The effects of specific conditioning on speed abilities in young female basketball players

by
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Authors analyzed the influence of training executed during preparation before Women's U-17 European Championships on speed abilities. The authors determined if is it possible to significantly change the level of speed abilities during 6 weeks of training and characterize relation between training volume and intensity and the level of maximal running velocity. Research was conducted on 12 elite young basketball female players, representatives of Polish U-17 national team(body height and mass respectively 178,04±6,827 cm and 67,89±6,812 cm). Testing procedure included 15 min. general warm-up, that included running and stretching followed by 4 maximal sprints at 30 m. They were separated by 5 min. rest intervals and only last two were registered. The time at 5th and 15th m was statistically significantly better after conducted training (F=5,963 and p=0,023; F=4,307 and p=0,050 respectively). A very important result was obtained in case of maximal velocity, which improved also significantly by 5,368% (F=4682 and p=0,041). The relation between time at 5th, 15th and 20th m are statistically significant as well as between 15th, 20th and 30th. A significant correlation appeared also between the longest distances i.e. 20th and 30th m. Authors determined that after six-weeks of training significant improvement was registered at short running distance (5 and 15m) and maximal running velocity. The relationship between training volume at specific intensities and improvement of speed abilities is unclear and need further experiments.
Keywords: *basketball, speed abilities, maximal running velocity*

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Introduction

Year-round conditioning specifically designed for basketball has reached a high level of sophistication over the past several decades. There is growing evidence that it can contribute to improved performance and reduced injury. The major components of conditioning for basketball have been identified as anaerobic power (stages I and II), aerobic power, muscular strength/power/ endurance, and flexibility. The concept of year-round conditioning uses the principles of periodization in work and rest to achieve peak performance and avoid injury. There are unique problems associated with various levels of competition that require diligent monitoring on the part of the coach to maximize physical conditioning and avoid overtraining (Stone and Steingard 1993).

One of them includes sexual differentiation of motor fitness in basketball. Hakkinen (1991) studied the force production characteristics of leg extensor, trunk flexor and extensor muscles in basketball subjects. As expected, the male players demonstrated greater absolute maximal strength in the tested muscle groups than females. When the force values were related to body weight, the differences became smaller but the male group could still produce higher values. The author suggests that the differences observed in force production characteristics between male and female groups may not be explained only by sexual differences but also by differences in overall volume and/or the type of strength and power training during the preparatory training season(s).

As it is commonly known basketball places high demands on specific preparation in many aspects of physical fitness. In order to determine what type of training is best in conditioning in basketball Balabinis et al. (2003) compared regimens of concurrent strength and endurance training. Subjects completed different training programs for 7 weeks, 4 days per week divided into strength (S), endurance (E) and strength and endurance (SE) groups Authors concluded that concurrent endurance and strength training is more effective in terms of improving athletic performance than are endurance and strength training separated. The SE group showed greater gains in VO_2max and had better post-training anaerobic power than the S group (6.2% vs. 2.9%).

The same author (Hakkinen 1993) examined changes in a physical fitness profile during a 22-weeks official competitive season. Specific explosive type strength training (1-2 sessions per week) was utilized throughout the season. The present findings showed that the entire competitive season led to no systematic changes in maximum oxygen uptake, in anthropometric characteristics or in maximal isometric force of leg extensor muscles. However, significant increases occurred during the season both in the average power output during the first 15 s work in an anaerobic jumping test and in maximal vertical jumping height in the squat jump and in the counter movement jump.

Trninic et al. (2001) performed analysis of effects of a two-month developmental training cycle realized within a basketball season revealed statistically significant positive changes at the multivariate level in components of motor-functional conditioning (fitness) status of the sample of talented basketball cadets (15-16 years). The greatest correlations with discriminant function were found in variables with statistically significant changes at the univariate level, more explicitly in variables of explosive strength of the upper body and trunk, anaerobic lactic endurance, as well as in jumping ability. The presented developmental conditioning training program, although implemented within the competitive period, induced multiple positive fitness effects between the two control time points in tested sample of basketball players.

The literature review did not reveal data about influence of training before championships in case of young female basketball players. Especially experimental data regarding speed was very scarce, however it is commonly known, that is a it relatively important ability in contemporary basketball. Basketball became a very fast game, and transitions from defensive to offensive activities (and vice versa) demands a high level of speed abilities and anaerobic fitness. Therefore the authors decided to analyze the influence of training executed during preparation before Women's U-17 European Championships on speed abilities. Analysis of existing theoretical and empirical knowledge regarding basketball and women's sport training. The authors formulated the following research questions:

a) Is it possible to significantly change the level of speed abilities during 6 weeks of training?
b) Is there any relation between training volume and intensity and the level of maximal running velocity?

Material and methods

Research was conducted on 12 elite young basketball female players, representatives of Polish U-17 national team. Basic characteristics of tested subjects are presented in tab. 1. The measurements were performed twice: in the first days of initial training in June and three days before the European

Championships qualifying tournament. Training work was executed during following preparation camps in year 2003:

a. Szczyrk (Poland) – 22.06 – 03.07,
b. Zakopane (Poland) – 08.07 – 22.07,
c. International tournament Strakonice (Slovakia) – 25.07 – 27.07,
d. International tournament Lugo (Spain) – 29.07 – 01.08,
e. Training consultation in Katowice qualifying tournament – 04.08 – 14.08.

During each training session players practiced with the use of heart rate monitors (Polar Team System, Finland) according to specific training intensity zones. These zones were calculated separately for each player on the basis of maximal heart rate registered during progressive aerobic test (VO_2max). Training volume in determined zones is presented in fig. 1 (in separate microcycles) and fig. 2 (as total volume of work).

Table 1 Basic characteristics of tested subjects

Variable	Body height [cm]	Body weight [kg]	Age [years]	Training experience [years]
$\bar{X}$	178,04	67,89	16,75	5,75
SD	6,827	6,812	0,452	0,621

Speed abilities were diagnosed, as mentioned above, twice with the use of newly developed laser diode system LDM 300C-Sport (Jenoptik, Jena, Germany) which provides on-line recording of the required distance-versus-time and velocity-versus-time relationship and of selected individual kinematic motion parameters, making these immediately available to coaches and sportsmen alike. Precise description of measurement technique was presented by Góralczyk et al. (2003).

Testing procedure included 15 min. general warm-up, that included running and stretching followed by 4 maximal sprints at 30 m. They were separated by 5 min. rest intervals and only last two were registered. For further analysis only the time at 5, 15, 20, 30 m and maximal velocity were taken. Acquired data was processed statistically using basic descriptive statistic and Kolmogorov-Smirnov test of distribution normality. The significance of differences between measurements was evaluated with the use of ANOVA with repeated measures.

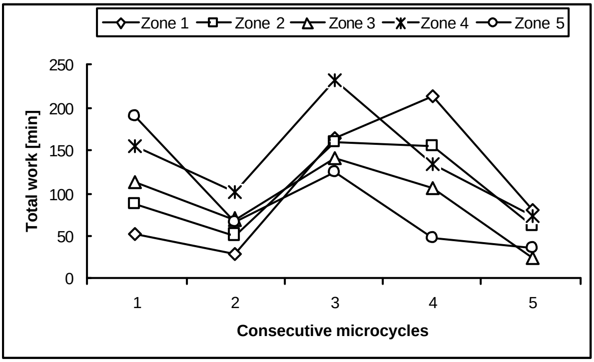

Fig. 1 Characteristic of total work in particular zones of exercise intensity in consecutive microcycles

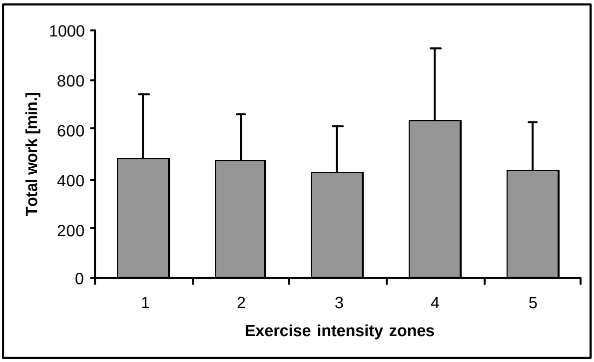

Fig. 2 Characteristic of total work in particular zones of exercise intensity

Results

The analysis of results showed that in all analyzed variables an improvement was observed. The level of changes and mean values are presented in tab. 2 and on fig. 3. The absolute and percent differences were not large but it has to be underlined that changes in area of speed abilities are always in small range and difficult to acquire. Nevertheless, the time at 5^{th} and 15^{th} m was statistically significantly better after conducted training (F=5,963 and p=0,023; F=4,307 and p=0,050 respectively). The time to reach other measuring points did not change significantly. A very important result was obtained in case of maximal velocity, which improved also significantly by 5,368% (F=4682 and p=0,041).

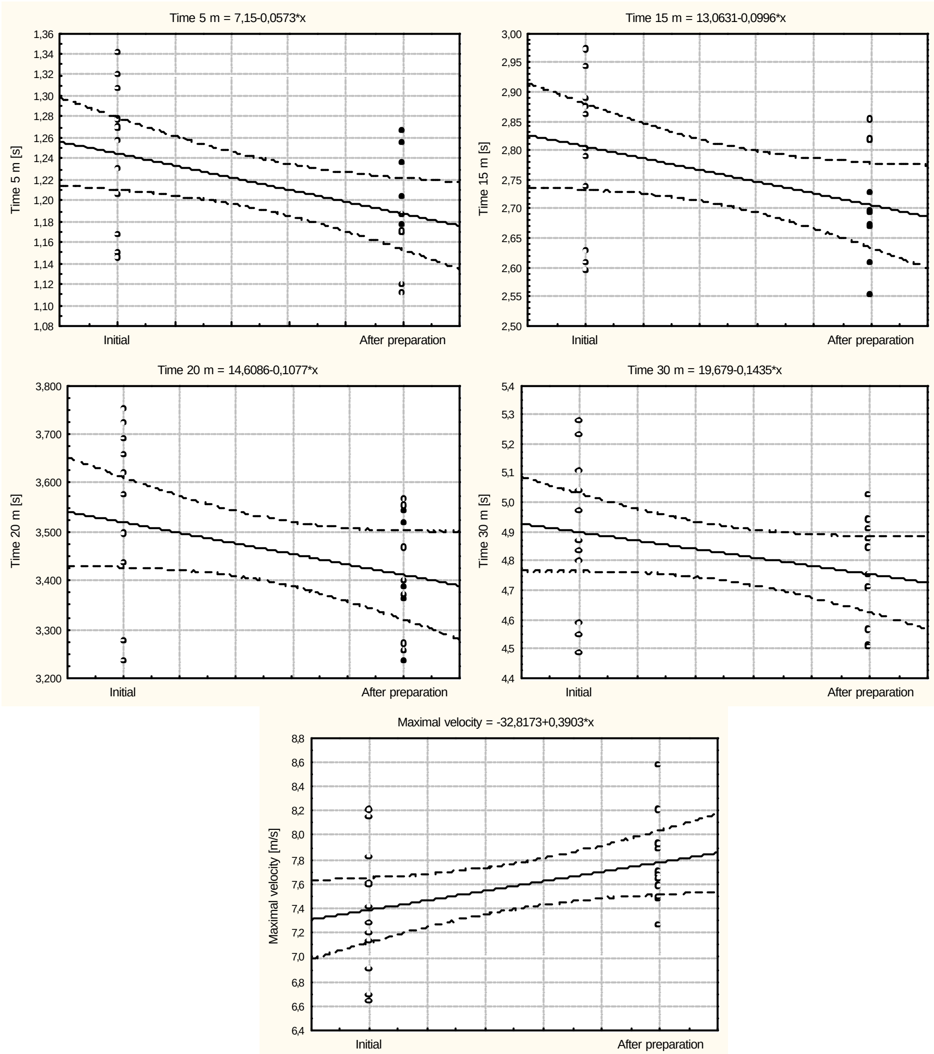

Fig. 3 The mean values and dispersion of individual results at specific measuring points

In order to determine the relationship between initial and final measurement and training work volume the Pearson correlations were calculated. The values presented in tab. 3 show that there are very clear relations between times reached at specific distances. The relation between time at 5th, 15th and 20th m are statistically significant as well as between 15th, 20th and 30th. A significant correlation appeared also between the longest distances i.e. 20th and 30th m.

Table 2 The differences between initial and final measurements at specific points of distance and maximal velocity

Variable	Dt_{5m}		Dt_{15m}		Dt_{20m}		Dt_{30m}		Dt_{vmax}	
	Abs.	[%]	Abs.	[%]	Abs.	[%]	Abs.	[%]	Abs.	[%]
$\overline{x}$	0,057	4,521	0,100	3,489	0,108	2,977	0,144	2,840	-0,390	-5,540
SD	0,033	2,578	0,056	1,891	0,070	1,902	0,104	2,003	0,359	5,368
ANOVA	p≤0,05		p≤0,05		NS		NS		p≤0,05	

This correlation seems to have strong physiological background. The relation between Zone 1 and 2 and results achieved by subject at 15 m was only two statistically significant relations. It may show that only work at these heart rate zones with moderate intensity allows improving speed abilities.

Table 3 Correlation matrix of variables describing time and maximal velocity differences and training volume

	Time 5	Time 15	Time 20	Time 30	Max. vel.	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Time 5										
Time 15	**0,68**									
Time 20	**0,76**	**0,71**								
Time 30	0,57	**0,67**	**0,96**							
Max. vel.	0,18	-0,02	-0,24	-0,36						
Zone 1	0,27	-0,15	0,17	0,10	0,36					
Zone 2	-0,28	**-0,69**	-0,33	-0,40	0,01	0,39				
Zone 3	-0,54	**-0,76**	-0,46	-0,43	-0,33	-0,06	0,70			
Zone 4	-0,01	-0,01	-0,32	-0,45	0,16	-0,48	0,18	0,01		
Zone 5	0,26	0,30	0,25	0,20	0,05	-0,55	-0,25	-0,29	0,54	
Total	-0,03	-0,49	-0,28	-0,42	0,21	0,20	0,83	0,46	0,59	0,20

Discussion

The results presented in this article reinforce experienced opinion of experts that, in the training process with youth teams, conditioning programs may be effectively applicable throughout the entire preparatory period. The proposed training model is a system of various training procedures, operating synergistically, aimed at enhancing integral fitness (preparedness) of basketball players. Further investigations should be focused on assessing effects of both the proposed and other training programs, by means of assessing and monitoring actual quality (overall performance) of players, on one hand, and, on the other, by following-up hormonal and biochemical changes over multiple time points. Improvement of results achieved after a 6-week training program indicated that a adequately designed program leads to successful changes in motor development, even in speed abilities.

It is worthy to emphasize that even a large volume of training allowed to increase speed abilities. It is known that intensive training, especially of anaerobic character causes significant changes in organism homeostasis. Specific training may even lead to changes in proportions of muscle fibers type. Janson et al. (1993) incorporated a training program consisting of repeated 30-s 'all-out' sprints on a Wingate bicycle ergometer, with rest periods of 15-20 min. between consecutive sprints. Thigh muscle biopsies were analyzed for fiber types using myofibrillar ATPase stain. The proportion of type I fibers decreased from 57 to 48% and type IIA fibers increased from 32 to 38%. This study indicates that it is possible to achieve a fiber type transformation with high-intensity training. Strong effects in humoral mechanisms are registered after two different eight-week training programs consisting of continuous (CR) or extensive interval running (IR) on serum growth (GH) and cortisol hormones in 33 male basketball players aged 15-16 were assessed. They stated that, an 8-week training program consisting of continuous or extensive interval running has been effective on acute GH and cortisol secretion in 15-16 year-old male athletes (Buykyazi et al. 2003). Intensive sprinting may also lead to disturbances in immunological responses. Meyer et al (2001) intended to compare the immune reaction after single and repeated short bouts of anaerobic exercise. In their experiment 12 unspecifically trained male subjects performed one 60-s all-out test (SMT) on a cycling ergometer and the same test followed by eight 10-s all-out tests every 5 min (AN-TS). These tests and one control day (Co-Day) were applied in randomized order. At rest and 15 min, 2 h, and 24 h after cessation of exercise the following venous blood parameters were determined: concentration of neutrophils and (CD16(+ -)) premacrophages (both flow-cytometrically), interleukin 6 and 8 (IL-6, IL-8), C-reactive protein (CRP) and cortisol. There were no significant changes only in IL-8. Authors concluded that repeated short anaerobic bouts of sprinting lead to an acute phase response, which is more pronounced than after a single bout. Athletes should take care in performing such training sessions several times a week because signs of inflammation are detectable even 24 h after cessation of exercise.

Resuming, it is possible to state that a 6-week training period allowed to increase speed abilities and maximal velocity to a significant degree. Improvement, however significant, was equal approx. 5% what may be treated as relevantly small one. Therefore the increase in speed abilities is very difficult and requires longer time and more specific training means. Improvement only at 5 and 15 m distance shows that during this specific period of time only processes responsible for particular energy production may be more efficient. Interesting is that the relationship between training volume and speed improvement appeared what suggests that it is possible to control at very precise degree training procedures.

Conclusions

Acquired experimental data and theoretical considerations allow to formulate the following conclusions:

1. After six-weeks of training significant improvement was registered at short running distance (5 and 15m) and maximal running velocity.
2. The relationship between training volume at specific intensities and improvement of speed abilities is unclear and need further experiments.

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