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ORIGINAL ARTICLE

EXAMINATION OF CHANGES IN BODY COMPOSITION DEPENDING ON THE TRAINING PROCESS IN ATHLETES

ISPITIVANJE PROMENA TELESNE KOMPOZICIJE U ZAVISNOSTI OD TRENAŽNOG PROCESA KOD VRHUNSKIH SPORTISTA

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Abstract

Introduction: It is well known that continuous physical activity leads to adaptive changes in all organ systems, and they are most noticeable in the body composition parameters. Therefore, it is important to monitor the body composition parameters of top athletes and examine the impact of the training process itself on them, considering their significant impact on the athlete's overall result.

Aim: Examination of the dynamics of changes in body composition depending on the period of the training process in athletes.

Material and methods: The research included 152 top athletes - male soccer players (18 to 40 years old), who at the time of the investigation were actively involved in competitive sports and trained at least 3 times and more than 10 hours a week. All data were analyzed from available medical records over a period of 16 years.

Results: The only parameters that record a statistically significant difference ($p < 0.05$) between the beginning and the end of the season are the amount of fat expressed in kilograms and the percentage of body fat.

Conclusion: According to the results in the examined group of top athletes, the change in body composition does not depend on the training process. The only notable changes were observed in the amount of fat and body fat percentage.

Keywords:
body composition,
athletes,
BMI,
BF

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Sažetak

Uvod: Dobro je poznato da kontinuirana fizička aktivnost dovodi do adaptivne promene na svim sistemima organa, a one najuočljivije su na parametrima telesne kompozicije. Stoga je važno pratiti parametre telesne kompozicije kod vrhunskih sportista i ispitati uticaj samog trenažnog procesa na njih, s obzirom na njihov značajan uticaj na celokupan rezultat sportiste.

Cilj: Cilj rada je ispitivanje dinamike promena telesne kompozicije u zavisnosti od perioda trenažnog procesa kod vrhunskih sportista.

Materijal i metode: Istraživanje je obuhvatilo 152 vrhunskih sportista – fudbalere muškog pola (18 do 40 godina), koji su se u vreme ispitivanja bavili takmičarski aktivno sportom i trenirali najmanje 3 puta i više od 10 časova nedeljno. Svi podaci telesne kompozicije i trenažnog procesa analizirani su iz dostupne medicinske dokumentacije u periodu od 16 godina.

Rezultati: Jedini parametri koji beleže statistički značajnu razliku ($p < 0,05$) između početka i kraja sezone su količina masti izražena u kilogramima i procenat telesne masti.

Zaključak: Prema rezultatima u ispitivanoj grupi vrhunskih sportista, količina masnog tkiva i procenat masti bili su značajno viši na kraju sezone, dok se ostali parametri nisu značajno razlikovali.

Ključne reči:
telesna kompozicija,
sportisti,
BMI,
BF

Introduction

It is well known that continuous physical activity induces adaptive changes in all organ systems, with the most pronounced effects on body composition parameters. Body composition is one of the most important determinants of athletic health. Body composition can change depending on sports practice and physical activity in general (1). It should be considered that each special sports discipline requires a specific type of training and activity, which clearly affects the physical structure of athletes. Body composition is a factor that can influence athletic performance and as such, it is of great interest to both athletes and coaches (2). Therefore, it is important to monitor the body composition parameters of top athletes, considering that their overall result highly depends on them. There is very little data available in the literature on the dynamics of changes in body composition parameters during one season, which would include a period of intensive training, competition and recovery (2-5).

As the body composition of athletes affects their success, sports also have a significant impact on body composition, especially in soccer players (6-8). Attention should be paid to preserving the athlete's long-term performance and health, because physical stress during training and competition can lead to changes in body composition, which can affect performance factors such as speed, strength, and risk of injury. This can be avoided by carefully monitoring the body composition parameters, planning appropriate exercises for each athlete in relation to their training and avoiding rapid and sudden changes that can potentially lead to harmful changes in body composition (1, 9-11).

This research aimed to examine the dynamics of changes in body composition depending on the period of the training process in top athletes.

Material and Methods

The research included 152 top athletes - male soccer players (18 to 40 years old), who were actively involved in competitive sports and trained at least 3 times and more than 10 hours a week, at the time of the study. All respondents were monitored in relation to the training period: the beginning of the season and the end of the season. All data were analyzed from the available medical records over a period of 16 years (13.1.2004 - 10.1.2020) and the body composition parameters were taken by a following order: body mass, body height, body mass index, fat percentage, fat mass, muscle mass, total amount of water in the body and lean mass. All these parameters were monitored at the beginning and the end of the season for the same athletes.

Body composition test protocol

All measurements of body composition parameters were performed in the Laboratory for Sports Medicine and Exercise Therapy according to standard procedures. Body height was measured using an anthropometer (Seca 214 Portable Stadiometer, Cardinal Health, USA) with an accuracy of 0.1 cm. Body mass, fat percentage, muscle mass, adipose tissue mass, fat-free mass were determined by using a medical decimal scale (InBody 370s Body Composition Analyzer, Seoul, Korea). The body mass index was recalculated directly from already measured values of body mass and body height.

Statistical analysis

The results of the research were processed using the methods of descriptive statistics. The ANOVA test was used to examine the results. Spearman's correlation coefficient was used to examine the correlation. Statistical significance was considered significant at the $p < 0.05$ level.

Results

The results of this research are shown in **table 1**. It was found that there is no significant statistical difference at the beginning and at the end of the season for the following variables: age, body height, body mass, body mass index, lean body mass and percentage of fat in the extremities. There is a statistically significant difference in the variables of the amount of fat in kilograms and the percentage of fat at the beginning and end of the season ($p < 0.05$).

Spearman's correlation coefficient was used to examine the correlation between the beginning and the end of the season and the following parameters, shown in **table 1**. It was found that the coefficients for the amount of fat in kilograms and the percentage of fat are positive. The correlation coefficient (ρ) for the amount of fat in kilograms was 0.101, and for the percentage of fat 0.114. (**figure 1, figure 2**) This shows that there is a statistically significant difference ($p < 0.05$) between the beginning and the end of the season in the amount of fat expressed in kilograms and the percentage of body fat, whilst the other parameters did not show any statistically significant difference.

Discussion

In this study, body composition in relation to the training stage was examined. The importance of the stage of the training process is that it allows us to indirectly assess the level of the athlete's current training load. The level of training load can affect a number of parameters, including the parameter of body composition. However, the change in body composition depending on the training process has not been sufficiently investigated, a limited number of works with the same or similar objectives are available.

In the examined athletes from this study, it was observed that there was a change in the amount of fat in kilograms and the percentage of body fat in the period from the beginning to the end of the season. These results differ from the study by Walker et al., which also compared the body composition of football players during the season (3). Namely, Walker et al. (3) concluded that there was an increase in lean body mass and fat percentage from the beginning to the end of the season, while there were no significant changes in the amount of fat, which is different from our results.

Table 1. Body composition and age in relation to the traning stage

Variable	Beginning of season	End of season	P value
Age	24.6 ± 5.3	24.7 ± 5.3	ns
BH (cm)	182.6 ± 7	183.1 ± 7.3	ns
BW (kg)	78.3 ± 7	78.9 ± 8.2	ns
BMI (kg/m²)	24.6 ± 14.8	23.4 ± 1.5	ns
LBM (%)	69.9 ± 6.1	68.4 ± 7.5	ns
Amount of fat (kg)	8,8 ± 6.1	9 ± 2.9	**0.05**
BF% (%)	10.8 ± 2.9	11.4 ± 2.9	**0.05**
Fat percentage in right arm (%)	9 ± 2.6	8.8 ± 2.5	ns
Fat percentage in left arm (%)	9.2 ± 2.9	8.9 ± 2.8	ns
Fat percentage in right leg (%)	9.9 ± 2.5	10.3 ± 2.3	ns
Fat percentage in left leg (%)	10.1 ± 2.5	10.5 ± 2.4	ns

All values are shown as mean values ± SD. BH-body height, BW - body weight, BMI - body mass index, LBM - lean body mass, BF% - body fat percentage

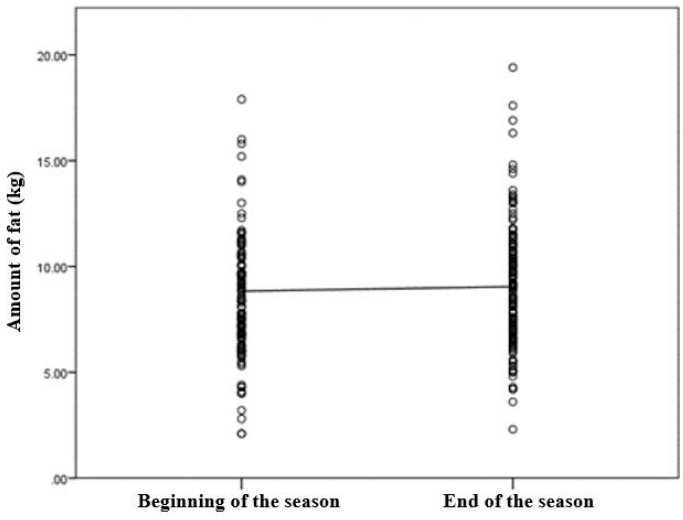

Figure 1. Correlation between beginning and end of season and amount of fat in kilograms

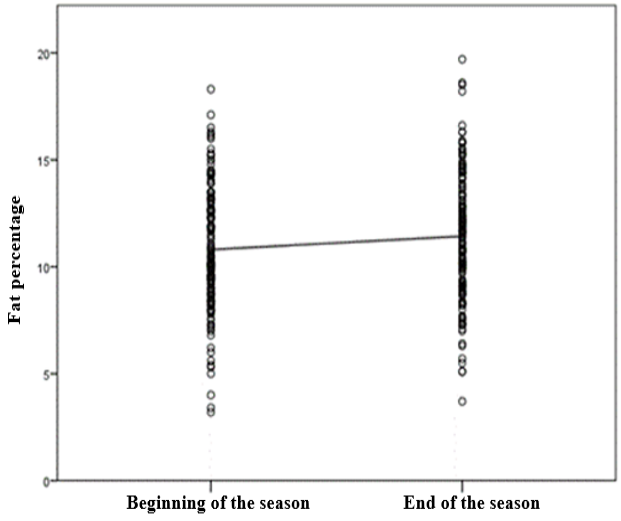

Figure 2. Correlation between beginning and end of season and fat percentage

Dommel et al. (4) showed that from the end to the beginning of the next season, there is an increase in body mass index and body fat in male athletes, which is partially different from our study. In this study, it was shown that the body mass index did not change in the period from the beginning to the end of the season, while the amount of fat did. However, in the study by Silva et al., which included variations in the physical health and body composition of soccer players, it was stated that body composition does not change excessively during the season, except that an increase in lean body mass and a decrease in fat percentage were observed (5).

The study showed that there is only a correlation between the amount and percentage of fat and the time frame of the season. In a study published by Malina (2), it was shown that there is a small increase in the amount of fat and the percentage of body fat from the end of the season to the beginning of the second. The author, however, statistically divided the athletes by sex, in which the study showed that there is a significant increase in the percentage of fat in female athletes more than in males from the start to the end of the season and also in between seasons. The study was based on male elite athletes and it also proved the increase in percentage of body fat, but the study did not include female athletes and in between period, which could be a potential limitation of the study.

The limitation of the study is the wide range in the age of the respondents, which is a possible reason for differentiating the results from other foreign studies.

Conclusion

According to the results in the examined group of elite athletes, the amount of adipose tissue and the percentage of fat were significantly higher at the end of the season, while the other parameters did not differ significantly.

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