ENDURANCE TRAINING IN THE PRE-SEASON PERIOD AT FOOTBALL PLAYERS

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Original scientific paper

Abstract

The research was aimed to determine the effectiveness of football players'endurance training in the pre-season period. The sample consisted of 100 respondents selected from the population of regular students of elementary schools in Nis 12 and 13 years of age and divided into the sub-samples of 50 football players, who are training in the soccer clubs in addition to regular physical education classes (experimental group) and sub-sample of 50 of them who have only the regular physical education classes (control group). Experimental group members were included in endurance training in the course of eight weeks or 32 classes pre-season period. Measuring instruments for the assessment of endurance consisted of three tests: 800 meters running, both 1000 meters running and Kuper's test, and five tests for the evaluation of the functional abilities: pulse in the first minute after the Kuper's test, the pulse in the second minute after Kuper's test, lung vital capacity, systolic arterial blood pressure and diastolic arterial blood pressure. Using analysis of variance, canonical discriminative analysis and analysis of covariances, obtained results have confirmed the positive effect of endurance training on the observed dimensions of the anthropological status of experimental group in relation to the control group.

Key words: *endurance training, pre-season period, endurance, functional ability, football*

Introduction

Good physical preparation at football team is reflecting in the players' ability of implementing all the technical and tactical tasks with optimal intensity throughout the game (90/120min). In moments of fatigue appearance (physical, psychological), good physical preparation allows the player to demonstrate his technical and tactical knowledge, and the matches are often solved in the last minutes. As one of the most demanding sports on the motor endurance, football requires a good aerobic base, because the game is characterized by short and explosive activities that are repeated in a longer period of time. During the years of football developing and improving of the football training legality, it can be noticed that the proportion of motor strength training increased as a part of the overall physical preparation of players. In 1986 at the World Cup in Mexico, Brazilian national team determined 33% of the overall preparation time for the motor endurance training (physical preparation), while at the 2002 World Cup, Germany spent 55% of their training time (Mihačić et al., 2003). During the match one player is running for about 10-11 km, with the constant change of movement, from walking, running over to the sprint with maximal intensity. Running distance also depends on the playing position (according to research of Verheijen, 1997), which was conducted at the games at England Premier League):

	Central back	Side back	Defensive midfielder	Atacking midfielder	Second striker	Central forward
Walking	4.2 km	2.8 km	2.4 km	2.2 km	2.2 km	4.4 km
Jogging	2.7 km	4.2 km	9.4 km	6.8 km	5.0 km	2.1 km
Running	0.5 km	1.3 km	0.6 km	2.6 km	0.6 km	1.3 km
Sprinting	0.2 km	0.3 km	0.1 km	0.4 km	0.4 km	0.9 km
Total	8.4 km	9.8 km	14.3 km	12.8 km	10.6 km	9.8 km

Researches have shown (Fratrić, 1993; Duraković, 2006) that the persons subjected to the sport training after the puberty, have the same physiological adaptational processes as adults. It has been found (Platonov, 1985; Verhosanskij, 1985) that the endurance training causes decreasing of heart frequency on the occasion of submaximal working intensity and increasing of the impact volume of heart, while the minute volume of heart is minimally changing. Maximum heart minute volume increases at children as a result of training in proportion of changing the maximum oxygen consumption. With using submaximal load under the influence of training, the value of breathing frequency and minute volume of breathing are also reducing. On the other side, maximum value of minute ventilation and breathing volume are increasing, as well as the efficiency of breathing (Bompa, 2006; Milanović, 2007).

How much a player will manage to play the whole game in high intensity, and how he will perform any sprint work, depends on the level of motor endurance (aerobic-anaerobic capacity). Endurance is one of the basic motor skills and can be defined as the ability of adapting and enduring the great physical efforts that last longer without reducing the efficiency of performing activities (Stanković, 2004). Motor endurance depends on the effective functioning of the mechanism for the regulation of energy that is manifested by the activities of adenosine triphosphat, creatine phosphat, glycogen and oxygen. Key indicators of player's training sessions are relative oxygen consumption, which in professional football is 60-67ml/min/kg and heart frequency, which varies from 185 to 195 beats per minute (Weineck, 2000).

Training of motor endurance in the pre-season period

The aim of endurance training is to affect positively the cardiovascular system so that blood and oxygen could qualitatively deliver to muscle stations, improve body ability for the greater oxygen consumption and faster recovery after a series of hard exercises (Demir, 2008). For the development of motor strength the following methods are used:

- continuous (long term) method
- interval method
- variable method (fartlek)

Pre-season period lasts six to eight weeks and consists of three phases: 1) basic preparation 2) specific preparation, 3) situational preparation.

In the *first phase* of motor endurance training, work is focused on increasing of aerobic capacity, which is the basis for the development of anaerobic capacity important for the football game, which creates a condition for entry into the sport form. The most widely used method for the development of motor strength in this phase is continuous method of training. In the *second phase* work is focused on the development of anaerobic and specific endurance using interval and variable methods. Specific endurance primarily allows a player adaptation to the specific movement that he is expected from during the matches. This phase is characterized by the most intensive training with maximum load, which is a basic requirement for entry into the sport form. In the *third phase,* motor endurance is developed through situational exercises with occasional use of interval method.

Methods

For the purposes of this research, sample of 100 examinees are taken from the regular student population of primary schools in Nis 12 and 13 years of age. The sample was divided into sub-sample of 50 football players, who are training in the soccer clubs in addition to regular physical education classes (experimental group) and sub-sample of 50 of them who have only the regular physical education classes (control group). Experimental group were included in the endurance training in the pre-season period that lasted for eight weeks with 32 classes of practice. The aim was to determine the efficiency of football players'endurance training in the pre-season period on the level of motor strength and functional ability in relation to the control group subjects.

Measuring instruments for the assessment of motor strength consisted of three tests: 800 meters running (TR800), 1000 meters running (TR1000) and Kuper's test (KUPER). There were five tests for the evaluation of the functional abilities: pulse in the first minute after the Kuper's test (FOPOR1), the pulse in the second minute after the Kuper's test (FOPOR2), lung vital capacity (FVKP), systolic arterial blood pressure (FSKP) and diastolic arterial blood pressure (FDKP). Motor endurance tests are taken from research of Kurelić et al., 1975. Tests of functional abilities were taken from the model of functional tests of Haimer et al., 1997.

Endurance training programme in the pre-season period

Pre-season period in which the motor endurance training was performed at the experimental group subjects lasted eight weeks or 32 classes of practice with 60 minutes duration each. First of all the initial measurement of endurance and functional abilities was fulfilled. The training classes contained the following elements (modified according to the Rak & Dimitrijević, 2003; Demir, 2008):

1. Development of aerobic endurance (multilateral-basic preparation), of equal long-term running which lasted 20-45 minutes, with a gradual extension of time without an increase in running speed (10 min run 2000m, 1min rest - three repetitions, interval running in aerobic conditions with the loading of 75% with sections of 150-500 m with 6-12 repetitions and variable running (fartlek) for 20-30 minutes with 8-12 stocks with intense loads, and the slow running.
2. Development of aerobic-anaerobic endurance (specific preparation), consisted of interval shares with 75-90% load in the aerobic-anaerobic conditions and fartlek in the aerobic-anaerobic conditions with the changing pace 3x10min, 2x15min, 1x20min, pulse from 170 to 190.
3. The development of anaerobic endurance (situational preparation), was carried out using situational exercise with ball (group working 5:5 two contacts 2x5min) and interval shares in anaerobic conditions - sprint 4x100m, 4x200m

At the end of the pre-season period, which lasted for eight weeks, the final measuring of the level of endurance and functional abilities in the experimental group was carried out.

Results

The canonical discriminant analysis between the initial and final measuring of the experimental group

Table 1. The significance of the isolated discriminant function in testing endurance

Disc Func.	Eigenvalue	CR	Wilks' Lambda	X^2	df	P
1	4.345	.902	.187	161.75	3	.000

We obtained a significant discriminant function of high intensity (CR= .902) which indicates the extent of the correlation within the data which we used for the discriminant analysis. The discriminant force has a value of .187 and indicates that there are differences between the two testings of endurance. The differences between the initial and final measuring in the area of endurance are significant (P=.000), as the value of the Chi square tests is high (X^2= 161.75).

Table 2. The factor structure of the isolated discriminant function

Variables	Root 1
TR1000	-.712
TR800	-.592
KUPER	.448

In order to evaluate the efficiency of the endurance training in the pre-season period at the football players, three tests of endurance were used, all of which are considered to be good predictors of the studied space. The results we have shown (Table 2) indicate that the greatest contribution to the discriminant function was made by high value coefficients, so it can be assumed that significant transformational processes of endurance have taken place among the subjects. The greatest contribution is from the test of 1000 meters running (TR1000 -.712), some smaller contribution comes from the test of 800 meters running (TR800 -.592) and the smallest contribution is from the Kuper's test (.448).

Table 3. The measuring centroids

Measuring	Root 1
Initial	-2.063
Final	2.063

The results shown in Table 3 represent the discriminant centriod function calculated on the basis of all the tests of motor agility, with values of -2.063 and 2.063. The significance of the shown measuring centroids, which has been tested by means of the significance of the discriminant function, indicates that their distance is high.

Table 4. The classification matrix

	Percent	Initial	Final
Initial	100.00	50	0
Final	100.00	0	50
Total	100.00	50	50

The group separation shown in Table 4 in the form of percentiles indicates that the separation (discrimination) of the results from the canonical correlation coefficients whose value is CR = 90% can be explained with an 100% precision (the means of the percentages of the groups themselves). The results from the discriminant analysis in the final measuring indicate, for the subjects of the experimental group, that under the influence of the endurance training in the pre-season period significant changes in the level of endurance of the subjects have taken place.

Table 5. The significance of the isolated discriminant function in testing functional abilities

Disc Func.	Eigenvalue	CR	Wilks' Lambda	X^2	df	P
1	1.459	.770	.407	85.92	5	.000

We obtained a significant discriminant function of mid-high intensity (CR= .770) which indicates the extent of the correlation within the data which we used for the discriminant analysis. The discriminant force has a value of .407 and indicates that there are differences between the two testings of functional abilities. The differences between the initial and final measuring in the area of functional abilities are significant (P=.000), as the value of the Chi square tests is high (X^2= 85.92). In order to evaluate the efficiency of the endurance training in the pre-season period at the football players, five tests of functional abilities were used, all of which are considered to be good predictors of the studied space.

Table 6. The factor structure of the isolated discriminant function

Variables	Root 1
FOPOR2	-.796
FOPOR1	-.740
FDKP	-.159
FVKP	.128
FSKP	-.094

The results we have shown (Table 6) indicate that the greatest contribution to the discriminant function was made by high value coefficients, so it can be assumed that significant transformational processes of functional abilities have taken place among the subjects. The greatest contribution to the discriminant function comes from the pulse in the second minute after the Kuper's test (FOPOR2 -.796) and the pulse in the first minute after the Kuper's test (FOPOR1 -.740).

Table 7. The measuring centroids

Measuring	Root 1
Initial	-1.196
Final	1.196

The results shown in Table 7 represent the discriminant centriod function calculated on the basis of all the tests of motor agility, with values of -1.196 and 1.196. The significance of the shown measuring centroids, which has been tested by means of the significance of the discriminant function, indicates that their distance (discriminant value) is high.

Table 8. The classification matrix

	Percent	Initial	Final
Initial	88.00	44	6
Final	90.00	5	45
Total	89.00	49	51

The group separation shown in Table 8 in the form of percentiles indicates that the separation (discrimination) of the results from the canonical correlation coefficients whose value is CR = 77% can be explained with an 89% precision. The results from the discriminant analysis in the final measuring indicate, for the subjects of the experimental group, that under the influence of the endurance training in the pre-season period significant changes in the level of functional abilities of the subjects have taken place.

The analysis of covariance

Table 9. The multivariate analysis of covariance between the groups in terms of endurance at the final measuring with a neutralization of the differences from the initial measuring

Wilks' Lambda	F	P
.529	27.55	.000

The results of the multivariate analysis of covariance (Table 9) between the subjects of the experimental and control group at the final measuring indicate that a statistically significant differences in favor of the experimental group was noted for the level of endurance, at the level of P= .000.

The difference occurred under the influence of endurance training in the pre-season period at football players, which had a positive effect on the transformational processes of endurance among the members of the experimental group.

Table 10. The univariate analysis of covariance between the groups in terms of endurance at the final measuring with a neutralization of the differences from the initial measuring

Tests	Adj. Mean (Exp)	Adj. Mean (Con)	F	P
TR800	155.09	156.72	882.46	.000
TR1000	192.87	195.28	671.47	.000
KUPER	2713.80	2654.98	91.30	.000

Table 10 shows the univariate values for the analysis of covariance between the experimental and control group at the final measuring with a neutralization of the differences in the area of motor agility from the initial measuring. A statistically significant intergroup difference was noted (P=<.01) in favor of the experimental group for all the tests of endurance: 800 meters running (TR800 .000), 1000 meters running (TR1000 .000) and Kuper's test (KUPER .000).

Table 11. The univariate analysis of covariance between the groups in terms of functional abilities at the final measuring with a neutralization of the differences from the initial measuring

Wilks' Lambda	F	P
.228	60.12	.000

The results of the multivariate analysis of covariance (Table 11) between the subjects of the experimental and control group at the final measuring indicate that a statistically significant differences in favor of the experimental group was noted for the level of functional abilities, at the level of P= .000. The difference occurred under the influence of endurance training in the pre-season period at football players, which had a positive effect on the transformational processes of functional abilities among the members of the experimental group.

Table 12. The univariate analysis of covariance between the groups in terms of motor agility at the final measuring with a neutralization of the differences from the initial measuring

Tests	Adj. Mean (E)	Adj. Mean (K)	F	P
FOPOR1	145.30	150.04	147.02	.000
FOPOR2	126.69	131.97	83.52	.000
FVKP	3845.23	3724.77	1153.53	.000
FSKP	119.02	119.94	191.93	.000
FDKP	72.03	73.05	14.50	.000

Table 12 shows the univariate values for the analysis of covariance between the experimental and control group at the final measuring with a neutralization of the differences in the area of motor agility from the initial measuring.

A statistically significant intergroup difference was noted (P=<.01) in favor of the experimental group for all the tests of functional abilities: pulse in the first minute after the Kuper's test (FOPOR1 .000), the pulse in the second minute after the Kuper's test (FOPOR2 .000), lung vital capacity (FVKP .000), systolic arterial blood pressure (FSKP .000) and diastolic arterial blood pressure (FDKP .000).

Discussion

When the graceful performance of the top football players is being seen at TV sets or from the stands, it could be said that there is nothing easier. The moves of the biggest professionals in this sport are making impression to be very simple. However, very few people at that moment are asking a question about physical challenges that football players have passed in order to make the game so fluttery. Endurance in football is more than the ability of continuous running *(Schmid & Alejo, 2004).* It is the ability to display all the technical and tactical elements during the game, with all the efforts and obstacles that are present there. The difference between average players and top professionals lies in the ability of conducting these elements equally well in the course of 90 or even 120 minutes of a game. A large number of researches *(Wisløff, Helgerud & Hoff, 1998; Jerkovic, Jerkovic & Mejovsek, 2003; Vucetic et al., 2003; Helgerud & Hoff, 2004; Komes et al., 2005; Vrgoc, 2007)* point to the fact that the endurance in all its forms of manifestation (aerobic and anaerobic endurance, speed endurance, staying in power), is very important for total locomotion status of football players and it is a prerequisite of entering the top sporting form. In the situation when the competition calendar is very condensed (domestic championships, international competitions, national teams), timing of entry the sport form is performed by the proper planning of training.

It is a demand for rest, and maintaining high level of training ability. Insight into the current researches can be concluded that there are different systems of physical preparations. Searching for an ideal solution, the author is giving his view of planning and programming of endurance training, the intensity and volume of load, and all of that for the purpose of high-quality preparation for efforts that soccer players have to invest in the competitive period. This research is a modest contribution to the better results of physical preparation. This was only one part of what makes a physical preparation in football to be successful. The research was limited to endurance training, although a good preparation in football consists of several elements: speed, power, agility, endurance, flexibility, quality of food, etc. Subjects in experimental group showed significant improvement in the level of endurance and functional abilities in relation to the control group, which pointed to the correct planning and programming of endurance training in the pre-season period at football players.

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TRENING IZDRŽLJIVOSTI U PRIPREMNOM PERIODU NOGOMETAŠA

Sažetak

Istraživanje je imalo za cilj da utvrdi efikasnost treninga izdržljivosti u pripremnom periodu kod nogometaša. Uzorak se sastojao od 100 ispitanika izvučenih iz populacije redovitih učenika osnovnih škola u Nišu uzrasta 12 i 13 godina ±6 mjeseci i podijeljenih na subuzorak od 50 fudbalera, koji pored redovne nastave tjelesnog odgoja treniraju u nogometnim klubovima (eksperimentalna grupa) i 50 nesportaša, koji imaju samo redovitu nastavu tjelesnog odgoja (kontrolna grupa). Ispitanici eksperimentalne grupe su bili obuhvaćeni treningom izdržljivosti u pripremnom periodu u trajanju od osam tjedana ili 32 sata. Mjerne instrumente za procjenu izdržljivosti činila su tri testa: trčanje na 800 metara, trčanje na 1000 metara i Kuperov test, a za procjenu funkcionalnih sposobnosti pet testova: puls u prvoj minuti nakon Kuperovog testa, puls u drugoj minuti nakon Kuperovog testa, vitalni kapacitet pluća, sistolički arterijski krvni tlak i dijastolički arterijski krvni tlak. Upotrebom analize varijance, kanoničke diskriminativne analize i analize kovarijance, dobiveni su rezultati koji su potvrdili pozitivno djelovanje treninga izdržljivosti na promatrane dimenzije antropološkog statusa kod eskperimentalne u odnosu na kontrolnu grupu.

Ključne riječi: *trening izdržljivosti, pripremni period, izdržljivost, funkcionalne sposobnosti, nogometaši*

Received: August 23, 2010
Accepted: December 20, 2010

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