CONDITION AND BODY CONSTITUTION OF SOCCER PLAYERS IN CATEGORY U19 BEFORE AND AFTER COMPLETING A PREPARATORY PERIOD

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Submitted in January, 2010

BACKGROUND: The level of one's conditioning predisposition and somatic factors are one of the main components determining the quality of an individual's performance in soccer.

OBJECTIVE: The aim of this study was to evaluate changes in selected motor, functional and somatic parameters of soccer players in category U19, who completed the long used model of a training program employed in the preparatory period of soccer players.

METHODS: The monitored group was composed of 14 players from SK Sigma Olomouc in category U19. The categories being evaluated comprised: their starting and acceleration speeds in the 10 m, 30 m and 30 m sprint with a flying start, the vertical jump, the isokinetic muscular strength of the knee joint and their maximum aerobic capacity. Of the monitored somatic factors attention was mainly focused on body height and weight, percentage of body fat, quantity of fat free mass and the overall amount of water in their bodies.

RESULTS: From the spectrum of examined motor and functional parameters the only value that changed significantly with the players was the average value of VO_2max from 56.65 to 58.85 $ml.kg^{-1}.min^{-1}$ ($p = 0.04$). Among the somatic factors a significant decrease was seen with the values of the Body Mass Index from 22.51 to 22.28 $kg.m^{-2}$ ($p = 0.03$).

CONCLUSIONS: In the context of the players' performance the expected changes of the monitored parameters were not observed. It is believed that the traditional model of soccer players' preparation does not lead to the desired changes in conditioning and somatic parameters.

Keywords: Physical preparation, soccer, motor-abilities tests, somatic diagnosis, spiroergometry.

INTRODUCTION

Any increase in trainability and sports performance is conditioned by means of a systematic training process leading to achieving specific adaptation changes in the organisms of athletes. The effectiveness of a training process is connected to managing adaptation mechanisms based on revealing the basis and effects of adaptation changes caused by training stimuli. The course of results of the adaptation processes to the repeated training stimuli has its specifics and is usually different among individual athletes. The decisive requirement is to optimize the training load and loading with regard to the current level of conditioning and trainability of athletes, their adaptation capacity, their current health and physical condition and tasks of their training cycle (Abernethy, Kippers, Mackinnon, Neal, & Hanrahan, 1996; Bompa & Carrera, 2005; Dobrý, 2001; Dovalil et al., 2002).

In sport games the load and its manipulation arise from the typical requirements of a game load, the specifics of the players' specializations and their roles within the system of the game of the team and the concept of the team's game performance The adaptation stimuli should be combined appropriately and at the same time sufficient opportunity and conditions for fast recovery should be created. The goals and tasks of smaller training cycles must be continuous, while the basic task of the periodization of an annual training cycle is to take advantage of the effects of different training loads that build on their complementing each other in an optimal time period and to limit fatigue and other negative factor accumulation that can lead to overtraining (Bompa, 1999; Kraemer & Häkinen, 2002). Especially in key stages of the training process, before, in fact, even after training cycles with high loads and before, and in fact even after competitions, testing becomes more crucial, since it reflects specific demands on the condition and preparedness of sportspeople (Stone, Me & Stone, Mi, 2006).

In soccer, the resultant activity of players in a game depends on the level of their technical, tactical, physical and condition abilities and somatic predispositions. The basic aspect from which each performance of an individual in sport games arises is their condition preparedness. The condition training program of top level teams must be specific, i.e. stem from a thorough analysis of sport performance requirements of their condition (Bravo, Impellizzery, Rampinini, Castagna, Bishop, & Wisloff, 2008; Hoffman, 2002; Holienka, 2005). Among the basic components of a soccer player's condition, which become the biggest focus during the preparation phase are the starting speed and running acceleration, explosive and fast power, aerobic and anaerobic endurance (Bradley et al., 2009; Psotta, Bunc, Mahrová, Netscher, & Nováková, 2006; Verheijen, 1998).

The level of a sporter's condition and its changes are in many cases connected to the level of somatic factors. Their testing and possible manipulation influences other factors of sports performance. Most commonly interest is focused on the individual's height and weight, length and width parameters, body mass index (BMI), the percentage of representation of body fat and muscle mass expressed in fractions and possibly on the somatotype. The focused development of the condition is most often the main task, especially during the preparatory period, which usually focuses on creating a sufficient condition level, starting from which the players should gain during the competition period. The generally used paradigm during the preparatory period is focused on all of the basic components of condition. Such conceived training requires, due to the duration of the preparatory period, a parallel application of many types of adaptation stimuli. Although the opinions of training programs of such character are not completely uniform, it is becoming apparent that their effectiveness may be lowered (Smith, 2003; Fry, 2004; Barnes et al., 2008).

AIM

The main aim of this study was to evaluate the effectiveness of the long used model of a training program applied in the preparatory period with soccer players of category U19.

METHODS

The monitoring was carried out with soccer players of a junior men's team, SK Sigma Olomouc, category U19 ($n = 14$; age 17.81 ±1.66 years of age; height 180.57 ±4.69 cm, weight 73.44 ±4.89 kg). Only players who had participated in more than 30 training sessions were included in the final analysis. From the original number of 20 players, six were eliminated due to their absences at training or testing. The testing of the selected motor and functional predispositions and body composition took place one day before the beginning and two weeks after the end of a five week training block. The measurements were carried out in the laboratories of Palacký University, Olomouc and at the athletic stadium in Olomouc. The beginning of the training period was preceded by a three week holiday. Two days before the measurements the players were not subjected to a higher training load.

The testing of the motor predispositions was carried out after a thorough warm up; no player indicated any health problems. The current levels of conditioning and somatic factors were evaluated with the help of the following tests:

Sprint tests

On a four hundred meter track, soccer players performed 3 tests: a 30 m sprint with a flying start (in order to run at their maximal velocity, they had 15 m to accelerate before the first timing light) and 30 m sprint from a standing position to estimate acceleration and velocity and a 10 m sprint from a standing position to estimate starting velocity. Sprint times were measured using electronic timing lights (TAG Heuer, Neuchatel, Switzerland). The higher values of the two trials were used for analysis; the recovery time was 6 minutes.

Vertical jump tests

In order to measure the explosive power of the lower extremities, participants jumped twice in each of the two jumping modalities: the standing vertical jump and the standing vertical jump with the arm fixed at the shoulders. Dynamometric platform (Kistler Instrumente, Winterthur, Switzerland), measuring the size of the reactive force during the jump was used. The higher values of the two trials were used for analysis; the rest interval was 30 seconds.

Isokinetic flexion and extension in the knee joint

The unilateral concentric strength of knee flexors and extensors was measured in a seated position using the isokinetic dynamometer, Isomed2000 (D. and R. Ferstl, GmbH, Hemau, Germany). The range of motion was 80°, the angular velocity was $60°\cdot s^{-1}$; three repetitions were performed in one set and the higher values of the two sets were used for analysis. The best maximal peak torque was measured. Recovery time was one minute between sets, and three minutes between the right and left leg measurements.

Assessment of maximum oxygen intake

The maximum running test was performed on a Lode Valliant treadmill (Netherlands). The test began with a warm up phase: 4 min. at 8 $km\cdot h^{-1}$ and one min at 8 $km\cdot h^{-1}$ with a 5% inclination, respectively. Immediately after the warm up, the speed increased to 10 km/h–1 and the elevation remained at 5%. Then the speed increased every 30 s by 1 $km\cdot h^{-1}$ till 15 $km\cdot h^{-1}$ (maximum speed). At 15 $km\cdot h^{-1}$, the elevation increased every 30 s by 2.0% till exhaustion. During the test, the subject breathed with a mask: ventilation and both O_2 and CO_2 exchange were analyzed.

Assessment of body composition

The body composition data was collected using multi frequency bioelectrical impedance analysis (MFBIA) (InBody 720; 1–1 000 kHz) under standard conditions provided in the manual of the equipment (Biospace, 2006). InBody 720 makes use of an eight point tactile electrode system and it differentiates body weight into three basic components (three component model): total body water (TBW), intracellular water (ICW) and extracellular water (ECW), dry body mass (DBM) (proteins and minerals) and body fat mass (BFM.). For a complex anthropometric description of the monitored collection the Body Mass Index (BMI), Fat Free Mass Index (FFMI) and Body Fat Mass Index (BFMI) were calculated.

Training program

The training program in the preparatory period, which has been long used at the club level, was modified and during the selection of training approaches and methods results of some current studies were taken into account (Hoff, Kaehler, & Helgerud, 2006; Dupont & Berthoin, 2004; Helgerud, 2007; McMillan, Helgerud, Macdonald, & Hoff, 2005). The five week training cycle included a total of 35 training units and eight friendly matches. Out of the 35 training units, 13 were primarily focused on the development of strength and 11 training units on aerobic endurance development (TABLE 1). The rest of the training units were focused on improvement of playing activities of individuals and practice of group and team tactics.

TABLE 1
Training units with strength exercises and endurance exercises and friendly matches in the preparatory period

Weeks	Strength (Half squats)	Endurance	Friendly matches
1st week	3×	3×	2×
2nd week	3×	3×	2×
3rd week	2×	2×	1×
4th week	3×	2×	2×
5th week	2×	1×	1×
Total	13×	11×	8×

Expert logical significance

The logical significance of the differences in average scores on motor and functional tests was determined in an expert way as follows:

- The height of a jump in a test of a vertical jump from a standstill – 3 cm.
- The height of a jump in a test of a vertical jump from a standstill with arms fixed – 3 cm.
- The time reached during a test of a sprint from a standing position for 10m – 0.06 s.
- The time achieved in the test sprint from a medium-high starting block for 30m – 0.19 s.
- The time achieved in a test of the 30 m sprint with a flying start – 0.15 s.
- Isokinetic flexion and extension in the knee joint – 15, in fact 20 N·m.
- The maximum oxygen uptake during the test VO_2max on a treadmill – 5 ml.kg^{-1}.min^{-1}.

Statistical analysis

For individual parameters basic statistical quantities were calculated. The average differences between the first and the second examination were evaluated through a Sign test. For statistical analysis of the data the Statistica 8 (Statsoft, 2008) program was used.

RESULTS

The results of the statistical verification of the significance of differences in test scores from the first and second measuring of motor and functional predispositions (TABLE 2) indicate that in following a five week training program, a significant increase in value took place only in cases where the average value was VO_2max. However, from the point of view of significance for game performance, such changes (improvement in the average test score by 1.94 ml.kg^{-1}.min^{-1}) are regarded as nonsignificant. In the case of isokinetic power it is possible to detect an increase in the value of the maximum peak moment during the flexion of the right leg by 3.93 N·m, nevertheless, this increase is regarded to be both statistically and logically insignificant.

The average values of body height are, during the first and the second examination, almost identical in cases of body weight where a lowering by 0.72 kg has been detected (TABLE 3). The average BMI values were localized in the normal range (18.5–24.9 kg/m^2; WHO, 2007) and the difference between the first and the second examination can be marked, based on statistical analysis, as significant ($p = 0.026$). A lowering of the amount of overall body water, especially its intracellular parts, has been revealed. TBW contributes to the body weight from 68.03% during the first examination and, in fact, from 67.82% in the case of the second examination. Regarding the fact that the intracellular body water is concentrated primarily in the fat free mass, its reduction is also reflected in the decreasing of the skeletal muscle mass by 0.65 kg, as well as in the reduction of the FFMI by 0.24 kg/m^2. Logically, with the lowering of the FFMI,

TABLE 2
The basic statistical characteristics of the monitored motor and functional indicators and verification of significance of the differences between the first and the second measurement (n = 14)

Characteristic	1st examination			2nd examination			d	Z
	M	Mdn	SD	M	Mdn	SD		
RL-Peak torque-Flexion (N·m)	165.36	165.50	19.20	169.29	167.50	31.11	3.93	.80
RL-Peak torque-Extension (N·m)	233.64	247.50	47.54	219.57	231.00	44.84	14.10	–.27
LL-Peak torque-Flexion (N·m)	169.86	167.50	22.27	162.14	162.50	27.33	7.72	.80
LL-Peak torque-Extension (N·m)	243.93	242.50	39.76	233.07	232.50	39.24	10.90	1.66
Sprint 10 m (s)	1.81	1.81	.07	1.82	1.80	.08	.01	.00
Sprint 30 m (s)	4.20	4.22	.09	4.23	4.20	.09	.03	.00
Sprint 30 m with a flying start (s)	3.45	3.46	.06	3.51	3.51	.05	.06	1.81
Vertical jump with arms (cm)	.42	.41	.04	.44	.41	.07	.02	.80
Vertical jump-arms on shoulders (cm)	.39	.39	.04	.38	.37	.41	.01	1.34
VO_2max ($ml.kg^{-1}.min^{-1}$)	56.65	57.35	6.97	58.59	58.85	5.09	1.94	*2.02

Legend:
RL – right leg
LL – left leg
M – mean
Mdn – median
SD – standard deviation
d – diference
Z – value of statistical criterion (Sign test)
* statistically significant values ($p < .05$)

TABLE 3
The basic statistical characteristics of the monitored anthropometrical indicators and verification of significance of the differences between the first and the second measurement (n = 14)

Characteristic	1st examination			2nd examination			d	Z
	M	Mdn	SD	M	Mdn	SD		
Height (cm)	180.57	180.00	4.69	180.43	179.50	4.82	.14	1.47
Weight (kg)	73.44	72.84	4.89	72.72	73.51	4.53	.72	1.87
Intracellular water (l)	31.67	31.45	2.55	31.16	31.50	2.11	.51	1.87
Extracellular water (l)	18.29	18.00	1.50	18.16	18.05	1.21	.13	–.27
Protein mass (kg)	13.69	13.60	1.12	13.49	13.65	.90	.20	1.44
Mineral mass (kg)	4.61	4.62	.42	4.57	4.57	.36	.04	.80
Body fat mass (kg)	5.16	5.40	1.95	5.34	5.35	1.79	.17	–.27
Percent body fat (%)	7.06	7.53	2.71	7.34	7.32	2.38	.28	–.01
Skeletal muscle mass (kg)	39.30	39.00	3.35	38.65	38.11	2.75	.65	1.87
Body mass index (kg/m^2)	22.51	22.61	1.19	22.28	22.29	1.13	.23	*2.22
Fat free mass index (kg/m^2)	22.92	20.74	1.18	20.68	20.68	.84	.24	1.34
Body fat mass index (kg/m^2)	1.60	1.65	.64	1.65	1.58	.59	.05	–.26

Legend:
M – mean
Mdn – median
SD – standard deviation
d – diference
Z – value of statistical criterion (Sign test)
* statistically significant values ($p < .05$)

representation is connected to the rise of the absolute and relative representation of body fat. During the first measurement the average value of the body fat equaled 5.16 kg, i.e., 7.06% of the body weight; in the case of the second examination a rise by 0.18 kg was detected, which corresponds to 0.28% in relative terms.

DISCUSSION

A possible explanation of the stagnation of the monitored conditioning characteristics could be the fact that between the stimulation of endurance and muscle power undesirable interactions took place. The effects of strength training could have been, in the preparatory period, negatively affected by the increased focus on the aerobic endurance training and vice versa. A cursory evaluation of the test scores of individual players revealed individual differences in the changes of their performance in the monitored predispositions following the preparatory period. The authors assume that the aforementioned differences/variations could have been caused by the players' varying reaction to load in the preparatory period. The training program should have apparently respected more the individual needs of the players (Fleck & Kraemer, 2004; Barnes et al., 2008; Reilly & Bangsbo, 1998).

Fleck and Kraemer (2004) warn that simultaneous training has a negative influence on the results of strength training, especially when both types are intensive. Fry (2004) also clarifies the reduction of the high resistance strength training effects by the incorporation of another training plan with catabolic effects. At the same time he reminds us that strength training can have different effects on different players. The problem with regard to creating adaptations in monitored areas could also be the duration of the preparatory period, which can be insufficient because the necessary period might be longer because of simultaneous strength and endurance training (Bompa & Carrera, 2005).

Next to conditioning predispositions, the levels of somatic factors, which are in close connection to conditioning factors, were also monitored. When comparing our collected data with the average values of other players of the same age and level, the authors found in the monitored parameters only a few negligible differences. The average values of body weight and height were almost identical with the values of young elite players of a Spanish club indicated in their study by Arroyo, González de Suso, Sanchez, Ansotegui and Rocandio (2008). Greater differences can be observed when comparing the somatic parameters of our collection with the values of Premier League players, presented in their study by Sutton, Scott, Wallace and Reilly (2009). In comparison to the adult Premier League players, the tested players in our study have, on average, lower body weight by 10.1 kg; whereas their average body height is identical.

The average values of the percentage representation of body fat in our monitored collection is found at the lower zone of the optimal level (5–15%) delineated by Heyward and Wagner (2004) for a physically active male population between the ages 18–34. During the mutual monitoring of the monitored collection with the Spanish players a significant difference in the percentile number of fat could not be detected. In comparison with common values presented by Riegerová, Přidalová and Ulbrichová (2006), the values of body fat in our monitored group are substantially lower. This result corresponds to values indicated by Sutton et al. (2009), because in our data we monitored a body fat representation which was lower by 3.4% in comparison with players of the Premier League. However, we have to take into account different methods of measuring body fat in the aforementioned studies, which preclude objective comparison. In this study the MFBIA method was used, while Arroyo et al. (2008) and Riegerová et al. (2006) establish the amount of body fat using the skin-fold method and Sutton et al. (2009) determine the amount of body fat via the dual energy x-ray absorptiometry – DEXA method. A reduction in the skeletal muscle mass was an observed trend, which can be termed as inadequate in relationship to sport performance. In the same manner the rise of the absolute and the relative representation of body fat can be commented upon. The lowering of the skeletal muscle mass and the rise of the absolute and relative % BFM representation were observed, which can be termed as inadequate in relationship to sport performance.

In view of the our findings, we put forward that the model of preparation employed by the majority of soccer teams is not appropriate and that the simultaneous focus on strength, speed and endurance development is partially counter productive and does not lead to a significant improvement in the players' conditioning. It is also important to consider the number of training units and the demands of the training stimuli they include, because a high number of training sessions in the preparatory period is not compensated for by sufficient regeneration. It is becoming apparent that it would be appropriate to suggest and verify a new training program for the preparatory period, which would respect more the individual differences among players, including the starting level of their trainability, which would facilitate sequencing and respect the mutual influencing of the training load in training units and training cycle, including their facilitation (Verheijen, 1998; Wirth & Schmidtbleicher, 2007). From the point of view of directing the training process, it will be necessary in the new model to focus on the optimal usage of the training stimuli, with special attention to their type, intensity, extent, duration and frequency, their simultaneous usage and also examine all of the above with regard to individual specifics. In terms of the players age and the character of their performance in soccer, the proportion of repeated speed stimuli, which at the same time stimulate the specific requirements on the players' endurance, could be stressed (Bradley et al., 2009; Bravo et al., 2008;), as well as progressive methods of increasing specific soccer speeds (Malý, 2009) and methods of strength development (Verheijen, 1998). A model based on the aforementioned fundamentals could have a higher potential for increasing players' performance in soccer. Considering the preventative measures of fatigue accumulation, injury and overloading, it would be significant during the preparatory period to also monitor the current level of adaptation capacity, i.e. monitoring the level of autonomous nervous system. The fact limiting this research is that the conditional and anthropometrical markers were evaluated from the point of view of the entire soccer team. Already from a cursory evaluation of the test scores, some individual variations in changes of the levels of the monitored predispositions become clear, e.g., with VO_2max improvement by 5.1 ml.kg^{-1}.min^{-1}, but also worsening by 6.9 ml.kg^{-1}.min^{-1} or during the isokinetic strength measurement improvement by 63 N·m during the right lower extremity flexion, but also a worsening by 41 N·m during the right lower extremity extension. From the methodological point of view, the executed research was limited by the absence of a control group. These facts will be taken into consideration in the following research project, which will focus on verifying a newly drafted training program.

CONCLUSIONS

The conclusion of this study is that the applied model of the preparation, which coincided in its fundamental points with the commonly used model of the preparatory period, did not lead to the desired changes in motor, functional nor somatic parameters. The conclusion of this study is that with soccer players, who during the preparatory period participated in the model of the commonly used training program, did not achieve the desired improvement of motor, functional or somatic parameters. Not in a single one of the monitored indicators did changes take place that could have a positive influence on the player's performance. The model of preparation that focused on the simultaneous development of speed, strength and endurance did not lead to expected adaptations and was contested. In future studies it will be therefore advisable to focus on verifying the training program with a different structure, different extent and dosage of load.

ACKNOWLEDGEMENT

The study has been supported by the research grant from the Ministry of Education, Youth and Sports of the Czech Republic (No. MSM 6198959221) "Physical Activity and Inactivity of the Inhabitants of the Czech Republic in the Context of Behavioral Changes".

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KONDICE A TĚLESNÉ SLOŽENÍ U FOTBALISTŮ KATEGORIE U19 PŘED A PO ABSOLVOVÁNÍ PŘÍPRAVNÉHO OBDOBÍ

(Souhrn anglického textu)

VÝCHODISKA: Úroveň kondičních předpokladů a somatických faktorů je jednou z hlavních komponent rozhodujících o kvalitě výkonu jednotlivce ve fotbale.

CÍLE: Cílem studie bylo posoudit změny vybraných motorických, funkčních a somatických parametrů u fotbalistů kategorie U19, kteří absolvovali dlouhodobě využívaný model tréninkového programu uplatňovaného v přípravném období fotbalistů.

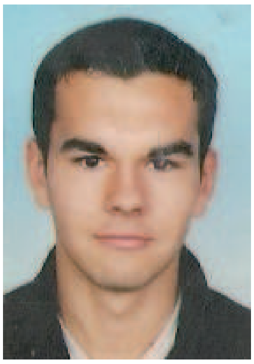
METODIKA: Sledovaný soubor tvořilo 14 hráčů SK Sigma Olomouc kategorie U19. Posuzovány byly startovní a akcelerační rychlost na úsecích 10 m, 30 m a 30 m letmo, vertikální skok, izokinetická síla svalů kolenního kloubu a maximální aerobní kapacita. Ze sledovaných somatických faktorů byla pozornost zaměřena na tělesnou výšku a hmotnost, procentuální zastoupení tuku, tukuprostou hmotu a celkovou tělesnou vodu.

VÝSLEDKY: Ze spektra zkoumaných motorických a funkčních parametrů se u hráčů signifikantně zvýšila pouze průměrná hodnota u VO_2max z 56,65 na 58,85 $ml.kg^{-1}.min^{-1}$ (p = 0,04). U somatických faktorů došlo k signifikantnímu snížení hodnot Body Mass Indexu z 22,51 na 22,28 kg/m^2 (p = 0,03) a viscerálního tuku z 31,06 na 26,28 cm^2 (p = 0,02).

ZÁVĚRY: Změny u sledovaných parametrů nepovažujeme v kontextu individuálního herního výkonu za klíčové. Domníváme se, že klasický model přípravy fotbalistů nevede k požadovaným změnám kondičních a somatických parametrů.

Klíčová slova: kondiční příprava, fotbal, motorické testy, somatodiagnostika, spiroergometrie.

Mgr. Zdenek Botek



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