

Individualization of Physical Loads and Speed Abilities of Young Soccer Players in a Six-Month Training Macrocycle

by

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The aim of this paper was to address the issue of individualized training loads and its influence on speed development among speed-type and endurance-type players during a six-month training macrocycle.

The research was conducted in a group of 36 young male soccer players from for two sport clubs: Lech Poznań and Warta Poznań. The stages of the study undertaken resulted from the time structure of sport training and were carried out during a six-month macrocycle. The players of Lech Poznań took part in a test which involved applying three series' (six repetitions each) of speed-type exercises, with regard to the player's motor type in each of the three training units comprising the weekly macrocycle. During each stage of data collection, the players were subjected to a stress test for stretches of 10, 20 and 30 m.

The study has shown a significant impact of individualization of training loads on development of speed abilities in the examined players. An increase of speed during the tests of 10 and 20 m was noted in both speed and endurance-type players. This was probably an effect of adapting individual training loads to motor predispositions of the players during the six months of the experiment. It can be also assumed that the increase in speed among the subjects is a result of rising phosphagen potential and enzymatic activity (especially creatine kinase), as well as improved motor units recruitment .

Key words: training loads, speed abilities, individualization, motor type

Introduction

Technical and technical-tactical abilities, gained during the primary stage of training, are not subject to major changes when a player reaches maturity. However, developing motor abilities may significantly increase a players' sport level. Thus, their promotion should be a permanent training task. It should be stressed that particular motor abilities do not develop simultaneously and are characterised by large variability, depending on age, sex and training experience. In case of sport training, it is the specificity of a sport discipline which determines the development of particular motor abilities.

Fitness training of a soccer player is a psychophysical adaptation process, on the basis of which one can start to perform activities with a ball. Frequent repetitions of tasks which emerge during trainings and competitions lead not only to developing motor abilities or mastering energetic processes, but also to establishing particular bonds between them. A characteristic feature of physical activities involved in football during a game is that a player performs efforts which often reach their maximum psychophysical abilities (Chmura, 2001).

It seems that one of the crucial training problems in contemporary football is the player's speed preparation for the season, and sustaining this motor abil-

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ity on a relatively high level throughout the match. Observations made during championship matches have shown that speed abilities of soccer players often determine the likelihood of success during match play; and hence, correlation to the percentage of victories. Ekblom (1986) claims that the main difference between players of different level of proficiency does not depend on total distance covered during a match, but on the distance covered with maximum speed during this game. A player who can perform a particular activity from between ten to twenty milliseconds faster may become a winning goal-scorer or prevent the opposite player from scoring a goal. Thus, speed, as one of the main pillars of a soccer player's physical condition, is a decisive factor in determining the final match result (Chmura, 2001). The aforementioned observations make up the main argument for shifting training loads towards promotion of speed abilities and all their components in contemporary soccer.

Speed, like any other motor ability, is one of the components of human motor potential, and so it has its biologic conditioning. Together with the processes of growing up, reaching physical maturity and dynamics of a developing organism, bodily conditions and abilities to display predispositions of speed are also subject to major changes. A developing body is a flexible creature, which, within particular limits of functional tolerance, can be shaped towards reaching sport championship. Considering the wealth of knowledge and practice in the literature, it is believed that childhood and adolescence create favourable conditions to achieve maximum success in sport (Gissis et al., 2006; Kotzamanidis et al., 2005; Reilly, 2007). What should be mentioned at this point, however, is the negative influence of so-called premature sport specialisation, which may obstruct full development of speed abilities in young athletes because of the use of excessive training and match burdens (Bangsbo, 1999; Franks et al., 1999).

Structural changes of muscle fibres most often take place until the moment of a quickened biological development of a human—the so-called critical period. An optimal biological period for speed development is during youth and adolescent, between 7 and 15 years of age (Martens, 1993). It should be taken into consideration that children, when compared to adults, have a greater number of intermediate fibres, which accounts for approximately 13 % in boys and only 2-3 % in adults (Valquer et al., 1998).

Thus, if the stimulus for speed is given to children from the earlier years of life, it is possible to influence the changes of muscle fibre structure to some degree, by transforming intermediate fibres into fast twitch fibres (Andersen et al., 2001). In turn, this will allow an increase in speed potential of a junior soccer player, despite genetically-conditioned structures of muscle fibre.

The analysis of recent literature has shown that individualization of training loads, with regard to motor type of a player, is not applied during every stage of one's sport career. It should be emphasized that in every training group there are athletes with diverse motor predispositions, such as speed-type, endurance-type, and both speed and endurance type. Each of these should be assigned an individual training program. It has not been definitively stated how the training loads should be selected in effort to achieve optimal adaptive effects, while preventing premature specialization.

Taking the aforementioned information into consideration, the aim of this study was to answer the following research questions:

1. Does individualization of training loads adjusted to motor type of a player influence changes in the level of speed abilities during a six-month training macrocycle?
2. What are the speed dynamics among the best speed-type and endurance-type players?

Material and methods

The participants comprised 36 young male soccer players from two sport clubs in Poznań: Lech Poznań (experimental group) and Warta Poznań (control group). One of the criteria of player's group selection was similar sport level of the two teams (respectively, first and second place in the league). Anthropometric characteristics, as well as training experience of the examined players are shown in Table 1.

The experiment was conducted during a six-month training macrocycle. The stages of the study resulted from the time structure of sport training and were carried out during the following terms:

- I term: the beginning of the spring round preparation period
- II term: the beginning of the competitive season during the spring round
- III term: the end of the competitive season during the spring round

The following methods have been applied:

Table 1

| <i>Characteristic features of the examined footballers</i> | | | | | | | |
|--|-------------------|-------------------|-------------|-----------------------------|-------------|----------------|--------------------------|
| Group | Statistical index | Number of players | Age [years] | Training experience [years] | Height [cm] | Body mass [kg] | BMI [kg/m ²] |
| Experimental (Lech Poznań) | \bar{x} | n=19 | 13,5 | 4 years | 159,69 | 48,09 | 18,89 |
| | SD | | 0,4 | | 8,51 | 8,43 | 1,79 |
| | min | | 13,1 | | 145 | 32 | 15,2 |
| | max | | 13,11 | | 172 | 62,9 | 22,2 |
| Control (Warta Poznań) | \bar{x} | n=17 | 13,6 | 4 years | 155,36 | 42,21 | 18,2 |
| | SD | | 0,3 | | 7,62 | 6,54 | 2,44 |
| | min | | 13,1 | | 142,2 | 33,6 | 14,6 |
| | max | | 13,11 | | 168,5 | 53,3 | 24,9 |

1. Methods of defining players' motor type: speed-type and endurance-type

From the methodological point of view, the best solution would be to conduct muscle tissue biopsy for determining a player's motor type. However, because this method was not feasible in our study, an indirect method has been applied instead. On the basis of locomotive speed tests conducted twice at three different distances of 20, 30 and 40 m and after calculating arithmetic means (the best result was used for the analysis), the examined Lech Poznań's players were divided into the two motor types: speed-type and the endurance-type. 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 subject was categorised as an endurance-type player (Andrzejewski and Chmura 2008).

2. Methods of stress test

In order to measure speed, a running test was applied. The test involved running at maximum speed for a distance of 30 m, with two split times at stretches of 10 and 20 m. Each examined player covered every distance twice, with ample time taken for full recovery (Chmura, 2001). The measurements were taken with 1/1000 accuracy, using an electronic speedometer and a set of photocells. A best test results was taken for final analysis.

3. Implementation of speed loads individualization

Individualization of speed loads in the experiment involved using three series' of six repetitions of

speed-coordination activities in every training unit being a part of the training macrocycle. In accordance with the research conducted by Chmura (2001), in the process of shaping speed abilities in soccer players, the duration time of active rest depended on a particular motor type and the length of the distance covered. The time of active rest, when compared to the distance covered, should be shorter in speed-type players than in endurance-type players. This, partly, results from the diverse structure of muscle cells, different characteristics of central nervous system and different enzymatic activity and phosphagen resources:

- The speed-type footballers covered longer running distances, from 10 to 16 metres (depending on the assumed training targets in the given macrocycle); and ratio between the length of time of the exercise measurements and the time of active rest varied from 1:20 to 1:32;
- The endurance-type footballers, in effort to increase anaerobic and non-lactate processes, as well as the level of explosive strength and the dynamics of starting for and from the ball, covered shorter running stretches from 5 to 11 metres (depending on the assumed training targets in the given macrocycle); and the ratio between the length of time of the exercise measurements and the time of active rest varied from 1:15 to 1:25;

When subjected to training, apart from being exposed to speed stimuli, young footballers were engaged in the process of gaining and mastering technical-tactical abilities, such as dribbling, receiving a ball, striking a ball, heading a ball, etc. In terms of shaping motor abilities, special attention was paid to developing coordination, strength and endurance

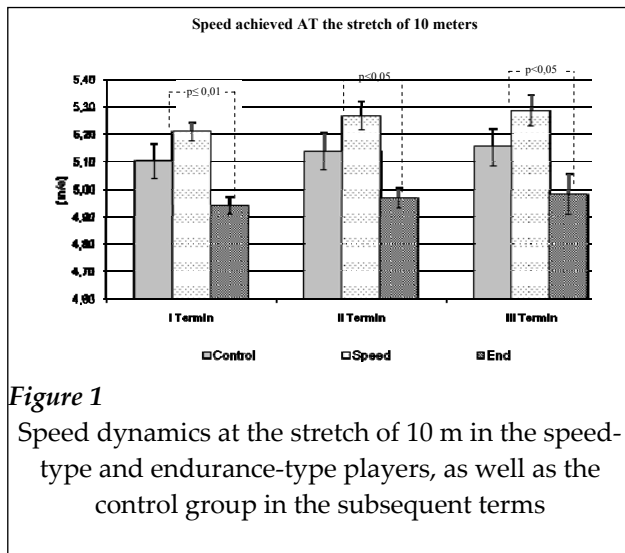


Figure 1

Speed dynamics at the stretch of 10 m in the speed-type and endurance-type players, as well as the control group in the subsequent terms

abilities, using a large number of various and interesting sport games for that purpose.

4. Statistical methods

Statistical analysis was carried out with the use of STATISTICA program. Concordance distribution of all the analysed parametres was checked against the normal distribution. Shapiro-Wilk's test was applied to assess the concordance. Significance level was established at the value of $p \leq 0.05$. For all the parametres, the following descriptive statistics were done: arithmetic mean, minimum, maximum, standard deviation and standard error. The significance of the arithmetic mean differences between the three examined groups for the normal distribution parametres and homogeneity of the variances was checked with the use of ANOVA analysis. In order to verify the differences between the mean values, Tukey's HSD test was used. Non-semi-metrical Kruskal-Wallis test was applied to check the significance of the mean value differences between the three examined groups, for the parametres whose distribution was different from the normal distribution or the non-homogeneity of the variances. To verify the differences between the mean values, multiply comparisons of the mean ranks for all the trials were applied.

Results

The comparative analysis has shown that the speed-type footballers covered the running distance of 10 metres significantly faster than the endurance-type footballers in all terms of the test. No significant differences were noted between the speed-type play-

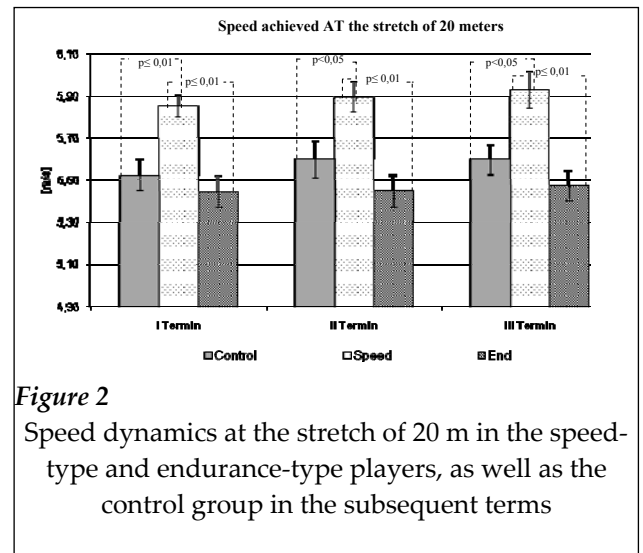


Figure 2

Speed dynamics at the stretch of 20 m in the speed-type and endurance-type players, as well as the control group in the subsequent terms

ers and the control group, or between the endurance-type players and the control group. What has to be stressed is the progress of speed abilities in each subsequent observation term in the speed-type footballers, which resulted in increased speed while covering the analysed stretch. Individual results achieved by the two best speed-type players during the third term of the research have shown that the difference of running speed at the stretch of 10 metres was 0.23 m/s, when compared to the results obtained before introducing individual speed loads. In contrast, the leading endurance-type footballer has shown a difference of 0.24 m/s between the first and the third term of the research. Figure 1 shows a graphic representation of the group differences with regard to the analysed motor ability.

The speed mean values achieved at the stretch of 20 metres between the examined groups have shown a statistically significant difference between the speed-type players, endurance-type players and the control group in all the research terms. No differences were observed between the endurance-type footballers and the control group. The running speed obtained by the fastest speed-type player during the third term of the research was 6.66 m/s, and was higher than the value achieved during the first term of the research (6.21 m/s), by as much as 0.45 m/s. Within the group of endurance-type players, the analysis of the individual differences was 0.15 m/s. The speed dynamics at the stretch of 20 metres is shown in Figure 2.

The comparative analysis of the speed mean values achieved at the stretch of 30 metres between the examined groups have shown a statistically significant difference between the speed-type players and

the control group, as well as between the speed-type and the endurance-type players. Analysing the individual results achieved by the best speed-type player, it has to be stressed that the difference of speed at the stretch of 30 metres was 0.16 m/s, as compared to 0.36 m/s, as seen in the endurance-type footballer. The speed dynamics are shown in Figure 3.

Discussion

The match analysis of professional soccer teams carried out by a number of authors (Ali et al., 1991; Bangsbo, 1999; Chmura et al., 2004; Drust et al., 2007; Helgerud et al., 2001; Krustup et al., 2005; Mohr et al., 2003; O'Donoghue, 2001; Rebelo et al., 1998; Stølen et al., 2005; Valquer et al., 1998; Rampinini et al., 2007; Barros et al., 2007; Bangsbo and Krustup, 2008) have shown that speed loads, which are specific for contemporary football, are most frequently used at stretches of 5 to 15 m, and only in some cases at distances of 20-25 m. In one study, Chmura et al. (2004) observed that during the Champions League qualifying match between Wisła Kraków and Real Madrid, one Spanish player had sprinted a distance of 65 m. Despite this, while improving speed abilities in footballers, longer running distances are covered during training sessions relatively often-between 30 and 40 m. As a result, lactic acid quickly appears produced in muscle cells and released into the blood.

Hence, a significant question that can be posed at this point concerns the appropriateness of using such running distances, which are not present or appear only sporadically during a soccer game. These observations seem to prove that running speed can be shaped, mainly by means of exercises without a ball, performed on coach's command.

Game analysis has shown that speed is combined with sudden changes in running direction, braking, changes of running rhythm, speed of perceiving, anticipating, reacting and decision-making (Chmura et al., 2004). Performing speed activities with a ball, together with a co-player, using coordination, as well as tactical and competitive elements, to mention but a few, will bring about more training benefits. These all help to develop motor and cognitive speed components, making the training resemble game specificity (Chmura, 2001).

As mentioned earlier, the lack of feasibility to perform muscle tissue biopsy has determined the necessity to search for other methods that could be applied to define players with appropriate motor predispositions. Taking an arithmetic mean as a

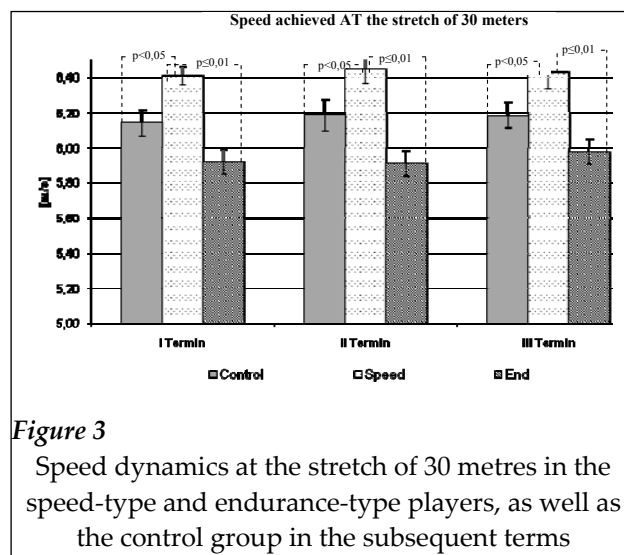


Figure 3
Speed dynamics at the stretch of 30 metres in the speed-type and endurance-type players, as well as the control group in the subsequent terms

qualification criterion was, hence, used as an indirect method. However, one limitation of it was the impossibility to define motor types of players whose results were close to the average values. A possible solution, which could make the method more precise and valid, would be to introduce the third group of endurance-speed players.

The present study has shown the influence of training loads individualization on the development of speed abilities among the examined players. Within the group of the endurance-type players, where the running distances of less than 20 m were used, the speed increase was noted during the tests at stretches of 10 and 20 m during the three subsequent terms of the research (Figures 1,2). The greatest speed increase was observed at the distance of 20 m. It was probably the effect of adjusting individual training loads to motor predispositions of the players during the period of six months of the experiment. It can be assumed that the increase in speed was a result of rising phosphagen potential, enzymatic activity (especially creatine kinase), as well as improving motor unit recruitment.

A similar course of changes was also noted in the group of the endurance-type players. A systematic growth of the examined factor was observed at stretches of 10 and 20 m during the three subsequent terms of the research (Figures 1,2). This can be explained as an effect of adjusting speed loads to motor possibilities and predispositions among these types of soccer players. Using shorter running distances of 5 to 11 m (in contrast to the speed-type players), could have influenced an increase in anaerobic power developed during the first few steps. The literature on this topic does not provide

any material which could be used to compare the results obtained in this research.

The study presented in this paper has shown that the speed-type players cover the running distance of 10 m significantly faster than the endurance-type players in all three research terms. During the third term, when the examined footballers achieved the best results, the difference between the speed-type and the endurance-type players was 0.34 m/s ($p < 0.05$), compared to 0.14 m/s between the speed-type players and the control group (Figure 1). During the test, at the stretch of 20 m, the speed-type players were better than the endurance-type players (0.46 m/s faster) and the control group (0.34 m/s faster) (Figure 2). The fact that even milliseconds may determine a winning goal is a confirmation of relevance of these differences. Apart from that, the differences in individual results obtained by the

leading players representing particular motor types can only add to the conclusions presented above. The speed-type players will likely make proper use of their speed abilities, both during defensive and offensive match tasks that are imposed on them.

The analysis of the obtained results made it possible to state that during a six-month training macrocycle, relevant changes in speed development have been observed. The changes also concerned adaptation to training loads performed, with regard to biological development of the examined subjects. The gathered results confirmed the presence of significant speed disproportions, as well as possibilities to shape them in youth players. Individualization of speed-type training loads, introduced early enough, should allow for taking an advantage of those specific, favourable age conditions: thus, facilitating development of this motor ability.

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