SOMATIC PROFILE AND FUNCTIONAL CAPACITY OF VOLLEYBALL PLAYERS

Bibiana **VADAŠOVÁ**

Faculty of Sports, University of Presov in Presov, Slovakia

Key words:

- percentage body fat,
- somatotypes,
- working capacity,
- maximal oxygen uptake,
- volleyball players

Abstract:

The present study deals with partial findings of the research project VEGA No. 1/1020/11 targeted at the variability of aerobic and anaerobic fitness in athletes throughout the annual training cycle. Complex baseline evaluation of somatic development and aerobic fitness was conducted in 14 players aged 24.2 4.5 years on the volleyball team VK Mirad PU Prešov. The players were tested for the measures of body height, body mass and percentage body fat using the personal digital scales Omron BF 511. The somatotypes were determined according to Heath-Carter (1967). Functional parameters of working capacity ($W170.kg^{-1}$), peak power output ($Wmax.\ kg^{-1}$) and maximal oxygen uptake ($VO_2\ max.\ kg^{-1}$) were measured using a spiroergometric test on a cycle ergometer to exhaustion. The results showed that the value of percentage body fat (11.5 %) was consistent with reference values for volleyball players and mean somatotype (2.1 - 3.6 - 3.0) was categorized between mesomorphic ectomorph and mesomorph-ectomorph. The comparison with reference values of functional parameters showed that mean value of peak power output ($3.6\ W.\ kg^{-1}$) equaled 05 % of the reference value and maximal oxygen uptake equaled 104 %, which showed to be lower than the reference values.

INTRODUCTION

Volleyball is one of the most popular team and net games in the world. Contemporary volleyball requires all-round and well-conditioned players and high level of technical and tactical skills together with high quality of moral and volitional qualities. Similarly to other sports, volleyball places different demands on genetic endowment, somatic parameters and functional capacity of players. Emphasis is placed especially on body build, lengths and proportionality of body segments (Havlíčková, 1993). These requirements differ between playing positions. As reported by Grasgruber, Cacek (2008) above-average body height and long extremities are important when jumping and playing at the net. Therefore, spikers and blockers usually have longer legs and shorter trunk. Defensive players are shorter, which is important for their flexibility. Most individual game skills are performed at maximum intensity in the shortest possible time requiring high level of explosive power, reaction speed and locomotion. The most important precondition in terms of energy supply and production in volleyball is the high capacity of anaerobic alactacid energy system (ATP-CP). Another important precondition is the capacity of aerobic zone of energy supply during the game. As compared to other team games, volleyball does not require such a high level of cardiorespiratory fitness. Therefore, this type of fitness is developed to a minimum extent (Přidal, Zapletalová, 2010). Aerobic capacity of volleyball players (VO_{2max}) should range from 50 to 60 ml. kg^{-1}. min^{-1} (Grasgruber, Cacek, 2008, Vavák, 2011). The present study

presents partial findings on functional capacity and somatic profile of volleyball players dealt with within the research project VEGA No. 1/1020/11.

METHODS

The study sample consisted of 14 volleyball players of VK Mirad PU Prešov of the Slovak top volleyball league. The mean age of the players was 24.2 ±4.5 years. The players were tested for body height using stadiometer with 0.1 cm precision, body mass and percent body fat using personal body composition monitor Omron BF 511. The somatotypes of players were determined according to Heath, Carter (1967) using the following parameters: body height, body mass, skinfold thickness on 4 sites (triceps, subscapular, supraspinale, calf), biepicondylar breadths of the humerus and the femur and limb girths of flexed upper arm and tensed calf. The somatotype data were processed using SOMATO software. Functional capacity was assessed by a sports physician working for a private sports medicine center SportmedEast s.r.o. in Prešov by means of spiroergometric testing to volitional fatigue. The testing was based on the progressive load increase and was performed on the cycle ergometer Ergoline. In terms of functional capacity, players were tested for working capacity (W_{170}), maximum power (W_{max}), maximal oxygen uptake (VO_{2max}) and oxygen pulse ($VO_2.SF^{-1}$). The functional capacity was evaluated using relative values per kilogram body mass. The results of exercise testing were processed using the software developed by Schiller company. The software allows for the comparison of the values of maximal oxygen uptake, maximal power and oxygen pulse with reference values according to age, gender, body height and body mass of the tested person. The collected data were characterized by descriptive statistical measures of location: arithmetic mean (x), maximal and minimal value and statistical measure of variation: standard deviation (s).

RESULTS AND DISCUSSION

Table 1 shows statistical characteristics of investigated somatic parameters. With respect to somatic parameters in volleyball, body height is considered to be a crucial somatic factor, which in elite volleyball players ranges from 190 to 210 cm. Among the shortest players are setters and the tallest ones are blockers. The mean body height of players was 190.8 cm. The lowest body height value 179.6 cm was recorded in a setter, while the highest value 197.8 cm was found in a blocker. Body mass is one of the most variable somatic parameters affected by the quality of nutrition. Inadequate nutrition can impair performance. The mean body mass of players was 85.1 kg. The highest body mass 102.8 kg was observed in a 187.6 cm tall player, whose percentage body fat was 19.1 %, which was the highest value of all players. Mean BMI value was 23.4, which according to the WHO classification for adults falls within the normal BMI range. Besides basic somatic parameters, athletes should be aware of their body composition. Volleyball players are required to have low percent body fat due to good preconditions for jumping performance (Havlíčková, 1993). As reported by Grasgruber, Cacek (2008), recommended percent body fat in volleyball players should equal 10 %. The results showed that percent body fat 11.5 % was close to percent body fat recommended for volleyball players. The intra-individual analysis showed that recommended percent body fat was observed in half of the sample. Body fat percent around 13 was found in one third of players. Values of percent body fat exceeding this value were found in two players with percent body fat 15.5 and 19.1 %.

The most complex parameter of body build is the somatotype. In volleyball, there is a variety of somatotypes. Generally, volleyball players are tall and have long legs (Přidal, Zapletalová, 2010). Mean somatotypes of volleyball players relative to their body height and agility are slender, not robust. As reported by Grasgruber, Cacek (2008) mean values of somatotypes components are 2.0 - 4.5 - 3.5. In general, high performance level was found in

players with ectomorphic-mesomorphic somatotypes with predominant mesomorphic component and minimal endomorphy rating (Vavák, 2011). Modern volleyball is becoming faster, therefore, strength components are beneficial. Therefore, certain degree of endomorphy in volleyball players is associated with the strength component underlying sports performance.

Table 1. Basic statistical characteristics of somatic parameters in volleyball players

Somatic parameter	Volleyball players VK Mirad Prešov (n = 14 , age x = 24.2 years)			
	x	**s**	**max**	**min**
Body height (cm)	190.8	5.9	197.8	179.6
Body mass (kg)	85.1	8.6	102.8	70.3
BMI (kg. m^{-2})	23.4	2.3	29.0	19.8
Percent fat	11.5	3.7	19.1	5.0
Endomorphic component	2.1	0.7	3.7	0.8
Mesomorphic component	3.6	1.2	5.8	1.6
Ectomorphic component	3.0	1.1	4.9	0.7

Legend
x - arithmetic mean s - standard deviation n - sample size
min - minimal value max - maximal value BMI - body mass index

As shown in Table 1, the mean somatotype of players was 2.1 - 3.6 - 3.0, which was on the range between mesomorphic ectomorph and mesomorph-ectomorph. The comparison with mean somatotype recommended for volleyball players (2.0 - 4.5 - 3.0) showed low mesomorphy rating, which is indicative of insufficient muscular development. The intra-individual analysis showed that somatotypes of two players with higher percent body fat were categorized as endomorphic mesomorphs (12), who are characterized by both high mesomorphy and endomorphy rating. The somatotype category of balanced mesomorph (1) and ectomorphic mesomorph (2) characterized by predominant mesomorphy was observed in 4 players. The mesomorph-ectomorph (3) somatotype category, where mesomorphy and ectomorphy do not differ by more than one-half unit, was found in 3 players. The categories characterized by predominant ectomorphy and low mesomorphy rating (4, 5, 6) was found in three volleyball players.

Cardiorespiratory fitness in volleyball players was evaluated using the following functional parameters: working capacity (W_{170}), which is a submaximal test of performance at 170 heart beats per minute, maximal power (W_{max}), which is indicative of strength and endurance of the tested person and maximal oxygen uptake (VO_{2max}), which is the most valuable parameter of cardiorespiratory fitness and oxygen pulse ($VO_2 . SF^{-1}$), which is the oxygen uptake per heartbeat at rest. Table 2 shows basic statistical characteristics of functional parameters in volleyball players measured by spiroergometric testing on a cycle ergometer.

Compared to the findings reported by Komadel (1997) the mean value of working capacity W_{170} 3.4 W.kg^{-1} fell within the recommended range for volleyball players (3.6 W.kg^{-1}). However, mean values of maximal power 3.6 W.kg^{-1} and maximal oxygen uptake 45 ml. kg^{-1}.min^{-1} were not within the recommended range. The values of maximal power are influenced especially by high exercise intensity and volitional qualities. In volleyball players, the value of maximal power should oscillate around the value of 4.4. W.kg^{-1} . Maximal oxygen uptake is one of the most important indicators in terms of functional capacity assessment. The sufficient VO_{2max} value ranges from 50 to 56 ml.kg^{-1}.min.$^{-1}$ (Laczo, 1996). The required VO_{2max} level above 50 ml. kg^{-1}.min^{-1} was found in only fifth of the sample.

Table 2. Basic statistical characteristics of functional parameters in volleyball players

Functional parameter	**Volleyball players VK Mirad Prešov (n = 14 , age x = 24.2 years)**			
	x	**s**	**max**	**min**
W_{170} (W. kg^{-1})	3.4	0.3	3.9	2.9
W_{max} (W. kg^{-1})	3.6	0.3	4.2	3.0
VO_{2max} (ml. kg^{-1}.min^{-1})	45.0	5.8	54.8	32.8
VO_2 . SF^{-1} (ml)	21.3	3.8	27.5	13.7

Legend

W_{170} - work capacity at 170 bpm W_{max} - maximal power

VO_{2max} - maximal oxygen uptake VO_2 . SF^{-1} - oxygen pulse

x - arithmetic mean s - standard deviation max - maximal value

min - minimal value n - sample size

The comparison of maximal power values and maximal oxygen uptake with reference values for volleyball players showed that the values equaled 105 % and 104 % of reference values, respectively. Maximal power did not fall within the recommended range in only one fifth of the sample. The lowest value of maximal power 3.0 W.kg^{-1} equaled only 75 % of the reference value, while the highest value of maximal power 4.2 W.kg^{-1} equaled 116 % of the reference value. In maximal oxygen uptake, the intra-individual analysis showed that the VO_{2max} values did not fall within the required range in one third of the sample. The lowest VO_{2max} value 32.8 ml. kg^{-1}.min^{-1} equaled only 76 % of the reference value and the highest VO_{2max} value 54.8 ml. kg^{-1}.min^{-1}. Oxygen pulse (VO_2 . SF^{-1}) is the indicator of the cardiovascular fitness. The oxygen pulse values in athletes range from 20 to 28 ml. The mean value of oxygen pulse was 21.3 ml, which equals 109 % of the reference value. The highest value of oxygen pulse was 27.5 ml, which equals 131 % of the reference value and was found in a volleyball player with VO_{2max} 47.3 ml. kg^{-1}.min^{-1}, equaling 124 % of reference value.

CONCLUSIONS AND RECOMMENDATIONS

Volleyball is a team game specific in terms of somatic parameters. The analysis of the somatic profile showed that mean body height 190.8 cm in volleyball players of VK Mirad Prešov is at the lower limit of the range recommended for volleyball players. The mean percent body fat 11.5 % falls within the recommended range. The somatotype analysis showed low mesomorphy rating, which is indicative of insufficient muscular development. The assessment of cardiorespiratory capacity revealed low level of aerobic capacity. Only fifth of volleyball players were found to have maximal oxygen uptake higher than 50 ml. kg^{-1}.min^{-1}, which is the lower limit of the range recommended for volleyball players. This leads to the conclusion that training process should be targeted especially at the development of muscular fitness and aerobic capacity.

REFERENCES

1. GRASGRUBER P., CACEK J. (2008). *Sportovní geny*. Brno: Computer Press, 2008. 480p.ISBN 978-80-251-1873-3.
2. HAVLÍČKOVÁ L. et al. (1993). *Fyziologie tělesné zátěže II. Speciálni část – 1. díl.* Praha: Univerzita Karlova, vydavatelství Karolinum 1993. 236p. ISBN 80-7066-815-6.
3. HEATH H., CARTER L. (1967). *A Modified Somatotype Method*. In Am. J. Phys. Anthropology. ISSN 0002-6597, 1967, vol. 27, no.1, pp.57-74.
4. KOMADEL Ľ a spol. (1997). *Telovýchovnolekárske vademecum*. Bratislava: SSTL a Berlin-Chemie, Menarini Group, 1997. 235s. ISBN 80-967806-3-8.

5. LACZO E. (1996). Rozvoj a diagnostika kondičných schopností vo volejbale. In *Metodický spravodaj AT SFV*, 2, 1996, no.1, pp. 3 - 13. ISBN 80-223-1002-6.
6. PŘIDAL V., ZAPLETALOVÁ L. (2010). *Volejbal: herný výkon - tréning - riadenie*. Bratislava: vydavateľstvo Peter Mačura - PEEM, 2010. 181p. ISBN 978 - 80-8113-030-4.
7. VAVÁK M. (2011). *Volejbal - kondičná príprava*. Praha: Grada Publishing a.s., 2011. 224p. ISBN 978-80-247-3821-5.
8. VILIKUS Z., BRANDEJSKÝ P., NOVOTNÝ V. (2004). *Tělovýchovné lékařství.* Praha: Univerzita Karlova, nakladatelství Karolinum, 2004. 257p. ISBN 80-246-0821-9.