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Changes in somatic build, body composition and motor performance of young female volleyball players in the preparatory period for the season

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Abstract

Introduction. Volleyball is one of the most popular sports in Poland. In recent years, there is a growing interest in this discipline among young people. It is important for researchers and trainers to find the factors that determine the achievement of high scores among youth athletes. Monitoring morpho-functional changes in the training cycle is an important method to assess the impact of training on a young, developing athlete's body.

Materials and methods. 27 volleyball players aged 16-17 participated in the study. The measurements included basic somatic features: height and body mass, BMI and in addition, motor tests were carried out. Body composition was assessed by bioelectrical impedance analysis (BIA). The tests were realized twice over two months.

Results and summary. The results show positive changes in body composition and improvement of results in fitness tests at the end of the preparatory period.

Keywords: body composition, female volleyball players, somatic build

1. Introduction

Distributing training stimuli in the right order and time is an extremely important and difficult element in sport. The process of periodisation, the aim of which is to build the highest level of sporting a player, depends on the variability of the specificity of training, i.e. intensity, volume and frequency (Gadula, 2018). Increased ability to exercise occurs only with the use of submaximal and maximal training stimuli, which is why a very important function of the trainer is to properly adjust the relationship between work and restoration of players in training microcycles (Naglak, 1999).

Playing volleyball is associated with a very large energy expenditure of the organism. Exercise in match conditions enforces intensive work of the cardiovascular, respiratory and muscular and nervous systems. The type of work in the volleyball game forces the players mainly to anaerobic exercise. However, breaks in the match and the game allow players to partially restitution by activating oxygen processes. Similar and sometimes higher loads during training are conditioned by a high level of exercise parameters during the start-up period, which makes the process of functional adaptation to the volleyball much easier (Bompa et al. 2013).

Schedule in volleyball games from the age of a youth, through junior to senior, divides the structure of training periods into preparatory, starting and transitional.

The preparation stage for the season (preparatory period) usually runs from August to the beginning of October. It can be divided into three phases. The first one is a versatile preparation, the main goal of which is the development of fitness and broadening the pool of habits and motor skills. Initially characterized by low intensity and larger volume. Then, it aims to increase the exercise capacity of the organism by applying higher loads. The second stage is targeted preparation. According to the name, in the case of targeted exercises, their volume and intensity increase in relation to other activities. The microcycles consist of two

phases: stimulating and reconstructing, of general preparatory or special preparatory character. The third and final stage of the period is the specialist preparation, in which special efficiency, technical and tactical skills are being sought. The main share of training measures is targeted and specialized, about 70%, versatile 30%. Each of the presented mesocycles contains from two to six microcycles (Uzarowicz and Zdebska, 1998)

The specificity of volleyball as a discipline in which a training cycle should be planned, spread over a long period, makes it necessary to use special structures through which it will be possible to maintain a sports form throughout the whole season. Due to the multifaceted stages of the season, it seems reasonable to include in the planning and monitoring process individual characteristics of players, based on special predispositions related to the sports discipline practiced, motor fitness, learning ability, personality and somatic build. (Łaska-Mierzejewska, 1999). The stage of player training related to their age is also very important.

Volleyball is a sport that continues to evolve. The changes concern the rules of the game, the training system or the way of prevention and rehabilitation of players. The trainer should be a professional in terms of theoretical knowledge, but also a researcher who can use the latest scientific knowledge in the implementation of the training, because it depends on him whether the player will succeed and become a champion (Superlak, 2006).

Changing regulations and requirements also change some of the morphological criteria for this discipline. Over the years, there has been a trend towards changes in the body height of volleyball players. The team led by Hubert Wagner, who won the World Championship in 1974, had players with an average body height of 188.5 cm. Forty years later, reaching the highest honors, a team of gold medalists of Stephan Antiga, consisted of players with an average height of 198 cm ([http://poland2014.fivb.org/en/turniej/dru%C5%BCyna/pol-poland / team_roster](http://poland2014.fivb.org/en/turniej/dru%C5%BCyna/pol-poland/team_roster)).

Similar tendencies can be observed among women practicing volleyball. The results of anthropometric studies conducted both among seniors and in younger groups allow to optimize the selection process and modify the training accordingly. The changing rules of the game and the nutrition of athletes also cause changes in the composition of the body tissue. There are more and more scientific publications on this subject, which constitute a valuable supplement to the control of the effects of training both in the period of micro- and mesocycles, as well as long-term training of athletes (Malá et al. 2010, Malý et al. 2011, Matillas et al. 2014, Hadzic et al. 2012, Stantforth et al. 2014, Malá et al. 2015).

The results of numerous studies indicate that the relevant tissue relationships and appropriately shaped some features of somatic construction are related to the level of league games and practicing sports professionally. Changes in the morphological structure and in the body composition are also reflected in the level of motor fitness, because both these spheres are strongly related to each other. Monitoring these changes is especially important for young athletes who have not yet completed growing processes.

The aim of this study is to assess the size and direction of changes in the basic somatic features, body composition and results of motor tests in women aged 16-17 in the preparatory period for the season.

2. Materials and methods

27 volleyball players aged 16-17 participated in the study. They train at KS AZS AWF Wrocław. Their training experience is between 4-6 years. Anthropometric measurements included basic somatic features: height and body mass. Based on these features, the BMI index was calculated.

Body composition was assessed by bioelectrical impedance analysis (BIA) using a BIA-101 Anniversary Sport Edition and the prepackaged Bodygram 1.3.1 software (Akern, Italy) to discern fat mass (FM), fat-free mass (FFM), body water (TBW) and muscle mass (MM).

Motor tests were also carried out, including a standing and running vertical jump, a 10-meter run, zig-zag test and long jump. The research was carried out twice: in August (beginning of the preparatory period) and in October (the end of the preparatory period).

Statistical analyses were performed using Statistica 12.0 (Statsoft, USA). Data were expressed as mean \pm standard deviation (SD). Pearson's correlation coefficients were calculated to assess the relationship between the anthropometric and motoric variables.

3. Results

Table 1. Anthropometry and body composition before and after the pre-season

Variable	1	SD	2	SD	t-Student's test (p level)
Body height (cm)	170,66	6,84	170,67	6,85	0,16
Body mass (kg)	62,10	8,13	61,43	7,64	0,03
Fat free mass (kg)	46,03	4,47	46,05	4,33	0,93
Total body water (kg)	33,67	3,00	33,73	2,86	0,75
Extracellular water (kg)	14,87	1,53	15,04	1,50	0,47
Body cell mass (kg)	25,67	3,50	25,52	3,16	0,71
Fat mass (kg)	16,06	4,57	15,37	4,22	0,01
Fat mass (%)	25,44	4,59	24,67	4,43	0,05
Fat free mass (%)	74,55	4,59	75,32	4,43	0,05
Total body water (%)	54,58	3,65	55,23	3,37	0,03
Extracellular water (%)	44,26	3,28	44,61	3,02	0,60
Intracellular water (%)	55,73	3,28	55,39	3,02	0,602
Body cell mass (%)	55,63	3,72	55,34	3,34	0,72
Muscle mass (kg)	31,40	4,07	31,26	3,70	0,75
Muscle mass (%)	50,72	3,74	51,04	3,78	0,64
Body Mass Index	21,39	2,52	21,15	2,35	0,03

The height of the body did not change significantly in two months, while body weight a significant decrease in the mean value by 0.7 kg was observed. Among the components of body mass, significant differences occurred only in the case of fat mass, where after two

months the average value decreased by 0.6 kg. In the percentage share of this component, one can also observe tendencies to reduce its share in the total body mass, however, the difference is not statistically significant.

Changes in the area of lean mass, total water and muscle mass are different. The percentage share of these components shows an upward trend, however, the differences are not statistically significant. The remaining tissue constituents do not show any changes in the investigated preparatory period. The consequence of the described tendencies in the body tissue composition is a significant decrease in the BMI index.

Table 2. Fitness tests results before and after the pre-season

Fitness test		SD		SD	t- Student`s test (p level)
Zig zag test (s)	14,52	0,98	13,94	0,69	0,00
Long jump (m)	1,89	0,16	1,98	0,15	0,00
10 m run (s)	2,34	0,18	1,99	0,12	0,00
Standing vertical jump (cm)	39,11	5,05	46,04	7,01	0,00
Running vertical jump (cm)	51,37	5,33	55,96	5,30	0,00

Table 2 shows the results of motor tests at the beginning and end of the preparatory period. The results of all fitness tests indicate improvement of the speed and jumping ability of the tested volleyball players. After two months, the time was improved in the zig-zag test, by about 0.55 s. Positive trends were also noted in the 10-meter run, this attempt was overcome by about 0.35 s.

Significant improvement of the results was noted in the jumping tests. The standing vertical jump was corrected on average by about 8 cm, and the running vertical jump was improved by about 5 cm. Similarly, in the long jump, the average result was improved by 9 cm.

4. Discussion

Monitoring morphological and functional changes in the training cycle is an important method to assess the impact of training on the athlete's body. The goals of individual training periods are varied, so one should also expect a differentiated reaction of the athlete's body to the loads and methods used. The preparation period, regardless of age and sport level, is aimed at shaping the functional and technical basis for future specialist training. The main assumption of this period is the increase in potential and the accumulation of reserves for future sports competition. The course of this stage is characterized by an initial very high versatile loads, then it decreases in favor of targeted and specialist exercises. The body's fastest response to this type of load are usually changes in tissue components. Over the last years, there has been an increased interest in the body composition of athletes and the search for an ideal pattern of tissue proportions in relation to sports (Hadzic et al. 2012, Stantforth et al. 2014, Malá et al. 2015). In the literature, we can also find publications on the body composition of volleyball players (Malá et al. 2010, Malý et al. 2011, Martina Matillas et al. 2014). The contribution of individual body components and, above all, the ratio of muscle mass to fat may play an important role in the possibility of undertaking offensive and defensive actions and indirectly decide on their effectiveness. The results of this works indicate that the fat content in body weight is different for female athletes in different disciplines. Volleyball players competing in the American university league NCAA achieve comparable sizes of fat mass as women who practice swimming. The same volleyball players in comparison to basketball students have less fat. In turn, against the background of track and field athletes, they show significantly greater fatness (Stantforth et al. 2014). Similar results were obtained by Martin-Matillas et al. (2014), examining the body composition of the volleyball players playing in the top class in Spain. The average value of adipose tissue (17.4 kg) is similar to that of American female athletes. The results of own research indicate a fairly high level of fatness among volleyball players from Wrocław compared to other groups of volleyball players of similar age (Malá et al. 2010). It should be noted, however, that the players examined by Malá et al. (2010) differ in the level of sport from the examined Wrocław residents, because they represent the national teams.

There are few studies on changes in the composition of the body in the training cycle. Pavlík et al. (2016) also assessed changes in these characteristics during the preparatory period in the group of players aged 14-19. The results of their research are quite similar to the

results obtained in our own research. During the month of the pre-season period there was a decrease in fat content and an increase in the percentage of muscle. The study of Buško and Lipińska (2012) show an increase in body mass and fat levels during the preseason training period and later a decrease in these values at the beginning of the competitive season.

Research on body morphology of people practicing volleyball, indicate the specificity of the physique of highly qualified volleyball players (Pastuszak et al. 2016, Kutáč and Sigmund, 2017). This specificity is already visible in the early stages of the training. In juvenile volleyball players some characteristic features of body structure are noted (Prokopec et al. 2003, Ivanović et al. 2015). Numerous analyzes and publications show that volleyball players are characterized by above average values in body length traits, the average body mass value. In addition, the representatives of this discipline are characterized by long upper and lower limbs, as a result of which they are usually slender people. The results of our own research confirm these reports. Body height values clearly exceed those typical of their peers from non-training girls (Burdukiewicz et al. 2009). The tested volleyball players are also characterized by a slender figure, which confirms the BMI value.

Numerous studies were also aimed at observing changes in motor performance during shorter and longer training periods (Newton et al. 1999, Sánchez-Moreno et al. 2018). The results obtained by these authors indicate a clear improvement during the season of selected elements of motoriness associated with the discipline being practiced. Lipińska and Michalski (2011) examining the jumping ability and power of volleyball players in the preparatory period received an improvement in the results of standing vertical jump while in running vertical jump from they did not notice any differences. In our research, improvement in results in both types of jump was found. Similar trends are also observed among men. Hills and Okraínec (2015) compared the power obtained in the jumping tests during the season. There was a constant progression of the results of the jumping tests during the competition. Consequently, the best results were obtained at the end of the season.

Many authors have observed positive connections between body structure, muscle mass and results of motor tests (Tsunawake 2003, Grządziel 2012, Cosmin and in 2014). In the context of our own research, it can be concluded that the improvement of the motor skills of volleyball players is the result of training that took place during the preparatory period. The consequence of the applied loads was both the increase in muscle mass and fat reduction, which probably contributed to the improvement of the results achieved in motor tests.

5. Summary

There were positive changes in the components of body composition and the results of motor tests among young volleyball players during the two months of the preparatory period. Increasing muscle mass while reducing fat and improving results of motor tests, can be a sign of proper preparation for the league season.

Monitoring changes in the body composition and the results of fitness tests of athletes in the training cycle should form the basis for trainers and instructors to reliably assess the disposition of their players. This should result in a better adaptation of the type and size of loads to the individual competitor's abilities.

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