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Body Composition

**SEASONAL ALTERATIONS IN BODY COMPOSITION AND SPRINT PERFORMANCE
OF ELITE SOCCER PLAYERS**

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ABSTRACT

SEASONAL ALTERATIONS IN BODY COMPOSITION AND SPRINT PERFORMANCE OF ELITE SOCCER PLAYERS. **Sergej M. Ostojic**. *JEPonline*. 2003;6(3):11-14. The purpose of the present study was to examine the effects of training and competition on body fat content and sprint performance in elite professional soccer players. Thirty professional male soccer players (1st National league) participated in the study. Anthropometric measurements were collected at the start of the first conditioning period, at the start of season, in the mid-season, end-season and at the start of the second conditioning period. Body composition was assessed by skinfold measurements. Estimated body fat percentage at the end of the season was significantly lower than levels at the start of the first conditioning period, mid-season, second conditioning period and at the start of the season ($9.6 \pm 2.5\%$ vs. 11.5 ± 2.1 , 10.2 ± 2.9 , 12.6 ± 3.3 and $10.9 \pm 2.4\%$ respectively; $p < 0.05$; values are mean \pm SD). There were no significant differences in fat-free mass between measurements performed during the season. Better 50 m sprint times were achieved at the end of season as compared to the start of the first conditioning period, at the beginning of the season and at the start of the second conditioning period (7.1 ± 0.5 s vs. 7.5 ± 0.6 , 7.3 ± 0.6 , 7.6 ± 0.5 s, respectively; $p < 0.05$). The main finding of the present study was that body fat content of professional soccer players significantly dropped during the conditioning and competitive periods and increased during the off-season.

Key Words: Anthropometry, Sport, Fitness, Muscle Power

INTRODUCTION

In the recent years, there has been remarkable development in the scope and quality of soccer physiology and medicine. However, there is a shortage of descriptive data concerning the physical and physiological characteristics of soccer players from Eastern Europe while much literature exists providing information on male soccer players from Western Europe and America (1-3). The ideal physiological and anthropometric profile of a successful soccer player was investigated (4,5), and it has been demonstrated that the game of soccer has become more dynamic, which can be attributed to improvements in the speed and agility of players. Body

composition is an important aspect of fitness for soccer as excess adipose tissue acts as dead weight in activities where the body mass must be lifted repeatedly against gravity (6, 7). Several studies have evaluated the seasonal alterations in body composition of different elite athletes (8, 9). However, there is no information available on changes in body fat percentage during the whole season (training, competition, pause) in professional soccer players. Alterations in body fat have only been investigated at the start and end of the competitive season (10). The purpose of the present study was to examine the effects of training and competition on body fat content and sprint performance in professional soccer players.

METHODS

Thirty professional male soccer players (1st National league) gave their informed consent and volunteered to participate in the study, which had the approval of the University's Ethical Advisory Commission. Their mean±standard deviation (SD) for physical and physiological characteristics were: age 23.5±3.1 years, professional training experience 6.3±1.7 years, height 182.8±6.0 cm, maximal oxygen uptake 54.2±8.1 ml/kg/min and maximal heart rate 196±3 beats/min. All participants were informed verbally and in writing about the nature and demands of the study as well as the known health risks. Subjects completed a health history questionnaire, and were informed that they could withdraw from the study at any time, even after giving their written consent.

All tests and measurements were performed on five occasions during the season between January and October. Measurements were collected at the start of the first conditioning period (after the end of pause lasting two weeks) (PRE I), at the start of the season (after the end of conditioning period) (SS), in the mid-season (MS), end-season (ES) and at the start of the next conditioning period (after the end of pause lasting three weeks) (PRE II). Body fat content was estimated by measurements of skinfold thickness at seven sites using a Harpenden caliper (British Indicators Ltd., St. Albans, UK). The skinfold sites were triceps, subscapula, mid-axillary, anterior suprailiac, chest, abdomen, and midthigh. The landmarks were identified and measured according to Wilmore and Behnke (11). Body density and the percentage of fat were determined according to equations of Jackson and Pollock (12). Body mass was obtained using a balance beam scale (Avery Ltd, Model 3306 ABV). The sprint test (in football boots) consisted of 50 meters maximal effort sprint timed using a infrared electric timing system (Speed Trap II Timer). The better of two attempts was recorded. The athletes were familiar with mentioned procedures as part of their regular training process.

The data are presented as mean±SD. Statistical significance was assessed using paired *t* test to compare variables (body mass, fat content, fat-free mass, 50-m sprint times) during the study. Relationships between body composition and sprint times were examined using Pearson's product-moment correlation coefficient on the change scores (PRE I to ES) for sprint times vs. change scores for body fat percentage. *P* values of less than 0.05 were considered to be statistically significant. The data were analyzed using the statistical package SPSS, PC program, version 7.5 (SPSS Inc., USA).

RESULTS

Body composition and sprint time results are provided in Table 1. Body mass was significantly lower at the end of the season than values at the start of the first conditioning period and at the beginning of season, respectively ($p < 0.05$). Estimated body fat percentage at the end of the season was significantly lower than levels at the start of the first conditioning period, mid-season, second conditioning period and at the beginning of season, respectively ($p < 0.05$). Fat percentage at mid-season was significantly lower than levels at the start of the first and second conditioning periods ($p < 0.05$). Estimated body fat percentage at the start of the season was lower as compared to the start of the second conditioning period ($p < 0.05$). There were no significant differences in fat free mass between measurements performed during the season.

Faster sprint times were achieved at the end of the season than at the start of the first conditioning period, at the beginning of season and at the start of the second conditioning period, respectively ($p < 0.05$). Subjects were faster at mid-season than at the start of the first conditioning period and at the start of the second conditioning period ($p < 0.05$). Subjects were faster at the start of the season than at the start of the first conditioning period and at the start of the second conditioning period ($p < 0.05$). Moreover, subjects run faster at the start of the first conditioning period as compared to the start of the second conditioning period ($p < 0.05$). In addition, a positive correlation was found between body fat percentage and sprint times in soccer players during the study ($r = 0.98$, $p < 0.05$). Further, there was a significant correlation between the change scores (PRE I to ES) for sprint times vs. change scores for body fat percentage ($r = 1$, $p < 0.05$).

Table 1. Body mass, body fat content, fat-free mass and 50-meters sprint times during the study. (N=30)

Phase	PRE I	SS	MS	ES	PRE II
Body mass (kg)	77.8±6.3	78.0±6.1	76.8±6.1	74.8±6.0 ^{1,2}	77.2±7.6
Fat content (%)	11.5±2.1	10.9±2.4 ⁸	10.2±2.9 ^{5,6}	9.6±2.5 ^{1,2,3,4}	12.6±3.3
FFM (kg)	68.8±5.3	69.5±4.9	69.1±6.4	67.6±5.3	67.4±6.2
50-m sprint times (s)	7.5±0.6 ⁹	7.3±0.6 ^{7,8}	7.2±0.5 ^{5,6}	7.1±0.5 ^{1,2,4}	7.6±0.5

Abbreviations PRE I, first preconditioning period; SS, start of season; MS, mid-season; ES, end-season; PRE II, second preconditioning period; FFM, fat free mass. ¹Statistically significant at $p < 0.05$ for ES vs. PRE I; ²Statistically significant at $p < 0.05$ for ES vs. SS; ³Statistically significant at $p < 0.05$ for ES vs. MS; ⁴Statistically significant at $p < 0.05$ for ES vs. PRE II; ⁵Statistically significant at $p < 0.05$ for MS vs. PRE I; ⁶Statistically significant at $p < 0.05$ for MS vs. PRE II; ⁷Statistically significant at $p < 0.05$ for SS vs. PRE I; ⁸Statistically significant at $p < 0.05$ for SS vs. PRE II and ⁹Statistically significant at $p < 0.05$ for PRE I vs. PRE II.

DISCUSSION

The main finding of the present study was that body fat content of elite professional soccer players significantly dropped during the conditioning and competitive period and increased during the off-season, while changes in sprint times were strongly correlated with changes in percentage of body fat.

Body mass, based on the classic two-component model of fat and fat-free compartments, is likely to change during the course of the competitive season as a result of training, habitual activity and diet. According to the results of the present study, seasonal body weight alterations in soccer players are in response to a significant reduction in fat mass, while fat-free mass values remains unchanged during the season. Burke *et al.* (10) and Reilly (6) suggested that football players can accumulate body fat in the off-season and lose weight more during pre-season training time than in other periods. Our study concluded that there were differing degrees of the effect of training and competition on reducing body fat. Despite the fact that observations may depend on the methods of measuring or estimating percentage of body fat, soccer players lost more fat during the competitive phase than conditioning period, reaching lowest levels at the end of the season. This was probably due to intensive training and competition schedules, heavier metabolic loads (i.e. twice-a-week matches, daily training sessions), dietary habits and psychological effects; the latter which requires more investigation. During the off time, before and after the season, most soccer players increased their fat content and body mass presumably because of reduced aerobic activity and nutritional and behavioral changes. Since football players, even at the highest levels, tend to have depots of body fat higher than optimal (4,6), it seems rational to advice the elite soccer players to keep their activity profile relatively high especially during the off-season in aim to stay fit and to prevent increased body adiposity.

Normal physiological functioning requires certain levels of body fat, though excess adipose tissue acts as an undesirable load in activities such as soccer in which the body weight must be lifted repeatedly against gravity (6, 7). In some competitive sports, players with a lower body fat percentage invariably have better performance. This occurs because low body fat is a direct measure of the intensity of training (6,13). Recent studies (3,9,14) have shown this to be true in such different sports such as soccer, rowing or Gaelic football. Our study supports

the conclusions of these laboratory and field studies, even though the type of sports activity and the nature of the exercise protocol were different. The main improvements in the sprint times during the present study were correlated with a reduction in body fat percentage. As body fat content decreased during the season, players become faster. Although we found a high level of correlation between body fat percentage and 50-m sprint times, further observations (i.e. coordination and learning effects, estimation of muscle mass) will be needed to further explain this association. However, these results should be of interest to soccer coaches because they may help, directly or indirectly, to improve athletes' performance. Periodic measurement of sprint performance and estimation of body fat percentage by simple skinfold thickness assessment allows the trainer to correct the training regime.

In summary, soccer players lose body fat content during the conditioning period and during the competitive season, with reductions in body fat percentage associated with faster sprint times.

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