THE INFLUENCE OF INDIVIDUALIZING PHYSICAL LOADS ON SPEED, CREATINE KINASE ACTIVITY AND LACTATE DEHYDROGENASE IN FOOTBALL PLAYERS

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Abstract. Introduction: One of the most important training problems in: contemporary football is speed preparation of a player for the season and the ability of keeping it on the same, relatively high level throughout the starting period [1]. The main process used for re-synthesis ATP during single, short-lasting efforts of maximal intensity, is decomposition of phospho-creatine under the influence of creatine kinase enzyme. Physical loads imposed during speed trainings often exceed the possibility of producing energy from phosphogenic reserve through oxygen - lactate free processes, because the supply of phospho-creatine is used very quickly. In such circumstances the lacking energy is refilled through processes called oxygen free glicolise with the help of lactate dehydrogenase enzyme. The aim of the work was to answer the question: "Does the individualization of physical loads influence the change of speed, creatine kinase activity and lactate dehydrogenase in young football players in six-month makrocycle?". Materials and Methods: The research was done on the group of 19 13-year-olds team players of WKP "Lech" Poznań. The stages of the research were conducted in six-month macrocycle. The average height of the players was 159,69+8,5 cm, and weight 48,06 +8,02 kg. The players had practiced football for four years. To complete the research the following methods were used: 1) players were divided into two motor types: speed and endurance. This was done on the basis of the speed results from three distances 20, 30, and 40 m.; 2) physical toads individualization was introduced. In each microcycle three series of six repetitions of speed exercises connected with coordination elements were used. For each motor type of players researchers used individual physical load program concerning the length of race and breaks of active rest; 3) At the beginning of the preparation period and before and after starting period the time of 30 m. distance was measured; 4) While resting and on a third minute after completing the endurance test the researchers took 5 ml of blood. In order to mark creatine kinase activity and lactate dehydrogenase the authors used diagnostic test Cormay and

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Spektrofotometr SEMCO S91E. Results: Individualization of physical loads during speed training for both types of players causes the change of creatine kinase activity and lactate dehydrogenase as well as influences the development of speed abilities of young footballers in six-month makrocycle. The conducted research of locomotive speed on 30 m. distance proved that for both types of players the ability rises. ***(Biol.Sport 25:177-186, 2008)***

Key words: Football - Training loads – Speed – Individualization - Creatine kinase - Lactate dehydrogenase

Introduction

Contemporary style of playing football sets high standards in terms of player's motoric preparation. Among motor abilities determining footballers' performance, the following should be mentioned: speed, dynamic strength and speed endurance [9]. One of the crucial training problems in contemporary football is high speed preparation to the season and sustaining this motor ability on a relatively high level during the match season [1].

Speed, just like the other motor abilities, is determined biologically. In the process of ontogenesis, body conditions and the ability to display speed resources change dynamically together with the processes of growing, reaching adolescence and differentiation of a developing body [6,10,13]. High speed preparation deserves a special consideration as almost 90 % of all the goalmouth actions take place next to or in the penalty area, both under time and opponent pressure. This causes the necessity for instant and precise choices between alternative match actions.

In recent times, one of the most controversial training problems is individualization of training loads in improving speed abilities of footballers. Differences in skeletal muscles structure, phosphagen potential, aerobic and anaerobic enzymes, nervous and muscular excitability in particular footballers, all indicate the need to introduce individualization of speed training loads. A common mistake made by coaches in the process of training footballers is applying the same training loads for all players.

Studies conducted by [1] on endurance type and speed type footballers of a leading team of the Polish Orange Extraclass have shown substantial differences in the examined players on every running distance covered. Considering the fact that in contemporary football every millisecond counts in terms of scoring a goal or blocking a strike, a significant difference between the examined players is clearly seen.

Training practice in professional sport clubs up to date has shown that the same training loads have been applied for the both types of footballers. From a methodological point of view, such approach is ineffective as the employed training loads do not account for individual abilities to perform speed effort.

Because there is a substantial difference in phosphagen potential and achieving a maximum anaerobic strength, it is impossible for an endurance footballer type to accomplish the same level of speed on a covered distance as a speed footballer type. Applying the distances of 10, 20 and 30 m long for the both types of footballers is unjustified as, instead of promoting genetic speed predispositions, coaches rather curb a possible development of such a motoric ability.

The main process used for ATP resynthesis at the time of single, short-lasting effort of a maximum intensity is a phosphocreatine catabolic process, influenced by creatine kinase enzyme. Post effort increase of creatine kinase activity in plasma depends on intensity and time of effort as well as types of muscular contractions. Practice up to date has shown that the applied speed training burdens often exceed capabilities of generating energy from phosphagen resources through anaerobic non-lactate processes because phosphagen resources are shortly depleted. In such conditions the lacking energy is supplemented through anaerobic glycolysis, thanks to lactate dehydrogenase enzyme.

Aim of work: The aim of the work is to examine the influence of training loads individualization on speed change, creatine kinase and lactate dehydrogenase activity in young footballers during a six-month macrocycle training.

Materials and Methods

19 young footballers at the age of 13, playing for WKP "Lech" Poznan, were the subjects of the research. The stages of the research resulted from a time structure of the sport training and were conducted during a six-moth macrocylce training [13]. The average body height of a player was 159.69±8.5 cm, the average body mass was 48.06±8.42 kg. The training experience of the young footballers was 4 years.

The research took place during a six-moth macrocyle training and was undertaken in III terms:

- I term: the beginning of a spring round preparation period
- II term: the beginning of the match season
- III term: the end of the match season

The following methods have been applied:

1. In order to determine a player type (a speed one or an endurance one), a 30 m and a 40 m long speed tests were conducted twice. After calculating arithmetic mean of the times achieved on every covered distance, the examined footballers were divided into the two motoric types of players. If the time achieved by the player was below the arithmetic mean, the person was classified as a speed type player. When the time was above this arithmetic value, the examined footballer was categorized as an endurance type player. The examined footballers covered every distance twice, with the time taken necessary for full rest [1]. The measurements were taken with 1/1000 s accuracy, using an electronic speedometer and a set of photocells [14].

2. Individualization of the training burdens concerned applying 3 series of 6 repetitions of speed activities combined with coordination elements, performed in each microcycle training. For each motoric player type, individual training loads were applied in terms of the length of the covered distance as well as time of the active rest. The speed type footballers covered longer running distances than the endurance type footballers. The time taken for the active rest by the speed type footballers was shorter in relation to the covered distance when compared with the endurance type footballers. This, among other things, results from the differences in muscle fibre structures, diverse properties of the central nervous system and phosphagen resources [1].

3. In the beginning of the preparation period, before and after the match season, the running time was taken at the distance of 30 m long. During the speed trial, the measurement of 0,001 accuracy with the use of a set of photocells was applied. The examined players began running from a standing start.

4. At the time of the rest and during the 3rd minute after completing the endurance test, 5 ml of the venous blood was taken from each player. Diagnostic tests produced by the Cormay company and a Spectrophotometre SEMCO S91E helped to establish the activity of creatine kinase and lactate dehydrogenase.

Results

During a six-month training cycle, an increase in locomotive speed has been observed in both player types. The most substantial increase have been noticed in the endurance type footballers between the second (5.078±0.143 s) and the third term of the research (5.025±0.158 s), which was 0.053 s. The differences proved statistically relevant ($p<0.05$). What should be stressed is the fact that the endurance type footballers achieved the worst results in the second term of the research. Fig. 1 shows the characteristic of locomotive speed changes in the endurance type footballers.

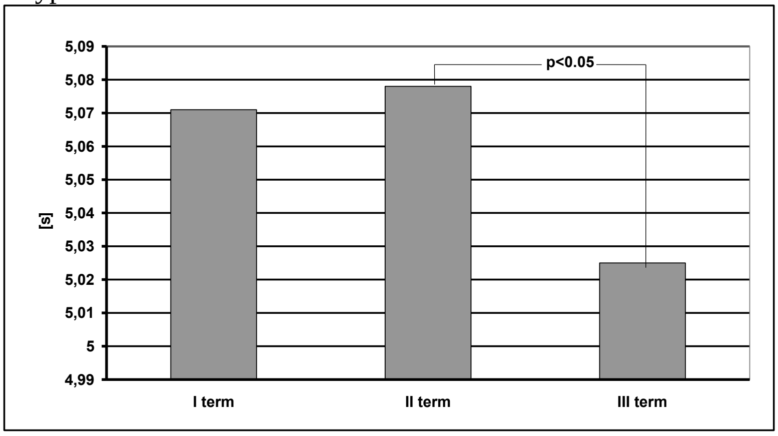

Fig. 1
Characteristic of locomotive speed changes at the 30 m long distance in the endurance type footballers during subsequent terms of the research

The greatest increase of 0.022 s has been observed in the speed type footballers between the first (4.685±0.0118 s) and the second (4.663±0.141 s) term of the research. Fig. 2 shows the characteristic of locomotive speed changes in the speed type footballers.

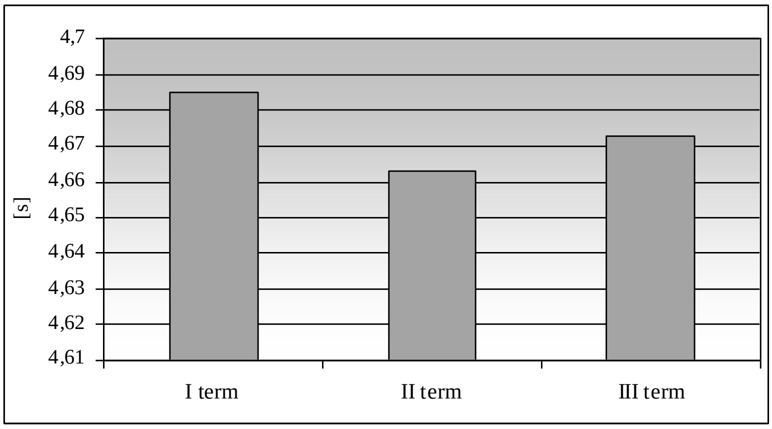

Fig. 2
Characteristic of locomotive speed changes at the 30 m long distance in the speed type footballers during subsequent terms of the research

Together with the increase of speed abilities, a statistically relevant ($p<0.05$) rise in creatine kinase activity has been noticed in the endurance type footballers from 73.3 $mmol \cdot l^{-1}$ to 105,24 $mmol \cdot l^{-1}$ (Fig. 3). The growth of the marked enzyme activity in the endurance type footballers from 58.74 $mmol \cdot l^{-1}$ to 70.81 $mmol \cdot l^{-1}$ of the blood proved statistically irrelevant (Fig. 4). It is merit indicating that the studied creatine kinase activity in the speed type footballers, measured in the 3 terms, grew systematically, both in relation to the rest and post effort values.

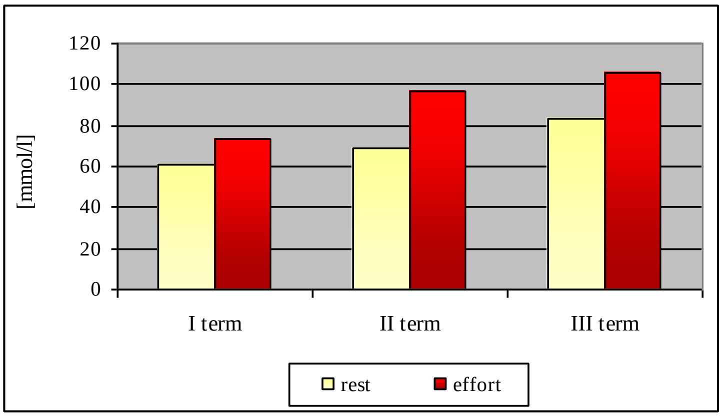

Fig. 3
Characteristic of creatine kinase value changes during rest and after test effort in the speed type footballers in subsequent research terms

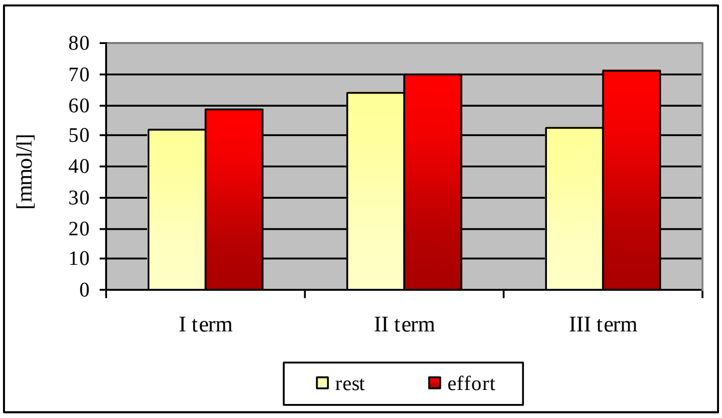

Fig. 4
Characteristic of creatine kinase value changes during rest and after test effort in the endurance type footballers in subsequent research terms

A similar course of change has been observed in terms of lactate dehydrogenase activity. In both motoric player types, the highest values of lactate dehydrogenase have been noticed in the second term of the research, both during rest and after completing the test effort. When it comes to the speed type footballers, their lactate dehygrogenase activity rose from 217.04 mmol·l^{-1} to 256.29 mmol·l^{-1} of the blood post effort values (Fig. 5). As far as the other footballer type is concerned, the activity of the marked enzyme grew from 205.44 mmol·l^{-1} to 241.71 mmol·l^{-1} of the blood (Fig. 6).

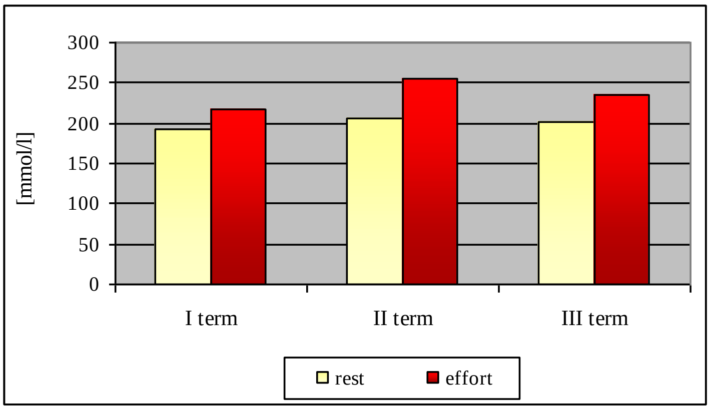

Fig. 5
Characteristic of lactate dehydrogenase value changes during rest and after test effort in the speed type footballers in subsequent research terms

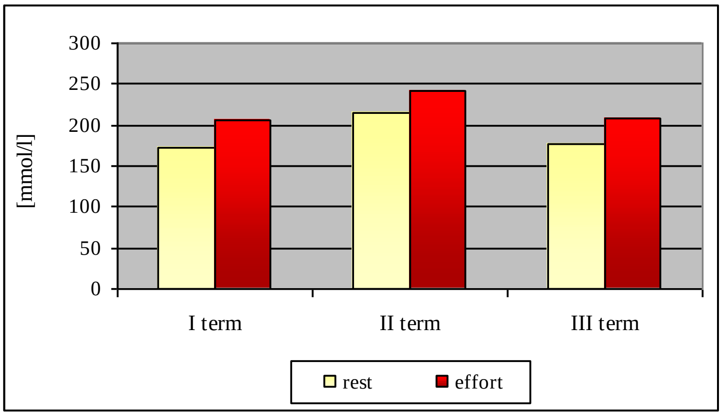

Fig. 6
Characteristic of lactate dehydrogenase value changes during rest and after test effort in the endurance type footballers in subsequent research terms

Conclusions

Individualization of training loads in speed training applied to both player types causes a change of creatine kinase and lacate dehydrogenase activity and influences development of speed abilities of the young footballers during a six-month long training macrocycle. The conducted research concerning locomotive speed at the 30 m long distance has shown an increase of the examined ability in both motoric types of the players. A higher rise in the values has been observed in the endurance type footballers, which might indicate that using short running distances (4-8 m) during a six-month long training cycle promotes the maximum anaerobic strength, start dynamics and facilitates better acceleration in the early stages of the run.

Physical effort, which is a basic component of sport training, causes numerous biochemical changes in man' s organs, tissues and body fluids. One of the post effort effects is an increase of intracellular enzymes in blood [2]. No research addressing the issue of marking creatine kinase or lactate dehydrogenase in young footballers has been found in the contemporary literature. There is a large number of studies conducted on senior sprinters, swimmers, wrestlers, kick-boxers, canoeists and footballers [2-4,7,15].

Physiological and biochemical tests performed on the young footballers have shown higher pre effort creatine kinase activity in the speed type footballers when compared with the endurance type footballers. The pre effort values of creatine kinase activity achieved by the speed type footballers explicitly indicate a substantial rise in the parameter in question during subsequent research period. The research shows a significant increase in post effort creatine kinase activity in plasma during the first, the second and the third terms (Fig. 3). The highest increase of the post effort parameter was observed during the third term (105.24 $mmol \cdot l^{-1}$ of blood). The increase was statistically relevant ($p \leq 0.01$) between the first and the third term. The above differences may be explained by specific features of the trial as well as time of the effort.

The highest post effort growth in creatine kinase activity in the speed type footballers has been detected between the first and the second term of the research, 58.74 $mmol \cdot l^{-1}$ and 69.96 $mmol \cdot l^{-1}$ of blood respectively (Fig. 4). A systematic increase of creatine kinase activity in the endurance type footballers may be the effect of extending anaerobic and non-lactate processes, thanks to employing the speed type training loads.

The study also aimed at marking lactate dehydrogenase activity in the blood of the young footballers. Lactate dehydrogenase is a glycolytic enzyme, responsible for a reversible reaction of reducing pirogronian acid to lactic acid. The enzyme is particularly active in the tissues where anaerobic glycolysis is prevalent, for example in muscles and erythrocytes, but also in the cells of liver or kindey. The pre effort activity of lactate dehydrogenase in plasma measured in the present study complies with the results reported by the other researchers [5,8,11]. The analysis of the data obtained after the trial effort have shown that the highest lactate dehydrogenase concentration in the speed and endurance type footballers was observed in the second term of the study, 256.29 $mmol \cdot l^{-1}$ and 241.71 $mmol \cdot l^{-1}$ of blood respectively. The lowest enzyme concentration was measured in the first term of the study. This might be due to the beginning phase of the test, which did not allow the optimal level of body adaptation to glycolytic changes. The research up to date does not confirm unequivocally that the changes of lactate dehydrogenase activity after single physical effort are determined by the level of adaptation to use the aerobic energy sources; however, such a possibility can not be excluded, either.

Taking into consideration the studies undertaken by other researchers as well as the results achieved in this experiment, it is worth stressing that the changes of creatine kinase and lactate dehydrogenase activity in relation to physical effort kind made by representatives of various sport disciplines require further analysis. This might provide additional information on physical effort adaptation and optimum training load significance.

The results presented above have showed the need to introduce training burdens individualization when building up speed abilities in young footballers. If introduced early enough, such individualization promotes developing these motoric skills with the help of specific and favourable age conditions of young players.

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