in training loads during the direct competition mesocycle). *Sport Wyczynowy*, 2005, 7-8, pp. 30-34.

[15] Roth W., Fizjologiczno-biochemiczne aspekty obciążeń w treningu wioślarskim (Physiological and biochemical aspects of training in rowing). *Sport Wyczynowy*, 1994, 1-2.

[16] Ryguła I., Wybrane elementy treningu sportowego (Chosen elements of sport training). AWF, Katowice 1999, pp. 285-346.

[17] Sozański H., Kosmol A., Jak analizować dynamikę obciążeń treningowych w makrocyklu (Analysis of training loads in a macrocycle). Trening, 1991, 2, pp. 8-34.

[18] Sozański H., Śledziewski D., Obciążenia treningowe (Training loads). RCMSKFiS, 1995.

[19] Sozański H., Podstawy teorii treningu (Introduction to sport training). RCMSKFiS, 1993.

[20] Stanisz A., Przystępny kurs statystyki (Basic course in statistics). Kraków 1998.

[21] Szwarc A., Zmiany struktury obciążeń treningowych w 3-letnim cyklu szkolenia młodych piłkarzy nożnych (The changes in training load structure in a three-year soccer training cycle). *Sport Wyczynowy*, 2002, 1-2, pp. 16-29.

[22] Ważny Z., Rozważania na temat metod analizy obciążeń treningowych (The analysis of training loads). *Sport Wyczynowy*, 1997, 3-4, pp. 10-20.

[23] Zając A., Cholewa J., Taktyka gry a charakter przemian beztlenowych (Basketball tactics and metabolism). Zeszyty Metodyczno-Naukowe. AWF, Katowice 1993, 2, pp. 297-302.

[24] Zając A., Przymęcka B., Poziom przygotowania kondycyjnego i sprawności specjalnej zawodników oraz jej wpływ na skuteczność gry w koszykówce (The level of physical fitness and its influence on game effectiveness). Roczniki Naukowe, AWF, Katowice 1991, 19.

[25] Zglinicki J., Trenerska koncepcja pomiaru obciążeń treningowych w piłce ręcznej (Coach's concept of training loads registration in basketball). *Trening*, 1993, 2.

[26] Zglinicki J., Wyniki analizy obciążeń treningowych jako czynnik planowania i kierowania procesem szkolenia w piłce ręcznej mężczyzn na poziomie I ligi (The results of training analyses as a factor determining the planning and control of training loads in men's team handball). Praca doktorska. AWF, Warszawa 1997.