Research Paper Physical Education

Muscle Imbalance and Body Composition of Elite Junior Female Volleyball Players

Tamara Cuckova Faculty of Physical Education and Sport, Charles University José Martího 31, Prague, Czech Republic

Vladimir Suss Faculty of Physical Education and Sport, Charles University José Martího 31, Prague, Czech Republic

ABSTRACT

This study presents the state of a muscular apparatus of junior female volleyball players and the impact of one-sided sport on their bodies.

A group of 12 female volleyball players aged 15–16 were examined by a complex kinesiologic analysis and anthropological tests by the InBody 3.0 instrument. The early specialization as well as the one-sided load can lead to muscle imbalance, deficient posture and further problems with a muscle apparatus. The aim of this study is to point out the situation in the group of examined volleyball players and also to show the necessity of an interventional compensating programme to counterbalance the lateral asymmetries

KEYWORDS Volleyball, muscle imbalance, kinesilogic analysis, InBody

Introduction

Volleyball is a typical one sided sport. With the majority of distinctive right-handed or left-handed players the dominant side is much more stressed. According to the previous studies (Modi et all., 2008, Parkanová, 2003, Větrovcová, 2007, Vorálek, Süss & Parkanová, 2007), we can say that a high number of tested volleyball players have deficient posture, tension of m. trapezius, tension of paravertebral muscles in the lower back region and owing to a forwarded carriage of head and shoulder protraction they have intensified cervical lordosis. Some muscles or muscle groups of the tested players are weakened, especially the lower part of abdominal muscles. All these problems affect the lower back posture. There are also some muscle groups, which are not usually used in volleyball training such as the lower abdominal muscles or lower trapezius. Those muscles are weakened and that leads to quite severe muscle imbalance and deficient posture, as well as chronic pain of some body segments. Volleyball players also have some overused body parts such as m. trapezius or m. pectoralis major, which are often shortened.

Aim

The aim of this study is to evaluate the impact of the one-sided load on muscular symmetry of elite junior female volleyball players throughout the season 2012/2013 by performing the complex kinesiologic analysis as well as the instrumental measurement via InBody 3.0.

Methods

As the research methods, the complex kinesiologic analysis and anthropological testing by InBody 3.0 instrument were used. The similar instrument to InBody 3.0, BIA, was used in a similar research done on junior volleyball players by Malý et all. (2011).

During the kinesiologic analysis we especially focused on testing the shortened muscles. The examination of shortened muscles was based on Janda's methods (Janda, 1996). We tested the following muscles: m. triceps surae, flexors of hip and knee joints, abductors of hip joints, adductors of knee joints, m. quadratum lumborum, paravertebral muscles, m. pectoralis major, m. trapezius, m. levator scapulae and m. sternocleidomastoideus. The procedure of kinesiologic analysis was described in many studies, besides Janda (Janda, 1996) we also used the similar methods as in Gross at all. and Haladová, Nechvátalová (Gross at all., 2005, Haladová & Nechvátalová, 1997). We evaluated the shortened muscles on a two value scale: S – shortened muscle, N – non-shortened muscle. The assessment of the frequency was done by means of percentage analyses, the significant quotient would be the value of 70%. We used the same data analyses as in the similar research done on downhill skiers. The same significant quotient was used to distinguish the skiers' shortened muscles (Matošková, Tietz & Süss, 2009).

The lateral asymmetry was measured by means of the InBody 3.0 instrument. Besides the TBW (total body water), ICW (intra cellular water), ECW (extra cellular water), BCM (body cell mass) FM (fat mass) this instrument enables to determine the segmental distribution of body water in upper and lower limbs and trunk as well. The accuracy and reliability of this instrument was tested by Bedogni et all., 2002. By means of those parameters we can diagnose the asymmetric body composition and also potential muscle imbalance or injury of some body part. The preliminary data of the person measured are height, age, and gender (Stablová, Skorocká & Bunc, 2003). The lateral asymmetry was also evaluated on a two value scale: E – existing, N – not existing. The assessment of the frequency was done by means of percentage analyses, the significant quotient would be the value of 70%. The testing was performed in the same room of constant temperature under the same circumstances and also by the same person to guarantee the same conditions.

The assessed group consisted of 12 elite junior volleyball players of the extra league team of PVK Olymp Praha Czech Republic aged 15–16 who have been playing competitively for 4 years at least and practice 4 times per week for two hours. The matches are played once per week. All the players took part in the research on their own record.

Results

Shortened muscles

Table 1 Muscular shortening

Muscle	Prevalence		Muscle	Prevalence	
	n	%		n	%
m. triceps surae	9	75	paravertebral muscles	8	67
hip flexors	7	58	m. pectoralis major	1	8
knee flexors	3	25	m. trapezius	5	42

hip abductors	10	83	m. levator scapulae	10	83
m. quadratus lumborum	8	67	m. sternocleidomastoideus	1	8

Table 1 shows the results of the kinesiologic analysis which was focused on the shortened muscles. The table also includes the players whose muscles were shortened only on one side. The assessment says that the highest percentage of the players have shortened m. levator scapulae, 83% exactly. Together with that, almost half of them (42%) have the m. trapezius shortened and 67% also the paravertebral muscles. As for the lower limbs, 83% of probands have the hip abductors shortened, 75% the m. triceps surae and 67% the m. quadratus lumborum. Some of the players have other additional problems with shortened muscles such as hip (58%) and knee flexors (25%). Only very few of them (8%) had the two muscles –m. pectoralis major and m. sternocleidomastoideus shortened. We did not distinguish which level of shortening was shown.

Lateral asymmetry

Hand in hand with shortened muscles some lateral asymmetry appears. All the right-handed (100%) players have their dominant arm more developed. The majority of them have their dominant arm also overused. It is due to a big load on their dominant extremity (hitting and serving). There is also one left-handed player in the team who has her left arm much more developed than the right one. The assessed group has also differences in the lower extremities. The majority of them (67%) have the right leg more developed, 17% have the left leg more developed and two players had no asymmetry. This lateral asymmetry depends on the players' specialization as well as the individual technique. All of the players had their legs overused. It is due to the great amount of jumps and squats during the practices and matches as well.

Table 2 Muscle asymmetry of upper and lower limbs

Lateral asymmetry	n	%
Right Arm (right-handed)	11	100
Right Arm (left-handed)	0	0
Left Arm (right-handed)	0	0
Left Arm (left-handed)	1	100
Right Leg	7	67
Left Leg	2	17
No Leg Asymmetry	2	17

Discussion

The results of previous studies made on this topic as well as the results of our study are quite alarming. All the studies (Modi et all., 2008, Parkanová, 2003, Větrovcová, 2007, Vorálek et all., 2007) agree on the fact that the state of the muscle apparatus of young volleyball players in not very good – the majority of them have muscle imbalance in many body regions which is due to a long-term one sided load and poor or no compensating exercises to counterbalance the lateral asymmetries. Mahrová (2008) is of the same opinion when she did very similar research using the same methods on young badminton players.

As significant findings we can consider that all the players of the tested group have overloaded lower extremities and also the dominant upper limb much more developed, in some cases also overloaded. Another significant fact is that the high percentage of probands have many muscles or muscle groups shortened. Parkanová (2003) also tested young volleyball players and is in agreement with the results of this study. Her results also showed that high percentage of players had deficient posture, 100% of them had shortened m. trapezius as well as 93% had the paravertebral muscles shortened. We are also in agreement with the work of Větrovcová (2007) and Vorálek et all. (2007), they had very similar results to the studies mentioned. Vorálek (2007) also measured the junior national team whose results were the most alarming. The players of his tested group had almost all the muscles shortened some of the muscles (m. levator scapulae, m. quadratus lumborum, m. trapezius) were shortened in 100% players. 90% of them had the knee flexors shortened. This fact can be explained by much higher load than the regular team players have. Muscle imbalance in the pelvic region, which was also shown, can intensify the lumbodorsal lordosis that can lead to appearance of lower back pain or some functional block. The long-term load and bigger tension of m. trapezius can also lead to some functional block as well as occasional headaches. Some of the players were complaining about headaches. We are also in agreement with Modi et all. (2008) who tested young volleyball players on prevalence of scoliosis. Our testes group showed better state of spine curve. The number of players with scoliosis was not as high as in Modi's study (44%) but we agree with the statement that volleyball players had a statistically significant increase in the incidence of scoliotic spinal curves and that the hand dominance was related to the curve direction. The following testing showed the shortened knee flexors, which explains the constant knee pain of most of the players. This is probably due to the great amount of jumps they have to perform. Even though the results of this study are not as extreme as the results of Parkanová (2003), Větrovcová (2007) and Vorálek (2007), we are, overall, in a great agreement with the studies made since all of them tested volleyball players of the same or similar age group. All the results show the necessity of an appropriate compensation in a training process.

Conclusion

Volleyball is a physically demanding sport which mainly applies load on one side of the body. This sooner or later leads to an assumption of prevalence of some bad effect of this sport on the muscle apparatus. According to the results, we can say, that the majority of the players as well as the coaches underestimate the necessity of an appropriate compensation. This paper wants to point out the importance of the compensation of the one-sided load on organism and lead to a change of training techniques – prevent the overuse injuries together with the potential increase of physical preparedness by doing appropriate compensation.

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